PRINT ISSN 1119-8362
Electronic ISSN 2659-1499

Full-text Available Online at
https://www.ajol.info/index.php/jasem
https://www.bioline.org.br/ja

J. Appl. Sci. Environ. Manage.
Vol. 28 (4) 975-984 April 2024

Varying Levels of Proficiency in the Delivery of Value Engineering Objectives among Built Environment and Allied Professionals in Kogi State, Nigeria

***ATAGUBA, JO; BIOKU, OJ**

Department of Estate Management and Valuation, School of Environmental Studies, The Federal Polytechnic Idah, Kogi State, Nigeria

**Corresponding Author Email: joataguba@fepoda.edu.ng*
**ORCID: https://orcid.org/0000-0001-7607-7563*
**Tel: +2348054836207*

Co-Author Email: femibioku3@gmail.com

ABSTRACT: Value Engineering (VE) practices analyze designed building features, systems, equipment, and material selections to achieve essential functions and enhance results while reducing the life-cycle cost. Hence, the objective of this paper was to evaluate the varying levels of proficiency in the delivery of VE objectives among the Built Environment and allied professionals in Kogi State, Nigeria. Data were harnessed from 94 study questionnaires administered across strata of these professionals in the study area. It was found that Architects, Builders, Engineers, Estate Surveyors and Valuers, and Town Planners in the study area exhibited varied levels of proficiencies across specific value engineering objectives (VEOs), whereas project managers and quantity surveyors exhibited very high-, and high levels of proficiency in the delivery of all the ten VEOs respectively. The variation which is an indication of their diversified skills in project cost management and control was significantly determined by the ten VE objectives commencing with enhancing of project functionality and terminating with minimizing project operating cost. The study recommended project managers and quantity surveyors as first- and second choice professionals in value workshop facilitation, given their high levels of proficiency in the delivery of these VEOs.

DOI: https://dx.doi.org/10.4314/jasem.v28i4.1

Cite this Article as: ATAGUBA, J. O; BIOKU, O. J. (2024). Varying levels of proficiency in the delivery of Value Engineering objectives among the Built Environment and allied professionals in Kogi State, Nigeria. *J. Appl. Sci. Environ. Manage.* 28 (4) 975-984

Dates: Received: 09 February 2024; Revised: 24 March 2024; Accepted: 27 March 2024 Published: 10 April 2024

Keywords: Value Engineering; Value Workshop objectives; Proficiency; Construction project; Professionals

Building and construction projects are initiated and funded by private- and public sector agents with the intent of delivering optimal performance and value-for-money at the least input and/or operating cost. However, the protracted phenomenon of escalating prices of building materials and services in Nigeria has induced multiplier effects comprising cost overrun and delay in project completion, (Adedeji and Abiodun, 2012; Mac-Barango, 2017; Oghenekevwe *et al.*, 2014), and reduction in the rate of property development and construction respectively (Akanni *et al.*, 2014; Otunola *et al.*, 2021). It is against this backdrop that value engineering (VE) had been suggested as a cost control measure that can be instantiated to offer multidisciplinary peer review of designs and alternative resources that will possibly avert cost overruns (Zhang and El-Gohary, 2015), achieve cost reduction, cost savings, optimal performance, and enhance project value to the benefit of the project owner (Cheah and Ting, 2005; Emami and Emami, 2020; Kelly *et al.*, 2004). In view of the conceptual synergy between value management (VM) and value engineering (VE) as averred by Connaughton and Green (1996) and Khodeir and El

**Corresponding Author Email: joataguba@fepoda.edu.ng*
**ORCID: https://orcid.org/0000-0001-7607-7563*
**Tel: +2348054836207*

Ghandour (2019), and the technical perspective of value methodology that features in value-engineered construction projects (RICS, 2017; SAVE International, 2007), the term - "value workshop objectives" (VWOs) can be construed to be synonymous to "value engineering objectives" (VEOs). Although the VE team is expected to exercise proficiency in the delivery of specific VWOs, there is dearth of studies identifying the proficiency areas of each group of expert with respect to these VWOs, unlike existing studies credited to Bowen *et al*. (2009) and Bowen *et al*. (2010) where the awareness of each VWO was evaluated and attributed to specific group of professional. Notwithstanding, proficiency has been attributed to the achievement of VWOs/VEOs and their surrogates namely - enhancing project functionality (Kolibácová, 2014), cost savings (Nasereddin and Price, 2021), enhancing project worth (Thneibat and Al-Shattarat, 2021), value optimization over project life cycle (Bennett and Mayouf, 2021), minimizing adverse environmental impact of project (Othman and Abdelrahim, 2020), enhancing project usability, convenience and comfort (Kolibácová, 2014; Lee *et al*., 2011; Leung and Kong, 2008; Schramm *et al*., 2018), enhancing project flexibility/adaptability (Oke and Ogunsemi, 2013; Saleh *et al*., 2009), effective risk management (Osazuwa *et al*., 2019), early project completion/delivery (Alsolami, 2022), and minimizing project operating cost (Hipkin and De Cock, 2000; Rich and Holweg, 2000); but with no attempt to identify the VWOs that feature as significant competence areas of built environment and allied professional, coupled with the analysis of variation among these professionals regarding their VE proficiency.

Hence, the objective of this paper was to evaluate the varying levels of proficiency in the delivery of Value Engineering objectives among the Built Environment and allied professionals in Kogi State, Nigeria.

