

Confirmatory factor analysis of value management current practice in the Nigerian construction industry

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ABSTRACT

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Value management explicitly targets to optimize value by providing necessary functions at the least cost without sacrificing quality and performance. However, the activities/methods of this technique in emerging economies are here and there related to informal methodology. Therefore, the occurrence of these activities in an evolving economy requires investigation. The exploration of the extent to which the measured variables influenced the latent factors informed the need for this study. Data was retrieved via self-administered questionnaire from 344 registered and practicing construction professionals in Nigeria. The data was analyzed using SPSS for descriptive analysis and Structural Equation Modelling (SEM). Kaiser-Meyer-Olkin measure of sampling adequacy revealed that the internal consistency of the developed research instrument was appropriate. Confirmatory factor analysis indicates satisfactory goodness of fit among acknowledged determinants of the model. Furthermore, the study revealed three (3) phases of the activities/methods of value management in the Nigerian construction industry which include: information, information/function analysis, and creativity/evaluation/development/presentation phases. This means that value management activities and methods are being practiced in Nigeria, however not as per the typical methodology or standard. The need to carry out the practice according to the formal value management methodology is therefore recommended.

Keywords:

Current practice, value management, construction industry, Nigeria

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1. Introduction

Value Management (VM) is one of those philosophies used to explicitly optimize value by giving the required performance at a lower cost without influencing quality and performance of a scheme. VM which was at first known as value analysis (VA) by Lawrence [1], was intended to enhance value without sacrificing intended functions. Consequently, most clients are now concern with value philosophies in order to achieve the best from their ventures. VM has been practiced in numerous nations like the USA, UK, Australia, China, Saudi Arabia, Malaysia, and Hong Kong. Karim *et al.* [2]

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noticed that, VM practices have extended and have been broadly acknowledged and carried out in many nations. In fact Luvara and Mwemezi [3] submitted that VM has existed for more than fifty years and its application has recorded a lot of successes especially in the United States' public projects. Conversely, according to a study by Olanrewaju [4] on one hundred and fifty two construction practitioners in Nigeria, VM has not been formally practiced but could facilitate the identification of client value system. Thus, most VM activities carried out by Nigerian construction organisations/firms seem not to conform to a typical formal VM methodology.

In any case, VM has picked up a substantial level of awareness in Nigeria, resulting to the suggestion for its implementation by a few researchers. As per Oke and Ogunsemi [5], VM is at present a part of Quantity Surveying scholastic educational modules of higher establishments yet has not been consolidated in the Nigerian construction works. However, Kolo and Ibrahim [6] articulate that, VM could be adopted in Nigeria, if the construction industry could connect with stakeholders on a team-oriented premise, executes viable development programs, investigates partnering forces and fortifies client organisations. In this way, Karim *et al.* [2] propelled that VM has been acknowledged comprehensively, and associations are currently surveying their qualities and shortcomings so as to quicken towards a superior VM usage. Therefore, this paper looks to examine the current practice (CP) of value management activities/methods (CPA1 to CPC21) in the Nigerian construction industry.

2. The Practice of Value Management

According to Society of American Value Engineers [7], VM job plan outlines sequential phases to be followed which support team synergy within a structured process. Figure 1 shows the actions that are usually carried out during each phase of the job plan. These activities would stimulate the team to find ideas and develop them into alternatives, identify project's basic and secondary functions, and to provide information necessary for the successful execution of the next phase. A previous stage may be re-examined as the team gains further information about the project.

