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Variability of Cost and Time Delivery of Educational Buildings in Nigeria

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ABSTRACT

Cost and time overrun in construction projects has become a reoccurring problem in construction industries around the world especially in developing countries. This situation is unhealthy for public educational buildings which are executed with limited government funds, and are in most cases time sensitive, as they need to cater for the influx of students into the institutions. This study therefore assessed the variability of cost and time delivery of educational buildings in Nigeria, using a study of selected educational buildings within the country. A pro forma was used to gather cost and time data on selected building projects, while structured questionnaire was used to harness information on the possible measures for reducing the variability from the construction participants that were involved in the delivery of these projects. Paired sample t-test, percentage, relative importance index, and Kruskal-Walis test were adopted for data analyses. The study reveals that there is a significant difference between the initial and final cost of delivering educational buildings, as an average of 4.87% deviation, with a sig. p-value of 0.000 was experienced on all assessed projects. For time delivery, there is also a significant difference between the initial estimated time and final time of construction as a whopping 130% averaged deviation with a sig. p-value of 0.000 was discovered. To remedy these problems, the study revealed that prompt payment for executed works, predicting market price fluctuation and inculcating it into the initial estimate, and owner's involvement at the planning and design phase are some of the possible measures to be adopted.

1. Introduction

All around the world, the issue of delay in the completion of construction project has proven to be a common problem in the construction industry. Most projects are delivered behind schedule and the situation is worse in most developing countries, of which Nigeria is no exception. This delay comes with its attributed effect on cost of construction projects. Wong, Teo and Cheung (2010) observed that, the building construction industry around the world is witnessing continuous modification of building process, speed and complexity of work which has placed a greater demand on construction managers to deliver projects on time and within planned budget.

Ogunsemi (2015) opined that cost and time has proven to be the most important criteria for measuring the success of construction projects and are considered as being very critical because of their direct economic implications if they are unnecessarily exceeded. Memon *et al.*(2010) observed that while construction cost is a crucial measure of project success throughout the project's lifecycle, a delay in completion of facilities is directly equal to the financial losses due to lack of revenue which such facilities would have been generating. Hence achieving a project within the specified budget and time is very important to stakeholders within the built environment.

Unfortunately, the Nigerian construction industry has a significant problem of cost and time overrun as observed by Mbachu and Olaoye (1999) and Ogunsemi and Jagboro (2006). This is based on its inability to complete projects on schedule and within budget. Ogunsemi (2015) further affirmed this assertion by stating that it is rare to find construction projects carried out within the construction industry that is free of cost and time overrun. The education sector suffers this same fate as most construction projects are delivered above budget and way behind schedules.

In Nigeria, the Federal Government is a major contributor to the education sector with several amounts being expended on infrastructures especially in tertiary institutions. Unfortunately, most of the projects being executed within these institutions are either left uncompleted or completed above budget, behind schedule and below standard (Ewa, 2013; Oyedele 2013; Edukugho, 2013). This unhealthy situation tends to deter these institutions from achieving their set out goals of teaching, research and service, with an overall aim of providing trained human resources for essential areas of human development as observed by Fadokun (2009).

Considering the poor economic background of the country, and the involvement of the government in the education sector through diverse funding, assessing the level of variability in the cost and time of the products of these funds is necessary. Thus, this paper concentrate on the variability between the initial estimated cost and time, and the completion cost and time of educational buildings in the country. It also identified the possible measures for reducing the variability in these parameters with a view to providing educational buildings delivered to time and within estimated budget.

2. Theoretical Background

Tertiary institutions comprise universities, polytechnics, and colleges of education and monotechnics that are owned either by the Federal Government, State Governments, private organizations or individuals. Thus in Nigeria, there are tertiary institutions which are publicly or privately funded. The Government is the major funder of public/ government established tertiary institutions in the country and a characteristic of tertiary institutions funding in Nigeria is that both tiers of government (federal and state) manage and fund their own institutions. On the whole, however, the Federal Government shares in tertiary institution financing are greater than that of the State Governments (Onuoha, 2013).

