

AN APPRAISAL OF VALUE ENGINEERING AND THE AWARENESS LEVEL AMONGST  
NIGERIAN CONSTRUCTION PROFESSIONALS

Olawuyi, B. J.<sup>1</sup>

Email: [babatundeolawuyi@yahoo.com](mailto:babatundeolawuyi@yahoo.com)

Department of Building, Federal University of Technology, Minna, Niger State, Nigeria.<sup>1</sup>

**ABSTRACT**

The practice of value engineering is known to enhance the provision of necessary functions reliably at the lowest cost; an act that should enhance effectiveness in Nigerian Construction Industry if properly and widely adopted. This paper appraised the concept of value engineering and sought to ascertain its level of popularity as a management technique amongst the professionals in Nigerian Construction Industry. Data was collected through the use of 30 randomly distributed questionnaires, of which 23(76.7%) were received back and analysed. The study revealed that the term “Value Engineering” is not very popular amongst Nigerian construction professionals, although the concept was observed to be incorporated in the cost control and reduction approaches being adopted by some of the professionals. Unhealthy professional practice was seen as a major hindrance to the full-fledge practice of value engineering as a management technique. Proper enlightenment of the professionals and clients of the Industry on the concept through seminars and workshop was thereby recommended while a call is made for an encouragement of the “Contractor’s Change Proposal” approach of value engineering with the enactment and implementation of a law backing its practices in Nigeria.

**KEYWORDS:** Value Engineering, Value Management, Value Analysis, Value Planning, Cost Control.

**INTRODUCTION**

Value Engineering (VE) is a management techniques which is widely used in many industries (be it Manufacturing or Construction), and it enhances the provisions of necessary functions reliably at the lowest cost.

The origin of the technique can be traced to the United State during the World War II in 1940’s, where it started as a search for alternative product components, a shortage of which had developed as a result of the war. The alternative components later being unavailable due to the war thereby led to a search not for alternative component, but to a means of fulfilling the function of the component by an alternative method. This process known as “Value Analysis” was later seen to produce low-cost products without reducing quality and thereby maintained as a means of both removing unnecessary cost from products and improving design; hence came the birth of Value Engineering processes based on analysis of function (Palmer, et al., 1996).

Value Engineering's first application to construction process was in the 1960's but it became widespread in the 1970's especially by the public sector bodies. Indeed it was often mandatory for general services administration contracts in the United States, and considerable success in its use was recorded.

This technique is totally new in Nigerian Construction Industry with no much records of its practice while most clients and professionals in the industry are ignorant of the techniques and the numerous benefits to be derived from its application.

This study therefore sought to offer answer to the following research questions.

- How acquainted are various professionals in the Construction Industry with the concept of Value Engineering as a management technique?
- What approaches of Value Engineering is being adopted and what level of cost savings is achieved?
- What are the factors militating against the application of Value Engineering as a management techniques in the Nigerian Construction Industry?

In line with the above, the under-listed hypothesis was tested:

- Most of the Construction Industry professionals are ignorant of the concept of Value Engineering as a management technique.
- The approaches being adopted for Value Engineering in the Nigerian Construction Industry are informal, while the Cost Savings achieved is below 25%.
- The practice of Value Engineering in Nigerian Construction Industry is being hindered mainly by Client's Ignorance and Unhealthy Professional Practices.

## **METHODOLOGY**

The study involved the use of 30 questionnaires distributed randomly to various professionals in the Industry. The spread represented the three broad parties in a project (i.e. the client, consultant and contractors) to gather information on their awareness on the concept and also their past involvement on its usage as a management technique. The paper also looked at past works of other authors, to discuss their views on the concept of Value Engineering, highlighting the various approaches on record and the generally accepted procedure of a Value Engineering exercise. This served as a foundation upon which this study is built.

The data collected was analysed and presented in the descriptive and inferential methods using tables, charts, the percentile and student t-test methods. Lagos environment served as the study area while

inference was made on Nigeria as a whole, Lagos State being the seat and headquarter of most organization in the Nigerian Construction Industry.

