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Cost Performance of Road Construction Projects in Nigeria

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Abstract

The construction of highways requires huge capital; therefore, to meet their performance goals, a significant amount of resources and meticulous preparation are needed. The study investigates the magnitude and causes of cost overruns in highway construction projects. A review of existing literature was conducted, followed by a focused group meeting to identify the cost-risks related to the construction of highway projects in Nigeria. Historical cost data on highway projects published by the Nigerian FMWH in 2017 served as a preliminary list of projects for the study, while cost data of more completed projects was gotten from highway engineers and quantity surveyors across Nigeria using the snowballing technique until 103 highway projects were identified. Major project participants were purposively chosen to fill out questionnaires on cost-risk factors associated with highway construction projects. The collection of primary data (risk factors) and secondary data (cost performance) was done simultaneously. The mean score (MS) and the severity of each of the factors were computed, while Pareto's rule was used to determine the significant risks. To determine the cost performance of the completed highway projects, the cost deviation of each identified project as well as the mean deviation of the total projects were calculated. The study identified six significant cost risks affecting federal highway projects in Nigeria. Further, findings revealed that Nigeria's federal highway projects have a mean cost overrun of 31.36%, and the probability of cost occurrence is 94.14%. Finally, findings show that 60% of federal highway projects in Nigeria experience very high cost overruns (of over 20 %), with their attendant effect on other project objectives.

Keywords: Highway Projects, Cost Risk, Cost Overrun, Cost Deviation, Risk Matrix

Introduction

Transportation infrastructures such as highway networks are essential components in any country due to their multiplier effects in advancing other socio-economic sectors in society. The provision of adequate highway infrastructure can reduce poverty, increase employment opportunities, improve assets, and close the gap in socioeconomic disparity

(Nurdiana et al., 2019). Large-scale public infrastructure projects such as highway construction impact the society, environment, economy, politics, safety, and security of citizens (Wang et al., 2016). Therefore, highway infrastructure investments are crucial, especially in developing countries (Akoh, 2018). Huge capital is required in the execution of highway construction projects; hence, meticulous planning requiring lots of time and resources is needed to achieve the project's set goals. These projects are frequently carried out; either by constructing new roads, bridges, or culverts or by doing recurring maintenance on existing highways (Heralova et al., 2014). Highway projects are exposed to the vagaries of adverse weather conditions, underground conditions, and sociopolitical effects. This imposes some degree of cost risk on highway construction projects.

Highway infrastructure projects frequently present cost overruns globally due to risk. Risk is the product of the connected likelihood of occurrence and the impact of a certain event scales (PMI, 2008; Bowers and Khorakian, 2014). Kovacevic et al (2021) attributed the frequent deviation in the planned cost and the actual cost of infrastructural projects to underestimation at their planning stage. Shane et al (2009) attributed the causes of cost deviations to changes in scope, inadequate planning, and design changes. Although studies have investigated and presented varying degrees of cost overruns in highway construction projects, still cost overruns remain prevalent among highway construction projects in developed and developing countries around the world. Flyvbjerg et al (2003) stated that the average global cost overrun for highway projects is 20%. In Australia, the mean cost deviation of highway projects was estimated at 16.30% (Creedy, 2010). In India, the mean cost deviation of highway projects was estimated at 26.14% (Ammar et al., 2022). In Thailand, the mean cost deviation of highway projects was estimated at 24.95% (Ammar et al., 2022). Similarly, in Pakistan, the mean cost deviation of highway projects was estimated at 28% (Nadir and Ahmed, 2022). According to PMI (2008), these mean deviations between the estimated project costs and the final project costs are rated to be high (above 10%) and very high (above 20%).

Aside from the mean cost overruns in the construction of highway projects, individual highway projects in developed nations like the United Kingdom, USA, Japan, and Germany experienced highway projects cost overruns ranging from 71% to 275% (Flyvbjerg, 2008; Odeck, 2019; Flyvbjerg, 2017). However, developing countries present poorer cost performance for highway projects (Oraegbune, 2008; Roslan et al., 2015; Rwelamila and Ogunlana, 2015). Furthermore, the frequency in the occurrence of cost overruns on highway projects is high. For instance, 2668 road projects were sampled and analyzed in the USA; findings revealed that 50% of the sampled projects had cost overruns. A similar study was conducted on 37 road infrastructure projects in Germany; it was reported that 62.2% of the projects presented cost overruns; in South Korea, 137 road projects were observed, findings revealed that 95% of the projects presented cost deviations (Herrera et al., 2020). Despite the challenges faced by stakeholders in the delivery of highway projects in the construction industry, the activities of the construction sector still contribute a significant portion of the gross domestic product in both developed and developing economies; these range from 3% to 6% for underdeveloped countries and 7% to 10% for developed countries (Stasiak-Betlejewska, 2015).

