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UNSETTLING UNCERTAINTIES OF CONSTRUCTION IN AN UNCERTAIN WORLD: THE COST, THE CHALLENGES AND THE CONQUESTS

By

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INTRODUCTION

Mr Vice Chancellor Sir, Principal Officers of the University, Members of Senate, Provosts, Deans, Directors, Heads of Departments, Royal Fathers, Ministers of the Gospel, Esteemed Colleagues, Distinguished Alumni here seated, Distinguished Guests, my dearest students, Members of the Press, Esteemed Online Audience, Distinguished Ladies and Gentlemen; it is with an immense appreciation and gratitude to the Almighty God that I stand before this highly esteemed gathering this evening to deliver the 318th Inaugural Lecture of the Obafemi Awolowo University entitled- *Unsettling Uncertainties of Construction in an Uncertain World: the Cost, the Challenges and the Conquests*. It is the second of its kind in the Department of Quantity Surveying. The first one was delivered by Professor G. O.Jagboro, the first Professor of Quantity Surveying in the Department, on 26th April, 2016. It is however the first to be delivered by an alumnus of the Department and the first to be delivered during the 2017/ 2018 Academic Session.

As the saying goes, *yesterday is history, tomorrow is a mystery, today is a gift from God and that is why it is called the present*. This is the day that the Lord has made, I will rejoice and be glad in it for He has made me glad. I cannot but start by giving glory and honour to the Almighty God who spared my life to see this day and to give an account of my academic stewardship here at home and abroad. Going by every human wisdom, I should not be standing before this esteemed gathering to deliver this Inaugural Lecture. However, thanks be to God who quickens the dead and calls things that be not as though they were.

I came to the University of Ife (now Obafemi Awolowo University) in 1979 to study Electronic and Electrical Engineering in the Faculty of

Technology. At that time, the Department of E ıvi mental Planning, Design and Management (EPDM) midwifed oy meritus Professor Kunle Ade Wahab was at its infancy (having st rte in 1977) and it was the latest addition to the departments in the Faculty of Technology. It was the practice of the Faculty at the time to consider all Part I students as 'Faculty particles.' Towards the end of the first year, Heads of various Departments within the Faculty would organize career talks to educate students on the prospects of each programme. It was during one of those talks that I first heard about Quantity Surveying (QS). At the end of the academic session, students were given forms to select three courses in order of preference and based on the new and improved understanding of the courses. Before it was time for completing the 'New Course Choice Form,' I spent time pondering the new QS course I had lately heard about. I made enquiries from a few senior students about the QS programme but with little or no new information from what I had heard.

Whilst in that state of mind as a young man, a friend of mine who was studying Architecture at Ibadan Polytechnic came visiting. Without him knowing what was going on in my mind, he expounded more to me about the QS course and that was the moment it was settled in my mind that that was the course I was going to make my first choice whilst Electronic and Electrical Engineering became my second choice. Mr Vice Chancellor Sir, that switch, which I believe was divine is the foundation of the Inaugural Lecture of today.

In 1982, the Department of Environment Planning, Design and Management was upgr ded to the status of a F culty and it became what is now known as the Faculty of Environmental Design and Management. As one of the pioneering students in the Department, we had a very rough start as we were faced with diverse problems

including dearth of core QS staff and lack of space – meaning that we had to struggle for identity for a long time. In the midst of these teething problems, I cannot forget the efforts of Emeritus Professor Kunle Ade Wahab who had to cope with teaching the majority of the courses alongside Part Time Lecturers until he was able to recruit from as far as Ghana. I also remember the role played by Mr Daniel Kyere who was the foundation Head of the Department and Mr Amoa Mensah; both of whom came from Ghana as the first set of full time staff in the Department. Despite the challenges we faced as pioneering students, I fell in love more and more with the QS course. As a son of a Carpenter who later became a Building Contractor, I later realised that most of the duties I had been rendering to my father as a teenager were actually those of a QS without me knowing it. That discovery got me the more interested in the course.

After graduating in 1984 and completing the mandatory National Youth Service, I had the opportunity of working with Qu-Ess Partnership, Ibadan; a reputable firm of Chartered Quantity Surveyors. There I had the privilege of working with an unusual Principal Partner, Mr Vincent Agha who took interest in me right from my student days when I served my tutelage as an industrial trainee. There, I gained diverse experiences from various projects. These experiences along with my training in the science of predicting construction cost while in the university as an undergraduate buoyed my excitement and entry into the QS Profession. What excited me most was the notion that a QS is able to predict the cost of a project from the drawing before it was ever built. Mr. Vice Chancellor Sir, it was not long after I entered into the profession before I saw a dark cloud of uncertainty eroding my notion of predictive astuteness as well as unsettling the crystal ball my experiences and training had offered me. First, I started noticing that

what we had as contract sum at the beginning of a project did not equate the final account. While I pondered the painful disparity, the unexpected happened. One day, a client we had worked for asked me, 'in your bills of quantities, you gave me the impression that my residential building project was going to cost N 10 million and now it is completed at N 11.2 million. Why should I engage you another time?'

The client's comment-cum-question momentarily startled and unsettled me. And as a young QS I had no convincing answer for the client. I, however realised that preventing future occurrences requires me to develop and deploy an uncanny imaginative response, which would not only break the fog of uncertainty that assails cost prediction but illuminate the dark world of uncertainty in which we live. Therefore, in 1986 I got enrolled for an MSc programme in Construction Management at the University of Lagos, vowing to contribute to the unsettling uncertainties of construction in our uncertain world. I started receiving new arsenals when Professor R. I. Iyagba gave us a lecture on Risk Management in Construction. From that moment, I started gaining insight into how risk affects the cost of construction and I made up my mind to do a thesis on that subject in order to gain more insight. While honing my skills at University of Lagos, the Obafemi Awolowo University gave me a good platform to battle uncertainties of construction through my appointment as an Assistant Lecturer in the Department of Quantity Surveying in 1988. Mr. Vice Chancellor sir, I am eternally grateful for this appointment. It has enabled me to fight uncertainties in construction cost both in theory and practice.

Coming to Ife, the mantra that greeted me was 'publish or perish.' In a bid to carve out a niche for myself, I decided to continue in my search to unsettle the uncertainties of construction and their untold impacts on construction cost. This search has taken me to the Netherlands, the

United Kingdom, France, United States, South Africa, India, United Arab Emirates and Canada and I'm happy to present the challenges and conquests made in this Lecture.

THE CONCEPT OF UNCERTAINTY

Uncertainty has been defined simply as lack of certainty (Winch, 2010). It is synonymous with unpredictability, unreliability, riskiness, chanciness, precariousness and unsureness. In decision making, **uncertainty** is a situation where the current state of knowledge is such that the order or nature of things is unknown; the consequences, extent, or magnitude of circumstances, conditions, or events is unpredictable and credible probabilities to possible outcomes cannot be assigned. Where there is too much uncertainty, nothing is ever decided (Winch and Mayterona, 2011). From the perspective of information theory, uncertainty is the difference between information required for a decision and the information available. A pictorial representation of uncertainty is shown in Fig.1.

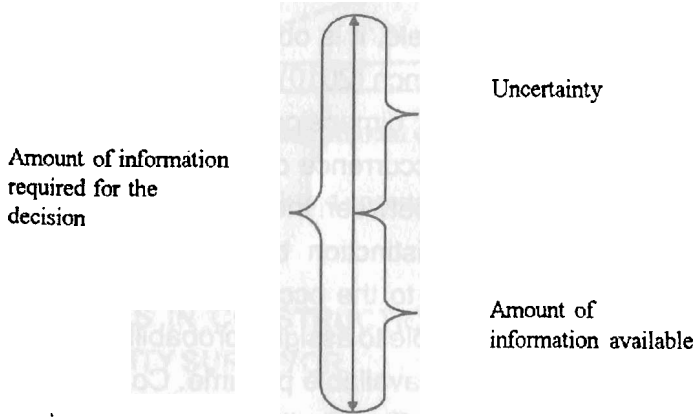


Fig. 1: The definition of uncertainty
Source: Winch (2010: 6)

We live in an uncertain world and as a result, uncertainty is a phenomenon we all live with daily: uncertain about car security, home security, health security, job security, etc. In short, we are uncertain about the future and that makes the insurance business a profitable one in the developed world. On February 12, 2002, the United States Secretary of Defense, Donald Rumsfeld was questioned at a U.S. Department of Defense (DoD) news briefing about the lack of evidence linking the government of Iraq with the supply of weapons of mass destruction to terrorist groups. In his response, Rumsfeld stated:

> '... as we know, there are *known knowns*; there are things we know we know. We also know there are *known unknowns*; that is to say we know there are some things we do not know. But there are the *unknown knowns* – the ones we don't know that we know and there are also *unknown unknowns* – the ones we don't know we don't know. And if one looks throughout the history of our country and other free countries, it is the latter category that tend to be the difficult ones.'

From the response of Rumsfeld, it is obvious that there are different dimensions of uncertainty. Winch (2010) uses the cognitive approach to partition the 'uncertainty dimensions' into four compartments depending on whether the occurrence of any event is either certain, impossible or somewhere in between the two. As shown in Fig. 2, this approach makes a clear distinction between when a probability distribution can be assigned to the occurrence of an event and the condition where it is not possible to assign a probability distribution due to the amount of information available per time. Considering the four 'uncertainty dimensions' in Fig. 2, it is evident that probability distributions could be assigned to the 'uncertainty dimensions' of '*known knowns*' and '*known unknowns.*' These dimensions are collectively referred to as risk dimension (Winch, 2010). Uncertainty on the other hand is where there is a lack of knowledge about the probability of incidence due to lack of reliable data (*known unknown*) or about the threat or opportunity itself (*unknown unknown*). These distinctions are helpful especially when it comes to managing risk and uncertainty in construction.

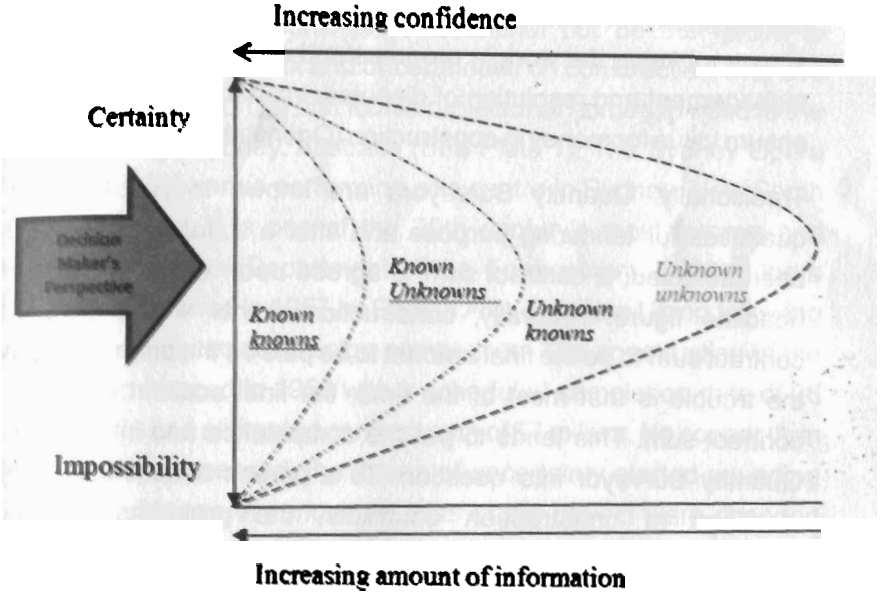


Fig. 2: A Cognitive Model of Risk and uncertainties
Source: Winch (2010)

UNCERTAINTIES IN CONSTRUCTION AND THE CHALLENGES TO THE QUANTITY SURVEYOR

The Quantity Surveyor is the construction professional involved in a wide range of services related to the development and construction processes of building, civil engineering and industrial engineering

projects. The work of the Quantity Surveyor may involve advising construction clients about the economic viability of proposed major developments as part of the strategic planning process, advising on procurement procedures, budgeting and cost planning, measuring construction work both from drawings and work in progress, preparing the bills of quantities, preparing tender documentation, construction commercial management services and construction project management services. When projects are under construction, quantity surveyors value the work in progress and are involved in contractual management and resolution of disputes. In short, Quantity Surveyors ensure value for money in construction (Ogunsemi, 2015).

