

# Peculiarities of Road Projects' Cost Overruns

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**Abstract**— Road projects contribute immensely to the development of an economy, yet they do not come without their own share of challenges; among which are cost overruns. Various scholars have carried out studies on cost overruns, including a few on road projects but the peculiarities of road projects cost overruns are yet to be identified. Do these road projects cost overruns have any similarity across the studies? The identification of the peculiarities could aid in developing specific cost management methods by taking into consideration the nature of road constructions. This study therefore aims at finding the peculiarities of road projects cost overruns from the review of literature. The findings reveal that road projects are prone to cost overruns, they have very large magnitude of cost overruns and the causes of cost overruns vary for all road projects.

**Index Terms**— Peculiarities, Road Projects, Construction, Causes, Cost Overruns, Estimate, Management.

## 1 INTRODUCTION

**R**OADS Roads are significant contributors to national wealth and are vital elements of the social fabric in many nations. They are indispensable tools of development in any society and are very essential to every member of the society for meaningful living. Ede [1] stated that the level of provision of good and efficient road network spread in a nation defines the level of mobility of persons, goods and services within that country: more efficient the transport system, more prosperous the nation's economy. This is one of the principal factors that have made the development of tourism a very lucrative source of earning in nations that run well coordinated and more rational approach to the provision and maintenance of transport systems [1]. Adetola [2] acknowledged that road infrastructure is a major catalyst for the physical and socio economic development of a country's gross domestic product (GDP) as the movement of people, labour, goods and services depend mainly on it.

Road also represents a significant component of national infrastructure capital [3]. The proper development of road transport network not only reduces the cost of transportation both in terms of money and time but also helps in the integration of various regions within the country and better understanding of neighbouring countries at the international level [4]. Canning and Pedroni [5] found strong evidence of causality between kilometres of paved roads and GDP among a significant number of the countries investigated. Despite the many benefits of road projects to the development of an economy, they do not come without accompanying challenges. Just like all other projects, road projects have their pros and cons and involve a lot of challenges.

## 2 LITERATURE REVIEW

### 2.1 Road construction projects' cost overruns

The term cost overruns sometimes referred to as budget increase, cost increase, or cost growth, has been defined by numerous scholars in different ways. Isma'il, Abdul Rahman and Memon [6] stated that cost overruns occur when the expenses required to complete a project exceeds the amount budgeted. According to Afetornu, Edum-Fotwe and McCaffer [7] cost overruns is the additional cost beyond the planned estimated cost of the project.

Love, Sing, Carey and Kim [8] in their study of estimating construction contingency in Australia posited that road constructions are more prone to overruns and reported the mean of road construction projects cost overruns as 13.55%. A research by [9] corroborated [8]'s framework where road projects in Dutch transportation infrastructure made the highest cost overruns. Mahamid and Amund [10] found that 100% of road projects in Palestine suffer from cost deviation and that 76% of projects have cost under estimation while 24% have cost over estimation; ranging from -39.3% to 98% with an average cost discrepancy between estimated and actual cost of 14.56%. Mahamid [11] similarly established that the average of cost deviation in road construction projects in the West Bank, Palestine is 16.73% (ranging from -20.33% to 56.01%) and also concluded that 100% of the projects suffer from cost deviation and that the cost is more predominant in road construction projects. Silva [12] found that cost deviations affect different stages of road construction projects, with direct and indirect consequences for all stakeholders.

### 2.2 Improvement in Accuracy of Cost Estimates over the Years

Construction cost estimating on roads and other major transport infrastructure projects has not increased in accuracy over the past 70 years [13]. The underestimation of cost is the same order of magnitude it was then [13]. There is also no real trend in improvement over the years [14] although [15] found that overruns in publicly funded infrastructure have declined since 1980 not only in absolute terms but also as a percentage of project cost.

### 2.3 Peculiarities of road construction projects and cost overruns

Road development is a large-scale endeavour, which involves multiple parties, time, planning and administration; and requires an intensive amount of capital. A large proportion of the cost also has to be irrevocably committed upfront before the project becomes operative. The high cost of funding involved necessitates government involvement in financing, constructing and maintenance. Each road project is unique in terms of technical solutions, operational logistics, public acceptance and investment scheme. Roads are unique in their

characteristics depending on their location, response of the society to their services and response to the regulatory services, and the interaction between parties involved [16]. The multiple stakeholders are involved in decision-making, planning and management, sometimes leading to conflict in interests.

