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UTILIZATION OF QUANTITATIVE TECHNIQUES IN DECISION MAKING AMONG CONSTRUCTION MANAGERS IN AKWA IBOM STATE, NIGERIA

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ABSTRACT

Purpose: Quantitative techniques are relevant in practically every aspect of production to assist in decision making for optimal use of resources. This study aimed at providing reasonable insight into the existing level of application of different decision techniques, as well as the prioritization the factors militating against their adoption with a view to enhancing construction projects delivery in Akwa Ibom state and Nigeria in general.

Design/methodology/approach: The aim of the study was achieved through, a cross-sectional survey of, Architects, Builders, Engineers and Quantity Surveyors, who practice as construction project managers in Akwa Ibom State. Data were collected using questionnaire administered on 150 staff, consisting of six managers chosen from each of the 25 purposively selected construction companies operating within Akwa Ibom state. The six managers comprised one top manager, two middle managers and three supervisory managers from each company. Twenty-one quantitative techniques and nineteen factors inhibiting the application of quantitative methods were identified and presented to the managers for evaluation, while quantitative analytical designs were utilized in the analysis and discussion of findings.

Findings: The result showed on the whole that there is inadequate utilization of quantitative techniques in decision making among construction managers, as not up to 50% of the identified quantitative methods are utilized by the construction managers, while the adoption of quantitative techniques are seriously plagued by many factors. The significance attached to, poor awareness by the supervisory managers may not be unconnected to their lower educational level and experience. The middle managers attached the most significance to, inadequate skills and knowledge attributable to inadequate training and experience. The top and middle managers rated data unavailability and inadequate training curriculum very high, attributable to poor data management by many companies, as well as inadequate course content to guide the teaching of these subjects in institutions.

Research limitations/implications: The limitations include the use of only perception of respondents from selected companies in Akwa Ibom. The contribution to knowledge is that this study established the current level of application of different forms of decision making tool, as well as the insight to prioritization the solution to tackling the factors militating against the adoption of the techniques.

Practical implication: It is recommended that construction managers should be encouraged through organisational polices which support the development of data bank, adequate training and skills. Government agencies should also ensure that quantitative method curricula

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adequately cover the required knowledge areas, which should be completely taught by the teachers in charge.

Originality/value: The study revealed the percentage level of utilization of the quantitative techniques as well as the extent to which the managers perceive the influence of the factors inhibiting the utilization of the techniques.

Keywords: Construction industry; construction managers; decision making; inhibiting factors; quantitative techniques.

1. INTRODUCTION

The work of managers in ensuring effective and effective outcome in any establishment concerns 'choosing issues that require attention, setting goals, finding or designing suitable courses of action, as well as evaluating and choosing among alternative actions (Esan, Akanbi, Esan, Fajobi and Ikenebomeh, 2016). These processes involve decision making, which is seen as a process of obtaining a team commitment to, and collective support for, sustainable results (Zulkiffli and Latiffi, 2019).

There are several theories or models to explain managerial decision making. Few of these include the pre-programmed organisational process model; the political views which is a personalised bargaining process. There is also the Simon's theory of rationality in decision making which entails the four steps of intelligence, design, choice and review assuming the manager has the needed information to make decisions. Simon also proposed the bounded rationality theory, where the manager is assumed to have incomplete information for decision making. The rationality models, ranks alternatives by calculating their subjective expected utility. The approaches employed in selecting the best alternative may include any or all of experience, experimentation, research and analysis (Esanet al., 2016).

Djordjević, Lepojević, and Janković-Milić (2008) opined that, all aspect of production and practically every aspect of daily living use quantitative techniques to assist in decision making. Barougha, Shoubia and Skardi (2012) noted that different decision-makers are involved at various stages of construction management such as design, construction, operation, utilization and maintenance. The importance of accurate decision making to overall goal of construction endeavours has also led to the use of quantitative methods in the construction industry. This according to The Institute of Cost Accountants of India (ICAI) (2014) is to help managers to make precise and perfect decisions for efficient utilisation of scarce resources. The method involves quantification of variables and determination of relationships among them through mathematical equations which helps the process of arriving at optimal decisions.