The constraint to the study was the non-challant and lukewarm attitude of respondents while the design of the questionnaire was made very simple to enhance ease of data gathering.

## **THE CONCEPT OF VALUE ENGINEERING**

As stated by Green and Moss (1993), Value Management often means different things to different people and there is considerable confusion between value management and value engineering. This is reflected in the definition of Value Engineering as offered by McGraw Hill Encyclopaedia of Engineering; “a thinking system (also called value management or value analysis) used to develop decision criteria when it is important to secure as much as possible of what is wanted from each unit of the resources used”.

Seeley (1996) opines that “in practice, value management is a term favoured in the United Kingdom and value engineering is used extensively in the United States, where it is often performed by engineers with application to manufacturing industry”. For purpose of clarity this paper will maintain the same stand as offered by the College of Estate Management COEM (1995) that “Value Engineering may be considered as a sub-set of value management in that it deals mainly with the design process rather than with the overall management of value throughout a contract.”

**Value Management** is generally deemed to include **Value planning**-dealing with value during the early stages in the planning of a project; **value engineering**-dealing with value during the design and/or engineering stages; and **value analysis**-identifying value in respect of the complete project (COEM, 1995).

The Society of American Value Engineers (SAVE) defines Value Engineering as “The systematic application of recognized techniques which identify the **function** of a product or service, establish a **monetary value** for that function and provide the necessary function reliable at **the lowest overall cost**.”

The premise is that some unnecessary cost is inevitable in any building design: value engineering sets out to identify and eliminate the unnecessary cost, resulting in cost savings. It focuses on the value rather than the cost, in relation to the function. **Cost** here relates to what an element is, whereas **value** relates to what an element does. This is mainly the line of distinction between cost control and value engineering.

**Value Engineering** is concerned with achieving design objectives at minimum cost without sacrificing quality while **cost benefit** on the other hand justifies cost by looking at the objectives in terms of the saving that may be made, and subjectively at benefit that may accrue (COEM, 1995)

Unlike other cost reduction techniques (such as work-study) which “clip costs” value engineering “blast cost”. Value Engineering is a disciplined and organized approach which takes nothing for granted while its utility lies in team work. The emphasis in value engineering is laid on function and the function, once clearly established has to be fulfilled without sacrificing quality. The technique peels the “cost onion” layer by layer identifying each unnecessary cost. Under such detailed and powerful scrutiny, the cost pyramid tumbles down (Kharbanda et. al., 1987).

**Value Engineering Function:** Value engineering attempt to remove unnecessary cost with no loss of function. In carrying out a value engineering exercise the aesthetic design should not be compromised. In essence it is another look at the design, with a view to identifying unnecessary cost and classifying ways in which they could be removed.

Two design teams looking at a common problem may often come up with two different solutions. Since one solution will clearly not be exactly the same cost as the other, then one solution must contain unnecessary cost; this is, provided that the function and quality are the same in both cases.

Value engineering would normally focus on key design issues that have been taken. An objective consideration of design decision is essential if the value engineering exercise is to be successful. It follows then that, at an early stage in design, a value engineering exercise may be carried out that looks at crucial or critical design features. For instance, we may consider the selection of the frame of the building, not considering any other design items. Alternatively, we may wish to consider the election of the frame type and cladding type as part of the value engineering exercise, all other design elements being left unchanged (COEM, 1995).

### **Approaches to Value Engineering**

There are a number of different approaches that can be adopted when carrying out value engineering with the choice often being decided by the type and nature of the project, the timing of the operation and the make up of the design team. It is customary to prepare a job plan incorporating a recognizable strategy, which normally comprise the six phases of information: creativity; evaluation; development; presentation/recommendation and action and feedback. The various procedures are as discussed below.

