The Application of Value Engineering on Construction Projects in Abia State, Nigeria

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Abstract- ***Value engineering is a management technique used in many industries, focusing at enhancing functions, and reliability at the lowest cost. The focus of value engineering is removing unnecessary cost and improving functionality, The construction industry is faced with myriad of challenges ranging from poor value analysis, cost deviation, time overrun and design ambiguities which has hindered its ability to satisfy the client's needs. Therefore this study assesses the application of value engineering in construction projects in Abia State. Its benefits and factors hindering its application in construction projects with the view to developing a framework for effective application of value engineering through the integration of building information modelling in the value engineering process. This thesis present an integrated framework for building construction professionals, owners and the VE team with automation capabilities to evaluate and compare different design alternatives of project components. A structured questionnaire was purposively distributed to four (4) groups of respondents, were completed and returned. Relative Importance Index was used to rank the agreement of the respondents. Spearman`s Rank Order Correlation coefficient was used to measure the strength and direction of association between the responses of the four groups of respondents. The results show the level of awareness and application of the concept within the construction industry, according to the rank agreement between the respondents, six (6) factors were ranked as most severe hindering factors to the application of value engineering in construction projects. The study concluded that value engineering is not commonly applied in the construction industry, there are potential benefits of integrating BIM into value engineering process in construction projects using the proposed framework which enables a 4D presentation to automate data extraction for project cost estimating, evaluation of alternatives, and to improved functionality of the projects, and recommended that there is the need for the construction industry to adopt the proposed value engineering framework to assist the VE team in decision making.***

I. INTRODUCTION

1.1 Background to the Study

Construction industries plays an important role in the development of a country, the success of any project depends on how that project can achieve its objectives in terms of cost, quality, functionality and durability. Construction industry globally has been under tremendous measures to improve its performance.

In Nigeria many construction project developments has failed and are left abandoned at various levels of completion, this is as a result of various technical and financial pressures of cost limits, quality and value optimization (Anyanwu, 2013), (Kolo and Ibrahim, 2010).

Barango, 2013, stated that the reasons for housing projects abandonment in Nigeria is predominantly the unforeseen factors resulting from initial estimating of the developers on the project cost during the planning stage.

There has been an increasing demand for value engineering in construction projects all over the world (Philip, Stephen Mansfield, Udo-Inyang, 2006)) and Nigeria is not left out, stakeholders in the Nigerian construction industry and researchers have continued to suggest ways of improving service delivery in the industry. One of such ways is the campaign for the industry to adopt concept of value engineering. (V.E) to improve the situation in terms of achieving value for money for the client (Oke and Ogunsemi, 2013).

Save (2015), defined Value Engineering is a systematic application of recognized techniques which identify the functions of the product or service, establish the worth of those functions, and provide the necessary functions to meet the required performance at the lowest overall cost.

The context of value engineering in the Nigerian construction industry is not fully embraced, despite its advocacy and practice in other developed countries of the world (Umar, 2015), as only few organizations adopt value engineering methodology in project execution. It's imperative that researches must begin to be conducted on responsiveness of the Nigerian construction industry towards value engineering.

1.2 Statement of problem.

The issue of project failure and abandonment have been left unresolved for a very long time and this has created obvious room for multiplier effect on the construction industry and the entire economy as a whole (Ewa, 2013 Many projects fails and are left abandoned due to myriads of problems, ranging from scope creep, cost overrun, time overrun, poor stakeholder management and ambiguous designs, (Amade, Amaeshi, Ubani and Okorocha, 2015) stated that the entire cronies of Nigeria is washed with evidence of failed and abandoned construction projects both in the private and public sector, which stems from cost related issues vi_z poorly articulated cost estimating principles and has resulted to both environmental and security issues in host communities.

There is a need for a better way/methodology for controlling the total cost of construction projects with the view to balance cost, schedule and scope through the generalization of alternative innovative.

1.3 Aim and Objectives

The aim of this research is to evaluate the level of application of value engineering in construction projects in Abia State, with a view of proposing a framework for use in the Nigerian construction industry through the integration Building Information Modelling in the value engineering process.

To achieve this aim, the following objectives are to be considered.

1. To identify the benefits of value engineering application in construction projects in Abia State.
2. To identify and rank the factors hindering the application of value engineering in construction projects in Abia State and apply it to the development of the proposed framework.

II. LITERATURE REVIEW

2.1 Value Engineering

Amruta, (2014), defined Value Engineering as it is a creative and disciplined process which seeks to offer the client a reliable opportunity for cost savings without detriment to main functions or performance. According to Kelly, Male and Graham (2004) Value engineering is a process of identifying and eliminating unnecessary cost during design and construction. They also stated that Value Engineering is the process of making explicit the functional benefits a client requires from the whole or part of a project at an appropriate cost during design and construction.