Traditionally, Quantity Surveyors are known to prepare bills of quantities for tendering purpose and after a suitable contractor has been selected, a contract sum is agreed upon which is usually the headline figure. Naturally, construction clients would expect the contract sum to be the final amount to be paid on the project. However, the trouble is that most of the time, the final account exceeds the contract sum. This tends to put the competence and integrity of the Quantity Surveyor into question. To a person acquainted with the workings of construction contracts, the problems posed by uncertainties in construction could be understood as contributing to the deviation. However, to a layman, foul play could be suspected.

Construction projects are heavily capital intensive and as a result, they are extremely susceptible to the forces of uncertainty. The causes of uncertainties in construction are numerous and varied. No sooner than a contract is awarded, there may be foreign exchange fluctuation as we all witnessed in Nigeria in the last two years. While construction is ongoing, a client may decide to change the scope of his project. It is a known law in project management that when scope changes, you

cannot expect construction cost and duration to stay the same. There may also be changes to design, problems with foundation, contract disputes, natural disasters such as earthquake, flood, land slide, fire, etc to name but a few. While some of these causes are in the realm of risk (*know-knowns* and *known-unknowns*), others are in the realm of uncertainties (*unknown-knowns* and *unknown-unknowns*).

All over the world, wherever the issues of uncertainties in construction are discussed, some iconic projects cannot but be mentioned to illustrate the impact of risk and uncertainties on construction cost and completion duration. The first iconic project that comes to mind is the Opera House in Sydney, Australia (See Plate 1). The Sydney Opera House is a multi-venue performing arts centre in Sydney, New South Wales, Australia. It is one of the 20th century's most famous and distinctive buildings (Department of the Environment, 2008). Opera House was designed in 1957 by Danish Architect Jørn Utzon following a worldwide architectural design competition. The construction of the building commenced in 1958 with a scheduled completion date of 26 January 1963 and estimated contract sum of $7 million. No sooner than construction commenced, the forces of uncertainty started pounding the project: designs of various aspects of the project were changed several times over, there was a change of government – with the new government very critical of the project, adversarial relationships amongst the client, architect, quantity surveyor, engineers and contractor, resignation of the design architect, etc. As a result of the forces of uncertainty, the project scheduled to be completed within 5 years was not completed until 10 years later in 1973. In addition, the estimated construction cost escalated from $7 million to $102 million – a cost overrun of 1,357% in real terms.

Plate 1: Opera House, Sydney, Australia
Source: Department of Environment (2008)

Another iconic building that comes to mind when talking of uncertainties and construction is the Scottish Parliament Building at Holyrood, Edinburgh, Scotland (See Plate 2). The building was designed by Enric Miralles, a Spanish Catalan Architect following an architectural design competition. The construction of the building commenced in 1999 with a scheduled completion date of 2001 and estimated contract sum of £ 55 million. No sooner than construction started, forces of uncertainty started ramming the project: there were over 2,000 design changes, change of initially proposed site, wrong procurement method, communication breakdown among the client, architect, quantity surveyor, engineers and contractor, etc. As a result, the project scheduled to be completed within 2 years was not completed until 3 years later in 2004. In addition, the estimated construction cost escalated from £ 55 million to £ 431 million.

Right within our purview at Obafemi Awolowo University, we have projects that were started with great optimism but as forces of uncertainty came pounding: cash flow problem, problems with foundations, fluctuations in foreign exchange, we all know the untold impact on the outturn cost. With this background, I welcome you to the world of uncertainties in construction.

Plate 2: The Scottish Parliament Building
Source: Johnson (2010)

UNSETTLING UNCERTAINTIES IN CONSTRUCTION: THE RISK DIMENSION

As stated earlier in this Lecture, using the cognitive model (Winch, 2010), uncertainty could be partitioned into two spaces of *risk* (known-knowns, and known-unknowns) and *uncertainty* (unknown-knowns and unknown-unknowns). In order to unsettle the uncertainties of construction, my research efforts have concentrated on the risk side of uncertainties, being the realm where probabilities could be assigned. Just as time could be perceived as a measured piece of eternity, so also, risk could be perceived as a measurable uncertainty. Beyond this general perspective, it is important to briefly discuss the fundamentals of risk in order to appropriately position my humble contribution to

Risk Perspectives in Decision Making

Risk is an important element in decision making and its significance has been confirmed by its consideration in decision theory, economics, behavioural and cognitive psychology and management. To understand the concepts of risk and the management of risk, it is important to consider how risk has been studied. Mayterona (2013) submitted that over the years, decision-making studies of risk have varied in their approach but that four perspectives are dominant: the rationalist, behavioural, cultural and cognitive.

The rationalist perspective: This is based on the use of probability, mathematical and economic theories in decision-making (Bernstein, 1998). Within the context of project risk management, Von Neumann and Morgenstem's modern utility theory suggests how individuals should make decisions when the probabilities of outcomes are known. Expected utility (EU) theory lies at the core of project risk assessments and this is exemplified in the application of probability/impact matrix. The basis of the theory is that individuals are rational and act to maximise utility. The application of EU theory in a project context requires knowledge about the probabilities of various future outcomes which is not always known in practice (Mayterona, 2013). The solution to this came with the development of subjective expected utility (SEU) theory (Savage 1954). The theory states that all probabilities are a state of the individual rather than a state of nature and that as long as personal (subjective) probabilities are ranked, there are no problems with applying the mathematics of objective probabilities (Winch and Mayterona, 2011). In this way, the problem of lack of data about the future is addressed by articulating probabilities as 'degrees of belief' held by an individual and provides a foundation for turning uncertainty (lack of knowledge) into risk (Mayterona, 2013). The effective

application of SEU theory requires training in the process of elicitation (a prescribed process), the identification of all future states of events, and the consideration of individual cognitive capacity and biases (Mayterona, 2013). These limitations have led to the consideration of the behavioural perspective.

The behavioural perspective: This is a response to the limitations of the rationalist perspective. Behavioural decision theorists started to consider individual behaviour when making decisions. Simon (1947) introduced the concept of 'bounded rationality' where rationality is limited to the information processing capacity of an individual. One of the most influential pieces of research related to risk and decision making is Tversky and Kahneman's (1974) experimental work which showed that individuals use a range of rule-of-thumb 'heuristics' when making many intuitive judgements. The use of these heuristics reduces the requirement for processing information but it can also lead to biased judgements (Mayterona, 2013). This body of research demonstrated that the elicitation of subjective probability was indeed problematic and that heuristics and biases studies analysed the ways in which decision makers tended to misuse information available to them to assess probabilities.

Despite this criticism, this area of study provides an explanation for poor probability judgements, which have implications for the assessment phase of the risk management process. Flyvberg, Bruzelius and Rothengatter (2003) provides an example of the role of biases in projects. In their review of the performance of infrastructure projects from around the globe, specifically at the feasibility/appraisal stage, they identified poor consideration of risk and over-optimistic estimates as the main reasons for poor performance. The importance of optimism bias is now gaining ground and this was taken into

consideration during the execution of the London 2012 Olympic and Paralympic Games project by allocating large contingency sums to the projects. The deficiencies of the behavioural perspective as well as the rationalist perspective have pointed the way for the consideration of the cognitive perspective.

The cognitive perspective: This perspective recognises the importance of individual mental states. It also acknowledges a decision maker's limited information processing capacity and considers how decision makers in their organisational context process and interpret information in order to take action (Mayterona, 2013). Winch (2010) suggested how to put the cognitive perspective into practice using a cognitive model of risk and uncertainty in projects as shown in Fig. 2.

This model as indicated earlier makes a distinction between risk (known-knowns and unknown knowns) and uncertainty (lack of knowledge – known unknowns, and unknown unknowns). It is cognitive because the perception of the possibility of future events taking place lies within the individual decision maker. It is, therefore, subjective as it is the decision maker who makes sense of their environment, processes the available information and mentally constructs possible future states. The future-oriented nature of projects indicates that it is common for the decision maker to navigate the 'information space'- the right side of Fig. 2 and in doing so, the decision maker perceives possible future events vis-à-vis their sources and possible consequences and thus makes sense of the information available.

A decision maker's perception of this information space is therefore central to how she or he makes sense of the situation in focus and cardinal to his or her decisions. The fact that the process is so subjective does of course have consequences for projects: The

decision maker navigating the 'information space' can interpret and make different inferences from the same information and experiences which could lead to serious consequences.

The cultural perspective: This is the fourth risk perspective. It takes into consideration the social and cultural contexts of the decision process and issues affecting the individuals' responses to risk. Studies in this area have tended to focus on understanding how power, social status and political views influence an individual's, group's or organisation's view of risk (Mayterona, 2013). Whereas the behavioural and to some extent the cognitive perspective have focused on individual processes of choice, the sociocultural perspective focuses on how social and cultural factors influence judgements on risk (Douglas, 1992). The foregoing risk perspectives are different attempts to develop a more sophisticated understanding of how we make sense of risk and they all derive either directly or indirectly from the rationalist perspective (Mayterona, 2013).

Risk and Probability

Winch (2010) uses the time-based framework for understanding risk and uncertainty, stating that the risk source is the underlying condition that can generate a possible risk event at some time forward from the time of decision-making. For instance, unsafe working practices are an existing risk source while an accident is a risk event that could occur at some point in the future. A risk source is therefore an underlying state of affairs; a risk event is an event that can happen given that underlying state of affairs. Conceptually, the relationship between the risk source and the risk event is expressed in terms of the probability of its occurrence given the risk source. Probability is therefore a property of the event and not the source. Winch (2010) identified four broad

schools of thought on the relationship between risk and the concept of probability.

The first school of thought is the *objectivist school* which argues that the probability of an event occurring in the future can be inferred from a sample of observations of previous occurrences drawn from a known population (Winch, 2010). This approach is inherently historical and is associated with the science of statistics. Its approach is essentially predictive in that it attempts to predict future events from known data about risk sources.

