INVESTIGATING THE USE OF UNCERTAINTY MANAGEMENT TOOLS AND TECHNIQUES WITHIN THE CONSTRUCTION SECTOR IN NIGERIA

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ABSTRACT

This study investigated the use of uncertainty management tools within the construction sector in Nigeria. The objectives were to evaluate the level of use of uncertainty management tools and techniques and to determine the factors responsible for the low knowledge and misconception of uncertainty within the construction sector. Views from project managers obtained from two sub-sectors, the real estate and the oil and gas was evaluated. Finding of the study revealed low level of use of uncertainty management tools and techniques due to the lack of clear understanding of uncertainty and its management parameters. Further finding identifies the type of project management practice in use, and over reliance on the use of deterministic approach as factors responsible for the low knowledge of uncertainties. The challenge therefore is how to improve the state of misconception among practitioners and to explore refinements to the traditional project management framework. To develop appropriate knowledge about uncertainty management, the notion that uncertainty management is about creating previously unknown information, must be repealed to embrace approaches encouraging information sharing, learning, and competence. The study provides an insightful perspective into understanding uncertainty in projects;and highlight possible refinements to extant project management practice in order to enhance uncertainty management within the construction sector.

Keywords:

construction Sector, Nigeria, risk, uncertainty, and uncertainty management tools

1.INTRODUCTION

One of the distinguishing feature that stand out the manufacturing sector, and set it as a model for adoption within the construction industry, is an understanding of its system. Every operational activity consists of three routines: processes; repetitive works; and projects. Although construction products are mainly one-off projects, there is sometimes an aspect of repetitive works. However, the introduction of the manufacturing technologies has not shifted the emphatic characteristic of the construction sector entirely, there are yet residual collocation prompted by inherent culturalpractice. The drive towards attaining competitive advantage means constant innovation; better briefing processes and improvement in the use of information technologies; better understanding and customisation of client needs; and the quest towards internalisation also require more dexterity. Customer orientation and continuous improvement are also identified in [20]. In all spheres, constant changes in the procurement and delivery perspectives of constructions projects create the need to manage change. Evolved procurement and construction approaches infuse complexity to the routinely traditional management systems notably in developing countries[7], where advance project management expertise is dearth.

Although, complexity is not the goal of this research, the research context need be x-rayed using complexity dynamics. Complexity naturally triggers uncertainty within a system and according to Meyer, Loch & Pich [13]; early project management practices and tools were developed to manage complexity. Stewart [25] in [28] identified two level of complexity: algorithmic and organisational, but mechanics of organisational complexity is explored in this study. According to Wood, Piroozfar, & Farr[29] organisational complexity refers to the behaviour of a system and its analysis. Complex systems within the construction industry are evolving e.g. procurement approaches such as concession and purchase of service. At this level, two major complexities can be established namely: task and relational complexity [26]. Task complexity is the number of interacting components within a system[30]. Relational complexity results from the management of relationship involving multiple stakeholders in the project with differing interest. The congruence of conflicting objective in a single contract can generate incongruity in respect of project objectives. At this point, the system dynamics degenerates into uncertainty. Uncertainty has been related to events that impedes the realisation of expected project outcome [20].

The concept of uncertainty has never been abandoned within the project management body of knowledge [13], neither is it relatively recent. A study by Sarden and Engstrom[23] on uncertainty in traditional constructions identified three major sources of uncertainty. According to Sarden and Engstrom, there are uncertainties originating from the sector a project emerges (sector uncertainties); organisation uncertainties (corporate uncertainties) and project uncertainties. Tools such as network analysis, and its probabilistic sub-sets and other qualitative approaches were designed to facilitate the management of uncertainty in projects in the 1950s and 1960s. Contract formalisation and conflict management are also available for resolving issues linked with relational complexity now days. These are however management flexibility promoters requisite for prompting quick alternate activities in managing scenarios uncertainty [13]. The use of these tools are wide spread across Europe, UK and America [13], but the level of embedding and use in developing countries remains vastly unexplored. The trend subsists despite the increasing scope of complexity in the industry resulting from the changes forced on the system by scarce resources and globalisation [6]. Although uncertainty cannot be eliminated completely, it is believed, reflective learning and information exchange makes it adaptable by minimising it meaningfully [20]. The challenge before this study and the aim of this study is to explore mechanisms for embedding intuitive reflective understanding of uncertainty and its management tools in the construction industry in Nigeria. According to Perminova, Gustafsson, & Wikstrom[20], failure to recognise uncertainty is a neglect of evolution, and evolution is a clear way of improving project performance. Project uncertainty management has also establishedan appropriate framework for treating risk as uncertainty [4] but extant practice develop towards traditional practices. The traditional practice lack reflective understanding of uncertaintyand this has been blamed on the lack of sufficient tool to manage them [20].