Government has been a major player in education in Nigeria through the implementation of various intervention programs such as the Universal Primary Education, the Universal Basic Education, award of scholarships, and establishment of Education Trust Fund now Tertiary Education Trust Fund (TetFund) and the mandatory contribution of 2% tax on profit by companies operating in Nigeria (Ewa, 2013). Majorly in tertiary institutions, construction works presently are funded through but not limited to; Capital Projects, TetFund Sponsored Projects, Internally Generated Revenue (IGR) Projects or Donated Projects by organizations or individuals.

Considering the economic background of the country, it is necessary to deliver construction projects in these tertiary institutions within specified and available budget. Therefore cost performance which is measured by comparing final cost against budget or initial cost, is posited as a major criteria of building project success. Bubshait and Almohawis (1994) describe this as the degree to which the general conditions promote the completion of a project within the estimated budget. Memon *et al*. (2010) further stated that construction cost is one of the most crucial measures of project success throughout the lifecycle of a project, and it is of high concern to stakeholders in the construction industry. Hussin *et al*. (2013) stated that although cost is one of the major considerations throughout the lifecycle of a project, most projects still fail to achieve project completion within the estimated cost. According to Azhar et al. (2008) cost overrun is a serious problem in the construction industry both in developed and developing countries. The trend is more severe in developing countries where these overruns sometimes exceeds 100% of the anticipated cost of the project.

Azhar *et al*. (2008) found out that construction projects in Pakistan have a minimum cost overrun of 10% of the estimated cost. Endut *et al.* (2009) conducted a study on 308 public projects and 51 private projects in Malaysia and discovered that only 46.8% and 37.2% of public and private sector projects were completed within budget. Zujo *et al*. (2010) remarked that in Croatia 81% of 333 analyzed projects were suffering from price overrun while in Bosnia and Herzegovina, a study on 177 structural projects found that the contracted price was not met in 41.23% of the projects. Memon *et al*. (2012) discovered that construction projects in southern part of peninsular Malaysia experience cost overrun of between 5-10%. In Nigeria, Omoregie and Radford (2006) reported that the minimum average percentage escalation cost of projects was 14%. These researches further confirm Ogunsemi (2015) assertion that getting construction projects executed without cost overrun is rare.

Time on the other hand refers to the duration of completing a project. Construction time is the absolute time that is calculated as the numbers of days/weeks from start on site to practical completion of the project (Chan and Chan 2004). Construction project performing to time is very important, as the clients, stakeholders and general public first criterion for project success appears to be the completion time (Lim and Mohammed, 1999). According to Hussin *et al.* (2013), achieving completion of construction projects on time is a basic requirement for a successful construction. However, it seems seldom for projects to be completed on time. This has become a worldwide problem. A study showed that the Vietnamese government has acknowledged this issue as a big headache, especially with government-related funded projects (Le -Hoai *et al.,* 2008). Al-Momani (2000) carried out a research on the construction projects in Jordan and found that delays occurred in 106 (82%) projects out of 130 public projects assessed. In a similar study, Frimpong, Oluwoye and Crawford (2003) found 33 (70%) out of 47 projects in Ghana were delivered behind schedule.

In Nigeria, out of 3,407 projects only 24 projects were completed on time, while 1517 were delayed and the rest were abandoned (Amu and Adesanya, 2011). Omoregie and Radford (2006) reported that the minimum average percentage escalation period of projects in Nigeria was found to be 188%. It is obvious that delay in delivering projects on schedule has become serious and expensive problems for parties involved in the delivery of construction projects. Late completion of projects can deny employers the benefits or profits potentially accrued through the use of the project. Delays may also expose them to serious financial and economic risks such as high interest rates and loss of market opportunities. On the contractor's side, delays in completion means additional cost accrued from extended insurances, extended use of site office overheads, labour and equipment, standby costs and other intangible cost such as opportunity cost (Kumaraswamy and Chan, 1998; Kikwasi, 2012).

