An Investigation of the Effects of Cost Overrun Factors on Project Delivery Methods in Nigeria

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ABSTRACT

The construction industry is an important sector of every economy the world over and as such it has its own peculiar problems, one of which is cost overrun. This study aims at investigating the effects of cost overrun factors on the various types of project delivery methods in Nigeria. Data for the study was elicited through questionnaires administered to experts and stakeholders in Edo and Delta States respectively. The questionnaire contained 32 cost overrun factors which were sub-divided into various groups according to their sources. Ninety six (96) of the questionnaires were sent to the respondents comprising 24 each from four groups that were randomly selected using the stratified random sampling technique. Descriptive and inferential statistics were both deployed in analyzing the data viz; fuzzy set analysis, analysis of variance (ANOVA) and earned value management (EVM) methodology. The study shows that a substantial relationship exists between project cost overrun and the delivery methods used in project execution in the study area. The results revealed that inaccurate cost estimates by cost estimators, changes in work scope by client and low price bidding by contractors top the list of major causes of cost overruns in Nigeria. The findings further revealed that the rate of project cost overruns was 45.56%, while the rate of project cost overruns lies between 30% and 58% of the total project cost. The results further revealed that the client is more prone to risk (65%) in Design Bid-Build (DBB) delivery method, while contractors are more prone to risk (54%) in Construction Manager at Risk (CMR) delivery methods; both clients and contractors bear 20% and 33% risks respectively in Design and Build (DB) delivery methods. The study concludes by recommending that government should discourage the use of Design-Bid-Build as the main official procurement method, and the need to adopt other viable alternative procurement methods that will protect the client from cost overrun tendencies.

Keywords: Cost overrun, contract types, construction project, delivery methods

I. INTRODUCTION

In recent times, there have been efforts geared towards delivering projects on schedule and within the budget. However projects are accomplished with delays and cost that are far above the budgeted cost. Unlike other industries, the uncertainties which are inherent in construction

projects are enormous. In contemporary times the nature, incidence and impact of risk in the construction industry has become a topic of discourse in recent times [1]. Therefore, the successful execution of construction projects and keeping them within the estimated cost depends on the procurement approach used in bidding, managing, and specifying a project [2].

In Nigeria, the conditions of contract as prescribed by the Federal Ministry of Works, states that no change to a contract sum can be made except it is provided for in the conditions of contract. Hence, for an increase in contract sum to be legal, it has to trace its roots to one or more of the contractual clauses. Risk allocation by contract clauses solely depend on the type of project delivery method adopted in project procurement [3],[4]

The initial stage of construction contract is usually characterized by high degree of imagination and abstraction; hence the client does not have the holistic view of the bottlenecks, before committing himself. Thus risks are important to the contractor as well as client and consultants in the industry. However the problems of risk assessment are complex and poorly understood in practice [5]. Hence, good risk assessment procedures are very necessary in order to measure the confidence level on an ongoing project and allowing the introduction of corrective measures and monetary contingencies so as to minimize the incidence of cost-overrun. This will increase the likelihood of the project being completed on schedule and within the budgeted cost estimate. Thus, the assessment process is very critical in order to make the best guess, which mostly is based on assumptions and expectations derived from the present knowledge for the future.

A. Statement of the Problem

Previous researchers have identified various causes of cost overrun in construction projects, [6]. However, attempts to determine the rate and effects of cost overrun in construction project is very rare. As opined by [7], cost overrun is one of the most important problems bedeviling the construction industry. They further stated that cost overrun is a very frequent phenomenon and is almost associated with all projects of construction industry in a myriad of ways. [8] in a study reiterated that, time and cost overruns impedes on the productivity of available economic resources, edges development potentials while also diminishing the effectiveness of an economy to a large extent. According to [9], the construction industry is endowed with a lot of projects that were completed far above their estimated cost. [9] further opined that the problem is not unique to developed countries alone, but is also experienced in most of the developing economies of the world. This research work therefore attempts to find out the effects of cost overruns factors on the contracting parties in the different construction delivery methods.

B. Objectives of Study

The objectives of this study are to:

i. Investigate the effects of cost overrun factors on the various types of project delivery methods in Nigeria.

C. Research Hypotheses

Ho_1: - Project cost overrun has no significant effect in the construction industry.
Ho_2: - Project cost overrun has no significant effect on project delivery methods.

Ho_3: Cost overrun factors have no significant effect on construction projects in the study area.
Ho_4: - Cost overrun factors do not have significant effect on the different types of project delivery methods in Nigeria

This empirical study on cost overruns in Nigeria was undertaken as a result of the lack of previous studies on effects of cost overruns on project delivery methods. The study would enable clients/stakeholders to assess and review project cost and risk factors before adopting a particular delivery method that would be able to reduce or curtail cost overruns as well as eliminate all the envisaged threats to project objectives. Thus, the application of the solutions proffered, will restore clients confidence on consultants with a view to producing realistic estimates that would not likely be exceeded.

II. LITERATURE REVIEW

Project cost overrun is when the actual cost of a project is more than budgeted cost of work with a margin above 5% acceptable contingency cost, thereby, creating a situation where the provision for contracted work would require more financial resources than the originally agreed upon price between the client and contractor. Hence, risk is a significant element of the total project costs and thus its allocation has a major effect on project's budget [10]. [11] defined cost overrun as the increase in the amount of money required to construct a project over and above the original budgeted amount.(p.35).

A. Managing Cost Overrun with Different types of Contracts

While construction contracts serve as a means of pricing construction projects, they also structure the allocation of risk to the various parties involved. The client has the sole power to decide whatever type of contract to be used for a specific project and to set forth the terms in a contractual agreement. The various types of construction contracts are as stated below;

B. Lump Sum Contract: - In a lump sum contract, the owner essentially assigns all the risk to the contractor. The contractor in turn asks for a higher markup in order to take care of unforeseen contingencies. If the actual cost of the project is underestimated, the underestimated cost will reduce the contractor's profit by that amount. An overestimate has an opposite effect, but may reduce the chance of being a low bidder for the project. The inherent disadvantage of this type of contract is that it threatens the quality of construction because of the contractor's inclination to cut corner in an effort to reduce cost [12].

C. Unit Price Contract: - In a unit price contract, the risk of inaccurate estimation of uncertain quantities for some key tasks has been removed from the contractor. However, some contractors may submit an "unbalanced bid" when they discover large discrepancies between their estimates and the owner's. Depending on the confidence of the contractor on its own estimates and its propensity on risk, a contractor can slightly raise the unit prices on the underestimated tasks while lowering the unit prices on other tasks. If the contractor is correct in its assessment, it can increase its profit substantially since the payment is made on the actual quantities of tasks. And if is the other way round, a contractor may lose the bid on this basis. Furthermore, the owner may disqualify a contractor if the bid appears to be heavily unbalanced.

D. Cost Plus Fixed Percentage Contract: - In this type of contract, the contractor earns an agreed percentage of the cost as his/her fee. This may encourage the contractor to spend more on the work because he/she earns more with an increase in the cost of work [12]. For certain types of construction involving new technology or extremely pressing needs, the owner is sometimes forced to assume all project risk. The contractor will receive the actual direct job cost plus a fixed percentage, and have little incentive to reduce job cost. Furthermore, if there are pressing needs to complete the project on time, overtime payments to workers are made and this will further increase the total cost of the project [13].