According to Department of Civil Defense, (2006) Value Engineering can be defined as an organized, systematic, interdisciplinary problem solving approach basically based on analyzing the function of systems, equipment, facilities, services, and supplies for the drive of accomplishing their crucial functions at the lowest life-cycle cost reduction with required performance, reliability, quality, and safety.

Galipogullari, (2013) further stated that the adoption of the VE process on a problem typically increases some combination of performance, reliability, quality, durability, effectiveness, or other desirable characteristics. (Alyousefi, 2011). Opined that there must be a recognized need for change and a distinct opportunity for financial benefit to deserve the added cost of a value engineering effort.

The approach is not without its critics, there is a potential for misunderstanding here, "eliminating unnecessary costs" can be misinterpreted as "cost cutting*"* as opined by Dallas (2006) "The associated functions to which a component contributes are

ignored, resulting in cost cutting in which functionality is lost".

The objective of the Value Engineering is in fact "cost effectiveness" (Farahmandazad, 2015). It is quite feasible that Value Engineering may result in a recommendation to increase the initial project construction cost, if it provides an overall cost benefit to the project, e.g. by energy efficiency and / or maintenance over the lifetime of the project. Therefore, it looks at life cycle costing. Therefore, Value Engineering is clearly not a cost cutting exercise; rather it is a process of identifying and eliminating unnecessary cost during the design and construction stage. This indicates that a holistic approach is required so that overall project objectives are not compromised. It is eminently possible that the cost of one component element can increase.

2.2 Benefits/Importance of Value Engineering

The utilization of value engineering brings substantial benefits for promoting sustainable construction principles. The principles and techniques of value engineering can provide the required quality to realize an optimal whole life cost and life-cycle assessment during the process of developing a project. Al-Yami and Price (2006)Mansour (2013) study on value engineering application on bridge construction in Egypt. The result vindicated the importance of value engineering and recommended the use of the methodology on bridges and other civil engineering construction.

Khaled and Pandey,(2016) suggest that a lack of management support is not a primary cause for the lack of use of value engineering(VE) as a construction management tool, senior management needs to appreciate the benefits of using value engineering as a construction management tool before its implementation can be increased. Professionals involved in managing the design need to understand the conflicting agenda that exist between design and management and understand the tools which can aid the management of the construction process. The decisions made in the early stages of a project affect all its aspects, yet the industry spends the least on this stage, in contrast with other industries.

The value engineering process has also led to better decision making, communication, trust and finally greater levels of satisfaction from the stakeholders involved in the construction industry process. Finally value engineering creates or increases the awareness and adoption of a value culture in organizations involved in the construction industry. This value culture will be valuable in ensuring that practices of the construction industry are carried with the view of satisfying the needs and expectations of the clients and other stakeholders involved in the process. This shall go a long way in increasing the efficiency and effectiveness of the construction industry in general.

SenayAtabay and NiyaziGalipogullari (2013), also noted the following as benefits of value engineering when applied on a construction projects

1. *Reducing Construction Production Costs*
2. *Finishing the Job before Time Schedule*
3. *Quality Improvement and Correction*
4. *Reducing Mistakes and Deficiencies in Project Drawings to Minimum*

The above benefits when achieved will improve the project worth and client satisfaction among the investors in the construction industry.

According to Oke and Ogunsemi (2011), the following are the perceived benefits of value engineering if fully incorporated into construction projects in Nigeria: Encourage use of local materials in construction, Adoption of new construction techniques/innovation, Cost effectiveness ,Effective delivery system/meeting completion period ,Aids conflict management, Improves quality of work ,It promotes adaptability and flexibility , It gives the true worth or value of money to client , It enhances competitive edge for the contractor, It enhances quality performance of construction projects, Eliminates unnecessary design, Improves functional space quality of projects, Enhance economic investment, Reduces cost and improves value

2.3 Factors hindering the application of Value Engineering in Nigeria.

Odeyinka (2006) defined value engineering as "a service, which maximizes 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". , value management can therefore be seen as "a systematic and multi-disciplinary process directed towards analyzing the functions of projects from its inception to completion and commissioning (through auditing or examination) for the purpose of achieving best value and return on investment at lowest possible overall life cycle cost.

Investigation of application of value engineering in the construction industry has attracted the interest of many researchers and practitioners. Shen (1997) conducted a survey to investigate value engineering awareness and applications in Hong Kong's construction industry and highlighted three most important reasons for not using value engineering at work, including lack of knowledge to implement value engineering, no confidence to introduce value engineering to clients, and lack of time to implement value engineering. He found out that the low level of applications is probably associated with the low level of awareness of value engineering among senior management in clients' organizations. Lack of time to implement value engineering and lack of knowledge about VM are also two key causes in hindering value engineering application to Southeast Asia (Cheah& Ting, 2005). Lai (2006) identified ten factors hindering the application of value engineering in the Malaysian construction industry. The main factors are lack of knowledge about value engineering, lack of support from parties with authority such as government and owners, and lack of local value engineering implementation guideline. Not surprisingly, the lack of knowledge about value engineering continues to be a key problem, whereas lack of time to implement value engineering is not a factor causing significant obstacles in Malaysia. A research conducted by Li and Ma (2012) in China also arrived at a similar conclusion that lack of time to implement value engineering is not a severe problem and main hindrance factors come from lack of expertise knowledge about value engineering, lack of technical norms and standards, and lack of VM experts.