Application of quantitative techniques plays tremendous role in various aspects of the construction. For example, optimisation techniques (linear programming, assignment, and transportation) are needed to analyse construction demands and supplies, and to assess how to plan and allocate them. Game theory is needed for ascertaining optimal use of strategies in competitive situations between two or more opponents and for conflict resolution. The queuing theory is needed to analyse and manage waiting lines in workers, plants, vehicles and others utilisation of facilities. Simulation techniques are necessary for observing the behaviour of a system under several alternative conditions in an artificial setting. Program evaluation review technique(PERT) or the critical path method (CPM) are necessary in project

implementation control system. Other methods include; forecasting (regression, path analysis, and time series), cost-benefit analysis, sensitivity analysis, significance testing, benchmarking, correlation, variance analysis, index numbers and total quality management, all of which help in reduction of cost, proper deployment of resources and minimization the time required for completing tasks (Verma and Sharma, 2017). These techniques which rely on available information have been noted to be very helpful in tackling the complex problems of modern business and industry, with the current tendency of combining several of these techniques to form more sophisticated and advance programming models.

Decision making at various level of management do not depend on available information only, but also on knowledge, skills and experience of "decision maker" who are usually the managers. Tyrańska (2016) and ICAI (2014) identified the three management levels to include top level management, middle level management and low/supervisory level management. This study supports the view that the extent of utilisation of the quantitative techniques and the successes achieved at the various levels of management depend greatly on knowledge, skills and experience of the managers and other factors. In line with the observation by Jabar, Ismail, Aziz, and Nurul (2013) that a construction manager needs to have competence in those areas that have the most impact on successful outcomes, this study is of the view that quantitative decision making is one of such areas which should be properly investigated.

According to Chukwudozie (2014), the application of a wide range of quantitative techniques in production planning and control activities for optimal utilisation of resources, as well as for the production of the required quantity and quality of products that meet consumers' demands, have tremendously achieved the accruing benefits in overseas countries like United States of America, Britain, Japan, Korea and China where industries. The study sadly observed that this is not the case yet in Nigeria, an indication that the level of utilisation of quantitative techniques and its associated benefits have not yet been adequately investigated. This therefore lends credence to this study which aims to investigate the level of utilization of quantitative techniques in decision making among construction managers, for enhanced project deliver in Akwa Ibom state, Nigerian. The specific objectives are, (i) to evaluate the level of application of quantitative techniques in decision making among top, middle and low level managers in Akwa Ibom state and, (ii) assess the factors militating against the utilisation of the techniques in decision making among the different levels of management in the construction industry.

Two hypotheses were postulated for this study, the first states that there is no significant variation in the application of quantitative techniques in decision making among top, middle and low level managers in Akwa Ibom state, while the second states that factors militating against the utilisation of the techniques in decision making do not significantly vary among the different levels of management in the construction industry. The results of these hypotheses will provide reasonable insight into the existing level of application of different forms of decision making tools, as well as the prioritization the factors militating against the adoption of the techniques. These will help policy makers in government and private establishments to re-strategise both during training and use of managers for decision making and realisation of optimal use of resources in construction projects.

2. REVIEW OF RELATED LITERATURE

This section has attempted to provide insight into some of the quantitative techniques, factors influencing their application as well as some available empirical studies in literature on quantitative methods in construction.

2.1. Some quantitative techniques for decision making in construction management

Generally, Quantitative Technique (QT) is otherwise called Operations Research (OR), Decision Science (DS), Analytical Technique (AT), Quantitative Analysis (QA), among others (Anene and Oyelere, 2014). According to Walczak (2012), Quantitative methods of project management date back to the beginning of the XX century, with a variety of methods optimizing projects being developed. In corroboration, (ICAI) (2014) observed that several quantitative methods exist which have been very useful decision making in business and production management.

Some of the techniques which can be used in decision making while managing construction projects, as identified from Walczak (2012), ICAI) (2014), Cvetkoska (2016), and Patel and Solanki (2017), are highlighted thus:

Linear programming: The technique is valuable under conditions of sureness of linear relationship among variables. It is used for optimisation (maximisation or minimisation) of an objective function under given resources and constraints.

