

EFFECTS OF ROAD PROJECT PARAMETERS ON FEDERAL CAPITAL TERRITORY ADMINISTRATION COST OVERRUNS

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ABSTRACT

Road is a significant component of national infrastructure capital, a key component of the social fabric in many countries, and a significant contributor to national wealth. However, there are many risks and difficulties involved in its construction, including time and cost overruns. Cost overruns lead to many detrimental effects including time overruns, disputes and abandonment of projects. Despite a wealth of studies on cost overruns, and the special nature of road projects there is no literature on the effects of project parameters on Federal Capital Territory Administration road projects. This study therefore, addressed the effects of road project parameters on the extent of Federal Capital Territory Administration cost overruns. Descriptive analysis was used to analyze historical data on road projects obtained from some districts within Abuja Municipal and the satellite towns. The size, length, level of competition, and location of road construction projects are all found to have no significant impact on the size of cost overruns. Reducing cost overruns in road construction requires effective project management, risk management, communication, and the use of cutting-edge construction methods and technologies.

Keyword: Cost Overruns, Federal Capital Territory Administration, Level of Competition, Parameters

1 INTRODUCTION

Effective transportation infrastructures serve as economic highways in today's globalized economy. Omozuwa [1] stated that a pro-growth economic climate cannot be formed without the necessary physical infrastructure that facilitates the movement of people, goods, and information. As the world becomes more networked, interdependent, and service-oriented, the ability to conduct business efficiently, quickly, safely, and easily becomes increasingly important for economic development, social cohesion, and cultural resurgence [1]. Despite their importance, road development can present a number of challenges including cost overruns. Although cost overrun has been extensively studied over the last two decades, it remains the most common concern without viable solutions. Different road projects face different obstacles and incur varying degrees of cost overruns due to a variety of factors. As a result, findings on one road may not necessarily be applicable to other roads [2]. Al Khuduri [3] recommended that the most effective technique of finding project-specific causes is to do a case-by-case study of the causes of project delays and cost overruns. Furthermore, the effects of project parameters on road construction's cost overruns have not been adequately addressed in literature, particularly in the Federal Capital Territory Administration road projects (FCTA) road projects.

2 LITERATURE REVIEW

The parameters of a project often shape the development process of that project to a great extent. Some of these construction project parameters have been identified as having an impact on the magnitude

of road construction cost deviations. These parameters are the size of the project, the level of competition during the tender measured by the number of bidders, the location, and the duration of the project.

2.1 Project size

Past empirical researches have shown that project size has influence on the rate of cost overruns. However, there is no agreement on how it influences cost overruns. Flyvbjerg, Holm and Buhl [4] noted that costs of projects have grown larger over time, and larger projects have larger percentage cost escalations. However, [5] contradicted that cost overruns appear to be more predominant among smaller projects as compared to larger ones. Roxas and Chalermpong [6] also found that the size of project significantly influences cost overrun and bigger projects have smaller cost overruns. Research findings by [7] also concluded that in average percentages, cost overruns are highest for small projects, but the impact of project size on cost overruns is minimal. Larger projects, on the other hand, contribute to cost to a greater extent in terms of net total overrun in percentages [7].

2.2 Project duration

According to [4], cost escalation was found to be strongly correlated ($p < 0.001$) with the length of the project implementation phase. Odeck [5] also concluded that the size of cost overruns was influenced by project completion time and that cost overruns increased until a certain time (200 weeks) and then decreased, implying that they decreased with time. Uncertainties may have decreased over time as cost prediction became easier to formulate, or that the management team's ability to oversee the primary causes of cost overruns improved as the project duration increased [5]. This was corroborated by [8] that cost overruns increased as construction duration increased. Bhargava *et al.* [9] discovered that cost overruns were higher at a 99% level of confidence for projects with longer planned durations. Amoa-Abban and Allotey [10] found that the longer it takes to complete a project, the more money it will cost. However, in contrast to building construction, [11] discovered that road construction had a negative correlation between cost and construction time.

2.3 Project location

Although overruns are common internationally, the percentage of cost overruns being experienced varies with geographical location [12]. It was established that the size of cost overruns was influenced by the regions where projects were situated [5]. The location of a project affects its cost through institutional and geographic realities [10]. Projects are implemented within the binding laws of their inter-connected environments, the laws differ from one region to the other and their effects on projects are also dissimilar [12]. According to [12], the discrepancy in cost overruns encountered in different areas could be due to changes in the regulations under which projects are implemented and according to [13], different state or local governments within the same country may enact separate contract terms under which projects are expected to be implemented. On the other hand, [6] reported that there are no significant variations in roads and other transport projects for both rural and urban areas.