To improve reflective understanding of uncertainty in the construction project delivery process, this study evaluates uncertainty management within the construction sector in Nigeria. The objective is to evaluate the level of use of uncertainty management tools and techniques and to determine factors associated with misconception of uncertainty within the construction sector in Nigeria.

1.1 Theoretical Framework

Two fundamental Economic thoughtsunderpin the basic distinction between risk and uncertainty, notably the works of Frank Knight, ‘Risk, Uncertainty and Profit’ [10] and Keynes [16]. According to Frank Knight, ‘risks are events subject to known and knowable probability, whereas

uncertainty refers to events for which it is impossible to specify numerical likelihoods'. These views may not have escaped unscathed by academic debates,these debates shape the fundamental, upon which literature that attempt distinguishing both terms are based. Keynes' view also explained uncertainty by the inability to assign 'definite probability but however percept uncertainty as a system dynamics that cannot be separated. Accordingly, when the project manager is unable to calculate risk, uncertainty eschews. Perminova, Gustafsson, & Wikstrom[20]embed the term uncertainty in the theory of psychology when they described it as a 'state of mind characterised by a conscious lack of knowledge about the outcomes of an event'. The viewpoints from the various school of thought explored above portrays two imminent sources of uncertainty in project delivery. The external environment is strongly conveyed in Frank Knight and Keynes' assertions, the psychological school bring to bear internal factors that create uncertainty in a system. Accordingly, there is an uncertainty in the mind of he who doubts [16].

To define context with realities obtainable in practice, 'uncertainty as a contextualised risks are events having a negative impact on the project's outcomes, or opportunities, as events that have beneficial impact on project performance' [20]. This definition does not only identify both positive and negative perspectives to uncertainty but also reinforced the level of embedding of risk within uncertainty. Within this established framework, risk management, create previously unknown data [20]. It does not however, suggests that, uncertainty can be managed in the same way as risk. The traditional project management inputs are planning, monitoring and control, and in the traditional risk management, this translates into risk analysis, mitigation and control [15]. The impropriety of risk management tools in curbing uncertainty stems from the extended ambient that identifies opportunity in uncertainty. Uncertainty management practice should therefore, pictures the project life cycle. This view is without prejudice to others which sees risk management as a life cycle process ([21]; [30]). Perminova, Gustafsson, & Wikstrom[20] contends that even when risk is regarded as life cycle process, in practice, its forecasting procedures are not repeated through at the various stages of the project development. Furthermore, control depend on historical cost data, and the implication is that, the source of uncertainty had already taken place and not futuristic.

The theoretical perspective explored in the foregoing section established the need for a careful examination of uncertainty management practices of construction industry practitioners. It portends that a careful and an effective management of uncertainty can engender positive improvement or refinements to the realisation of the project objectives than inherent viewpoints that sees uncertainty as entropy to the project management system.

1.2 Types of Uncertainty and their Management Tools

Various attributes characterise project uncertainty, and these features are used in categorising uncertainty in management research. Schrader, Riggs & Smith [25] identified uncertainty in the perspective of technology and marketing scenery, Steward [24]provides generalised attributes and differentiated between uncertainty impact parameter when the relationship are known, only the values are unknown, and ambiguity. In ambiguity, both the parameter and purposeful affiliation are unknown. Building on these classifications, Meyer, Loch & Pich [13] profiled four types of uncertainty: variation; foreseen uncertainty; unforeseen uncertainty; and chaos and turbulence.

Variation is a common source of uncertainty in project outcome. The implication is that the characteristics of the project are known from the outset, planned and coordinated, but schedules and budget exhibit variability around forecasted values. To guide against variability in cost, schedule and other performance objectives, contingencies and buffers are built into the budget

estimates and timescale [11]. Statistical process control charts, earned value management (EVM), and linear responsibility chart are increasingly used in managing variation associated uncertainty.

Foreseen uncertainties are recognised, but unpredicted, impact in a project [13]. While variation may predispose the project manager to prescribe a range of event that may influence a project, foreseen uncertainty is simply a recognisable event with single effect on the project plan. Unlike variation, in which a single course of action can proffer solution, foreseen uncertainties may necessitate 'contingent paths' in the project plan. Foreseen uncertainty can be managed using decision trees diagram. The key improvement in this technique is; it may prompt the project manager to consider the implication of early decisions on later risks. Similarly, the branches of the tree can create a different decision taking. The use of decision tree enhances the exploration of preferences inherent in the branches, however working out these preferences is not easy to implement.