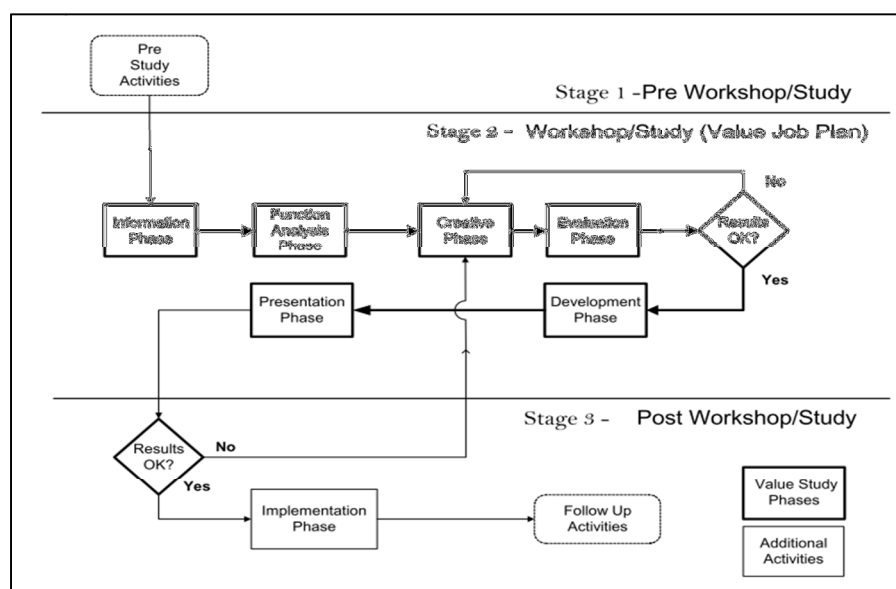


Fig. 1. Value Study Process Flow Diagram, Source: SAVE International [7]

Therefore, the execution of a VM methodology is basic with a specific end goal to accomplish the objectives of applying VM. The VM session is usually executed by a multi-disciplinary group of

construction professionals (Architect, Quantity Surveyors, Builders, and Engineers), the client (owner), and the end-user. The session is essentially separated into three phases (Preparation, the Job Plan, and Presentation) as depicted in Figure 1.

2.1 Stage 1: Pre- Workshop (Preparation)

The preparatory stage is committed to obtaining information on the proposed project for effective running of the workshop. Information such as timing, function, constraints, background, objectives, location, cost, and the scope of the project are usually obtained at this stage. The project stakeholders must actively participate in this stage of the workshop. Dedicated roles should be assigned to stakeholders (e.g., clients, consultants) and each stakeholder should prepare background information on how the project is related to them [8].

2.2 Workshop (6-Phase Job Plan)

The structured procedure of a VM workshop is known as the Job Plan. This stage of workshop is designed according to the six phases of the job Plan.

2.2.1 Information phase

Sharing of information is paramount at this phase. Clients should unequivocally express the scope, objectives and expectation of their projects. According to Chen and Liao [9], this phase should recognise client's needs with regard to function and cost. However, other stakeholders can also present their perceived project constraints. This phase gains much detail as possible about the project design, background, constraints, and projected cost [10, 11]. A study by Ramly *et al.* [8] revealed that at this phase, consultants such as architect, civil and structural engineers, mechanical and electrical engineers, and quantity surveyors presented critical information related to their disciplines. The procurement approach, project timeframe, quality and environmental issues were also figured out at this phase.

2.2.2 Function Analysis

Function Analysis is first and foremost a systematic approach that establishes and meets the requirements and expected functions of a project. According to Ramly *et al.* [8], the primary objective of this phase is to generate and classify functions into basic and secondary functions. At this phase, the function of a project is identified, analysed and represented in a hierarchical function diagram called the functional tree diagram. Jaapar *et al.* [12] submitted that the main aim of this phase is to comprehend the project via the function of the project. Therefore, this phase ascertains and ranks the primary and secondary functions with their associated costs.

2.2.3 Creativity

At this phase, ideas are generated to meet the desired functions of an agreed functional tree diagram. During this phase, the VM team explores alternative approaches, means and methods for the achievement of functions [13]. Creative techniques such as brainstorming lateral thinking and synectics are employed at this stage. The VM facilitator must ensure that criticism does not exist among the participants and a positive atmosphere should be created.