E. Cost Plus Fixed Fee Contract: - Under this type of contract, the contractor will receive the actual direct job cost plus a fixed fee, and will also have some incentive to complete the job quickly since its fee is fixed regardless of the duration of the project. However, the owner still assumes the risks of direct job cost overrun while the contractor may risk the erosion of its profits if the project is delayed on beyond the project duration [12].

F. Cost Plus Variable Percentage Contract: - For this type of contract, the contractor agrees to a penalty if the actual cost exceeds the estimated job cost, or a reward if the actual cost is below the estimated job cost. In return for taking the risk on its own estimate, the contractor is allowed a variable percentage of the direct job-cost for its fee. Furthermore, the project duration is usually specified and the contractor must abide by the deadline for completion. This type of contract allocates considerable risk for cost overruns to the owner, but also provides incentives to contractors to reduce costs as much as possible [13].

G. Target Estimate Contract: - This is another form of contract which specifies a penalty or reward to a contractor, depending on whether the actual cost is greater than or less than the contractor's estimated direct job cost. Usually, the percentage of savings or overrun to be shared by the owner and the contractor are predetermined and the project duration is specified in the contract. And also, bonuses or penalties may be stipulated for different project completion dates [14].

H. Guaranteed Maximum Cost Contract: - When the project scope is well defined, an owner may choose to ask the contractor to take all the risks, both in terms of actual project cost and project time. But, once the maximum price is reached, all the risks belong to the contractor [12]. Once the predetermined price is reached, any work change orders from the owner must be extremely minor if at all, since performance specifications are provided to the owner at the outset of construction. The owner and the contractor would agree to a project cost guaranteed by the contractor as Guaranteed Maximum Price (GMP).

Finally, regardless of the type of construction contract selected by the owner, the contractor recognizes that the actual construction cost will never be identical to its own estimate because of imperfect information [14].

I. Project Delivery Methods

A project delivery method equates to a procurement approach and defines the relationships, roles, and responsibilities of project team members and sequence of activities required to complete a project. A contracting approach is a specific procedure used under the large umbrella

of a procurement method to provide techniques for bidding, managing, and specifying a project [2].

Delivery methods for capital project construction are a mainly traditional process which evolves during the industrial revolution age, where specialization of professional organizations was the key trend then [3]. The polarization of construction from design stage in the construction industry has risen above the expected efficiencies due to specialization and perceived need for independent design and construction. But resulting from fragmentation and adversarial contractual principles, which has been seen by stakeholders as an unfortunate departure from the single-point procurement provided by the master builder of centuries ago. Attempts to redress these imbalances have led to experimentation with a proliferation of procurement options. These include different approaches such as:

i. The allocation of design, construction, supervision and management functions

ii. Distribution of risk as reflected in the various contract conditions

iii. Mode of payment

iv. Selection of project team and sub-teams

The different delivery methods are distinguished by their approach, the contract between the owner, the designer, and contractor are formed and the technical relationship that evolve between each party in these contracts.

According to the Construction Industry Institute CII, there are only three fundamental project delivery methods: Design-Bid-Build (DBB), Design and Build (D-B), and Construction Manager at Risk (CMR). Although there are other multitude of names for project delivery methods throughout the industry, but the CII has simplified the categorization process by focusing specifically on the contract's content and the roles of each contracting party. Thus the various delivery methods would be discussed in light of the roles and responsibilities of the contracting parties in the three major delivery methods.

J. Design-Bid-Build (DBB)

Design Bid Build is the traditional project delivery method in which a client either completes the design using his/her own design professionals or retains a designer to provide complete design services. He/she then advertises and awards a distinct construction contract based on the completed construction documents. The owner maintains most of the risk and is responsible for the details of the design. After the completion of the project, the owner is responsible for operating and maintaining of the project.

In a Design Bid Build, the client "owns" the details of design during construction and as such is financially liable for the cost of any errors or omissions encountered in construction. This is called the "Spearin Doctrine". Public DBB projects are generally awarded on a low-bid basis. There is no contractual incentive for the contractor to minimize the cost growth in this delivery system. A contractor who has submitted a low bid may need to look to post-award changes as a

means to make a profit on the project after bidding the lowest possible margin to win the project [15]; [4].

Design-Bid-Build (DBB) projects can also be awarded on a negotiated basis and a best-value basis. In both cases, the probability that the project will be awarded to a contractor who has submitted a mistakenly low bid is reduced [15].

Regardless of the award method, DBB is distinguished by little contractor input to the design. Thus, the owner relies heavily on the designer alone for constructability review.

K. Construction Manager at Risk (CMR)

There are two types of construction manager (CM) arrangement namely Construction Manager at Risk (CMR) and Construction Manager at Fee (CM @ Fee). Construction Manager at Risk (CMR) projects are characterized by a contract between a client and a construction manager who will be at risk for the final cost and time of construction. The original idea of CMR is to furnish professional management at all phase of a project life for a client whose organization may not have that capacity internally [16]. In this arrangement, the client authorizes the construction manager to provide inputs during the project design stage. The Construction Manager (CM) acts as the general contractor during construction, that is, the Construction Manager holds the risk of subletting the construction work to trade subcontractors and guaranteeing completion of the project for a fixed, negotiated price which is the Guaranteed Maximum Price (GMP). Above this price, the client is not responsible for payment, if the project scope change after the Guaranteed Maximum Price (GMP) has been established. Often, this contract also includes incentive clauses in which the Construction Manager at Risk (CMR) and the client can share any cost saving realized below the GMP. However, in this scenario, the Construction Manager (CM) also provides advisory professional management assistance to the client prior to construction, offering schedule, budget and constructability advice during the project planning phase. Thus, instead of a traditional general contractor, the owner deals with a hybrid construction managers/general contractors [17].

In addition to providing the owner with the benefit of pre-construction services which may result into advantageous changes to the project, the CM-At-Risk scenario offers the opportunity to begin construction prior to completion of the design. The CM can bid and subcontract portions of the work at any time, often while design of unrelated portion is still not complete. Furthermore, CM may allow performance specifications or reduced specifications to be used, since the CM's input can lead to early agreement on preferred materials, equipment types and other project features. However, most commonly, the client retains the traditional responsibility of keeping a separate design contract team to furnish the CMR with a full set of plans and specifications upon which all construction subcontracts are based [18].

According to Project Delivery System for Construction [19] the characteristics of the CMR are that:

i. The designer and the CMR hold separate contracts with the owner (as opposed to DB), and
ii. The CMR is chosen based on a criterion other than just the lowest construction cost (as opposed to DBB).

Enhanced constructability, real-time construction pricing capability, and speed of implementation are the major reasons why a client would select the CMR method. Unlike DBB, CMR brings the contractor/builder into the design process at a stage where definitive input can have a positive impact on the project. The construction Manager at risk CMR can and is expected to provide realistic project cost estimates early in the project life cycle.

L. Construction Manager at Fee (CM-@ FEE)

The Construction Manager at Fee is not contractually responsible for the project cost or schedule. Its role is purely consultative and should not be confused with Construction Manager at Risk who ultimately delivers the project within contractual set time and cost limits. Thus, Construction Manager at Fee is not a project delivery method but rather a project management method [20]. This process is similar to the traditional method, in which the client is responsible for the design, bidding, and construction of the project. However the construction manager (CM) takes on the responsibility for the administration and management, the constructability issues, day-to-day activities, and also assumes an advisory role to the owner. The Construction Manager (CM) organization has no contractual obligations to the design and construction entities.