**(a). The Charette:** This is undertaken after the project brief has been formulated and the design team appointed but before the actual design is commenced. The client’s representatives and the design team meet under the chairmanship of a value engineer or facilitator for two days to examine the brief in

detail and questions raised. They then generate ideas rationalizing the brief, when functional analysis of the space requirement can form a major component and improving the project cost effectiveness. The ideas are then evaluated and if accepted becomes a revised brief (Seeley, 1996).

**(b). The 40 Hour Value Engineering Workshop Study:** This is probably the most widely accepted formal approach to value engineering, and is used as the basis for training of value engineers as prescribed by the Society of American Value Engineer (SAVE). It is normally undertaken at about 35 percent of the way through the design stage (i.e. about as late as is reasonably practicable). The sketch design of the project is reviewed by an independently appointed second design team, under the chairmanship of value engineering team coordinator (VETC), the composition of this team is made up of possibly six to eight professionals reflecting the characteristics of the project under review.

The workshop normally takes place near the project site, probably in a hotel or a room in the client's office. The complete drawings are sent to the VETC for distribution to the team during the week preceding the workshop/study. During workshop/study the team will follow strictly the stages of the job plan (Kelly and Male, 1991 and 1993).

- This approach is known to work fairly well. It involves the value engineering team meeting over a period of 5 days in order to produce a solution.
- On day 1, they look at the information phase.
- On the morning of day 2, the speculation phase.
- On the afternoon of the day 2, on day 3 and day 4, the evaluation and development phase are dealt with.
- On day 5 the presentation takes place (COEM, 1995).

The 40 hour study spread over five days and concludes with a number of design/construction modifications which are referred to their client for endorsement. It is claimed that savings of up 30 percent may be achieved in the United States (Seeley, 1996). The drawbacks as highlighted by Carter (1992a) are that the potential exists for confrontation and the external team's proposal can be seen to be critical of the project design team and may be resisted, the short time scale may make it difficult for the external teams to fully understand all aspects of the project proposal and it leaves only a restricted period of time to prepare revised design and for them to be fully and accurately costed.

**(c). One-Two Day Workshop/Study:** This approach has been strongly advocated by Carter (1992a) as being more appropriate for use in the United Kingdom. He recommends that a two-day study be held on a Friday and Monday, while a one-day study can be held on any weekend. All members of the design team should be represented including the client, the facilities manager, letting agent and other relevant parties. At the beginning, each team member usually makes a brief verbal presentation using drawings or other suitable material, with a maximum duration of 10 to 15 minutes.

The value engineer frequently records the relevant data on flip charts and seek to identify major constraint, which can be physical (site ground condition, statutory (company or legislative), time or cost) each having an input on the project. This is followed by the preparation of a Functional Analysis System Technique (FAST) diagram. The quantity surveyor/cost engineer then breaks down the cost plan (where available) over the weekend, hence the choice of Friday and Mondays for study.

The FAST diagram is then examined to identify any function which appear to have an abnormally high cost or identify function which can be omitted or modified. The next step is an intensive session (brainstorming), which could reasonably be expected to generate 50 or more suggestion to modify the brief, relax the constraints or modify the design construction proposal in order to achieve a more efficient design or these suggestions are reviewed as being either:

(i). rejected (with reason recorded) or (ii).to be developed by the project team.

The latter items are then prioritised. The Value Engineer then compiles a comprehensive report (probably of some 40 to 50 pages), encompassing all the elements of the study and concluding with recommendation as to which items are to be developed by the end of the study to the client/project sponsor for implementation (Seeley, 1996).

This shortened form of study is assessed to be much cheaper and quicker than 40 hour workshop and is considered to be more appropriate to the United Kingdom. Carter (1992b) has claims of having achieved benefit ratios of between 1:3 and 1:300 using this approach.

**(d). Two or Three Days Workshops:** According to Doyle (1993), this is another approach to value management/engineering adopted by a joint venture of E.C Haris and Australian Value Management. This involves a planned series of highly structured think thank session chaired by an outside professional facilitator. The two successive workshops explore the objective perception and interpretation of the brief and address issues in a pre-emptive way.