The second school of thought is the *logical school* which addresses the probability of a failure event in engineered systems (Winch and Mayterona, 2011). While there might not be a data set associated with failure – or only limited forensic data that does not meet the requirements for statistical inference – engineers' understanding of the design of the system and the scientific properties on which that design is based can be used to identify risk sources and hence the probable failure events in closed systems (Winch 2010). This approach also aims to be predictive.

The third school of thought is the *subjectivist school* which emphasises the degree of belief held by the decision-maker in the probability of a particular event and it is the basis for the discipline of decision sciences where the elicitation of subjective probabilities extends the application of the tools associated with the objectivist school to future-oriented analysis (Winch and Mayterona, 2011). This approach is the intellectual underpinning of the tool box of ct risk management. It is essentially prescriptive in that it provides tools and techniques for how decisions ought to be made (Winch, 2010).

The fourth school of thought is the *behavioural school* which focuses more on the actual behaviour associated with decision-making under

uncertainty (Winch 2010). The empirical research techniques associated with the behavioural school range from the ethnographic to the experimental in its attempt to be descriptive about how decisions are made in practice.

Risk Dimensions and Risk Measurement

Williams (1996) submitted that fundamentally, risk is two dimensional in nature and Heemstra and Kusters (1996) submitted that using the two-dimensional nature of risk, the degree of risk could be measured as a product of the probability of risk occurrence and the impact on a project. This view is also supported by the Project Management Institute (2016). Akintoye *et. al.* (2001) referred to this as the risk exposure or expected value (EV) while Tweeds (1996) referred to it as average risk estimate. This method of risk measurement has a well-established place in the decision theory domain. Williams (1996) however contended that rather than decreasing the two-dimensional nature of the risk measure, it should be extended to three dimensions.

Charette (1989) uses three-dimensional graphs with independent axes he labels severity (i.e. impacts), frequency (i.e. likelihood) and 'predictability' (in technical terms, the extent to which the risk is aleatoric rather than epistemic). Three dimensions of risk have been considered in many studies, namely: probability of risk occurrence, extent of risk occurrence and impact of occurrence. These three dimensions of risk could be viewed in two pairs. The first is the prob[illegible] of risk occurrence/impact of occurrence. This is referred to by Adams (2006) as subjective risk and also belongs to the subjective [illegible]ool of thought in probability elicitation. The second is the pair of extent of risk occurrence and the impact of occurrence. This is referred to b[illegible] (2006) as objective risk and it also belongs to the

objectivist school of thought in probability elicitation.

UNSETTLING UNCERTAINTIES OF CONSTRUCTION: THE CONQUESTS

In over three decades of my research efforts on risk impacts on construction cost, I have embraced both the objectivist and subjectivist schools of thought.

Construction Cost Research involving Objective Risk

Mr. Vice Chancellor sir, in this section of my lecture, I would like to present the outcomes of some empirical studies I carried out involving elicitation of objective risk. Using the cognitive model of risk and uncertainty earlier described (Fig.2), objective risk would be those under the 'risk space' of known-knowns. This means that we know that the risk factors are there but we need to assign probabilities to them. Since we are dealing with a post hoc evaluation of completed construction projects, from our experience, we could place a probability or evaluate the extent of occurrence of the identified risk. In the same way, we could evaluate the impact of risk occurrence using a probability measure or a Likert-type scale. Risk elicitation using this approach is known as objective risk elicitation.

Fig. 3 illustrates the 'speculative' risk to a client and contractor for specific procurement methods. Speculative risk is that which can be apportioned in advance of the project as decided by the parties in the contract (Davis *et al.* 2009). As illustrated in Fig. 3, speculative risk can wholly lie with the employer or the contractor depending on the procurement method selected. It is evident from Fig. 3 that under the traditional forms of procurement, the more definite the Bill of Quantities (BOQ) is before contract award, the less is the speculative risk retained

by the employer. This could be contrasted with the design and build procurement method where the majority or all of the speculative risks lie with the contractor. This contrast has implications while researching risk impacts on construction costs and suggesting that different procurement methods would need to be treated differently for meaningful conclusions to be drawn. Realizing this, attempts were made to study risk impacts on construction cost in traditional procurement differently from design and build procurement.

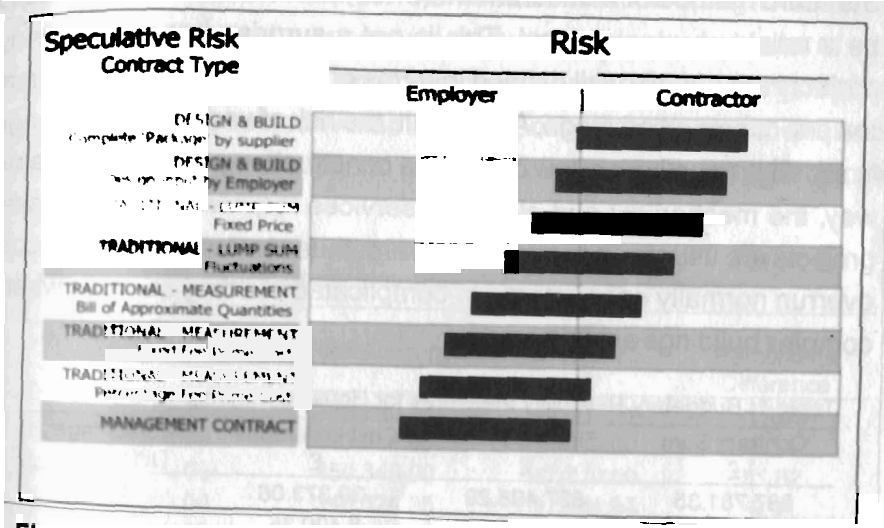


Fig. 3: Risk Apportionment between Client and Contractor
Source: Davis et. al. (2008)

In a preliminary study conducted by Odeyinka, Kelly and Perera (2009) the budgetary reliability of the BOQ in procuring building projects was investigated using secondary data from completed building projects in the UK. Table 1 presents the contract sum as well as final account figures for 5 housing projects studied. An analysis of the percentage difference between the contract sum and final account figure gives an indication of the budgetary reliability of the BOQ. From the Table, it is

evident that the percentage difference between the budgeted cost and final account ranges between

-3.42% and +3.85%. This falls between the ±5% range recommended by Morrison (1984) as the acceptable accuracy range between the Quantity Surveyor's estimate and the accepted tender.

Within the limitation of the data set, this then suggests that in traditional procurement, where traditional BOQ, produced according to the Standard Method of Measurement (SMM) are used, the BOQ tends to be a reliable budgetary tool. This is not a surprise because housing projects are usually well defined in terms of design and specification at the pre-construction stage. As a result, the risk of variation and change in scope is usually very low during the construction phase. In the same way, the mechanical and electrical services requirements in housing projects are usually very straightforward, thus removing the risk of cost overrun normally encountered in complicated building services where complex buildings are involved.

Table 1: Budgetary Reliability Measures for Housing Projects

Contract Sum £	Final Account £	Cost Difference £	Percentage Difference
887,781.35	857,408.29	-30,373.06	-3.42
397,228.49	405,628.84	8,400.35	2.11
452,750.00	460,340.00	7,590.00	1.68
765,539.36	751,366.86	-14,172.50	-1.85
517,180.00	537,105.00	19,925.00	3.85

Table 2 presents the contract sum as well as final account figures for 5 educational building projects. An analysis of the percentage difference between the contract sum and final account figure gives an indication of the budgetary reliability of the BOQ. From the Table, it is evident that the percentage difference between the contract sum and final account ranges from -3.69% to +17.05%. This is a range of more than 20%

which is on the high side. A detailed examination of the elemental breakdown for each of the 5 projects studied showed wide variability between the contract sum and final account figures in some elements such as floor and wall finishes, electrical and mechanical engineering services and external works. The observed high variability suggests that the use of a BOQ does not guarantee cost certainty in educational projects. This is a bit of a surprise as one would expect that educational projects like housing projects should be straightforward enough. However, as evident from the elemental breakdown, high variability was observed in some cases which suggest the occurrences of risk factors such as variation and change in specification among others. According to Cooke and Williams (2009), one of the risks with the most serious effects for the client is the failure to keep within the cost estimate.

Table 2: Budgetary Reliability Measures for Educational Projects

Contract Sum £	Final Account £	Cost Difference £	Percentage Difference
247,159.97	289,290.08	42,130.11	17.05
352,780.00	363,850.00	11,070.00	3.14
402,730.00	450,340.00	47,610.00	11.82
129,000.00	140,624.95	11,624.95	9.01
298,500.00	287,479.42	-11,020.58	-3.69

Table 3 presents the contract sum as well as final account figures for 5 small to large commercial projects. An analysis of the percentage difference between the budgeted cost and final account shows a range from -19.94% to +19.92%. This is a range of more than 39% which is on the very high side. A cursory look at the percentage differences of each of the 5 projects showed that the bigger the scope of the commercial project, the higher the level of variability on the positive side between

the budgeted cost and the final account. A detailed examination of the elemental breakdown for each of the 5 projects showed wide variability between the contract sum and final account figures in some elements such as roof element, internal wall, floor and wall finishes, electrical and mechanical engineering services and external works. The observed high variability suggests that the use of a BOQ does not guarantee cost certainty in commercial projects, especially where the project is large in scope and of a complex nature. This is not a surprise because where large and complex projects are involved, there is uncertainty in a lot of project information available. The more uncertain the project information is at the pre-construction stage when the BOQ is prepared and priced, the more risky it is for cost and time certainty to be guaranteed to the client at project completion.

Table 3: Budgetary Reliability Measures for Commercial Projects

Contract Sum £	Final Account £	Cost Difference £	Percentage Difference
270,149.83	261,760.76	-8,389.07	-3.11
306,050.00	245,033.74	-61,016.26	-19.94
2,350,740.00	2,591,830.00	241,090.00	10.26
5,086,741.64	6,100,000.00	1,013,258.36	19.92
230,379.04	238,610.04	8,231.00	3.57

Table 4 presents the contract sum as well as final account figures for 5 refurbishment projects. An analysis of the percentage difference between the contract sum and final account shows a range of between -10.72% and +36.90%. This is a range of more than 47% which is on the very high side. A cursory look at the Table does not show a clear cut pattern of percentage variability. For instance, the highest positive variability came from what would be expected to be a small refurbishment project. A detailed examination of the elemental

breakdown for each of the 5 projects showed wide variability between the tender figure and final account figures in some elements such as demolitions and alterations, external wall, finishes and mechanical and electrical services installations. The observed high variability suggests that the use of a BOQ does not guarantee cost certainty in refurbishment projects. This is not a surprise as refurbishment projects are known for their unpredictability in terms of cost and time certainty due to many unknowns in terms of scope and complexity at project commencement.

Table 4: Budgetary Reliability Measures for Refurbishment Projects

Contract Sum £	Final Account £	Cost Difference £	Percentage Difference
283,250.00	313,965.67	30,715.67	10.84
337,248.49	375,628.84	38,380.35	11.38
83,250.00	113,965.67	30,715.67	36.90
206,283.65	184,171.89	-22,111.76	-10.72
63,723.52	57,007.54	-6,715.98	-10.54

Further analyses were carried out in order to ascertain the budgetary reliability of the BOQ for procuring buildings of different types previously analysed. One of the analyses is the Root Mean Square (*RMS*) measure. A normalization adjustment was made to the *RMS* measure to convert it to percentage measure so as to make it comparable to other measures. This is referred to in Table 5 as the *adjusted RMS* measure. The normalization precaution was taken because the RMS values obtained are more of the function of the tender and final account figures. However, the adjusted values are relative values which are more comparable. The second analysis is the Relative Mean Absolute Deviation (*Rel. MAD)* measure. The results of these further analyses are presented in Table 5.