Findings from an in-depth review of literature by Awuku et al (2022) indicate that North America, Asia, Europe, and the Middle East made the largest contributions to the advancement of highway cost estimation research between 1983 and 2019. Despite the huge degree and frequency of cost overruns in construction projects in developing countries,

including Nigeria, few studies have been conducted on the cost performance of highway projects and the factors impacting highway project performance. Hence, it is vital to identify, evaluate, and apply risk assessment matrices that will allow project experts and stakeholders to absorb, avoid, mitigate, or eliminate potential cost-risks in a timely and suitable manner. This study therefore investigated the frequency of cost overruns; the degree of cost overruns; and the factors affecting cost overruns in highway projects in Nigeria. Furthermore, the study developed a cost risk matrix for highway projects in the study area. The findings of this study will enable project managers and stakeholders to assign ratings to each risk based on their overlapping factors to enhance project cost performance. The choice of Nigeria's federal highway is premised on its socio-economic importance and its potential to stimulate economic growth across the entire region of Nigeria and neighboring West African countries, since the federal road network forms the skeletal framework for the entire nation (FMWH, 2013).

Literature Review

Identifying Cost Risk Factors

The usefulness of cost estimates is based on their accuracy. However, these estimates are subjected to diverse risk factors (cost risks), which cause variability between initial estimates and planned estimates of highway projects. A total of 154 highway risk factors were identified in this research through a review of literature. The identified risk factors were then examined via a focus group discussion of experts with 15-25 years of experience for the purpose of selecting only highway cost risks for further analysis. This process of selecting the cost risk factors involved 10 experienced professionals in the fields of construction and project management (Gondia et al., 2020). The process led to the identification of 29 cost-risk factors and further assisted in the validation of the construct by eliminating repeated variables in the questionnaire. Figure 1 shows the numbers of cost risk factors and their sources.

Fig. 1 - Sources of highway cost risk factors

Risk Possibility and Consequences Analysis

According to PM1 (2008), risk-possibility analysis evaluates the likely effects of risk on the project's performance and further entails the negative effect of threat and positive effect of opportunity. Risk probability and effect assessment can also be referred to as risk rating, risk index, or risk possibility and consequence analysis. Grimaldi et al (2012) investigate the possibility of the occurrence of a specific risk. Table 1 was adapted from Akoh (2018), which corroborated PMI (2008) on risk possibility and consequence rating definition of cost risk. It

can be deduced from the table that the consequences of risks are affected by the degree of deviation or overruns. In this study, the negative impact of risks on highway construction projects' cost performance is considered.

Table 1
Possibility and consequence risk ratings on projects cost objectives

Consequence Rating	**Very low (1)**	**Low (2)**	**Medium (3)**	**High (4)**	**Very high (5)**
Cost	Insignificant cost increase	< 5 % cost increase	5 to 10% cost increase	10 to 20% cost increase	> 20% cost increase

Risk Possibility and Consequence Matrix

A risk possibility and consequence matrix, sometimes called a probability-impact matrix, is a method of evaluating each risk's likelihood and effects in relation to predetermined scales (PMI, 2008; Bowers and Khorakian, 2014). Each risk's relative importance is indicated by its position on the matrix, and by defining high, medium, and low zones, risks can be graded and prioritized according to prior experience or organizational procedures. Ahmed et al (2007) used the risk possibility and consequence matrix to provide a simple format for illustrating the relative importance of risk events (see Table 2). Blue denotes low relevance, yellow indicates medium importance, and red indicates great importance. The risk score is determined by adding the possibility and consequence numbers together. For example, a risk with a medium consequence and a high possibility would be in the red zone and have a consequence score of 12. Though the focus of this study is on threats, the approach can be applied to analyzing opportunities as well.

