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AWARENESS AND UTILISATION OF COST OPTIMISATION STRATEGIES FOR ENHANCED DELIVERY OF BUILDING PROJECT PHASES IN SOUTH-SOUTH, NIGERIA

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ABSTRACT

Purpose: Against the backdrop of increased cost failures and abandoned public building projects attributable to poor cost management in South-South Nigeria, this study aimed at providing an insight into the level of awareness and utilisation of cost optimization strategies at the planning, design, procurement and construction phases of building projects by construction professionals in the south-south zone of Nigeria. The knowledge and understanding of cost optimization strategies and their application is imperative in achieving cost performance thereby enhancing project delivery.

Design/methodology/approach: The study adopted a survey design approach. Data were collected using structured questionnaire administered on 741 construction professionals across the state capitals of the south-south zone of Nigeria by the researcher and research assistants. Some questionnaires were administered through electronic format using google forms. This was achieved by sending a brief introductory letter to respondents through an email with a hyperlink (https://docs.google.com/form) of the survey created electronically. The construction professionals comprised of Architects, Builders, Quantity Surveyors and Engineers registered with their respective professional bodies. Having achieved the population frame of 1122, the sample size of 741 was determined using the Taro Yamane (1967) formula. 546 retrieved valid questionnaires were used for the analysis.

Findings: The findings from the study revealed that construction professionals in the study area were aware of most of the cost optimisation strategies identified at project phases, however, only about 45.68% of the strategies are utilised by construction professionals at the planning phase, 17.89% at the design phase, 43.57% at the procurement phase and 45.54% at the construction phase. The study also revealed that there was no significant correlation between the level of awareness and utilisation of cost optimisation strategies at the planning, design and procurement phases, but a strong positive correlation exists between the level of awareness and utilisation of cost optimisation strategies at the construction phase of building projects.

Research limitations/Implications: The study was limited to public building projects in South-South States of Nigeria rather than the whole country, although the results of the study can be generalised to other parts of the country.

Practical implications: The research recommends that appropriate measures should be put in place by stakeholders in the building construction sector in order to improve the satisfactory utilisation of cost optimization strategies at project phases, thereby enhancing cost performance.

Originality/value: The study revealed the percentage level of awareness and utilisation of cost optimisation strategies at the planning, design, procurement and construction phases of public building projects in south-south, Nigeria. It also established the relationship between the level of awareness and utilisation of cost optimisation strategies at project phases.

Keywords: Cost Optimisation; Cost performance; Phase evaluation; Project delivery; South-South, Nigeria.

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1. INTRODUCTION

The role of the construction industry in economic development of a nation cannot be overemphasized as it contributes to the provision of shelter, employment and labour productivity of a nation (Oladiran et al., 2012 and Uwatt, 2019). The main objective of the construction industry is to ensure that construction projects are completed successfully within approved budget. Project success largely depends on how it can achieve its set objectives. Cherop (2016) described a project as an investment activity that involves a current or future outlay of funds in the expectation of satisfactory future benefits. Similarly, the main objectives of a project are to complete the project on time, within budget, satisfactory quality and client satisfaction. Every construction project consists of phases known as life cycles that begin with a concept and end with utilization (Saad, 2011). The phases under consideration in this study are the planning, design, procurement and construction phases.

Consequently, it is important to systematically plan building projects by putting in place adequate cost optimization strategies at the different phases in order to achieve cost performance and timely completion. Construction projects are complex in nature and encumbered with significant economic, political and environmental ramifications as it passes through several distinct phases over its life (Adeli and Kasim, 2001). Owning to the complex and time-consuming nature of building projects, it is important to incorporate adequate planning, monitoring and control from the inception of the project to its completion. The success of any construction project depends to a great extent on how the project objectives can be effectively managed. Failure to deliver a project within targeted time, budgeted cost and desired quality presents us with various unexpected negative effects on project performance (Alzahrani and Emsley, 2013). Public building projects are in most cases funded by the government and basically owned by the government for the use of the general public. These projects include hospitals, educational facilities, offices, libraries and recreational facilities and so on. Regrettably, the Nigerian construction industry is faced with several challenges in the execution of public building projects and this has made it difficult to achieve project objectives of timely execution of projects, optimal cost performance of projects, client's satisfaction as well satisfactory quality of work (Omopariola et al., 2020).

