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ANALYSIS OF FACTORS RESPONSIBLE FOR PROJECT COST UNDERESTIMATION IN NIGERIA

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Abstract

Since cost estimates are the basis for decision making regarding project selection, underestimation lead to selection of project with significant cost risks. This paper analyzed the factors responsible for project cost underestimation, with the aim of determining the main cause of the problem and proposing appropriate remedies. Using a questionnaire survey, 64 individuals rated 18 factors responsible for cost underestimation. The relative importance index (RII) used as analytical tool reveal that unintentional factors (inadequate information, project complexity, inexperienced forecasters, or future uncertainties) are not the main factors responsible for cost underestimation; but the main factors are intentional such as project promoters intentionally understating cost to gain acceptance and funding commitments for project. A t –test analysis of cost data from 15 projects revealed that there is a significant difference in cost estimation between private and public sector projects, but no difference in

estimation in large and small projects, or in projects estimated in different time periods. It is concluded that project cost underestimation can best be explained as intentional, with project promoters having strong incentives to understate project costs. It is recommended that disincentives for intentionally understating cost should be introduced such as sanctions, fines, and even legal prosecution.

Keywords: Project Management; Project Costs; Cost estimation; Cost Underestimation; Hiding Hand Principle; Strategic Misrepresentation

INTRODUCTION

Project cost estimates are the basis for serious decision making, it is therefore important that the estimates of project costs are accurate; that is, as much as possible they truly reflect the actual cost of completing the project. As Akintoye (1998) noted, the impact of inaccurate cost estimating on contracting business is significant. But, despite the well documented importance of accurate cost estimates and the dire consequences of inaccurate estimates; Flyvbjerg et al (2002), Akintoye (1998), Pickrell (1990), and Wachs (1990) discovered in their different studies that project cost estimates are consistently inaccurate.

Depending on the higher of actual costs and estimated costs, cost estimation inaccuracies generally take two forms: overestimation and underestimation (Akintoye, 1998). Overestimation is where the estimated costs are higher than the actual costs of completing the project, while underestimation is where the actual costs significantly exceeds the estimated costs. Researchers seem to agree that cost overestimation is not much of a problem as cost underestimation (Flyvbjerg et al, 2002; World Bank, 2004; Creedy, 2006). The error of underestimating costs is significantly much more common and much larger than the error of overestimating costs.

This research paper analyzes the factors responsible for project cost underestimation, with the dual aim of determining the main cause of the problem and proposing appropriate remedies to check the problem. The study is therefore set out to address the following problems associated with project cost underestimation in Nigeria. There has been insufficient fund to complete various projects because the amount of fund released is a function of the amount specified in project cost estimation – which in this case underestimated. Therefore on-going projects in Nigeria are usually characterized by incessant request for upward review of contract sum above what was bidded (that is, the underestimated cost) and originally presented. The multiplier effects include project conflict, lack of trust and goodwill among project stakeholders,

project time overrun, shoddy deliverables, temporary abandonments, and even permanent abandonment. The objectives of this study are therefore to:

- Identify and examine the factor(s) mainly responsible for project cost underestimation so as to control and take into consideration the salient factors to be used in enhancing accuracy of project cost estimation.
- Rank the factors in order of their significance using Relative Importance Index (RII) as analytical tool
- Establish if there is any significant difference between: private sector and public sector projects; large and small projects; projects in a first period (1984 – 1999) and projects in a second period (2000 – 2014).

LITERATURE REVIEW

Explanations of Cost Underestimation

According to Flyvbjerg (2009), three main types of explanations exist that claim to account for cost overruns and benefit shortfalls in major infrastructure projects. These are: Technical; Psychological; and Political-Economic.

Technical factors: These factors are the most common type of explanation of inaccuracy in forecasts (Morris and Hough, 1987; Wachs, 1990; Flyvbjerg et al., 2002, 2005). Some of the factors ranked under technical explanations in the open literature are: Imperfect forecasting techniques (Hester et al, 1991) Inadequate data (Hartgen et al, 1997; Creedy, 2006), Inherent problem in predicting the future, Lack of experience on the part of the forecasters, Honest mistakes (Flyvbjerg et al., 2002, 2005).