On day one of the first workshop, arranged at the earliest possible stage, ideas which may amount to hundreds are reduced to a workable shortlist by rating their cost and functional values. On the second day, appropriate cost implications are identified in groups working with the quantity surveyor and project manager. They are finally rated and prioritised for possible incorporation on the third day. After design development, a further three day workshop ensure that the project is reflecting its original aims and that cost effectively solution are being identified.

**(e). The Concurrent Study:** This approach uses the existing project team under the chairmanship of a value engineer or facilitator. The group meets on a regular basis during the project design phase offering maximum continuity. However, it is the disadvantage that creativity is not so evident and it may be more expensive than the 40 hour workshop (Smith, 1993).

**(f). The Package Review:** This is often the management form of contract, where-in-packaging reviews consisting of a detailed appraisal of each package (or element or trade), are undertaken by the project teams as an on going process continuing throughout the design, procurement and construction phases. Discussions with specialist contractors and management form an important part of this process (Smith, 1993).

**(g). The Contractor’s Change Proposal:** This is the value engineering change proposal initiated by the contractor after the contract is awarded. Under US government contracts, the contractor is encouraged to develop value engineering (VE) proposal on a voluntary basis. The contractor then share in any resultant saving if the VE plan is implemented (Smith, 1993). The major benefit is that it permits the contractor to be pro-active and to use his construction/engineering knowledge and expertise to improve a facility at the on-site stage. The disadvantage on the other hand, is that contract may be delayed while the design team investigates the merits and viability of the proposed change. Any change therefore tends to be relatively superficial (Kelly and Male, 1993).

**(h). Design and/or Construction Audit:** This process aims to define a project objective by formulating a list of clients need and wants, and provides clear indication of both the cost and the worth of a project. The procedure adopted often follows that of a Charette or a 40 hour workshop (Smith, 1993).

Kelly and Male (1993) also describe a value engineering audit, whereby a value engineer acting on behalf of a large corporate company or government department reviews expenditure proposals submitted by subsidiary companies or regional authorities, and the procedure follows that of the normal job plan.

## RESULTS AND DISCUSSION

Table 1 and 2 respectively presents the classification of the respondents in terms of their Professional Training and their Organization while the result and analysis of the questionnaire survey follows.

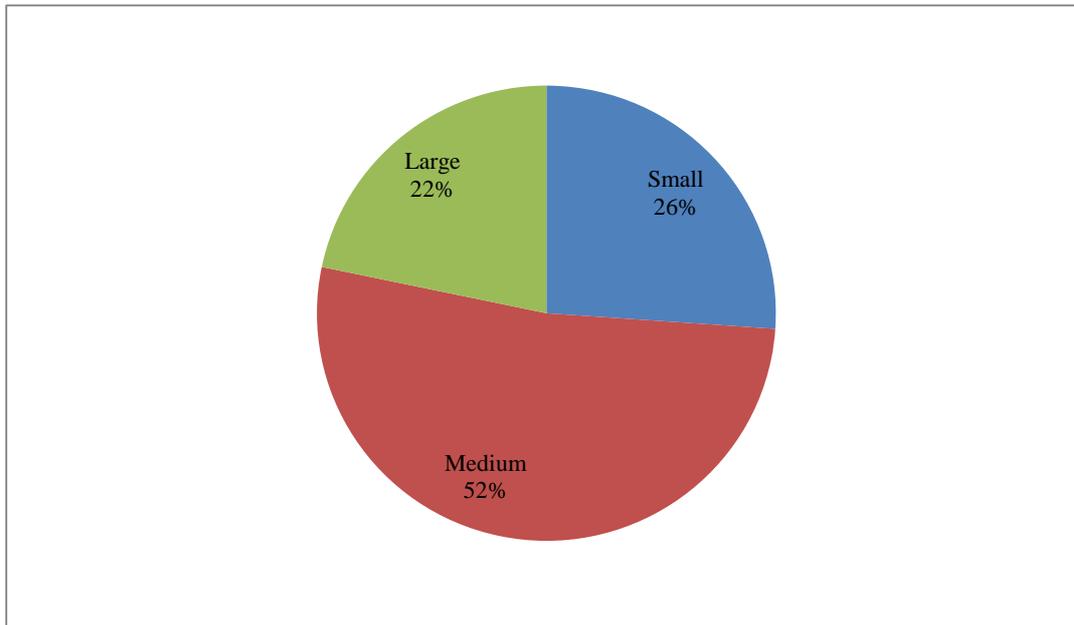
**Table 1 : Professional Training of Respondents**

