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An investigation into cost overruns for ongoing building projects in Abuja, Nigeria

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Abstract

The total amount of cost overruns for any construction project can be fully determined once the project is completed. Estimating the amount of cost overruns at different stages of ongoing construction projects is important for project success. There is, however, a dearth of research for this exercise. This article reports the results of an investigative study on cost overruns for ongoing building projects in Abuja. The quantitative technique was adopted in this study. The investigation included ongoing building-construction projects within Abuja, from which a sample of 30 building projects (public and private) was purposively selected (project value of ZAR100 million and above). The data were sourced from the archival records (drawings, bills of quantities, project progress reports, and specifications) on the issues relating to the costs and duration of building projects. The data were analysed using descriptive (percentages) and inferential methods. The results revealed that the percentage of cost overruns ranged from a minimum of 5.56% with 90% project completion, and within 88% of the estimated time limit, to a maximum of 216.08% with merely 5% project completion, and within 8.3% of the estimated time limit. The entire projects had average cost overruns of 44.46%, with an average project completion of 52.4%, and within 91.4% of the average estimated time limit. Based on these findings, it can be concluded that continuous investigation into, and analyses of cost overruns at stages of building projects would encourage professionals to apply the best mitigation measures, in order to achieve a significant reduction in the total cost overrun at the completion of a project. Construction professionals should be well informed of these consequences (cost overruns) at an early stage, in order to evaluate the extent to which these consequences could be minimised.

Keywords: Actual cost, cost overrun, estimated cost, Nigeria, building projects

Abstrak

Die totale koste-oorskryding van enige konstruksieprojek kan ten volle bepaal word nadat die projek voltooi is. Koste-oorskrydingberamings op verskillende stadiums van deurlopende konstruksieprojekte is belangrik vir 'n projek se sukses; maar daar is gebrekkige navorsing daaroor. Hierdie artikel gee die resultate van 'n ondersoek oor koste-oorskryding van voortgesette bouprojekte in Abuja. Die kwantitatiewe navorsingmetode is in hierdie studie gebruik. Die ondersoek sluit deurlopende bouprojekte binne Abuja in, waaruit 'n steekproef van 30 (openbare en private) bouprojekte doelgerig geselekteer is (projekwaarde van ZAR100 miljoen en hoër). Die data is verkry uit die argiefrekords (tekeninge, wetsontwerpe van hoeveelhede, projek-vorderingsverslae en spesifikasies) oor die kwessies wat verband hou met die koste en duur van bouprojekte. Die data is ontleed met behulp van beskrywende (persentasies) en inferensiële metodes. Die resultate het getoon dat die persentasie van koste-oorskryding gewissel het van 'n minimum van 5.56% met 90% projekvoltooiing, en binne 88% van die beraamde tydslimiet, tot 'n maksimum van 216.08% met net 5% projekvoltooiing, en binne 8.3% van die beraamde tydslimiet. Die hele projek het 'n gemiddelde koste-oorskryding van 44.46% met 'n gemiddelde projekvoltooiing van 52.4%, en binne 91.4% van die gemiddelde geskatte tydslimiet gehad. Op grond van hierdie bevindinge, kan daar afgelei word dat deurlopende ondersoek en ontleding van koste-oorskryding by stadiums van bouprojekte professionele persone sal aanmoedig om die beste versagtingsmaatreëls toe te pas, ten einde 'n aansienlike vermindering in die totale koste-oorskryding op die voltooiing van 'n projek te bereik. Professionele konstruksiemense moet goed ingelig wees van hierdie gevolge (koste-oorskryding) op 'n vroeë stadium, ten einde die mate waartoe hierdie gevolge geminimaliseer kan word te evalueer.

Sleutelwoorde: Beraamde koste, bouprojekte, koste-drempeloorskryding, Nigerië, werklike koste

