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The Impact of Time and Cost Factor Toward the Accomplishment of Highway Road Construction Project: A Case Study of Mbeya City

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Abstract: The study aimed at assessing the impact of Time and cost factors toward the completion of Mbeya city highway road construction. Specifically, the study examined financial cost operational efficiency upon the whole process of supplying materials in road construction, exploring the quality and technical performance of road construction project as well as evaluating the time schedule of material supply for highway road construction. Where by a mixed approach was used on a sample size of 100 respondents using contractors, consultants, and beneficiaries as target population, moreover, the researcher used desk study and the questionnaire survey to get data about the impact of time and cost factors. Data was analyzed using statistical package for social science (SPSS), Excel and Relative importance index (RII. The relative importance index was useful for calculating the impact of time and cost factors by ranking different factors;), The main factor leading to delay upon the accomplishment of the road construction project in Mbeya was identified as inadequate budget which ensure insufficient provision of fund upon project , and discussion was made in relation to other supporting factors like poor project design, poor management process and political interference s. In the end of study recommendation and conclusion was made following various policies reinforcement and relation upon different construction project of Tanzania nation.

Keywords: *Road Construction Project, Time & Cost Factors and Road Project Accomplishment.*

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I. INTRODUCTION

Road construction has been one of the mostly conducted projects worldwide with the intention of solving and meeting various human need and fostering economy of different places worldwide. The issue of road construction can be traced backward since the era of economic production of 1800 to 1950, whereas different kind of roads where being constructed to enhance, military superiority, capitalism widening of economy through disparities of different territories. Belt and Road Initiative (BRI) play a role of the most ambitious infrastructure project in history of road construction, marked by its ratio of investment, extensive geographical access, throughout continents and countries, and a diverse array of projects from roads to digital networks. From year 2008 towards 2023, 328 million tons of construction materials have accumulated in 540 BRI projects through the world, mostly in Asia and Africa. Aggregates (gravel and sand) constitute the largest share (82%), followed by steel, cement and other useful materials. Most of the materials are used during the construction of transportation infrastructures especially roads (Hou, 2024). Road construction deal much mostly with material-intensive industry which uses nonmetallic building materials. The increasing rates of road constructions and the need to reduce material and financial resources cost is important during road construction by preserving environment and fostering budget of other economic activities (Lyapin, 2020)

China era of road construction can be traced back since 1978 economic reform under the project support of Belt and Road Initiatives (BRI). The BRI was built to facilitate the national infrastructure, including road construction projects in rural with intention of reducing poverty. BRI didn't end over there since acted as the key component of both domestic and international road construction for development. The construction of road cannot be achieved without proper management of materials supply (Zhao, 2023) Since there is the need of proper material supply to accomplish the construction of roads hence better economy of people since there is indigenous connection between total economic activity increase and transportation growth, through movement of people with their commodities the potentiality to generate wealth and prosperity is more viable.

In Tanzania there was the Tanzania National Development Vision 2025 and the Third Five-Year Development Plan (FYDP III: 2021/22-2025/26) which

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intended to prioritize transformative transport infrastructure, including roads. The transport infrastructure characterized by large-scale, government-led projects, significant Chinese financing and contractor involvement**,** and a growing intention upon public-private partnerships (PPPs). There are different Governing Bodies and Key Policy which facilitate better transport infrastructure Tanzania National Roads Agency (TANROADS) which Executes maintenance and development of the Trunk and Regional Roads network. Tanzania Rural and Urban Roads Agency (TARURA) tend to perform Management of Feeder, Urban, and District Roads. There are Ministry of Works and Transport (MoWT) which perform the Sets overall policy and oversight and Key Policy which Build Better for Tomorrow (BBT). On other hand the durability and safety of district, urban and feeder roads are the responsibility of local government authorities (LGAs) who are under the oversight of the Prime Minister's Office Regional Administration and Local Government (PMO-RALG) (Tillya, 2019). In Tanzania nation (PMO-RALG) has an oversight duty of enhancing, preparing and implementing policies and strategies in consultation with stakeholders as well as coordinating, monitoring, and providing support to LGAs in road works implementation activities (TANROADS 2020).In the five-year development of 2025 vision, there were road network status and targets of Total Road Network: ~160,000 km (classified as Trunk, Regional, Urban, and Feeder Roads). Paved roads: Approximately 12-15% of the total network. A major focus is increasing this percentage. Strategic Target, Upgrade key corridors to international standards to position Tanzania as a regional logistics and transport hub for the Great Lakes Region and Southern Africa.

