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Reviewing the Challenges of Achieving Sustainable Road Infrastructure in Developing Nations

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ABSTRACT
Construction of road network has been one of the earliest engineering skills of men towards easing the movement of people, good and services. This act has gained revolutionary advancement over the years and has indeed connected people, enabled faster delivery of goods and services, influenced other economic sectors, and promoted sustainable living to a great extent. However, there are challenges in experiencing the expected planned transportation networks. Indeed, scholars have quarried and have made meaningful expositions on the causes and possible solutions to the problem but there has not been comprehensive research combining all the causes of road failure. This study, hence, presents a review of road construction challenges with the aim that actors in the industry would be guided and have a single framework to consult while considering future projects in the construction of road infrastructures. Using relevant literatures, the study investigated project failure in road construction. The results of this study showed that, although many variables contribute to road project failure, but disasters are majorly due to inflation rate, delay in payment, design changes during construction, soil conditions, lack of resources, inadequate skills and experience, unfavorable environmental conditions, political interference, poor planning and coordination, corruption and nepotism, procurement delays, poor work ethics, poor project management, budget overruns, poor risk and safety management, poor communication, community and residents actions, poor maintenance culture.
Keywords*: Road construction; Project failure; Infrastructural sustainability, Construction quality*

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I. INTRODUCTION

Transportation has been with man for ages and has evolved to ease human existence. Movement of man, goods and provision of services is part of daily activities on earth. Hence, the need for a clear and sustainable path to convey people, their goods, products and rendering of services to where needed inter or intra connectivity, cannot be over emphasized for urbanization and population growth (Wang, Xue, Zhao, & Wang, 2018).

Road transportation is a major bedrock for national development, the transportation industry contributes immensely to national social and economic growth by enhancing faster, cheaper, and safer conveyance of people, goods, and services. It also aids firsthand valuable communication path by ensuring demand and supply are achieved as planned(Mustapha, 2011). A good transportation network promotes collaboration, spread of people and increased exchange, as production reaches consumers timeously, safer, and overall cost of production is reduced.(Naazie, Braimah, & Atindana, 2018).In Malaysia, exchange of information and knowledge has been recorded to have been enhanced through safer, faster and effective road infrastructural network as trained workforces can actually engage in far-flung areas without an itch while the village residents are able to absorb talents from well informed experts from the urbanized cities who visits and work in their environment, this helps in promoting exchange of ideas, culture, one-on-one communication and improved overall economic advancement(Naazie, Braimah, & Atindana, 2018).

Despite the high dependence of people on good transportation, a high-rate poor road infrastructure is still recorded, especially in developing and underdeveloped countries. The impact of road quality is expected to be of positive value to the community and overall residents. However, road infrastructure has exhibited negative impact especially on the environmental stability through various level and degrees of pollution, change in climatic condition, safety, socio-economic, and health challenges. These effects directly impact the geospatial condition and livelihoods of the people(Meijer, Huijbregts, Schotten, & Schipper, 2018). Several factors contribute to the

problems encounter on road usage ranging from poor conduct of required soil tests, improper engineering design and implementation, lack of adequate governmental or regulatory policies, human activities, natural disaster to lack of effective maintenance culture.

In developing and underdeveloped world, death rate in addition to other health and safety challenges are on elevated projectile due to poor road conditions, ineffective government policies and regulations compared to the experience in western developed countries(Onyemaechi & Ofoma, 2016).

II. LITERATURE REVIEW

The area of failed projects and road construction deplorable condition causes has been attracting attention in recent times. However, the attention given to this important aspect of livelihood has yielded little result due to researchers focusing on a linear or aspect of failure and associated causes. As a result, failure in any specific project will have a negative impact on the institution not just financially, but also in terms of opportunity cost, staff morale, future ardor for initiatives, and corporate credibility or reputation. Similarly, (Nzekwe et al., 2015) found that project failure results in a drain on government expenditures, abuse of taxpayers' money, and a drop in goodwill.