Table 2
Risk Possibility and Consequence Matrix

RISK POSSIBILITY AND CONSEQUENCE MATRIX FOR HIGHWAY CONSTRUCTION PROJECTS						
POSSIBILITY RATING	5: Very high					
	4: High					
	3: Medium					
	2: Low					
	1: Very low					
		1: Very low	2: Low	3: Medium	4: High	5: Very high
CONSEQUENCE RATING						

Highway Project Cost Performance

The performance of construction projects in terms of cost is of major concern to projects stakeholders, as it constitutes one of the three (cost, time, and quality) major success parameters of construction projects common to all stakeholders (Bhangale, 2016; Borse and Khare, 2016; Moghayedi and Windapo, 2018). Project performance refers to the degree of

actualizing the project set out or planned target (Chitkara, 2009; Ganiyu and Zubairu, 2010). However, most projects experience varying degrees of variability between the planned target and actual performance. The additional amount of money above the initial contract sum or estimated project schedule is referred to as cost overruns (Al-Hazim and Salem, 2015). According to Memon et al (2012), a project is successful if it maintains its schedule, remains within its budgeted costs, and accomplishes other objectives at its completion.

As presented in Table 3, across the globe, construction projects exceed their initial budgets, with developing countries having worse project performance (Roslan et al., 2015; Rwelamila and Ogunlana, 2015). A review of previous literature shows that the poor cost performance of 258 highway construction projects averages 20% globally (Flyvbjerg, 2003). A survey of 169 highway projects in Palestine presents an average cost performance of 14.40% (Mahamid et al., 2012). In Australia, a mean cost overrun of 16.30% was derived from 231 highway construction projects (Creedy et al., 2010). According to Ammar et al. (2022), China has a mean cost overrun of 5.41%. Other countries cost overruns range from 7.90% to 28% (Flyvbjerg et al., 2008; Ammar et al., 2022; and Nadir and Ahmed, 2020).

Table 3
Average cost overruns of highway projects in some selected countries

S/N	Author	Location	Cost Overrun (mean %)
1	Flyvbjerg (2003)	Global	20%
2	Creedy (2010)	Australia	16.30%
3	Flyvbjerg et al. (2008)	Norway	7.90%
4	Ammar et al. (2022)	China	5.41%
5	Ammar et al. (2022)	India	26.14%
6	Ammar et al. (2022)	Thailand	24.95
7	Ammar et al. (2022)	Bangladesh	8.44%
8	Mahamid et al. (2012)	Palestine	14.60%
9	Nadir and Ahmed (2020)	Pakistan	28%
10	Belay et al. (2021)	Ethiopia	18%

Although the mean cost of construction projects is usually minimal when compared with individual projects, it is also important to sample some projects in order to adequately comprehend the magnitude of the problem. Poor performances on construction projects are a global phenomenon, ranging from developed countries like the USA, UK, Germany, Japan, and Denmark to developing countries like Nigeria. Table 4 shows the percentage of cost overruns on some highway infrastructure projects executed in the UK, such as the Jubilee line expansion (71%), the Channel Tunnel project (111%), and the Humber Bridge (175%). The Central Artery Tunnel Project in the USA suffered a huge cost overrun of 275%. This situation also played out in construction projects on other continents, such as Asia and Europe, as shown in Table 4.

Table 4

Some transportation infrastructural projects cost overruns across the globe

S/N	Author	Projects	Country	Cost overrun (%)
1	Danisworo and Latief (2019)	Jakarta MRK	Indonesia	47.57
2	Flyvbjerg (2017)	Underground subway	Thailand	67
3	Odeck (2019)	The green belt link	Denmark	54
4	Odeck (2019)	Oresund link	Sweden & Denmark	68
5	Flyvbjerg (2008)	Jubilee line expansion	UK	71
6	Odeck (2019)	Channel tunnel project	UK	111
7	Odeck (2019)	The Humber bridge	UK	175
8	Flyvbjerg (2008)	Central artery tunnel	USA	275
9	Flyvbjerg (2017)	Japanese bullet train	Japan	100
10	Odeck (2004)	Stuttgart metro station	Germany	115

The government remains the largest client of the construction industry and uses taxpayer money to fund public projects; however, the continuous persistence of poor cost overruns indicates the poor use of taxpayers' money (Alinaitwe et al., 2013; Shrestha et al., 2013). From the foregoing, it is evident that highway construction projects have a history of poor cost performance globally. There is an urgent need for continuous efforts to discover ways to prevent the negative effects of systemic underperformance in the construction product development process (Olatunji, 2008).