➢ *Statement of the Problem*

The goal of road construction projects doesn't end into its accomplishment of construction, instead it proceeds into usefulness of the road after it has been constructed. Since good road project ensures easy transportation of people and commodities hence the poverty alleviation and growth of economy unfortunately efficiency of road transport systems in lot of developing nations tend to be constrained by high vehicle operation and maintenance costs due to poor road conditions. Meanwhiles demand for transport infrastructure proceeds to grow rapidly, as result of high population growth rates, urbanization and growth in economic activities. Budget and resources for road maintenance and road network replacement continue to be a burden for many developing countries due to inappropriate budgeting system and resource utilization.

To ensure smooth financial provision and time maintenances for highway road construction sponsorship of budget can be from external and internal sources of the nation. Whereas for external source could be loans, aids and grant from World bank, international Monetary Fund (IMF), SADC and EAC. For internal source within nation to ensure smooth supply of material on road construction budget for highway road project, budget can be sponsored by central government and other road organization like TANROADS and TARURA. Mbeya highway is the bridge to foster transportation of goods and products not only within Mbeya city but also in different nearby nations of Zambia, Congo, Malawi and Zimbabwe. The issue of highway road construction in Mbeya city matters because it acts as the route channel boosting Tanzania economy but also the nearby nations. That's why this journal study intend to seek the impact of time and cost factor towards highway road construction, a case study of Mbeya.

➢ *Research Objectives*

- To examine financial cost operational efficiency upon the whole process of supplying materials in road construction of Mbeya highway.
- To explore the quality and technical performance of road construction project
- To evaluate the time schedule of material supply for highway road construction

➢ *Scope of the Study*

The study focused on road upgrading project recently carried out by TANROADS along the country's central corridor. The project was delivered through the traditional method of design-bid-build. In order to accomplish this work, all factors leading to cost and time overruns were identified. However, the study focused in detailed concerning the highway road project from Nsalaga in Iringa Road side to Songwe airport on the side of Songwe road region. in which this road part is located in southern zone of Tanzania, Mbeya region specifically to Mbeya city

II. LITERATURE REVIEW

➢ *Theoretical Literature Review*

The Iron Triangle (Triple Constraint) believes the project success hinges on balancing three key factors which are cost, scope and time, disruption of any factor inherently impacts the other factor. Time observes the schedule or duration required to complete a project; cost observes the budget or financial resources allocated to the project example labor costs, material costs, equipment costs, transportation expenses and administrative expense where by scope observes the amount of work, features, objectives, and quality standards expected in the project. by looking, what the project should deliver, required standards and expected outputs (Makovec, 2025)

➢ *The Triple Constraints / Iron Triangle Theory*

The theory shows how the three variables affect each other (Tremblay,2023), as the theory reflect to this study by making relationship of time and cost factors towards completion of highway road construction project in Mbeya since without proper cost management the time schedule of project is affected automatically hence the delay upon completion of project and vice versa with proper cost/financial management of the project, results to early completion of project. (Rivera,2020) delays affect not only the last time of the project but also the cost and quality. Recommendations to decrease delays in road projects must include authorities of services in the early stage of the project.