Managing cost effectively is crucial in order to ensure the success of a project, cost performance being the fundamental criteria for the success of any project (Igwe and Oke, 2019). According to Rajguru and Mahatme (2015), project managers face the difficult task of achieving project success because of the necessity of regularly measuring project progress as well as evaluation of plans and carrying out corrective actions when needed. In Nigeria, the growing rate of failed contracts and abandoned public building projects attributable to a lack of an adequate cost management system is alarming as incidence of abandoned projects abound all over the country. Ewa (2013), stated that about four thousand uncompleted abandoned public projects running to billions of naira flourish all over Nigeria, and this appalling situation will take over a period of thirty years to get them completed. In addition, Anyawu (2013) acclaimed that majority of abandoned building projects were as a result of poor or lack of cost management and adequate utilization of cost optimization strategies during the project execution. Furthermore, Nnadi (2015) opined that cost of construction projects in Nigeria is ranked amongst the highest in the world and this increase in construction cost in spite of various models employed to predict cost has become a cause of worry to all stakeholders in the industry. The need for adequate awareness and utilization of cost optimization strategies on public building projects in south-south Nigeria cannot be overemphasised as cases of poor cost performance of building projects are reported annually in the zone. The south-south zone of Nigeria consists of six states which include Akwa Ibom, Bayelsa, Cross River, Delta, Edo and Rivers states. These states are also part of the nine states of the Niger Delta region and have the same peculiarities (Ujene, Idoro and Odesola, 2013). The zone as reported by Ejiro (2014) has a budget per capita that is equal to almost two times that of any other zone in Nigeria which has made the zone an area for rapid construction activities. It has become inherent for cost optimization strategies to be adequately utilised at the planning, design, procurement and construction phases of public building projects in south-south, Nigeria as cases of poor cost performance and abandoned projects are reported annually in the area. For instance, Obebe et al., (2020) acclaimed that forensic investigation revealed that about 12,128 abandoned public projects abound in the Niger Delta of which the six south-south states are part of. Similarly, a study by Alade et al., (2021) revealed that nineteen years after the award of contracts worth eight hundred and thirty-three billion naira to the NDDC for the construction of public construction projects across

the Niger delta region, a large number of failed and abandoned projects still litter the area as at 2020. This has heightened the necessity for effective utilisation of cost optimization strategies like BIM-based estimating, value management, adoption of cost effective innovative and Eco-friendly housing technology for the construction of buildings to mention just a few. Rajguru and Mahatme (2015) defined cost optimisation "as the achievement of real and permanent reduction in the unit cost of services provided without damaging their suitability for the in planned use". Rajguru and Mahatme (2015) further opined that despite the availability of cost optimization techniques, most construction projects still fail to achieve project success because such techniques are not implemented at each phase of the project with the analysis of the information available. In recent years, cost management has become one of the most researched areas in management studies owning to its rising importance as a management strategy for improving cost performance of construction projects worldwide. Managing cost on construction projects in Nigeria has become an arduous task which requires the joint efforts of all stakeholders in the built environment to adopt and implement adequate cost optimisation strategies at the different phases of building projects, set up adequate guidelines which will enhance cost performance as well as reduce to a great extent cost overruns and failed contracts. Given the background above, this study aimed at investigating the level of awareness and utilisation of cost optimization strategies at different phases with a view to enhancing project delivery in south-south, Nigeria.

The specific objectives of the study are: (i) to appraise the level of awareness of cost optimisation strategies among construction professionals at planning, design, procurement and construction phases of building projects in south-south, Nigeria, (ii) to determine the level of utilisation of cost optimisation strategies at the planning, design, procurement and construction phases of building projects in south-south, Nigeria.