Methodology

The methods of data collection, data organization, and data analysis for the study are illustrated in Figure 2 below.

Using questionnaire and pro forma to collect data from relevant professionals in highway projects

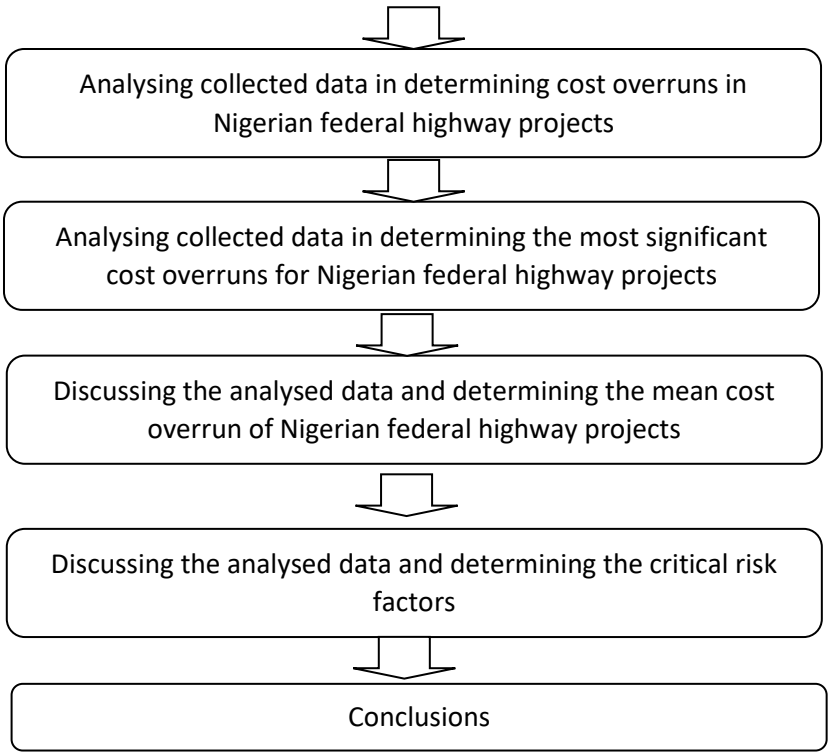

Fig. 2 – Stages of research methodology

Data Collection

The snowballing technique was used in identifying and administering pro forma and questionnaires to experts (quantity surveyors and highway engineers) in consulting firms, contracting organizations, and client's organizations responsible for the planning and execution of federal highway projects in Nigeria. Data collection instruments for the study were distributed in hardcopy and electronically. The choice of the field of experts for this study is based on their core responsibilities in managing costs as construction managers, project managers, and consultants during project planning and execution of highway projects. The characteristics of the respondents for the study are presented in Table 5.

Table 5

Characteristics of respondents

Variables	Grouping	Distribution (n)	Percent (%)
Years of post-qualification experience	0-5	9	8.70
	6-10	19	18.40
	11-15	43	41.70
	16-20	27	26.20
	>20	5	4.90
	Total	***103***	***100***
Occupational category	Client organization	49	47.57
	Consulting	26	25.25
	Contracting	28	27.18
	Total	***103***	***100***
Locations	South-West	15	14.60
	South-East	15	14.60
	South-South	29	28.20
	North-East	17	16.50
	North-West	14	13.60
	North-Central	13	12.50
	Total	***103***	***100***

Historical data on 103 completed federal highway projects was identified for the study. The preliminary investigation of the secondary data commenced with the examination of a publication by the Federal Ministry of Works and Housing (FMWH) in 2017. The list of projects in the publication consists of 229 ongoing and completed highway projects. The list presented the basis for extracting completed projects at the time of publication and tracking those that were later completed at the time of fieldwork. 68 projects were initially identified, but unfortunately, sufficient information could not be retrieved from five of them. Therefore, it was excluded, leading to 63 completed projects from this source. For the purpose of including more recently completed projects in the study, a pilot study was carried out. This resulted in the identification of an additional 40 completed highway projects, amounting to 103.