Profession	No. of Respondents	Percentage%
Architecture	3	13.0
Building	6	26.1
C/Engineering	6	26.1
Estate Mgt.	6	26.1
Q/Surveying	2	8.7
Total	23	100.0

**Table 2: Classification of Respondents Organisation**

Type of Organisation	No. of Respondents	Percentage%
Client	2	8.7
Consultant	6	26.1
Contractor	10	43.5
Consulting & Contracting	5	21.7
Total	23	100.0

**Organization Staff Strength:** Figure 2 shows the staff strength of respondents organisations reflecting that more than half are from medium size firms.

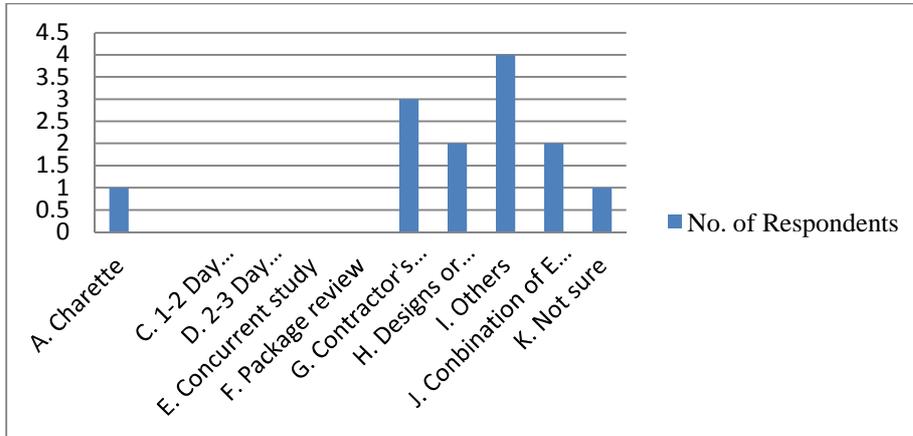


**Fig. 2: Pie – Chart Showing Staff Strength of Respondents Organisations**

**Familiarity with Value Engineering (VE):** The feedback received as presented in Table 4 reveals that 13 respondent (56.5%) are familiar with the Value Engineering Technique while 10 respondent (43.5%) claimed the technique is new to them. Table 5 on the other hand shows details of the respondents’ past involvement in VE exercise.

**Table 4: Respondents' Past Involvement in Engineering Exercise**

Past Involvement	No. of Respondents	Percentage%	Inference
None	9	39.13	Not Familiar (43.48%)
Once	1	4.35	
2-4 times	8	34.78	
5-10 times	4	17.39	Familiar (58.52%)
Above 10 times	1	4.35	



**Fig. 3: Bar-chart Showing Approaches of VE Adopted**

Figure 3 above shows that all the respondents had never been involved in formal organized known approaches of Value Engineering Techniques as stipulated by the Society of American Value Engineer (SAVE), only one respondent (7.69%) had been involved in Charette while all others had been involved in the other approaches with the Design and/or Construction Audit being the most adopted approach having 4 respondents (30.77%), one respondent (7.69%) was not even sure of the approach adopted in the VE exercise in which he was involved. The result in Table 5 reveals that 5 respondents (38.46%) had applied VE during the Construction stage, this being the most popular, followed by the application at the preliminary design, having 3 respondents (23.08%), while all other variants has one respondents (7.69%) respectively.