Psychological explanations: This attempt to explain inaccuracies in forecasts by a bias in the mental make-up of project promoters and forecasters (Flyvbjerg et al., 2002). Psychological explanations account for cost overruns and benefit shortfalls in terms of what psychologists call the planning fallacy and optimism bias (Kahneman and Tversky, 1979; Lovallo and Kahneman, 2003). The most common psychological explanation is probably that of “appraisal optimism.” According to this explanation, promoters and forecasters are held to be overly optimistic about project outcomes in the appraisal phase of projects (Mackie & Preston, 1998; World Bank, 1994, p. 86).

Political-economic explanations: By these explanations, project planners and promoters are seen as deliberately and strategically overestimating benefits and underestimating costs when

forecasting the outcomes of projects. They do this in order to increase the likelihood that it is their projects, and not the competition's, that gain approval and funding.

Theories that aid Cost Underestimation

Many researchers have postulated theories that are responsible for cost underestimation. There are certain theories, principles and concept that though were developed for the utmost good, but whose application is seen to lend a helping hand to cost underestimation. Examples include: the principle of the hiding hand, the salami tactics, and the noble lie.

1) The Principle of the Hiding Hand: The principle as developed and coined by Hirschman (1991) is essentially a way of inducing action through error, the error being an underestimate of the project's costs or difficulties. What this principle suggests is that, far from seeking out and taking up challenges, people are apt to take on and plunge into new tasks because of the erroneously presumed absence of a challenge because the task looks easier and more manageable than it will turn out to be. As a result, the Hiding Hand can help accelerate the rate at which people engage successfully in problem-solving: they take up problems they think they can solve, find them more difficult than expected, but then, being stuck with them, attack willy-nilly the unsuspected difficulties- and sometimes even succeed (Hirschman, 1991).

2) Salami tactics: In management, Salami tactics is the popular name used to describe the practice of introducing project components and risks one slice at a time in order to make costs appear low as long as possible (Flyvbjerg et al, 2002). In other words, problems or costs are presented in small pieces, and so it is hard to get the big picture. Using the Salami tactic, the figures presented as the projects estimates do not even come close to completing the project, and this fact is well known to the project promoters. This is done just to give the project favourably low cost, and boost its chances of being accepted and selected. Once the project is approved and the execution starts, hidden project cost elements will be introduced bit by bit and backed with well-rehearsed convincing explanations. Each increase in the project estimates will usually be relatively small and so well-explained that the project sponsor will willingly even happily approve them; this continues until the sponsor realizes too late (near or after project completion) that the project have actually consumed much more than the initially estimated cost. At that point there is nothing the sponsor can do but to accept the project, and wonder (i) how the project has come to consume so much more than was estimated, and (ii) how he did not realize the path the project was taking.

3) Noble Lie: By definition (Business Dictionary, 2011), a noble lie is a myth or untruth, knowingly told by an elite to maintain social harmony or to advance an agenda beneficial to the general public. As noted by Flyvbjerg et al (2002), the noble lie principle has crept into project management especially in the public sector, and persons are using the principle as a basis for underestimating costs of public works. This could be in situations where a particular development project would serve the people's interest, but the actual cost figures might kill public support for the project. The noble lie is told; cost are significantly understated; the public weigh the perceived projects benefits against the cost estimates they are given and finding them favourable, throw their support behind the project even hailing the project promoters. But if actual costs data had been revealed, various uproars would have been heard; popular among them would be that the project promoters or leaders simply want to use the proposed project to siphon public funds. Not only will the public condemn the project, they could distrust the leaders and loss faith in the administration and that has its attendant consequences.

Research Gaps based on review of current literature on Project Cost Underestimation

Many research works have been conducted in the areas of project cost estimation, but little or none has been extended and explored in the area of project cost underestimation. Project cost underestimation is one of the major problems plaguing project management as the success of project management depend on the accuracy of cost estimation. There are some gaps based on the review of current literatures on project cost underestimation that this research aims to fill.

There is no agreement among researchers as to the main factor(s) responsible for the problem of project cost underestimation. For example, Akintoye (1998) studied technical factor; Kahneman and Tversky (1979) and Lovallo and Kahneman (2003) advanced psychological explanations such as estimators' over-optimism as the major cause of the problem; while Flyvbjerg et al (2002) and Flyvbjerg (2009) rejected both technical and psychological explanations in their studies, and concluded that economic/ political explanation which is strategic misrepresentation or lying constitutes the main reason for the problem of cost underestimation.

