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EVALUATION OF BARRIERS TO VALUE MANAGEMENT APPLICATION IN CONSTRUCTION PROJECTS

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Value Management (VM) initiatives have been recognized as beneficial to the construction industry of most developed and developing countries. The Society of American Value Engineers (SAVE) has reiterated that the application of VM methodology would enhance the quality and performance of construction projects. Though a number of countries apply the VM technique, a developing country like Nigeria seems to have a limited application. This study therefore evaluates the critical barriers to VM application in the Nigerian construction industry. Data collection was based on self-administered questionnaires from construction professionals, while data analysis techniques employed include: descriptive analysis, normality test; reliability test; validity test using Kaiser-Meyer-Olkin (KMO) and Barlett's test of sphericity; factor analysis; and structural equation modelling (SEM). Lack of VM experts, lack of awareness on VM among clients, poor working relationship among stakeholders, inadequate facilitation skills/training, and absence of local VM guidelines are the major barriers to VM practice. Fifteen (15) barriers were validated under four major classifications (People, Government, Environment, and Methodology). The implication of this study is to assist construction practitioners, researchers, and academics to focus on the important concerns that are necessary to support the application of VM in developing countries in order to enhance the value of construction projects.

Keywords: barriers, construction industry, construction professionals, Nigeria, structural equation modelling, value management

INTRODUCTION

The construction industry is one and only sector that is saddled with the commitment of transforming various resources into constructed physical structure. As a viable sector in the economy of any country (Abdullah et al., 2004; Ogunsemi et al., 2008), the industry is largely concerned with the development of roads, railways, bridges, residential, institutional and commercial buildings. Construction activity in Nigeria is handled by construction professionals, and indigenous/foreign construction contractors who offer their services to both private and public clients. Nevertheless, Nigerian Bureau of Statistics (2010) submitted that government is

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the biggest investor of the industry as a large amount of capital formation goes into investments in real estate and infrastructure development. This submission is maintained by Dim and Ezeabasili (2015) who stated that the Government of Nigeria procure 70% of the construction projects while 30% are procured by the private sector. Since construction projects are sponsored by the Federal, State and Local Governments, it means that the Nigerian construction industry is directly influenced by the public sector as a major client of the industry. According to Kolo and Ibrahim (2010), the federal government of Nigeria has realised the need to improve service delivery by stipulating that procurement of public assets and services must go through the application of value-added practices. Value-added actions and activities assume an indispensable part in the delivery of projects in the construction industry. These actions feature all techniques and methods that would ensure that projects are executed at the least possible cost while maintaining value and quality. However, there are several construction projects that are on hold or abandoned in Nigeria as a result of several factors including the lack of sustainable value ventures.

A study by Tanko et al. (2017a) revealed a considerable number of value-added activities and methods in the Nigerian construction industry. Kolo and Ibrahim (2010) articulated that value management (VM) is a universally accepted methodology that can realise value-added initiatives. Consequently, most clients and stakeholders are now getting involved with value thinking to achieve the best from their ventures (Ramly and Shen, 2012). Kissi et al. (2015) put forward that a good number of countries (USA, UK, Australia, Hong Kong, China, Saudi Arabia and Malaysia) with new value-added needs have embraced value-added innovations through VM. In the same vein, Thiry (1997) advanced that other countries like Italy, Germany, France, South Korea, Kuwait, Denmark, Taiwan, South Africa, Hungary, and Canada have also embraced VM. Consequently, Ramly and Shen (2012) capitulated that VM has been brought into the construction industry to achieve the best value-for-money. Mohd Rahim et al. (2016) described Value-for-money as the ideal combination of quality and whole life cost with the primary drive to satisfy the requirements of users. Although, according to Ong (2004), VM has extended the traditional emphasis on value-for-money to value for stakeholders, environment, systems, quality, social, ethics, etc. Following the introduction of VM in the construction industry, the technique has gained popularity among industrial scholars and academics (Ramly et al., 2013), and its demand has generally been on the increase (Oke and Ogunsemi, 2011). Various terms such as value assessment, value review, value analysis, value methodology, value engineering, value planning and value control have been associated with VM. Thus, Kissi et al. (2015) and Ong (2004) put forward that VM is synonymous with value engineering (Fan et al. 2013), and value analysis. Thiry (1997) also advanced that VM encompasses value engineering, value analysis, value control, and other value techniques. The agreement to use the term 'VM' is basically to describe the combined extensive application of value techniques. Although many terms have been used, what is very important is the improvement of value without sacrificing the intended function.

Tanko et al. (2018a) defined VM as a systematic, team oriented and multi-disciplinary value-added methodology (job plan) aimed at optimizing functions of systems or facilities at the lowest overall life cycle cost and a value system determined by the client. It is a well-thought-out framework that aids successful decision making relating to the 'best value'. In addition, VM is a process by which the project is assessed and analysed to have the best value-for-money by adhering to a certain methodology, the process being led by a trained facilitator (Rangelova and Traykova, 2014). The concept of VM targets to optimise the value of construction projects by providing vital functions or elements at the lowest cost without giving up performance criteria. Therefore, Hwang et al. (2014) and Tanko et al. (2018b) acknowledged VM as a potent technique for attaining best value for construction clients. VM has a propensity to obviously define responsibilities of participants, resolve uncertainties and misperceptions in construction projects, and enhance relationships among stakeholders. A study by Tanko et al. (2018b) inferred that "VM creates innovative and systematic ideas, reduces unnecessary costs, optimises quality and develops teamwork as a means to improve productivity". Nonetheless, Thiry (1997) stated that VM can only exist when a goal needs to be accomplished or a problem needs to be resolved, when there is no goal or problem, there is no need to improve value. Thus, within the context of this paper, VM is a team-oriented, analytical, and multi-disciplinary methodology directed at enhancing the value of projects. The attainment of better value, removal of unnecessary costs, savings in project cost, understanding and evaluating project's objectives, improving team work among construction stakeholders, and enhancing the function of projects are some of the benefits of VM.