2.2.4 Evaluation

The generated ideas are assessed and appraised at this phase. All the suggestions and ideas established during the creative phase should pass through evaluation and short-listing. Ramly *et al.* [8] submitted that, the ideas should undergo additional screening to realistically determine how they could be implemented to meet the desired function, and should be classified into: realistically possible to be implemented; remotely possible; and impossible to be implemented. Thereafter, the ideas will be developed in the development stage.

2.2.5 Development

The VM team develops the short-listed ideas and prepares descriptions, sketches, diagrams, drawings and information on manufacturer/producer, materials as formal VM proposal. Each short-listed idea is designed into a feasible and viable solution. The development phase consists of the recommended design and capital, life cycle cost comparisons and a complete description of the constraints and benefits of the proposed recommendation.

2.2.6 Presentation

Each of these components or tasks at the development phase will be presented in the action plan.

2.3 Post-workshop

This stage involves the submission of the final written report to the client. The final report consists of all the processes and output of each phase, a detailed action plan and recommendations. It is necessary to hold an implementation review meeting few weeks after the workshop stage. The status of actions should rigorously be monitored as well as follow up of implementation action plan.

Table 1 shows the various activities and methods of value management as put forward by various researchers.

3. Methodology

The study adopted a stratified random probability sampling approach. 465 structured questionnaires were administered to Architects, Quantity Surveyors, Builders, Civil Engineers, and Services Engineers in Jos, Kaduna, and the Federal Capital Territory (Abuja). The professionals were chosen from contracting, project management, consulting engineering, quantity surveying, consulting architects, and client organizations. 344 (73.98%) questionnaires were appropriately filled and returned. This sampling approach provided the prospect of meeting the target groups with a high response rate. The response, through a 5-point Likert scale was measured to allow freedom of opinion and ease of analysing data.

Table 1
 Previous research on activities/methods of value management

CP	Authors	Kelly et al. [14]	Jaapar et al. [12]	SAVE. [7]	Ramly et al. [8]	Che Mat & Shah [15]	Hwang et al. [16]
	Activities and Methods of VM						
CPA1	Carry out site visitation			√			
CPA2	Obtain relevant background information on the proposed project		√		√		
CPA3	Define the timeframe and scope of the project			√			
CPA4	Define and understand the objectives and functions of the project			√			
CPA5	Involve clients at the initial stage of the project						√
CPA6	Involve and assign responsibilities to construction professionals at the initial stage of project		√		√		
CPA7	Define the procurement approach of the project				√		
CPB8	Commit client organisations in the project cycle	√	√				
CPB9	Clarify project background information and constraints		√	√			
CPB10	Share project information among professionals and stakeholders						√
CPB11	Make client to unequivocally express the scope and expectation of the project				√		
CPB12	Presentation of perceived project constraints by stakeholders						√
CPB13	Identify high cost areas by undertaking relative cost ranking	√					
CPB14	Generate and classify functions/elements into basic and secondary elements with their associated costs		√	√	√		
CPC15	Brainstorm ideas to meet the desired functions/elements and associated costs	√	√	√			
CPC16	Assess brainstormed ideas to meet the desired functions/elements				√		
CPC17	Classify the ideas from the brainstormed section into realistically possible to be implemented		√		√	√	√
CPC18	Classify the ideas from the brainstormed section into remotely possible to be implemented				√		
CPC19	Classify the ideas from the brainstormed section into realistically impossible to be implemented				√	√	
CPC20	Develop an action plan on the short-listed ideas			√	√		
CPC21	Hold an action plan review meeting		√				

The Staistical Package for the Social Sciences (SPSS) was employed in the Exploratory Factor Analysis (EFA) that established the structure of the measurement model. The Structural Equation Modelling (SEM), using Confirmatory Factor Analysis (CFA) in AMOS software further validates the measurement model by indicating satisfactory goodness of fit among acknowledged determinants of the models.