Unforeseen uncertainty is unexpected during the project planning stage of the project development. Because these uncertainties are unanticipated, the project managers do not have predetermined response to the events. This state of indecision is lassie faire and emerges from two fronts: either the events are entirely unforeseen or the likelihood of occurrence is negligibly low to be prioritised. The common pragmatic approach is to transform the uncertain events to foreseen. The transformation process however requires a great deal of effort and investment. As a result, contingency planning is made very difficult due to inability to predict outcomes and impact of branches in the decision tree. In the context of unforeseen uncertainty, the decision evolves as the project progresses from one phase to another. The management of unforeseen uncertainty is therefore iterative. Information, learning and knowledge sharing is critical at this point. This can be achieved by constantly adding branches as information emerges, courses of action identified in sufficient to the branches.

Chaos or turbulence refers to uncertainty that threatens the fundamental framework of the project management plans. Turbulence is imminent in innovative projects where theoretical insight is lacking. In this scenario, the formulation of organisational policy is itself uncertain and incomprehensive. The essential management perspective is flexibility and review of feedback. This is because, a fundamental change cannot be treated as a branch in the decision tree analysis, and rather, it requires a definite re-conceptualisation of the project. No specific approach might be suitable but a combination of alternates tool simultaneously may suffice. Similarly, the team approach advocated in the previous section may not suffice in turbulent environment; rather autonomy of the project team is essential. Meyer, Loch & Pich [13] advocated the autonomy of an entrepreneur. However, there is need to observe restraint in order to balance the organisation's philosophy in cutting excesses when the probability of success significantly become too small. Meyer, Loch & Pich [13] therefore recommends collaborative management framework. The success of this approach to a large extent depends on long term relationship of trust. The state of trust embedding in projectdelivery is subjective and the extent in which project participants are willing to collaborate is marred with differing outcome (Wood, 2005).

1.3 Uncertainty Management

The traditional project management inputs are planning, monitoring and control.In traditional risk management, these inputs translate into risk analysis, mitigation and control (Nikanda & Eloranta, 1997). While these tools have helped in solving problems encountered in every day project, they can also curb the management of foreseeable uncertainty (Meyer, Loch & Pich, 2002). There are however, advanced levels of uncertainties which are unforeseeable. The management of uncertainty at this level therefore, requires another level of management. The

impropriety of traditional risk management tools in curbing advanced level of uncertainty emanates from the extended perspective that identifies opportunity in uncertainty.

To provide an understanding into uncertainty management, first, the notion that risk management is about creating previously unknown information must be repealed to embrace contemporary practice, which is, as encompassing information sharing, learning, knowledge and competence. Second, there is the need to start a project by understanding the context and the profile of inherent uncertainties in the project system. This dimension was identified by McFarlan (Portfolio Approach to Information Systems) in asserting that the effectiveness of project management tool dependent significantly on the attributes of the project). Third, it is not in every situation, external and internal to the project that can influence project outcome, thereby constituting a source of uncertainty. Continuous reflective learning and information sharing underpins two critical parameters that can be explored in managing uncertainty [21].

Contributing to the search towards uncertainty management practice, Meyer, Loch & Pich [13] argued that an understanding of the type of uncertainty determines the management approach. They identified three elements guiding the selection of an approach to be adopted namely: project management style, task management, and relationship management. These elements have been considered under the type of uncertainty literature. Meyer, Loch & Pich [13] therefore proposes three steps 'road map' to uncertain management: project diagnosis; organisational phase; and an assignment phase. Project diagnosis evaluates the uncertainty profile of the project. Traditionally, projects began with the identification of task, contemporary practice emphasises uncertainty determination, and therefore sees task as secondary[11]. The first step towards managing uncertainty profiling is designing lists of various potential sources, and assessing and screening them into variation (common cause uncertainty), foreseen uncertainty (transferable source turbulences), unforeseen uncertainty (unexpected sources of opportunities, and turbulence (building a project on falsehood), and scoring both their likelihood of occurrence and the degree of impact.