(Eja and Ramegowda, 2020) made research on project failure in developing nations with a focus on Nigeria. It became clear that project failure occurs often in developing nations (Pojani and Stead, 2015)and that there are a variety of causes, impacts, and repercussions. Poor financial capability, inaccurate costing, corruption, incompetence and a lack of knowledge, poor planning and estimation, poor communication, poor contracting and contractor practices, frequent design scope changes and errors, interference from sociocultural and political factors, poor leadership, and poor knowledge were some of the causes identified(Eja and Ramegowda, 2020).In other studies, various factors were highlighted as contributing factors to the bad condition of roads, some of which are design errors, deploying of substandard materials and tools, engaging inexperienced labor, poor workmanship, inadequate construction supervision, heavy duty vehicular traffic plying the road against what it was designed for, poor maintenance culture on existing roads(Okigbo, 2012).(Onwubiko, 2010) added that poor roads contribute to high rate of accidents because it is the most affordable and most used, he also made recommendations on the need to decongest Nigerian roads, demarcating specific roads for high duty vehicles from small vehicles.(Oguara, 2010)agrees that indeed, government invests greatly in transportation and road takes the highest focus in movement of people, and goods. However, the concentration on road infrastructural development and investments lacks adequate, accurate and reliable information data especially, for maintenance purposes(Oguara, 2010).

In south Africa, transportation is considered a major factor in national economic growth according to the Department of Transport 2012. Logistics is aided through adequate transportation system which a good road infrastructure plays a major factor in achieving. A foremost challenge to road effective usage in south Africa is heavy commercial vehicles plying same routes as small and medium vehicles, increasing travel time, degradation of such roads because of carrying heavier load than design, among other contributing vices. Weather and other environmental effects and ineffective road accessories like streetlights, proper drainage system and so on also affect the road network and its usage(Naude & Chitakunye, 2014).

(Locatelli et al., 2017)The repercussions of project failure were found to include lost state income, project cost overruns, citizen revenue losses, poor infrastructure, and low community empowerment. Slow economic growth, sector-focused underdevelopment, a loss of foreign funding and grants, stricter donor requirements, lack of trust from financial institutions in the government were the results.

(Nallathiga et al., 2017) conducted a study on Public-Private Partnership (PPP)-based road infrastructure development in India. The purpose of the paper was to assess the key success and failure variables for road infrastructure PPP projects in India. Political influence and public resistance are the major reasons why road PPP projects fail at the project preparation stage, procurement stage, development stage, force-majeure stage, construction, operation, and maintenance stages.

(Abankwah, 2020) The study evaluated the cost, timeline, and scope of failed road projects. The study investigated project failure in Ghana's road-building business using the social constructivism paradigm through interviews. The Ghana Highway Authority's supervision over several road projects served as the foundation for this study. The study found that although many causes contribute to the occurrence of the failure factors (cost failure, time failure, and scope failure) in the literature now in use, cost failure was caused by a lack of resources, insufficient skills, and price variations of building materials, while time failure was brought on by financial limitations, adverse environmental conditions, then bureaucracy, and scope failure was brought on by an unrealistic scope, political instability, and bad management.(Oluwafunmilola et al., 2022)also conducted a study on the crucial elements that contribute to the failure of road projects. Based on the findings and the following analysis of the findings, they concluded that the 82 km Bida-Minna Trunk-B Road project failed due to causes including a lack of finance, official corruption, political interference, an unorganized bureaucracy, and climatic fluctuations.

The work of (Lende and Rathod, 2018) made it clear that the primary causes of cost overruns in road building projects include changes in the cost of services, delays in payment, design modifications made during construction, changes in quantity brought on by real site circumstances, delays in design and approval of designs, delays in moving existing utilities, and poor communication between government entities. (Seninde, 2020) said that poor resource mobilization, inadequate geological and hydrological evaluations, and a lack of equipment are important concerns that hinder road development.

According to (Niazi and Painting, 2017), the biggest factors contributing to cost overruns in the Afghan construction sector are corruption, client delays in making progress payments, contractors issue with funding projects, security, and clients' requests for changes to be made during the building phase.

III. RESEARCH METHODOLOGY

This study adopted the guidelines provided for conducting systematic literature reviews (SLRs) by (Kitchenham et al., 2009). by interpreting and evaluating available materials that is related to the formulated research questions and topics (Pacheco et al., 2012). The SLR was conducted to provide a summary of existing literatures(Keele, 2007, Zakari et al., 2020b, Zakari et al., 2020a).