MATERIALS AND METHODS

Brief description of the study area: Kogi state, occupying a land mass of approximately 29,833 square kilometres, is among the 36 states of the Nigerian Federation located in North-Central Nigeria, and bounded by the geographical coordinates - 6°30'00" and 8°45'00" North of the Equator, and 5°15'00" and 7°50'00" East of the Greenwich Meridian (Figure 1).

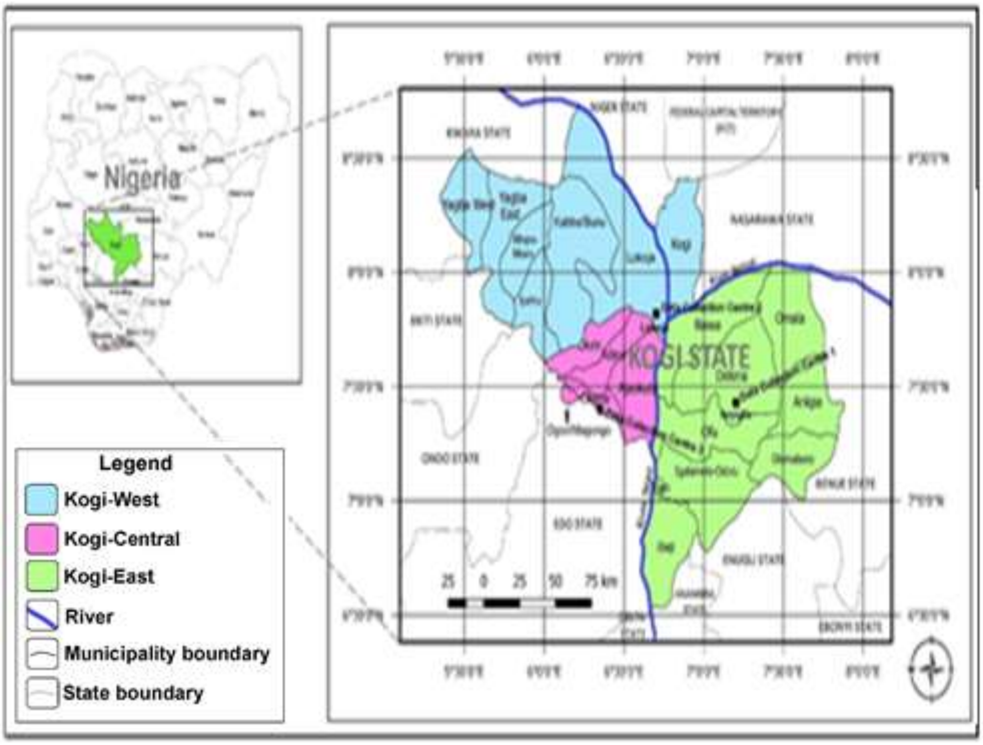

Fig. 1: Map of Kogi state showing the three regional centres of data collection

Its landmass is physically bisected by the rivers Niger and Benue after forming a confluence at the capital city of Lokoja (Bamidele, 2018). The state, which is political stratified into Kogi-Central, Kogi-East, and Kogi West is located within the tropical climatic zone and characterized by atmospheric temperatures in the range of 28°C to 35°C, annual rainfall periods mainly from the months of March to October, mountainous landscapes, and woody guinea savannah vegetation (Ibitoye, 2012). Existing studies on the Kogi state construction industry have indicated the active presence of built environment and allied professionals comprising Architects, Builders, Engineers, Estate Surveyors and Valuers, Quantity Surveyors, and Town Planners (Omopariola and Olufemi, 2015). In addition to these professionals is the project manager, whose indispensable role in the coordination of construction projects has been duly acknowledged across Nigeria (Ayodele *et al*., 2015). The activities of these professionals are manifested in their involvement in public- and private sector sponsored construction projects across the state, their pedagogic and research efforts in higher educational institutions offering training in these disciplines across the state, and the development control machinery of town planning and development board.

Sample size determination: Constituting the population of study are the built environment and allied professionals comprising Architects, Builders, Engineers, Estate Surveyors and Valuers, Project Managers, Quantity Surveyors, and Town Planners in the study area. A snowballed pilot study was instantiated to quantitatively determine the maximum sample, as well as strata of these professionals (respondents) with a view to capture respondents that are actually domiciled and practicing within Kogi state, irrespective of the state branch of professional organizations they are affiliated across Nigeria. The expected sample size of 365 respondents was determined using the reversed Cochran's equation:

$$N = \frac{n\{p(R)\bullet(\neg p(R))\}^2}{\{p(R)\bullet(\neg p(R))\}^2 - ne^2} \qquad (1)$$

Where; N = Total expected sample; $p(R)$ = 0.3818; $\neg p(R)$ = 1- $p(R)$ = 0.6182; e = 0.05, and n = 21; so that N = 365; based on 21 out of 55 snowballed pilot questionnaires were successfully retrieved as indicated in Table 1.

Table 1: The derived operational sample size for the study

Strata of built environment and allied professionals	Snowballed pilot study questionnaire			Actual sample stratified [b.]	Main study questionnaire Snowballed (administered)	
	Total	Retrieved and valid			Total	Successfully retrieved and valid
		Freq.	(%)			
Architects	10	4	7.27	70	70	16
Builders	10	4	7.27	70	70	19
Engineers	8	3	5.46	52	52	15
Estate Surv. & Valuers	11	4	7.27	69	69	16
Project Managers	3	1	1.82	17	17	4
Quantity Surveyors	8	3	5.45	52	52	15
Town Planners	5	2	3.64	35	35	9
Total	55	21	38.18	365 [a.]	365	94[c.]