The issues related to value engineering 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 value engineering in construction organizations is relatively new and very little evidence on its application in the construction industry. Some reasons for the absence of value engineering application could be lack of standard procedure for value engineering process, lack of encouragement, advice or guidance on projects for practicing value engineering from the construction industry regulatory body, and no guidance or knowledge about the benefits.

Lately, Aduze (2014) has undertaken a study of the prospects and challenges of value engineering in the Nigerian construction projects. The study concluded that lack of policy as government legislation, client's negative reception, and lack of knowledge about value engineering are some factors impeding the value engineering application. As a result discovered, lack of awareness about value engineering 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 value engineering application in the Nepalese construction industry which include incentive clause for value engineering re-proposal in contract document, commitment from top management, forming a value engineering team with experienced members, and sufficient time to apply value engineering. 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 value engineering 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 value engineering workshop.

Oke and Ogunsemi (2011) in their study of value engineering in construction projects in Nigeria suggested the following as the major impediments to the application of value management to construction projects in Nigeria: ambiguous design; time of completion/delay; conflict management; finance; construction methodology; inadequate knowledge of benefits of value management; lack of involvement

of professionals i.e. Specialists right from the onset; greediness of the contractors and consultants; lack of total quality management principles in construction firm; professional incompetence; technology level; finance/fund; procurement style; government factor; human factor; communication gap; government policy; unstable economy; poor management especially on the part of the client; lack of professional competence; use of wrong/quack professionals for construction works; lack of understanding of the concept; and lack of information.

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 value engineering is one of the biggest obstacles for its limited application in the construction industry.

2.4 Integrating BIM into Value Engineering process

BIM application to value engineering brings many benefits to the value engineering team, such as improving communication between the values engineering team and facilitates faster decision making in choosing alternative design and evaluation. The ability of BIM to foster collaboration between construction key players facilitates the design process decision (Azhar, Behringer, sattineni and Maqsood, 2012).

The accuracy of a cost estimating during value engineering relies on a number of factors such as market condition which is changing over time, the time slack between estimation and execution, design changes and quality issue (Aya Hasan, 2017).). The accurate and computable inherent of building information models enables a more reliable source for owners and stakeholders to perform quantity takeoff and estimating during value engineering process. This results in faster cost feedback on design changes. During the early stages of the construction project process, particularly in the conceptual and feasibility phases, the ability to affect cost is stronger (Eastman, Teichol, and Sacks, 2011).

Insufficient time, poor documentation, and communication breakdowns between the value engineering team is one of the main reasons for poor estimates. Integration of an automatic quantity takeoff system with value engineering to generate a cost estimating report is a method to address the difficulties of the cost estimate during value engineering exercise. With BIM the estimates will be visual and very comprehensive and ensure that any of the project scope is not missed. With BIM, it is visual and very comprehensive, it allows the generation of takeoffs, counts and measurements directly from a model (Darshan and Jitendra, 2017).). Improving the overall accuracy of evaluation of alternatives and cost estimating is the key motivator for integrating BIM into value engineering exercise.

The Revit Architecture provided by Autodesk Inc. amongst other BIM tools has more advantages with built-in sequencing options to build a 3D model and its integration into the proposed framework will enable effective evaluation of alternatives and its related cost due to the following reasons: High performance of 3D BIM Modeling, the ability to add 4D and 5D to the same model, quick changes to design, no repetitive tasks, accurate estimation of quantities and cost.

III. METHODOLOGY

The study is exploratory research, comprising of 300 registered construction specialists in Abia State, ranging from architects, structural engineers, quantity surveyors and builders, these set of population was chosen due to their vast knowledge in the construction sector and as such are in position to give accurate information on the topic under study.

Data triangulation method was adopted for data collection, comprising of structured questionnaire and case study of some selected projects within Abia State. Using Taro Yamani (1967) theoretical formula, a total number of 171 structured questionnaire where purposively distributed, completed and returned, the data were analyzed using relative importance index to rank the responses of the respondents and the strength of association of the ranked variables was analyzed using spearman`s rank correlation coefficient.

IV. RESULTS AND DISCUSSION OF FINDINGS.

Q- 1. What are the benefits of value engineering application on building projects in Abia, State?

The researcher sought information from the respondents on the perceived benefits of value engineering application on building projects in Abia State, this is to show if the objectives of value engineering is being achieved when applied on construction projects.