2.4 Level of competition

According to [14], the selection of contractors is another problem in the industry that is being worked on extensively and many techniques are being developed for the selection of a suitable contractor to ease the stresses that arise. Many attributes of the contractors are considered and then contractors are being selected for a specific project using a multi-criteria decision approach [14]. In Nigeria however road projects are usually awarded to the lowest bidder. Hence, the level of competition, measured as the number of bidders may be a determinant of cost overrun. Bidders, many a times lower their bids so that they can win contracts, thereby increasing the chances for inaccurate estimates. This could ultimately harm the project by causing disagreements, delays, and cost overruns. According to [15], the number of competitors, which is unpredictable in practice, has a significant impact on the estimates. The higher the level of competition, the more competitive the bidding, and consequently the higher the cost overruns [16]. Shrestha and Pradhananga [8] concluded that the bid price of the contractor influences the contract award cost growth and the higher the number of bidders, the lower the low bid price the owner received.

3 METHODOLOGY

Reviewed relevant literature formed the basis for data collection on road construction projects parameters and cost overruns. Data on road estimated and final costs, duration, number of bidders, and road projects' location were obtained from construction historic data. The data was collected from one hundred and forty-two roads projects awarded and constructed between 2004 and 2014. This is because the data used for this study came from road projects that were completed, still had working drawings, and had not exceeded their expected construction schedule by more than two years. These road projects were part of the infrastructure provided to some districts within Abuja Municipal or satellite towns. Infrastructure provision included road construction, water supply, storm and foul water drainage, and the installation of electricity and telecommunication ducts. As the projects were not billed separately, quantities and costs for the road constructions had to be computed using the bill of engineering measurement and evaluation, and engineering working drawings. The magnitude of the cost overruns was obtained from equation one.

$$\lambda_i = \left(\frac{\kappa - \epsilon}{\epsilon} \right) i \rightarrow = 1 \dots n \tag{1}$$

Where κ is the actual cost and ϵ is the estimated cost [17]. Further analysis of collected data was carried out using descriptive statistics, which included the mean, standard deviations and coefficient of variations of the cost overruns of all the roads projects used for the analyses. The descriptive statistics was used to determine how project parameters (size, duration, competition and location) influence cost overruns. The coefficient of variation was used to compare the extent of cost overruns variation on the road project parameters.

4 RESULTS AND DISCUSSION

4.1 Project parameters as determinants of cost overruns

Table 1 shows the descriptive statistics of cost overruns of road projects parameters. The data include the project parameters, number of projects, the percentage of projects corresponding to the project parameter, the mean percentage overruns, standard deviation, coefficient of variance and the cost overruns of the particular category as a ratio of grand total overruns in percentage.

Table 1. Road Project Parameters and Cost Overruns

Project Parameter	Category	No. of Projects	% of Projects	Mean of Cost Overruns (%)	Standard Deviation	Coef. of Variation (%)	% of Category Cost Overruns
Project Size (Estimated Costs)	Small	85	59.85	63.65	27.2	42.74	1.77
	Medium	30	18.94	40.56	42.46	83.29	6.1
	Large	12	9.09	36.46	25.09	68.83	6.36
	Very Large	15	11.36	46.52	47.57	102.24	86.35
Project Construction Duration (months)	≤ 6 months	98	69.01	55.96	30.25	54.06	10.08
	> 6 months	44	30.98	58.18	39.72	68.27	89.92
Competition (number of bidders)	7	71	50	67.98	28.17	41.44	63.17
	9	23	16.2	60.5	25.37	37.32	6.03
	10	48	33.8	39.7	37.04	93.3	30.8
Project Location	A	56	43.75	71.03	25.23	35.52	22.28
	B	21	16.41	63.81	22.58	35.39	20.56
	C	24	18.75	40.73	37.89	90.03	10.57
	D	27	21.09	43.7	30.46	69.7	46.59

4.2 Duration

The review of road projects historic documents showed that ninety-eight (69.01%) of the road projects were constructed within 6 months and this contributed 10.08% of the overall category cost overruns. The group had average cost overruns of 55.96% (standard deviation - SD of 30.25%) with a coefficient of variation of 54.06%. The 44 (30.98%) road projects in the 2nd group of the duration category took more than 6 months to construct and contributed 89.35% of the total cost overruns. Their mean of cost overruns was 58.18% (SD of 39.72%) and coefficient of variation of 68.27%. A bar chart of the cost overruns (Figure 1) shows an overlap of the standard deviations (error bars), indicating no difference in the cost overruns for the duration of road projects construction.