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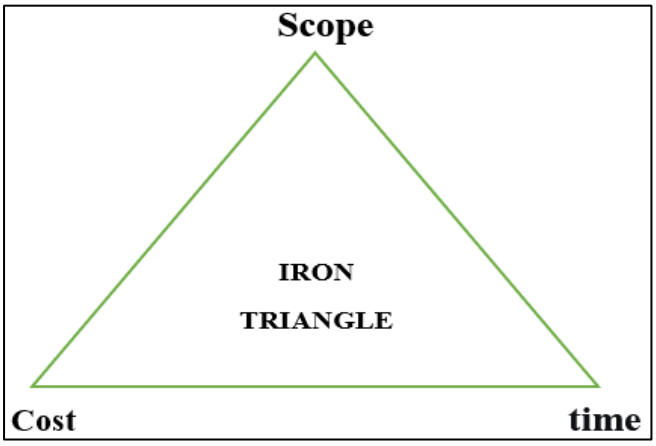

Fig 1 The Triple Constraints / Iron Triangle Theory

➢ *Empirical Literature Review*

- *Quality and Technical Performance of Road Construction Project*

Road construction projects are the gateway for other economic project since most of economic activities relay on the use of road transport system. Due to that concern, the road construction procedure must be taken into serious consideration by ensuring, they work under desired aim through following the planned schedule, scope and quality for the sake of accumulating progression of other economic activities.

For road construction to be done There are three most important bodies which operates separately regarding the nature of the responsibility they have in regulating the activities of the construction sector. There is Contractors' Registration Board (CRB) whose duty is to regulate, register as well as to develops the capacity of contractors. The other board is Engineers' Registration Board (ERB) who performs the engendering duties during construction. The last bord is Architects' and Quantity Surveyors' Registration Board (AQRB), whose duty is to perform architect designs and surveying duties, as for attaining proper standard roads these boards need to cooperate fully to come up with standard roads.

To accomplish road construction still not only boards are responsible instead are being companied similar numbers of associations who performs likely responsibilities. Such associations include Architects' Association of Tanzania (AAT), Tanzania Civil Engineering Contractors' Association (TACECA), Tanzania Institute of Quantity Surveyors (TIQS), Institute of Engineers Tanzania (IET) and Association of Citizen Contractors of Tanzania (ACCT).

- *Financial Cost Operational Efficiency*

Road construction projects to be undertaken the Roads Fund board (RFB) should be involved , as Road Fund Board in Tanzania formed by The Road Tolls (Amendment, No. 2) Act 19981 (RFB, 2018) and began its duties of operations in 2000 with the authority of advising the ministers on matters concerning new sources of road and fuel tolls, furthermore it dealt with changing in rates of existing roads and fuel tolls, and on regulations for the collection of road and fuel tolls for the purpose of ensuring an adequate and stable flow of funds to road operations (Kikwasi, 2018).

- *Time Schedule of Material Supply for Highway Road Construction*

Material supply in project is one of the most important insertion procedures for any project to stay on lane. People with Procurement career play a great role in various organization to ensure that the project proceeds or delay because of the whole concern of material supply. Although the issue of material supply in any project is influenced by different factors like the issue of policy of particular nation, budget prevailed and the seriousness of procurement expert upon supply matter without delays. The Public Procurement Regulatory Authority (PPRA) enhances procuring entities and LGAs adhere to the provisions of the Public Procurement Act 2011 and its 2013 Regulations. In recent year in Tanzania to ensure no delay of material supply the field of procurement and material supply has employed the use of new model of material supply via National e-Procurement system of Tanzania (NeST) which allows different organization both private and non-organization to bid for tenders in reasonable budget and schedule. The concern remains upon the winners of tenders on how they supply materials, whether the materials are on aimed quality, standards and quantity not only that the issue of supply follows the intended schedule of the project and scope. Since without following critical principle in supply of material over there it's where the delay of materials protrudes hence the stagnant of project.