Four hypotheses were postulated for the study, the first states that; there is no significant correlation between the level of awareness and utilisation of cost optimisation strategies at the planning phase of building projects. The second states that; there is no significant correlation between the level of awareness and utilisation of cost optimization strategies at the design phase of building projects. The third hypothesis states that; there is no significant correlation between the level of awareness and utilisation of cot optimization strategies at the procurement phase of building projects. The fourth hypothesis states that; there is no significant correlation between the level of awareness and utilisation of cost optimization strategies at the construction phase of building projects. The results of these hypotheses will provide insight into the existing relationship between level of awareness and utilisation of cost optimisation strategies at project phases by construction professionals.

2. LITERATURE REVIEW

Literature were reviewed in related areas covering cost optimisation strategies and project phases.

2.1. Cost Optimisation Strategies and Project Delivery

Adeli and Kasim (2001) described a project as an endeavour to achieve a desired goal and the achievement of said goals is an undertaking that requires careful planning and management. Therefore, effective project planning and management is needed to ensure that the goals of a project are met to the satisfaction of the parties involved. A project is termed successful if it meets the requirement of the triple constraint which are performance, cost and time (Zuofa and Ochieng, 2014, Tahir *et al*., 2018). It is important to consider cost in the execution of construction projects because it is regarded as a measure of a project's success. Omran and Mamat (2011) described construction cost as the total cost incurred in a project from inception to the completion as well as a definitional criterion to the success or failure of any construction project. Mermon *et al*., (2010) pointed out that while cost is a driving force for success in building production processes, it is however a very important consideration throughout the construction management life cycle. National Optimisation Strategy (NOS) defined optimization as 'efforts during any phase which seeks to identify and implement specific actions that improve effectiveness and cost-efficiency of that phase' (EPA,2012). Rajguru and Mahatme (2015) described cost optimisation as parameters for achieving real and permanent reduction in the unit cost of services provided without damaging their suitability for their intended functions. Cost optimization is one of the most important management techniques carried out by

project managers in enhancing sustainable building project performance. It consists of diverse processes undertaken at different phases in the project life cycle to achieve cost performance, therefore understanding the current trend in cost management research will form the crux of identifying the critical cost optimisation strategies for enhancing project performance hence facilitating effective project delivery. According to Ekung (2019), cost optimisation was developed by the United States Army in the late 1990's and the system was first deployed on remedial system evaluation (RSE) and remedial performance optimization (RPO). Ekung (2019) further pointed out that cost optimisation seeks to reduce the overall cost of a system and concludes that optimisation strategies achieve real objectives and are implemented in specific phases of the project life cycle. Poor cost performance of construction projects is a common problem worldwide and cost optimization is not necessarily about the techniques that are adopted but rather the poor management of these techniques and the laxity in supervision (ICTAD/CM/01). Consequently, managing construction cost is important for the planning, design, procurement and construction phases of a building project. A number of studies have been carried out in recent years on cost optimisation strategies as the problem of cost overrun is a major problem in both developing and developed countries and this has provided the basis for review of literature. For instance, the survey conducted by Garimella (2018) in his study on cost control during the pre-contract stage of a construction project identified adequate cost advice to the client and the design team to enable the design to be finalised within the approved budget, performing value engineering, selecting adequate procurement strategies, selecting competent contractors, and understanding client's brief as cost optimization strategies to be undertaken at the planning and procurement phases of building projects.

At the planning phase of building projects, proper coordination and communication amongst stakeholders is imperative in order to avoid excessive waste while the objectives and goals of the project are outlined and important decisions made at the design phase to enhance the schematic and final designs. Cost optimization strategies to be applied at the planning phase was derived from literature and they include: adopting value engineering methodologies, carrying out adequate feasibility studies, commitment by owner, target costing, improving knowledge, education and skill, life cycle costing and so on. (Morris and Langdon, 2007, Opoku and Ahmed 2013, Cunningham, 2015, Garimella, 2018, Opatunji, 2018 and Ekung, 2019). At the design phase target costing, value engineering, activity-based-costing, carrying out adequate cost forecasting, adopting a proactive approach and so on were identified from literature. The procurement method selected will assist in adequate cost management and control by taking into consideration the client's need for value for his money. Therefore, selecting adequate procurement options, optimizing project selection, implementing cost-effective competitive processes, selecting competent contractor and adoption of E-procurement (Cunningham, 2015, Aarthi and Sasikumar (2015), Garimella 2018 and Ekung, 2019) is crucial. At the construction phase of a project, it is imperative to carry out adequate cost reduction techniques on site in addition to proper monitoring and material management. In addition, adopting a cost effective innovative and eco-friendly housing technology for construction of buildings, replacing conventional materials with alternative materials, mitigating unnecessary resource waste, use of better technology, schedule and feedback for monitoring performance, improving effectiveness and continuously improving cost (Cunningham, 2017, Wan, 2018 and Ekung, 2019) were important considerations at the construction phase.