Assignment model: Assignment problems are classical combinatorial optimization problems, which comprises allocation of renewable resources (construction equipment, crews, or contractors) of limited availability to a set of activities. The classical model for this problem minimizes the total time or cost of completing all activities with the assumption that each activity is assigned to one particular resource (Sarbapriya, 2016).

Transportation model: Transportation problems are special form of linear programming problem used for inventory control, managing of fund, and resolving disputes of scheduling production over different time periods for construction materials. The transportation technique is concerned with the transportation of products from different sources to different destinations and deal with suitable data like capacity of various sources, requirement at the destination and the cost of transportation along each route because of the prime effect of transportation costs on total cost of products.

Probability decision theory: This theory is based on the principle that the behaviour of the future is probabilistic and not deterministic. Different probabilities are assigned to the 'state of nature' on the basis of available information or subjective judgment and the likely outcomes of the alternative courses of action are evaluated accordingly before a particular alternative is selected. Pay-off Matrices and 'Decision Trees' are constructed to represent the variables.

Queuing theory/waiting line models: The technique is designed to find solutions to waiting line problems for personnel, equipment or services under conditions of irregular demand. The objective is to find optimum volume of facilities to minimise the waiting period, on the one hand, and the investment associated with building up and maintaining

the facilities, on the other. Public transport systems, hospitals, and big departmental stores are some of the possible users of this technique.

Game theory: This theory which originated from the mathematical sciences helps the decision maker under conditions of competitive rivalry or conflict. The adversaries in the conflict are supposed to be involved in a game of gaining at the total or partial expense of each other. There are 'two-person', 'three-person' and 'n- person' games as also zero-sum and non-zero sum games.

Simulation: It is a technique for observing the behaviour of a system under several alternative conditions in an artificial setting. When the conditions of the environment are very complex and when it is not possible to find the one best way of doing things, it provides the manager a way out. The likely behaviour of events and variables is observed and evaluated in a simulated setting. It is possible to experiment with various possibilities or alternatives in a simulated setting rather than in a natural setting.

Network techniques: There are two powerful network techniques—Critical Path Method (CPM)and Programme Evaluation and Review Technique (PERT) which are useful for project planning and control. Complex projects involve considerable cost and time. The objective is to minimise both by working out a 'critical path' where managerial attention is to be concentrated. A diagrammatic net-work of activities required for completion of a project is prepared in detail to assess their interrelation, to segregate sequential activities from simultaneous ones and to estimate the probable time and cost of their completion.

Forecasting: According to Ezeliora, Umeh, Mbeledeogu, and Okoye (2014), forecasting is the process of making statements about events whose actual outcomes (typically) have not yet been observed. Forecasting is similar to Prediction in that, both might refer to formal statistical methods employing time series, cross-sectional or longitudinal data, or alternatively to less formal judgmental methods. In specific term while 'forecasting" is sometimes reserved for estimates of values at certain specific future times, "prediction" is used for more general estimates, such as the number of times floods will occur over a long period. Hence, regression, path analysis, and time series belong to almost the same class of purpose

Other methods: Other quantitative methods which cannot be described for brevity of this article include, break even analysis, inventory models, integer programing, goal programing, non-linear programing, dynamic programing, project management, Markov processes and multi-criteria decision making (Cvetkoska, 2016).

2.2. Factors affecting quantitative decision making

Anene and Oyelere (2014) observed that in applications of quantitative techniques to actual management of any organization generally, certain important aspects are often overlooked which constitute impediment to success of decision making. These are the cost in time and the cost of required resources for developing and using QTs. The manpower requirements, financial cost, staff skills and in recent time, sophisticated information technology (IT) equipment required to develop and use quantitative techniques (QTs). Chukwudozie (2014) also revealed unawareness, lack of qualified manpower and lack of

financial resources, as factors inhibiting the application of Quantitative Techniques to production process.

It is obvious that life for any manager in any organization is becoming increasingly difficult and complex, because of many factors which exert pressures on decision making and increasingly becoming problematic to organizations operating in complex construction environment. These factors include: Changes in government policy, privatization, increasing complex business environment, increasing competition from both home and abroad, more complex business structures, changing markets, complex information need, changing customer expectation, increased risk and uncertainty, larger error costs, and reduced reaction time (Edounand Mbohwa, 2016).