There are no studies that compares cost estimation in private sector projects to cost estimation in public sector projects, and therefore it cannot be statistically determined if public sector projects are more liable to cost underestimation Notable works that address the problem of cost underestimation (such as: Flyvbjerg et al, 2002; Flyvbjerg, 2009; Sawyer, 1952; Merewitz, 1973; and Pickrell, 1990) all examined cost estimation in public works project. Flyvbjerg et al (2002) summed this by saying that, there is no conclusive evidence that private projects perform better or worse than public ones as regards cost underestimation. This study

therefore aims to fill this research gap by establishing statistically whether cost underestimation in private and public sector projects are significantly different, with a view to solving the problem. Studies in project cost underestimation have focused on large infrastructural projects only, and therefore it cannot be determined if the problem of cost underestimation is any different in relatively smaller projects.

Many of the studies establishing the abysmal performance of projects as regards cost underestimation were done using large infrastructural projects from around hundreds of millions to several billion dollars (Flyvbjerg, 2009; Sawyer, 1952; Merewitz, 1973; Pickrell, 1990). With all these studies revealing large underestimation of costs, the question that would arise is whether the problem of cost underestimation would be any different in relatively smaller project. This research gap will also be filled with this study, as it would examine both large and smaller projects, and establish statistically whether the project size affect cost underestimation.

There are few studies that examine the problem of project cost underestimation over a long time span in order to determine if there is any significant difference in the problem in different time periods. Many of the above-mentioned comparative studies of project actual costs and estimated costs pool data from one time frame. That is, they do not tell the effect of time span on cost estimating accuracy. Or in other words, is there any significant difference between cost underestimation 20 and 30 years ago with cost underestimation today? Only the study of Flyvbjerg et al (2002) examined such effects, but with a sample of only large public projects. This study will examine such effects using large and small, public and private projects.

METHODOLOGY

Two main classes of primary data were collected for a 2-part analysis; primary data collected directly from project individuals, and primary data collected from documented project files. Judgmental sampling was employed in collecting the data. The project individuals are persons that were involved in the 15 projects examined in this study in the capacity of owner, promoter, consultant, planner, scheduler, manager, or supervisor.

The main instrument for collecting this data was the use of structured questionnaires administered to these individuals. 64 persons out of a possible 75 responded, showing a response rate of 85.33%. The questionnaire listed18 factors derived from the open literature as being responsible for project cost underestimation, and respondents were required to, based on a five-point Likert scale, give their ranking of the impact of the factors in causing cost underestimation. For the analysis of their responses, the Relative Importance Index (RII) was employed.

The Relative Importance Index for each factor is given by the following expression:

$$RII = \frac{\sum_1^5 (W_i \, X \, N_i)}{\sum_1^5 N_i}$$

(N_i = number of respondents scoring each factor; i = the order number of respondents; W_i = rating given to each factor by the respondents ranging from 1 to 5, where 1 represents 'strongly disagree', 2 represents disagree, 3 represents neutral, 4 represents agree, and 5 represents strongly agree)

The primary data collected from documented project files included the cost details (cost estimate, actual completion cost) of the 15 projects project studied. The projects were all executed in different states in Nigeria. For the publicly owned, the projects' cost detail was sourced from the Ministry of Works of the states, while the cost details of the privately owned projects were sourced from the files of the owners. To enable the analysis of the project cost data, 3 project classifications was employed: type, size and time period. By type classification, the projects are separated into public sector project and private sector project. By size classification, the projects are separated into large projects and small projects (The large projects are those whose actual execution costs exceeded N500, 000,000 while the small projects are those whose actual execution costs do not exceed N500, 000,000). By time period classification, the projects are separated into two; those whose cost estimates were made during the period 1984 – 1999, and those whose cost estimates were produced during the period 2000 – 2014. The t – test statistics was employed for the analysis to determine: whether cost underestimation in private and public sector projects differ significantly; whether cost underestimation in large and relatively smaller projects differ significantly; and whether cost underestimation in one time period (1984 – 1999) and in another time period (2000 – 2014) differ significantly.