4. Results and Discussion

4.1 Respondents Characteristics

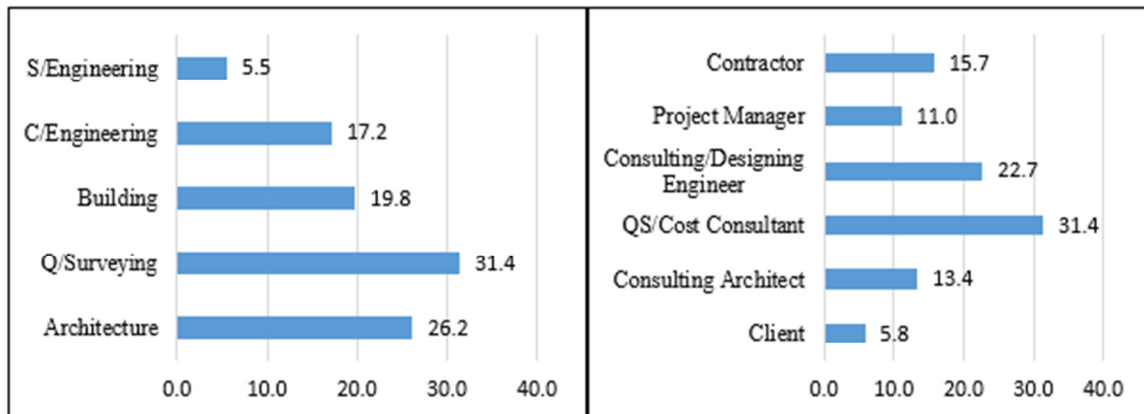


Fig. 2. Respondent's profesional fields and organisations' role

From Figure 2, it can be inferred that 31% of the total respondents are Quantity surveyors, 26% Architects, 20% Builders, 17% Civil Engineers, and 6% are Services Engineers. It can also be deduced that 31% of the professionals emanate from the quantity surveying firms, 23% from the consulting/designing engineering firms, 16% from contracting firms, while 13%, 11%, and 6% were from consulting architects, project management, and client organisations.

The reliability test was conducted using the Cronbach's alpha coefficient to confirm the reliability and validity of the data collected. The attributes or variables (CPA, CPB, CBC) of the CP of VM are described in Table 1. The results of reliability and validity test through the Cronbach's Alpha in Table 2 show that the current practice attributes are within the range of 0.96 to 0.97. This implies that the result is highly statistical significant because the values obtained are higher than the recommended minimum value of 0.60 [17].

Table 2
 Reliability of VM current practice attributes

Variable	Label	Items	Cronbach Alpha
CPA	Information	7	0.96
CPB	Information/Function Analysis	7	0.97
CPC	Creativity/Evaluation/Development/Presentation	7	0.97

4.2 Exploratory Factor Analysis

The level of acceptance of the factor loading is determined by the sample size of the research data which indicates that a factor loading above 0.30 should be significant at 95% confidence level [18, 19].

As recommended by most researchers, factor extraction, principal component extraction, and varimax rotation were carried out for all the measured variables (CPA1 to CPC21). The threshold for Eigen value that is greater than 1 was also upheld. According to Baba *et al.* [20], variables with cross-loadings on at least two factors of > 0.4 and items with a factor loading of less than 0.4 are usually removed. Nonetheless, the exploratory loadings for all the variables in this research were above the values of either 0.30 or 0.40 as shown in Table 3.

Table 3
 Rotated component matrix for current practice of VM attributes

Variables	Component		
	1	2	3
Site Visitation			894
Background Information			857
Scope of Project			914
Project Functions and Objectives			943
Involve Clients at IP			928
Assign Responsibilities			862
Define Procurement Approach			914
Commit Client Org	897		
Clarify Project Information	862		
Share Project Information	922		
Make Client Express Scope of Project	942		
Presentation of Project Constraints	936		
Identify High Cost Areas	889		
Generate and Classify Functions	923		
Brainstorm Ideas to meet Functions		921	
Assess Brainstormed Ideas		903	
Classify Ideas into Realistically Possible Implemented		909	
Classify Ideas into Remotely Possible Implemented		920	
Classify Ideas into Impossible Implemented		913	
Develop an Action Plan		906	
Hold an Action Plan Review Meeting		888	

Extraction Method: Principal Component Analysis.
 Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 4 iterations.