Road construction projects in different developing countries tend to suffer much due to due to lack of technology. (Egina, 2021). Kumar (2016) elaborated on different factors leading to delay of road construction projects which included delay payments, delay in approving shop drawings and sample materials. Delay on immediately decision-making process due to bureaucratic procedures. poor estimation of project time and quantities of material required before contracting.

Many researchers conducted researchers concerning road construction in various aspect some have identified multiple causes for a variation order in road construction, contribution of road construction projects upon economy, the contribution of roads towards rural development areas growth, some researchers have looked upon the relationship between material supply towards road construction but for this study intend to assess the impact of time and cost factors towards the accomplishment of road construction in Mbeya city Tanzania.

III. METHODOLOGIES

The study employed mixed research approach both qualitative and quantitative data were explored with the sample size of 100 respondents Data was collected through a desk study and a questionnaire survey. Various phases can be examined using research methodologies by studying their research problems and reasoning via desk research / secondary data, data collection without field work

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(Salaam,2023). A desk study was conducted on selected factors for delay upon road construction and through questionnaire survey the reality and practicability of factors was studied. A series of questionnaires were distributed to various respondents to collect data.

The first section included respondents' personal information such as their name, agency name, address, education level, and experience with road construction projects. Furthermore, the second section included questions regarding the factor leading to delay of high way road construction project in Mbeya city. And those factors were supposed to be answered following the Likert scale order (1-5 Likert scale)

The results of the discussions were then analyzed in great detail. Based on the outcome of the literature review, projects completion reports review and the discussions, a set of pertinent issues were identified and studied further. These pertinent issues were factors that were thought to have profound effects on the causes of cost and time overruns of road construction projects

In order to study the road construction project in Mbeya city different variables were identified and analyzed from research field and categorized as follows. The study used the relative importance index (RII) formular Kullaya (2022), to cross check the four main factors in ascending order as the main drive upon delay of road construction in Mbeya city.

From formular of Relative importance index (RII)

$$RII = \frac{\sum W}{AXN}$$

Where:

$\sum W$= Total weight given to a factor by respondents

A= Highest weight in scale (according to1-5 Likert scale) A=5

N= Total number of respondents (100)

Table 1 Delay Factors

DELAY FACTORS	Total Weight ($\sum W$)	Formula	RII Value	Rank
Inadequate financial provision	450	450/ (5×100)	0.90	1
Poor construction management processes	420	420/ (5×100)	0.84	2
Political interference	380	380/ (5×100)	0.76	3
inadequate project designs	340	340/ (5×100)	0.68	4

Factor which led to delay of completion of highway road construction in Mbeya were given a rank according to the number of attributes since researcher used relative significance indices (RIIs)and correlation coefficients to estimate the data and variable.

IV. FINDINGS

The data analysis protocol was designed to determine the relative importance of various factors leading to construction delays. Following the evaluation of time schedule in supply of road construction materials, there are delays which are influenced by factors like inadequate financing poor contractual relations, poor construction management processes, inadequate project designs, unavailability of resource, and political interference.