M. DESIGN-BUILD (DB)

The Design-Build (DB) method dates back to the construction of pyramids, when it was referred to as master builder. Design-Build (DB) is a project delivery method in which the client procures both design and construction services in the same contract from a single, legal entity referred to as the design-builder. The method typically uses request for qualifications (RFQ)/ request for proposals (RFP) procedures rather than the DBB invitation for bids procedures. There are a number of variations on the DB process, but it all involves three major components.

Firstly, the client develops a RFQ/RFP that describes essential project requirements in performance terms. Secondly, proposals are evaluated, and thirdly, with evaluation completed, the owner engages in some process that leads to contract award for both design and construction services. The Design and Build (DB) entity is liable for all design and construction costs and normally provides a firm, fixed price in its proposal [21]; [22]. Therefore, if the client fulfills his/her entire contract obligations as at when due, he/she would not be liable for any future cost growth [23].

The contractor/builder has early constructability input to the design process as the client no longer owns the details of design and its relationship with the design-builder is based on a strong degree of mutual professional trust. The design-builder literally controls this project delivery process. The Design and Build (DB) delivery method has the greatest ability to compress the project delivery period and as a result of this is often used for “fast-track” or “Quick Win” projects [24].

The Design-Build delivery methods are modified to suite different types of project depending on the scope of the project.

The modified Design-Build (DB) project delivery methods are as follows:

N. Design – Build – Operate - Maintain (DBOM): - This is a project delivery mechanism in which the owner/client selects an organization that will complete the design, construction, maintenance and agreed-upon period of operation all in one agreement. Upon the termination of the operational period, the owner is responsible for the operation and maintenance of the project.

O. Design-Build-Finance-Operate (DBFO): - This project delivery method is similar to DBOM, except that the contractor is also responsible for financing the project. The contractor assumes the risk of financing until the end of the contract period. The owner is then responsible for operation and maintenance of the asset.

P. Build – Own – Operate – Transfer (BOOT): - Popularly known as BOT (Build-Operate-Turnover), it represents complete integration of the project delivery process. This project delivery method is similar to DBFO, except that there is actual transfer of ownership i.e., after some concessionary period, the facility is transferred back to the owner. The contractor is responsible for the design, construction, maintenance, operating and financing of the project. The contractor assumes the risk of financing until the end of the contract period. Subsequently, after the concessionary period the owner is then responsible for the operation and maintenance of the asset [25].

Q. Design – Build – Operate – Own: - Popularly known as "Turnkey", the developer assumes all the risk until the project is completed.

A summary of the key factors affecting cost overruns as obtained from the literature is provided in Table 1.

Table 1. Cost overrun factors as extracted from the various literature

	Cost Overrun Factors	**Sources**
1.	Bureaucracy in tendering method	[35]; [36]; [30]; [37]; [44]
2.	Change in Government policies	[43]; [30]
3.	Political interference	[7]; [38]; [39]
4.	Excessive approval procedure	[44]
5.	Statutory Changes	[42]; [34]
6.	High interest rate	[29]; [31]; [43]; [38]; [42]
7.	Inadequate fund for project	[29]; [31]
8.	Unforeseen site conditions	[43]; [28]; [40]; [34]
9.	Inflation of project cost	[43]; [36]; [42]
10.	Change in work scope by client	[28]; [32]; [30]; [33]; [34]
11.	Selection of delivery method	[43]
12.	Poor financial control	[29]; [32]; [36]; [35]; [30]
13.	Mistake in design	[28]; [29]; [31]; [43]; [9]
14.	Incomplete/inaccurate cost estimate	[28]; [30]; [37]; [33]
15.	Incomplete technical documents	[33]; [37]

16	Inadequate planning of project	[43]; [9]; [37]; [42]; [30]; [40]; [34]
17	Delays in inspection/testing of work	[29]; [33]
18	Inadequate site information	[28];
19	Contractor cartel	[31]
20	Previous experience of contractor	[31]; [43]; [36]
21	Poor construction management	[36]; [30]; [34]
22	Bidding lower price to win projects	[30]; [9]
23	Contractor claims	[30]; [36]
24	Tight project schedule	[28]; [43]
25	Sub-contractor/Supplier manipulation	[28]
26	Incompetency of sub-contractor	[43]
27	Fraudulent practices by sub-contractor	[28]; [31]; [43]
28	High cost of transportation	[8]
29	High cost of machineries	[30]
30	Fluctuations in price of material	[8]; [28]; [29]; [30]; [31]; [7]; [38]; [41]; [35]; [33]; [40]; [34]
31	Others…….	
32	Others…….	

III. RESEARCH METHODOLOGY

The study was limited to rate of project cost overrun and its effect on project delivery methods in Edo and Delta States of Nigeria. The target respondents for this study were the principal actors in the construction industry namely: the Clients, the Consultants, the Contractors and the Sub-contractors with a population size of about 8 million people from the 2006 population census. The sample size consists of 96 experts and stakeholders which comprises of consultants, contractors, subcontractors, and clients in the construction industry.

In identifying the causes of cost overrun in projects from the perspective of experts and stakeholders, this was done in two phases**.**

In performing preliminary studies and designing of the questionnaire, some ongoing and completed projects that have undergone some cost overruns were selected and studied. These projects were fundamentally identified and scrutinized with reference to experts and stakeholder involved in these projects. A preliminary and comprehensive list of one hundred (100) causes of project cost overruns were identified both from the literature and collated. Some of the causes that were irrelevant were removed from the questionnaire, while those causes with common factors were merged thereby reducing the total to thirty two (32). Therefore, the thirty two (32) causes were gotten from five (5) sources. They comprise of five causes of government, clients, consultants, contractors, and sub-contractors and two were attributed to other causes that were

not stated. Ninety six (96) questionnaires were sent to respondents comprising 24 each for the four groups. They were randomly selected using stratified random sampling technique as a type of probability sampling in order to give everyone that falls into any of these identified target groups equal and independent chances of being included in the sample.

Information and availability of past historical cost data of construction projects as earlier stated were not readily available. Hence the usual model such as normal probability distribution could not be used effectively for the analysis. Thus a conceptual model such as fuzzy set analysis was used in this study.

Diagrammatic Representation of Fuzzy Set

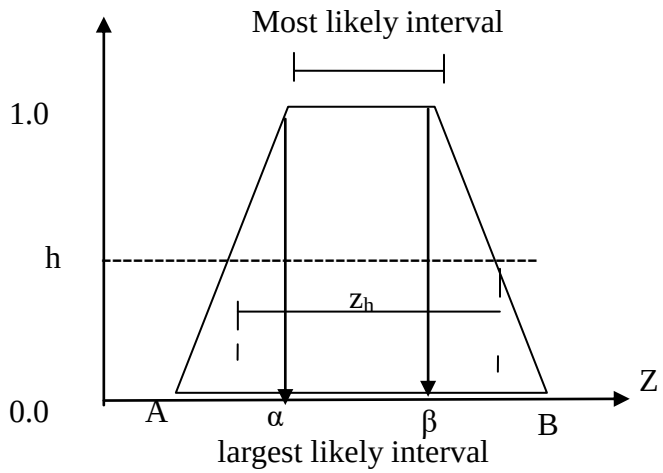

Fig 1 – Trapezoidal membership function

In figure 1, the distance between A and B is the largest zone of experts' opinions which are located in the vicinity of A and B, with the lowest level of membership to this set. The opinion located between α and β in the most likely zone having the highest level of membership. In this study, the ranking method was used to transfer the fuzzy number into the crisp value (Risk Coefficient RC), making the ranking value which is the fuzzy number Z equal to that of the crisp value (RC). Using the ranking method developed by [26], the crisp value RC can be expressed as:

$RC = (V1 + V2)/2(W1+W2)$ …….. i

Where

$V1= B3 (B + 3\alpha - 3A) - B2 (4\alpha A+\beta A+\alpha B)$..... ii
$V 2 = A3 (3B - 3\beta - A) + A2 (4\beta B +\alpha B +\alpha\beta)$.....iii
$W1= B2 (2B - 7A-\beta + 2\alpha) + 3(AB)(\beta -\alpha)$.....iv
$W2 = A2 (7B - 2A- 2\beta +\alpha) - (\alpha\beta)(B - A)$.....v

In above formulas RC is the crisp value while;
V1 = Largest number,

V2 = Larger than medium number,
W1 = Less than medium,
W2 = Lowest number,
A = Maximum cost overrun,
B = Minimum cost overrun,
α = less than medium cost overrun,
β = Greater than medium cost overrun,

IV. ANALYSIS OF RESULTS

For the assessment of relative significance among cost overrun factors, t-test and f-test were used to test the hypotheses.