2.3. Some related previous empirical studies

Anene and Oyelere (2014) evaluated the Applications of Quantitative Techniques(QTs) to Production Planning and Control as well as the factors that affect applications of Quantitative Techniques (QTs) to production planning and control in selected Nigerian manufacturing industries. Data were collected using questionnaire administered on 160 staff of 20 companies randomly chosen from each of the 8 purposively selected Small-Scale Industries. Analysis of data done descriptively and quantitatively showed that, the types of QTs commonly in use include: Control Charts, Graphical and Charting Techniques, Forecasting Techniques (Simple Regression and Time Series Analyses), Inventory Model, Range, Variance and Standard Deviation, Capacity Utilization Model, and Acceptance Sampling. Control Charts topped the list. The study concluded that certain QTs are being applied to production planning and control by a significant number of companies from the selected Nigerian small-scale industries. Lack of adequate financial resources was the most important of all the assessed factors. The emphasis of the study was on small scale manufacturing industries, with consideration on very few influencing factors.

Onukwuli, Onwuka and Nwagbala (2014) examined the application of quantitative techniques in small scale business management in Anambra State, Nigeria. The study used a sample of 225 managers of small scale business determined at 5% level of significance for sample error, using Eastman Kodak's sample size for inventory formula, selected from a population of 12,627 managers using stratified random sampling method for the purpose of questionnaire administration. Data analysed using quantitative techniques, reveal that there is no significant variation between the impact of information communication technology and the use of quantitative techniques in small scale business in Anambra State, Nigeria. The result also revealed that there is no significant variation between business decision areas and quantitative techniques application. Such business decision areas include; production, marketing, advertising, packaging and finance. The study recommended that subjective approach be avoided as much as possible especially where records are available and called for government intervention in making quantitative techniques a compulsory subject in schools for sustainable development since quantitative techniques is used to quantify variables in any discipline. The study however, focused on small scale business management in Anambra state, without also investigating the factors influencing the application of the quantitative techniques.

Chukwudozie (2014) carried out an empirically, analysis from results of 160 randomly chosen companies from eight purposively selected Nigerian small-scale industries to examine whether, Qualitative Techniques are applied by the studied companies and the actual number of these companies that apply Qualitative Techniques, as well as factors inhibiting the use of Qualitative Techniques. A wide range of 11 Qualitative Techniques

(QTs) tools were found to be applicable to Production Planning and Control with 35(23.2%) of the companies actually applying QTs, while three factors were found as inhibiting factors. The study is similar to this study, except that it was not based on the perceptions of various categories of construction managers, the focus of the study area is different, and while very few factors were considered.

Esan, Akanbi, Esan, Fajobi and Ikenebomeh (2016) compared the applicability of quantitative techniques and its relevance in decision making by clinical and non-clinical healthcare managers and administrators. A comparative cross-sectional study in design conducted at the Obafemi Awolowo University Teaching Hospital, Ile-Ife amongst 52 clinical and 50 non-clinically related healthcare managers and administrators. Data were collected using semi-structured self-administered questionnaire and analysed using descriptive and inferential statistics. The result shows that a higher proportion of the non-clinical healthcare managers and administrators were familiar and had used more quantitative techniques than their clinical counterparts. There was no statistically significant difference in the respondents' perceived effectiveness of the current methods guiding decision making, while statistically significant difference was found in the methods preferred by both study populations. The study concluded that approach to decision making in the Nigerian health sector is still largely experiential and more of a personalised bargaining process. Thus, recommended the application of the relevance of quantitative techniques by clinical and non-clinically related health managers and administrators improved health service delivery and health outcomes. This study was found to be limited to the perception of managers in the health sector, as well not considering influencing factors.