Table 1. Benefits of value engineering application on building projects.

		Level of Benefits								
		V/L	L	H	V/H	Total respondents	W/total	RII	Mean	RANK
1	Design Improvement	15	10	10	98	133	457	0.85902256	3.43609	6
2	Improved functionality	2	9	9	113	133	499	0.93796992	3.75188	3
3	Cost Effectiveness		3	6	124	133	520	0.97744361	3.90977	1
4	Remove unecessary cost	2	7	7	117	133	505	0.94924812	3.79699	2
5	To achieve innovative design	4	16	6	107	133	482	0.90601504	3.62406	5
6	Improved life cycle cost maintainance		14	9	110	133	495	0.93045113	3.7218	4

Source: field Data, 2018

Table 1. Represent the relative importance index for the four groups of correspondents on the benefits of value engineering application on building projects in Abia State. The Table shows the benefit of value engineering is to achieve cost effectiveness with a mean of 3.91, this is followed by to remove unnecessary cost with a mean of 3.79, improve functionality with a mean of 3.75, improved life cycle cost maintenance with a mean of 3.72, to achieve innovative design with a mean of 3.62 and lastly design improvement with a mean 3.43. This shows that is a strong backing that the core benefit of value engineering is to achieve cost effectiveness within a construction project.

V. CASE STUDY

- Project details

Project: hotel development
Client: Jacony properties
Location: Potharcourt road Aba, Abia state.

- Project description

1) Contract sum = N350, 000,000.
2) Ground floor
3) 3 upper floors
4) 62 rooms, all en-suit
5) Restaurant, Bar, Kitchen
6) Parking lot.

The value management team were faced with the challenge of upgrading the aesthetics of the hotel in the face of stiff competition from other similar developments within the area. Consequently a building information modelling was created using Revit provided by Authodesk, comprising of the architectural, structural and MEP of the proposed hotel development, the model was developed during the design stage based on the professional guidance from both the architect, structural engineer and the quantity surveyor, using this model the project team was able to optimize the functionality the project life through the review the following building elements:

1 Roof
2 Internal walls
3 External walls

4 External works.

- Summary of Review by the VE Team

1) Roof

At the height of over 13metres, the value management team considered the use of slate roof tiles uneconomic, since the original design provided for roof parapet with concrete gutters, the team substituted slate tiles with long span aluminum roofing sheet of 0.45m gauge stucco mill finish.

2) Internal Walls Finishing

The team recommended the use of POP screeding finish with one coat of deluxe vinyl paint finishes instead of original design of cement and sand plastering and two coats of emulsion paints.

3) External Walls Finishing

The finishing to the external walls was cement and sand plastering and two coats emulsion paint. This was changed to Aluco board sidings.

4) External works.

The parking lot was originally tarmacadam finish, this was substituted with interlocking concrete paving slabs.

- Cost Variations of Recommendations.

Table 2 Analysis of cost Variation in case study

	Original Contract Sum						350,000,000
	ELEMENT	Quantity	Unit	Rate	Amount		
					OMIT	ADD	
	Roof						
1	slate roof	859	m2	4,000	3,436,000		
	Longspan	859	m2	1,400		1202600	
2	External Walls						
	P+ P	1482	M2	2,500	3,705,000		
	Aluco bond	1482	m2	7,000		10374000	
3	Internal Walls						
	P +P	4570	M2	2,500	11,425,000		
	POP + vinyl	4570	M2	4,000		18280000	
4	External Works						
		1038	M2	2,800	2,906,400		
	Interlocking	1038	m2	5,500		5709000	
	TOTAL				21,472,400	35565600	
	NET ADDITIONAL COST						14,093,200
	NET CONTRACT SUM						364,093,200
	% INCREASE						4.02%

Table 2 shows, that there was 4.02% increase in the contract sum, unlike the conventional cost cutting that is believed to be associated with value engineering, this is because the value engineering team was concerned with the clients need to optimize the project to meet with the stiff competition within the projects location, and as such so many elements in the projects where optimized to meet the required functionality, while looking at the life cycle cost maintenance of each element of the building, this conforms with the researchers ideology that value engineering is "cost effective" which can result in a recommendation to increase the initial project construction cost, if it provides an overall cost benefit to the project.

- Summary of Findings from Case Study

The objective of the Value Engineering is in fact "cost effectiveness". It is quite feasible that Value Engineering may result in a recommendation to decrease or increase the initial project construction cost and performance, if it provides an overall cost benefit to the project, e.g. aesthetics purposes, functionality or maintenance over the lifetime of the project as seen in case study, it looks at life cycle costing and project optimization. Therefore, Value Engineering is clearly not a cost cutting exercise, rather it is a process of identifying and eliminating unnecessary cost during the design and construction stage. This indicates that a holistic approach is required so that overall project objectives are not compromised, as it is eminently possible that the cost

of one component element can increase due to the building requirement.