A. F -Test

F-test was used to test the significance of cost overrun on project delivery methods. The following parameters were calculated;

SST – Sum of square of total $=\sum_{i=j}\sum x_{ij}^2 - \frac{T^2}{rk}$; df = n-1,

Where, df = degree of freedom

SSB – Sum of square between groups = $\sum_j - \frac{T^2}{rk}$; df = n-k,

SSE – Sum of square of error, = **SST – SSE**

Table 2 - ANOVA Table

Source of Variation	Sum of Square	Degree of Freedom	Mean of Square	F-ratio
Between Groups	**SSB**	k-1	SSB/k-1 = MSB	MSB/MSE
Due to Error	**SSE**	n-k	SSE/n-k = MSE	-
Total	**SST**	**N-1**	-	-

B. T -Test

T-test was used to test the significance of each of the cost overrun factors. The random variable x is normally distributed, with the standardize test statistic:

$$t = \frac{x - U}{\frac{s}{\sqrt{n}}}$$

Definitions of the terms in Figure 1 are as follows:

i. Type A: The contract clauses definitely stipulate that the client should take certain risks.

ii. Type B-1a: The contract clauses definitely stipulate that the contractor should take certain risks, and the contractor has no objection to such allocation.
iii. Type B-1b: The contract clauses definitely stipulate that the contractor should take certain risks, but the contractor is unwilling to accept such allocation, transgressing the principle of good faith and fair dealing.
iv. Type B-2: The contract has some sketchy stipulations about certain risks, and for this reason the risk allocation remains unconfirmed.
v. Type C-1: Although there is no clause in the contract to allocate certain risks, the two contracting parties have a consensus that the owner should take the risks.
vi. Type C-2: Although there is no existing clause in the contract to allocate certain risks, the two contracting parties have a consensus that the contractor should take the risks.
vii. Type D: There is no clause in the contract to allocate certain risks, and the two contracting parties have no consensus on who should bear risk.

Based upon Fig 1, the attributes of each of the 32 causes of cost overrun in construction projects were determined with reverence to the seven (7) classification of risks stated above. Afterward, each of these cost overrun risk factors that significantly affected construction projects from the t-test were assigned to each of the contracting parties (i.e. contractor or client) in each of the major delivery methods to determine their effects**.**

In this aspect, both descriptive and inferential statistics were used to present the results. The objectives of the study were addressed using descriptive statistics in different stages, while inferential statistics was utilized in testing the hypotheses.

C. Data Sources of Cost Overrun

After several follow-ups about 50% of the questionnaires were retrieved and analyzed as in table 3.

Table 3- Respondents

Questionnaires	Client	Consultant	Contractor	Sub-contractor	Sum
were sent or delivered	24	24	24	24	96
were collected	12	11	15	10	48

The respondents were all construction industry practitioners, comprising both public and private clients, main contractors/developers, sub-contractors, and consultants. They had an average of 14 years work experience in the construction sector. It is evident that 93% of the respondents have put in more than 5 years in the construction industry (Figure 2). Furthermore, 95% of the respondents had tertiary education. The long working experience and tertiary educational background of the respondents showed that the respondents had adequate knowledge of construction projects and cost overrun factors associated with the various project delivery methods.

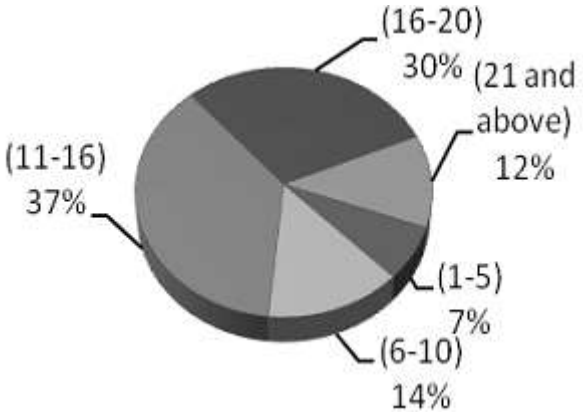

Figure 2. Distribution of respondent's years of working experience in the industry

D. Testing - Hypothesis I.

Ho_1: - Project cost overrun has no significant effect in the construction industry;
In order to analyze the rate of occurrence of cost overruns in construction projects in Nigeria, information on cost collected from 12 respondents (clients/owners, cost consultants), including the budgeted cost in the contract documents and the actual cost were used for the analysis as shown in table 4.

According to [27], cost overrun i.e.,

$$\text{Cost Overrun} = \frac{(BCWP - ACWP)}{BCWP} \times 100;$$

where,

BCWP = Budgeted cost of work in place (earned value at the time of update).
ACWP = Actual cost of work in place at the time of update.

Table 4. Percentage of Projects Cost Overrun

Project	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
BCWP₦(Million)	35	108	82	208	1,050	42	540	2,180	10	158	680	720
ACWP ₦(Million)	43	175	95	270	1974	51	886	2507	16	194	802	900
Cost overrun ₦(Million)	8	67	14	62	924	9	346	327	6	36	112	180
% of Cost-Overrun	23	62	16	30	88	21	64	15	58	23	18	25

From Table 4,

Where;

Minimum Cost-overrun (A) = 15
Maximum Cost overrun (B) = 88
Less than Medium Cost overrun (α) = 30
Greater than Medium Cost overrun (β) =58

Table 5. Rate of Projects Cost Overrun

RC	W2	W1	V2	V1	Larger than medium	Less than medium	Average	Max (B)	Min (A)
45.56	**14,520**	**621,904**	**5.8E6**	**49.5E6**	**58**	**30**	**41**	**88**	**15**

(Note: - at A = 15, α = 30;β = 58, B = 88)

$$Crisp\ Value\ (RC) = \frac{V1 + V2}{2(W1+W2)} = 45.56$$

Where,

Largest Number (V1) = $B^3 (B + 3\alpha - 3A) - B^2 (4\alpha A + \beta A + \alpha B) = 49{,}515{,}136$
Larger than Medium (V2) = $A^3 (3B + 3\beta - A) - A^2 (4\beta B + \alpha B + \alpha\beta) = 5{,}832{,}225$
Less than Medium (W1) = $B^2 (2B + 7A - \beta - 2\alpha) + 3(AB)(\beta - \alpha) = 621{,}904$
Lowest Number (W2) = $A^2 (7B + 2A - 2\beta - \alpha) + (\beta\alpha)(B-A) = -14{,}520$

From the results above, the rate of cost overruns in the Nigerian construction industry was 45.6% overrun of the estimate project cost. It can be shown diagrammatically in accordance with trapezoidal membership function diagram as shown in figure 3.