3. METHODOLOGY

This study is a cross-sectional survey study with quantitative approach. The population consists of Quantity Surveyors, Architects, Builders and Engineers who practice as construction project managers (Ameh & Odusami, 2014) in Akwa Ibom State. Data were collected using questionnaire administered on 150 staff, consisting of six managers chosen from each of the25 purposively selected construction companies operating within Akwa Ibom state. The six managers comprised one top manager, two middle managers and three supervisory managers from each company. The choice of project managers as respondents is due to the observation that they are the decision-makers involved at various stages of construction management (Barougha, Shoubia and Skardi, 2012; Edoun and Mbohwa,2016). The managers are usually fewer at the top and more at the lower level with varying degrees of tasks (Tyrańska, 2016). This study identified Twenty-one quantitative techniques and nineteen factors inhibiting the application of quantitative methods inthe study area. The managers were then requested to evaluate the extent of application of the identified quantitative techniques as well as the factors militating against the use of the techniques. The measurements were on a five point Likert-scale namely: poorly used=1, low used=2, moderately used=3, highly used =4 and very highly used=5. The relative Usage index (RUI) method was used, similar to the formula used by Ugwu and Haupt (2007) and Enshassi, Mohamed and Abushaban (2009) as shown in equation 1:

$$RUI = \sum \frac{TWV}{A} x\ N \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots..(1)$$

TWV is defined as the summation of the products of the number of responses for the rating of each variable and the respective weight value for each rating. 'A' represents maximum weight = 5; 'N' represents the total respondents.

A cut-off score of RUI computed was determined by summing the weights and dividing by the total number of weighting items and highest weight respectively: (1+2+3+4+5)/5/5 = 0.60. Thus, 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 0.60 representing above average, since there is no specific threshold of a RUI similar to RII (relative Importance Index) available in the literature as authors use threshold of 0.6 or 0.7, while others select the top 5 or top 10 variables for explanation (Alashwal and Al-Sabahi, 2018). The variation in the application of quantitative techniques and the influencing factors were analysed using Kruskal Wallis tests.

4. RESULTS, ANALYSIS AND DISCUSSION OF FINDINGS

The result arising from the data analysis and the discussion of finding are presented in this section.

Table 1: Descriptive results of construction managers Features

Features	**Sub features**		
		N	**%**
Category of Manager	Top Managers	25	16.7
	Middle Managers	50	33.3
	Supervisory Managers	75	50.0
	Total	150	100
	Builders	28	18.7
Professional Affiliation	Architects	48	32.0
	Engineers	45	30.0
	Quantity Surveyors	28	19.3
	Total	150	100
	1-17yrs	0	0
Age	18-60yrs	112	75
	>60yrs	38	25
	Total	150	100
Senatorial District	Uyo	61	40.7
	Eket	40	26.7
	IkotEkpene	49	32.6
	Total	150	100
	OND	6	4.0
	HND	21	14.0
Qualification	B.Sc	74	49.3
	M.Sc	48	32.0
	P.hD	01	0.7
	Total	150	100
	1-5yrs	04	2.7
Experience	6-10yrs	12	8.0
	11-15yrs	74	49.3
	16-20yrs	40	26.7
	>20yrs	20	13.3
	Total	150	100

4.1. Characteristics of respondents used for the study

For the purpose of comprehending the characteristics of the people whose perceptions were investigated, the managerial level, professional affiliation, age, senatorial district of operation, qualification and experience of the respondents were evaluated and the result presented on Table 1. The result shows that the managers were fairly spread according to their presence in companies, the professional affiliation and the three senatorial districts in Akwa Ibom state. Majority of the respondents equally have the basic qualification and experience expected of construction managers. Hence, the results generally imply that the selected respondents have the required features to provide reliable information for this study.

4.2. Utilisation of quantitative techniques by construction managers

To achieve the first objective of this study, twenty-one identified methods were presented to the categories of managers for evaluation, with the expectation that the various categories of managers should be knowledgeable in these techniques for adequate application in all aspects of production planning and control (Djordjević, Lepojević and Janković-Milić, 2008). The result of this evaluation presented in Table 2 shows that the supervisory managers utilize 28.57% of the quantitative methods identified, the middle level managers utilize 33.33% of the quantitative techniques, while the top level managers utilize 42.86% of the quantitative techniques identified.