4.3 Measurement and Structural Model

The measurement model demonstrates the strength of relationship among the constructs of this research. It basically measures the relationship of the variables or items to each construct (CPA, CPB, and CPC). While the structural model shows the relationship among the unobserved variables and how they influence the values of other latent variables of the model. The base limits of indices utilized as a part of measuring the goodness of fit of the measurement model are stipulated by Awang *et al.* [21], Enegbuma *et al.* [22], and Hair *et al.* [17] as $p < 0.05$, Comparative Fit Index (CFI) ≥ 0.90 , Goodness of Fit Index (GFI) ≥ 0.90 , Chi-square/df (χ^2/df) < 5 , and Root Mean Square Error of Approximation (RMSEA) $\leq 0.05-0.80$.

The statistics shown in Figures 3 & 4 discovered a p-value of 0.001, CFI value of 0.992, GFI, 0.94, χ^2/df value of 1.37, and RMSEA value of 0.03. Figure 3 indicated that the fit statistics are adequate and within the acceptable thresholds to establish the convergence validity of the measurement model for the job plan (CPA, CPB, CPC) of the current practice of VM activities and methods in the Nigerian construction industry.

The results from the structural model (Figure 4) are found to have met acceptable thresholds on all of the statistical parameters in literature for a model fit. The tested latent factors of the CP have been verified by the analysis of results.