The formula for computing the t test is as below:

$$t_{cal} = \frac{M_1 - M_2}{\sqrt{\left[\frac{N_1 {S_1}^2 + N_2 {S_2}^2}{N_1 + N_2 - 2}\right]\left[\frac{N_1 + N_2}{N_1 N_2}\right]}}$$

(Where: N_1 and N_2 are the number of observation for the two groups being compared; M_1 and M_2 are the mean score of the two groups; S_1 and S_2 are the standard deviations of the two groups)

The decision rule on t – test is: If the $t_{cal} < t_{tab}$; We accept that the two parameters are not significantly different.

ANALYSIS

Analysis of Questionnaire Data and Discussions of Findings

TABLE I: Factors Responsible for Project Cost Underestimation

Key	Description of Factor
F_1	Complexity of project design and construction
F_2	Buildability/ constructability
F_3	Uncertainties inherent in predicting the future
F_4	Technological requirements and complexities of project
F_5	Inadequate information and poor information flow
F_6	Capacity and skills of design team
F_7	Deliberately producing low estimates in order to gain approval and funding
F_8	Inadequate consultancy in project cost estimation
F_9	Low level of experience and/ or expertise of cost estimators/ forecasters
F_{10}	Desperation for winning the contract
F_{11}	Poor contractual arrangement/ requirements
F_{12}	Change in project scope/ design/ construction requirements
F_{13}	Frequent change in policy/ regulation
F_{14}	Inflation and fluctuations of costs
F_{15}	Strikes and civil unrest
F_{16}	Over-optimism of project estimators/ forecasters
F_{17}	Honest mistakes made during project estimation
F_{18}	Low level of Project team experience

TABLE II: Summary of Respondents' Rating of the Factors

Factors	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	RII	Rank
F_1	16	24	18	6	-	3.78	5
F_2	2	8	22	28	4	2.63	13
F_3	6	10	24	24	-	2.97	9
F_4	8	10	18	26	2	2.94	10
F_5	22	20	16	6	-	3.91	4
F_6	12	14	30	8	-	3.47	7
F_7	62	2	-	-	-	4.97	1
F_8	5	9	34	8	8	2.92	11
F_9	18	13	25	6	2	3.61	6
F_{10}	60	4	-	-	-	4.94	2
F_{11}	-	8	15	20	21	2.16	14
F_{12}	-	8	42	10	4	2.84	12
F_{13}	-	-	10	12	42	1.50	15
F_{14}	-	-	6	18	40	1.47	16
F_{15}	-	-	4	14	46	1.34	18
F_{16}	24	16	19	5	-	3.92	3
F_{17}	12	8	35	9	-	3.36	8
F_{18}	-	-	8	12	44	1.44	17

The results of the analysis as presented in Table II above show that the highest ranking factors responsible for project cost underestimation are: “Deliberately producing low estimates to gain approval and funding” (ranked first with RII of 4.97), and “Desperation for winning the contract” (ranked second with RII of 4.94). These two factors are the most significant factors responsible for project cost underestimation. The closeness of the relative importance of these two factors (4.97 and 4.94) to the highest possible relative importance (5.00) further underlines their significance as perceived by the respondents. This is in line with the conclusions reached in the 19th century by Sawyer (1952) and even recently by Flyvbjerg et al (2002) that in a number of ultimately successful economic undertakings, deliberately underestimating cost were crucial to getting the enterprise launched at all, and that had the total investment required been accurately and objectively known at the beginning, the project would not have been begun. The other factors in the ranking are all factors that cannot be termed as deliberate/ intentional as opposed to the first two factors in the rankings in which project costs are deliberately understated; and none of these other factors have importance of up to 4.00.

This further underlines the significance of the first two “deliberate” factors. “Over-optimism of project estimators/ forecasters” is third in the rankings with RII of 3.92. Optimism is a form of self-deception where the forecasters erroneously believe that the project can actually be completed within the estimates. While it can cause cost underestimation, it is not the most significant factor, as shown by its importance index and its place in the rankings. Other mostly investigated factors such as “Inadequate information”, “complexity of design and construction”, “inexperience of forecasters”, “honest mistakes by forecasters”, and “uncertainty inherent in predicting the future” are ranked 4th, 5th, 6th, 8th, and 9th respectively, with RII of 3.91, 3.78, 3.61, 3.36, and 2.97 respectively.