3. METHODOLOGY

To achieve the objectives of the study, which are to appraise the level of awareness as well as determine the level of utilisation of cost optimization strategies at the planning, design, procurement and construction phases, a questionnaire survey was adopted. Having determined the population frame of 1122, the sample size was determined based on 95 percent confidence level for 5 percent margins of error using the Taro Yamane formula for finite population (Yamane 1967). This method was also adopted by Adewuyi and Effiong (2017). A calculated sample size of 741 was obtained. The selection of sampled professionals for the study was based on probability sampling. Field survey was carried out using the calculated sample size of seven hundred and forty-one (741) copies of structured questionnaire. The questionnaire was administered to construction professionals registered with their various professional bodies across the south-south state capitals of Uyo, Yenagoa, Calabar, Asaba, Benin and Port Harcourt. State capitals of the south-south states were used for the survey because of the volume of work usually carried out in the area. The professionals comprised of Architects, Quantity Surveyors, Builders, and Civil/Structural Engineers. The simple random method of sampling

was used in the distribution of the questionnaire. Some questionnaires were administered through electronic format using google forms. This was achieved by sending a brief introductory letter to respondents through an email with a hyperlink (https://docs.google.com/form) of the survey created electronically. Data was analysed using 546 returned valid questionnaires. The variables of cost optimisation strategies were obtained from literature and previous studies. The respondents were asked to select their level of awareness of identified cost optimization strategies as well as the extent of use of the identified cost optimization strategies at the planning, design, procurement and construction phases of building projects. Simple percentage was used to determine the respondents' characteristics while the relative importance index (RII) was used to determine the level of awareness of cost optimisation strategies. The data for level of awareness were collected on a five-point Likert-scale of 1 - very low level, 2 - low level, 3 - moderate level, 4 - high level and 5 - very high level. The RII were classified as 0-0.359 very low level, 0.36-0.529 low level, 0.53-0.679 moderate level, 0.68-0.839 high level and 0.84-1.0 very high level (scale of $0 \leq RII \leq 1$) as adapted from (Ujene and Udoudoh, 2019). Similarly, the Relative Usage Index method was used to determine the level of use of cost optimisation strategies, data for level of utilisation for cost optimisation strategies were collected on a five-point Likert-scale namely: very low utilisation = 1, low utilisation = 2, average utilisation = 3, high utilisation = 4 very high utilisation = 5. This method was also used by Ujene (2019). The formula is as shown in equation 1:

$$RUI = \sum \frac{TWV}{AXN} \qquad \ldots 1$$

Where TWV =summation of the products of the number of respondents for the rating of each variable and respective weight value for each rating

'A' = maximum weight = 5; 'N' = the total respondents.

By summing the weights and dividing by the total number of weighting items and highest weight respectively, a cut-off score of RUI was computed: (1+2+3+4+5)/5/5 = 0.60. Therefore, events that have RUI that are equal to or higher than 0.60 are defined as 'used' while those less than 0.60 are 'less used'. This study adopted a threshold of a RUI similar to RII (relative importance index) as authors use a threshold of 0.6 or 0.7 as shown in literature (Ujene, 2019). In addition, the Spearman Rank Correlation test was applied in determining the relationship between the level of awareness and utilisation of cost optimisation strategies at different phases).