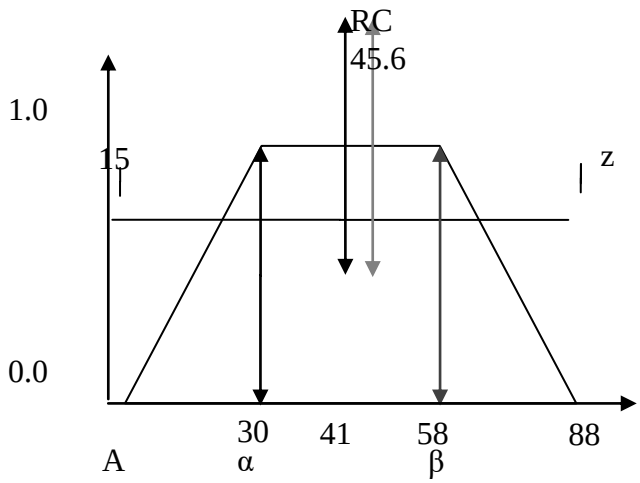

Figure 3: Trapezoidal Membership Function–Diagrammatical representations of the rate of cost overrun of some construction projects in Edo and Delta States of Nigeria

Figure 3 depicts that construction projects from the perspective of cost growth, did not go less than 15% or more than 88% of cost overruns in the study area. While most project cost overruns lies between 30% and 58% (most likely). The Crisp value RC was 45.56% overrun of the estimated cost therefore the null hypothesis (Ho_1: - Project cost overrun has no significant effect in the construction industry), is rejected, and alternative hypothesis, (Ha_1: - Project cost overrun has significant effect in the construction industry), is accepted.

Table 6. Cost Overrun in the Different Delivery Methods

Sources of Cost Overruns		Cost Overrun Factors	DBB Average	DB Average	CMR Average	Mean Average
REGULATION	1.	Bureaucracy in tendering method	0.88	0.62	0.88	**0.79**
	2.	Change in Government policies	0.98	0.62	0.98	**0.86**
	3.	Political interference	0.93	0	0.93	**0.62**
	4.	Excessive approval procedure	1.265	1.32	1.265	**1.28**
	5.	Statutory Changes	1.96	0.32	1.96	**1.41**
	6.	High interest rate	1.08	0.64	1.08	**0.93**
CLIENT	7.	Inadequate fund for project	1.4	1.16	1.05	**1.20**
	8.	Unforeseen site conditions	1.2	1.1	1.74	**1.35**
	9.	Inflation of project cost	1.2	0.78	0.8	**0.93**
	10.	Change in work scope by client	2.12	0.66	1.06	**1.28**
	11.	Selection of delivery method	1.16	0.96	1.53	**1.22**
	12.	Poor financial control	1.12	0.86	1.12	**1.03**
CONSULTANT	13.	Mistake in design	1.275	0.945	1.275	**1.17**
	14.	Incomplete/inaccurate cost estimate	0.78	0.75	0.78	**0.77**
	15.	Incomplete technical documents	2.075	1.375	2.075	**1.84**
	16	Inadequate planning of project	1.07	1.59	1.07	**1.24**
	17	Delays in inspection/testing of work	0.99	0.795	0.99	**0.93**
	18	Inadequate site information	0.92	0.62	0.92	**0.82**
CONTRACTOR	19	Contractor cartel	1.8	1.275	1.5	**1.53**
	20	Previous experience of contractor	1.42	1.42	0	**0.95**
	21	Poor construction management	1.775	1.45	1.065	**1.43**
	22	Bidding lower price to win projects	0.345	0.355	0.345	**0.35**
	23	Contractor claims	1.335	0.99	1.335	**1.22**
	24	Tight project schedule	0.99	0.76	1.485	**1.08**
SUB-CONTRACTOR	25	Sub-contractor/Supplier manipulation	1.98	0.615	1.98	**1.53**
	26	Incompetency of sub-contractor	1.875	0.825	1.125	**1.28**
	27	Fraudulent practices by sub-contractor	0.445	0.945	0.445	**0.61**
	28	High cost of transportation	2.105	1.575	2.105	**1.93**
	29	High cost of machineries	1.01	0.79	1.515	**1.11**

	30	Fluctuations in price of material	1.605	1.425	1.605	**1.55**
	31	Other ……	1.07	0.36	1.605	**1.01**
	32	Other ……	0.29	1.675	0.29	**0.75**
			40.45	**29.575**	**37.905**	

E. Hypothesis Testing II

Ho_2: - Project cost overruns has no significant effect on project delivery methods;

Decision Rule

*if p-value > 0.05, it is not significant,
*if p-value < 0.05, it is significant

Or

*if F calculated < F table, it is not significant,
*if F calculated > F tabulated, it is significant

Table 7. ANOVA Results on the Effects of Cost Overrun Factors

	Result of ANOVA				
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.969	2	.984	4.360	.015
Within Groups	20.997	93	.226		
Total	22.966	95			

Fcal=4.360 P-value=0.015, Ftab = 3.114

The results revealed possibility value of 0.015 is less than the critical value of 0.05, and Fcal is greater than Ftab, so it is significant, therefore we reject the null hypothesis (Ho_2: - Project cost overrun has no significant effect on project delivery methods) and accept the Alternative Hypothesis (Ha_2: - Project cost overrun has significant effect on project delivery methods).

F. Testing - Hypothesis III.

Ho_3: cost overrun factors have no significant effect on construction projects in the study area;

Decision Rule

*if p-value >0.05, it is not significant,
*if p-value <0.05,it is significant;

Table 7, reveals that cost overrun factors had significant effects on construction projects because 23 factors contributed significantly to cost overrun in the study area. Therefore, the null hypothesis was rejected and alternative hypothesis (Ha_3: Cost overrun factors have significant effect on the construction projects in the study area) was accepted.

Table 8. One-Tail Sample Test of Cost Overrun Factors

Sources of Cost Overruns		Cost Overrun Factors	Overall Mean	t	df	P<0.05	Decision
REGULATION	1.	Bureaucracy in tendering method	.79	9.15	2	.012	Sig.
	2.	Change in Government policies	.86	7.17	2	.019	Sig.
	3.	Political interference	.62	2.00	2	.184	Not Sig.
	4.	Excessive approval procedure	1.28	2.94	2	.099	Not Sig.
	5.	Statutory Changes	1.41	2.59	2	.123	Not Sig.
	6.	High interest rate	.93	14.23	2	.005	Sig.
CLIENT	7.	Inadequate fund for project	1.20	11.65	2	.007	Sig.
	8.	Unforeseen site conditions	1.35	6.77	2	.021	Sig.
	9.	Inflation of project cost	.93	6.36	2	.024	Sig.
	10.	Change in work scope by client	1.28	70.00	2	.000	Sig.
	11.	Selection of delivery method	1.22	10.61	2	.009	Sig.
	12.	Poor financial control	1.03	11.92	2	.007	Sig.
CONSULTANT	13.	Mistake in design	1.17	10.59	2	.009	Sig.
	14.	Incomplete/inaccurate cost estimate	.77	77.00	2	.000	Sig.
	15.	Incomplete technical documents	1.84	7.89	2	.016	Sig.
	16	Inadequate planning of project	1.24	7.17	2	.019	Sig.
	17	Delays in inspection/testing of work	.93	6.77	2	.021	Sig.
	18	Inadequate site information	.82	8.20	2	.015	Sig.
CONTRACTOR	19	Contractor cartel	1.53	3.35	2	.079	Not Sig.
	20	Previous experience of contractor	.95	2.00	2	.184	Not Sig.
	21	Poor construction management	1.43	6.97	2	.020	Sig.
	22	Bidding lower price to win projects	.35	104.50	2	.000	Sig.
	23	Contractor claims	1.22	7.29	2	.018	Sig.
	24	Tight project schedule	1.08	5.04	2	.037	Sig.
SUB-CONTRACTOR	25	Sub-contractor/Supplier manipulation	1.53	10.03	2	.010	Sig.
	26	Incompetency of sub-contractor	1.28	4.08	2	.055	Not Sig.
	27	Fraudulent practices by sub-contractor	.61	3.67	2	.067	Not Sig.
	28	High cost of transportation	1.93	10.92	2	.008	Sig.
	29	High cost of machineries	1.11	5.15	2	.036	Sig.