Table 2: Application of quantitative techniques in decision making among categories of construction managers in Akwa Ibom State

Quantitative techniques for decision making	**Supervisory managers, N=75**			**Middle managers N=50**			**Top managers N=25**		
	RII	**Rank**	**Rmk**	**RII**	**Rank**	**Rmk**	**RII**	**Rank**	**Rmk**
Critical Path Method	0.62	4	UD	0.66	1	UD	0.73	1	UD
Programme Evaluation & Review Technique	0.64	3	UD	0.63	5	UD	0.71	2	UD
Break-Even Analysis	0.65	2	UD	0.65	2	UD	0.68	3	UD
Regression Analysis	0.50	16	LUD	0.61	7	UD	0.67	4	UD
Probability decision theory	0.56	9	LUD	0.64	4	UD	0.66	5	UD
Probability & Probability Distributions	0.57	8	LUD	0.57	10	LUD	0.65	6	UD
Forecasting	0.60	5	UD	0.65	2	UD	0.64	7	UD
Time Series Analysis	0.44	19	LUD	0.59	8	LUD	0.63	8	UD
Inventory Models	0.66	1	UD	0.63	5	IP	0.61	9	UD
Multi-Criteria Decision Making	0.58	7	LUD	0.44	18	LUD	0.58	10	LUD
Goal Programing	0.59	6	LUD	0.55	12	LUD	0.57	11	LUD
Linear Programing	0.55	10	LUD	0.53	14	LUD	0.56	12	LUD
Assignment model	0.60	5	UD	0.52	16	LUD	0.54	13	LUD
Transportation Models	0.54	12	LUD	0.56	11	LUD	0.53	14	LUD
Markov Processes	0.53	13	LUD	0.53	14	LUD	0.52	15	LUD
Simulation	0.55	10	LUD	0.58	9	LUD	0.51	16	LUD
Integer Programing	0.52	14	LUD	0.55	12	LUD	0.50	17	LUD
Nonlinear Programing	0.50	16	LUD	0.45	17	LUD	0.49	18	LUD
Dynamic Programing	0.52	14	LUD	0.44	18	LUD	0.47	19	LUD
Queuing model	0.40	20	LUD	0.36	20	LUD	0.44	20	LUD
Game Theory	0.28	21	LUD	0.32	21	LUD	0.40	21	LUD

RUI= relative usage Index; Rmk= Remark; UD= Used; LSD= Less Used

The result shows that the supervisory managers utilize such techniques as; Inventory Models, Break-Even Analysis, Programme Evaluation & Review Technique, Critical Path Method, Forecasting and assignment models. The middle managers mostly use; Critical Path Method, Break-Even Analysis, forecasting, probability decision theory, Programme Evaluation & Review Technique, Inventory Models and regression analysis. The top managers mostly utilise, Critical Path Method, Programme Evaluation & Review Technique, Break-Even Analysis, Regression Analysis, Probability decision theory, Probability & Probability Distributions, Forecasting, Time Series Analysis and Inventory Models. These results generally indicate inadequate utilization, as not up to 50% of the identified quantitative methods are utilized by the construction managers. This study supports the findings by Chukwudozie (2014), and Onukwuli, Onwuka and Nwagbala (2014), that the application of a wide range of quantitative techniques in production planning and control activities for optimal utilisation of resources in Nigeria has not attained the desired level, as obtainable in most developed countries. The implication of the result is that inadequate utilization of appropriate decision technique may affect the course of building works as well as the final shape of an edifice or a structure, while consequences of the decisions will often be felt in many years to come, when the erected construction is being used as noted by Szafranko (2017).

4.3. Comparison of level of utilisation of quantitative techniques by construction managers

In order to ascertain if there exists statistically significant variation in the level of utilisation of quantitative techniques among the categories of construction managers, and that the variation does not occur by chance, the first hypothesis was postulated as earlier stated. The hypothesis was tested with Kruskal Wallis test at $p \leq 0.05$. The decision rule is that if p-value > 0.05, the hypothesis is accepted, but if p-value ≤ 0.05 the hypothesis is rejected. The results presented on Table 3 show that the p-value for the first hypothesis is 0.603, which is more than the significance level of 0.05, thus the null hypotheses was accepted, indicating that there is no significant variation in the level of quantitative technique utilisation by the project managers.