According to Fisk (1997) in order to control cost and achieve appreciable cost performance, two measures needs to be adopted. The first is the application of value engineering concept, which aims at a careful analysis of each function and the elimination or modification of anything that adds to the project cost without adding to its functional capabilities. He argues that by carefully investigating costs, availability of materials, construction methods, procurement costs, planning and organizing, cost/benefit values and similar cost influencing items, an improvement in the overall cost of project can be realized. The second is to provide comprehensive and error free designs and specifications to avoid misinterpretations by the contractor or delay due to missing details. Ashworth (2000) observed that profitable firms may be generating their revenues from the elimination of waste at both professional and trade practice levels. Eshofonie (2008) also stated that establishing firmly the requirements and features of the project at the onset before getting started is an effective cost control measure. Azis *et al.* (2013) also proposed several measures for mitigating poor cost performance some of which are; use of contractors with adequate experience on the job, use of appropriate construction methods, use of up-to-date technology, clear information and communication channels and frequent coordination between the parties.

3. Methodology

The study was based on selected educational building projects executed in public tertiary institutions in Ondo State, Nigeria within 2006 to 2016. These institutions are funded through the various governments funding scheme. Since the government is a major contributor to the educational sector, and these funding schemes are used in the provision of educational buildings in all public institutions within the country, it can be said that these selected public institutions gives a reasonable insight of happenings in government owned tertiary institutions around the country.

Ondo State houses 9 public institutions of higher learning; however, this study was restricted to 5 of them because of the availability of data required. These institutions are; Adekunle Ajasin University, Akungba, Adeyemi College of Education, Ondo, Federal University of Technology, Akure, Ondo State University of Science and Technology, Okitipupa, and Rufus Giwa polytechnic, Owo. For the remaining 4 tertiary institutions, 2 were left out of the study due to the absence of a physical planning/works department in the schools and absence of construction project within the selected time frame. The other 2 were omitted because they are newly established institutions and construction works are just commencing, getting data for finished projects was not possible. The private institutions were left out because they are individually owned institutions and are funded as such. Their details are mostly kept confidential; hence getting data from such schools will be difficult.

The population for the study were building projects carried out within the stated time frame for which adequate information was gathered, and the participants involved in the delivery of these construction projects. A total number of 167 building projects were identified in these institutions. Purposive sampling was then adopted in selecting 66 building projects based on the availability of the needed information. The cost and time data for these projects were collected from archives through the use of a pro forma, while the possible measures for reducing the variability in construction cost and time were obtained through the use of structured questionnaire administered on 207 identified participants of these building projects. These participants include: The Client, represented by the construction professionals in the Physical Planning Unit/Works Department of the identified institutions. The construction professionals chosen were those that acted in the capacity of a clerk of work on the identified projects. The Consultants (Architects, Quantity Surveyors and Civil and Services Engineers) which were outsourced were also part of the participants sampled, as well as the Contractors that handled the construction of each identified building projects. Out of the 207 questionnaire distributed, 134 were however retrieved and deemed fit for analysis.

The questionnaire used was designed in two parts based on information gathered from review of related literatures. Part A dwelt on the background information of respondents. Information gotten from this section provides quality check to the data gotten from the other part of the research instrument. Part B assessed possible measures for reducing the variability in construction cost and time of educational building projects. A total of 18 possible measures were selected from literature and respondents were asked to rank them base on their importance using a 5-point Likert scale, with 5 being very important, 4 important, 3 averagely, 2 low and 1 not important. The validity of the questionnaire was done using face validity in line with Sushil and Verma (2010) suggestion that face validity is assessed by having expert researchers to review the contents of the test to see if the items seem appropriate. At the end, the questionnaire was considered face valid. Also the reliability of the questionnaire was further tested using Cronbach's alpha test. This method is used to measure the reliability of the questionnaire between each field and the mean of the whole fields of the questionnaire. The normal range of Cronbach alpha value is between 0.0 and +1.0, and the higher value, the higher degree of internal consistency. The Cronbach alpha value of 0.72 was derived for the assessed criteria. This shows that the instrument is reliable since the degree of reliability of an instrument is more perfect as the value tends towards 1.0 (Moser and Kalton, 1999).