Q-2. What are the hindering factors to value engineering application in commercial building project in Abia State?

The study identified 16 hindering factors to the application of value engineering on building projects which will enable us achieve objective two of the study. Factors were extracted from the literature review and the respondents are required to rate their responses using 5 likert scale.

Table 2.1 Ranking for Quantity Surveyors on the Factors that Hinder Value Engineering Application in Construction Projects in Abia State

		Level of impact									
		V/L	L	M	H	V/H	Total respondents	W/total	RII	Mean	RANK
1	Lack of knowledge about VM		2	5	3	30	40	181	0.905	4.525	7
2	Lack of local VM guidelines as well as technical norms and standards		1	4	2	33	40	187	0.935	4.675	3
3	Lack of investment and support policy and human resources to conduct VE construction companies		3	1	5	31	40	184	0.92	4.6	6
4	Lack of legislation providing for application of VM in the construction industry		2	1	7	30	40	185	0.925	4.625	5
5	Lack of support and active participation from owners and stakeholders			4	1	35	40	191	0.955	4.775	2
6	Lack of the collected information in the early stage causing difficulties in making ideas and alternatives		5	5	3	27	40	172	0.86	4.3	12
7	Inexperienced and incompetent contractors	2	2	2	2	32	40	180	0.9	4.5	8
8	Lack of contract provisions on implementation of VM between owners and stakeholders	3	1	2	2	32	40	179	0.895	4.475	9
9	Inexperienced and incompetent VM team's members	5		2	10	23	40	166	0.83	4.15	13
10	Unqualified VM facilitator		8	5	7	20	40	159	0.795	3.975	14
11	Lack of cooperation and interaction with the internal VM team		5	2	3	30	40	178	0.89	4.45	10
12	Too few construction projects applied VM	5	1	4	11	19	40	158	0.79	3.95	15
13	Lack of competence in cost estimation of VM team	3	1	18	7	11	40	142	0.71	3.55	16
14	Defensive attitude of the original design team		2	1	6	31	40	186	0.93	4.65	4
15	The complexity of proposed projects to apply VM	3	1	1	6	29	40	177	0.885	4.425	11
16	Difficulties of conducting analysis and evaluation of alternatives			1	2	37	40	196	0.98	4.9	1

Source: field Data, 2018

Table 2.1 presented the relative importance index by Quantity Surveyors on the factors that hinder value engineer application in construction projects in Abia State. From the table it can be observed that the five top most factors that hinder value engineering application in construction projects in Abia State. are difficulty in conducting analysis and evaluation of alternatives, Lack of support and active participation from owners and stakeholders, lack of value engineering guidelines as well as technical norms and standards, defensive attitude of the original design team, Lack of legislation providing for application of VM in the construction industry.

Table 2.2 Ranking for Architects on the Factors that Hinder Value Engineering Application in Construction Projects

		Level of impact									
		V/L	L	M	H	V/H	Total respondents	W/total	RII	Mean	RANKING
1	Lack of knowledge about VM		2	2	4	28	36	166	0.922	4.611	7
2	Lack of local VM guidelines as well as technical norms and standards		2	2	3	29	36	167	0.928	4.639	6
3	Lack of investment and support policy and human resources to conduct VE construction companies		2	2	0	32	36	170	0.944	4.722	5
4	Lack of legislation providing for application of VM in the construction industry			2	2	32	36	174	0.967	4.833	3
5	Lack of support and active participation from owners and stakeholders			1	2	33	36	176	0.978	4.889	2
6	Lack of the collected information in the early stage causing difficulties in making ideas and alternatives	3	1	2	1	29	36	160	0.889	4.444	9
7	Inexperienced and incompetent contractors	5		1	7	23	36	151	0.839	4.194	12
8	Lack of contract provisions on implementation of VM between owners and stakeholders	1	2	2	4	27	36	162	0.9	4.5	8
9	Inexperienced and incompetent VM team's members	2	1	3	5	25	36	158	0.878	4.389	11
10	Unqualified VM facilitator		11	3	3	19	36	138	0.767	3.833	14
11	Lack of cooperation and interaction with the internal VM team	1	3	1	6	25	36	159	0.883	4.417	10
12	Too few construction projects applied VM	4	3	4	10	15	36	137	0.761	3.806	15
13	Lack of competence in cost estimation of VM team	7	5	2	5	17	36	128	0.711	3.556	16
14	Defensive attitude of the original design team		2	1		33	36	172	0.956	4.778	4
15	The complexity of proposed projects to apply VM	4	2	5	2	23	36	146	0.811	4.056	13
16	Difficulties of conducting analysis and evaluation of alternatives			1	1	34	36	177	0.983	4.917	1

Source: field Data, 2018.