3.1 Research Aim/Objective

The aim of the study is to explore the in-depth causes of road infrastructural failure with a view to consolidating and presenting a more comprehensive factors causing road defects. The presentation is expected to reach all road construction experts and stakeholders in the industry with an objective of understanding what to avoid and aspects to prioritize for achieving a sustainable infrastructure.

3.2 Data Source

Data exploration for this study was obtained using electronic databases. The archives were considered primary databases for relevant studies retrieval(Zakari et al., 2020a).

3.3 Inclusion Criteria (IC) and Exclusion Criteria (EC)

Inclusion and exclusion criteria were set for this study to further sieve results obtained through the search process. To search for relevant studies, a period of seven years was set (from 2015 to 2022), ensuring that only relevant and up-to-date articles published within the last decade are considered in the study.

The inclusion criteria are:

- IC1: This study cover papers published from 2015 to 2022
- IC2: Papers that used Project Failure
- IC3: Papers that used Road Construction

The exclusion criteria are:

- EC1: Papers that are not in English
- EC2: Papers published before 2015

IV. DISCUSSION

Project experts from all around the world have been discussing road infrastructural failure a lot lately, and this subject has been the subject of several studies. According to (Habibi et al., 2018) there are several reasons why projects fail. Hence, the elements that influence project execution and ultimately result in failure vary by industry, region, etc. (Belassi and Tukel, 1996). However, prior research demonstrates that certain reasons for road project failure are consistent. Below subsection presents detail about the related causes of road infrastructural failure.

Inflation Rate

Changes in the cost of services are the top cause of project failure in road construction. It denotes a rise in the cost of money(Shah and Management, 2016). It is brought about by fluctuations in the cost of labor, supplies, equipment, and other construction-related activities. Inflation is mostly to blame for this price increase(Fazio et al., 2015), which is one of the primary causes of cost overruns in road construction. This uncontrolled expense mostly applies to changes in labor costs and material costs. Although there may be no solution to this issue, careful preparation during the procurement process might somewhat curb price inflation and high changes in cost of production.

Delay in payment

Payment delays and finance for finished works are ranked among the numerous causes of road infrastructural failure(Venkateswaran and Murugasan, 2017). Nearly 95% of road projects are supported by government agencies(Harding, 2015), although money is often not disbursed on schedule owing to different government policies and reasons. The effectiveness and advancement of the road project work will be impacted by this. This had an impact on project delivery since the contractor was sometimes unable to pay personnel or get

the materials required for project completion. Several writers have identified this variable as one of the reasons based on a study of the literature. Late payment of project payments was identified as a problem by (Damoah et al., 2018), and (Thandi, 2020)

Design changes during construction

The design modifications made during construction contribute to road infrastructural failure (Amoatey et al., 2015). Some of the reasons for design revisions include insufficient planning, inadequate site study, incorrect data interpretation, misunderstanding of future demands, and clients demand for additional features during construction stages could cause changes and deviation from design. (Aziz and Abdel-Hakam, 2016). It will cost more to fix the mistakes if the design stage is not carefully inspected and appropriately supervised.

Soil Conditions

Another cause of road infrastructural failure is the soil and underlying properties of the project site. Varied soil conditions, inadequate tests and examinations are great factors contributing to unsustainable road construction projects(Shere, Worku, & Keno, 2018). This factor also causes a rise in material amount as a result of site actual conditions(Shah and Management, 2016). Unexpected ground and terrain conditions are the cause of it. The real quantity fluctuates because the ground conditions and soil layers were improperly assessed during the preliminary survey. Unexpected subsurface conditions will also have an impact on required materials.

Lack of resources

This aspect contributes to failure since sometimes contractors bid for projects without having required resources. Ranging from a lack of funding (financial resources), the necessary equipment and tools, or skilled labor (human resources) as demonstrated by (Damoah and Akwei, 2017). This cause has also been mentioned by other authors.