*Notes: **a.** Total expected sample was determined using equation 1 to be 365; **b.** Actual number of questionnaire snowballed per strata is the total expected sample, (365) multiplied by the ratio of the retrieved pilot questionnaire in a stratum and the total retrieved pilot questionnaire, (21); **c.** The operational sample size for the study. Source: Field survey, 2023*

This was scaled up to an expected total sample of 365 respondents using the reversed Cochran's equation (equation 1), and further stratified based on the frequency of successfully retrieved pilot study questionnaire. Consequently a total of 94 valid questionnaires with stratified distribution in Table 1 were retrieved to feature as the operational sample size for this study.

Data collection and questionnaire design: This study utilized primary and secondary sources of data to address the research problem. Notable among the secondary sources of data that formed the theoretical and conceptual basis for the study include published scholarly works on the subject matter of value methodologies (VA, VE, and VM), value engineering objectives (VEO) or value workshop objectives (VWO), VE practice, VE pedagogy, and VE competence/proficiency among these professionals. Primary data collection was instantiated through survey designs which lead to the preparation of a uniform study questionnaire that was tested during the pilot study, and eventually administered to the respondents in Okene for Kogi-Central, Anyigba for Kogi-East, and Lokoja for Kogi-West through snowballing. Questions eliciting the respondents professional background, affiliation, and experience featured in the first section of the questionnaire; whereas the second section featured questions eliciting closed-ended response pertaining to strategic focus of VE practice, and the levels of respondents' proficiency in delivering VEO/VWO measured using 5-point Likert-scales coded 5, 4, 3, 2, and 1 to represent "Very high proficiency", "High proficiency", "Average proficiency", "Low proficiency", and "No proficiency" respectively.

Data validation for inferential statistical tests: The Cronbach's reliability-, Wald-Wolfowitz (runs) randomness-, and the Shapiro-Wilk W-normality tests were all carried out to validate the conformity of datasets to appropriate inferential statistical tests. Across the three data collection centres and for the entire study area, the Cronbach's test result in Table 2 indicates aggregate internal consistency of the 5-point Likert responses pertaining to respondents' proficiency in the delivery of the ten VWOs presented in the study questionnaire, which is in consonance with the acceptance benchmark of $0.7 \leq \alpha \leq 1.0$ as averred by Habidin *et al*. (2017). In tandem with the assertion of Bujang and Sapri (2018) regarding the possibility of obtaining random data from a non-probability sample, the results of the Wald-Wolfowitz runs test featured in Table 3 indicated randomness of the 5-point Likert scale data on the level of VE proficiency among built environment and allied professionals in the study area, notwithstanding the non-probability sampling of the questionnaire respondents. Consequently, the interpretation of the inferential statistical test associated with this dataset was accorded prudent attribution to the sample of these professionals in the study area.

Table 2: Reliability test of assessed level of proficiency

Data collection locations	Operational sample size	Items	Cronbach's alpha, α
Kogi-Central	$n_1 = 25$	10	0.802
Kogi-East	$n_2 = 23$	10	0.660
Kogi-West	$n_3 = 46$	10	0.762
Aggregate	N = 94	10	0.854

Source: Field survey, 2023

Table 3: Runs- and the Shapiro-Wilk W-normality tests on the VWOs

Value workshop objectives (VWOs)	[a] Two-tailed runs test		[b] Two-tailed normality test	
	$\|Z\|$	*p*-value	W	*p*-value
Minimize capital cost of project	-1.656	0.098	0.836	0.000
Minimize project operating cost	-1.711	0.087	0.820	0.000
Enhance project worth	-1.073	0.283	0.842	0.000
Effective risk management	-1.656	0.098	0.807	0.000
Early project completion/delivery	-1.075	0.282	0.833	0.000
Value optimization over project life cycle	-1.539	0.124	0.845	0.000
Minimize adverse environmental impact of project	-1.556	0.120	0.867	0.000
Enhance project flexibility	-0.491	0.623	0.831	0.000
Enhance project functionality	-1.200	0.230	0.837	0.000
Enhance project usability, convenience and comfort	-0.152	0.879	0.831	0.000

Note: ***a.*** *With* $Z_{0.975} = \pm 1.96$*, randomness is in-significant where (p < 0.05) p > 0.05:*
b. *With* $W_{\alpha = 0.05, n = 94} = 0.947$*, normality is in-significant where (p < 0.05) p > 0.05.*
Source: Field survey, 2023

The Shapiro-Wilk test across all the VWOs in Table 3 that were used to assess respondents' level of VE proficiency showed a significant departure from normality ($p < 0.05$); hence, the decision to relax the normality assumption in order to pave the way for the deployment of the Kruskal-Wallis *H* test in lieu of the one-way Analysis of Variance (ANOVA).

Data analysis and presentation techniques: Data for this study were mainly presented using cross-tabulations of frequency distributions, weighted mean scores, standard deviations, and statistical tests, notably the Kruskal-Wallis *H* test and the associated effect size (eta-squared - η^2) for the tests.