Table 3: Results of Kruskal-Wallis test for comparison extent of use of quantitative techniques by construction managers

Items compared	**Extent of use of quantitative techniques by construction manager**
No of variables (N)	21
Supervisory Managers	29.67
Middle level managers	31.17
Top level managers	35.17
Chi-Square	1.012
P-value	0.495
Significance level	0.603
Decision	Accept

This lack of difference in the level of utilization of the identified quantitative techniques may be attributable to the general low level of application among all the managers resulting from unawareness and lack of qualified manpower (Chukwudozie, 2014). The implication of this is that the top, middle and supervisory managers may be making similar decisional

errors, which will increase cost, hamper deployment of resources and minimization the time required for completing tasks against the observation of Verma and Sharma (2017).

4.4. Factors inhibiting the application of quantitative methods in construction management

Having established a low level application of quantitative techniques by the construction managers, the second objective sort to assess the possible factors that inhibit the application of the quantitative methods in construction management decision. Hence, nineteen factors were identified from literature and presented to the three categories of managers for evaluation. The expectation is that, since, the managers operate at different levels and different tasks, the application of the techniques may be differently influence by the identified factors. The result is presented in Table 4.

Table 4: Factors inhibiting the application of quantitative methods in construction management decisions.

	Supervisory manager N=75			**Middle managers N=50**			**Top managers N=25**		
Factors inhibiting application of QT	**TWV**	**RII**	**Rank**	**TWV**	**RII**	**Rank**	**TWV**	**RII**	**Rank**
Data unavailability	300	0.80	3	200	0.80	2	109	0.87	1
Inadequate training curriculum	248	0.66	12	195	0.78	3	105	0.84	2
Inadequate skills & Knowledge	311	0.83	2	205	0.82	1	103	0.82	3
Poor awareness	323	0.86	1	193	0.77	4	99	0.79	4
Lack of financial resources	293	0.78	5	173	0.69	7	98	0.78	5
Complex information need	206	0.55	17	168	0.67	10	94	0.75	6
Sophisticated information technology & equipment required	296	0.79	4	178	0.71	6	89	0.71	7
Unfavourable organisational policies	270	0.72	9	170	0.68	8	88	0.70	8
Increasing complex business setting	233	0.62	14	160	0.64	11	86	0.69	9
more complex business structures	293	0.78	5	180	0.72	5	85	0.68	10
Changing markets,	214	0.57	16	148	0.59	16	83	0.66	11
Increased risk and uncertainty	225	0.60	15	170	0.68	8	81	0.65	12
larger error costs,	240	0.64	13	158	0.63	12	80	0.64	13
Parameter selection	278	0.74	8	143	0.57	17	76	0.61	14
Parameter estimation	293	0.78	5	155	0.62	13	75	0.60	15
Limited decision time	255	0.68	11	153	0.61	14	71	0.57	16
Changing customer expectation,	263	0.70	10	150	0.60	15	68	0.54	17
Increasing competition from both home and abroad	199	0.53	18	130	0.52	19	64	0.51	18
Changes in government policy,	191	0.51	19	138	0.55	18	59	0.47	19

The results in Table 4 show that only 21.1% of the factors identified were perceived not to have significant influence on the utilization of the quantitative methods by all the levels of construction managers, while 78.9% of the factors were perceived to have significant influence. The supervisory managers perceived that poor awareness, inadequate skills & knowledge, data unavailability and sophisticated information technology & equipment requirement have most significant influence on their adoption. The middle level managers perceived that, inadequate skills & knowledge, data unavailability, inadequate training curriculum, and poor awareness have most significant influence on their adoption. The top level managers on the other hand perceived that, data unavailability, inadequate training curriculum, inadequate skills & knowledge and poor awareness are the most significant

factors influencing the adoption of the quantitative techniques. The results generally indicate that adoption of quantitative techniques are seriously plagued by many factors. The significance attached to, poor awareness by the supervisory managers may not be unconnected to their lower educational level and experience. The middle managers attached the most significance to, inadequate skills & knowledge this may be attributed to inadequate training and experience. The top and middle managers rated data unavailability and inadequate training curriculum very high, this may be attributable to poor data management by many companies, as well as inadequate course content to guide the teaching of these subjects in institutions.