However, VM has not been formally practiced in Nigeria (Akinpelu, 2016; Sabiu and Agarwal, 2016) as a result of many barriers hindering its implementation (Li and Ma, 2012). Hence, this study seeks to identify the barriers to VM application; evaluate the identified barriers; develop measurement and structural models of barriers to VM application, and to answer the big question, "What are the critical barriers to VM application in the Nigerian construction industry?"

LITERATURE REVIEW

Historical development of VM

The origin of VM is traced to the United States General Electric Company, which during the Second World War, searched for way out to address the major shortages of existing resources, raw materials and skilled labour (Whyte and Cammarano, 2012). VM was first introduced in the US by a purchase engineer called Lawrence Miles. The engineer works with the General Electric Company (GEC) in the 1940s during World War II. The company (GEC) was compelled to use substitute materials due to the shortages caused by the war. Thus, the engineer proposed the value analysis method to provide the needed functions at a lower cost. Mr Lawrence Miles found out that a good number of substitutes give equal or better performance without incurring much cost. Therefore, a formal procedure known as value analysis was later developed by him and applied in GEC (Shen and Yu, 2012). Value analysis was widely adopted by other industries after the war due to the noteworthy effect on products performance and cost reduction. In 1954, a more proactive value program was used at the design and engineering stage by the United States Department of Defense's Navy Bureau of ships, thus, value analysis was changed to value engineering (Thiry, 1997) and was used in North America. Thereafter, the Society of American Value Engineers was established in 1959 (Thiry, 1997), and value engineering was practiced by many engineering firms, government formations and the construction industry. It is a tool which seeks to meet the basic functions of a product, service or project at the lowest cost (Zhang et al., 2009). Therefore, the justification of value engineering in the construction industry is to come up with innovative ideas and proffer solutions for increased value of construction projects. Value engineering began in the United Kingdom in the early to mid-1960s and to Australia in mid to late 1960s. Whyte and Cammarano (2012) put forward that the construction industry in the UK adapted Lawrence Mile's value analysis and advanced it under the name VM which is synonymous with value engineering. Also, Thiry (1997) advanced that in 1965, VM was introduced in Japan. Since it was recognised that the orientation of value engineering activity was more of management than engineering, the UK Institute of Value Management (IVM) was formed in 1966 (Shen and Yu, 2012). VM afterwards was introduced in Germany, France (1978), South Korea, Kuwait, Denmark, Hungary (Thiry, 1997), China (1978), Saudi Arabia (1981), Malaysia (1986) and Hong Kong (1988). According to Thiry (1997), VM was introduced in South Africa and Taiwan in the eighties, while in 1993, it was introduced in Canada.

Definitions of VM

Shen (1993) defined VM as "an organised function-oriented and systematic team approach, directed at examining the functions and costs of a service, system, equipment, supply, or facility for the aim of improving its value through attaining the required functions indicated by the clients at the least cost, consistent with the requirements for performance". It is a creative and a system approach to validate a certain proposal; and has to undergo a structured and systematic job plan which emphasises on the analysis of functions (Che Mat, 1999). Jaapar et al. (2009) upheld that VM is a "multi-disciplinary, team oriented, structured, analytical process and systematic analysis function, which specifically seeks best value through the design and construction process to meet client's perceived needs". In addition, it is a technique for improving the overall life cycle of projects, products and systems. Odeyinka (2006) defined VM as "a service, which maximise the functional value of a project by managing its development from concept to completion and commissioning through the audit (examination) of all decisions against a value system determined by the client". It is a systematic and multi-disciplinary effort focused on analysing the functions of projects for the sole aim of achieving the best value at the lowest overall life cycle cost (SAVE, 2008). The Institute of Value Management UK (2008) distinct VM as a style of management particularly committed to motivate people, improve skills, and stimulate synergies and innovation, with the goal of maximising the general performance of an organisation. On the other hand, Oke and Ogunsemi (2011) likened VM to "a systematic and multi-disciplinary process which is aimed towards analysing the functions of projects from its inception to completion and commissioning (through auditing or examination) for the goal of achieving best value and return on investment at lowest possible overall Life Cycle Cost".

Therefore, VM has been described as an organised framework that aids effective decision making regarding the best value. Essentially, it is a process where a project is examined and studied to achieve maximum value-for-money by adhering to a particular methodology, and led by a knowledgeable and experienced facilitator (Rangelova and Traykova, 2014) while minimising or keeping the overall life cycle cost (Saifulnizam, et al., 2011). Olawumi et al. (2016) simply attributed VM as a well-established methodology meant to define and maximise the value-for-money, while Luvara and Mwemezi (2017) recognised VM as a function-oriented method which has been established and verified as an operationally effective management technique for achieving better-quality design, construction, and cost effectiveness in many construction projects.

The VM methodology

The practice of VM in any setting necessitates facilitation. Facilitation is an activity that assist a specific task and makes it realizable. A person who takes on such responsibility is called a facilitator. Consequently, a VM facilitator is one who knowledgeably designs, manages, controls, and leads a VM study team throughout the value management process (Leung and Kong, 2008). However, the VM facilitator is expected to making sure that VM workshops are completed according to an established schedule. Japaar et al. (2012) inferred that an effective VM facilitator requires sufficient knowledge on VM methodology, experience and skills.