RESULTS AND DISCUSSION

Membership cadre of respondents' profession: In Table 4 the distribution of the sample of professionals indicates 62 full members of their professional organizations. This is followed by 24 Associate members, 3 technical members and 5 graduate members. Contributing significantly to the full membership category include Architects, Builders, Engineers, and Quantity Surveyors. The dominance of respondents in the category of full- and associate membership of their professional organizations has reposed a measure of confidence in the elicited data.

Respondents' years of experience in Construction practice: In spite of the 15.7 years' average, a true reflection of the construction industry experience of the respondents was observed to be 15.5 years in tandem with the convergence of the median and mode of the distribution as indicated in Table 5, there is a 95% likelihood that the minimum and maximum years of experience among the sample of these professionals might range from 14.1 to 17.5 years. This result implied that the respondents have amassed reasonable years of construction industry experience in order to repose a good measure of confidence in the survey data elicited from them regarding their proficiency levels in the delivery of VE objectives.

Table 4: Respondents' professional affiliation and membership

Profession	Membership category				Sub-Total
	Full member	Associate member	Technical member	Graduate member	
Architects	14	2	0	0	16
Builders	14	2	3	0	19
Engineer	10	5	0	0	15
Estate Surveyors & Valuers	N/A	15	N/A	1	16
Project Managers	4	0	0	0	4
Quantity Surveyors	12	N/A	N/A	3	15
Town Planners	8	N/A	N/A	1	9
Sub-Total	62	24	3	5	94

N/A = not applicable; Source: Field survey, 2023

Table 5: Descriptive statistics of respondents' years of experience

Parameter		Value (Years)	Standard error
Mean		15.7	0.828
95% Confidence interval of mean	Lower bound	14.1	
	Upper bound	17.3	
Median		15.5	
Mode		15.5	
Standard deviation		8.029	
Variance		64.470	

Note: Descriptive Statistics for a sample size of 94 respondents. Source: Field survey, 2023

Strategic focus of Value Engineering practice: The first five strategic areas of VE service delivery in Table 6 include review of design (21.3%), the use of alternative construction materials (18.1%), price monitoring and budget review (17%), expenditure control (13.8%), and market intelligence and end-user surveys (10.6%). The review of design attracted the highest frequency probably because the goals of achieving cost-savings and enhanced worth of a project can be traced to an overhaul of the initial design to make it cost-effective. Furthermore, the cluster of strategic VE services comprising the use of alternative construction materials, price monitoring and budget review, expenditure control, and market intelligence and end-user surveys might have featured in the 2nd, 3rd, 4th, and 5th positions owing to their synergy with the VE goals of project functionality, cost-savings, and value-for-money. The other four strategic areas, namely - environmental assessment, time management, recycling and reuse of materials, and risk management did not receive attention by majority of the respondents probably because, a limited frequency of these respondents are proficient in the delivery of these services.

Table 6: Strategic focus in value engineering practice

Dimension of VE Support	Frequency	Percentage (%)	Rank
Review of design	20	21.3	1
Alternative construction materials	17	18.1	2
Price monitoring and budget review	16	17.0	3
Expenditure control	13	13.8	4
Market intelligence and End-user surveys	10	10.6	5
Environmental assessment	7	7.4	6
Time management	6	6.4	7
Recycling and Reuse of materials	4	4.3	8
Risk management	1	1.1	9
Total	94	100.0	

Source: Field survey, 2023

Respondents' Level of proficiency in delivering Value Engineering objectives: At this juncture is an analysis of the respondents' capability to deliver on the ten VWOs or VEOs. The pooled descriptive statistics in Table 7 indicated that all categories of built environment and allied professionals in the sample exhibited high levels of proficiency ($3.50 \leq W_{\bar{x}} \leq 4.49$) in the delivery of the ten workshop objectives for value engineering of construction projects. Unlike the case-by-case assessment of the professionals' level of proficiency, this pooled mean score did not provide adequate insight into the variation in the levels of VE proficiency among the respondents. In the first thematic column of Table 7, the sample of Architects in the study area appeared to exhibit high levels of proficiency ($3.50 \leq W_{\bar{x}} \leq 4.49$) in the delivery of all but one of the VWOs, being effective risk management ($2.50 \leq W_{\bar{x}} \leq 3.49$). Nevertheless, their average level of proficiency in the delivery of most of these VWOs is a reflection of their ability to comprehend the collaborative roles of the other professionals in the VE team. The sample of Builders and Engineers in the study area appeared to exhibit high levels of proficiency in the delivery of all of the value engineering objectives ($3.50 \leq W_{\bar{x}} \leq 4.49$), but with varying proficiency in the use of VE to minimize project operating cost; enhance project usability, convenience and comfort; enhance project flexibility; enhance project functionality; effectively risk management; enhance project worth; and optimize value over project life cycle as indicated in Table 7. Notwithstanding, these proficiencies avowed by Builders and Engineers in the VE process are required to translate the conceived ideas in the design and workshop session into functional projects that might avail value-for-money to project owners and end-users. Estate Surveyors and Valuers were found to exhibit high levels of proficiency in the delivery of all of the value engineering objectives ($3.50 \leq W_{\bar{x}} \leq 4.49$), but with strong competencies in enhancing project functionality; enhancing project usability, convenience and comfort; enhancing project flexibility; effective risk management; and early project completion/delivery. In the fifth thematic column of Table 7, the sample of Project Managers in the study area appeared to exhibit very high levels of proficiency in the delivery of all the VWOs ($4.50 \leq W_{\bar{x}} \leq 5.00$), which might be attributed to the pedagogic and experiential pre-qualification requirements for project management practice. Corroborating this result is a similar study in Malaysia where project managers were found to exhibit overall awareness of VM application especially to small-scale project (Lin *et al*., 2022). This finding indicates that project managers have the basic expertise required for pre-qualification as VE facilitators (Kelly *et al*., 2004), and further underscores their relevance in collaborative project design and planning (Moradi *et al*., 2020). In the sixth thematic column of Table 7, Quantity Surveyors were found to exhibit high levels of proficiency in the delivery of the ten value engineering/value workshop objectives ($3.50 \leq W_{\bar{x}} \leq 4.49$), but with notable competencies in minimizing project operating cost; enhancing project functionality; enhancing project usability, convenience and comfort; minimize capital cost of project; and minimizing adverse environmental impact of project.