4. PRESENTATION AND DISCUSSION OF RESULTS

4.1. Respondents Characteristics

The characteristics of the respondents for this study were analysed in order to determine their level of awareness and utilisation of cost optimization strategies. The number of questionnaires used for the analysis was 546 which represents 73.68% of the 741 that were distributed. From the findings, 71.4% represents male respondents while 28.6% represents female respondents. The highest academic qualifications of the respondents are 32.2% had HND, 42.1% had BSc, 20.5% had MSc and 5.1% had PhD. Also, 26.9% of the respondents were Architects, 24.1% were Builders, 29.1% were Quantity Surveyors while 19.8% were Engineers. The response on the membership status with their professional bodies are, 17.2% were fellows, while 82.8% were associate members. The results also show that 13.2% of the respondents have been in practice between 1-5 years, 32.2% have been in practice between 6-10 years, 34.4% have been in practice between 11-20 years while 20.2% have been practicing for over 20 years. The result imply that the selected respondents have the required features and experience to provide reliable information for this study.

4.2. Level of Awareness of Cost Optimisation Strategies

The first objective of the study was achieved by collecting data on the level of awareness of cost optimisation strategies by construction professionals in the study area, 32 cost optimisation strategies at the planning, design, procurement and construction phases were identified as indicated in Table 1 in the course of the study. Findings reveal that at the planning phase, construction professionals have a high level of awareness of improving knowledge and skill (RII of 0.815), providing adequate feasibility studies (RII = 0.787), life cycle costing (RII = 0.745), improving drivers and constraints (RII = 0.731), target costing (RII = 0.719), similarly, respondents have a moderate level of awareness

of effective cost planning (RII = 0.63) and optimizing owner's competence (RII = 0.61), nevertheless, they have a low level of awareness of implementing an integrated design approach (RII = 0.505). This finding is consistent with the study of Garimella, (2018) who identified lack of an awareness by stakeholders of an integrated design approach during the planning phase of projects.

Table 1: Level of Awareness of Cost Optimization Strategies N = 546

Phases	Cost Optimization Strategies	1	2	3	4	5	TWN	RII	RANK
Planning Phase	Adequate feasibility studies	24	40	109	143	230	2153	0.789	2
	Integrated approach	127	236	42	50	91	1380	0.505	8
	Target costing	54	65	120	115	192	1964	0.719	5
	Life cycle costing	50	46	116	125	209	2035	0.745	2
	Improving Knowledge and skill	36	20	90	120	280	2226	0.815	1
	Improving drivers and constraints	62	50	108	120	206	1996	0.731	4
	Effective cost planning	54	150	101	129	112	1733	0.634	6
	Optimising owner's commitment	103	82	137	128	96	1670	0.612	7
Design Phase	Target costing	34	32	90	140	250	2178	0.797	2
	Value engineering	136	132	78	112	88	1522	0.557	7
	Activity-based-costing	40	34	102	150	220	2114	0.774	3
	Adopting a proactive approach	36	25	85	130	270	2211	0.809	1
	Involve early experienced key contractors	138	120	70	130	88	1548	0.567	6
	Adoption of BIM-estimating	150	135	115	82	64	1413	0.518	8
	Adoption of passive design strategies to reduce cost	106	142	80	134	84	1586	0.581	5
	Risk based estimating	96	141	92	99	118	1640	0.601	4
Procurement Phase	Selecting adequate procurement options	33	40	70	150	253	2188	0.801	2
	Optimizing project selection	135	95	80	140	96	1605	0.588	7
	Implementing cost effective competitive process	86	82	94	130	96	1822	0.667	5
	Selecting competent contractors	9	22	90	130	295	2318	0.849	1
	Adoption of E- procurement	45	40	90	170	201	2080	0.762	3
	Use open and transparent procedure	92	86	103	122	143	1776	0.651	6
	Use collaborative based contract forms	116	140	90	102	98	1564	0.573	8
	Select team members based on understanding of cost optimization strategies	55	79	94	131	187	1952	0.715	4
Construction Phase	Adequate cost reduction techniques	46	40	60	130	270	2176	0.797	1
	Material management	56	30	70	140	250	2136	0.782	2
	Adopting a cost effective and innovative eco-friendly technique	117	72	85	102	170	1774	0.649	4
	Replacing conventional materials with alternative materials	60	46	90	160	190	2012	0.737	3
	Use continuous value engineering process as part of integrated design team effort	106	142	80	134	84	1586	0.581	7
	Adopt target costing	98	90	95	141	122	1737	0.636	5