1. Introduction

The construction industry contributes to the socio-economic growth of any nation by improving the quality of life and providing infrastructures such as roads, hospitals, schools, and other basic facilities. Hence, it is imperative that construction projects be completed within the scheduled time, within the budgeted cost, and meet the anticipated quality. However, being a complex industry, it is faced with severe problems of cost overruns (Abdul-Rahman, Memon & Abd Karim, 2013: 268). Cost overrun is a common problem in both the developed and the developing nations, making it difficult to complete many projects within budget. Being a common problem, Allahaim & Liu (2012: 2) reported that cost overruns were found across 20 nations and five continents. Cost overruns affect 90% of completed projects (Flyvbjerg, Holm & Buhl, 2004: 7; Memon, 2013: 1; Abdul-Rahman, Memon & Abd Karim, 2013: 268). However, the majority of developing countries experience overruns exceeding 100% of the initial budget (Memon, Abdul-Rahman, Zainun & Abd Karim, 2013: 1970). The argument in the construction industry on how to reduce or totally remove cost overruns from projects has been

ongoing among built-environment professionals, project owners, and users for the past 70 years (Apolat, Alinaitwe & Tindiwensi, 2010: 305; Allahaim & Liu, 2012: 1). There is, however, no substantial improvement or significant solution in mitigating its detrimental effects (Allahaim & Liu, 2012: 1).

Consequently, studies from different countries have revealed that cost overruns represent a large percentage of the production costs. For instance, 33.33% of the construction project owners in the United Kingdom are faced with the problem of cost overruns (Olawale & Sun, 2010: 511; Abdul-Rahman, Memon & Abd Karim, 2013: 268). The Big Dig Central Artery/Tunnel project in Boston could not be completed within its budgeted cost, and it had an overrun of 500%. The Wembley stadium in the United Kingdom had a 50% cost overrun, and the Scottish parliament project, which had a time overrun of over three years, also experienced a cost overrun of 900% (Love, Edward & Irani, 2011: 7).

Over the years, research interests in addressing construction cost overruns across the world have resulted in a large number of publications. However, research evidence has shown that previous studies from different parts of Nigeria have centred on the investigation into the total amount of cost overruns for completed works; identification of causes of cost overruns, as well as the control measures for mitigating cost overruns in the construction industry (Ogunsemi & Jagboro, 2006: 253; Olatunji, 2008: 1; Ameh, Soyingbe & Odusanmi, 2010: 51; Olawale & Sun, 2010: 511; Ubani, Okorocha & Emeribe, 2011: 74; Kasimu, 2012: 775; Malumfashi & Shuaibu, 2012: 21). Nonetheless, these studies have failed to objectively investigate cost overrun for ongoing building projects in Nigeria. Therefore, this led to the development of the problem posed in this study that data on the amount of cost overruns for ongoing building projects are minimal in the Nigerian construction industry. On this basis, this article reports the findings of an objective investigation into cost overruns for ongoing building projects in Abuja, Nigeria. The recommendations of this paper, if properly implemented, would achieve the best value for money to the client, as it would encourage professionals to explore possible ways of minimising the rate of cost overrun on site.

2. Literature review

2.1 The concept of cost overrun in the construction industry

Cost overrun is referred to as "cost increase" or "budget overrun". It involves unanticipated costs incurred in excess of the budgeted amounts (Shanmugapriya & Subramanian, 2013: 735). Saidu &

Shakantu (2016: 125) view cost overrun as simply an occurrence, where the final or actual cost of a project surpasses the original or initial estimates. Cost overrun is defined as a percentage difference between the final completion cost and the contract-bid cost (Shanmugapriya & Subramanian, 2013: 735; Shrestha, Burns & Shields, 2013: 2; Saidu & Shakantu, 2016: 125). Cost overrun has also been referred to as the percentage of actual or final costs above the estimated or tender cost of a project (Ubani *et al.*, 2011: 74). Nega (2008: 48) defines cost overrun as an occurrence, in which the delivery of contracted goods/services is claimed to require more financial resources than was originally agreed upon between a project sponsor and a contractor.

2.2 Cost overruns worldwide

The history of the construction industry worldwide abounds in projects that were completed with a significant amount of cost overrun, despite the use of modern technologies and software packages (Memon, 2013: 16). In the United States of America, only 16% of the 8 000 surveyed projects in 1994 could satisfy the following requirements: timely completion within the budget, and maintaining a high standard of quality (Ameh *et al.*, 2010: 51). In Canada, 50 road-construction projects were investigated, and the results revealed a cost overrun of up to 82% in 2006 (Odeck, 2014: 71).

Cost overruns were slightly lower in Europe compared to North America and other geographical areas (Brunes & Lind, 2014: 3). In the United Kingdom, Barrick revealed, in 1995, that almost one-third of the clients complained that their construction projects generally overran budget (Memon, 2013: 16).