Table 7: Distribution of the level of proficiency in delivering VE objectives among the built environment and allied professionals

Respondents' Profession / VE objectives	Architecture			Building			Engineering			Estate Surv. & Valuation		
	Mean	Stdev	Rank	Mean	Stdev	Rank	Mean	Stdev	Rank	Mean	Stdev	Rank
Minimize project operating cost	3.75	0.86	3	4.00	0.67	6	4.00	0.76	3	4.06	0.77	6
Enhance project usability, convenience and comfort	3.69	1.08	6	3.89	0.57	8	4.00	0.76	3	4.31	0.70	2
Enhance project flexibility	3.75	0.93	3	4.05	0.71	4	4.40	0.74	1	4.25	0.77	3
Enhance project functionality	3.69	0.95	6	3.89	0.66	8	4.07	0.80	2	4.38	0.72	1
Effective risk management	3.31	1.01	10	4.21	0.71	1	4.00	0.76	3	4.13	0.72	4
Minimize capital cost of project	3.75	0.86	3	4.00	0.67	6	3.73	0.80	9	4.06	0.77	6
Early project completion/delivery	3.81	0.66	2	4.21	0.63	1	3.87	0.74	8	4.13	0.72	4
Enhance project worth	3.56	1.03	8	4.05	0.62	4	4.00	0.76	3	4.06	0.77	6
Value optimization over project life cycle	3.50	0.89	9	4.11	0.74	3	3.53	0.64	10	3.88	0.62	9
Minimize adverse environmental impact of project	3.94	0.85	1	3.53	0.96	10	3.93	0.70	7	3.69	0.70	10

Note: Ranks (with ties) have been assigned on the basis of calculated mean score; Source: Field survey, 2023

Table 8: Distribution of the level of proficiency in delivering VE objectives among the built environment and allied professionals (Continued)

Respondents' Profession / VE objectives	Project Management			Quantity Surveying			Town Planning			Pooled statistics		
	Mean	Stdev	Rank	Mean	Stdev	Rank	Mean	Stdev	Rank	Mean	Stdev	Rank
Minimize project operating cost	5.00	0.00	1	4.47	0.64	1	2.67	0.71	10	4.10	0.76	1
Enhance project usability, convenience and comfort	5.00	0.00	1	4.40	0.63	3	4.00	0.50	1	4.09	0.77	2
Enhance project flexibility	4.75	0.50	7	4.33	0.62	6	3.22	0.67	3	4.09	0.81	2
Enhance project functionality	4.75	0.50	7	4.47	0.64	1	3.33	0.71	2	4.04	0.82	4
Effective risk management	5.00	0.00	1	4.27	0.70	8	2.78	0.67	8	4.03	0.71	5
Minimize capital cost of project	5.00	0.00	1	4.40	0.63	3	3.22	0.83	3	4.01	0.75	6
Early project completion/delivery	5.00	0.00	1	4.13	0.64	10	3.11	0.60	5	3.99	0.74	7
Enhance project worth	4.50	0.58	10	4.20	0.68	9	3.11	0.60	5	3.91	0.81	8
Value optimization over project life cycle	5.00	0.00	1	4.33	0.72	6	2.78	0.67	8	3.88	0.79	9
Minimize adverse environmental impact of project	4.75	0.50	7	4.40	0.74	3	2.89	0.78	7	3.82	0.89	10

Note: Ranks (with ties) have been assigned on the basis of calculated mean score; Source: Field survey, 2023