The VM process is usually carried out by a multi-disciplinary group of construction professionals, the client (owner), the end-user, and other relevant stakeholders. Generally, the process is separated into pre-workshop, workshop, and post-workshop stages. The pre-workshop is dedicated to gathering of relevant background details of proposed projects. Ramly and Shen (2012) put forward that at the pre-workshop stage, roles and responsibilities are assigned to stakeholders. Subsequently, the definite workshop stage has six (6) phases which include: Information; function analysis, creativity, evaluation, development, and presentation phases (Kelly et al., 2004; SAVE International, 2007; Japaar et al., 2012; Hwang et al., 2014). At the information phase, sharing of project information related to scope, timing, cost, location, and function is imperative. At the function analysis phase, functions are generated and classified into basic and secondary functions (SAVE International, 2007; Ramly and Shen, 2012;) and high cost areas are also identified. The ideas are being brainstormed and assessed to meet the desired functions of projects at the creativity phase (Kelly et al., 2004). At the evaluation phase, Ramly and Shen (2012) advanced that brainstorming should go through further screening to convincingly determine how they could be applied to meet the desired function, and should be classified into: realistically possible to be implemented; remotely possible; and impossible to be implemented. At the development phase, the short-listed ideas are then developed into a feasible solution and presented as an action plan at the presentation phase.

Barriers to VM application in the construction industry

Many academics and researchers have investigated the barriers to applying VM in the construction industry. In Saudi Arabia, Al-Yami (2008) identified the following barriers to VM application in the construction industry: lack of information (specifications, standards, historical data, etc.), lack of leadership, lack of time to implement VM, lack of awareness on VM, and client commitment. A study in Southeast Asia by Cheah and Ting (2005) revealed that lack of knowledge on VM, and lack of time for implementation are the main factors that hinder the application of VM. In the Hong Kong's construction industry, Shen (1997) identified three most significant reasons (lack of knowledge to implement VM, no confidence to introduce VM to clients, and lack of time to implement VM) for not using VM. However, in China, Li and Ma (2012) found out that lack of time to implement VM is not a severe challenge but lack of knowledge on VM, lack of technical norms and standards, and lack of VM experts. In Malaysia, Lai (2006) identified lack of knowledge about VM, lack of government support, and lack of local VM implementation guideline as main barriers to VM application in the construction industry. Similarly, Jaapar et al. (2009) 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 difficulties faced during the VM workshop. Jaapar et al. (2012) also found out that one of the challenges of VM application is the VM workshop which could not efficiently be implemented due to insufficient information provided. Also the difficulty of handling different character, background, and values of people was a key barrier faced by VM facilitators. In addition, a study by Ramly et al. (2015) revealed some factors that would promote VM application in the Malaysian construction industry. This include: VM knowledge and experience of participants, multidisciplinary team mix of participants, competency of the facilitator, attitude and discipline of participants, and client support/active participation. Finally, inadequate regulatory frameworks, and poor stakeholder management are also some of the challenges facing the application of VM in the construction industry (Kissi et al., 2015).

RESEARCH DESIGN AND METHODS

The study utilized data obtained from construction professionals based in Abuja, Kaduna, and Jos. Abuja is the federal capital of Nigeria located at the middle of the country. In 2015, Abuja experienced an annual growth rate of 35% (United Nations Report, 2015) with a significant level of construction output. Kaduna and Jos were chosen because of the proximity to Abuja, high construction activities, and population. According to Rowley (2014), "questionnaire is one of the most extensively used means of collecting data, and is typically used in surveys to profile a population". This study adopts the 5-point Likert scale closed-ended questions for the structured questionnaire based on the methodology, objectives of the research, and the outcome of a pilot survey. The questionnaire was structured into four (4) sections. The third section was made up of questions aimed at identifying the barriers to VM application in the construction industry, and these barriers were identified from literature and pilot survey. The quantitative approach was adopted for this study. This is because sampling, measurement and the use of questionnaires are utilized due to the complexity and fragmentation of the construction industry. The study began with identifying the research challenges and establishing the gap that exists in the application of VM. The research question was developed and the review of past and present studies was conducted to get an in-depth knowledge of the research problem.

The study had 93 variables, 5 responses per variable (i.e. 465) as recommended by most researchers for factor analysis (Pallant, 2005). Self-administered questionnaires were distributed to 465 construction professionals who were chosen from contracting, project management, consulting engineering, quantity surveying, consulting architects, and client organisations. A total of 344 (73.98%) questionnaires were appropriately filled and returned. Normality test was first conducted using skewness and kurtosis to confirm the normality of the data collected. Similarly, Tabish and Jha (2012) pointed out that in order to establish the stability and comprehension of respondents, instrument reliability should be used to adequately measure the variables of a study. Hence, reliability test was conducted using the Cronbach's alpha coefficient to confirm the reliability of the data collected. The Kaiser-Meyer-Olkin (KMO) and Barlett's test of sphericity were also used to establish the instrument validity by assessing the sample adequacy and multivariate normality of the study variables. Structural Equation Modelling (SEM), using Confirmatory Factor Analysis (CFA) in AMOS software further validates the measurement models by indicating satisfactory goodness of fit among acknowledged determinants of the study. In addition, cross-tabulation using SPSS version 25 was used to record the frequency of respondents that have specific characteristics. Subsequently, mean scores were used to determine the frequency of occurrence, the degree of severity of the respondents' responses, as well as the ranking of different research variables. The research design was followed, and the summary of research findings were extracted from the results of the analysis.