Cantarelli, VanWee, Molin & Flyvbjerg (2012: 87) noted that the Dutch construction projects were reported to have an average cost overrun of 10.6% for railways, 18.6% for roads, and 21.7% for fixed links. In Portugal, construction projects face, on average, a minimum of 12% of cost overrun (Abdul-Rahman, Memon, Abdul-Azis & Abdullah, 2013: 1964). These results of cost overruns are not different in the developing countries.

In Bosnia and Herzegovina, Abdul-Rahman, Memon & Abd Karim (2013: 288) reported that, in a study of 53 building projects, 29 new construction projects experienced a cost overrun of 6.84% on average, while the remaining 24 re-construction projects had a cost overrun of 9.23% on average. In Pakistan, the minimum amount of cost overrun was reported to be approximately 10% for small-sized firms, 40% for large construction firms, and this percentage could

increase to 60% for medium-sized firms (Azhar, Farooqui & Ahmed, 2008: 506). Aziz (2013: 54) surveyed 15 different projects in Kuwait, and the results revealed that only one project had been completed without a cost overrun. Aziz (2013: 52-53) also reported that 70% of the building projects in Oman experienced a delay and were completed with cost above the initially estimated budget.

Moreover, a study conducted on 359 projects (308 public and 51 private projects) in Malaysia revealed that only 46.8% and 37.2% of public sector and private sector projects, respectively, were completed within the budget, with an average cost deviation of 2.08% (Endut, Akintoye & Kolley, 2009: 244).

In Nigeria, Olawale & Sun (2010: 602) conducted a survey on cost overrun and found that 41% of the respondents had experienced a cost overrun of less than 10% of their projects, while 59% of the respondents had experienced a cost overrun of 10% or more on their projects.

In South Africa, Baloyi & Bekker (2011: 53) reported that the construction of FIFA 2010 World Cup stadia in different cities was completed with cost overruns ranging from 5% to a maximum of 94%.

In Uganda, Apolot, Alinaitwe & Tindiwensi (2011: 310) reviewed 30 projects of the Civil Aviation Authority of Uganda and found that 535 of the projects, although not fully completed, experienced cost overruns; 40% of these projects were within the budgeted cost, and 7% of the projects were still below the budget. A total of 84% of the cost overruns were occasioned by changes in the scope of the work, while the remainder were largely attributed to material-price inflation.

In Zambia, Kaliba, Muya & Mumba (2009: 523) revealed that road projects also faced over 50% of cost overruns as a result of delay and other factors.

2.3 Causes of cost overruns

The causes of cost overruns are critical to the success of any project (Allahaim & Liu, 2012: 2). Hence, it is imperative to comprehend the main causes of cost overruns for different projects. Therefore, cost overruns have been attributed to a number of sources, including technical errors in design or estimation; managerial incompetence; risks and uncertainties; suspicions of foul play; deception and delusion, and even corruption (Ahiaga-Dagbui & Smith, 2014: 683). According to Flyvbjerg, Holm & Buhl (2004: 7), the two main causes of cost overruns in a project are optimism bias (systematic tendency of decision-makers to be more positive about the results of planned

action) and strategic misrepresentations (confusing or misleading actions to ensure that projects succeed). Allahaim & Liu (2012: 2) contend that the practical causes of cost overruns are the lack of experience among the project team; contract size/complexity, and design error. Other surveys have identified the following four major factors that cause cost overruns for a project: variations in design; insufficient project planning; inclement weather conditions, and building materials' price fluctuation (Allahaim & Liu, 2012: 2). Love *et al.* (2011: 7) opined that design error at the pre-contract stage of a project is the major cause of cost overruns for hospital and school buildings.

In India, Subramani, Sruthi & Kavitha (2014: 1) surveyed the causes of cost overruns, and the results indicated that the major causes of cost overruns are slow decision-making at the planning stage of a project; poor project schedules and management; increases in the prices of materials and machines; poor contract management; poor design/delay in producing design; rework due to mistakes or wrong work; land-acquisition problems; poor estimation or estimation techniques, and the long time taken between the design and the time of bidding/tendering.

In Egypt, Aziz (2013: 51) examined the factors causing cost overruns in waste-water projects and concluded that the major causes of cost overruns are lowest tendering procurement method; additional works that are not included in the original work; bureaucracy in tendering or offering methods; wrong cost-estimation methods, and funding problems by client.