Although this result corroborates the findings from an earlier study regarding the leading role of the quantity surveyor in value methodology service-delivery (Saifulnizam *et al*., 2011), the essential collaboration and peer-review activities required in VE practice does exclude the other professionals from playing leading roles in specific aspects of the value workshop (Kelly *et al*., 2004; Oke and Ogunsemi, 2013; RICS, 2017). In the seventh thematic column of Table 8, Town Planners were found to have exhibited high levels of proficiency in enhancing project usability, convenience and comfort ($3.50 \leq W_{\bar{x}} \leq 4.49$), in affirmation of its being among the competencies of the Town planner (Ratcliffe *et al*., 2009). Furthermore, the VWO of project usability, convenience and comfort might be recalled to be congruent to the concepts of habitable building/infrastructure (Preiser, 1983), and user satisfaction (Russell *et al*., 1994). Beside this result is the average level of proficiency ($2.50 \leq W_{\bar{x}} \leq 3.49$) in the delivery of the remaining nine value workshop objectives among the sample of Town Planners in the study area. Corroborating all these results are studies attributing proficiency in this context to project functionality (Kolibácová, 2014), cost savings (Nasereddin and Price, 2021), enhanced project worth (Thneibat and Al-Shattarat, 2021), value optimization over project life cycle (Bennett and Mayouf, 2021), minimized adverse environmental impact of project (Othman and Abdelrahim, 2020), enhanced project usability, convenience and comfort (Kolibácová, 2014; Lee *et al*., 2011; Leung and Kong, 2008; Schramm *et al*., 2018), enhanced project flexibility/adaptability (Oke and Ogunsemi, 2013; Saleh *et al*., 2009), effective risk management (Osazuwa *et al*., 2019), early project completion/delivery (Alsolami, 2022), and minimized project operating cost (Hipkin and De Cock, 2000; Rich and Holweg, 2000); but with varying areas of attention attributed to each group of built environment and allied professional in a typical value engineering team. It is generally observed from Table 7 that the sample of project managers in the study area might likely exhibit very high level of proficiency in the delivery of the ten VE objectives. This is followed by quantity surveyors in the study area who were assessed to likely exhibit high level of proficiency in the delivery of the ten VE objectives. Table 7 however indicated varying VWOs for which the other groups of professionals tend to exhibit their strengths of proficiencies. It is against this backdrop that the next sub-section analyzed the variations in the levels of VE proficiency among these professionals as well as the VWOs/VEOs that accounted for the variations.

Variation in the proficient delivery of Value Engineering objectives: Within the framework of the 5% hypothesized level of significance, it can be deduced from Table 8 that all the ten value workshop objectives (VWOs) significantly accounted for a variation in the level of value engineering proficiency among the built environment and allied professionals in the study area ($p < 0.05$). Eight out of these ten VWOs were found to have exhibited large effect sizes in the range: $\eta^2 \geq 0.14$, except for the VWOs of enhancing project worth, and enhancing project usability, convenience and comfort that both exhibited medium size effects in the range: $0.06 \leq \eta^2 < 0.14$. If a hypothesized significance level of 1% had been chosen for the Kruskal-Wallis *H* test in Table 8, then the eight VWO that would have accounted for the variation in the level of VE proficiency among these professionals shall be outlined to include minimizing capital cost of project ($\chi^2(6) = 20.324$, $p = 0.002$); minimizing project operating cost ($\chi^2(6) = 29.879$, $p = 0.000$); effective risk management ($\chi^2(6) = 29.529$, $p = 0.000$); early project completion/delivery ($\chi^2(6) = 23.818$, $p = 0.001$); value optimization over project life cycle ($\chi^2(6) = 31.310$, $p = 0.000$); minimizing adverse environmental impact of project ($\chi^2(6) = 22.721$, $p = 0.001$); enhancing project flexibility ($\chi^2(6) = 18.639$, $p = 0.005$); and enhancing project functionality ($\chi^2(6) = 19.678$, $p = 0.003$).

Table 8: Kruskal-Wallis test of professionals' proficiency in the delivery of VE objectives

S/N	Value Engineering objectives	Adjusted Test statistic [a.] *H* Statistic	[b.] *p*-value	Symbolic inference	Decision	Effect size (η^2)
1	Minimize capital cost of project	20.324	0.002***	p <0.05	Reject H_0	0.16
2	Minimize project operating cost	29.879	0.000***	p <0.05	Reject H_0	0.27
3	Enhance project worth	16.591	0.011**	p <0.05	Reject H_0	0.12
4	Effective risk management	29.520	0.000***	p <0.05	Reject H_0	0.27
5	Early project completion/delivery	23.818	0.001***	p <0.05	Reject H_0	0.20
6	Value optimization over project life cycle	31.310	0.000***	p <0.05	Reject H_0	0.29
7	Minimize adverse environmental impact of project	22.721	0.001***	p <0.05	Reject H_0	0.19
8	Enhance project flexibility	18.639	0.005***	p <0.05	Reject H_0	0.15
9	Enhance project functionality	19.678	0.003***	p <0.05	Reject H_0	0.16
10	Enhance project usability, convenience and comfort	15.069	0.020**	p <0.05	Reject H_0	0.10

Notes: [a.] *Test was based on Critical* $\chi^2 = 12.592$ *derived from d.f. = 6, and* $\alpha = 0.05$; [b.] ****Significant at p < 0.01; **Significant at p < 0.05;* [c.] *Test priori power for the entire test* $(1 - \beta)$*, is 0.974;* [d.] *Bonferroni corrected alpha,* α' *for the entire test is 0.002*

Notwithstanding, inference could be drawn at 5% level of significance that the built environment and allied professionals in the study area have varied levels of proficiency in the use of value engineering to actualize all the ten VWOs. This variation might be attributed to the inherent differences in their pedagogic formation as well as the requirements for professional qualification and practice in Nigeria; and given the emphasis on hard systems approach for the training of Architects, Builders, Engineers, and Quantity Surveyors; whereas Estate Surveyors and Valuers, Project Managers, and Town Planners are trained from the combined perspective of soft- and hard systems approach, which in the perspective of Kelly *et al.* (2004) appears to be the optimal strategy for exercising value methodologies in construction projects.