ANALYSIS AND DISCUSSION OF RESULTS

This section presents demographic analysis, reliability test, factor analysis, perception of construction professionals on VM barriers, and the overall ranking of barriers to VM application. The barriers are the main obstacles to applying VM by the respective construction professionals, and were derived from literature and pilot survey. The pilot survey was conducted in Nigeria and consisted of consultations and discussions. A thorough literature review was initially carried out to identify the factors that constitute the practice of VM with their associated barriers. A list of factors were derived and developed from literature review. At the commencement of the conversations, the participants were given the list of the factors identified from literature, and were asked to indicate their opinions on whether they considered the factors relevant or advise whether existing factors are irrelevant, or suggest other factors that they considered relevant but were not stated in the list. As a consequence, some variables were deleted while a few were added to the list. The modified and added factors were used to design the main questionnaire. A total of 45 pilot questionnaire survey were administered to the five (5) different professionals in the construction industry, while 32 (71%) questionnaires were returned and completed.

Demographic analysis

Table 1 provides an understanding of the respondents' demography. These consist of the respondent's working experience, specialisations, and the role of their respective organisations.

Most of the respondents worked for a good number of years in the construction industry. From the analysis, it was revealed that the respondents had the necessary experience to carry out this research survey as 83% (285) of the respondents had at least 6 years working experience, while only 17% (59) had less than 5 years' experience in the construction industry. The results of the demographic analysis indicated the specialisations of the respondents. From Table 1, 31% (108) of the total respondents are Quantity Surveyors, 26% (90) Architects, 20% (68) Builders, 17% (59) Civil Engineers, while 6% (19) are Services Engineers. The role played by the different organisations in the Nigerian construction industry was also revealed. The respondents from the quantity surveying firms constitute 31% (108), 23% (78) from consulting/designing engineering firms, 16% (54) from contracting firms, while 13% (46), 11% (38), and 6% (20) were from consulting architects, project management, and client organisations respectively. This indicates that the respondents are from the core area of study under investigation, and gives credibility to the data used.

Table 1. Demographic characteristics

Demographic Characteristics		(N= 344)	
		f	%
Profession	Architects	90	26
	Quantity Surveyors	108	31
	Builders	68	20
	Civil Engineers	59	17
	Services Engineers	19	6
Working Experience	> 20 years	25	7
	16 – 20 years	38	11
	11 – 15 years	117	34
	6 – 10 years	105	31
	≤ 5 years	59	17
Role of Respondents' Organisations	Contractor	54	16
	Project Manager	38	11
	Consulting Engineer	78	23
	Cost Consultant	108	31 13
	Consulting Architect	46	6
	Client	20	

Instrument reliability test and factor analysis

The reliability test was conducted using the Cronbach's alpha coefficient to confirm the reliability and validity of the data collected. The least Cronbach's alpha coefficient was 0.80 while the highest value was 0.91. The KMO test, which is a measure of sampling adequacy that compares the magnitudes of the partial correlation coefficients of measuring variables, is 0.711, while Barlett's test of sphericity, which tests the correlation matrix is significant since the p-value is less than 0.05 (Table 2).

Table 2. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy			.711
	Bartlett's Test of Sphericity	Approx. Chi-Square	8431.239
Barriers		Df	210
		Sig.	.000

The extraction of the components of VM barriers was based on the total variance explained which indicated eigenvalues of 1 and above. Thus, the four components explain a total variance of 73.21%, while the loading of each of the variables is presented in Table 3. Instrument reliability was used to satisfactorily measure the variables of this research. The Cronbach's Alpha values were used to examine the internal consistency of the interrelated multiple scale items. The results of reliability and validity test through the Cronbach's Alpha in Table 4 show that the barrier attributes are within the range of 0.87 to 0.91. This indicates that the results are highly significant since according to Enegbuma et al. (2015), the values obtained must be higher than the recommended minimum value of 0.60. The barriers are categorised into four groups: Environment (BP), People (BG), Government (BE), and Methodology (BM) based on factor analysis and presented in Table 4.

Table 3. Rotated component matrixa

	Component			
	1	2	3	4
BP1	.894			
BP2	.747			
BP3	.541			
BP4	.690			
BP5	.672			
BP6	.852			
BP7	.705			
BG1		.832		
BG2		.800		
BG3		.754		
BG4		.909		
BG5		.771		
BE1				.819
BE2				.906
BE3				.911
BE4				.847
BM1			.886	
BM2			.720	
BM3			.897	
BM4			.784	

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalisation.
a. Rotation converged in 5 iterations.

Table 4. Reliability of barriers to VM Application

Variable	Label	Items	Cronbach Alpha
BP	Environment	7	0.875
BG	People	5	0.907
BE	Government	4	0.904
BM	Methodology	4	0.883

Perception of construction professionals on barriers to VM application

The results of cross-tabulation of the data provided an understanding on the frequencies of the respondents' perception on barriers to VM application. Consequently, the Mean Score (Equation 1) was used to analyse the weight of the respondent's responses.

$$\text{Mean Score} = \sum \frac{ni.pi}{N} (0 \leq \text{index} \leq 5) \qquad 1$$

Where, ni = number of respondents that chose pi.

pi = 1 to 5 on a Likert scale.

N = total number of questionnaire returned.