In Nigeria, Ameh *et al.* (2010: 49) concluded that the significant factors causing cost overruns in the telecommunication projects include the contractor's lack of experience; the high cost of importing materials, and the materials' price fluctuation. Kasimu (2012: 775) found that "fluctuations in materials prices", "insufficient time", "lack of experience in contracts works", and "incomplete drawings" were the major causes of cost overruns in building-construction projects in Nigeria. Malumfashi & Shuaibu (2012: 19) conducted a study on the causes of cost overruns in the infrastructural projects in Nigeria. The results revealed that the major causes include "improper planning"; "material-price fluctuations", and "inadequate finance from the project's inception".

In South Africa, Baloyi & Bekker (2011: 61) conducted a study on the causes of cost overruns for the 2010 FIFA World Cup stadia. The results revealed that the main causes of cost overruns are project complexity; increases in labour costs; inaccurate quantity estimations; differences

between the selected bid and the consultants' estimates; variation orders by clients during construction, and manpower shortage.

In Zambia, Kaliba *et al.* (2009: 524) concluded that the problem of cost overruns was caused by inclement weather conditions; changes in the size of projects; the cost of environmental sustainability; delays in the work programme; civil unrest; technical constraints, and increases in material prices.

Other studies have identified a variety of causes of cost overruns, including technical factors such as the lack of experience; the project size; errors in design; price fluctuations; wrong estimates, and scope changes (Love *et al.*, 2011: 6; Memon *et al.*, 2011: 59).

2.4 Mitigation measures for cost overruns

Project cost overrun is minimised and mitigated when maximum attention is paid to well-developed technical skills in modern projects (Doloi, 2013: 267). Olawale & Sun (2010: 513) noted that a critical investigation into cost overrun mitigation measures would result in their categorisation according to the broad function they perform. Thus, Olawale & Sun (2010: 513) identified the top five leading causes of cost overrun for a project and recommend a total of 90 mitigation measures for them. These mitigation measures were further categorised into four major classes, namely preventive, predictive, corrective, and organisational. Some of these measures (categories) are fluid and can sometimes appear as though they could be classified into more than one category, depending on their actual usage during the project. They include corrective-preventive and corrective-predictive measures.

Similarly, Abdul-Azis, Memon, Abdul Rahmann & Abd Karim (2013: 2627) identified and categorised cost overrun mitigation strategies into three major classes, namely proactive, reactive and organisational strategies. The proactive and organisational approaches are similar or almost the same as the preventive and organisational measures recommended by Olawale & Sun (2010: 513). The reactive strategies, however, are adopted to mitigate the effect of the factor that actively contributes to cost overruns, while the organisational strategies are the normal measures put in place by an organisation, which must not be specific to one project, but would normally affect all projects. Some of these measures are classified in more than one strategy. For instance, proactive and organisational; reactive and organisational; pro-active and reactive, as well as pro-active, reactive, and organisational-control measures. The issues in each control measure are detailed in Figure 1.