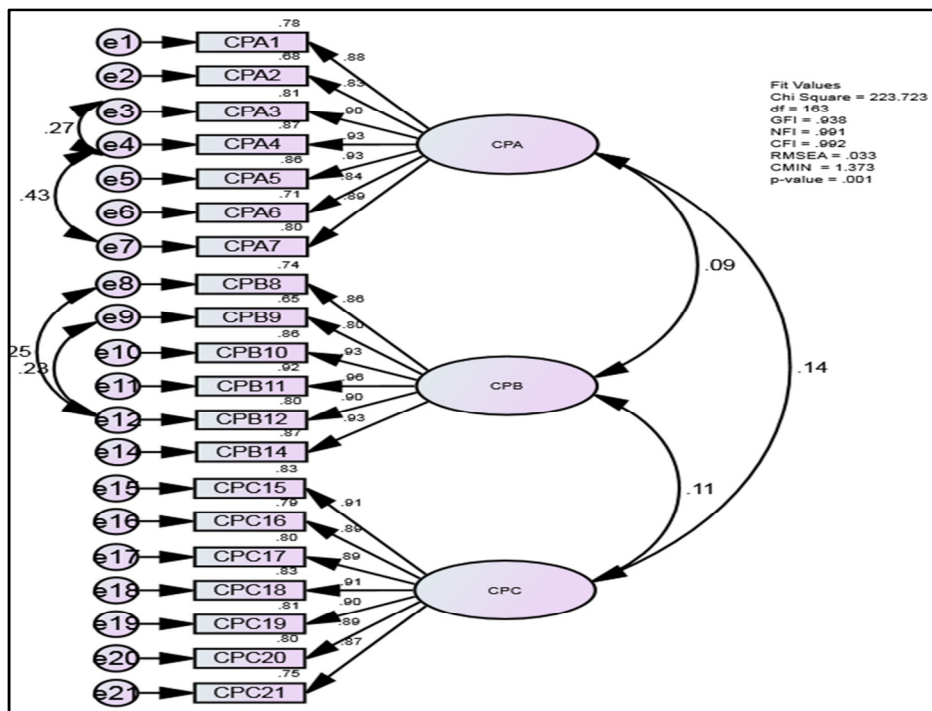


Fig. 3. Measurement model for current practice of value management

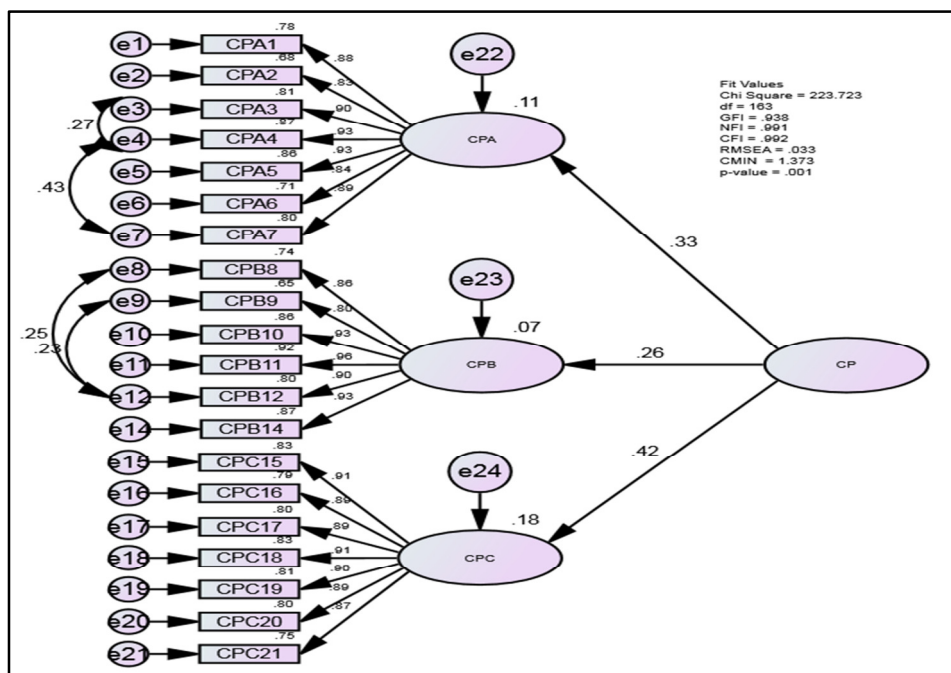


Fig.4. Structural model for current practice of value management

5. Conclusion

This paper carried out an exploration to discover the current practice of VM application in the Nigerian construction industry. The job plan (methodology) responsible for measuring the relationship and extent of predicting the current practice in Nigeria were identified as CPA

(Information phase), CPB (Information/Function Analysis phase) and CPC (Creativity/Evaluation/Development/Presentation phase). The activities executed at the CPA are: carrying out site Visitation, obtaining relevant Background Information on proposed projects, defining the timeframe and scope of proposed projects, defining the objectives and functions of the project, involving clients at the initial stage of projects, assigning responsibilities to construction professionals at the initial stage of projects, and defining the procurement approach of proposed projects. At the CPB phase, the following are carried out: committing client organisations in the project cycle, clarifying the background information and constraints of proposed projects, sharing project information among professionals and stakeholders, expressing the scope and expectations of proposed projects by clients, presentation of perceived project constraints by stakeholders, and classifying proposed projects' functions/elements into basic and secondary elements with their associated costs. And lastly at the CPC phase, brainstorming ideas to meet the desired functions/elements, assessment of the brainstormed ideas, classifying the brainstormed ideas into possible/impossible to be implemented, development of an action plan, and presentation of the action plan constitute the key activities carried out in this phase.

However, one of the critical activities of the Function Analysis phase (CP13) which is identifying high cost areas via relative cost ranking was eliminated as a result of very low loading factor. Nevertheless, most of the activities and methods of the VM practice are evident in the Nigerian construction industry but not in accordance with the usual 6-phases of information, function analysis, creativity, evaluation, development, and presentation. Therefore, the need to carry out the practice according to the formal VM methodology is recommended to ensure value optimization of construction projects.

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