The second task is to develop the project implementation infrastructure. The project implementation infrastructure is the planning systems, the coordination of and incentives and tracking [13]. Planning is the heart of project management, even without uncertainty in project, project still present a level of challenges ([12]). Appropriate determination of buffer and contingency could suffice for variation, but foreseen uncertainty requires flexibility while unforeseen uncertainty, dynamic flexibility. This requires the additional capability to work out responses to abrupt occurrences at every level. The last, turbulence needs prompt turnaround ability and on the spot decision making.

1.4 Research Methodology

The study is both descriptive and inferential research involving questionnaire survey. The core construction industry practitioners (architects, builders, engineers and quantity surveyors and others) who practice as project managers and construction managersin varying organisations were targeted in the study. Owing to the large size of the population, it is impracticable to investigate all its members. The study's sample was first identified in two sectors, real estate and oil and gas. The real estate practitioners are those in general construction practice, building and civil engineering. Two sampling techniques stratified random and the snowballingwas used. The stratified random sampling was used to sample professionals with practice inscription 'A & B partnership, quantity surveyors& project managers'. Lists of registered professional practices were obtained from the respective professional bodies. 105 professionals are listed with the respective professional bodies of Architects, Builders,Quantity Surveyors and Engineering in the

study area but 28 do not practice with the inscription and they were not considered for the study. Also, as a result of the lack of an appropriate database of respective professionals in the oil and gas sector, currently working in the various oil fields at the time of study, the size of the population in the sector could not be obtained due to varying degree of platforms. Thus, snowballing technique was employed in identifying 28 professionals to participate in the study. A total of 105 sample respondents were randomly sampled.

The study was conducted in Akwa Ibom State, Nigeria. The State is situated in the Niger Delta region of Nigeria, an oil rich region with very high content of indigenous and foreign nationals in the real estate and oil and gas sectors. The study was conducted in three locations namely: Uyo the state capital; Eket; and Oron. The state was selected for the study due to its shifting chaotic environment that significantly influences the delivery of construction projects.

The questionnaire consists of two parts, A and B. Part A elicited background information of the study's participants, and level of understanding of the term uncertainty.This section consists of seven questions. Questions 1-3 elicit respondents' on the nature of practice, academic qualification and years of experience; 4-7 address the level of understanding of the term uncertainty. Part B collected data on the specific objectives of the study that is;factors associated with misconception of the term uncertainty and level of use of uncertainty management tools. Sixteen uncertainty management tools ranging from variation and foreseen uncertainty management to the advance relationship and experimentation based tools were presented; as well as seven factors that could be responsible to the misconception of uncertainty generated individually and collectively form the literature. Piloting involving 4 participants was carried out and feedbacks obtained deployed in refining the questionnaire. A 5-points Likert scale (where 5=very high to 1=very low) was used to rank the level of use and the factors associated with uncertainty misconception. Because no previous study had aggregated these tools for a study, it became pertinent to carry out reliability and validity test. Reliability measures the stability in instrument while validity measures the extent in which instrument capture the hemisphere of the subject matter ([2]). Alpha Cronbach reliability test was conducted. Alpha-Cronbach is valid at 0.7 and above and where the number of items in the scale is less than 10, it tends to yield low value. Correction using inter-item correlation was applied. The applied correction yielded a high Cronbach's value of .85.

Data for the study were processed and analysed with the aid of Statistical Packages for Social Science (SPSS). The mean item score and percentages were used in analysing collected data and the test of hypothesis involved t-test and Homogeneity test.Rating scores provided by the respondents were aggregated in data analysis package and their means calculated that is, (1n + 2n + 3n + 4n +5n/N); where n is number of respondent rating 1-5, and N is total number of respondents. The factor or tool with the highest score is assigned the highest rank in no specific order.

1.5 Results

The focal objectives of the study were to evaluate the level of use of uncertainty management tools and techniques; and to determine problems associated with the low knowledge and misconception of uncertainty within the construction sector. The result of the study is presented in the following sections.

First the study evaluates the respondents' characteristics. The study focused mainly on professionals with strong construction project management background. In Table 1, 76% of the respondents are current industry practitioners in the real estate sector while 24% are practitioners in the oil and gas sector. The blend of their various perceptions about the subject of uncertainty

helps in determining the root cause of the misconception surrounding the term uncertainty. Similarly, 61% are holders of first and second degree in their respective fields and construction project management, while only 14% are first degree holders. One quarter of the sampled population are PhD holders in the related fields. 41% also have less than 10 and 20 years working experience respectively and 18% had been practising for over 20 years.