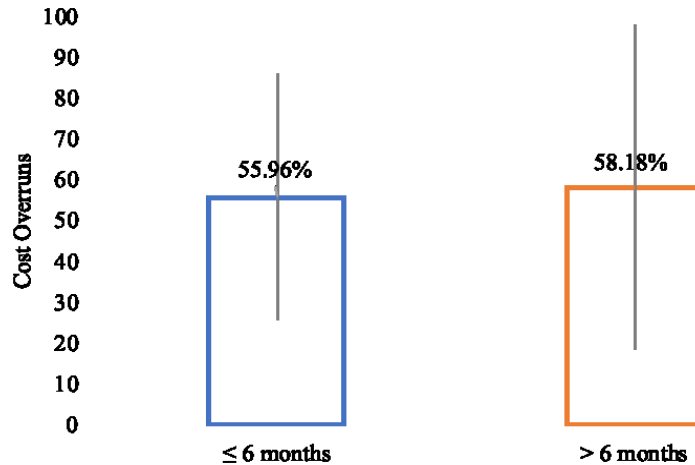


Figure 1. Cost Overruns Versus Duration

This shows that the duration of implementation of the projects has no impact on the cost overruns of FCTA road projects. the influence of duration on the extent of cost overruns is also not significant. This is shown by the overlapping standard deviations that difference in the average cost overruns between the 2 groups of the duration category is minimal. This finding counteracts the findings of [4, 8, 9, 10, 11]. This difference may be attributed to most of the longer duration group projects also belong to large and very large sizes group projects. Project size. The road projects were initially categorised as small for projects less than ₦500 million, medium for those between N500 million and N1 billion, and large for those that were executed for more than N1 billion. The small projects size category had relatively more number of projects than the medium and large project size groups. Therefore, the small project category was further divided into two and all the groups were relabelled as small, medium, large and very large. The small size projects, which are the largest in number constituting 59.85% of the total number of the analysed projects contributed 1.77% of the total cost overruns. They had the highest mean cost overruns of 63.65% (SD - 27.20%) with a 42.74% coefficient of variation, indicating that the cost overruns for the group of projects are consistent and clustered around the mean. The 30 (18.94%) of the medium size projects that contributed 6.10% of the total overruns on the other hand had lower average cost overruns of 40.56% (SD of 42.46%) with a wider coefficient of variation (83.29%). The large project group consisted of only 9.09% (12) of the projects used for the analysis. The group had the lowest average cost overruns of 36.46% (SD of 25.09%) and the 2nd lowest coefficient of variation of 68.83%. Although the average cost overruns of the large group are high, it is relatively more consistent than the medium and very large size groups. The very large size group had 15 road projects and contributed the highest proportion of cost overruns of 86.35%. The group had mean cost overruns of 53.19 (SD of 63.58%) and a very high coefficient of variation of 102.24%. However, the standard deviations for all the four (small, medium, large and very large) groups overlap indicating that the groups' cost overruns do not really differ (Figure 2).

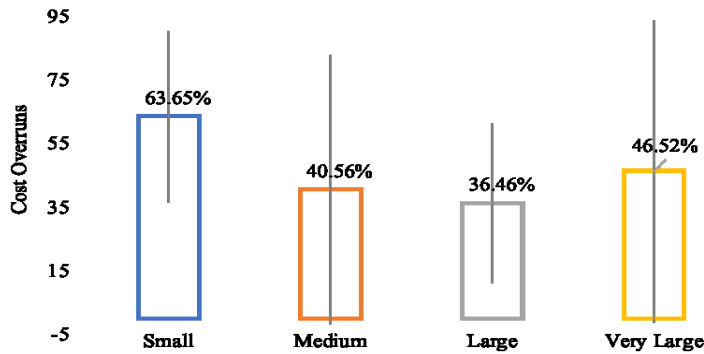


Figure 2. Cost Overruns Versus Project Size

The small size project groups had a higher frequency and higher average cost overruns than the medium, large and very large project size groups. The very large size project group mean cost overruns, though lower, is the most critical with regards to the total amount of not budgeted fund expended. The percentage of cost overruns for the group translated into huge financial deficits that resulted to the loss of billions of Naira. The difference in the extent of road construction projects' cost overruns though cannot be linked to effect of the project sizes. This finding agrees with that of [7] who reported that the impact of project size on cost overruns is minimal. Hence, this contradicts the findings of [4, 5, 6] that cost overruns are affected by the size of project.

4.3 Competition

Half (71) of the road projects had the least number of competitors (6) in terms of construction firms that submitted tenders. This group contributed 63.17% of the total cost overruns and had mean cost overruns of 67.98% (28.17% SD) and a coefficient of variation of 41.44%. The mean cost overruns for the group that had a higher competition (9) was lower (mean of 60.50% and 25.37% SD) but more consistent with a coefficient of variation of 37.32%. The third group in the competition category with 48 (33.80%) projects had the highest competition (10) and contributed 30.80% of the category total cost overruns. This group of projects had the lowest mean cost overruns (39.70%) of the category (37.04% SD) and the highest coefficient of variation of 93.30%. The standard deviations of cost overruns for all the groups however, overlap so do not really differ (Figure 3).