Data gathered from the questionnaire were analysed using frequencies, percentiles, relative importance index (RII), and Kruskal-Walis test was employed in testing the relationship in the view of the respondents. For the cost and time data gathered, paired sample t-test was employed to test the significant difference between the initial and the final estimated cost and time. Effect size was further used to determine the magnitude of difference between both means of the initial cost estimates and final cost. Tabachnick and Fidell (2001) opined that effect size also known as 'strength of association' is a set of statistics which indicates the relative magnitude of the differences between means. In other words, it describes the amount of the total variance in the dependent variable that is predictable from the independent variable. There are different effect size statistics, the most common of which is eta-squared, Cohen's d and Cohen's f. This study employed the eta-squared. For a paired t-test, eta-squared is calculated using the following formula:

$$\eta^2 = \frac{t^2}{t^2 + N - 1}$$

Where, t = t-value and N = Total number of variables. According to Cohen (1998), the values for eta-squared can be from 0 to 1. In this case, if eta-squared is 0.01, then it is considered to have small effect. Similarly, 0.06 (moderate effect) and 0.14 (large effect).

4. Results and Discussions

4.1 General Information of the Respondents

Analysis of the characteristics of the respondents shows that the most represented categories of respondents are the Consultants with 48.7%. This is followed by the Contractors with 31.3% and Clients with 20%. The most represented professionals are Engineers (Civil and Service) and Quantity Surveyors with 36.6% and 32.1% respectively. This is followed by Architects and Builders with 19.4% and 11.9% respectively. Most of the respondents sampled hold Bachelor of Science/Bachelor of Technology degree (36.5%) and Masters of Science/Masters of Technology degree (35.8%), while 17.2%, 9.7% and 0.8% possess Post Graduate Diploma (PGD),

Table 1: *Paired samples t-test for Cost of Educational Buildings*

			Paired Differences					T	Df	Sig. (2-tailed)
			Average Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
		Mean				Lower	Upper			
Pair 1	final cost - initial cost	99037680.57 94299836.84	4737843.72	9191013.52	1131335.56	2478410.60	6997276.85	4.188	65	0.000

Higher National Diploma (HND) and PhD respectively. The overall average years of work experience of the respondents is 12.7 years. These vast years of experience in turn influences the number of projects handled by the respondents, as an average of 15 construction project was observed. Based on this general information, it can be assumed that the respondents are well equipped not only academically but also in terms of years of working experience, thus, making them capable to provide sufficient response that addresses the objective of this study.

4.2 Cost Delivery of Educational Building Projects

Table 1 shows the result of a paired sample t-test conducted to evaluate the significant difference in the initial and final cost of the identified educational building projects. Result shows an average mean of 4,737,843.72 with t-value of 4.188 and sig. p-value of 0.000. At a 95% confidence level, this sig. p-value shows that there is a significant difference between the final construction cost and the initially estimated cost. The eta squared which represents the proportion of variance of the dependent variable (final cost of construction) that is explained by the independent variable (initial estimated cost) was further calculated as 0.21. This indicated a large effect size as it is above the 0.14 suggested for a large effect (Cohen, 1988). This means that a larger portion of variance of the final cost of construction of educational building projects is predictable from the knowledge of the initial estimated cost.

Further analysis in Table 2 shows that out of the 66 building projects assessed, 30 were completed within budget, while 34 projects experienced cost overrun ranging between 0.02% to 23.46% and only 2 made savings of 0.15% and 2.67%. On the average, there is an increase of estimated budget by 4.78% on all projects assessed. This 4.78% deviation of final cost from the initial estimated cost is in line with Memon *et al.* (2012) findings where it was discovered that construction projects in southern part of Peninsular Malaysia faces cost overrun between 5-10%. When compared to the findings of Omoregie and Radford (2006) which showed that the minimum average percentage escalation cost of public projects in Nigeria was 14%, it could be seen that there exist appreciable measure of improvement in cost performance of construction works in the Nigerian construction industry. However, despite this appreciable decrease in the cost overrun experienced in these two studies, these educational buildings are still not in the clear yet as the result (4.78%) is above the range stated by the National Institute of Building Science (2013), which gives the range of acceptable deviation for a final estimated cost (initial cost estimate) from the final cost of completion as 2% to 3%. This implies that more can still be done in order to further close the gap between the initial estimated cost and final cost of construction of educational buildings.

It is also interesting to note that the 30 projects completed within budget recorded the exact initial estimated cost for their final construction cost as seen in Table 2. Reason for this can be can be attributed the strict rule placed on the procurement of construction works in most institutions, especially those funded by the government. Some of these projects are fixed without allowance for variation. Thus it is not uncommon to see institutions claiming to have completed construction projects at the exact estimated cost of construction. This reason can therefore account for the appreciable success in terms of cost record in this study when compared to that of other studies carried out on other public and private projects within and outside the country.