The 20 barriers to VM application among construction professionals were identified, selected, and accepted by the respondents at the pilot survey phase of this study. While Tables 5 shows the mean scores of barriers to VM application among construction professionals, Table 6 depicts the ranking of these barriers by the respective respondents within the construction industry. Consequently, Majid and McCaffer (1997) posited that factors can be rated as "very hinder" (3.5 ≤ mean < 4.5), or "averagely hinder" (2.5 ≤ mean < 3.5) depending on their mean values. Hence, the criticality of the barriers was established.

Table 5. Mean scores of barriers to VM application

Var.		Architects		Q/Survey		Builders		Civil Engr		Serv. Engr		Overall	
		MS	Rk	MS	Rk	MS	Rk	MS	Rk	MS	Rk	MS	Rk
BP	1	4.023	11	4.204	2	4.015	6	4.034	3	4.339	3	4.100	4
	2	3.739	15	3.648	16	3.794	13	3.831	13	4.111	7	3.757	15
	3	4.091	9	3.935	11	3.838	11	3.881	12	4.056	8	3.953	11
	4	4.148	6	4.056	5	3.985	9	3.983	7	4.333	4	4.067	7
	5	3.614	16	3.722	15	3.691	16	3.678	15	4.167	6	3.704	16
	6	3.761	14	3.944	10	3.794	13	3.814	14	4.000	9	3.848	12
	7	3.818	13	3.843	13	3.824	12	3.678	15	3.833	13	3.804	14
BG	1	4.534	1	4.278	1	4.235	1	4.102	2	3.833	13	4.282	1
	2	4.102	8	3.870	12	4.015	6	3.949	8	3.889	11	3.974	10
	3	4.420	2	4.056	5	4.074	4	4.034	3	3.889	11	4.141	3
	4	4.364	3	3.963	8	4.088	3	4.000	5	3.944	10	4.097	5
	5	4.273	4	4.093	4	4.029	5	4.000	5	3.833	13	4.097	5
BE	1	3.966	12	3.796	14	3.750	15	3.949	8	3.556	16	3.845	13
	2	4.216	5	4.148	3	4.176	2	4.136	1	4.556	1	4.191	2
	3	4.136	7	4.037	7	4.015	6	3.949	8	4.278	5	4.056	8
	4	4.034	10	3.963	8	3.941	10	3.932	11	4.389	2	3.994	9
BM	1	2.330	18	2.111	19	2.250	18	2.203	20	2.667	17	2.240	19
	2	2.000	20	2.278	18	2.238	19	2.525	17	2.667	17	2.282	18
	3	2.023	19	1.991	20	2.147	20	2.254	19	2.556	20	2.106	20
	4	2.568	17	2.528	17	2.456	17	2.424	18	2.611	19	2.510	17

From Table 5, the Architect perceives the following five (5) factors as "very hinder" or of major hindrance to VM application in the construction industry. These are: lack of VM experts [BG1]; poor collaboration and working relationship among stakeholders [BG3]; inadequate facilitation skills and training [BG4]; lack of willingness to accept changes and new innovations [BG5], and Lack of awareness among clients [BE2].

In addition, other barriers that are of major hindrance to the application of VM by the Architects include: lack of active involvement of clients and stakeholders [BP4]; absence of local VM guidelines [BE3]; lack of VM knowledge [BG2]; difficulty in the involvement of decision makers/other key partners in VM workshop [BP3]; and lack of encouragement on the part of government [BE4]. However, barriers that are considered “averagely hinder” or of moderate hindrance to the Architects are: incurring additional cost as a result of VM workshop; lack of time to conduct VM studies; difficulty in conducting analysis/evaluation of functions, and inappropriateness of procurement strategies to implement VM.

Secondly, the research revealed that the Quantity Surveyors distinguishes lack of VM experts [BG1], stakeholders resistance to accept new innovations [BP1], lack of awareness among clients [BE2], lack of willingness to accept changes and new innovations [BG5], and lack of active involvement of clients and stakeholders [BP4] as major hindrances to VM application in the construction industry. Other barriers that are of major hindrance to the Quantity Surveyors are: poor collaboration and working relationship among stakeholders [BG3], absence of local VM guidelines [BE3], inadequate facilitation skills and training [BG4], lack of encouragement on the part of government [BE4] and self-justifying attitude of the original design team [BP6]. Conversely, lack of time to conduct VM studies, difficulty in conducting analysis/evaluation of functions, VM workshop incurs additional cost, and inappropriateness of procurement strategies to implement VM were considered to be of moderate hindrance to VM application by the Quantity Surveyors.

Table 6. Ranking of barriers among construction professionals

Ranking	Architects	QS	Builder	Civil Engineer	Services Engineer
1	BG1	BG1	BG1	BE2	BE2
2	BG3	BP1	BE2	BG1	BE4
3	BG4	BE2	BG4	BP1	BP1
4	BG5	BG5	BG3	BG3	BP4
5	BE2	BP4	BG5	BG4	BE3
6	BP4	BG3	BP1	BG5	BP5
7	BE3	BE3	BG2	BP4	BP2
8	BG2	BG4	BE3	BG2	BP3
9	BP3	BE4	BP4	BE1	BP6
10	BE4	BP6	BE4	BE3	BG4
11	BP1	BP3	BP3	BE4	BG2
12	BE1	BG2	BP7	BP3	BG3
13	BP7	BP7	BP2	BP2	BG1
14	BP6	BE1	BP6	BP6	BG2
15	BP2	BP5	BE1	BP5	BG5
16	BP5	BP2	BP5	BP7	BE1
17	BM4	BM4	BM4	BM2	BM1
18	BM1	BM2	BM1	BM4	BM2
19	BM3	BM1	BM2	BM3	BM4
20	BM2	BM3	BM3	BM1	BM3