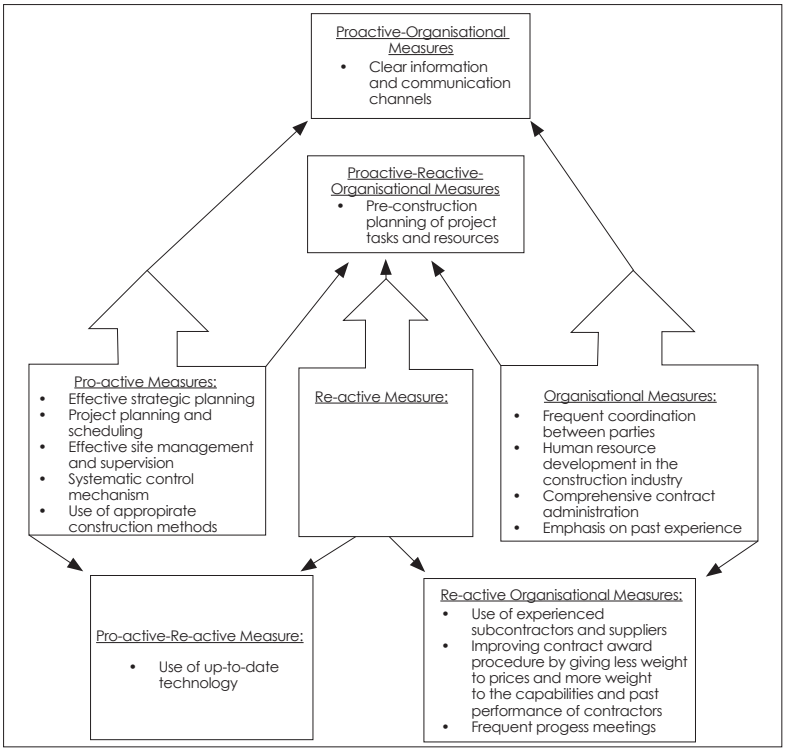

Figure 1: Cost overrun factors from each mitigation measure

Source: Researcher's construct adapted from Abdul-Azis *et al.,* 2013

Flyvbjerg (2008: 6-7) suggested two main concepts for minimising the cost overruns on construction projects, namely reference-class forecasting and increased public sector accountability through more involvement by the private parties.

Brunes & Lind (2014: 5) suggested three key areas on how cost overruns could be reduced in a project:

> decentralization of budgets, where cost overruns in one project in a region lead to less cost overruns in other projects in the specific region … It should be easy to see when and where cost overruns occur, and who was primarily responsible … ensuring a systematic use of external reviewers at the different stages of a project.

Peeters & Madauss (2008: 81) recommend a five-step approach to mitigating the effects of cost overruns in a project: realistic cost

estimation; considering the project's life-cycle cost; appropriate contractual framework; cost control and risk management during the project phase, and a communication-managed insurance approach. Memon *et al.* (2013: 1970) concluded that site-management factors are the important factors causing cost overrun. They thus suggest that improved site management and supervision of contractors could result in better control of cost overruns. In conclusion, the magnitude of the cost overrun was reduced after a mandatory quality assurance process was introduced in Norway (Magnussen & Olsson, 2006: 286).

3. Research methodology

The mode of inquiry in this research is the quantitative method that is rooted in the positivist research paradigm, because the data were generated from the numeric measurement of the estimated costs of projects, estimated time and actual time for projects, estimated cost and actual costs of work completed, as well as the amount of cost overrun for each project.

The study covers "ongoing" building-construction projects in Abuja, the Federal Capital Territory of Nigeria, from which a sample of 30 projects was selected. The sample comprised both public and private projects, with a value of 1.6 billion Naira/ZAR100 million and above, using purposive sampling techniques. The rationale for the selection of purposive sampling is that building-construction projects of ZAR100 million and above are likely to generate a huge amount of cost overruns, when compared with projects of less value. In addition, it is possible to have more experts (experienced professionals) than in smaller sized/lower valued projects.

Abuja was selected as the geographical case-study area, because it is one of the metropolitan cities in Nigeria with the highest population of professionals within the built environment, and many ongoing construction projects. This study focused mainly on the primary data, which included the archival records and project progress records in Abuja, Nigeria.

3.1 Projects' archival and progress records

The data on Estimated Cost of project (EC), Estimated Time for project (ET), Cost Now/actual cost (CN), and Time Now/actual time (TN), the percentage of the Work Completed (%ofWC), the Estimated Cost of the Work Completed (ECWC), and the Actual Cost of Work Completed (ACWC) for different projects were all collected from the

archival records (bills of quantities, specifications, and drawings) and the project-progress records compiled by the Quantity Surveyor for individual projects. The collected values of "ACWC" were deducted/ subtracted from the values of "ECWC" to determine the project's cost overruns. The percentage amount of cost overrun for each project was determined by dividing the amount of cost overrun by the estimated cost of work completed and multiplied by 100.

3.2 Data analyses

Both descriptive and inferential analyses of the data were employed in this study. The descriptive analysis included the percentage distributions (percentage amount of cost overruns for each project). This included describing and comparing the percentages of cost overrun to the percentages of work completed for projects. The linear regression (inferential) analysis available from the Statistica software package was performed to determine the relationships between the following variables: Estimated Time (x) and Actual Time (y) of projects; Estimated cost (x) and Actual cost (y) of projects; Percentage of work completed (x) and amount of cost overruns (y), as shown in Table 2.

The results of this research are presented in tabular form.

The linear-regression equation was used to determine the relationship between the variables.