4.3 Time Delivery of Educational Building Projects

Table 3 shows the result of a paired sample t-test conducted to evaluate the significant difference in the initial and final duration of the identified educational building projects. Result shows an average mean of 31 weeks with a t-value of 8.518 and a significance p-value of 0.000. Since this p-value is less than 0.05, it therefore implies that there is a significant difference between the initial estimated time and final time of construction. Eta squared gave a value of 0.53 and this indicated a very large effect size (difference) as it is far above the 0.14 figure suggest for a large effect. This means that a larger portion of variance of the completion time of educational building projects is predictable from the knowledge of the initial estimated time.

Further analysis on Table 2 shows that out of the 66 building projects assessed only 10 (15% of the total projects assessed) were completed within the estimated time, while the remaining 56 (85% of the total projects assessed) experienced time overrun of within 17% to 860%. On the average, there is an overshot of estimated project duration by 130.25% on all projects assessed. This implies that these building projects experience a poor time performance. This unhealthy situation is rather disheartening considering the nature of educational building projects where time is always of the essence and buildings need to be completed in time to meet up with the high influx of students every year.

Interestingly since 56 of the assessed building projects experienced time overrun, it is only logical to expect these same projects to have significant cost overrun as delay in time mostly affects the cost of construction. However, result proves otherwise as only 34 projects experienced cost overrun as against the 56 that experienced time overrun. Reason for this can be attributed to the understanding between the institutions and the contractors. In most cases, when the delay is caused as a result of non-payment for works done on the part of the client, depending to the extent of delay and its effect on the contractor, claims are not usually placed by the contractors. This is as a