Table 2.2 presented the relative importance index by Architects on the factors that hinder value engineer application in construction projects in Abia State. The five top most factors are difficulty in conducting analysis and evaluation of alternatives Lack of support and active participation from owners and stakeholders, Lack of legislation providing for application of VM in the construction industry, Lack of investment and support policy and human resources to conduct VE construction companies.

Table 2.3 Ranking for Civil Engineers on the Factors that Hinder Value Engineering Application in Construction Projects

		Level of impact									
		V/L	L	M	H	V/H	Total respondents	W/total	RII	Mean	RANKING
1	Lack of knowledge about VM		5			25	30	135	0.9	4.5	7
2	Lack of local VM guidelines as well as technical norms and standards	1	2	1	1	25	30	137	0.913	4.567	5
3	Lack of investment and support policy and human resources to conduct VE construction companies	2	1			27	30	139	0.927	4.633	4
4	Lack of legislation providing for application of VM in the construction industry	1	1	1		27	30	141	0.94	4.7	3
5	Lack of support and active participation from owners and stakeholders			4	1	35	40	191	0.955	4.775	2
6	Lack of the collected information in the early stage causing difficulties in making ideas and alternatives	4	1	1		24	30	129	0.86	4.3	10
7	Inexperienced and incompetent contractors	3	2	1	4	20	30	126	0.84	4.2	12
8	Lack of contract provisions on implementation of VM between owners and stakeholders	1	4			25	30	134	0.893	4.467	8
9	Inexperienced and incompetent VM team's members	4	1	1	1	23	30	128	0.853	4.267	11
10	Unqualified VM facilitator	5	1	1		23	30	125	0.833	4.167	13
11	Lack of cooperation and interaction with the internal VM team	4	1		1	24	30	130	0.867	4.333	9
12	Too few construction projects applied VM	7	1		2	20	30	117	0.78	3.9	16
13	Lack of competence in cost estimation of VM team	6	1	1	3	19	30	118	0.787	3.933	15
14	Defensive attitude of the original design team	2	1	1	1	25	30	136	0.907	4.533	6
15	The complexity of proposed projects to apply VM	3	3	1	4	19	30	123	0.82	4.1	14
16	Difficulties of conducting analysis and evaluation of alternatives				2	28	30	148	0.987	4.933	1

Source: field Data, 2018

Table 2.3 presented the relative importance index by Civil Engineers on the factors that hinder value engineer application in construction projects in Abia State. From the table the five top most ranked factors that hinder value engineering application in construction in Abia State are difficulty in conducting analysis and evaluation of alternatives, Lack of support and active participation from owners and stakeholders, Lack of investment and support policy and human resources to conduct VE construction companies, Lack of investment and support policy and human resources to conduct VE construction companies, lack of value engineering guidelines as well as technical norms and standards

Table 2.4 Ranking for Builders on the Factors that Hinder Value Engineering Application in commercial Projects

		Level of impact									
		V/L	L	M	H	V/H	Total respondents	W/total	RII	Mean	RANKING
1	Lack of knowledge about VM		5			22	27	120	0.889	4.444	8
2	Lack of local VM guidelines as well as technical norms and standards	1	1			25	27	128	0.948	4.741	3
3	Lack of investment and support policy and human resources to conduct VE in construction companies	2	1			24	27	124	0.919	4.593	5
4	Lack of legislation providing for application of VM in the construction industry	2				25	27	127	0.941	4.704	4
5	Lack of support and active participation from owners and stakeholders	3			1	23	27	122	0.904	4.519	6
6	Lack of the collected information in the early stage causing difficulties in making ideas and alternatives	6	1	1	1	18	27	105	0.778	3.889	13
7	Inexperienced and incompetent contractors	2	2	1	3	19	27	116	0.859	4.296	9
8	Lack of contract provisions on implementation of VM between owners and stakeholders		4		2	21	27	121	0.896	4.481	7
9	Inexperienced and incompetent VM team's members	7	1	2	2	15	27	98	0.726	3.63	14
10	Unqualified VM facilitator	6	1			20	27	108	0.8	4	12
11	Lack of cooperation and interaction with the internal VM team	6				21	27	111	0.822	4.111	11
12	Too few construction projects applied VM	9		1		17	27	97	0.719	3.593	15
13	Lack of competence in cost estimation of VM team	10				17	27	95	0.704	3.519	16
14	Defensive attitude of the original design team	1		1		25	27	129	0.956	4.778	2
15	The complexity of proposed projects to apply VM	4	1		1	21	27	115	0.852	4.259	10
16	Difficulties of conducting analysis and evaluation of alternatives			1	1	25	27	132	0.978	4.889	1

Source: field Data, 2018

Table 2.4 presented the relative importance index by builders on the factors that hinder value engineer application in construction projects in Abia State. From the table the five top most ranked factors that hinder value engineering application in construction in Abia State, are are difficulty in conducting analysis and evaluation of alternatives, Defensive attitude of the original design team, lack of value engineering guidelines as well as technical norms and standards, Lack of legislation providing for the application of VE in construction projects, Lack of investment and support policy and human resources to conduct VE construction companies.