Mean Score (MS)

Responses received from respondents on highway cost risk factors were based on the frequency and impact of occurrences on a 5-point Likert scale, as presented in Figure 3 below. The responses of respondents were analyzed using the mean score (see Equation 1), as has been previously used in similar studies (Oboirien, 2019; Thaseena and Vishnu, 2017). In order to determine the level of risk, the mean score of the risk factors was categorized and ranked from the highest to the lowest using a similar approach as the Likert scale as presented in Figure 2, as has been previously used by similar studies (El-Sayegh and Mansour, 2015; Nadir and Ahmed, 2020).

$$\mathrm{MS} = \frac{5n5+4n4+3n3+2n2+1n1}{\mathrm{N}} \quad (1)$$

Where N = total number of survey respondents; MS = mean score of each factor; the numbers n1, n2, n3, n4, and n5 = number of survey respondents who scored the responses as 1, 2, 3, 4, and 5 accordingly.

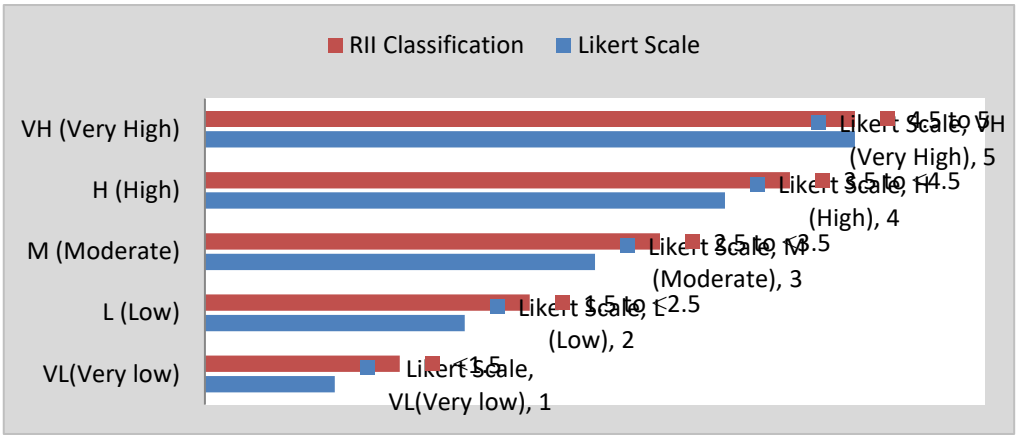

Fig. 3 – Likert Scale and Classification of Mean Score

Determination of Significant Cost Risk Factors

Similar to the study of Fabi (2018), the importance of the cost risk was determined by the risk severity index, which is derived as the sum of the mean score of risk occurring and risk impact of each variable (see Equation 2). It is important to understand that risks in construction projects can be quantified as a combined function of impact and likelihood of occurrence (Nicholas and Steyn, 2012). The significant cost-risk factors impeding federal highway cost performance were derived using the 80/20 Pareto rule (see Equation 3). The rule is based on the idea that 80% of results stem from 20% of causes (Robert, 1987; Svenssson and Wood, 2006; and Grosfeld-Nir et al., 2007). The rule's application facilitates the creation of quick models for organizations whose overall productivity is determined by focusing on fewer activities (Rizwan and Igbal, 2011; Pandey et al., 2013).

$$Risk\ Significance\ Index = P\ x\ I \qquad (2)$$

Where P = Probability of risk occurrence; and I = Impact of risk occurrence.

$$\text{SR} = \frac{20}{100}\ \text{x N} \qquad (3)$$

Where SR = Significant cost risk; and N = Number of cost risks.

Cost overrun computation

The deviation in the planned cost and the actual cost of the projects, which are the main subject of this research, were computed using Equation 4. The cost deviation can be calculated by deducting the planned cost from the actual project cost and dividing the value by the planned cost (Gransberg and Villareal, 2002).

$$Cost\ Deviation = \frac{(Actual\ cost - Planned\ cost)}{Planned\ cost} \qquad (4)$$

Results and Discussions

Highway Project Cost Overruns

This part presents the findings from the analysis of the historical secondary data and the sample characterization, based on the previously established methodology. The variability between the initial contract sum and the actual project cost is presented in Figure 4 below. 62 out of 103 projects investigated exceed 20% cost overruns, indicating a very high increase

in cost (PM1, 2008; Akoh, 2018). The implication of this finding is that over 60% of federal highway projects in Nigeria experience very high cost overruns, with their attendant effect on other projects' objectives. Table 6 shows the statistical summary of the cost variation for each of the 103 roadway projects that were examined. The mean cost deviation represented a greater value of 31.36% over the estimated budget; the cost overruns ranged from 2.05% to 99.17%. . Out of a total of 103 highway projects investigated, 97 of the projects experienced cost overruns, representing 94.17% of the entire projects investigated (see Figure 5).