**Table 5: Stage at which VE was Adopted**

Stage	No. of Respondents	Percentage (%)
1. Preliminary Design	3	23.08
2. Final Design	0	0.00
3. Just before Contract Award	0	0.00
4. During Construction	5	38.46
5. Any Stage	1	7.69
6. Stages 1, 2 & 3	1	7.69
7. Stages 2 & 4	1	7.69
8. Stages 1, 2 & 4	1	7.69
9. Stages 1 & 3	1	7.69
Total	13	100.00

***Who Initiates the Value Engineering Exercise?***

Table 6 below shows the reaction of respondents to the question on who initiated Value Engineering exercise as offered by those familiar with the VE exercise.

The result shows four (30.77%) of the respondents offering that the exercise was initiated by the project manager, followed by the stand of 2 respondents (15.38%) that all the professionals except the consultant builder could be seen to initiate the exercise. The other variants had only 1 respondent (7.69%) each opting for them while none of the cases was seen to have been initiated by a Consultant Builder.

**Table 6: Who Initiates the VE Exercise**

Options	No. of Respondents	Percentage (%)
1. Client	1	7.69
2. Project Manager	4	30.77
3. Quantity Surveyor	1	7.69
4. Consultant Builder	0	0.00
5. Architect	1	7.69
6. Civil/Structural Engineer	1	7.69
7. Any Member of the Team	1	7.69
8. Options 4 & 6	1	7.69
9. Options 4 & 5	1	7.69
10. All except 4	2	15.38
Total	13	100.00

**Saving, Sharing Ratio in Contractor's Change Proposal:** Only five people responded to this issue, due to their past involvement and the result is as shown in Table 7.

**Table 7: Savings Sharing Ratio in Contractor's Change Proposal**

Options	No. of Respondents	Percentage (%)
30:70 (Contractor : Client)	1	20.00
50:50 (Contractor : Client)	2	40.00
Contractor takes all	2	40.00
Total	5	100.00

**Function Maximization by the VE Exercise:** The entire respondent agreed that the Value Engineering exercise in which they were involved enhanced function maximization.

**Cost Reduction by Value Engineering Exercise:** The VE exercise in which all the respondents were involved was adjudged by them to have reduced cost.

**Percentage (%) of Cost Saving/Reduction Achieved by VE:** Table 8 below shows the result of questionnaire survey carried out on percentage of cost savings achieved through the use of Value Engineering. The data was thereby analysed using the student t-distribution test (SPSS 13.0) on the Null Hypothesis;  $H_0: U < 25$ . Mean ( $\bar{x}$ ) = 22.14, Standard Deviation ( $\delta$ ) = 13.11, Degree of Freedom = 13 (see output as attached in Appendix).

Testing at 5% level of significance (i.e. 95% confidence level) we have

Test of Statistics (TS) = -0.816

(Okafor & Esan, 1995)

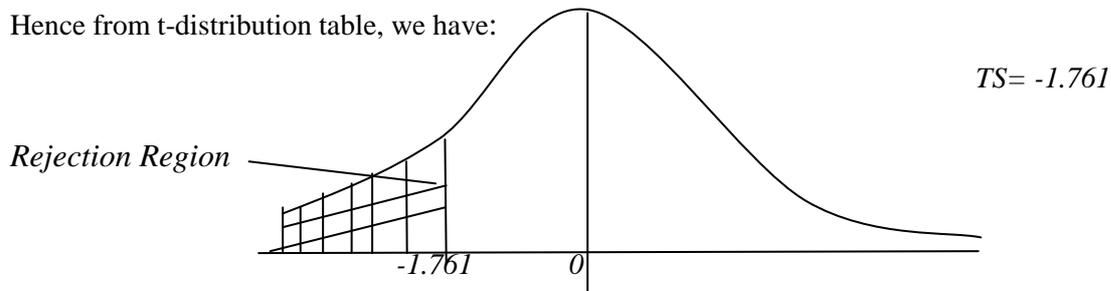
**Table 8: Percentage (%) of Cost Savings/Reduction Achieved by VE**