Table 2.5.Agreement Analysis Between all the four Groups of Respondents (Quantity Surveyors, Architects Civil Engineers and builders)

										Absolute Difference								
		Category Ranking								Ranked By Sector								
	VARIABLES	Q.S	ARCH	ENGR	BLDR	QS-ARCH	d^2	QS-ENG	d^2	Q.S-BLDR	d^2	ARCH-BLDR	d^2	ARCH-ENG	d^2	ENG-BLDR	d^2
1	Lack of knowledge about VM	7	7	7	8	0	0	0	0	-1	1	-1	1	0	0	-1	1
2	Lack of local VM guidelines as well as technical norms and standards	3	6	5	3	-3	9	-2	4	0	0	3	9	1	1	2	4
3	Lack of investment and support policy and human resources to conduct VE construction companies	6	5	4	5	1	1	2	4	1	1	0	0	1	1	-1	1
4	Lack of legislation providing for application of VM in the construction industry	5	3	3	4	2	4	2	4	1	1	-1	1	0	0	-1	1
5	Lack of support and active participation from owners and stakeholders	2	2	2	6	0	0	0	0	-4	16	-4	16	0	0	-4	16
6	Lack of the collected information in the early stage causing difficulties in making ideas and alternatives	12	9	10	13	3	9	2	4	-1	1	-4	16	-1	1	-3	9
7	Inexperienced and incompetent contractors	8	12	12	9	-4	16	-4	16	-1	1	3	9	0	0	3	9
8	Lack of contract provisions on implementation of VM between owners and stakeholders	9	8	8	7	1	1	1	1	2	4	1	1	0	0	1	1
9	Inexperienced and incompetent VM team's members	13	11	11	14	2	4	2	4	-1	1	-3	9	0	0	-3	9
10	Unqualified VM facilitator	14	14	13	12	0	0	1	1	2	4	2	4	1	1	1	1
11	Lack of cooperation and interaction with the internal VM team	10	10	9	11	0	0	1	1	-1	1	-1	1	1	1	-2	4
12	Too few construction projects applied VM	15	15	16	15	0	0	-1	1	0	0	0	0	-1	1	1	1
13	Lack of competence in cost estimation of VM team	16	16	15	16	0	0	1	1	0	0	0	0	1	1	-1	1
14	Defensive attitude of the original design team	4	4	6	2	0	0	-2	4	2	4	2	4	-2	4	4	16
15	The complexity of proposed projects to apply VM	11	13	14	10	-2	4	-3	9	1	1	3	9	-1	1	4	16
16	Difficulties of conducting analysis and evaluation of alternatives	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
						$\sum^2$	48		54		36		80		12		90
				Rs			0.929		0.921		0.947		0.883		0.982		0.868

Source: field Data, 2018

Table 2.5 shows the agreement of all the four groups of respondents on the factors hindering the application of value engineering in commercial building projects in Abia state, using spearman`s Rank Coefficient, the coefficients are Rs = + 0.929, +0.921, +0.947, +0.883,+0.982, +0.868, and the Statistical significant level p=0.001(which is 99.95 statistically significant). This shows a positive correlation between the four groups of respondents.

VI. SUMMARY, CONCLUSION AND RECOMMENDATION

This chapter will present the summary of the findings from the research, conclusion based on the findings and make recommendations for the effective application of value engineering on construction projects.

5.1 Summary of Findings

The research set out to examine the applicability of Value Engineering in construction projects in Abia

State, the benefits and hindering factors. It has considered existing literature relating to Value Engineering applicability in construction projects and integration of BIM tools in value engineering process using case study, It has presented the factors hindering its application in the research using questionnaire analysis.

From the analyses of data presented in chapter four, the following summary of findings were made. From the analysis of the research questions, it revealed the benefits of integrating BIM into value engineering application in construction projects, such as cost benefits, optimum functionality of the projects and other perceived benefits.

The six top most factors that hinder value engineering application in construction projects in Abia State, as ranked by Quantity Surveyors, Architects, Civil engineers and Builders are, Difficulties of conducting analysis and evaluation of alternatives, Lack of support and active participation from owners and stakeholders, Defensive attitudes of original design team, Lack of local value management guidelines as well as technical norms and standards , Lack of legislation providing for application of VM in the construction industry, Lack of investment and support policy and human resources to conduct VE construction companies.

5.2 Conclusion

The study concludes that, While the professionals in the construction industry are aware of the potential benefits of Value Engineering application on a construction project, the methodology is not fully applicable in the Nigerian construction industry as only few professionals are conversant with its application , even when there is a need to its application, the resource persons and technicalities needed to conduct it are scares, making the process difficult to apply, thereby resulting in reduction of the potential benefit, as a result of deficiencies in the evaluation of alternatives, management and control of the Value Engineering process within the context of the overall project.