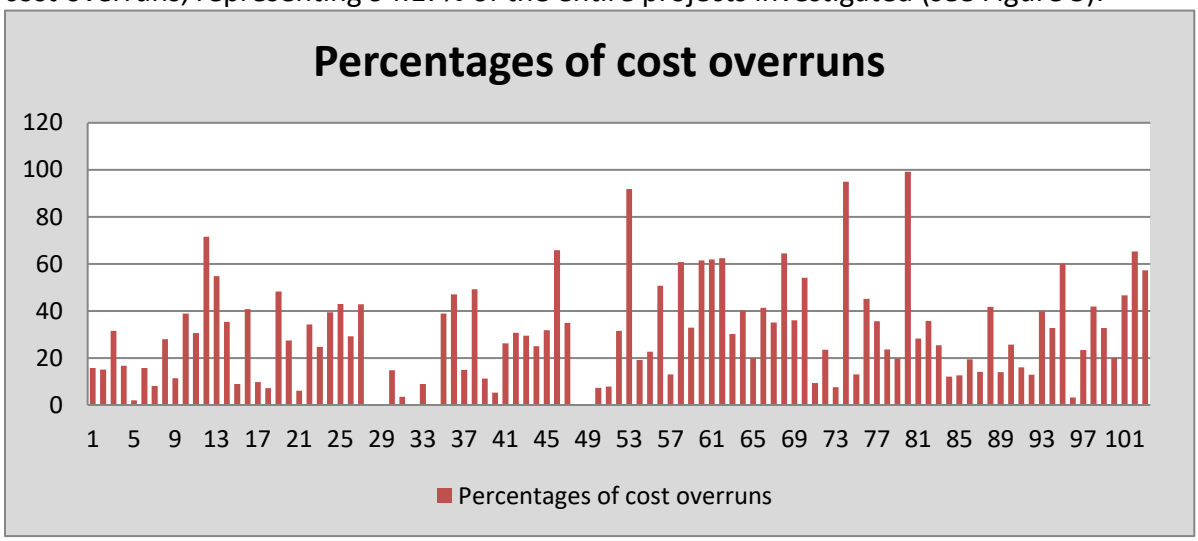

Fig. 4 – Likert Scale and Classification of MS

Table 6
Characteristics of respondents

Cost Deviation (%)	Max	Min	Mean
	99.17%.	0.0%	31.36%

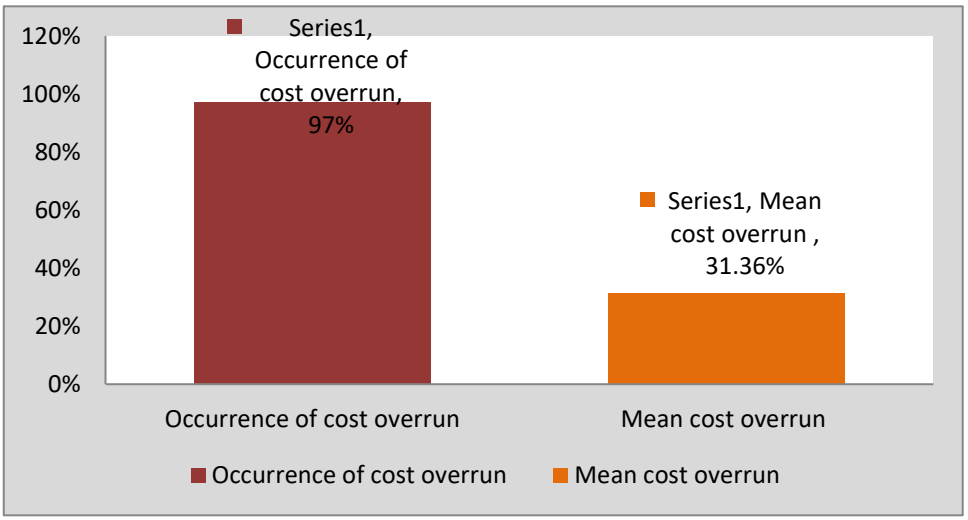

Fig. 5 – Cost overrun occurrence and mean cost overrun

Critical Risk Factors Causing Highway Project Cost Overruns

Table 7 below shows the results of the analysis and ranking of the risk factors impeding the cost performance of federal highway projects in Nigeria. Based on the risk probability consequence matrix, the identified critical cost-risks are in the red zones. 4 out of the 6 critical/significant cost-risks have a consequence score of 16 (i.e., 4 x 4), as their probability and impacts are both high. The remaining 2 critical risk factors have consequence scores of 12 (i.e., 3 x 4), as their probability of occurrence is medium and their impacts are both high.

Inflation in the cost of materials and labor has the most significant effect on highway project cost performance, as unanimously agreed by all the respondents. Nigeria's economy is highly unstable as prices of commodities, including of construction materials and labour experience steady rise during short period intervals. Some attributes to the rise in prices of construction materials include lack of government interventions, the reliance on fuel importation and its attendant effect on Nigeria's currency, and poor road conditions across the country.

According to the respondents' unanimous response, improper feasibility study is a significant cost risk impeding the performance of federal highway projects in Nigeria. Comprehensive feasibility studies are crucial to highway projects' success due to their nature and complexity. Highway projects are constructed over vast geographical area of land; therefore, due diligence should be observed in the investigation and production of feasibility reports for highway construction projects.

According to the respondents' unanimous response, foreign exchange rate increase/variations significantly impacted highway project cost performance. Over the years, Nigeria's currency has steadily lost its value, from 1 Naira to 1 United State Dollar in the early 1960's to 1,000 Naira to 1 United States Dollar in 2023. Foreign exchange rate increase/variations impact on cost of construction materials (Okafor, 2016).

Changes in input resource prices/variation in raw material prices is ranked as the 4th most significant cost-risk factor, as unanimously agreed by all the respondents. This factor can be jointly attributed to several other factors, including local construction material shortages, supplier monopolies, and artificial scarcity created by the producers of goods. This finding concurs with findings in Nigeria and other countries (Abdul Raman et al., 2013; Elinwa and Buba, 1993; Enshassi et al., 2008).