For a linear regression equation: $y = a + bx$, and $x = a - \frac{y}{b}$,

$$b = \frac{n\sum xy - (\sum x)(\sum y)}{n\sum x^2 - (\sum x)^2}$$

Where "*y*" is the dependent variable (Volume of waste); "x" is the independent variable (volume of material used); "*b*" is the coefficient of "x" and "*a*" is a constant.

The approximate conversion rates used as at the period of data collection were: Nigerian Naira to US dollar = ₦200 = 1USD; Nigerian Naira to South African Rand = ₦16 = ZAR1.

For the purpose of anonymity, the names of the firms and the projects are not disclosed in this research, but are represented by project numbers.

4. Results and discussion

It is apparent from Table 1 that all the building projects visited had attained an average percentage completion of 52.4%. Approximately 15 out of the 30 projects were 50% completed and

only seven were 90%-99.9% completed, because the constructions were ongoing as at the period of data collection. These findings are reliable, because the average percentage of project completion is above 50%.

Moreover, research results from Table 1 also show that the percentage amount of cost overruns ranges from a minimum of 5.56% up to 90% project completion, and within 88% of the estimated time limit. This rose to a maximum of 216.08% with merely 5% project completion, and within 8.3% of the estimated time limit. All the projects had an average cost overrun of 44.46%, with an average project completion of 52.4%, and within an average estimated time limit of 91.4%. These results confirm the findings of Flyvbjerg, Holm & Buhl (2004: 7); Ameh *et al.* (2010: 49-53); Memon (2013: 1-3), and Abdul-Rahman, Memon & Abd Karim (2013: 268) that cost overrun is a common problem in the construction industry, because a huge amount of cost overrun has been noticed in a project with merely 5% completion.

Table 1: The research data

Project No.	**Estimated Cost of Project in** *(₦)000*	**Estimated Time** *(Month)*	**Actual Time** *(Month)*	**Percentage of work completed** *(%)*	**Estimated cost of work completed in** *(₦)000*	**Actual cost of work completed in** *(₦)000*	**Amount of cost overrun** *(₦)000*	**Percentage amount of cost overrun** *(%)*
1	3,200,000	24	11	17%	544,000	800,000	256,000	47.06%
2	14,000,000	24	15	47%	6,580,000	8,540,000	1,960,000	29.79%
3	1,650,000	20	36	59%	973,500	1,155,000	181,500	18.64%
4	6,000,000	24	12	35%	2,100,000	2,400,000	300,000	14.29%
5	5,880,000	22.5	54	43%	2,528,400	3,609,400	1,081,000	42.75%
6	1,800,000	16	11	63%	1,134,000	1,632,321	498,321	43.94%
7	15,900,782	36	13	30%	4,770,235	5,678,313	908,079	19.04%
8	7, 300,000	24	32	30%	2,190,000	3,285,000	1,095,000	50.00%
9	1, 800,000	24	21	68%	1,224,000	1,681,100	457,100	37.35%
10	6, 000,000	24	16	23%	1,380,000	1,800,000	420,000	30.44%
11	1, 650,000	24	23	65%	1,072,500	1,451,300	378,800	35.32%
12	1, 900,000	18	9	25%	475,000	600,000	125,000	26.32%
13	2, 580,333	18	7	15%	387,050	5,805,745	193,525	50.00%

Project No.	Estimated Cost of Project in(₦)000	Estimated Time (Month)	Actual Time (Month)	Percentage of work completed (%)	Estimated cost of work completed in (₦)000	Actual cost of work completed in (₦)000	Amount of cost overrun (₦)000	Percentage amount of cost overrun (%)
14	40,000,000	36	3	5%	2,000,000	6,321,562	4,321,562	216.08
15	20,940,557	48	19	17%	3,559,895	5,152,850	1,592,955	44.75%
16	3,450,000	24	11	23%	793,500	1,293,512	500,012	63.01%
17	1,666,346	18	8	31%	516,567	833,732	317,165	61.40%
18	2,300,000	24	10	25%	575,000	805,000	230,000	40.00%
19	2,300,000	24	21	90%	2,070000	2,185,000	115,000	5.56%
20	15,031,448	40	5	11%	1,653,459	1,935,632	282,173	17.07%
21	1,880,000	20	14	48%	902,400	1,534,000	631,600	69.70%
22	1,686,921	17	39	99.9%	1,670,052	3,100,000	1,429,949	85.62%
23	1,635,000	24	18	56%	944,693	1,265,324	320,631	33.94%
24	1,800,000	26	16	68%	1,224,000	1,364,562	140,562	11.48%
25	1,686,951	24	54	99.9%	1,670,082	2,700,000	1,029,918	61.67%
26	1,700,000	68	92	60%	1,020,000	1,360,000	340,000	33.33%
27	2,860,000	24	36	88%	2,516,800	3,162,831	646,031	25.67%
28	2,635,001	18	21	95%	2,503,251	2,985,333	482,082	19.27%
29	1,931,622	24	24	98%	1,892,989	2,161,313	268,324	14.18%
30	63,000,000	60	96	90%	56000,000	62,333,222	5,333,222	9.52%
	Average =	**27.25**	**24.90**	**52.4%**	**==24.9/ 27.25*100==**	**===91.4%**	**Average cost overrun=**	**44.46%**