No two roads projects will cost the same amount of money no matter how similar they are; these variations could be the result of the basic technical factors and the wide range of economic and institutional conditions in different member states [17]. The completion of a road construction involves the combination of many events and interactions, planned or unplanned, over with changing participants and processes in a constant changing environment [18]. Road projects, unlike building projects, are linear projects and take place on large and lengthy construction sites, with their greater risk lying below the ground level. Hence road construction takes a long time to execute and the funding is always spread out over an extended period of time. Consequently, road projects encounter different types of challenges along their routes and are exposed to different risks during their various stages of construction.

Kaare and Koppel [19] stated that road construction management embodies many challenges and restrictions due to the temporary and complex nature of their construction. These risks and challenges are threats to the overall projects' viability. Road construction projects are prone to experiencing cost overruns from the point of contract award even when a traditional lump sum contract is used [8]. Jenpanitsub [20] affirmed that the cost overruns in roads and rails have been constant for thirteen years and cost estimates have not improved over time. The reasons for cost overruns in road construction are many folds and there is no simple solution for improving the reliability of cost estimates [21].

Cost overruns on road construction projects are not only hard to predict but also difficult to manage [22]. According to Flyvbjerg, Holm and Buhl [12] when cost overrun occurs, highway organizations loose credibility and time is always taken defending deviations from the published program.

## 2.4 Cost Overruns Causes on Road Construction Projects

Risk factors leading to cost overrun in the delivery of Highway Construction Projects in Queensland, Australia was analysed by [14]. Creedy [14] used factor analysis and multivariate regression to identify correlation between cost overruns and various attributes and risks present in projects with excessive cost overruns. The research found that design and scope changes are the highest contributing risk factor to project cost overrun in highway projects analysed, followed by insufficient investigations and latent conditions, then deficient documentation (specification and design).

Lee [23] found that 95% of road projects have 50% cost overruns. The causes of cost overruns include increase on capacity after the feasibility study or during construction, adjustment of supervision fees due to design changes, cost increase due to changes in construction methods, varying compensation, lane addition and changes of a bedrock line [23]. Kaliba, Muya and Mumba [24] studied the causes and effects

of cost escalation and schedule delays on road construction projects in Zambia. Using interviews and questionnaires, [24] established that bad or inclement weather due to heavy rains and floods, scope changes, environmental protection and litigation costs, schedule delays, strikes, technical challenges, inflation and local government pressures were the major causes of escalation in Zambia's road construction projects.

Chileshe and Berko [25] utilized email survey of 34 randomly selected samples in their study of causes of project cost overruns within the Ghanaian road construction sector. The findings established that project cost overruns are caused by factors inherent in technology and its management to those resulting from physical, social and financial environment. The analysis revealed delays in monthly payments to contractors, variations, inflation, underestimating, lack of project knowledge and design errors/omissions as the main factors that cause cost overruns.

Mahamid and Bruland [26] carried out a study to identify the causes of cost overruns in road projects in the West Bank in Palestine through a questionnaire survey of forty consultants. The ranking of fifty-one identified factors revealed the top five to be materials price fluctuation, insufficient time for estimates, inexperience in contracts, size of contracts and incomplete drawings.

Similarly, a study was carried out by [27] on cost overruns in roads construction projects in Sri Lanka using questionnaire survey. The research, with a response from 44-road organisation workers revealed that the critical significant factors influencing road projects are delays in making payments, delays due to utility relocation, design changes during construction phase, cost escalation and land acquisition related issues. Anku [28] also did a questionnaire survey to find the causes of delay and cost overrun in road construction projects in Ghana. The paper identified delay in payment for work done, under estimation by contractors and frequent breakdown of equipment as the three most contributing factors of cost overruns.

Isma'il, Zakari and Gambo [29] identified thirty-eight cost overruns causes that affect the cost of road construction in Nigeria from the literature and ranked them according to responses in order of priority. Their finding revealed the four top most influencing factors as increase in global demand for construction materials, out-dated estimates, traffic control planning and corruption.

Al-Hazim and Salem [30] studied delay and cost overrun in road construction projects in Jordan by analysing project documents and final reports of projects executed from 2000 to 2008. The study found that terrain conditions, weather conditions and variations were the significant causes of time and cost overruns. The analysis of factors affecting time and cost overrun in road construction in Addis Ababa was done out by [31]. The study also involved reviewing contract documents and questionnaire survey of clients, contractors and consultants. The result of the analysis revealed that design change, fluctuation in material costs and inadequate review of drawings and contract documents were the most common causes of cost overruns.