Mismanagement of site and supervision by contractors and changes in government /political change ranked 5th and 6th most significant factors respectively. Proper site organization and supervision of works are important in achieving good cost performance as it minimizes double handling and reworks. Also, change in government /political change have significant effect on federal highway projects in Nigeria, as political positions are usually tenured (i.e., four years per tenure). However, due to the long duration of highway construction coupled with the usual time overrun associated with the projects, highway projects usually outlive the tenure of the government that initiated them, while subsequent administrations may decide not to prioritize the project or review the contract.

Table 7

Analysis and ranking of factors Causing cost overruns in Federal highway projects in Nigeria

S/N	Cost risk factors	Probability *(P)*		Impact *(I)*		Degree of risk *(D)*	Rank/Significant Risk (*)
		Level	Mean Score	Level	Mean Score	*D = P X I*	
1	Inflation in cost of construction materials and labour	H	4.01	H	4.33	17.36	1*
2	Improper feasibility study	H	3.87	H	4.07	15.75	2*
3	Foreign exchange rate fluctuation/ variation	M	3.48	H	4.33	15.07	3*
4	Change in input resources prices /variation in raw material prices	M	3.29	H	4.32	14.21	4*
5	Mismanagement of site and supervision by contractor	H	3.83	H	3.7	14.17	5*
6	Change in government /political change	H	3.63	H	3.88	14.08	6*
7	Interest rate fluctuation/ Increase	H	3.61	H	3.83	13.83	7
8	poor communication/coordination between construction parties (owner, consultant and contractor)	M	3.48	H	3.81	13.26	8
9	Lack of experience contractor	H	3.59	H	3.69	13.25	9
10	Lack of experience consultant	H	3.5	H	3.69	12.92	10
11	Mishandling of resources	H	3.74	M	3.42	12.79	11
12	Poor estimating/inaccurate cost estimate	H	3.9	M	3.27	12.75	12
13	Construction cash flow problems/project funding challenges	M	3.19	H	3.98	12.7	13
14	unexpected location/ground conditions	M	3.02	H	3.9	11.78	14
15	Discrepancies between actual and contractual quantities	M	3.46	M	3.25	11.25	15
16	High cost of maintenance	H	3.39	M	3.18	10.78	16
17	Lack of joint risk management mechanism by the contractor and parties	M	2.85	H	3.75	10.69	17
18	Not applying cost control	M	2.87	H	3.65	10.48	18
19	Uncertainty of project budget	M	2.74	H	3.82	10.47	19
20	Lack of Professionals/Expert	M	3.1	M	3.23	10.01	20
21	Incompetent project supervision /Poor project management	M	2.72	H	3.63	9.87	21
22	Multiple approval problems	M	2.98	M	3.28	9.77	22
23	Health, Safety and environmental (HSE) issues	M	3.36	M	2.85	9.58	23