Table 1: Respondents Characteristics

Respondents' Practices	Number	Percentage
Quantity Surveyors & Project Managers	6	18.00
Builders & Project Managers	2	6.00
Engineers & Project Managers	2	6.00
Architects & Project Managers	5	15.00
Builders & Construction Managers	4	13.00
Engineers & Construction Managers	6	18.00
Architects & Construction Managers	2	6.00
Members of the Academics	7	24.00
Total	**32**	**100.00**
Respondents Academic Qualifications		
BSc Building & MSc Construction Project Management	6	18.00
BSc Quantity Surveying & Construction Project Management	6	18.00
BSc Engineering & MSc Construction Project Management	8	25.00
BSc Building, Architecture, Quantity Surveying & Engineering	4	14.00
BSc/MSc/PhD	8	25.00
Total	**32**	**100**
Years of Experience		
0-5 years	8	25.00
5-10 years	5	16.00
10-15 years	5	16.00
15-20 years	8	25.00
Above 20 years	6	18.00
Total	**32**	**100.00**

An industry wide perceptions and understanding of the term is presented in Table 2. The term uncertainty is widely misconstrued by many to be synonymous with risk in practice. The result of the survey witnessed three quarter of the study's sample aligning concordance with this misconception. However, one quarter differs with this widely held misconception by agreeing both terms are not synonymous. Similar understanding was sought to know whether in practice, risk and uncertainty could imply the same thing. Half of the study's population maintained earlier position by agreeing they convey same meaning. One quarter of the study still differ in their opinion,and maintainedan earlier position that, they are actuallydifferent. 32% are however indifferent. This neutral position could be explainedas the lack of proper understanding about what the term mean.Again, the understanding of the term uncertainty cannot create or eliminate it. The opinion of respondents in this question is disperse with 82% agreeing, it create, eliminate and not create, and not eliminate uncertainty in projects. But 18% are again indifferent, and the implication portrays a balance perspective to the true state of inherency of uncertainty in every projects. A proper understanding of the term means ability to successfully manage them and improve project performance. This is the view of over 90% of the study's sample; negligible 6% however still doubt this possibility.

Table 2: Basic Understanding of the term Uncertainty

Is the term uncertainty synonymous with risk conceptually?		
Yes	24	75.00
No	8	25.00
Total	**32**	**100.00**
In practice can they mean the same thing?		
Yes	16	50.00
No	6	19.00
Indifferent	10	31.00
Total	**32**	**100**
Do you think managers idiosyncrasies (attitude and understanding) of uncertainty can create or eliminate it?		
Yes it can eliminate	8	25.00
Yes it can create	5	16.00
No it cannot create	5	16.00
No it cannot eliminate	8	25.00
Indifferent	6	18.00
Total	**32**	**100.00**
Would proper understanding of the term facilitate your understanding in sense making by seeking alternative management tool for uncertainty?		
Yes	30	94.00
No	2	6.00
Total	**32**	**100**

1.6 Problems Associated with the Low Knowledge and Misconception of Uncertainty

In this section (Table 3),the rating opinion of the perceived factors associated with misconception of uncertainty is presented. Seven factors rated by respondents yielded mean score between 2.76 and 3.76 (Table 3).The most significant problem underpinning the misconception of uncertainty within the construction sector is the project management practice in use. The construction industry in Nigeria is bedevilled with traditional project management practice. In this practice, the architect led other project team, the expertise and management know-howof the project leader in this practice have been widely questioned. This result in risks and uncertainty being enveloped together and contingency assigned. There is also a significant lack of awareness on uncertainty management tools in the construction sector. This is the second most significant problem influencing misconception of uncertainty. The traditional project management simply employs basic risk management inputs, and the propriety of these tools was earlier argued against in the foregoing literature review section. There is also a general lack of requisite project management skills; (3^{rd}) most significant problem. Others are the use of deterministic approach, (4^{th}); lackof perceptual skills to evaluate information emanating from different spheres of the project, (5^{th}).

Table 3: Problems Associated with low Knowledge and Misconception of Uncertainty

Problems	**Mean**	**Rank**
Lack of management skills	3.08	3^{rd}

Over reliance historical data and use of deterministic approach	3.06	4th
Type of project management practice in use	3.76	1st
Lack of intuitive judgement to evaluate information emerging from various sphere of project (within and outside project organisations)	3.00	5th
Project manager personality profiles	2.76	7th
Project management leadership style	2.86	6th
Lack of awareness on appropriate management tool and techniques	3.09	2nd
The use of rigid contractual form	3.05	5th