The findings of this study is somehow similar to those of Chukwudozie (2014) and Anene and Oyelere (2014) by identifying poor awareness and inadequate skills and training, but slightly differs in that it does not see finance as the ultimate factor, instead it sees data unavailability as the greatest challenge. This is noticeable in the study by Oladimeji and Aina (2018), where the research on the financial performance of locally-owned construction firms in south west, Nigeria was limited by paucity of financial data due to poor data storage and management by the firms. Data storage and management is very vital, because quantitative techniques rely on data which have been kept over time. This information is not bought in the market, they must be obtained accurately and preserved for future quantitative use. The management of this data and application of the techniques also require some level of training and knowledge which is lacking in most organization possibly due to unfavourable organizational policies. The implication of this result is that if organization do not bring up policies that support the development of data bank, provide adequate training and experience, before looking at other factors, then construction managers will continue to make intuitive decision which are not scientific and this may spell doom for construction firms.

4.5. Comparison of factors inhibiting application of quantitative techniques

The second hypothesis was postulated to establish if there exists statistically significant variation in the factors influencing the utilisation of quantitative techniques among the categories of construction managers, and that the variation does not occur by chance. The second hypothesis was tested in similar condition as the first. The results presented on Table 5 show that the p-value for is 0.495, which is more than the significance level of 0.05, thus the null hypotheses was accepted, indicating that there is no significant variation in the perception of factors influencing quantitative technique utilisation by the project managers.

Table 5: Results of Kruskal-Wallis test for comparison of factors inhibiting application of quantitative techniques

Items compared	Extent of use of quantitative techniques by construction manager
No of variables (N)	19
Supervisory Managers	31.13
Middle level managers	26.74
Top level managers	29.13
Chi-Square	0.669
P-value	0.495
Significance level	0.716
Decision	Accept

The similarity in perception of the influence of these factors may be attributable to the common organizational culture and generally poor implementation of relevant management practices by most operators in the construction industry (Osuolale, 2019). The implication of the result of this hypothesis, is that if construction managers do not imbibe enough different decision making techniques, and device varying approaches among the levels of management, the industry will continue to be plagued by poor performance and constraints which may cause undesirable consequences that hinder organizational goals as noted by Iheme and Chiagorom (2018).

5. CONCLUSION AND RECOMMENDATIONS

The study has provided reasonable insight into the existing level of application of different forms of decision making tool, as well as the prioritization the factors militating against the adoption of the techniques with a view to enhancing construction projects delivery in Akwa Ibom state and Nigeria in general.

The study has evaluated identified Twenty-one quantitative techniques and nineteen factors inhibiting the application of quantitative methods in the study area with the perception of respondents who have adequate features to provide reliable information. It was concluded on the whole that there is inadequate utilization of quantitative techniques in decision making among construction managers, as not up to 50% of the identified quantitative methods are utilized by the construction managers. This has the implication of project failure and consequences of the decisions will often be felt even years after the decision had been made. The level of utilization of the identified quantitative techniques was also found not to vary significantly among the levels of management, probably because of the generally low level of application among all the managers resulting from unawareness and lack of qualified manpower.

The study concluded that the adoption of quantitative techniques is seriously plagued by many factors. The significance attached to, poor awareness by the supervisory managers may not be unconnected to their lower educational level and experience. The middle managers attached the most significance to, inadequate skills & knowledge this may be attributed to inadequate training and experience. The top and middle managers rated data unavailability and inadequate training curriculum very high, this may be attributable to poor data management by many companies, as well as inadequate course content to guide the teaching of these subjects in institutions. The implication of this result is that if organization do not bring up policies that support the development of data bank, provide adequate training and experience, before looking at other factors, then construction managers will continue to make intuitive decision which are not scientific and have grievous consequences on the overall goals of organisations. The perceptions of the influence of these factors were found to be similar probably due the common organizational culture and generally poor implementation of relevant management practices by most operators in the construction industry. The concludes the if construction managers do not imbibe enough different decision making techniques, and device varying approaches among the levels of management, the industry will continue to be plagued by poor performance arising from poor and unscientific decisions.

Arising from these conclusions it is recommended that construction managers should be sensitised and encouraged through favourable organisational polices which support the development of data bank, provision of adequate training and experience. Government

agencies should also ensure that quantitative method curricula adequately cover the required knowledge areas, which should be completely taught by the teachers in charge.

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