Table 2: *Cost and Time Delivery of Educational Building Projects*

S/n	Project Type	Final Cost (₦)	Initial Cost (₦)	Cost Deviation (%)	Final Time (weeks)	Initial Time (weeks)	Time Deviation (%)
1	A	58,145,667	58,145,667	0.00	92	48	91.67
2	A	197,840,275	197,840,275	0.00	84	36	133.33
3	A	39,684,127	39,684,127	0.00	24	24	0.00
4	A	17,010,341	17,010,341	0.00	24	12	100.00
5	A	29,844,677	29,844,677	0.00	84	20	320.00
6	C	15,118,688	15,118,688	0.00	56	32	75.00
7	A	60,786,409	60,786,409	0.00	92	48	91.67
8	C	105,142,668	108,027,172	(2.67)	124	28	342.86
9	A	147,897,086	133,107,377	11.11	72	15	380.00
10	A	111,839,946	95,063,954	17.65	12	12	0.00
11	A	304,546,475	268,000,898	13.64	48	32	50.00
12	C	69,161,348	62,245,213	11.11	48	48	0.00
13	C	64,478,745	63,833,957	1.01	18	12	50.00
14	A	55,363,485	50,661,046	9.28	18	12	50.00
15	A	4,167,911	4,167,911	0.00	12	12	0.00
16	A	11,821,289	11,821,289	0.00	56	48	16.67
17	A	43,941,029	43,941,029	0.00	28	12	133.33
18	A	10,034,231	10,034,231	0.00	60	48	25.00
19	B	90,477,587	87,872,012	2.97	48	32	50.00
20	A	101,662,625	100,000,000	1.66	56	22	154.55
21	A	116,664,338	116,664,338	0.00	124	32	287.50
22	A	55,433,000	52,661,350	5.26	48	48	0.00
23	A	64,284,911	55,927,873	14.94	60	48	25.00
24	A	45,765,992	39,816,413	14.94	48	32	50.00
25	A	448,211,783	445,622,373	0.58	56	22	154.55
26	A	112,340,483	100,161,756	12.16	64	32	100.00
27	B	9,224,328	8,000,000	15.30	48	28	71.43
28	C	172,664,910	160,218,471	7.77	48	15	220.00
29	C	22,835,730	19,119,303	19.44	48	26	84.62
30	C	45,881,542	40,304,958	13.84	60	36	66.67
31	C	4,200,000	4,200,000	0.00	72	24	200.00
32	A	244,678,435	213,056,669	14.84	72	24	200.00
33	A	140,675,924	122,583,402	14.76	48	20	140.00
34	A	140,675,924	122,543,910	14.80	45	20	125.00
35	B	39,078,469	37,065,469	5.43	32	14	128.57
36	B	21,410,849	21,410,849	0.00	26	14	85.71
37	B	21,410,715	21,410,715	0.00	30	14	114.29
38	B	21,410,965	21,410,965	0.00	28	14	100.00
39	B	8,981,274	8,981,274	0.00	13	10	30.00
40	B	7,604,215	7,604,215	0.00	10	10	0.00
41	B	14,278,583	14,278,583	0.00	8	8	0.00
42	A	103,862,971	97,674,357	6.34	63	24	162.50
43	A	37,095,639	34,319,111	8.09	26	16	62.50
44	A	20,992,043	18,841,035	11.42	144	15	860.00
45	B	118,171,918	118,171,918	0.00	124	36	244.44
46	B	99,925,316	99,925,316	0.00	56	22	154.55
47	A	191,706,467	191,706,467	0.00	68	41	65.85
48	A	111,839,946	111,839,946	0.00	124	32	287.50
49	A	56,099,131	56,099,131	0.00	48	48	0.00
50	A	102,313,719	102,313,719	0.00	92	48	91.67
51	A	12,245,991	12,245,991	0.00	28	12	133.33
52	A	11,832,949	11,832,949	0.00	48	48	0.00
53	C	51,101,270	51,101,270	0.00	24	12	100.00
54	A	119,672,156	119,849,612	(0.15)	48	26	84.62
55	A	131,809,385	131,500,417	0.23	72	36	100.00
56	A	84,641,028	79,301,128	6.73	124	24	416.67
57	B	93,090,225	80,098,496	16.22	124	36	244.44
58	A	500,200,324	500,100,000	0.02	92	48	91.67
59	A	7,700,000	7,700,000	0.00	28	12	133.33
60	A	698,624,073	687,747,906	1.58	24	12	100.00
61	A	132,810,360	128,841,739	3.08	48	26	84.62
62	A	85,264,331	75,885,254	12.36	60	36	66.67
63	A	162,793,861	160,723,724	1.29	124	24	416.67
64	A	17,205,703	16,345,418	5.26	56	22	154.55
65	A	28,630,150	28,630,150	0.00	64	32	100.00
66	C	260,180,980	210,745,015	23.46	47	16	193.75
Average percentage deviation				**4.78**			130.25

NOTES:

1000 Nigerian Naira = 3.17 USD

A: Academic buildings such as classrooms, lecture theatres and offices, B: Accommodation buildings,
C: Social and health services buildings.

Table 3: *Paired samples t-test for time delivery of Educational Buildings*

			Paired Differences					t	df	Sig. (2-tailed)
			Average Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
		Mean				Lower	Upper			
Pair 1	Final time - Initial time	57.58 26.48	31.091	29.653	3.650	23.801	38.380	8.518	65	0.000

result of the understanding from the inception of the contract, whereby the mode of funding of such job must have been started clearly and every anticipated delay can be accommodated. Contractors tend to accommodate this delay and hence they do not make claim due to several reasons, one of which is to keep a good working relationship with the institution because of future jobs. Hence, these projects are said to be completed to cost but above the expected duration.

Odeyinka and Yusif (1997) submitted that the average time overrun experienced on construction projects in Nigeria is 70%. However, Omoregie and Radford (2006) submitted that the rate of time overrun in the Nigerian construction industry is increasing, as a total of 188% time overrun was experienced on public construction projects. This is about 118% difference when compared to the findings of Odeyinka and Yusif (1997) carried out 9 years earlier. Finding of this study however shows a decrease in this trend as 130% time overrun was discovered, which is about 58% difference when compared to findings of Omoregie and Radford (2006). However despite this decrease, the overall delay in construction project delivery within the industry is still too high. If not properly check, this may disrupt the activities of the industry and reduce to confidence of clients and other stakeholders of the industry. This findings also further affirmed Akindoyin (1988) and Ogunsemi (2015) assertion that in Nigeria and indeed the world at large, most construction projects are completed after duration, longer than initially planned.