Thirdly, the study revealed that the Builders also identify lack of VM experts [BG1], lack of awareness among clients [BE2], inadequate facilitation skills and training

[BG4], poor collaboration and working relationship among stakeholders [BG3], and lack of willingness to accept changes and new innovations [BG5] as major hindrances to VM application in the construction industry. Afterward, stakeholder's resistance to accept new innovations [BP1], lack of VM knowledge [BG2], absence of local VM guidelines [BE3], lack of active involvement of clients and stakeholders [BP4], and lack of encouragement on the part of government [BE4] are some of the major hindrances to VM application as perceived by the Builders. However, the following barriers were considered to moderately hinder VM application. These are: lack of time to conduct VM studies; incurring additional cost as a result of VM workshop; difficulty in conducting analysis/evaluation of functions; and inappropriateness of procurement strategies to implement VM.

The civil engineer recognises the following five (5) factors as "very hinder" or of major hindrance to VM application in the construction industry. These are: lack of awareness among clients [BE2]; lack of VM experts [BG1]; stakeholder's resistance to accept new innovations [BP1]; poor collaboration and working relationship among stakeholders [BG3]; and inadequate facilitation skills and training [BG4].

In addition, other barriers that are of major hindrance to VM application by the Civil Engineer include: lack of willingness to accept changes and new innovations [BG5]; lack of active involvement of clients and stakeholders [BP4]; lack of VM knowledge [BG2]; lack of legislation which provides VM application in the construction industry [BE1]; and absence of local VM guidelines [BE3]. On the other hand, barriers that are considered "averagely hinder" or of moderate hindrance to the Engineers are: lack of time to conduct VM studies; inappropriateness of procurement strategies to implement VM; difficulty in conducting analysis/evaluation of functions; and incurring additional cost as a result of VM workshop.

And last but not least, the Services Engineer distinguishes lack of awareness among clients [BE2], lack of active involvement of clients and stakeholders [BP4], stakeholder's resistance to accept new innovations [BP1], Lack of active involvement of clients and stakeholders [BP4], and absence of local VM guidelines [BE3] as the major obstacles to VM application in the construction industry. The Services Engineer also sees other barriers as major obstacles to VM application in the construction industry. These take account of: difficulty to establish mutual project objectives by stakeholders [BP5]; lack of commitment to implement VM [BP2]; difficulty in the involvement of decision makers and other key partners in VM workshop [BP3]; self-justifying attitude of the original design team [BP6]; and inadequate facilitation skills and training [BG4]. On the contrary, lack of time to conduct VM studies, difficulty in conducting analysis/evaluation of functions, VM workshop incurs additional cost, and inappropriateness of procurement strategies to implement VM were measured to be of moderate hindrance to VM application in the Nigerian construction industry.

It is essential to note here that the barriers that moderately hinder the application of VM are common to all the construction professionals in this study.

Ranking of barriers to VM application in the construction industry

From Table 5, the people-related factor (lack of VM experts-BG1) ranked top (Av.MS=4.282) by the construction professionals, inferring that VM experts are essential for the implementation of VM in the Nigerian construction industry. This finding is supported by Li and Ma (2012), therefore VM experts can be forerunners who would aid the application of VM in the domestic construction projects. A government-related factor (lack of VM awareness among clients-BE2) was 2nd with MS of 4.191. This implies that there is need to orientate public clients on the potential and benefits of applying VM in construction projects. Similarly, Al-Yami (2008) found out that lack of awareness about VM is a major hindrance to VM application in the Saudi construction projects. Another people-related factor (poor collaboration and working relationship among stakeholders-BG3) ranked 3rd (Av.MS=4.141). This finding is supported by Ojoko et al. (2016) and Tanko et al. (2017b) who identified poor communication and teamwork as one of the challenges facing the Nigerian construction environment. That is to say effective communication and collaboration would assist to drive home the actualisation of VM implementation.

The 4th (Av.MS=4.100) barrier is an environment-related factor (stakeholder's resistance to accept new innovations-BP1). Jaapar et al. (2009) maintained that resistance to changes is a major hindrance to VM application. Therefore, stakeholders should endeavour to welcome new innovations and ideas in order to promote the VM technique and add value to construction projects. Inadequate facilitation skills/training-BG4 and lack of willingness to accept changes-BG5, which are people-related factors ranked 5th (Av.MS=4.097) and 6th (Av.MS=4.097) respectively. Based on these findings, insufficient VM facilitation skills/knowledge and unwilling acceptance to changes would inevitably affect the existence and application of VM. Hence, construction professionals should be trained in the aspect of VM because it is implausible for professionals who have inadequate facilitation skills to request their clients to apply VM in their projects. Next, a local environment-related factor (lack of active involvement of clients and stakeholders-BP4) ranked 7th (Av.MS=4.067), while government-related factors (absence of local VM guidelines-BE3 and lack of encouragement on the part of government-BE4) ranked 8th (Av.MS=4.056) and 9th (Av.MS=3.994) respectively. The 10th (Av.MS=3.974) barrier to VM application is the lack of VM knowledge-BG2 among construction professionals which is classified under people-related factor.

The study also revealed other barriers (11th-16th) that were rated as "very hinder" which include: difficulty in the involvement of decision makers and other key partners in VM workshop (Av.MS=3.953); self-justifying attitude of the original design team (Av.MS=3.848); lack of legislation which provides VM application in the construction industry (Av.MS=3.845); client's inability to communicate requirements and needs to the design team (Av.MS=3.804); lack of commitment to implement VM (Av.MS=3.757); and difficulty to establish mutual project objectives by stakeholders (Av.MS=3.974).