Analysis of Project Cost Data and Discussions of Findings

TABLE III: summary of Projects Cost Data

Projects	Average Cost escalation (%)	Classification of projects					
		Type		Size		Time period	
		Public sector	Private sector	Large >N500m	Small <N500m	1984-1999	2000-2014
1	38.79		√	√			√
2	98.21	√		√		√	
3	120.82	√			√		√
4	14.15		√	√			√
5	22.31	√			√	√	
6	18.14		√		√	√	

7	32.50	√			√	√	
8	9.86		√		√		√
9	11.97		√		√	√	
10	80.24	√		√		√	
11	36.34	√			√		√
12	14.77		√		√	√	
13	69.83	√			√		√
14	10.45	√		√			√
15	12.76		√	√			√

The table critical value of t (that is, t_{tab}) is obtained at 5% level of significance and $(N_1 + N_2 – 2)$ degree of freedom. For all project classifications, $(N_1 + N_2 – 2) = 13$

Therefore, $t_{tab} = 1.77$

TABLE IV: Result of Project Cost Data Analysis (Type Classification)

Type of Project	No of Projects N	Average cost Escalation (%) M	Standard Deviation S	t_{cal}
1. Public sector	8	58.84	36.82	2.71
2. Private sector	7	17.20	9.13	

Since t_{cal} of 2.71 is greater than t_{tab} of 1.77, we reject that cost underestimation in public sector projects is not significantly different from cost underestimation in private sector projects, and accept that public sector projects and private sector projects significantly differ with respect to cost underestimation. This means that public sector projects are more liable to cost underestimation than private sector projects.

TABLE V: Result of Project Cost Data Analysis (Size Classification)

Size of Project	No of Projects N	Average cost Escalation (%) M	Standard Deviation S	t_{cal}
1. Large (>N500m)	6	42.43	34.78	0.26
2. Small (<N500m)	9	37.39	34.24	

Since t_{cal} of 0.26 is less than t_{tab} of 1.77, we accept that cost underestimation in large projects is not significantly different from cost underestimation in relatively smaller projects. Thus, the size of the project has no effect on the problem of cost underestimation; large projects and smaller projects alike suffer from the same level of cost underestimation.

TABLE VI: Result of Project Cost Data Analysis (Time Period Classification)

Period of Execution	No of Projects	Average cost Escalation (%)	Standard Deviation	t_{cal}
	N	M	S	
1. 1984 – 1999	7	39.73	32.24	0.03
2. 2000 - 2014	8	39.13	36.44	

Since t_{cal} of 0.03 is less than t_{tab} of 1.77; we accept that cost underestimation during the first period (1984 – 1999) is not significantly different from cost underestimation during the second period (2000 – 2014).

This means that cost underestimation has not improved over the years. The level of cost underestimation in the 30 years period of this study is not significantly different. This result explains Flyvbjerg et al (2002) assertion that cost underestimation cannot be explained by technical factors such as errors/ mistake or inexperience of forecasters. If for example, forecasters' errors/ mistakes are held as the main cause of cost underestimation; then it means, forecasters have continually made the same mistakes in the 30 years period studied in this study, and that scenario is highly unlikely. Also, if underestimation were unintentional and related to lack of experience or faulty methods in estimating and forecasting costs; then, apriori, we would expect underestimation to decrease over time as better methods were developed and more experience gained through the planning and implementation of more infrastructure projects. But the result of this research reveal that cost underestimation has not decreased over the years but have remained the same.

CONCLUSIONS

The results of the tests conducted in this study so far has ruled out "unintentional" technical factors such as honest mistake, errors, inexperience of estimators, project complexity etc as being mainly responsible for cost underestimation. The ranking of factors using their relative importance revealed that the main factors responsible for cost underestimation are "intentional factors"; that is, deliberately understating project costs so as to be awarded the contract, and intentionally understating project cost so as to ensure acceptance of project and gain funding commitments. It is concluded that the problem of project cost underestimation can best be explained as intentional, because project promoters have strong incentives to intentionally understate project costs. However, this conclusion is reached based on the result of our small sample of 15 projects whose cost data could be obtained, which restricts generalizability of the research findings.

Given that there are strong incentives and weak disincentives for underestimating project costs; it is recommended that, to solve the problem of cost underestimation, strong disincentives for intentionally understating project costs should be introduced. This could be in the form of penalties, fines, or even legal prosecution.

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