In similar studies elsewhere, Al-Momani (2000) found out that delays occurred in 106 (82%) projects out of 130 public projects assessed in Jordan. Frimpong et al. (2003) found 33 (70%) out of 47 projects in Ghana were delivered behind schedule. This implies that the issue of poor time performance is not only synonymous to Nigeria construction industry alone, but to most countries around the world as observed by Ogunsemi (2015).

4.4 Measures for Reducing the Variability in Cost and Time Delivery of Educational Buildings

In assessing the possible ways by which the difference in cost and time of educational buildings can be reduced, certain measures were identified from literature and respondents were asked to rank them based on their level of importance. Result in Table 4 shows the ranking of these measures. Kruskal-Walis test which is used in ascertaining the significant difference in the perception of three or more categories of respondents was employed in determining consistency in the opinion of the three sets of construction participants (Clients, Consultants and Contractors) as regards the identified measures. Looking at the highest ranked measure by each of the categories of respondents, it can be seen that both the clients and contractors rated prompt payment for executed works to ensure sufficient cash flow to the contractors as top. The consultants however are of the opinion that predicting market price fluctuation and inculcating it into the initial estimate is the most important measure. Reason for these ratings can be associated with

Table 4: *Measures of reducing variability in cost and time*

	Client		Consult.		Contr.		Overall		Kruskal-Walis	
Measures	RII	Rank	RII	Rank	RII	Rank	RII	Rank	Chi Sq	Sig.
Prompt payment for executed works to ensure sufficient cash flow to the contractors	0.898	1	0.895	2	0.924	1	0.904	1	1.030	0.597
Predicting market price fluctuation and inculcating it into the initial estimate	0.891	2	0.927	1	0.854	5	0.893	2	1.232	0.540
Owner's involvement at the planning and design phase	0.868	3	0.877	5	0.892	2	0.878	3	0.554	0.758
Involvement of professionals at the initial stage of project	0.868	3	0.882	4	0.886	3	0.878	3	0.209	0.901
Clear and thorough project brief	0.853	6	0.873	6	0.876	4	0.866	5	1.178	0.555
Thorough detailing of design	0.853	6	0.886	3	0.843	9	0.861	6	3.417	0.181
Comprehensive site investigation	0.857	5	0.850	7	0.849	6	0.852	7	0.228	0.892
Use of project scheduling/management techniques	0.845	8	0.836	8	0.849	6	0.843	8	0.418	0.811
Specification of readily available materials	0.838	9	0.836	8	0.849	6	0.840	9	0.168	0.920
Avoid wastage of materials during construction	0.811	11	0.827	10	0.811	10	0.816	10	0.338	0.845
Accurate calculation of quantities in BOQ	0.815	10	0.814	12	0.789	13	0.807	11	0.857	0.651
Good communication and coordination system between parties	0.804	13	0.823	11	0.784	14	0.804	12	0.692	0.708
Use of good and applicable construction methods	0.811	11	0.791	15	0.800	11	0.801	13	0.771	0.680
Granting mobilization advance to contractors	0.804	13	0.800	13	0.773	15	0.794	14	1.472	0.479
Having knowledge of previous projects	0.777	15	0.800	13	0.724	17	0.770	15	2.166	0.339
Involvement of contractor at planning and scheduling stage	0.751	16	0.759	17	0.795	12	0.766	16	2.626	0.269
Use of technology to improve and speed up project process	0.743	18	0.755	18	0.757	16	0.751	17	0.074	0.963
Value management at initial stage of project	0.751	16	0.777	16	0.719	18	0.751	17	1.174	0.556

the role of each party in the delivery of construction. While the client is responsible for payment of executed works carried out by the contractor, the contractor on the other hand requires prompt payment from the client so as to ensure cash flow and keep to schedule. The consultant is responsible for making sure that the dream of the client is brought into reality through proper management of the project. This management include both seen and unforeseen situations. The onus is therefore on the consultant to forecast the unforeseen situations (such as fluctuation in the market price) and make adequate provision for same from the onset of the project.