4.1 Regression analyses

The result of the linear-regression analysis for 52.4% average project completion reveals the following.

It was observed from analysis No. 1 (relationship between the 'estimated time' and the 'actual time' of projects) that the probability value (0.000355) was less than the 0.05 (5%) significance level, and an R-square value of 37.08%. Therefore, it is inferred that the relationship was statistically significant. The result implies that, on average, the actual completion times (months) for projects are moving in line with

the estimated times. This result differs for some individual projects, as further explained in Tables 3 and 5.

Analysis No. 2 (relationship between the 'estimated cost of work completed' and the 'actual cost of work completed') revealed a statistical significant relationship between the variables with a probability value of 0.00000 less than the 0.05 (5%) significance level, and a very strong R-square value of 98.9%. This implies that, on average, the 'actual costs of work completed' are in line with the 'estimated costs of work completed' for all the projects. However, this is different for some individual projects, as further explained in Table 1.

Analysis No. 3 (relationship between the 'percentage of work completed' and the 'amount of cost overrun') shows that the evidence is not statistically significant, because the probability value (0.854496) was greater than the 0.05 (5%) significance level. This implies that the 'amount of cost overruns' does not necessarily depend on the 'percentage of the work completed'. In other words, cost overrun could occur at an early stage of a project with a small percentage of project completion. This result is further explained in Table 3.

Table 2: Results of the linear regression analyses

SN	Variables		Type of analysis	Observation			Inference	
	x	y		R square	Adjusted R^2	R	P value	Remarks
1	Estimated Time (Month)	Actual Time (Month)	Linear regression	37.08%	34.8%	0.6089	0.000355	Statistically significant
2	Estimated cost of work completed	Actual cost of work completed	Linear regression	98.9%	98.85%	0.994	0.000	Statistically significant
3	Percentage of work completed	Amount of cost overrun	Linear regression	0.122%	0.021231	0.0349	0.854496	Not significant

4.2 Building projects that have high cost overruns of 50% and above

Table 3 shows the results of the projects that have high cost overruns (50% and above). It is obvious from Table 3 that **Pn14** recorded a maximum of 216.08% cost overrun with merely 5% completion, and

within the first three months of the project commencement. This could not be as a result of delay, because the project was not delayed in any way, but could be occasioned by other factors such as mismanagement of resources, poor planning, or even corruption.

Both **Pn22** and **Pn25** had an additional 22 and 20 months, respectively, to attain 99.9% completion level. They recorded a cost overrun of 85.62% and 61.67%, respectively. These could have been as a result of extension of time and other related factors. However, **Pn8,** which was to be completed within 24 months, instead took an additional eight months, was only 30% completed, and had a cost overrun of 50%.

Table 3: Projects with high (50% and above) cost overruns

Project No. from Table 1	Estimated Time	Actual Time (Month)	Difference in time (Month)	Percentage of work completed	Percentage of cost overrun
Pn8	24	32	+8	30%	50%
Pn13	18	9	-9	15%	50%
Pn14	36	3	-33	5%	216.08%
Pn16	24	11	-13	23%	63.01%
Pn17	18	8	-10	31%	61.40%
Pn21	20	14	-6	48%	69.70%
Pn22	17	39	+22	99.9%	85.62%
Pn25	24	54	+20	99.9%	61.67%

4.3 Building projects that have 'low percentage of work completed' and 'high cost overruns'

It is apparent from Table 4 that **Pn14** had the highest cost overrun (216.08%), and that only 5% of the work was completed within the first three months of the estimated 36 months. Moreover, both **Pn1** and **Pn15** had percentage completion of 17%. They were both within their estimated time limits (13 and 29 months left), but had cost overruns of 47.06% and 44.75%, respectively. **Pn13,** which had only 15% rate of completion had a cost overrun of up to 50%. This implies that, unless the management of the projects is tight, these projects can continue to overrun their initial budget.