From the Table, it is evident that the adjusted RMS measure and the Rel. MAD measure are relatively close and they follow the same trend, indicating that the measures are reliable for measuring the phenomenon under study. From the Table, the reliability ranking based on the *adjusted RMS* and *Rel. MAD* measures shows that the BOQ is most reliable as a budgetary tool in procuring housing projects.

Table 5: BOQ Budgetary Reliability Measures of Different Building Types

Building Type	RMS Measure (£)	Adjusted RMS Measure (%)	Rel. MAD Measure (%)	Reliability Ranking
Housing	18,157.99	2.73	2.58	1
Educational	29,734.81	10.34	8.94	2
Commercial	466,621.47	13.58	11.36	3
Refurbishment	27,906.95	19.15	16.08	4

This is followed by educational projects and commercial projects in that order. The reliability ranking showed that the BOQ is least reliable as a budgetary tool in procuring refurbishment projects. Whilst this finding is not a surprise, it reveals a great deal about the danger of relying too much on the BOQ as a budgetary tool. Apart from housing project with a budgetary reliability of ±2.58% which is quite acceptable, the deviation margins for other project types are quite high. This suggests that where clients are interested in cost certainty, Quantity Surveyors and Project Managers need to qualify the price they give to clients with an indication of confidence limits. This is very essential because the deviations observed are as a result of risk factors which are inherent in construction. The study reported concluded that in traditional procurement where bills of quantities were used to ensure 'cost certainty', deviations between the contract sum in the BOQ and final account figures were still observable.

Odeyinka and Larkin (2012) explored the conjecture that instead of getting hung on whether or not cost certainty could be guaranteed by using BOQ, risk factors normally inherent in every construction project is responsible for the observed deviation between the contract sum and final account. The objectives of the study were two-fold, first to identify and prioritize the risk factors impacting construction cost in *traditional procurement*. Second, to develop and validate models for assessing risk impacts on the variability between contract sum and final account. It was envisaged that the developed models would facilitate a proactive approach to managing risk impact on construction cost.

A two- stage approach to data collection was adopted in the study. The first was a UK wide online survey aimed at determining the significant risk factors to focus on for modelling purpose. The questionnaire was designed to elicit information on the extent of occurrence of the identified risk factors and their impact in case of occurrence (objective risk). The second stage involved the collection of case study data. This involved determining significant risk factors from the questionnaire survey and requesting construction professionals (architects, quantity surveyors and project managers) to provide objective probabilities on the extent of occurrence of the identified significant risk factors on specific building projects and their impacts on construction cost. The result of the analysis from the first stage of data collection and the data set from the second stage were used to develop multiple linear regression (MLR) models for assessing risk impacts on the variability between contract sum and final account. Result of the developed model showed the potential for risk/ impact modelling but it also revealed that the relationship is not strictly linear. This led to a search for a more suitable modelling method.

In a research project sponsored by the Royal Institution of Chartered Surveyors (RICS), Odeyinka, Larkin, Weatherup, Cunningham, McKane and Bogle (2012) employed the cognitive theory of risk and two dimensional nature of risk to obtain two sets of data. One was for the extent of risk occurrence and the other was for the impact of risk on the outturn project cost. Using these two sets of data, we were able to rank order the risk factors impacting the variability between contract sum and final account. Table 6 presents the identified risk factors and how they rank. Using risk/impact matrix developed by Project Management Institute (2012) to determine the degree of risk, it was found that the top 5 risk factors in Table 6 were significant and they were taken forward in modelling the impact of risk on the variability between contract sum and final account. In this project, instead of using the MLR, the artificial neural networks (ANN) modelling method was adopted. Fig. 4 shows the ANN modelling architecture with 5 input nodes, 2 hidden layers and one output node.

Using the Smartlab ANN software (See Plate 3) for training and testing, better predictive results were obtained. Table 7 shows the model validation results. Using absolute deviation measure and percentage absolute deviation measure, the Table shows that the difference between the predicted variation and actual variation ranges from 0.2% and 6.5%. Given the limitation of the available data set, the accuracy level of the model is very promising.

Mr Vice Chancellor Sir, the result of this study was presented at No. 4 Parliament Square Building in London that houses the Royal Institution of Chartered Surveyors in May 2012. Amongst the number of sponsored research projects presented that evening, it was not only adjudged the best, it also drew worldwide attention within the Quantity Surveying research community. Due to its practical relevance to the construction industry, the outcome of the study was highlighted in the November/ December 2012 edition of the RICS Construction Journal. The research output was also well received at the RICS COBRA conference held in September 2012 in Las Vegas, USA. The fact that risk impact could be modelled in an objective way confirms the claims of the objectivist school of thought that objective risk elicitation are useful for predicting risk impact in future projects.

Table 6: Ranking of extent of risk/ impact and degree of risk

Risk factors	Overall extent of risk occurrence mean	Overall risk impact mean	Overall degree of risk	Rank
Variations by the client	3.26	3.05	9.93	1
Change in design by the client	3.16	2.98	9.41	2
Change in scope of works	2.74	2.86	7.84	3
Unexpected site conditions	2.21	2.26	4.99	4
Change in design by Architect	2.09	1.95	4.08	5
Problems arising due to client's lack of experience	2.07	1.91	3.95	6
Inadequate specification	2.05	1.77	3.62	7
Extremely competitive tender	1.98	1.7	3.36	8
Third party delays	1.93	1.67	3.23	9
Defects in design	1.86	1.65	3.07	10
Delay in resolving disputes	1.79	1.65	2.96	11
Delay in nominated/ named material supplier	1.72	1.6	2.76	12
Underestimation of quantities	1.65	1.49	2.46	13
Local concerns and requirements	1.51	1.47	2.21	14
Contract document conflicts	1.4	1.42	1.99	15
Project funding problems	1.35	1.37	1.85	16
Ambiguous contract terms	1.28	1.26	1.61	17
Loss or damage by fire or flood	1.07	1.05	1.12	18

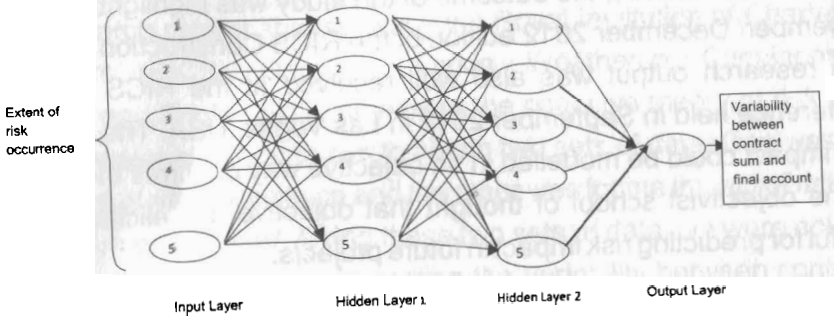


Fig. 4: Artificial Neural Network Modelling Architecture of Risk impact on Contract Sum

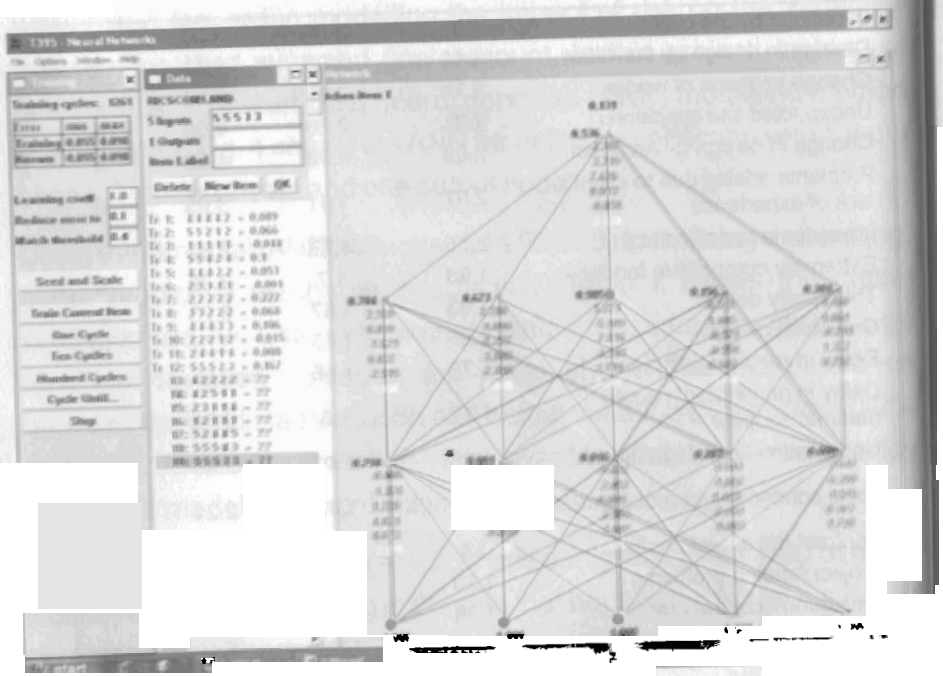


Plate 3: Artificial Neural Network Modelling of Risk impact on Contract sum

Table 7: Modelling validation results

Project No.	Actual % variation	Predicted variation	absolute deviation	% absolute deviation
1	0.106	0.156	0.050	5.0
2	0.093	0.044	0.049	4.9
3	0.270	0.240	0.030	3.0
4	0.017	0.015	0.002	0.2
5	0.041	0.106	0.065	6.5
6	0.131	0.094	0.037	3.7
7	0.104	0.131	0.027	2.7

Having developed an expertise in risk elicitation and modelling, I was able to write a proposal for PhD research studentship as a Lecturer at the University of **Ulster,** Belfast, **UK.** The studentship was won by Keren Larkin **who had** previously **worked** with me as a Research Assistant on the RICS sponsored project. The PhD research was co-supervised by Dr Robert Eadie, also a Lecturer at the University of Ulster. Also pitching a tent with the objectivist school of thought, the study investigated risk impacts on the variability between contract sum and final account in *design and build procurement*. The study examined different perspectives of risk using the cognitive model of risk so as to position the study in the wider context of existing body of knowledge in the construction domain. The insights gained was used in devising a methodological framework for assessing the variability between the contract sum and final account in client-led and contractor-led Design and Build projects (Larkin, **Odeyinka** and Eadie,. 2012). Further works involved elicitation of objective risk from respondents as well as perceived impacts. An analysis of these pair of data set was instrumental to determining the significant risk factors to focus on in design and build procurement method (Larkin, **Odeyinka**, and Eadie, 2016).