Using questionnaire survey of 50 respondents, [32] did an analysis of cost overrun in road construction activities in India. The study requested the respondents to rank 30 identified

causes of cost overruns on a scale of 0 to 3, which were analysed using relative importance index (RII). The critical factors contributing to cost overruns identified by the study included land related issues, inflation, delay in payment, force majeure, design changes, etc.

### 3 DISCUSSION

It is obvious that road construction projects suffer from cost deviations and the magnitudes are different for different studied locations. Although some road projects were constructed within the estimated costs, most of the studies reported cost overruns in road constructions. The magnitude of cost overruns for road construction are as excessive as 100%. The reasons for these overruns in road constructions are many and differ across the studies conducted worldwide. Many researchers identified many a number of causes for the road projects going beyond their estimated costs. Although some of the causes and explanation given are similar, they differ in the significance given to them for the various locations studied.

The variations in the magnitude and causes of cost overruns could be attributed to the uniqueness of road construction projects. The unique characteristics of each road project poses different risks and challenges for different road projects. Road projects are seasonal; dry season is more favourable to all stages of road construction works therefore road constructed during rainy seasons are more prone to delays, and cost overruns. Road construction also depends on topography and even though a road may be built on a relatively small area, the impact of a road in hilly terrain may be much larger. Two roads having approximately same length and similar projects attributes would have different construction cost, different risks and challenges; hence different magnitudes and reasons, and explanations for cost overruns.

### 4 CONCLUSION

Road construction projects are unique and differ from other construction projects. They are capital intensive, involve different types of professionals, have a long construction duration and are constructed over a long distance with varying soil properties. These oddities make road construction projects susceptible to cost deviations and even huge overruns.

No two road projects cost the same no matter how similar they may appear, due to the peculiar nature of every roads and their own challenges and risks. These variations could be responsible for the distinctive explanations for the causes of cost overruns for different road projects. It is established from the reviewed literature that road construction projects suffer cost deviations with more projects being constructed with cost overruns than within budget. The nature of road construction projects makes them susceptible to cost overruns and the causes of these overruns vary for different road projects. It can therefore be concluded that findings on one road are not always applicable to other roads.

This study has provided baseline information on the peculiarities of road construction projects cost overruns. The study has pointed out that the causes of road projects cost overruns are not generalizable, therefore no single cause can be taking

as the most significant contributor to road construction project cost overruns. Since the construction of a single road usually involves managing numerous interdependent activities and multiple participant, multiple reasons could contribute to the occurrence of road projects' cost overruns. The researchers therefore recommend that in order to minimise road construction projects cost overruns occurrences, the causes of cost overruns should be studied as a system of interacting causes.