% Cost Saving (Class Interval)	Mid-Point ( $X_i$ )	Frequency ( $f_i$ )	$f_i x_i$	$f_i x_i^2$
5 -15	10	5	50	100
15 – 25	20	5	100	2000
25 – 35	30	1	30	900
35 – 45	40	2	80	3200
>45	50	1	50	2500
Total		14	310	9100

For  $H_0: U < 25$

$\alpha = 0.05$

Hence from t-distribution table, we have:



Since TS (-0.816) < value from the t-distribution table (= -1.761) => accept the Null Hypothesis

**The cost saving achieved is less than 25%**

Meanwhile 13(92.86)% respondent maintained that the cost savings achieved justify the effort involved in Value Engineering while only one (7.14%) is of a different opinion.

**Existence of A “VE” Team in Nigeria:** None of the respondents is aware of the existence of Value Engineering Team or a Value Engineering Consultancy Outfit in Nigeria.

**Problems Militating Against VE Application:** Table 9 shows the identified problems militating against the application of the “VE” technique in Nigeria. Unhealthy Professional Practices was adjudged the greatest problem, closely, followed by Client’s ignorance and Ignorance on Professional’s side.

**Table 9: Problems Militating against Application of VE Technique in Nigeria**

Problems	No. of Respondents	Percentage (%)
A. Client's ignorance	12	52.17
B. Unhealthy Professional Practices	13	56.52
C. Ignorance on Professionals' Side	11	47.83
D. Unwillingness to Enforce its Application	1	4.35

**Willingness to participate in a “VE” Team**

Only one (4.35%) respondent is not interested in participating as a member of a team while the remaining 22 (95.65%) respondents wish to participate as a member of future VE Team. Some to acquaint themselves with the practices while some to acquire experience on the practice as a management technique.

### **Summary Findings**

In a concise form, the findings of the study can be outlined as follows:

1. The term “Value Engineering” is not very popular among professionals in Nigerian Construction Industry. Although the concept is observed to be incorporated in the cost control and reduction approaches being adopted by some of the professionals in the Industry.
2. The various approaches of “VE” being practiced in Nigerian Construction Industry does not involve the formal organized workshop/study as clamored for by the Society of American Value Engineers (SAVE). It does not fall in the 40 hour “VE” workshop/study known as the most accepted formal approach nor any of its modified forms (i.e. One-Two Day Workshop/Study, Two or Three Day Workshops and Concurrent Study)

The most adopted approaches in practice are modified forms of the Design and/or Construction Audit, the Package Review or a combination of the two and the Contractor’s Change Proposal.

3. The percentage of cost Saving/Reduction achieved through VE’s application is generally less than 25%, while most of the respondents were seen not to even suggest the technique to their clients at all.
4. No Value Engineering Team is known to exist in practice in Nigeria, while the sampled professionals are yearning for an involvement in an organized Value Engineering team or Workshop.
5. The problems identified as militating against application of Value Engineering as a management technique, in order or their impact are (i).Unhealthy Professional Practices, (ii).Clients Ignorance (iii).Ignorance on side of the Professionals and (iv).Unwillingness/Non-existence of a law, enforcing its application.

### **CONCLUSION AND RECOMMENDATION**

Value Engineering (VE) is not merely a cost cutting exercise; it takes account of the three-way relationship between function, cost and value. The formal concept of the “VE” technique entails the establishment of a team, component of assessing a design, proposing alternative design solution and evaluating the cost as accurately as possible.