24	Insufficient design details/specification	M	3.03	M	3.11	9.42	24
25	Unethical practices/corruption fraud /bribe	M	2.7	M	3.22	8.69	25
26	Claims	M	2.87	M	2.79	8.01	26
27	Low budgeting	M	2.85	M	2.8	7.98	27
28	Scope Vagueness	L	2.48	M	2.72	6.75	28
29	Changes in taxation /new tax rates	L	1.73	L	2.28	3.94	29

Table 8 below shows the computation of the results of the analysis in Table 7. From the computation, it can be seen that out of the entire 29 cost risk factors examined, 4 of them fell under level risk, while 19 variables fell under medium risk, and 4 of the risk factors fell under the high risk category.

Table 8

Computation of Risk Possibility and Consequence Matrix

RISK POSSIBILITY AND CONSEQUENCE MATRIX FOR HIGHWAY CONSTRUCTION PROJECTS						
POSSIBILITY RATING	***5: Very high***					
	4: High				***1 (SCORE= 16)***	
	3: Medium		***23 (SCORE = 6)***	***5,6,7,8,9,10,11,12,13,14,15,16,20,24 (SCORE= 9)***	***2,3,4 (SCORE = 12)***	
	2: Low		***26,27 (SCORE = 4)***	***17,19,21,22,25 (SCORE = 6)***		
	1: Very low		***29 (SCORE = 2)***			
		1: Very low	***2: Low***	***3: Medium***	***4: High***	***5: Very high***
CONSEQUENCE RATING						

Conclusion

A study of cost overrun occurrences and magnitude in highway infrastructure projects in the world construction industry was carried out in order to properly situate Nigeria's federal highway projects in line with global realities. The historical data of 103 completed highway projects executed by the Federal Ministry of Works and Housing across the six geopolitical zones of Nigeria was examined, along with the risk-causing cost overruns and the development of a cost-risk matrix. The main conclusions are summarized below:

- Out of the 103 highway projects considered in this study, 94.17% experienced cost variation. Only 7 of the entire projects were completed within budget. The overall average cost overrun is 31.36%, with the highest cost overrun being 99.17% and the lowest cost deviation being 2.05%. The mean cost overrun of the projects investigated exceeds those reported in previous studies from other countries. The implication of this finding is that federal highway projects in Nigeria have very high cost overruns (see Table 1).
- 62 out of 103 projects investigated exceeded 20% in cost overruns, indicating a very high increase in cost. The implication of this finding is that over 60% of federal highway

projects in Nigeria experience very high cost overruns, with their attendant effect on other projects' objectives.

- Significant risk factors affecting the cost performance of the project investigated are Inflation in the cost of construction materials and labour, improper feasibility study, foreign exchange rate fluctuation/ variation, change in input resources prices /variation in raw material prices, mismanagement of construction sites and supervision by contractor, and change in government /political change. Majority of the identified factors are beyond the control of the parties to the project. Therefore, it is very important for the government to legislate and implement adequate policies that will enhance the performance of highway projects in Nigeria.
- Furthermore, inadequate management techniques and lack of proper feasibility study lead to a creeping project and unpleasant financial situations during project execution. Also, construction professionals and project managers should ensure timely and thorough risk analysis in order to minimize highway cost overruns. The cost risk matrix identified four cost risk factors (see Table 7 and Figure 8 for the risk factors) as high risk factors; hence, it is recommended that federal highway project stakeholders ensure that adequate attention is given to these risk factors, as failure to address them will result in high cost overruns.
- In summary, the findings of this study will be highly beneficial to highway professionals and stakeholders in understanding how potential cost risks can be identified and prioritized towards effective decision-making and communication in order to enhance project successes.

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