Moreover, in recognition of my expertise in risk elicitation and modelling, I was invited by colleagues at the University of Auckland,

New Zealand to co-supervise the early stage of a PhD research on risk impact on the variability between design stage elemental cost plan and contract sum. This was a study carried out using the objectivist approach to risk elicitation. At the early stage, the study provided a review of the risk elements inherent in preparing design stage elemental cost plan and also developed a methodology for assessing risk impacts on the variability between the design stage elemental cost plan and final tender sum (Adafin, Wilkinson, Rotimi and **Odeyinka,** 2014).

Back home in Nigeria, the risk elicitation and modelling approach has been applied in a supervised postgraduate research. Leo-Olagbaye and **Odeyinka** (2017) applied the technique to investigate risk impacts on road projects in Osun State. The study brought to the fore, significant risk factors that construction professionals could not afford to ignore in procuring road projects. These include change in scope of work, defective design, change in design, delay in availability of design details and unforeseen adverse ground conditions.

Furthermore, as a PhD student at Glasgow Caledonian University, Glasgow, UK, I have used the objectivist approach to risk elicitation to investigate risk impacts on construction cash flow forecast (Odeyinka, 2003). The aim of the research was to develop a model that assesses the impacts of risk occurring during in-progress period on construction cash flow forecast. The essence of the model is to help the contractor's QS to predict in advance, the impacts of risks occurring during project execution on his cash flow profile without any recourse to cumbersome re-calculations. The first approach was to identify and categorize the various methods used in construction management and economics literature to model cost profile-based cash flow forecast. Figure 5 illustrates these methods and out of them all, the cost flow approach

(negative cash flow) had been proven in literature to give more reliable prediction.

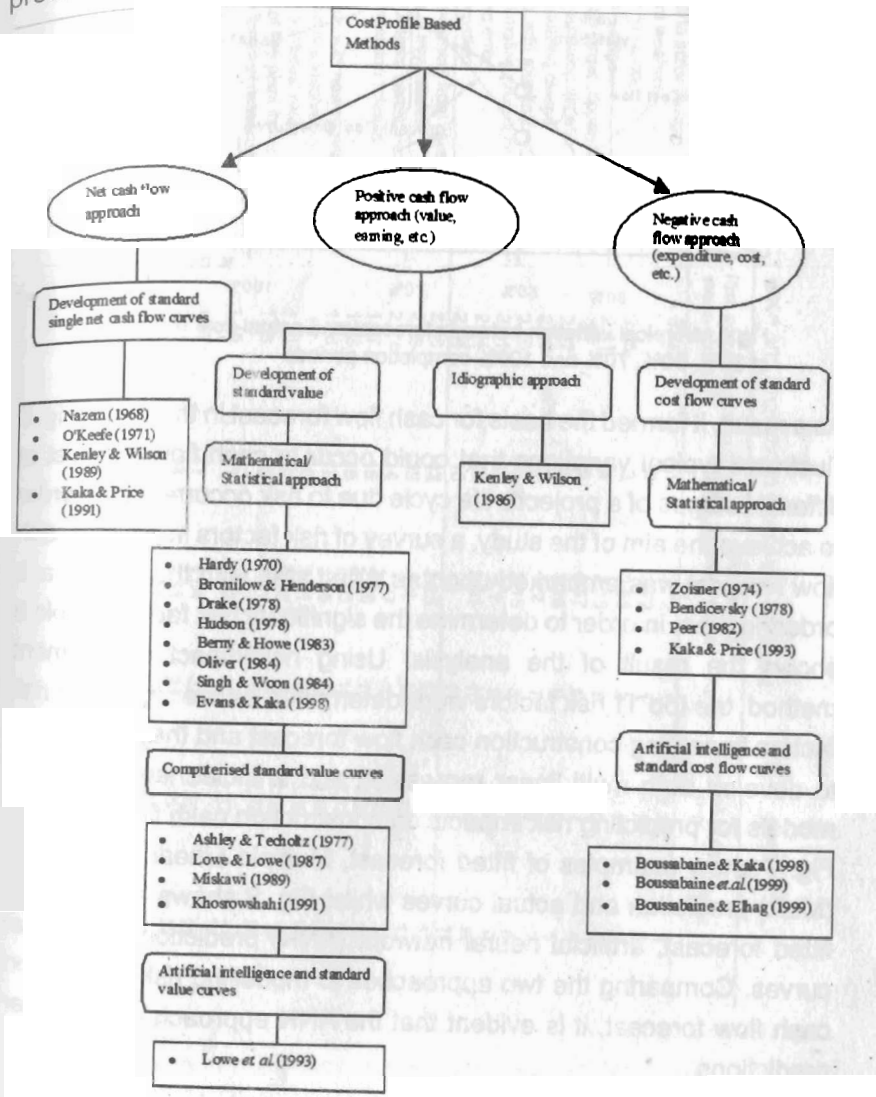


Fig. 5: Conceptual classification of models developed using cost-profile based methods
Source: Odeyinka (2003)

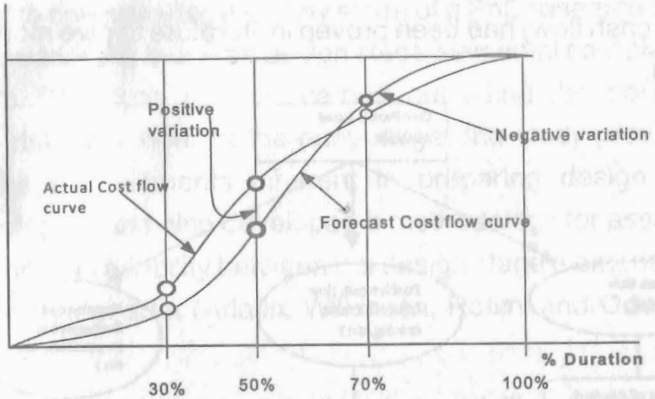
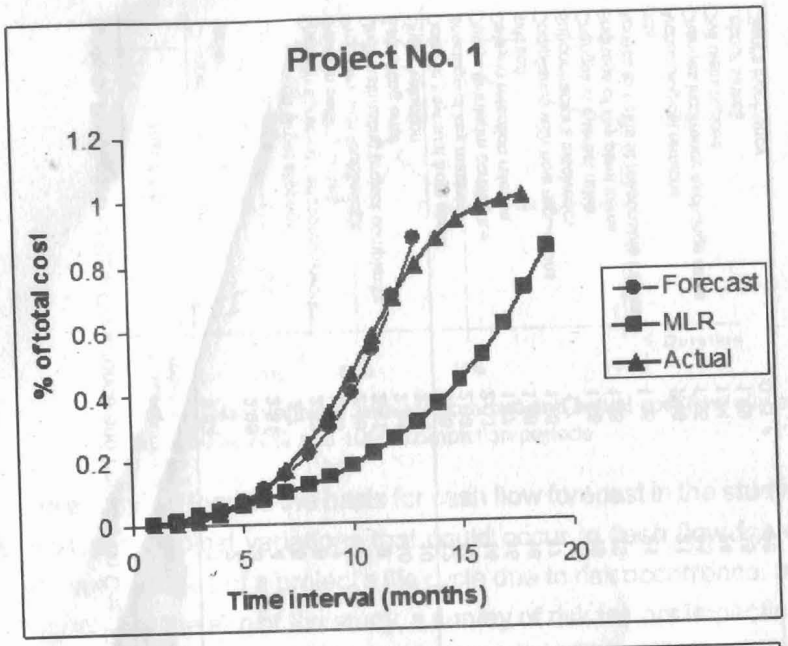


Fig 6: A typical variation between forecast and actual cost flow curves at 30%, 50%, 70% and 100% completion periods

As a result, it formed the basis for cash flow forecast in the study. Fig. 6 illustrates typical variations that could occur in cash flow forecast at different stages of a project's life cycle due to risk occurrence. In order to achieve the aim of the study, a survey of risk factors impacting cash flow forecast was embarked upon as a first step with the aim of rank ordering them in order to determine the significant risk factors. Table 8 shows the result of the analysis. Using risk/impact assessment method, the top 11 risk factors were determined as the significant risk factors impacting construction cash flow forecast and they were used to develop both multi linear regression and artificial neural network models for predicting risk impacts on construction cash flow forecast. Fig. 7 show examples of fitted forecast, Multiple Linear Regression (MLR) prediction and actual curves whilst Fig. 8 shows examples of fitted forecast, artificial neural network (ANN) prediction and actual curves. Comparing the two approaches to modelling risk impacts on cash flow forecast, it is evident that the ANN approach offers better predictions.

Table 8: Perception of Risk Occurrence and Impacts on Cost Flow Forecast

Risk Factors	Risk occurrence mean score (P)	Rank	Risk impact mean score (I)	Rank	Degree of risk (P*I)	Rank
Changes to initial design	3.32	1	3.72	1	12.35	1
Inclement weather	3	2	3.72	1	11.16	2
Variation to works	2.95	3	3.55	3	10.47	3
Labour shortage	2.81	4	3.53	4	9.92	4
Production target slippage	2.7	5	3.47	5	9.37	5
Delay in agreeing variation/dayworks	2.62	6	3.28	6	8.59	6
Delay in settling claims	2.59	7	3.2	7	8.29	7
Problems with foundations	2.46	8	3.15	8	7.75	8
Underestimating project complexity	2.41	9	3.1	9	7.47	9
Estimating error	2.24	10	3.01	10	6.74	10
Under valuation	2.24	10	3	11	6.72	11
Delay in payment from client	2.08	12	2.35	12	4.89	12
Shortage of key materials	2.08	12	2.3	13	4.78	13
Delays in interim certificates	2.03	14	2.27	14	4.61	14
Delay in retention release	1.97	15	2.16	15	4.26	15
Inflation	1.96	16	2.03	16	3.78	16
Compliance with new regulations	1.78	17	1.95	17	3.47	17
Subcontractor's insolvency	1.7	18	1.81	18	3.08	18
Changes in interest rates	1.68	19	1.76	19	2.96	19
Shortage of key plant items	1.68	19	1.62	20	2.72	20
Access to funds at reasonable interest rate	1.46	21	1.62	20	2.37	21
Archaeological remains	1.46	21	1.54	22	2.25	22
Changes incurrency exchange rates	1.35	23	1.41	23	1.9	23
Civil disturbances	1.24	24	1.35	24	1.67	24
Labour strikes	1.19	25	1.32	25	1.57	25
Client's insolvency	0.11	26	0.49	26	0.05	26