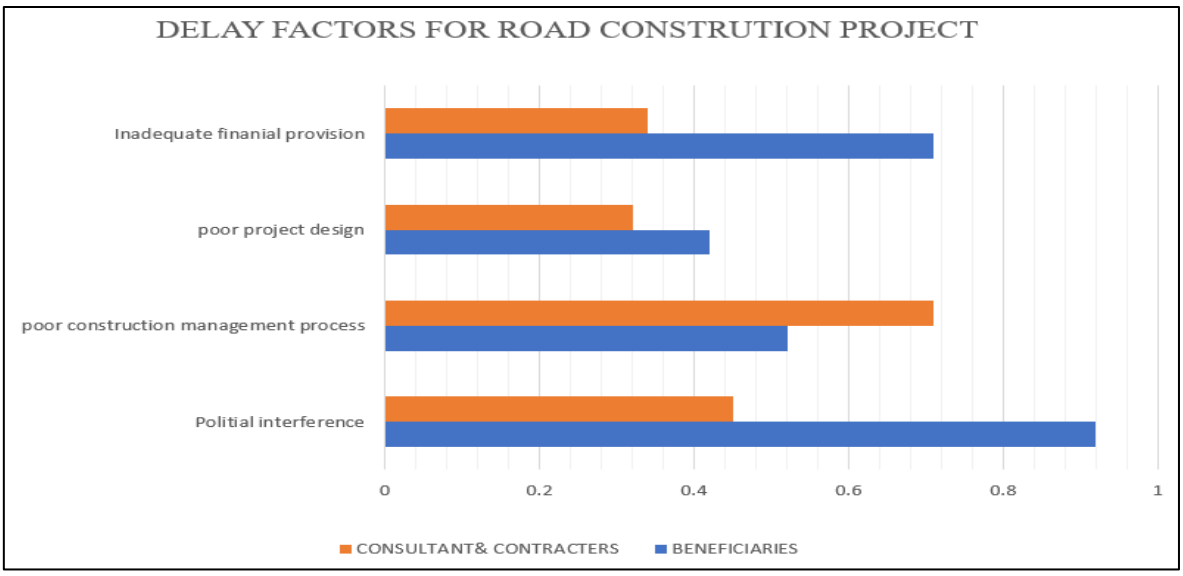

Fig 2 Delay Factors for Road Construction Project

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Inadequate provision of fund upon the project act as the main drive towards delay upon completion of Mbeya city highway road construction because don't have reasonable financial plan to pay for contractors according to contract agreements (Kumar, 2025). the domestic financial resources tend to be insufficient hence road accomplishment becomes impossible (Truong, 2020), since Client's delay in honoring timely payments certificates, resulted to project delays to a very large which cause difficulties in accessing credit (contractor and sub-contractor) hence road construction project delay. project managers, engineers, and contractors, lack finance which provide a prioritization framework that supports proactive risk planning, enabling more effective allocation of resources during the early project stages (Zhasmukhambetova, 2025) as inadequate financial provision is not only the standing factor since leads to failure of equipment and inadequacy of materials supply which in turn timely completion/performance of road construction projects becomes affected (Oluwajana, 2022)

Poor project design tends to be the driving factor upon delay of project since improper design stalls project execution due to time taken for such design to be reviewed, amended and accepted for construction processes (Simon 2017). When errors are observed in the design, works are temporary suspended until such errors are eliminated. One of the major common factors highlighted in almost all projects is inadequate design. However, their extents as well as the causes have remained under-studied. It is unfortunate that delays in project implementation mean that the people (road users) and the economy have to wait for the road longer than it is necessary; which in turn limits the growth potential of the economy at large. furthermore, poor project design results from technical incompetence of clients and consultant" staff, since some of client staff are not fully experienced upon design review of documents which are submitted by consultants as a result poor designs are likely to be approved. Furthermore, consultants engage semi-skilled personnel to carry out design works. Meanwhile they lack knowledge of design sequence and management of design projects (Santos, 2020), also incapable to have time review upon design documents and inadequate Terms of Reference (TOR) for design review, Inappropriate staffing level, Political pressure, Lack of road geometric design manual and the use of outdated designs.

Poor management process tends to affect the accomplishment of road construction (Saki 2022). The design-bid-build delivery technique is used, in which the client hires a design consultant and then chooses a contractor through a tendering process. since there are Contractor's employees who are not skilled in project management also not able to manage their project site appropriately, thus, culminating in faulty work, reworks and delay in completion of tasks. Inexperienced contractors usually make repeatedly errors during construction. Sometimes contractors employ low skilled staff in order to make more profit by paying them lower salaries hence tendencies of errors. Furthermore, there are is existence of Corruption in the procurement process, which is followed by "non-consideration of security risk during the procurement of highway road projects" and "award project to lowest bid price" are identified as the most key factors causing delay upon road construction