Adopt integrated project delivery	147	228	63	51	57	1281	0.469	8
Improving drivers and constraints	56	140	109	128	113	1740	0.637	6

RII = Relative Importance Index; TWN = Total weight value; N = Number of Respondents

At the design phase, construction professionals have a high awareness of adopting a proactive approach towards cost control (RII = 0.809), target costing (RII = 0.792) and activity-based-costing (RII = 0.774), however, similarly they have a moderate level of awareness of risk-based estimating (RII = 0.601), adopting passive design strategies to reduce cost (RII = 0.581), involving early experienced key contractors (RII = 0.567) and adopting value engineering methodologies (RII = 0.559). However, they have a low level of utilisation of adopting BIM based estimating (RII = 0.518). This finding is consistent with that of Opoku and Ahmed (2013) and Cunningham (2015) who identified a moderate level of awareness of selecting competent key contractors early in the design phase of building projects. Similarly, at the procurement phase, respondents have a high level of awareness of selection of competent contractors (RII = 0.849), selection of adequate procurement options (RII = 0.801) and adoption of E-procurement (RII = 0.762) and selecting team members based on understanding of cost optimization strategies (0.715). Similarly, they have a moderate level of awareness of implementing cost effective competitive process (RII = 0.667), optimizing project selection (RII = 0.588) and use of collaborative based contract forms (RII = 0.573). The result confirms to the study of Cunningham (2015) who stated that selecting appropriate procurement options was a key decision in ensuring that cost targets are achieved. At the construction phase, stakeholders have a high level of awareness of providing adequate cost reduction techniques (RII = 0.797), material management (RII = 0.782), replacing conventional materials with alternative materials (RII = 0.737) and adopting a cost effective innovative and eco-friendly techniques for construction of buildings (RII = 0.649), while they have a moderate level of awareness of improving cost drivers and constraints (RII = 0.637) and value engineering (RII = 0.567). However, they have a low level of awareness of adopting integrated project delivery (RII = 0.469). This finding is consistent with that of Cunningham (2017), Wan (2018) and Opatunji (2018) who agreed that construction professionals were more aware of providing adequate cost reduction techniques and material management at the construction phase of building projects.

4.3. Level of Utilisation of Cost Optimization Strategies

The second objective of the study was achieved by collecting data on the level of utilisation of cost optimization strategies at different phases from the respondents. The result of this evaluation is presented in Table 2 and shows that 45.68% of the cost optimization strategies identified are utilised by construction professionals at the planning phase, 17.89% are utilised by construction professionals at the design phase, 43.57% are utilised at the procurement phase, while 45.54% are utilised at the construction phase.

Findings reveal that, at the planning phase, improving knowledge and skill was the most utilised cost optimization strategy having an RUI of 0.72 while provision of adequate feasibility studies had an RUI of 0.70 came second followed by optimizing owner's commitment through clear vision with an RUI of 0.64. Findings also revealed that, target costing, improving drivers and constraints, effective cost planning, providing an integrated approach and life cycle costing were less utilised strategies with RUI's of 0.54, 0.52, 0.50 and 0.49 respectively. This is a clear indication that construction professionals though aware of cost optimization strategies such as target costing, life cycle costing and improving drivers and constraints, however these strategies are not adequately utilised in the execution of projects. This finding is similar to those of Otali and Essien (2017), Opatunji (2018) who stated that most cost control strategies are not utilised by construction professionals even though they are aware of such strategies. At the design phase, the most used cost optimization strategy was adopting a proactive approach towards cost control with RUI of 0.75. On the other hand, target costing (0.53), activity-based-costing (0.51), value engineering (0.55) and involving early contractors at the design stage (0.48), risk based estimating (0.47) and adopting passive design strategies and methods to reduce cost (0.42) are less used by construction professionals. This result is in line with that of Azis *et al*, (2012) who revealed that value engineering was yet to become widely practiced as a cost management technique in Malaysia. The result is also similar to the findings of Opatunji (2018) who observed that construction professionals adopted a proactive approach towards cost control at the design stage. At the procurement phase, selecting