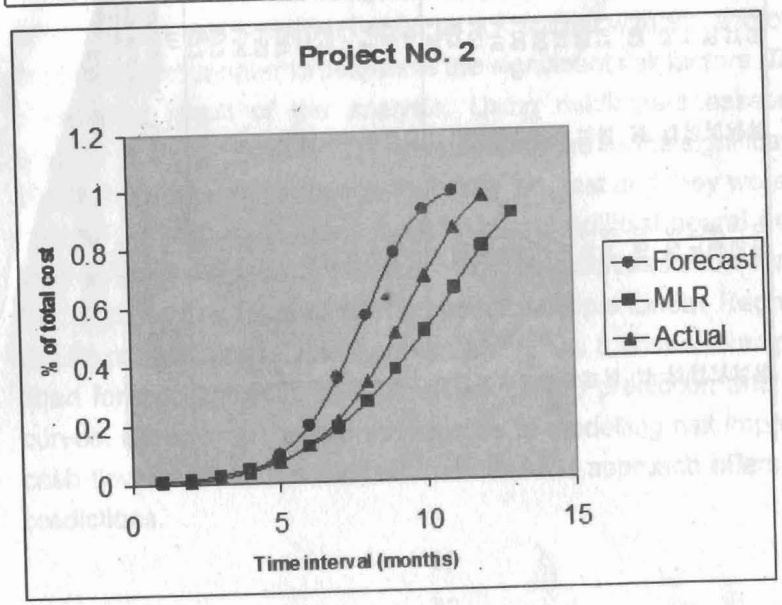
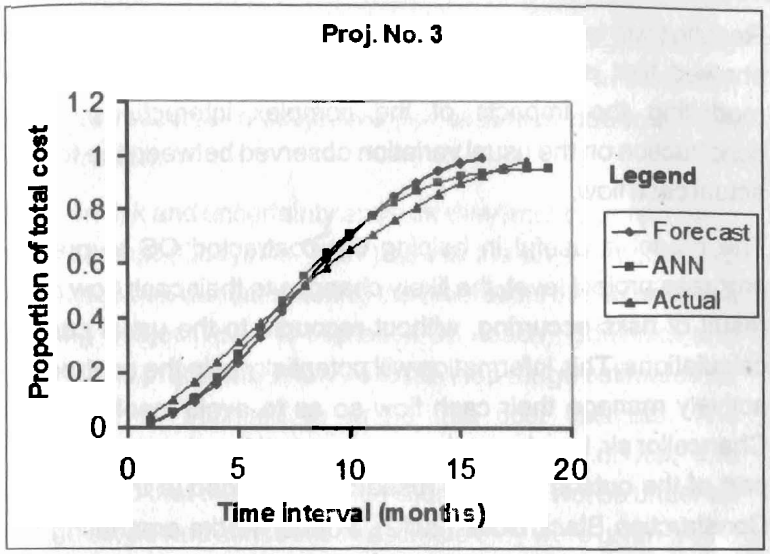


Fig. 7: Examples of fitted forecast, Multiple Linear Regression (MLR) prediction and actual curves



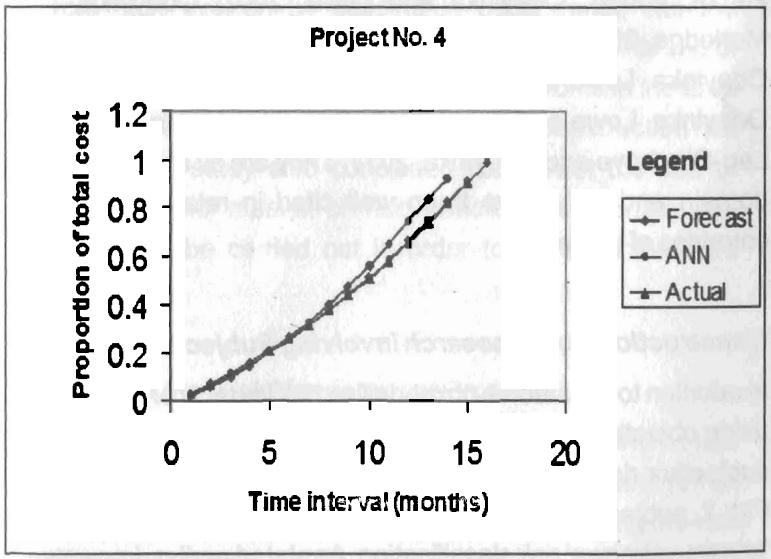


Fig. 8: Examples of fitted forecast, ANN prediction and actual curves

Results from testing and validating data from other case study projects showed that an artificial neural network model could be useful in modelling the impacts of the complex interactions of risks in construction on the usual variation observed between the forecast and actual cash flow.

The model is useful in helping the contractor' QS to predict at in-progress project level, the likely changes to their cash flow profile as a result of risks occurring, without recourse to the usual cumbersome calculations. This information will potentially help the contractor to pro-actively manage their cash flow so as to avoid insolvency. Mr Vice Chancellor sir, I am happy to announce to this esteemed gathering that part of the outcome of this research is included in the RICS QS and Construction Black Book (2012). Further works emanating from this study are as follows: Odeyinka and Lowe, 2000; Odeyinka and Lowe, 2001a, 2001b; Odeyinka and Lowe, 2002; Odeyinka, Kaka and Morledge, 2003; Odeyinka and Yusif, 2003; Odeyinka and Ojo, 2007; Odeyinka, Lowe and Kaka, 2008; Odeyinka, Lowe and Kaka, 2012; Odeyinka, Lowe and Kaka, 2013; Odeyinka, Larkin and Eadie, 2016; Leo-Olagbaye and Odeyinka, 2017. They are all available in the public domain and they have been well cited in related studies in other countries of the world.

Construction Cost Research involving Subjective Risk

In addition to my studies on modelling risk impacts on construction cost using objective risk, I have also carried out research projects exploring subjective risk. Using the cognitive model of risk earlier described in Fig. 2, subjective risk would be those under the 'uncertainty space' of 'known unknown' risk classification. As stated earlier, *known unknowns* 'risk classification' is the cognitive condition of *uncertainty* where a risk source has been identified but a probability cannot be assigned to the occurrence of the risk event. In order to assign probability in this case, one has to have recourse to subjective risk elicitation due to lack of complete information.

In my journey on risk and uncertainty and how they impact construction cost, my first attempt (Odeyinka, 1987) was in the area of subjective risk elicitation, howbeit without knowing the theoretical underpinning at the time. Using subjectivist risk elicitation approach, Odeyinka and Iyagba (2000) used probability analysis to develop range estimates for construction cost as opposed to single rate cost estimate. The approach was an attempt to incorporate the notion of risk into construction cost so that the construction clients would not be under an illusion that the single rate construction estimate they were given would be the out turn cost of the construction project. The approach was meant to avoid cost overrun by building in contingency into the estimate using scientific means and not relying on the rule of thumb of adding a certain percentage for contingency. Further works in the area of subjective risk is the use of insurance in managing construction risk (Odeyinka 2000). The study also concluded that whilst the use of insurance is a veritable means of risk transfer, appropriate risk assessment needs to be carried out in order to arrive at the right insurance premium.

Subjective Risk and the Risk Management Protocol

In construction project management domain, risk management has been acknowledged as the most difficult job of a project manager as construction project is always a very risky project. Overcoming the risk factors is what leads to successfully constructed facilities. The risk management framework (Fig. 9) involves: risk identification, risk

assessment/analysis, risk categorization, risk response and management strategy.

The most difficult aspect in the risk management framework is risk assessment/ analysis. This is the phase that involves risk elicitation. Since we are dealing with future risk, uncertainty is also involved and we are then operating in the 'known unknown' risk space in our cognitive model (Fig. 9). In this case also, we also need to take recourse to subjective risk elicitation. As such, the intellectual foundation of the risk management framework in construction project is the subjectivist school of thought.

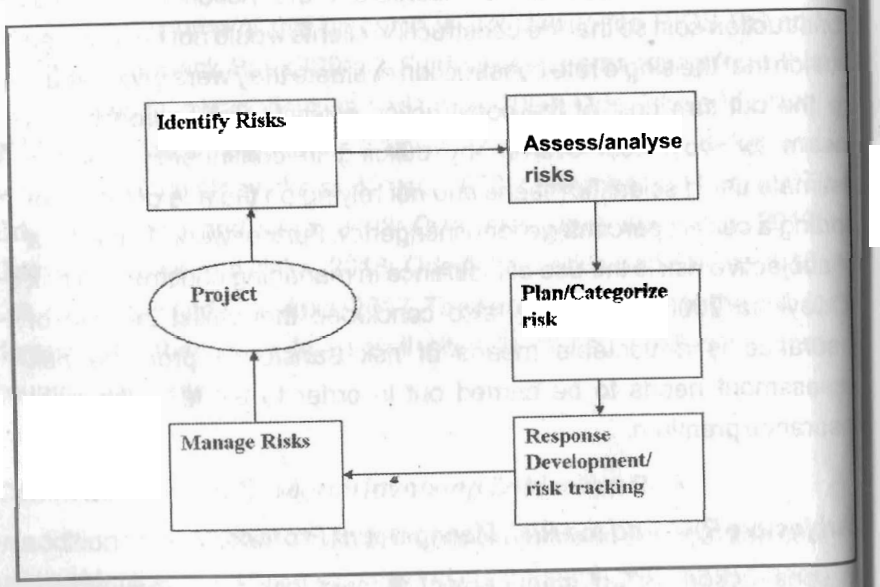


Fig. 9: The Risk Management Framework
Source: Mayterona (2013)

SUMMARY, RECOMMENDATIONS AND FUTURE DIRECTIONS

The journey into the world of researching risk and construction cost that commenced in 1986 during my MSc programme at the University of Lagos has now yielded fruits within the shores of Nigeria and outside the shores of Nigeria. The range estimates of construction cost which was my first seminal work was well received by eminent Quantity Surveyors in Nigeria. The study sponsored by the RICS leading to the development of models for assessing risk impacts on the variability between contract sum and final account was overwhelmingly received at an RICS Education Trust presentation made at the RICS Headquarters in London. It was also well received at RICS COBRA conferences held in Paris and Las Vegas. The RICS was proud to advertise the research output in her Construction Journal, November-December 2012 and this made the research output to be well received worldwide. However, like any seminal piece of work, it did not go without some criticisms and those who contacted me directly were given further explanations regarding the theoretical foundations and assumption made in developing the models. The ANN cash flow risk assessment model was also well received with positive comments from reviewers and some confirming it as innovative.

Mr Vice Chancellor Sir, in view of the progress made so far in pushing forward the boundaries of knowledge in unsettling uncertainties of construction regarding costing of construction works, the following recommendations are made:

(a) Construction is a risky and uncertain business, as a result, it is recommended that Quantity Surveyors are trained not only in the science and art of predicting construction cost but also in the science and art of risk and uncertainty management

(b) Traditionally, Quantity Surveyors are known to deal with risk and uncertainties involved in construction cost by adding contingency sum to their estimates. The addition is usually based on a rule of thumb or gut feeling with no rational or scientific basis. It is suggested that Quantity Surveyors embark on more pro-active approach to risk and uncertainty management.

c) Using the Bills of Quantities, Quantity Surveyors provide an estimate of the contract sum to the construction client without any qualification regarding whether the estimate could be exceeded or bettered. This gives the client a false sense of certainty, it is suggested that Quantity Surveyors should include as part of their advice to client, a qualification to their estimate, based on their prior knowledge of risk and uncertainties inherent in the project. This approach worked well in the 2012 London Olympic projects and the result was that the projects were delivered within budget and ahead of time, a great contrast and a huge success story when compared with Opera house, Sydney and Scottish Parliament projects.

Despite the applaud to the majority of my seminal works, it is sad to note that studies into quantity surveying problems are not receiving adequate research grants (both within and outside Nigeria) that will encourage researchers to move the frontiers of knowledge forward in the field of Quantity Surveying. I would like to use this august occasion to call on the Federal Government to have a particular look at this and make necessary amends.