5.3 Recommendations

Based on the literature review, questionnaire analysis and findings, the following recommendations were made by the researcher:-

i. Organizing value engineering training workshops and seminars in order to enlighten the participants of the construction industry on the principles, concept and techniques involved in the value engineering process.
ii. There is a need for the construction industry in Nigeria to adopt value engineering process/analysis in their construction projects to achieve value for money.
iii. The need to adopt the proposed framework for value engineering exercise, for the ease of alternative selection and evaluation.

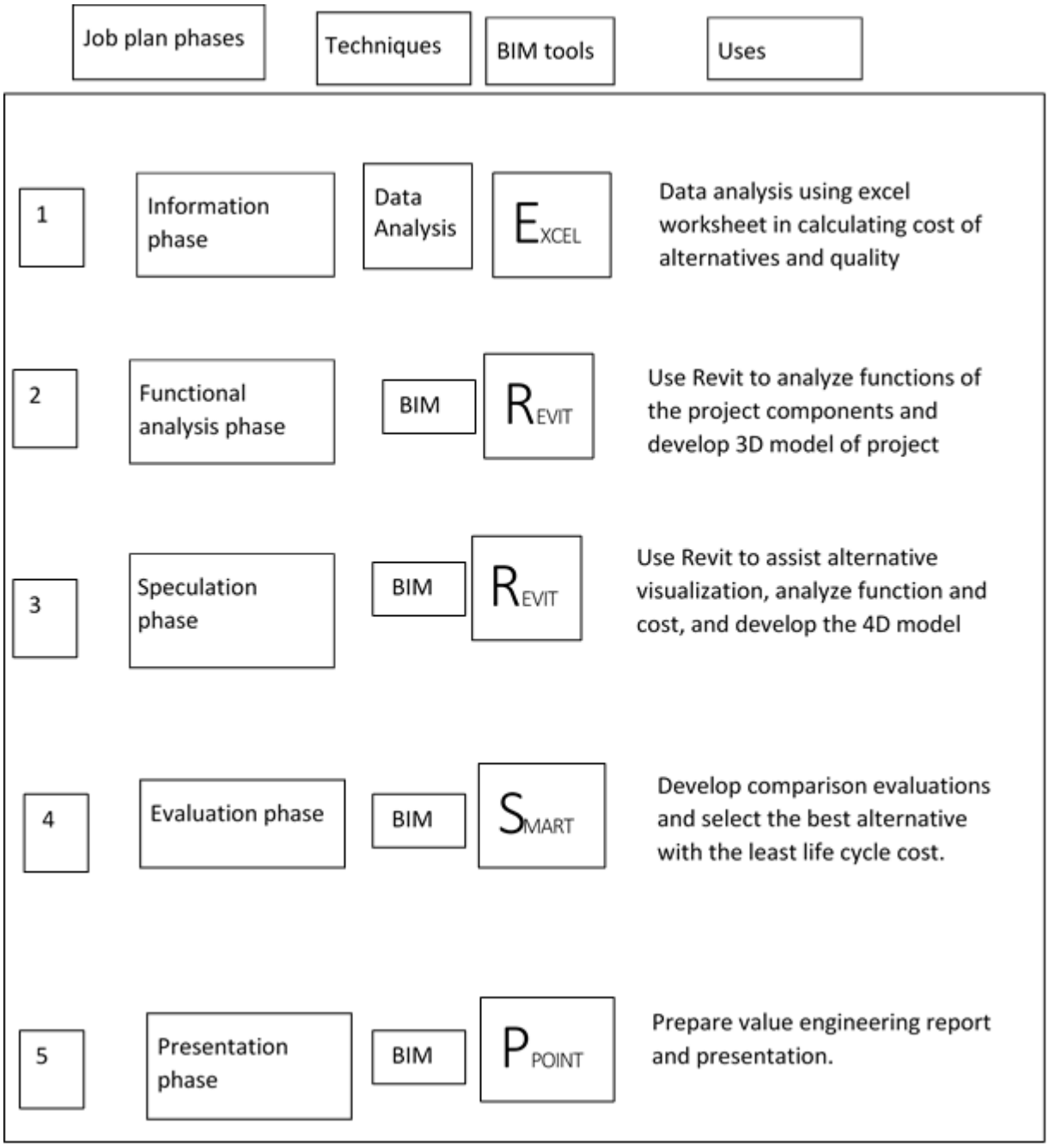

Figure 5.1: proposed framework.

The programs in the proposed framework is not binding, as it is designed in such a way that the user, is free to use any other program that best suit his desired outcome in each phase of the job plan.

5.4 Contribution to knowledge

i. Automating the assessment and evaluation procedures of competing alternatives.
ii. Broadening the use and integration of BIM in the automatic evaluation of alternatives.
iii. Providing a framework that supports value engineering job plan.

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