On the overall, the most important of them are prompt payment for executed works to ensure sufficient cash flow to the contractors, and predicting market price fluctuation and inculcating it into the initial estimate. These two measures were ranked high with an over RII of 0.904 and 0.893 respectively. The cash flow/finance and payment of completed work to contractor is very important as most contractors in Nigeria are small-medium size contractors (Ogbu, 2017) and they cannot finance projects independently prior to client's financial contribution (Odediran *et al*., 2012). Kikwasi (2012) also stated that delay in payment to contractors is a major reason for the delay in completion of construction projects in Tanzania. In similar vein, price fluctuation is a common phenomenon in Nigeria, due to the economic instability within the country (Sanusi, 2010); hence its impact on the cost and time delivery of construction project is no stranger to professionals in the built environment. Thus adequate measure must be made for such occurrence while estimating. This finding is in line with Abu-Shaban (2008), Ameh *et al.* (2010) and Memon *et al*. (2012).

Owner's involvement at the planning and design phase, and involvement of professionals at the initial stage of project were rated equally as the third most important measures with an overall RII of 0.878 each. In the case of tertiary institutions, the "owner" of a structure can be seen as those for which the structure is being built. In most cases, the dean of the faculty in the case of an academic building or even the head of departments can represent the owner as they have a vivid view of the need of the departments in the faculty. Involving them at the planning and design stage will go a long way in avoiding frequent design changes and change in scope of the project when it finally commences. In similar vein, the role of construction professionals cannot be over emphasized in the delivery of successful construction projects. Their involvement from the early stage of the project is crucial for successful project delivery.

Fisk (1997) argued that in order to control cost and achieve appreciable cost performance, two measures needs to be adopted. The first is the application of value management concept, which aims at a careful analysis of each function and the elimination or modification of anything that adds to the project cost without adding to its functional capabilities. The second is to provide comprehensive and error free designs and specifications to avoid misinterpretations by the contractor or delay due to missing details. Although the use of value management concept is ranked the least on the table, it still shows an overall RII of 0.751 which is way above average of 0.50. This implies that respondents recognised the importance of this measure. However reason for it being ranked the least might be as a result of its low usage in the construction industry as observed by Aghimien and Oke (2015).

Finding of this study further agrees with Fisk (1997) suggestion as clear project brief and thorough detail design are seen to be among the top rated measures. Memon *et al.* (2012) found design changes as one of the most occurring causes of poor cost performance, and according to Gkritza and Labi (2008), the more the time spent on correction of design during construction, the more likely the occurrence of cost overrun and by extension, time overrun. Thus, for effective performance in terms of cost and time, Odediran *et al*. (2008) suggested that providing comprehensive and error free designs and specifications to avoid misinterpretations by the contractor and its associated cost implication is necessary.

Kruskal-Walis test carried out shows that at 95% confidence level, there is no significant difference in the ranking of all the measures for reducing the variability in cost and time of educational buildings by the 3 categories of respondents. All the measures recorded a significant p-value of above 0.05.

5. Conclusions

This study set out to assess the variability in the cost and time delivery of educational buildings in Nigeria, using a study of selected building projects in five public tertiary institutions. The study concludes that the there is a significant difference in the initial and final cost of delivering educational buildings as an average of 4.87% deviation was experienced on all assessed projects. Although this deviation shows an improvement when compared to past findings within the country, more can still be done to reduce the deviation margin up to the 2-3% stated by the National Institute of Building Science (2013). As regards the timely delivery of education building projects, the study reveals that there is a significant difference also in the initial and final time of construction of educational buildings. A whopping 130% deviation of initial estimated time from final time of construction was discovered on all assessed building projects. This is rather sad considering the nature of educational buildings where time is a major factor as construction projects need to be carried out within short period to meet intake of students. To remedy these problems, the study revealed that prompt payment for executed works to ensure sufficient cash flow to the contractors, predicting market price fluctuation and inculcating it into the initial estimate, owner's involvement at the planning and design phase, involvement of professionals at the initial stage of project, providing clear project brief and thorough detail design will play a major role.

It is believed that this study will go a long way in helping the participants in the delivery of educational buildings across the country, and within developing countries with similar characteristics in terms of construction industry, to deliver cost and time effective educational buildings. The findings of this study also provide possible directions for further studies as it was restricted to public tertiary institution building projects. Similar study can be carried out in on other type of constructions within these public tertiary institutions in order to compare the result of the different types of constructions being executed within the education sector.

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