It is also worthy of note that there abounds great potential in risk and uncertainty research in construction domain for those who may be interested in that area. For instance, we need to understand risk

impacts on project cost in other procurement methods like management contracting, public/private partnership (PPP) and construction joint venture. With the advent of Building Information Modelling (BIM), we expect some risk factors to be eliminated but the issue is that BIM itself will create its own risk and this also needs researching. Besides, our knowledge of risk impacts on the cost of infrastructure projects needs to be unlocked. In addition, while this author has concentrated on the use of MLR and ANN to develop risk assessment models, some other modelling methods need to be employed such as fuzzy logic or neuro-fuzzy which may have the potential of yielding better modelling predictions.

MY OTHER CONTRIBUTIONS

Mr Vice Chancellor sir, I am happy to note that I have not only contributed my humble quota to research, I have also contributed in the areas of Quantity Surveying professional services, University Administration within and outside of Obafemi Awolowo University and Academic Mentorship.

Quantity Surveying Professional Services

Within the space of 5 years that I was actively involved in core Quantity Surveying practice with Oye Adesida & Partners and Qu-Ess partnership, Ibadan (both of which are Chartered Quantity Surveyors), I was privileged to be involved in the pre and post contract services of the following projects:

(a) Federal Government low cost housing

(b) Administrative block of the Nigerian Institute for Social and Economic Research (NISER), Agbowo Ibadan.

(c) Staff Houses, NISER, Ibadan.

(d) Re-development of Heinemann Educational Building, Jericho Ibadan.

(e) Orisun students' Hostel Agbowo Ibadan

(f) Irawo students' Hostel, Ibadan

(g) Refurbishment of St. James. Cathedral, Oke-Ado, Ibadan.

During the Vice Chancellorship of Professor Wale Omole between 1996 and 1997, I was a member of Obafemi Awolowo University Staff Quarters Maintenance Group by virtue of my being the Acting Head of the Department of Quantity Surveying at the time. I was involved in carrying out housing condition survey of the staff quarters. Under this exercise, we were able to determine the quantities of materials required for staff quarters' rehabilitation. Following the success of that exercise, I was also invited to serve as a member of Obafemi Awolowo University Academic Buildings Rehabilitation Task Force. Under the Chairmanship of Professor Akingbohungbe as the DVC (Acedemic), I was involved in carrying out condition survey of academic buildings for maintenance purposes. That survey provided invaluable information for costing which was used in determining priorities for tender award. Moreover, as a member of the Obafemi Awolowo University Capital Projects' Advisory Sub-Committee between 1995 and 1998, I was involved in providing professional advice regarding contractor selection and contract award. Between 2005 and 2006, at the instance of the then Vice Chancellor, Professor Roger Makanjuola, I was involved in valuing new works done on the extension to the University Conference Centre for the purpose of settling investment accounts.

At the professional level, I served as an Examiner to the Nigerian Institute of Quantity Surveyors (NIQS) between 1996 and 1999.

Currently, I am still serving as an Examiner. I also served as an Examiner to the Nigerian Institute of Building (NIOB) between 1996 and 1998. Moreover, I served as a member of the Cost Research Group of NIQS between 2015 and 2017 and I have served as a guest speaker and resource person at many RICS events.

In offering my professional services, I have been privileged to be a member of many professional bodies. I am a Fellow of the Nigerian Institute of Quantity Surveyor (FNIQS) and a Registered Quantity Surveyor (RQS) with the Quantity Surveyors Registration Board of Nigeria (QSRBN). I am a Fellow of the UK-based Higher Education Academy (FHEA), member of the Royal Institution of Chartered Surveyors (MRICS), a member of the Association for Project Management (MAPM) and a member of the Association of Researchers in Construction Management (ARCOM).

My Contribution to University Administration in Obafemi Awolowo University

At the Departmental level, I was the first alumnus of the Department to be appointed as Acting Head of the Department of Quantity Surveying (1995-1998 and 2005-2006) and I am also the first alumnus to serve as full Head of the Department in professorial capacity (2015-2018). As an Acting Head of Department in 1997, I successfully coordinated the first ever MSc viva in Quantity Surveying. History was made then as we had two students supervised by Prof. G.O Jagboro completing their MSc thesis and examined by Prof. Kunle Ade Wahab (internal examiner) and Prof. M.O Ogedengbe (of blessed memory and also an internal examiner) and Prof. T.C Mogbo (Federal University of Technology, Minna as external examiner). It is worthy to note that under my current

headship, the enrolment on Msc programme has now grown to about 25 MSc students.

Also as an Acting. HOD in 2005, I commenced the supervision of the first ever PhD student in the Department. When it became necessary for me to travel out of the country, the supervision was transferred to Prof. (Mrs) M.O. Babalola with the candidate (Dr. Mrs G.K Ojo) successfully completing in 2010. It is gratifying to see that the small beginning has now grown to a current enrolment of about 12 PhD students at different stages of completion.

It is also worthy of note that under my headship in 1997, the Department moved from a 6.00m x 7.00m office that housed it for many years to a block of ten offices. In 2005 as an Acting Head of Department, I initiated prize awards for various courses in the Department in order to promote academic excellence. I'm happy to announce that today, there is no course at final year level that does not have a prize award associated with it. I am also grateful to the donors, many of whom are present at this lecture. In order to lift the profile of the Department to international standard, between 2005 and 2006 as an Acting Head of Department, I approached FO.AB and Partners (one of the leading QS firms in Lagos) and Masterbill, London (producers of dedicated QS software) to donate computers and software for teaching our students in tandem with international standard. I'm happy to announce that the initiative translated into the Department having an FO.AB and Masterbill Computer laboratory. Under my current headship and with the generous support of our alumni, some of which are present at this lecture, the computer lab has been transformed to an ultra-modern computer lab that the students and staff are proud of.

Currently and also in tandem with international practice, I am leading the Department in setting up measurement studios in order to enhance

the measurement skills of our students. I am happy to announce that with the help of the Dean, Heads of the Departments in the faculty and Faculty professoriate, the Department will soon be moving to the new Faculty building where there will be ample space to accommodate our measurement studios, computer lab and staff offices. Also as part of my stewardship in the Department, to the glory of God, I successfully led the Department to full National Universities Commission (NUC) accreditation in 2005. I also led the Department in another NUC accreditation in November 2017 and I'm happy to announce to this esteemed gathering that with the report received a few weeks ago, the Department got another full NUC accreditation for the next five years. By the time I joined the Department in 1988, the Department was given little or no chance of survival as it was considered as an endangered specie. I am however thankful to God that today, with the help of the founding fathers, successive university administrations and a virile body of committed alumni, the Department has now taken its pride of place within the university community.

At the Faculty level, I have been a member of various statutory committee. It is however worthy of note that more recently I have held some positions in advancing the course of the Faculty. Currently, I am the Editor-in-Chief of the Faculty journal, the Journal of Environmental Design and Management (JEDM). In the last four years, I was able to lead a team of highly committed faculty staff to re-brand the journal and ensure that the journal is produced twice a year. Between 2013 and 2017, I was the chair of the Faculty Conference Committee, Environmental Design and Management International Conference (EDMIC). Again, leading a team of exceptionally committed faculty staff, we were able to raise the profile of the conference from being a local one to a truly international conference. We were able to draw high profile keynote speakers from UK, Unites States, Australia and South

Africa. We were also able to draw participants from UK, US, Hong Kong, South Africa, Australia and New Zealand in addition to teeming participants from various institutions in Nigeria. In addition, between 2013 and 2017, I was the chair of the Faculty Book of Readings Committee. The mandate given to the Committee by the then Dean, Professor B. T. Aluko was to produce a Book of Reading in honour of the foundation Dean, Professor Kunle Ade Wahab, having been made an Emeritus Professor. Again, leading a team of highly committed Faculty staff, we were able to produce an epoch-making book: *Meeting Nigeria's Housing Needs* which was launched in July 2017 with Emeritus Professor Kunle Ade Wahab in attendance and under the chairmanship of the current Vice Chancellor, Professor Eyitope Ogunbodede.

At the university level, I have served as a member of the 2016 – 2020 university strategic planning committee. To the glory of God, I was able to serve meritoriously under two sub-committees. Under the leadership of Professor Funso Sonaiya, I was able to serve the Research and Innovation sub-committee. Under the leadership of Professor Bayo Amole, I was also able to serve the Environment sub-committee. I actively participated in drafting part of the report which culminated in the 2016 – 2020 University Strategic Plan which is available on the university web page. In addition, I have been a member of the Business Committee of Senate since 2015 and I have been able to contribute my humble quota to various senate matters referred to the committee.

My Contributions in other Universities

Mr Vice Chancellor sir, whilst giving the account of my stewardship within the confines of Obafemi Awolowo University, kindly permit me to

say a bit about my stewardship in other universities I have been privileged to be associated with outside of Nigeria and within Nigeria.

As a PhD student in the United Kingdom when my PhD studentship grant was exhausted, I had to seek employment in order to complete my studies. To the glory of God, a door opened up at Nottingham Trent University, Nottingham where I was employed as a Senior Lecturer. Between 2003 and 2005, I functioned in that capacity and I was privileged to meet the 'best measurer' in the world at the time, Roger Winfield. I had thought that I was a good lecturer in measurement of construction works but my encounter with him humbled me to the extent that sometimes I had to request him to allow me sit in his measurement class even though I was a lecturer. At Nottingham Trent, I was privileged to become a very good measurement lecturer and a very good module coordinator to the extent that students were literally weeping at the time I had to return home. Measurement of construction works is a course many QS lecturers would rather avoid due to its demanding nature. However, the rare experience I gained at Nottingham Trent never left me and I'm happy to state that much as I would rather have wished to avoid teaching measurement but up till now, I still find myself teaching measurement of construction works to our first year undergraduate students.

In 2006, I had to return to the UK due to some compelling reasons. There, I found employment at the University of Ulster, Belfast, UK. To the glory of God, I was again privileged to meet world class researchers who taught me that research is not just in the number of papers one is able to churn out but in research quality and impact. At the University of Ulster, I did not only learn about theories of teaching and learning, I also learnt about grantmanship. At Ulster, I was able to take my research to another level as I was admitted to the prestigious Built Environment

Research Institute (BERI) and I was able to attract some grants and had opportunities to present my research outputs in various national and international conferences in the UK, France, India, South Africa, Canada, United States and UAE. Consequently, my research outputs were also included in the UK wide research assessment exercise of 2008 and the Research Excellence Framework of 2013. At Ulster, I learnt about teaching and research nexus and the need for teaching and research to be aligned. That made me take a bit of shift form core Quantity Surveying to Construction Project Management and Construction Commercial Management. As part of the strategic plan of the university, I had to lead a team of lecturers in developing a new postgraduate programme: PgD/ MSc Commercial Management in Construction on which I later became the Course Director.

In addition to developing a new course, I was heavily involved in PhD supervision as well as engagement in funded research projects. At the university level, I was involved in RICS sponsored research and university sponsored research projects. At the national level, I was invited as a resource person to serve on a UK government project, seeking to understand the experiences of Black and Minority Ethnic Group in UK Higher Educational Institutions. I have also served as an External Examiner to Leeds Metropolitan University (now Leeds Beckett University, Leeds, UK) and Salford University. The teaching and research experiences gained are now invaluable assets for use as we are currently re-designing the postgraduate programmes in our Department at OAU.