competent contractors (0.76), implementing cost effective competitive processes (0.63) and selecting team members based on understanding of cost optimization strategies (0.61) are the most used cost optimization strategies while optimizing project selection (0.59), selecting adequate procurement options (0.56), adoption of E-procurement (0.47) and use of collaborative based contract forms (0.50) are less used.

Table 2: Level of Utilisation of Cost Optimization Strategies N = 546

Phases	Cost Optimization Strategies	1	2	3	4	5	TWV	RUI	RMK
Planning phase	Adequate feasibility studies	67	77	92	124	186	1923	0.70	UD
	Integrated approach	130	232	42	52	90	1378	0.50	LUD
	Target costing	103	226	48	73	96	1471	0.54	LUD
	Life cycle costing	135	220	67	48	76	1348	0.49	LUD
	Improving Knowledge and skill	53	75	95	125	198	1978	0.72	UD
	Improving drivers and constraints	130	226	47	75	68	1087	0.40	LUD
	Effective cost planning	124	179	96	87	60	1418	0.52	LUD
	Optimising owner's commitment	92	97	109	110	138	1743	0.64	UD
Design Phase	Target costing	107	228	45	76	90	1452	0.53	LUD
	Value engineering	104	213	42	87	100	1504	0.55	LUD
	Activity-based-costing	116	209	59	87	75	1434	0.52	LUD
	Adopting a proactive approach	42	60	102	125	217	2043	0.75	UD
	Involve early experienced key contractors	149	222	58	43	74	1309	0.48	LUD
	Adoption of BIM-estimating	197	131	101	72	45	1275	0.47	LUD
	Adoption of passive design strategies to reduce cost	181	233	54	47	31	1152	0.42	LUD
	Risk based estimating	136	231	82	46	51	1283	0.47	LUD
Procurement Phase	Selecting adequate procurement options	148	110	72	124	92	1540	0.56	LUD
	Optimizing project selection	97	144	83	134	88	1610	0.59	LUD
	Implementing cost effective competitive process	54	150	101	129	112	1733	0.63	UD
	Selecting competent contractors	31	65	101	134	215	2075	0.76	UD
	Adoption of E- procurement	154	220	59	41	72	1295	0.47	LUD
	Use open and transparent procedure	194	133	109	62	48	1275	0.47	LUD
	Use collaborative based contract forms	124	225	68	58	71	1365	0.50	LUD
	Select team members based on understanding of cost optimization strategies	102	83	135	125	101	1678	0.61	UD
Construction Phase	Adequate cost reduction techniques	67	152	98	127	102	1683	0.62	UD
	Material management	84	75	90	119	178	1870	0.68	UD
	Adopting a cost effective and innovative eco-friendly technique	48	153	101	130	114	1747	0.64	UD
	Replacing conventional materials with alternative materials	105	141	81	132	87	1593	0.58	LUD
	Use continuous value engineering process as part of integrated design team effort	166	217	56	38	69	1265	0.46	LUD
	Adopt target costing	176	193	87	48	42	1225	0.45	LUD
	Adopt integrated project delivery	181	233	54	47	31	1152	0.42	LUD
	Improving drivers and constraints	201	215	68	38	24	1107	0.41	LUD

RUI = Relative usage index; UD = Used; LUD = Less Used; TWV = Total Weight Value; RMK = Remark

At the construction phase material management (0.68), adopting a cost effective eco-friendly technique for construction buildings (0.64), and carrying out adequate cost reduction techniques (0.62) were mostly utilised by construction professionals while replacing conventional materials with alternative materials (0.58), value engineering (0.46), adopting integrated project delivery (0.42) and

improving cost drivers and constraints (0.41) were less used. This finding is consistent with the research of Cunningham (2015) and Opatunji (2018) who identified the most utilised cost control techniques at the construction phase as material management on site and carrying out adequate cost reduction techniques.