1.7 Uncertainty Management Tools and Techniques

In this section of the result presentation, the level of use of different tools and techniques for managing uncertainty were tested. The objective sought to evaluate the level of use of uncertainty management tools and techniques within the construction sector, the results are presented in Table 4. Among the respondents in the oil and gas sector, the extent of knowledge yielded mean score between 2.56 to 3.48. The level of knowledge of the sixteen tools among these respondents is significant and above average. Earned value management is rated first, tree diagram 2nd, flexible contracting 3rd, relationship management 4th Gantt chart 5th. Among the first five tools, only the Gantt chart appears conventional, and others are indeed unheard of. Within this band of tools, estimating using risk analysis is least known and is rated(16th); SCERT[5](Synergistic Contingency Evaluation and ReviewTechniqueVersion 5) (15th), GERT[4](Graphical valuation Review Technique Version 4) (14th); and force field analysis (13th) in descending order.

Among the practitioners in the real estate sector, contingencies planning is rated 1st, critical path 2nd, Gantt chart 3rd, force field analysis 4th, conflict management 5th most familiar tools. Among the first five tools in this category is again, the Gantt chart now 3rd against 5thrated by theoil and gas practitioners' category. This result underscore the wide spread use of the tool in project management. Among the least familiar tools are the tree diagram 16th, estimating using risk analysis 15th, earned value management 14th, SCERT[4] 13th, flexible contracting 12th, and GERT[4]. These results reflect the persistent use of deterministic approaches to uncertainty management.

To determine whether the extent of knowledgeof project/construction managers determines applicability of these tools, Table 4 also presents data on the level of use. The Gantt chart is again very popular and widely used; this tool is rated 1stwith a mean score of 3.16. Critical path is also popular and the 2nd most widely used tool. The Gantt chart and the critical path are complimentary and can be obtained in single application software, Microsoft projects. The complimentary tool to the Gantt, the Bar chart can also be prepared using Microsoft Excel, and these packages are relatively cheap and easy to come by. Contingencies' planning is 3rd most deployed uncertainty management tool. This is a form of the deterministic techniques where pockets of buffers are added to scheduled time and estimated costs to address uncertainty. Force field analysis is also common among the practitioners in Nigeria. This technique mainly used in foreseen and variation uncertainty is traditionally, a risk management tool. It is rated 4th with a mean score of 3.01. Conflict management although not very apparent as a management tool, its applicability should be viewed in the context that conflict is a source of uncertainty. This tool is the 5th most popular tool used in the construction industry. On the down side of the scale are relationship management (16th), this is understandable in the context that, non-relational contracts proliferates the construction industry in Nigeria. Estimating using risk analysis (15th) is a relativistic perspective into uncertainty management. This approach bridges the divide by enabling quantitative profiling of uncertainty and transforming them into risk for appropriate mitigation. SCERT[5](14th) and GERT[5](13th) are relatively unknown statistical uncertainty

management tools. Their application in the Nigerian construction industry for uncertainty management is low.

Table 4: Tools and Techniques for Uncertainty Management

	EoK				LoU	
	Oil & Gas		Real Estate			
Tools & Techniques	**MS**	**Rank**	**MS**	**Rank**	**MS**	**Rank**
Critical Paths	3.01	11th	3.23	2nd	3.10	2nd
Gantt Chart	3.09	5th	3.11	3rd	3.16	1st
Force field analysis	2.86	13th	3.09	4th	3.01	4th
GERT[4]	2.76	14th	2.32	11th	2.00	13th
SCERT[5]	2.56	16th	2.23	13th	1.99	14th
Analysis of problems	2.91	12th	2.45	7th	2.09	12th
Contract formalisation	3.07	6th	2.66	6th	2.56	6th
Conflict management	3.06	7th	2.76	5th	2.66	5th
Statistical control process	3.05	8th	2.34	10th	2.32	8th
EVM	3.48	1st	2.22	14th	2.24	9th
Tree diagram	3.36	2nd	2.18	16th	2.19	11th
Flexible contracting	3.29	3rd	2.30	12th	2.23	10th
Relationship management	3.12	4th	2.41	8th	1.97	16th
Transformation	3.04	9th	2.36	9th	2.33	7th
ERA	2.70	15th	2.21	15th	1.98	15th
Contingencies planning	3.02	10th	3.45	1st	3.09	3rd

EoK = extent of knowledge; LoU = level of use; MS = mean score; EVM = earned value management; estimating using risk analysis

Based on the use of cross sector population, the study sought to establish whether there is a significant difference in the rating opinion of respondents in the oil and gas, and the real estate sectors using an inferential statistics. To determine this relationship, a hypothesis was set up. The hypothesis states that, there is no significant relationship between the level of use in the real estate, and oil and gas sub-sectors of the construction industry. The test of the hypothesis involved Student t-test and Homogeneity test, and is valid at critical p-value ≤ 0.005. The result is presented in Table 5.