	30	Fluctuations in price of material	1.55	25.75	2	.002	Sig.
	31	Other ……	1.01	2.81	2	.107	Not Sig.
	32	Other ……	.75	1.63	2	.245	Not Sig.

**Sig. at 5%, if P-value <0.05.*

Table 9. Ranking Cost Overrun Factors

	Cost Overrun Factors	Overall Mean	t	df	P<0.05	Decision	Ranking
1.	Change in work scope by client	1.28	70.00	2	.000	Sig.	1st
2.	Incomplete/inaccurate cost estimate	.77	77.00	2	.000	Sig.	1st
3.	Bidding lower price to win projects	.35	104.50	2	.000	Sig.	1st
4.	Fluctuations in price of material	1.55	25.75	2	.002	Sig.	4th
5.	High interest rate	.93	14.23	2	.005	Sig.	5th
6.	Inadequate fund for project	1.20	11.65	2	.007	Sig.	6th
7.	Poor financial control	1.03	11.92	2	.007	Sig.	6th
8.	High cost of transportation	1.93	10.92	2	.008	Sig.	8th
9.	Selection of delivery method	1.22	10.61	2	.009	Sig.	9th
10.	Mistake in design	1.17	10.59	2	.009	Sig.	9th
11.	Sub-contractor/Supplier manipulation	1.53	10.03	2	.010	Sig.	11th
12.	Bureaucracy in tendering method	.79	9.15	2	.012	Sig.	12th
13.	Inadequate site information	.82	8.20	2	.015	Sig.	13th
14.	Incomplete technical documents	1.84	7.89	2	.016	Sig.	14th
15.	Contractor claims	1.22	7.29	2	.018	Sig.	15th
16	Change in Government policies	.86	7.17	2	.019	Sig.	16th
17	Inadequate planning of project	1.24	7.17	2	.019	Sig.	16th
18	Poor construction management	1.43	6.97	2	.020	Sig.	18th
19	Delays in inspection/testing of work	.93	6.77	2	.021	Sig.	19th
20	Unforeseen site conditions	1.35	6.77	2	.021	Sig.	19th
21	Inflation of project cost	.93	6.36	2	.024	Sig.	21st
22	High cost of machineries	1.11	5.15	2	.036	Sig.	22nd
23	Tight project schedule	1.08	5.04	2	.037	Sig.	23rd
24	Incompetency of sub-contractor	1.28	4.08	2	.055	Not Sig.	24th
25	Fraudulent practices by sub-contractor	.61	3.67	2	.067	Not Sig.	25th
26	Contractor cartel	1.53	3.35	2	.079	Not Sig.	26th
27	Excessive approval procedure	1.28	2.94	2	.099	Not Sig.	27th

28	Political interference	.62	2.00	2	.184	Not Sig.	28th
29	Previous experience of contractor	.95	2.00	2	.184	Not Sig.	28th
30	Other ……	1.01	2.81	2	.107	Not Sig.	30th
31	Statutory Changes	1.41	2.59	2	.123	Not Sig.	31st
32	Other ……	.75	1.63	2	.245	Not Sig.	32nd

The ranking of the cost overrun factors according to their significance level, table 9 shows that changes in work scope, inaccurate, and lower price bidding top the list of the cost overrun factors that contributes to cost overrun.

G. Testing - Hypothesis IV.

Ho_4: - Cost overrun factor does not have significant effect on the different types of project delivery methods in Nigeria

Allocation of cost overrun factors on the basis of contract type

The output from the t-test in Table 8 reveals that nine (9) cost overrun factors had no significant effect on construction projects while twenty three (23) cost overrun factors significantly affected construction projects in the study area. Thus, these twenty (23) cost overrun factors were used to determine the various effects of cost overruns on the contracting parties on the various project delivery methods.

Table 10. – Contractual allocation of cost overrun factors based on type of delivery methods

S/N	COST OVERRUN FACTORS	AVERAGE	DBB			CMR			DB		
			TYPE	CLIENT	CONTRACTOR	TYPE	CLIENT	CONTRACTOR	TYPE	CLIENT	CONTRACTOR
1.	Bureaucracy in tendering method	.79	C-1	1.76	0	C-1	1.76	0	C-1	1.24	0
2.	Change in Government policies	.86	C-1	1.96	0	C-1	1.96	0	C-1	1.24	0
3.	High interest rate	.93	C-1	2.16	0	C-2	0	2.16	D	0.64	0.64
4.	Inadequate fund for project	1.20	A	2.8	0	C-1	2.10	0	C-1	2.32	0
5.	Unforeseen site conditions	1.35	A	2.4	0	B-1b	0	3.48	B-1b	0	2.2
6.	Inflation of project cost	.93	C-1	2.4	0	A	0	1.6	C-1	1.56	0
7.	Change in work scope by client	1.28	A	2.24	0	A	2.24	0	A	1.72	0
8.	Selection of delivery method	1.22	C-1	2.32	0	C-1	3.06	0	C-1	1.92	0
9.	Poor financial control	1.03	A	4.24	0	C-2	0	2.12	C-2	0	1.32

10.	Mistake in design	1.17	A	3.6	0	C-2	0	3	B-1a	0	2.55
11.	Incomplete/inaccurate cost estimate	.77	A	1.56	0	B-1a	0	1.56	B-1a	0	1.5
12.	Incomplete technical documents	1.84	C-1	4.15	0	C-2	0	4.15	B-1a	0	2.75
13.	Inadequate planning of project	1.24	C-2	0	2.14	B-1a	0	2.14	B-1a	1.64	1.54
14.	Delays in inspection/testing of work	.93	B-2	0	1.98	B-1a	0	1.98	A	1.59	0
15.	Inadequate site information	.82	C-1	1.84	0	B-1b	0	1.84	B-1a	1.24	0
16.	Poor construction management	1.43	B-1a	0	3.55	B-1a	0	2.13	B-1a	0	2.9
17.	Bidding lower price to win projects	.35	C-1	0.69	0	B-1a	0	0.69	B-1a	0	0.71
18.	Contractor claims	1.22	C-1	2.67	0	D	0	2.67	D	0	1.98
19.	Tight project schedule	1.08	C-2	0	1.98	B-1b	0	2.97	B-1a	0	1.52
20.	Incompetency of sub-contractor	1.28	C-1	3.96	0	B-1a	0	3.96	C-2	0	1.23
21.	High cost of transportation	1.93	C-1	4.21	0	C-2	0	4.21	B-1a	0	3.15
22.	High cost of machineries	1.11	C-2	0	2.02	C-2	0	3.03	B-1a	0	1.58
23.	Fluctuations in price of material	1.55	C-1	3.21	0	B-1b	0	3.21	B-1b	0	2.85
TOTAL				**48.17**	**11.67**		**11.12**	**35.88**		**26.98**	**48.83**
Percentage of cost overrun per delivery method				**80%**	**20 %**		**19%**	**81%**		**36 %**	**64 %**
Percentage of cost overrun per contracting party				**65%**	**13 %**		**15%**	**54%**		**20 %**	**33 %**

The percentage of cost overrun per contracting party (Client and Contractor); for the Client was; DBB, 65%; CMR, 15%; and CMR, 20%; while the Contractor was; DBB, 13%; CMR, 54%; and DB, 33% (Table 10). This implies that project cost overruns had different effects on the contracting parties within the three (3) types of project delivery methods. Hence, the null hypothesis (Ho_4: - Cost overrun factors does not have significant effect on the various types of project delivery methods in Nigeria) was rejected and alternative hypothesis, (Ha_4: - Cost overrun factors does have significant effect on the various types of project delivery methods in Nigeria) was accepted.