4.4. Relationship between the level of awareness and utilisation of cost optimisation strategies at the planning, design, procurement and construction phases of building projects

To determine the existence of correlation between the level of awareness and utilisation of cost optimization strategies by construction professionals at project phases, and that the correlation does not occur by chance, the two variables were correlated using the Spearman's Rank correlation method. The first hypothesis which states that there is no significant correlation between the level of awareness and utilisation of cost optimization strategies at project phases was tested using the Spearman's Rank Correlation test at $p \leq 0.05$. The decision rule is that if p-value > 0.05, the hypothesis is accepted, but if p-value is ≤ 0.05, the hypothesis is rejected. The result presented on Table 3 shows that at the planning phase, the rho is 0.357 while the p-value is 0.385. This indicates that there is a weak positive correlation between the level of awareness and utilisation of cost optimisation strategies. On the other hand, the p-value of 0.385 is greater than the significant level of 0.05, so we accept the null hypothesis. The second hypothesis was tested to determine the relationship between the two variables at the design phase, the rho was found to be 0.455 while the p-value is 0.257. Since the p-value is greater than the significant value of 0.05, we accept the null hypothesis. Similarly, at the procurement phase, the rho is 0.347 while the p-value is 0.399. This indicates that the null hypothesis is accepted because the p-value is greater than the significant level of 0.05. The fourth hypothesis was tested to determine relationship between level of awareness and utilisation of cost optimisation strategies at the construction phase, the rho was calculated as 0.743 with a p-value of 0.035. Since the p-value at the construction phase is less than 0.05 the null hypothesis was rejected. The result shows that there is a strong positive significant correlation between the two variables at the construction phase.

Table 3: Results of Spearman's Rank correlation of the level of awareness and utilisation of cost optimisation strategies

Phases	Level of awareness and utilisation of cost optimisation strategies (rho)	P-Value	N	Decision
Planning	0.357	0.385	8	Accept
Design	0.455	0.257	8	Accept
Procurement	0.347	0.399	8	Accept
Construction	0.743*	0.035	8	Reject

*correlation is significant at the 0.05 level

5. CONCLUSIONS AND RECOMMENDATIONS

The study aimed at providing an insight into the level of awareness and utilisation of cost optimization strategies at the planning, design, procurement and construction phases of public building projects in south-south zone of Nigeria. The knowledge and understanding of cost optimization strategies and their utilisation at project phases is imperative in achieving cost performance thereby enhancing project delivery. The study appraised thirty-two cost optimization strategies at different phases. It was concluded that only about 45.68% of identified strategies were utilised by construction professionals in the study area at the planning phase, 17.89% were utilised at the design phase, 43.57% at the procurement phase and 45.54% at the construction phase. In addition, the study revealed that there is no significant correlation between the level of awareness and utilisation of cost optimization strategies at the planning, design and procurement phases of building projects, but there exists a positive correlation between the level of awareness and utilisation of cost optimisation strategies at the construction phase. Regrettably, the study observed that although, adequate cost optimization strategies were in place, these strategies were not properly utilised by construction professionals, this could be as a result of inadequate training of professionals as well as inadequate financing of the project from the planning right through to the construction phase. The implication of this is that cost performance of public building projects in the study area will not attain

optimum success. However, this study has contributed to knowledge by providing an in-depth knowledge of the awareness and utilisation of cost optimization strategies at the planning, design, procurement and construction phases of public building projects in South-South, Nigeria as well as Nigeria in general. The study will provide a step by step guide to all stakeholders in the construction sector on how to control cost from the inception to the completion phase of building projects thereby enhancing project delivery.

It is recommended that adequate measures should be put in place to enhance satisfactory utilisation of cost optimisation strategies at project phases in order to achieve better cost performance of building projects thereby enhancing project delivery in south-south zone of Nigeria.

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