Table 4: Projects that have 'low percentage of work completed' and 'high cost overruns'

Project No. from Table 1	Estimated Time (Month)	Actual Time (Month)	Difference in time (Month)	Percentage of work completed	Percentage of cost overrun
Pn15	48	19	+29	17%	44.75%
Pn14	36	3	+33	5%	216.08%
Pn1	24	11	+13	17%	47.06%
Pn13	18	7	+11	15%	50%

4.4 Building projects that have 'high percentage of work completed' and 'low cost overruns'

It is clear from Table 5 that **Pn25,** which was 90% completed, had the lowest cost overrun of 5.56%, although the project had an extension of 30 months. This is followed by **Pn30,** which was 90% completed, had an extension of 33 months, and recorded a cost overrun of 9.25%. These percentage amounts of cost overrun could probably have been as a result of the extension of time and other related factors.

Moreover, **Pn24** was 68% completed, had a cost overrun of 11.48%, and the project is still within its normal estimated time limit (10 months left). However, **Pn29,** which was almost completed (98%) within the estimated time limit, also had a cost overrun of 14.18%. **Pn28,** which had a cost overrun of 19.27%, had an additional three months' extension to be completed at 95%. These results confirm the findings of Ameh *et al.* (2010: 49-53) who believed that the history of the construction industry worldwide abounds in projects that are completed with significant cost overruns. Despite the high percentage of work being completed, these projects still recorded low amounts of cost overruns between 5.56% and 19.25%.

Table 5: Projects that have 'high percentage of work completed' and 'low cost overruns'

Project No. from Table 1	Estimated Time	Actual Time	Difference in time	Percentage of work completed	Percentage of cost overrun
Pn30	60	96	-36	90%	9.25%
Pn29	24	24	0	98%	14.18%
Pn28	18	21	-3	95%	19.27%
Pn24	26	16	+10	68%	11.48%
Pn25	24	54	-30	90%	5.56%

5. Conclusion and recommendations

Estimating the amount of cost overrun at different stages of a construction project is important, but the total amount of cost overrun can only be determined once a project is completed. The dearth of research that determines the amount of cost overruns for ongoing building projects necessitated this study. The aim of this research was to report the results of cost overruns for ongoing building projects in Abuja, Nigeria.

The relationship between the 'estimated time' and the 'actual time' and 'estimated cost' and the 'actual cost' of projects was statistically significant. The results imply that, on average, the actual completion times (months) and the actual cost for projects are moving in line with the estimated times and the estimated costs, respectively, although the results differ for some individual projects that recorded high cost overruns. Conversely, the relationship between the 'percentage of work completed' and the 'amount of cost overrun' was not statistically significant. This implies that the 'amount of cost overruns' does not necessarily depend on the 'percentage level of the work completed' to occur. In other words, cost overrun could occur at an early stage of a project with a small percentage of project completion.

The results also revealed that the percentage amount of cost overruns ranged from a minimum of 5.56% with 90% project completion, and within 88% of the estimated time limit, to a maximum of 216.08% with merely 5% project completion, and within 8.3% of the estimated time limit. The projects had an average cost overrun of 44.46%, with average project completion of 52.4%, and within the average estimated time limit of 91.4%.

The projects that had high cost overruns ranged from a minimum of 50% to a maximum of 216.08%. Similarly, the project that had high percentage completion and low cost overruns ranged from the minimum of 44.75% cost overrun, with 17% completion to a maximum of 216.08% cost overrun, with 5% completion. However, the projects that had a high percentage of completion time and low cost overruns ranged from a minimum of 5.56% cost overrun, with 90% completion to a maximum of 19.27% cost overrun, with 95% completion. Based on these findings, it can be concluded that continuous investigation and analyses of cost overruns at stages of building projects would encourage professionals to apply the best mitigation measures, in order to achieve a significant reduction in the total cost overrun upon completion of a project.

It is recommended that construction professionals be well informed of these consequences at an early stage of a project, in order to enable them to evaluate the extent to which these consequences could be minimised.

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