Conclusion: This study is among the novel attempts at evaluating the proficiency of construction and allied professionals in Nigeria to deliver value-engineered projects. The varying levels of VE proficiency among these professionals as attributed to the ten VWOs is a reflection of their diversified skills in project cost control. It is however recommended that project owners and financiers should consider the first- and second choices of project managers-, and quantity surveyors for the job of value workshop facilitators.

Acknowledgments: This article was drawn from the Institutional-based research (IBR) funded by the Tertiary Education Trust Fund (TETFUND) in Nigeria, under the research grant registration number - ETF/DR&D/CE/POLY/IDAH/RG/2020/VOL.1. The authors wish to appreciate the collective efforts of TETFUND, the field/research assistants, and the cooperation of the survey participants.

REFERENCES

Adedeji, YMD; Abiodun, OO (2012). An evaluation of accessibility of low-income earners to housing finance in Nigeria. *Eur. Sci. J.* 8(12): 80 - 95.

Akanni, PO; Oke, AE; Omotilewa, OJ (2014). Implications of Rising Cost of Building Materials in Lagos State Nigeria. *SAGE open*, 1 - 7. DOI: https://doi.org/10.1177/2158244014561213

Alsolami, BM (2022). Identifying and assessing critical success factors of value management implementation in Saudi Arabia building construction industry. *Ain Shams Engr. J.* 13(6): 101804. DOI: https://doi.org/10.1016/j.asej.2022.101804

Ayodele, VM; Olatunji, SO; Oke, AE; Akanni, PO (2015). Project management tools application for construction works project planning in Nigeria. In: Ogunsemi, DR; Awodele, OA; Oke, AE (Eds). *Confluence of Research, Theory and Practice in Quantity Surveying Profession for a Sustainable Built Environment*. The Nigerian Institute of Quantity Surveyors, Abuja, pp. 164-177

.

Bamidele, FF (2018). Geology and Mineral Resources of Kogi State, Nigeria. *Int. J. Multidisc. Sci. Engr.* 9(7): 7 – 13

Bennett, K; Mayouf, M (2021). Value Management Integration for Whole Life Cycle: Post COVID-19 Strategy for the UK Construction Industry. *Sustainability*. 13: 9274. DOI: https://doi.org/10.3390/su13169274

Bowen, P; Edwards, P; Cattell, K; Jay, I (2010). The awareness and practice of value management by South African consulting engineers: Preliminary research survey findings. *Int. J. Proj. Manage.* 28(1): 285 - 295. DOI: https://doi.org/10.1016/j.ijproman.2009.07.001

Bowen, PA; Edwards, PJ; Cattell, K (2009). Value management practice in South Africa: the built environment professions compared. *Constr. Manage. Econs*. 27(11): 1039 - 1057. doi: https://doi.org/10.1080/01446190903280435

Bujang, MA; Sapri, FE (2018). An Application of the Runs Test to Test for Randomness of Observations Obtained from a Clinical Survey in an Ordered Population. *The Malays. J. Med. Sci.*, 25(4): 146 - 151. DOI: https://doi.org/10.21315/mjms2018.25.4.15

Cheah, CYJ; Ting, SK (2005). Appraisal of value engineering in construction in Southeast Asia. *Int. J. Proj. Manage.* 23: 151 - 158. DOI: https://doi.org/10.1016/j.ijproman.2004.07.008

Connaughton, JN; Green, SD (1996). *Value Management in Construction: A Client's Guide*. GRIA publications, London. pp.7

Emami, K; Emami, T (2020). Value Engineering: Opportunities and Challenges. *Irrig. Drain*. 69(2): 307 - 313. DOI: https://doi.org/10.1002/ird.2410

Habidin, NF; Zubir, AFM; Fuzi, NM; Latip, NAM; Azman, MNA (2017). Sustainable Performance Measures for Malaysian Automotive Industry. *Wld. App. Sci J.* 33(6): 1017-1024. DOI: https://doi.org/10.5829/idosi.wasj.2015.33.06.257

Hipkin, IB; De Cock, C (2000). TQM and BPR: lessons for maintenance management. *Omega*, 28(3); 277-292. DOI: https://doi.org/10.1016/S0305-0483(99)00043-2

Ibitoye, SJ (2012). Survey of the performance of agricultural cooperative societies in Kogi state, Nigeria. *Eur. Sci. J.* 8(24): 98 – 114

Kelly, J; Male, S; Graham, D (2004). *Value Management of Construction Projects*. Blackwell Science Ltd., Oxford. pp. 29, 81 – 90

Khodeir, LM; El Ghandour, A (2019). Examining the role of value management in controlling cost overrun [application on residential construction projects in Egypt]. *Ain Shams Engr. J*. 10(2): 471 - 479. DOI: https://doi.org/10.1016/j.asej.2018.11.008

Kolibácová, G (2014). The Relationship Between Competency and Performance. *Act. Univ. Agri. Silv. Mend. Brun.* 82(6): 1315 - 1327. DOI: https://doi.org/10.11118/actaun201462061315

Lee, TS; Kim, D-H; Lee, DW (2011). A competency model for project construction team and project control team. *KSCE J. Civil Engr.* 15(5): 781–792. DOI: https://doi.org/10.1007/s12205-011-1291-9

Leung, MY; Kong, SN (2008). Identifying key competencies of VM facilitators based on international standards. Paper presented at the the Proceedings of the HKIVM 9th International Conference, Hong Kong, 29th October - 1st November