Furthermore, the results indicates that Design Bid Build (DBB) delivery method was very risky for client to embark on largely due to the highest percentage (65%) of the total cost overrun factors affecting clients in the study area. The results also revealed that Construction Manager at Risk (CMR) delivery method was very risky for contractors to adopt due to the highest percentage (54%) of the total cost overrun factors affecting contractors in the study area.

H. Discussion of findings

The fuzzy trapezoidal membership function, revealed the risk coefficient of cost overrun of 46.56% of the total project cost, which is in consonance with similar studies carried out by [28]; [29]; [30]; [31]; [7] and others whose findings revealed the utmost causes of cost overrun was fluctuations in the prices of materials with 57%. The trapezoidal diagram in figure 3 reveals that

the rate of most project cost overruns in the study area ranged from 15% to 88% of their initial estimated cost. The most likely cost overruns in construction projects lies between 30% and 58% as shown in figure 3. On the cost overrun factors and project delivery methods, the objective of this study was to find out the effects of cost overrun factors on project delivery methods. The results in Table 7 revealed that the P-value 0.015 is less than the critical value, thus it is an indication that cost overrun significantly affects project delivery methods in the study area. Table 8 reveals that after the t-test analysis, that out of the thirty two (32) cost overrun factors in the questionnaire, only twenty three (23) project cost overrun factors had significant cost overrun effect on construction projects, while nine (9) cost overrun factors had no significant effects. More so, in Table 9 the t-test revealed that change in work scope, inaccurate cost estimate and bidding low by contractors to win contracts was the most significant factors, with the lowest p-value of 0.000. The three (3) factors had earlier been identified by different researchers as the prime causes of cost overrun. Firstly, [32]; [30]; [33]; [34] stated that changes in project work scope by the client is one of the major causes of cost overrun in projects, this is because from the inception, most construction professionals lack a holistic view of the work packages of their projects. Therefore the client's brief and scope definition by designers is not always clear and complete at the beginning of each project. [6] described cost estimates by bill of quantity as merely costs assigned to individual work packages without any attempt at incorporating physical resources into it, which in most cases is a major cause of inaccurate cost estimate. [30] and [9], stated that most contractors give more priority to winning projects by bidding low during tendering as a major factor precipitating project cost overrun. Table 10 reveals that project cost overrun had effects on contracting parties in the three (3) major types of project delivery methods. The first contracting party i.e., the client had DBB, 65%; CMR 15%; DB 20%; while the second contracting party the contractor had DBB 13%; CMR 54%; DB 33%. Also the percentage per delivery method in DBB the client 80%; contractor 20%; in CMR the client 19%; Contractor 81%; and in DB the client 35%; Contractor 65%.

Thus, from the clients' perspective, it is very risky for clients to embark on Design-Bid-Build DBB delivery method, because of the high percentage (54%) (80%) of cost overrun the client has to bear in DBB procurement contract. Therefore, there is the need to weigh options in the light of project objectives before proceeding into contracting. More so, if cost should be the determining factor among the four project objectives (i.e., cost, time, scope, and quality) then Design-Bid-Build procurement method should not be used, rather alternative delivery methods should be considered.

Also, from the contractor perspective, Construction Manager at Risk CMR delivery method is very risky for contractors to embark on without a proper risk assessment, risk evaluation and review because it has the highest risk percentage 54% (81%) overrun. Construction-Manager at Risk (CMR) delivery method would be suitable for the private sector because the contractors' inputs at the design stage could enhance constructability reviews and would also lead to cost reduction via value engineering.

Furthermore, Design and Build (DB) delivery method had a fare share of cost overrun between the contacting parties with the client 20%; and contractors 33%; while the client 13% compared to 65% of contractor in the design bid build method of delivery. It is logically to agree with the literature that the contractors are in a more suitable position to manage and control the risk of cost overruns during the execution stage of their project life cycle. Design and Build (DB) would be more suitable for public project procurement, since the public sector has an in-house

professional who can monitor and evaluate the Design and Build contract procedure and moreover the risks of cost overruns would be reasonably distributed between the contractor and the client.

V. CONCLUSION AND RECOMMENDATIONS

The study concludes that cost overrun rate in the study area was 45.56%. The study further concluded that there are three (3) major causes of cost overruns in construction projects in the study area. The study established that the Design Bid Build (DBB) which is the official method of delivery in Nigeria was not the best because of its high percentage of cost overrun factors on the client on the type of delivery method. It further revealed that cost overrun was fairly shared by client and contractors in the design and build (DB) delivery method. The study further concludes that contractors were more exposed to cost overrun in the Construction Manager at Risk (CMR) delivery method. More so, the study concludes that contractors are in a good position to control cost overruns in their construction projects.

Based on the outcome of this study, the following recommendations were made towards improving the procurement of construction projects which would eventually lead to the reduction of cost overruns in construction projects in Nigeria.

a) Bureau of Public Procurement (BPP) should discourage the use of traditional procurement method as the sole procurement method, as it has been proven by this study that it is more prone to cost overruns.

b) Contract award should not be based on lowest bid.

c) Government should adopt Design and Build (DB) delivery method in public project procurement.

d) Private sector project procurement should adopt Construction Manager at Risk (CMR) delivery method. Because the client can transfer risk of cost overruns to the contractor in a guaranteed maximum price contract agreement.

e) The project owner (or project manager) must ensure the completion of all design documentation with all associated value engineering analysis and buildability reports before tendering, so that design changes during project execution would be minimized.

REFERENCES:

[1] Ojo, G.K. (2010). *An assessment of impact of risk and uncertainty on construction client cash flow forecast in selected location in Nigeria*. PhD Thesis of the Obafemi Awolowo University, Ile-Ife, Nigeria.

[2] Walewski, J., Gibson Jr, G.E., & Jasper, J. (2001) Project delivery methods and contracting approaches. Available for Implementation by the Texas Department of Transportation, Report No. FHWA/TX-0-2129-1, Center for Transportation Research, Austin, Tex., 116.

[3] Pakkala, P. (2002). Innovative project delivery methods for infrastructure-An international perspective. Helsinki: Finnish road enterprise.

[4] Okore, O.L. (2014). *Risk assessment of cost overrun in project delivery methods in south-south Nigeria.* Master's Thesis, Federal University of Technology, Owerri, Nigeria.

[5] Laryea, S. (2008). Risk practices in finance, insurance and construction. The construction and buildings research conference of the Royal Institute of Chartered Surveyors (COBRA), 1: 6.