On the other hand, only one factor (inappropriateness of procurement strategies to implement VM) which is methodology-related obeys the decision rule of "averagely hinder" (2.5 ≤ mean < 3.5), ranked as the 17th (Av.MS=2.510) barrier. Other barriers (VM workshop incurs additional cost, difficulty in conducting analysis/evaluation of functions, and lack of time to conduct VM studies) were neither high nor moderate and fall under the methodology-related factors. These barriers ranked 18th, 19th, and 20th respectively.

The four (4) identified groups of barriers to VM application were ranked to reveal the criticality of the groupings. The people-related group ranked 1st with an average MS of 4.12 followed by the government-related group with Av.MS of 4.02. The environment-related and methodology-related groups ranked 3rd (Av.MS= 3.89) and 4th (Av.MS= 2.29) respectively. Figure 1 shows the ranking of the VM barrier components in the Nigerian construction industry.

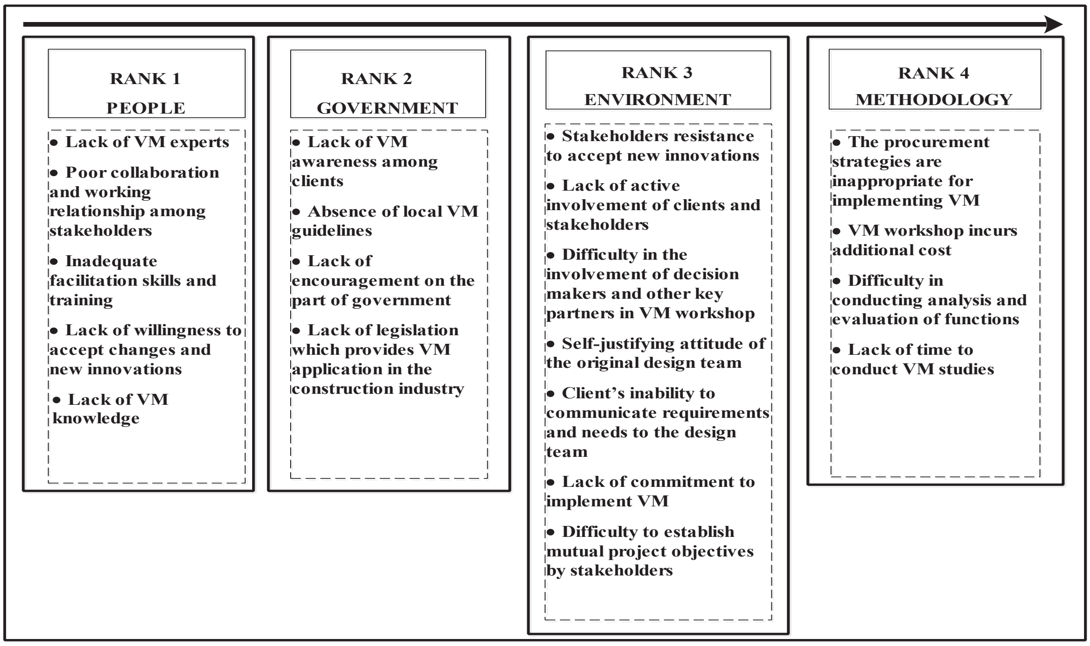

Figure 1. Barriers to VM Implementation

Measurement and structural models for VM Application

The barriers to VM application were validated using measurement and structural models to determine the leading authenticated barriers hindering the successful application of VM. The first-order measurement model establishes the strength of relationship of the items or variables of each construct. According to Musa et al. (2015), the first order measurement analysis is often initially carried out to test the validity of measurement models. The base limits of indices used as a part of measuring the goodness-of-fit of the measurement model are specified by Awang et al. (2015), Enegbuma et al. (2015) and Hair et al. (2008) as $p < 0.05$, Comparative Fit Index (CFI) ≥ 0.90, Goodness of Fit Index (GFI) ≥ 0.90, Chi-square/df (X2/df) < 5, and Root Mean Square Error of Approximation (RMSEA) ≤ 0.05-0.08. Musa et al. (2015) also established that the values of X2 /df should be less than 3, GFI > 0.9, CFI > 0.9, and RAMSEA < 0.08.

Therefore, the measurement model in Figure 2 mainly measures the relationship of the variables or items to each first-order construct (BP, BG, BE, and BM). The fit statistics discovered a p-value of 0.000, CFI value of 0.942, GFI, 0.90, χ^2/df value of 2.98, and RMSEA value of 0.08. These values are adequate and within the acceptable thresholds to establish the convergence validity of the measurement model for the barriers to VM application in the Nigerian construction industry. The results from the structural model for barriers to VM application in Figure 3 are also found to have met satisfactory thresholds on all of the statistical parameters for a model fit. The statistics revealed a p-value of 0.000, CFI value of 0.93, GFI, 0.89, $\chi 2/df$ value of 3.65, and RMSEA value of 0.088. Hence, the tested latent factors of the barriers have been verified by the analysis of results.