Back home in Nigeria, I am currently involved as an External Examiner on Quantity Surveying undergraduate programmes at Ahmadu Bello University, Zaria, Federal University of Technology, Minna and University of Ilorin, Ilorin. In addition, I am currently an External

Examiner on Quantity Surveying postgraduate programme at the University of Lagos and I served between 2014 and 2017 as an External Examiner on MSc Construction Management programme at the University of Lagos.

Mr Vice Chancellor sir, I am happy to announce to this esteemed gathering that I was recently invited to be a member of Senate of the new Technical University, Ibadan to coordinate one of the new programmes being proposed for future development. I am also happy to announce that at the first Senate meeting held in March 2018, I was elected on the floor of Senate as a Council member of the new University.

Academic Mentorship

Mr Vice Chancellor sir, as the saying goes, *the greatest exercise for the heart is to bend down and lift someone else up*. In the course of my academic sojourn, I have been privileged to contribute to mentoring the next generation of Quantity Surveying professionals and academics. I have contributed to the training of well over 1,000 Quantity Surveying graduates here in Nigeria and the United Kingdom. It is also heartwarming to note that the majority of them are gainfully employed and some of them are part of this esteemed gathering. I have also supervised many MSc theses to successful and timely completion. Whilst in the UK, I supervised 3 PhD and 1 MPhil to successful completion. Since my return to Nigeria in 2013, I was privileged to be invited by Prof Ogunsemi and Prof Aje of the Federal University of Technology, Akure to co-supervise to successful completion, the first PhD thesis in Quantity Surveying to be presented by an Oba in Southwestern Nigeria. It is a thing of joy to have Oba (Dr) Samuel Olatunji, the Onimojo of Imojo Ekiti in Oye Local Government of Ekiti

State here with us today. He did not come alone but also in the company of other eminent Royal fathers. Here in OAU, I am currently supervising 3 PhD thesis and one is scheduled for oral exam within this month and two others at advanced stages of completion. At Covenant University, I am also co-supervising a PhD work which is also at an advanced stage of completion. In recognition of my works in financial modelling, I have been invited by colleagues at the University of Cape Town, South Africa to co-supervise 2 PhD projects and one is at the final thesis write-up stage.

CONCLUDING REMARKS

Undoubtedly, many hands have lifted me up in my professional and academic journey. Mention cannot but be made of Emeritus Professor Kunle Ade Wahab for his boldness in establishing Quantity Surveying as a course at OAU despite the palpable risk and uncertainties at the time. Your singular determination and mentoring genius sir has helped me to fulfill my destiny. Mention must also be made of Mr Vincent Agha of Qu Ess Partnership, Ibadan who believed in me and gave me opportunities at a young age to be exposed to Quantity Surveying services of diverse projects in Ibadan. I cannot but also mention Professor Reuben Iyagba for introducing me to the world of risk Management in construction during his MSc class in 1987 at the University of Lagos. I salute Professor Akin Akintoye, currently Dean School of Engineering and Built Environment, Leeds Becket University, Leeds for being a tool in God's hand to re-shape my destiny by helping me secure a PhD studentship at Glasgow Caledonian University, Glasgow, UK. I am also grateful to Dr John Lowe (Glasgow Caledonian University), Dr Helen Lowe of Strathclyde University (late) and Prof. Ammar Kaka (Heriot Watt University) who supervised my PhD research to successful completion.

I would like to specially appreciate the contributions of the various academic mentors in my life. The list is endless but the following deserve special mention: Prof. J.I. Ighalo, Prof. Ralph Mills-Tettey, Prof. O.T Olateju (of blessed memory), Mr. D. K Kyere, Mr Amoa-Mensah, Prof. Bayo Amole, Prof. G.O Jagboro, Prof C. A. Ajayi, Prof. D.A Adesanya, Prof. S.O. Fadare, Prof. J.R.O Ojo, Prof. Ogunjumo, Prof. I. O. Okewole, Prof Olayiwola, Prof I.J Ikpo, Prof. K. O. Ajibola, Prof (Mrs) C.O. Osasona, Prof. Femi Ajibola, Prof & Mrs Kehinde, Prof. Stanley McGreal, Prof. George Heaney, Prof. Paul Olomolaiye, Prof. Stephen Ogunlana, Dr. Femi Olubodun, Prof. Charles Egbu, Dr & Mrs. Komolafe, Prof. Odu, Prof and Mrs Adeniyi.

It is also important for me to acknowledge the unflinching support I have received from academic and non-academic staff in my Department over the years. Mention cannot but be made of Professor G. O Jagboro, Prof (Mrs) M.O. Babalola, Dr (Mrs) G. K. Ojo, Dr J. O. Dada, Dr N. A. Musa, Mr. D. S. Kadiri, Dr A. Opawole, Dr S. O. Babatunde, Dr S. J. Odediran, Mrs B. F. Akintola and Mrs E. I. Ebunoluwa.

Mention must also be made of the singular contribution of Prof. Tale Omole, the immediate past Vice Chancellor for believing in me and giving me the chance to return to my alma mater to contribute my quota after my sojourn abroad. Mention must also be made of Prof. Ayobami Salami, the immediate past DVC (Academics) and currently, the Vice chancellor of Technical University, Ibadan for inviting me to be a member of Senate of the new university and thus giving me an opportunity to be elected as a council member of the young but promising university. I cannot but also acknowledge Prof. Matthews Ojo, the current Vice Chancellor, Bowen University for being a true senior brother, a cheerleader and a mentor.

I would also like to acknowledge the contribution of the current president of the Nigerian Institute of Quantity Surveyors, QS Obafemi Onashile who is the first alumnus of this University to occupy that exalted position. His support to our Department over the years is phenomenal. I also acknowledge the contribution of other distinguished alumni here seated and those watching online. Special mention must be made of the Quantity Surveying Alumni chairman, QS Olayemi Shonubi whose love for the growth of the Department shines through in all he does. Special mention must also be made of QS Taiwo Olutimilehin, QS Tunde Asupoto, QS Sesan Obe and QS Banji Adesanmi who have at one time or the other risen to the occasion by giving generously to advance the course of the Department.

I would also like to specially acknowledge the contributions of distinguished colleagues from sister universities – Prof. K.T Odusami (an alumnus of OAU and former Dean, Faculty of Environmental Studies, University of Lagos), Prof. D.R Ogunsemi, (an alumnus and former Dean Faculty of Environmental Technology, Federal University of Technology, Akure); Prof. O.S Oyediran, (an alumnus and foundation Head, Department of Quantity Surveying, University of Lagos); Prof Iroro Idoro (an aumnus and former Head, Department of Building, University of Lagos), Prof. Bopo Fagbenle, (an alumnus and former Head, Department of Building, Covenant University), Dr Ade Oladapo, (an alumnus and a Course Director at the University of Central Lancashire, Preston, UK and Dr A. A. Aibinu, (an alumnus and an Assistant Dean (Research), Melbourne University, Australia.

I want to specially recognize the presence of the Royal fathers here present, the Vice Chancellor of Technical University, Prof A. T. Salami, Members of Council, Principal Officers and members of Senate of Technical University, Ibadan, my esteemed colleagues from other

universities: Bells University, Covenant University, Federal University of Technology, Akure, University of Ibadan, University of Lagos, University of Ilorin, etc. I also recognize the presence of my esteemed colleagues from various Polytechnics, various Ministries of Works and Local Governments in Oyo, Ogun, Ondo, Osun, Ekiti and Lagos States. I specially recognize the presence of the representative of the President of the Nigerian Institute of Quantity Surveyors, State Chairmen and members of Senate of Oyo, Ogun, Ondo, Osun, Ekiti and Lagos States Chapters of the Nigerian Institute of Quantity Surveyors. The sacrifices you made to attend this occasion are much appreciated.

Special mention must be made of Rev. (Prof.) G.E Erhabor, the President, Spokesman Communication Ministries and Pastor of Sanctuary of Hope Church, Ile-Ife who is my spiritual father, mentor and coach and who has been my pastor for the last 30 years since I joined the services of Obafemi Awolowo University. His indepth teachings and leadership expertise have greatly enriched my life. His labour of love has contributed immensely in making me who I am today and his pastoral care is manifested in his visits to wherever I was in my sojourn outside the country. From you I have come to learn that *out of the broken pieces of my past, God can build an edifice of hope*. I cannot but also appreciate the rock solid support of Rev. Mrs. Ayodele Erhabor at all times, you are one in a million.

I want to use this occasion to publicly appreciate Prof. and Mrs. L.O Kehinde for lifting me out of the horrible pit in my darkest hour and for always offering godly solutions whenever I am at cross roads in matters of university administration. I also appreciate Pastor (Dr.) Cecil & Mrs. Evelyn Stewart for providing me spiritual support during my sojourn at the University of Ulster. Also Pastor (Dr) and Pastor (Mrs) Alawale for

providing me spiritual support during my sojourn in Nottingham. I also appreciate the graceful support at all times of Pastor (Dr) and Pastor (Mrs) Odun Orioke and Rev (Dr) Mike Oye. I celebrate you all.

I would like to specially appreciate my late parents, Chief and Mrs Adigun Odeyinka for giving me a good head start in life and for providing me with the opportunity they never had. I appreciate the support of my siblings at all times, Mr. Emmanuel Adigun Odeyinka (late), Pastor Jimmy Adigun Odeyinka, Engr. Billy P. Odeyinka, Mrs Rebecca O. Oladejo, Mrs. Bosede Omoregbee and Mrs. Olapeju Okodogbe. I also warmly appreciate the entire Odeyinka family and family connections – all here seated and those watching online. I also warmly appreciate my distinguished in-laws, Pastor & Mrs. R.A Teniola, Mrs R.A Popoola, Dr. & Mrs. S.O Teniola and Prof. & Mrs Omoigui. To everyone who has helped in one way or another to make this Inaugural Lecture a huge success, I say thank you. For everyone who has taken time to honour me with your attendance on this occasion, I say a big thank you.

This lecture will not be complete without a special mention of my loving, caring, darling wife, Simisola Mercy Odeyinka. A woman that loves so much and cares so much. Indeed, you are a pillar of support who held the family together despite your busy roles during my sojourn away from home. In the word of the late sage, Obafemi Awolowo, you are indeed a jewel of inestimable price! Our lovely children also deserve a special mention: Toluwani, Inioluwa and David, Son-in-law: Zuwa Omoigui and grandson Asiel. I love you all and I thank you for your understanding when I could not spare as much of the time I ought to spend with you.

Last but not the least, I want to give glory and thanks to the Almighty God, who causes me to triumph in all situations and makes me an

aroma of His knowledge in every place. To the one who alone dwells in light so dazzling that no mere man can approach, to the immortal, invisible God, the only wise God, I say thank you for taking me thus far in my life's journey. I thank you because you will take me further and faster yet. To you be glory forevermore!

Mr Vice Chancellor sir, Principal Officers, Royal fathers, Distinguished guests, esteemed alumni, ladies and gentlemen, I thank you all most sincerely for your attention and I pray that the God of heaven will unsettle all uncertainties ahead of you and give you clarity in Jesus' name.

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