### REFERENCES

- [1] A. K. Ede, "Cumulative Damage Effects of Truck Overloads on Nigerian Road Pavement," *International Journal of Civil and Environmental Engineering*, vol. 14 no. 1, pp. 21 - 26, 2014, [http://www.ijens.org/Vol\\_14\\_I\\_01/148101-7373-IJCEE-IJENS.pdf](http://www.ijens.org/Vol_14_I_01/148101-7373-IJCEE-IJENS.pdf)
- [2] A. E. Adetola, "A Conceptual Elaborative Engagement Framework for the Road Infrastructure Management in Nigeria," 2014, (Doctor of Philosophy Thesis, University of Central Lancashire, United Kingdom). [http://clok.uclan.ac.uk/10982/3/Adetola%20Alaba%20Final%20e-Thesis%20\(Master%20Copy\)%20-%20with%20abstract%20and%20chapters%208%209%2010%20extract%20ed.pdf](http://clok.uclan.ac.uk/10982/3/Adetola%20Alaba%20Final%20e-Thesis%20(Master%20Copy)%20-%20with%20abstract%20and%20chapters%208%209%2010%20extract%20ed.pdf)
- [3] D. Thorpe, "Evaluating Factors in Sustainable Road Construction and Management - A Life Cycle Approach" In Smith, S. D. (Ed) *Proceedings of the 28<sup>th</sup> Annual ARCOM Conference*, 2012, [http://www.arcom.ac.uk/-doc/proceedings/ar2012-1235-1244\\_Thorpe.pdf](http://www.arcom.ac.uk/-doc/proceedings/ar2012-1235-1244_Thorpe.pdf)
- [4] M. Aldagheiri, "The Role of the Transport Road Network in the Economic Development of Saudi Arabia," 2009, DOI:10.2495/UT090251
- [5] D. Canning, and P. Pedroni, "Infrastructure and Long Run Economic Growth. Discussion," 1999, [http://pdf.usaid.gov/pdf\\_docs/PNACH814.pdf](http://pdf.usaid.gov/pdf_docs/PNACH814.pdf)
- [6] I. Ismail, I. Abdul Rahman, and A. H. Memon, "Study of Factors Causing Time and Cost Overrun throughout Life Cycle of Construction Project," *Proceedings of Malaysian Technical Universities Conference on Engineering & Technology*, 2013, [https://www.academia.edu/8408099/Study\\_of\\_Factors\\_Causing\\_Time\\_and\\_Cost\\_Overrun\\_throughout\\_Life\\_Cycle\\_of\\_Construction\\_Project](https://www.academia.edu/8408099/Study_of_Factors_Causing_Time_and_Cost_Overrun_throughout_Life_Cycle_of_Construction_Project)
- [7] C. Afetornu, F. T. Edum-Fotwe, and R. McCaffer, "Estimating budget variability for road projects," 2006, [www.researchgate.net/...BUDGET...PROJECTS/.../54819ae00cf22525dc..](http://www.researchgate.net/publication/22252525dc)
- [8] P. E. D. Love, C. Sing, B. Carey, and J. T. Kim, "Estimating Construction Contingency: Accommodating the Potential for Cost Overruns in Road Construction Projects," 2014, <http://ascelibrary.org/doi/pdf/10.1061/%28ASCE%29IS.1943-555X.0000221>
- [9] C. C. Cantarelli, "Cost overruns in Dutch transportation infrastructure Projects. Contribution to the Transport Planning Research Colloquium," 2009, [http://www.cvs-congres.nl/cvspdfdocs/cvs09\\_156.pdf](http://www.cvs-congres.nl/cvspdfdocs/cvs09_156.pdf)
- [10] I. Mahamid, and B. Amund, "Cost Deviation in Road Construction Projects: The Case of Palestine," *Australasian Journal of Construction Economics and Building*. vol. 12 no. 1 pp. 58 - 71, 2012, <http://dx.doi.org/105130/AJCEB.v12i1.2427>