The informal approaches presently adopted in Nigeria, accounts for the low level of its popularity among construction professionals and clients. This can be directly linked to the ever-increasing cost of

projects and occurrences of non-functional economic designs. The technique requires inputs from the various parties and professionals in a project and a value analysis of a proposal/design possibly by non-members of the proposing team.

This study hereby offers that the “VE” techniques if properly applied to all construction projects will ensure effective function maximization and removal of unnecessary cost. This is really a necessity for maximum utilization of the scarce resources of the nation in providing functional and efficient shelter and all other infrastructures facilities. In line of the aforementioned findings and conclusion, this paper offers the following recommendations.

1. The Professionals and clients of the Construction Industry should be properly enlightened on the concepts of Value Engineering through seminars and workshops. Emphasis should be on function analysis and removal of unnecessary costs.
2. The approaches of Value Engineering presently being adopted in Nigeria should be improved to accommodate inputs from all the various parties and specialists involved on the project.
3. Professional in the industry should make it a duty to suggest Value Engineering exercise to their Clients. They should adopt the appropriate approach of the concept of value analysis to their various aspect of work.
4. The various professionals should imbibe the teachings of their professional ethics. Professionalism, implying rendering service to the environment and humanity should be their watchword and not the amount of money made from the project. They should see themselves as partners in progress and work effectively as a team to offer the client maximum value for his financial commitments.
5. The professionals should receive inputs from others and accommodate it in their work. A contractor’s change proposal should be encouraged and not seen as a challenge of their own professional competence.
6. Government should encourage the application of the “VE” technique on all her projects while laws should be enacted to back its practices with proper clauses included for effective savings sharing ratio between Client and Contractors/Consultants as appropriate.

## **REFERENCES**

Carter, T. G. (1992a):“Value Management Selected Papers” Davis Langdon Management U.K.

Carter, T. G. (1992b):“Value Engineering: A Comparison between the 40hours Workshop and a One\ Two Day Study”. RICS: Quantity Surveying Bulletin (April), U.K.

COEM (1995):“Value Engineering”. Postal Courses of the College of Estate Management (COEM), UK.

Doyle, N. (1993):“Straight Talking” New Building Magazine (Vol.22, Jan.), U.K., pgs.12& 13

Esan, E. O. & Okafor, R.O. (1995): Basic Statistic Methods, Lagos, JAS Publishers, pgs. 34 &132-145

Green, S. & Moss, G. (1993): “Value for Money from SMAT Management”, Chartered Builders Magazine (Oct.), U.K. Pgs. 5-7.

Kelly, J. & Male, S. (1991): “The Practice of Value Management: Enhancing Value or Cutting Cost?” Heriot –Watt University RICS (QS Division)

Kelly, J. & Male, S. (1993): Value Management in Design and Construction, U.K. Spon Publishers.

Kharbanda, O. P. et al. (1996): Project Cost Control in Action (2<sup>nd</sup> Ed.), Gower Technical Press Ltd. Pgs. 64 -71

Palmer, A. et al. (1996): “Holistic Appraisal of Value Engineering Construction in United States”, Journal of Construction Engineering & Management (Vol. 22 Nov.), U.S.A (ASCE), Pgs. 324-328.

Parker, S. P. et al. (1982): “McGraw-Hill Encyclopaedia of Engineering”, USA McGraw-Hill Inc. Pgs.1159-1161

Seeley, I. H (1996): Building Economics (4<sup>th</sup> ed), London, Macmillan Press ltd., pgs 277-295.

Smith, M. (1993): “Value Engineering: Is it Withering on the Vine?” Chartered Quantity Surveyor (Feb.), U.K., pgs. 18-19

**APPENDIX: Output of Student T – Test Using SPSS Version 13.0**

**T-Test**

**One-Sample Statistics**

	N	Mean	Std. Deviation	Std. Error Mean
VAR00001	14	22.1429	13.11404	3.50487

**One-Sample Test**

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
VAR00001	6.318	13	.000	22.14286	14.5710	29.7147