[6] Akpan, E.O.P & Igwe, O. (2001). Methodology for determining price variation in project execution. *Journal of Construction Engineering & Management of the America Society of Civil Engineers (ASCE), 127* (5), 367-373.

[7] Mahamid, I. & Dmaidi, N. (2013). Risks leading to cost overrun in building construction from consultant's perspective. *Organization, Technology and Management in Construction: An International Journal, 5* (2) 860-873

[8] Shanmugapriya, S. & Subramanian, K. (2013) Investigation of significant factors influencing time and cost overruns in Indian construction project. *International Journal of Emerging Technology and Advanced Engineering, 3* (10) 734-740

[9] Abdulaziz, A. (2015). Cost overrun in construction projects in Saudi Arabia: Contractor's perspectives. *International Journal of Engineering and Technology*, *15* (4) 35-42

[10] Hartman, F.T. (2000). Don't park your brain outside. A practical guide to improving shareholder value with SMART management'. NYC, PMI Publication.

[11] Alinaitwe, H., Apolot, R. & Tindiwensi, D. (2013). Investigating into the causes of delays and cost overruns in Uganda's public sector construction projects. *Journal of Construction in Developing Countries, 18* (2) 33-47

[12] Akpan, E.O.P. & Chizea, E.F. (2002). Project management theory and practice: 1st Edition, FUTO Press Ltd, Owerri.

[13] Jain, H. & Sudir, R. (2006). Managerial Economics, Pearson Education, New Delhi.

[14] Ulrika, B. (2008). The selection of the sharing ration in target cost contract. *Engineering, construction and Architectural Management, 15*, 54-65

[15] Scott, S., Molenaar, K., Gransberg, D. & Smith, (2006). Best value procurement for highway construction projects. Transportation Research Board of the National Academies, Washington D.C, NCHRP Report 561: 167.

[16] Strang, W. (2002). The risk in CM at Risk' *CM e-Journal,* Construction Management Association of America, Mc Lean, VA. 1-9.

[17] Kwak, Y.H. & Bushey, R. (2000). Construction management at risk: An innovative project delivery method at Stormwater treatment area in the Everglades, Florida. *Proceedings,* Construction Congress VI, Orlando, Fla., 2nd ed, 477–482.

[18] National Cooperative Highway Research Programme NCHRP (2010). A transport research board of national academies. Washington DC: 5-8

[19] Project Delivery Systems for Construction (2004), Associated General; Contractors of America, Washington, D.C.

[20] Bearups, W., Kenig, M. & Donnell, O. (2007). Alternative delivery methods: A primer. Proceeding. Airport board member and commissioners' Annual Conference, Airport Council International, North America, Chicago.

[21] Graham, P. (1997) *Evaluation of Design-Build Practice in Colorado.* Research Report IR (CX) 70-4(143), Colorado Department of Transportation, Denver.

[22] Ibbs, C.W., Kwak, Y. & Odabasi, (2003). A Project delivery system and project change: A quantitative analysis. *Journal of Construction Engineering and Management, ASCE, 129* (4), 382–387.

[23] El Wardani, M., Messner, J. & Horman, M. (2006). Comparing procurement methods for design-build-projects. *Journal of Construction Engineering and Management, ASCE, 132* (3), 20-26.

[24] Alder, R. (2007). Construction manager general contract (CMGC). Annual Report, Engineering Services and Bridge Design Section, Utah Department of Transportation Project Development Group, Salt Lake City, pp 39.

[25] Creedy, G.D. (2006). *Risk factors leading to cost overrun in the delivery of highway construction projects*. PhD Thesis, Queensland University of Technology, Barisbane.

[26] Chen, S.H. (1985). Ranking fuzzy number with maximizing set. *Fuzzy Sets System*. *17*(2), 113-129.

[27] Chizea, E.F. (1991). *Application of Network analysis technique to construction tendering for the control of construction failures in Nigeria.* A PhD Thesis, of the Federal University of Technology, Owerri, Nigeria.

[28] Omorogie, A. & Radford, D. (2006). *Infrastructure delays and cost escalation: Causes and effects in Nigeria.* Proceedings of the 6th International Conference Postgraduate Research. Netherlands April 3-7.

[29] Enshassi, A., Al-Najjar, J. & Kumaraswamy, M. (2009) Delays and cost overruns in the construction projects in Gaza Strip. *Journal of Financial Management of Property and Construction*, *14* 126-151

[30] Azhar, N. and Farooqui, R.U. & Ahmed, S. (2008). *Cost overrun factors in the construction industry of Pakistan.* Proceedings of the 1st International Conference on Construction in Developing Countries: Advancing and Integrating Construction Education, Research and Practice. Karachi, Pakistan, 18– 20 April.

[31] Ameh, O.J., Soyingbe, A.A. & Odusami, K.T. (2010). Significant factors causing cost overruns in telecommunication projects in Nigeria. *Journal of Construction in Developing Countries, 15* 49-67

[32] Long, L., Young, D.L. & Jun, Y.L. (2008) Delay and cost overruns in Vietnam large construction projects: A comparison with other selected countries. *KSCE Journal of Civil Engineering, 12* (6) 367-377

[33] Mansfield, N.R., Ugwu, O.O., & Doran, T. (1994). Causes of delay and cost overruns in Nigeria construction projects. *International Journal of Project Management, 12* (4) 254-260

[34] Siemiatycki, M. (2015). *Cost overruns on infrastructure projects: Patterns, causes and cures.* IMFG Perspectives No. 11/2015 University of Toronto.

[35] Okpala, D.C. & Aniekwu, A.C. (1988). Causes of high costs of construction in Nigeria. *International Journal of Management in Engineering ASCE, 114* 233-244

[36] Frimpong, Y., Oluwoye, J. & Crawford, L. (2003). Causes of delay and cost overrun in construction of ground project in developing countries: Ghana as a case study. *International Journal of Project Management, 21* (5) 321-326

[37] Al-Juwairah, Y. (1997). *Factors affecting construction costs in Saudi Arabia.* Master's Thesis, King Fahd University of Petroleum and Minerals, Dhahran.

[38] Al- Najjar, J. (2008). *Factors influencing time and cost overruns on construction projects in the Gaza Strip.* Master's Thesis, Islamic University, Gaza.

[39] Alinaitwe, H.M., Mwakali, J.A. & Hansson, B. (2007) Factors affecting the productivity of building craftsmen: Studies of Uganda. *Journal of Civil Engineering and Management, 13* (3) 169-176

[40] Dlakwa, M.M. & Culpin, M.F. (1990). Reasons for overrun in public sector construction projects in Nigeria. *International Journal of Project Management, 8* (4) 237-241

[41] Elinwa, A. & Buba, S. (1993). Construction cost factors in Nigeria. *Journal of Construction Engineering and Management, 119* (4) 698-713

[42] Nega, F. (2008). *Causes and effects of cost overrun on public building construction projects in Ethiopia.* Master's Thesis, Addis Ababa University, Addis Ababa, Ethiopia.

[43] Olawale, Y.A. & Sun, M. (2010). Cost and time control of construction projects: Inhibiting factors and mitigating measures in practice. *Construction Management and Economics*, *28* 509-526

[44] Bardat, C., McCullouch, L. & Sinha, K.C. (2004). *An analysis of cost overrun and delay*. Joint Transportation Research Program Technical Report No. 11, West Lafayette, Indiana: Indiana Department of Transportation and Purdue University.

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