The result of the hypothesis reveals no significant relationship in the level of use of the identified uncertainty tools in the real estate and the oil and gas sector (p-values are less than critical $P \leq 0.005$). This result applies despite the significant level of knowledge exhibited by the project managers in the oil and gas sector (Table 4). This assertion is demonstrated in the significant homogeneoustest values of 11.420 and 4.131. But both result are significantly high, the implication signifies similarity in the level of use of uncertainty management by practitioner in both sectors. This is also, an indication of the need for improved awareness and usage in order to improve the management of uncertainty in construction project delivery.

Table 5: Test Statistics Summary

T-test		Homogeneity Test	
p-value	**Sig(2-tailed)**	**Statistics**	**Sig**
.002	.652	11.420	.500
.003	.618	4.131	.740

2. Discussion

There is the lack of clear understanding of the term uncertainty and low level of application of uncertainty management tool by construction professionals in the real estate and oil and gas sector in Nigeria. This result is obtained despite the findings presented in Zuofa & Ocheng [31]. These authors studied risk perception in offshore oil and gas projects, and respondents in their study had established a significant level of cognizance of the presence of uncertainties in oil and gas projects. The imperativesignifies there is the lack of preventive management protocol evolution,and the use of established management techniques in that sector is also low. Conceptually, the term is misconstrued to mean the same thing as risk. This view is the same in practice, and more than half of the study'ssample strongly agrees to this position. However, there is a segment of the study's sample, who maintains anonymous position. This could mean the lack of proper understanding about what the terms actually mean (misconception). The lack of understanding cannot create nor eliminate uncertainty because uncertainty is inherent in every construction projects. This misconception is not new, Beurtey, Inga-Abere & Kumi [1] had acknowledged that the term uncertainty is most misunderstood within the construction sector. The perception is also responsible for the deterministic perspectives touncertainty management using contingencies planning. The use of contingencies in Nigeria, although widespread, only account for cost within the region of foreseen uncertainty (Jimoh & Adama and Otali & Odesola). The finding of this study affirm this wide spread use and identify the use of contingencies planning as the 3rd most used uncertainty management tool. The use of this approach has been criticised for the failure to address unforeseen and chaotic uncertainty. The use of Gantt chart and critical path is also wide spread.Although, no singular tool may be a one cap fit all for any given circumstance, it is imperative to always switch instinctively between tools or a combination of tools for effective management of construction project uncertainties.

Many events in uncertainty may be expected and manageable using risk management tools, the level of use of risk management tool in the construction sector in Nigeria is reportedly low [32]. Obtaining a related result in this study is therefore not surprising. This state of affairs in the global construction industry perspective is blamed on the 'off-the-record' events that are not documented [37]. The risk management tools tested in Adedokun's et *al*[32] study include sensitivity analysis, system dynamic, probabilistic influence diagrams, event and fault tree, fuzzy logic and Monte Carlo Simulation. The implication therefore suggests that uncertainty and its management tools are integral with risk management and control. Stare [35]; Heldman and Heldman [32] and Oni [34] sees this view point similarly but however, embeds uncertainty within the change management theory. While this appears useful in other sector, its application in the construction sector is in the area of uncertainty assessment only since it provides mechanism for prevention, early detection and effective realisation. The propriety of this viewpoint in uncertainty management is not certain because, change are ordered, directed and tailored within

organisational and scope objectives. Uncertainty on the other is weird and non-directional, in this view therefore, change management application is considered insufficient. This is not to say that, change management protocol can't be applied in uncertainty management. Flexibility as uncertainty management tool for instance explores uncertainty requirements, evaluates approval and realised improvement [33]. According to Gosling & Naim [36], there is the lack of literature on the subject within construction context. Although, extant literature associates flexibility to environmental uncertainty; and is describe as a system's tendency to adapt to variation in with little or no impact on cost, time and effort.