Lin, X; Mazlan, AN; Ismail, S; Durdyev, S (2022). Status of Value Management Implementation in Small and Medium Construction Projects in Malaysia. *Bldgs.* 12: 658. DOI: https://doi.org/10.3390/buildings12050658

Mac-Barango, D (2017). Construction Project Abandonment: An Appraisal of Causes, Effects and Remedies. *Wld. J. Innov. Mod. Technol.* 1(1): 1 – 10

Moradi, S; Kähkönen, K; Aaltonen, K (2020). Project Managers' Competencies in Collaborative Construction Projects. *Bldgs*, 10(3): 50. DOI: https://doi.org/10.3390/buildings10030050

Nasereddin, M; Price, A (2021). Addressing the capital cost barrier to sustainable construction. *Devts. Built Environ.* 7: 100049. DOI: https://doi.org/10.1016/j.dibe.2021.100049

Oghenekevwe, O; Olusola, O; Chukwudi, SC (2014). An assessment of the impact of inflation on construction material prices in Nigeria. *PM Wld. J.* 3(4): 1-22

Oke, AE; Ogunsemi, DR (2013). Key competencies of value managers in Lagos State, Nigeria. Paper presented at the 5th West Africa Built Environment Research (WABER) Conference, Accra, Ghana, 12th -14th August

Omopariola, ED; Olufemi, JE (2015). Vulnerability of building collapse at various stages of buildings' life span: A case study of Lokoja, Kogi state of Nigeria. In: Ogunsemi, DR; Awodele, OA; Oke, AE (Eds). *Confluence of Research, Theory and Practice in Quantity Surveying Profession for a Sustainable Built Environment*. The Nigerian Institute of Quantity Surveyors, Abuja, pp. 863 - 873.

Osazuwa, EM; Ogbu, CP; Oke, AO (2019). Assessment of Risk Management Skills of Construction Professionals in Edo State, Nigeria. *J. Sci. Technol. Res.* 1(3): 75 - 83.

Othman, AAE; Abdelrahim, SM (2020). Achieving sustainability through reducing construction waste during the design process. *J. Engr. Dsg Technol.* 18(2): 362–377. DOI: https://doi.org/10.1108/jedt-03-2019-0064

Otunola, AO; Musa, HA; Likman, YG (2021). Effect of rising cost of building materials on property development in Bariga, Lagos State, Nigeria. *Int. J. Env Dsg Constr. Manage*. 20(4): 287 - 306.

Preiser, WFE (1983). The habitability framework: a conceptual approach towards linking human behaviour and physical environment. *Dsg. Stds.* 4(2): 84 – 91. DOI: https://doi.org/10.1016/0142-694x(83)90038-8

Ratcliffe, J; Stubbs, M; Keeping, M (2009). *Urban Planning and Real Estate Development* (3rd ed). Routledge, Oxon. pp. 397, 603.

Rich, N; Holweg, M (2000). Value Analysis, Value Engineering: Report produced for the EC funded project. INNOREGIO: Dissemination of innovation and knowledge management techniques. Retrieved from https://www.ivma.org.au/wp-content/uploads/2019/05/14. Value_Analysis_Value_Engineering_-_Rich_and_Holweg_2000.pdf

RICS. (2017). *RICS professional standards and guidance, UK: Value management and value engineering*. Royal Institution of Chartered Surveyors (RICS), London. pp. 4, 13

Russell, JS; Swiggum, KE; Shapiro, JM; Alaydrus, AF (1994). Constructability Related to TQM, Value Engineering, and Cost/Benefits. *J. Perf. Constr. Facil.* 8(1): 31 - 45. DOI: https://doi.org/10.1061/(ASCE)0887-3828(1994)8:1(31)

Saifulnizam, M; Coffey, V; Preece, CN (2011). Value Management: An Extension of Quantity Surveying Services in Malaysia. Paper presented at the International Construction Business and Management Symposium, Kuala Lumpur, Malaysia.

Saleh, JH; Mark, G; Jordan, NC (2009). Flexibility: a multi-disciplinary literature review and a research agenda for designing flexible engineering systems. *J. Engr Dsg*. 20(3): 307 - 323. DOI: https://doi.org/10.1080/09544820701870813

SAVE International. (2007). Value Standard and Body of Knowledge. Society of American Value Engineers [SAVE International]. Dayton, Ohio, USA, Society of American Value Engrs. Retrieved 5th September, 2019, from http://www.value-eng.org/pdf_docs/about/VM%20Standard%20Methodology.pdf

Schramm, U; Reichart, S; Becking, D (2018). From Pre- to Post-occupancy Evaluations: Acceptance of Intelligent Building Technologies. In: Preiser, WFE; Hardy, AE; Schramm, U. (Eds), *Building Performance Evaluation From Delivery Process to Life Cycle Phases* (2nd ed), Springer, Switzerland, pp. 73 - 86.

Thneibat, MM; Al-Shattarat, B (2021). Critical success factors for value management techniques in construction projects: case in Jordan. Int. J. Constr. Manage. 23(4): 669-678. DOI: https://doi.org/10.1080/15623599.2021.1908933

Zhang, L; El-Gohary, NM (2015). Discovering Stakeholder Values for Axiology-Based Value Analysis of Building Projects. *J. Constr, Engr. Manage*. 04015095. DOI: https://doi.org/10.1061/(ASCE)CO.1943-7862.0001004