- [11] I. Mahamid, "Effects of Project's Physical Characteristics on Cost Deviation in Road Construction," *Journal of King Saud University - Engineering Sciences*, vol. 25 no. 1 pp 81 - 88, 2013, DOI:10.1016/j.jksues.2012.04.001
- [12] J. R. B. Silva, "Risk Management in Road Construction Works - Quantitative Analysis of Cost Deviations from a Project Owner's Standpoint," *Technico Lisboa*. 2000, <https://fenix.tecnico.ulisboa.pt/downloadFile/395145458979/Extended%20Abstract.pdf>
- [13] B. Flyvbjerg, M. S. Holm, and S. Buhl, "Cost Underestimation in Public Work Projects: Error or Lie," *Journal of the American Planning Association* vol. 68 no. 3 pp 279 - 295, 2002, <http://www.tandfonline/doi/abs/10.1080/01944360208976273>
- [14] G. D. Creedy, "Risk Factors Leading to Cost Overrun in the Delivery of Highway Construction Projects," 2006, (Doctor of Philosophy Dissertation, Queensland Australia)
- [15] R. Singh, "Delays and Cost Overruns in Infrastructure Projects: Extend, Causes and Remedies," *Economic and Political Weekly*, vol. 45 no. 21 pp 43 - 54, May, 2010, <http://www.jstor.org/stable/27807050>
- [16] S. Sarkar, and R. K. Kovid, "Framework of Risks Factors and Financing Implications for Road Projects in India: Study of Selected Cases," *Pacific Business International*, vol. 8 no. 2 pp 110 - 122, 2015, <http://oaji.net/articles/2016/3050-1456550240.pdf>
- [17] N. I. El-Sawalhi, "Support Vector Machine Cost Estimation Model for Road Projects," *Journal of Civil Engineering and Architecture*, pp 1115 - 1125, 2015, DOI: 10.17265/1934-7359/2015.09.012
- [18] E. K. Nyabaro, "Factors Influencing Implementation of Major Road Infrastructure Projects in Kenya: A Case of the Southern Bypass Project, Kenya," 2015, (Master's Thesis, University of Nairobi).
- [19] K. K. Kaare, and O. Koppel, "Improving the Road Construction Supply Chain by Developing a National Level Performance Measurement System: the Case of Estonia," *International Journal of Social, Behavioural, Educational, Economic, Business and Industrial Engineering*, vol. 6 no. 2 pp 217 - 223. <http://waset.org/publications/10265/improving-the-road-construction-supply-chain-by-developing-a-national-level-performance-measurement-system-the-case-of-estonia>
- [20] A. Jenpanitsub, "Cost Overruns in Transport Projects - Experiences from Sweden," 2011, <http://kth.diva-portal.org/smash/get/diva2:447030/FULLTEXT01.pdf>
- [21] Matintupa, E. "Impact of the Planning Process on the Road Construction Cost," Master Thesis, Helsinki University of Technology. 2009, <http://www.nvfnorden.org/lisalib/getfile.aspx?itemid=2669>
- [22] Gutae, F. "Cost Overrun Factors in Road Projects: Pedestrian and Cyclist Bridge at Skansen," Bachelor Thesis, Sor - Trondelag University College. 2015, [http://brage.bibsys.no/xmlui/bitstream/handle/11250/297789/Bacheloroppgave\\_2015\\_Ferew\\_Gutae.pdf?sequence=1](http://brage.bibsys.no/xmlui/bitstream/handle/11250/297789/Bacheloroppgave_2015_Ferew_Gutae.pdf?sequence=1)
- [23] J. Lee, "Cost Overrun and Cause in Korean Social Overhead Capital Projects: Roads, Rails, Airports and Ports," *Journal of Urban Planning and Development*, vol 134 no. 2 pp 59 - 62, 2008, [http://scihub.cc/10.1061/\(ASCE\)0733-9488\(2008\)134:2\(59\)](http://scihub.cc/10.1061/(ASCE)0733-9488(2008)134:2(59))
- [24] C. Kaliba, M. Muya, and K. Mumba, "Cost Escalation and Schedule Delays in Roads Construction Projects in Zambia," *International Journal of Project Management*, vol. 22 no. 5 pp 522 - 531 2009, <http://www.sciencedirect.com/science/article/pii/S0263786308000951>
- [25] N. Chileshe, and P. D. Berko, "Causes of Project Cost Overrun within Ghanian Road Construction Sector" *Proceeding of ASOCSA 5th Built Environment Conference, Durban South Africa*, 2010, [https://www.irbnet.de/daten/iconda/CIB\\_DC22741.pdf](https://www.irbnet.de/daten/iconda/CIB_DC22741.pdf)
- [26] I. Mahamid, and A. Bruland, "Cost Overrun Causes in Road Construction Projects: Consultants' Perspective," *International Conference on Construction and Project Management*, IPEDR. IACSIT Press, Singapore, vol. 15 pp 6 - 10. 2011, <http://www.ipedr.com/vol15/2-ICCPM2011A00003.pdf>
- [27] S. B. Wijekoon and AMCTK Attanayake, "Study on the Cost Overruns in Road Construction Projects in Sri Lanka," 2013, <http://dl.lib.mrt.ac.lk/handle/123/8969>
- [28] R. Anku "Delay and Cost Overrun in Road Construction Projects in Ghana," 2012, <https://www.amazon.com/Causes-Delays-Overrun-Construction-Project/dp/3659240346>
- [29] U. Isma'il, A. Zakari, and D. Gambo, "Prioritizing Cost Overrun Causes in the Nigerian Road Construction" *Interdisciplinary Journal of Contemporary Research in Business*, vol. 5 no 6 pp 287 - 294, 2013, <http://journal-archievs36.webs.com/287-294.pdf>
- [30] A. Al-Hazim, and Z. Abu Salem, "Delay and Cost Overrun in Road Construction Projects in Jordan," *International Journal of Engineering Technology*, vol. 4 no. 2 pp 288 - 293. DOI:10.14419/ijet.v4i2.4409
- [31] A. J. Mustefa, "Analysis of Factors Affecting Time and Cost Overrun in Road Construction Projects in Addis Ababa," (Master Thesis, Addis Ababa University). 2015, <http://etd.aau.edu.et/bitstream/123456789/8177/1/Abubeker%20J%20emal.pdf>
- [32] A. C. Rajakumar, "Analysis of Cost Overrun in Road Construction Activities: A Critical Review," *International Research Journal of Engineering and Technology*, vol. 3 no. 4 pp 1433 - 1439. 2016, <http://www.ijret.net/archives/V3/i4/IRJET-V314284.pdf>