To address chaotic uncertainties in projects, collaborative management utilising relationship management have been canvassed and widely adopted in global construction industry practice [22]. Although these techniques are not new, the level of awareness (knowledge) and level of application within the construction real estate sector development is low. Other techniques, earned value management, event tree, contract formalization, and estimating using risk analysis are widely deployed in other sector's project (oil and gas). The use of transformation seems apparent and may gain possible industry wide usage. But there is a barrier of asymmetric information disclosure arising from the contractual practice in use. The traditional contractual is prominent among public and private sector clients in Nigeria. The lack of information disclosure is one the mechanism used by parties in traditional practice to explore the adversarial context of its relationship. This assertion is reflected by the respondents rating of factors responsible for the misconception of uncertainty within the construction sector in Nigeria. In Table 3, the type of project management practice in use was the highest ranking factor identified by the respondents as the root cause of low knowledge and misconception of uncertainty. Since transformation requires sufficient information supply and disclosure, several studies' recommendation had been directed towards refining elements of traditional practice. A study by Ekung & Ingirige [3] advocates the use of flexible contracting and restrain of opportunism. For effectiveness, the implication is that, parties must agree to collaborate to devised joined management of eschewing uncertainties in a project.

To enhance industry wide awareness about the context of these advance techniques, a brief description of some tools is given in the following section.

Earned Value Management: Earned value management is a tool used in generating an unbiased periodic cost and schedule performance information during the lifecycle of a project. This is an advance application of traditional monitoring and control practice of comparing planned against actual expenditure and schedules. This tool highlights variations early and identifies their sources. The challenge to the use of this tool is not just in mechanics of application but cultural change in the system.

Event Tree Analysis: Event tree analysis represents a logical combination of numerous events that may eschew from an originating event. In an event tree, every event in a project is identify and described graphically. This is effective since it enhance the identification of an event in respect to time because the tree is related to the sequence of occurrences[5]. The tool can be used to verify the parameter for improving project performance, criteria for evaluating performance and management of performance at the various stages of the project. In this way, the event tree is therefore used to identify parameters for preventing the project system from failure.

Estimating using Risk Analysis (ERA): ERA presents an improved method to the intuition based 'traditional' contingency estimation techniques. ERA involves quantitative uncertainty

transformation into a manageable risk event. The steps in the process include risk identification, classification and costing of uncertainties associated with a project.

Flexible Contracting: Flexibility contracting enhances modification of contract terms to address unforeseen and chaotic uncertainty arising from the project delivery environment. Flexibility describe as a system's tendency to adapt to variation in with little or no impact on cost, time and effort.

3. Conclusion

Due to the failure of traditional risk management practice to curb extreme uncertainty events, the management of uncertainty is marred by misconception.To determine the colossus underpinning effective project management requirements in this area, the literature has evolved various tools and techniques over the years. However, an in-depth empirical research, seeking to determine the level of application of these tools and techniques is dearth. This study therefore explored this research gap and investigated the use of uncertainty management tools and techniques within the construction sector in Nigeria.The objectives were to evaluate the level of use of uncertainty management tools and techniques and to determine the factors responsible for the misconception of uncertainty within the construction sector. Views from project managers in the Nigerian construction industry,obtained from two sub-sectors, the real estate and the oil and gas was evaluated. Findings of the study reveals there is the lack of clear understanding of the term uncertainty. The level of use of uncertainty management tools and techniques by project managers in the real estate and oil and gas sector in Nigeria is also low. The implication is the lack of preventive management protocol, and non-application of established management tools and techniques. Further finding identifies the type of project management practice in use, lack of awareness on uncertainty management tools and over reliance on the use of deterministic approach as factors associated with the misconception of uncertainty.

The challenge therefore is how to improve the state of misconception held by practitioners and to implement refinements to the traditional project management in use. To develop appropriate knowledge about uncertainty management, the notion that uncertainty management is about creating previously unknown information, applied to management risk must be repealed to embrace contemporary practice, which is, as encouraging information sharing, learning, knowledge and competence. Second, there is the need to start a project by understanding the context and profile of inherent uncertainties in the project system. This practice strictly requires collaborative management approach, flexible contracting is the recommended refinements to the traditional contractual practice to entrench relationship management, contract formalisation and the use of other advanced tools and techniques such as experimentation.

This study implements survey research design which adopts and tested uncertainty management tools and techniques from the literature. The tendency subsists that there may be extant bespoke tools and techniques in used by practitioners in the various sectors not captured by the designed survey instrument. Qualitative interviewing is another method that can generate these bespoke approaches for improving the survey instrument. Another recommended perspective is the use of mixed approach by future study. Focus group discussion can also be used to improve participants' knowledge of the enlisted tools and techniques in the questionnaire to enhance their rating opinion. Despite the observed refinements, the data on respondents' background shows a population, well educated in the respective professions with appropriate post graduate degrees; their opinion therefore, cannot be biased on the ground of novice.

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