Political interference, has become one of the driving factors upon the delay of road construction in Mbeya city one of respondent reported "*lot of government leader do not treat the road construction project of Mbeya city as economy and development project instead a political project The implementation of road construction is delayed since 2024 and no any positive initiations undertaken by political leaders"* as according to respondent no clear effort is kept upon project of road construction project instead the effort is kept towards other minor project which have low contribution towards economy compared to the project of road construction in Mbeya. Road Construction organization's efficiency and effectiveness normally depend on how managers scan the external project environment, identify the critical factors and adapt their organizations in relationship to environment available (Badarpur, 2021)

V. RECOMMENDATION AND CONCLUSION

Mbeya city is growing up with high population of people day to days who conduct various economic activities hence due to high population of people and their economic activities there is the need of connecting streets with different feeder roads as contingency road plan to avoid congestion to international high way road, which accommodate not only Tanzania nation but also the neighborhood nations.

For high way road construction perspective as seen from the study made, before implementation processes there is the need of various stakeholders like contractors, consultants from TANROAD, TARURA, LGA'S to follow some of precaution and measure to avoid delay upon completion of other roads projects which may be conducted in the future.

- The need of Speculation and obtaining of accurate data concerning procurement transactions, materials, and plants. If possible, contractors are advised to obtain the entire amount of specific material to avoid a shortage of material during the implementation process.
- Contractors need to increase the capacity of their technical staff to enable themselves to effectively manage the planning and scheduling of the work and to improve site management and supervision to achieve quality completion of work within a specified time
- All parties need to perform site analysis and geotechnical studies as well perform scrutinization from the bidding stage
- Consultants should make sure the blueprints/specifications plunge in authorized fund allocation before accepting the tender, both parts should be financially stable and well prepared to avoid variation in order during implementation processes. Furthermore, consultants should avoid launching many projects, also owner should have fixed dedicated funding projects. Furthermore, during tendering procedures, owner should avoid bids of low prices and set a floor price to ensure the duration and quality of the project is smoothly attained. Effective project management and thorough pre-project

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planning should be performed to reduce or eliminate these delays. adjustments and legal terms to avoid economic risks.

- The need to provide sufficient time in the devising stage for the sake of coming up with appropriate plane. Before filling in the bidding document and estimating, contractors must conduct an effective site visit to see all obstacles and consider them in the bid.
- Ministry of Transport needs to improve the capacity of their survey and design teams to produce more up-todate, reliable and accurate design documents, especially, more attention should be paid to the bills of quantities.

LIST OF ABREVIATIONS

- AAT Architects' Association of Tanzania
- ACCT Association of Citizen Contractors of Tanzania
- AQRB Architects' and Quantity Surveyors' Registration Board
- BRI Belt and Road Initiative
- CRB Contractors' Registration Board
- EAC East Africa Community
- ERB Engineers' Registration Board
- FYDP Five Years Development Plan
- IET Institute of Engineers Tanzania
- IMF International Monetary Fund
- NeST National e-Procurement system of Tanzania
- MoWT Ministry of Works and Transport
- PMO-RALG Prime Minister's Office, regional Administrative and Loal Government
- PPP' s Private Public Partnership
- PPRA Procurement Regulatory Authority
- RFB Road Fund Board
- RII Relative Importance Index
- SADC Southern African Development Community
- SPSS Statistical Package for Social Science
- TACECA Tanzania Civil Engineering Contractors' Association
- TIQS Tanzania Institute of Quantity Surveyors
- TOR Terms of Reference
- TARURA Tanzania Rural and Road Agency
- TANROADS Tanzania National Road Agency

➢ *Consent for Publication*

- Not applicable.

➢ *Standards of Reporting*

- Core guidelines were followed.

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➢ *Conflict of Interest*

- The authors declare that they have no competing interests.

➢ *Acknowledgements*

- Declared none

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