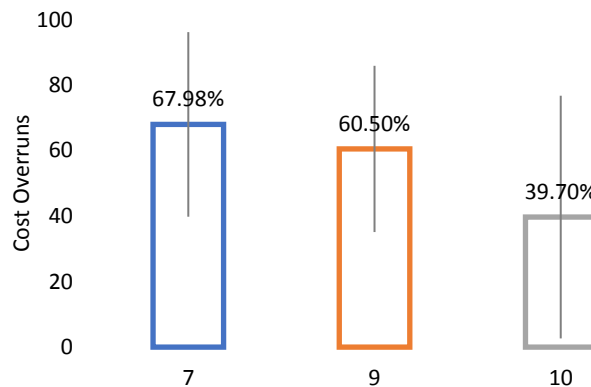


Figure 3. Cost Overruns Versus Competition

The result on the effect of competition shows a decrease on the extent of cost overruns as the competition increased. This disagrees with [8, 16] findings. The decrease in cost overruns cannot however be tied to the level of competition because of the interrelationship among the overlapping standard deviations. This therefore indicates that the differences in the extent of road projects' cost overruns are not significantly influenced by the level of competition during tender.

4.4 Location

There were four sets of road data from four different locations, as well as one set from roads that connected some districts within the F.C.T. and satellite towns. The study relied on data collected from four different locations because the fifth set could not be assigned to a specific location. Therefore, 128 roads were used in the analysis for this category. The locations were designated as A, B, C and D; locations A and B were from the satellite towns, while locations C and D were from the FCT. Although A had 56 (43.75) projects, which was the largest number within the location category and the highest average cost overruns of 71.03% (SD of 25.23%) and variation of 25.23% (Figure 4), it is the group that had contributed the 2nd lowest percentage to the overall cost overruns. As a result, 128 roads were used in this category's analysis. Despite having only 21 (16.41%) of the projects, location B had the second highest mean cost overruns of 63.81% (22.58 SD) and the highest coefficient of variation of 35.39%, contributing 20.56% of the category cost overruns. Group C accounted for 24 (18.75%) of the road projects and contributed 10.57% of the total cost overruns in the category, with an average cost overrun of 40.73% (37.89 SD) and a coefficient of variation of 90.03%. The final group included 27 (21.09%) road projects with mean cost overruns of 43.70% (30.46% SD) and coefficients of variation of 69.70%, accounting for 46.59% of total cost overruns. Figure 4 however, show that the average cost overruns of the groups do not significantly differ.

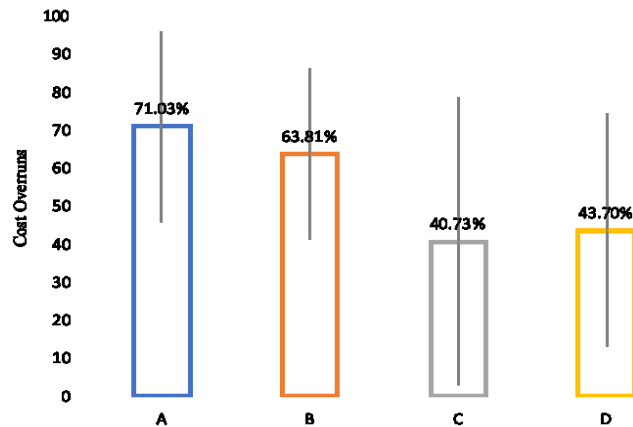


Figure 4. Cost Overruns Versus Location

Comparing the average cost overruns based on locations, locations A and B that are situated at two different extremes of the FCT had higher magnitude of cost overruns than locations C and D that are very close districts within the Abuja Municipal. However, the standard deviations of the cost overruns overlap so the differences are not significant. This implies that the extent of FCTA road projects' cost overruns is not significantly affected by location. This result conforms to the findings of [6]. The similarity in extent of the cost overruns for the different locations could be due to their being implemented within similar binding laws as explained by [12].

5 CONCLUSIONS

The impact of project size, duration of the implementation of project, project location, and competition (number of bidders) on road projects cost overruns was examined in this study. Considering the influence of the project parameters on cost overruns, the relationship between the parameters (size, duration, location and competition) and extent of cost overruns are all weak. The extents of the cost overruns among the groups of the parameters interact (overlap). This implies that while the road project parameters contributed to cost overruns, they had discernible effect on the amount of cost overruns experienced by FCTA road construction projects. Therefore, to reduce cost overruns on road construction projects, a combination of effective project management, risk management, communication, and the use of innovative construction techniques and technologies is required.

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