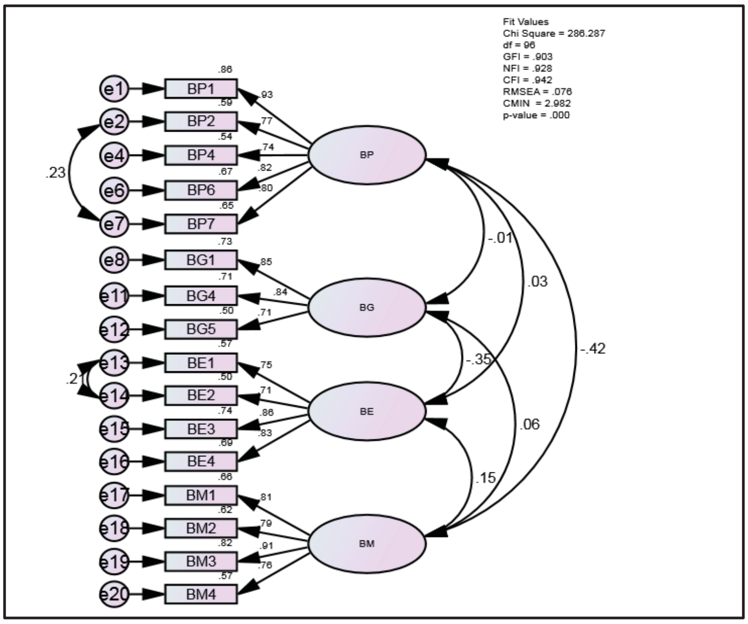

Figure 2. Measurement model for barriers to VM application

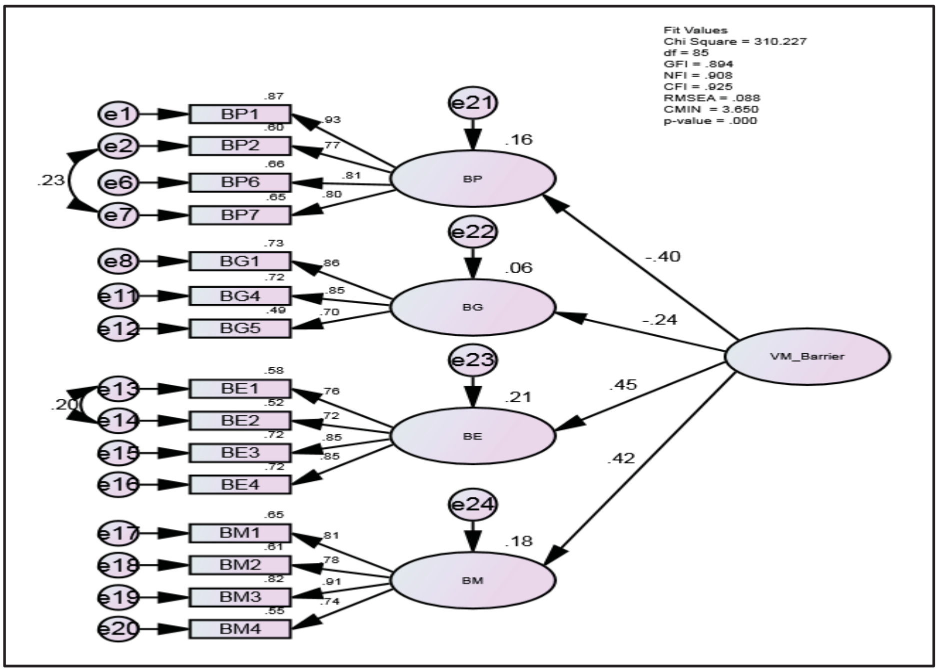

Figure 3. Structural model for barriers to VM application

CONCLUSION AND RECOMMENDATIONS

The study revealed the barriers to VM application in order to establish the impediments to VM practice in the construction industry. The critical barriers are: lack of VM experts; lack of awareness on VM among clients; poor collaboration and working relationship among stakeholders; stakeholder's resistance to accept new innovations; lack of willingness to accept new changes in the construction industry; inadequate facilitation skills and training; lack of active involvement of clients and stakeholders in a VM workshop; absence of local VM guidelines; lack of encouragement on the part of government; difficulty in the involvement of decision makers and other key partners in VM workshop. It was discovered that the people-related factor (lack of VM experts, poor collaboration, lack of awareness/knowledge on VM, inadequate facilitation skills) which ranked top by the Nigerian construction professionals is supported by the findings of Li and Ma (2012), AI-Yami (2008), Ojoko et al. (2016), and Kissi et al. (2015); inferring that trained VM experts are essential for the implementation of VM in the Nigerian construction industry in order to optimize the value of construction projects.

Based on the findings of this study, the following recommendations are made:

I. VM experts are needed for the successful implementation of VM in the Nigerian construction industry.
II. There is a dare need to familiarise both public and private clients on the potential and benefits of applying VM in construction projects.
III. Effective communication and co-operation among construction professionals, clients, contractors, government agencies, and other stakeholders would support the actualisation of VM implementation in Nigerian construction projects.
IV. Stakeholders must be ready and willing to welcome and adopt new value-added innovations and ideas so as to promote VM.
V. Construction professionals should be adequately trained in VM.
VI. Active participation of clients and other participants will stimulate successful implementation of VM in the construction industry.
VII. Government and top management play the leading role in terms of policy initiation, strategy development, and the implementation of strategies and policies. Therefore, the implementation of VM guidelines as well as government support are central to VM application.
VIII. The participation and decision making ability of government and other associates in the realm of VM would uphold the implementation of the technique in Nigerian construction projects.

In general, it is vital to note that the "people" and "government" related factors posed a major hindrance to VM application in the Nigerian construction environment. Therefore, the need to remedy the identified barriers should be given high priority so as to improve the value of Nigerian construction projects without sacrificing any performance standard.

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