Inadequate skills and experience

Inadequate skills were mentioned as an important determinant of road project failure. This implies that the factor is an important one, understanding that pressure has been mounted on government and project sponsors to engage small and medium sized contractors in a bid to support their growth(Otim & Alinaitwe, 2014). However, some of these small and medium size enterprises lack adequate and competent skilled labor which could most times result to technical mistake being made by any of the project members resulting in safety issues else, losses in time, cost, or material for the project(Amadi et al., 2017) and probably, the project manager exhibited poor project management skills which could have been avoided if an experienced and competent supervisor was selected for the project (Brière et al., 2015). Another implication might be that incompetent or untrained team members were used for these projects to help cut costs sinceprofessionalsareexpensivetobeemployedbuttheyhelpinthesmoothdelivery of these projects.

Unfavorable environmental conditions.

Because of the nature of the road projects, any environmental variables can affect the progress of a road project (Teo et al., 2019). These environmental risks and change in climatic conditions may take the shape of land settlements, precipitation or unforeseeable circumstances like the land's characteristics (Abankwah, 2020).

Political interference.

Political reasons stem from personal gains and party gains, among others. Most government projects are discontinued because political parties that are in power fear that, if they continue with previous government projects, they may not get the accolade as the project was not initiated by them. Apart from that, individual politicians also think that they need to gain. They, therefore, award projects to contractors who are often their party faithful or friends and families or their partners and associates. This eventually leads to corruption, hence, project failure of certain benefits once they are in power and therefore do not care about the well-being of the public, but about their personal gains.

Poor planning and coordination

The incapacity of many consultants, clients and contractors to put in place a strategy for project execution demonstrates faulty project planning(Bagaya and Song, 2016)(Otim & Alinaitwe, 2014). Planning entails making decisions and selecting alternate courses of action to complete a project. Many writers, including (Damoah et al., 2018), (Adebisi et al., 2018), and (Thandi, 2020), have identified this component as a prevalent cause.

Corruption and Nepotism

Nepotism is associated with the granting and awarding of tenders. Contractors thought that the tendering process was unfair since contract projects were repeatedly granted to the same organizations. This prevents other contractors from expanding. (Damoah et al., 2018),and (Igwe and Ude, 2018)identified corruption as one of the root causes for project failure.

Procurement delays

This was largely attributed to the client and suppliers as the procurement procedures tends to be too cumbersome and causes delay to road project implementation. (Thandi, 2020)sited procurement delays as among the causes of project failure. When suppliers don't deliver to time and in expected qualities or quantities, making materials and other logistics ready according to schedule.

Poor work ethics

(Rivera et al., 2020) Lamented that some contractors cause road project failure for having poor work ethics and organizational culture. This is indicated by contractors using mobilization funds for other reasons other than project implementation. And other unprofessional practices being exhibited such as delayed start date for projects after mobilization (Otim & Alinaitwe, 2014)

Poor project management

Poor project management has been identified as a problem by many authors, including (Damoah et al., 2018), and (Ahady et al., 2017). It was also revealed that some construction works even commenced before appointing a project consultant(Otim & Alinaitwe, 2014). This is associated with lack of contract or project management, no commitment to completing road projects, poor team selection, and uncoordinated project activities. Contractors misusing mobilization resources provide proof of this.

Budget overruns

This element is strongly connected to the lack of proper costing, financial control and poor contractor cash flow. This issue arises from underestimating costs or undercharging for the necessary work, especially in bidding for contracts and tenders. Contractors are urged to provide accurate estimates for all required work. According to (Okoro et al.) and (Asiedu et al., 2020), this element contributes to road project failure.

Poor risk and safety management

Risks are ambiguous occurrences that, when they do, have a negative impact on the project's objectives, schedule, budget, and quality (Khodeir and Mohamed, 2015). It is indeed typical practice for contractors to overlook possible safety and risk management concerns when doing their duties and negligence make road project a failure.

Poor communication

A lack of clear directives between the users, consultants, government department and the contractor can result in giving the user the service he/she does not need(Byaruhanga and Basheka, 2017). Communication entails obtaining input from the users of the project. (Lebeza, 2021)and (Antony and Gupta, 2018)hinted at this factor as a cause of road project failure in their research. There must be clear understanding of what the end users require and features that would be beneficial to the commuters or communities to form the basis of the feasibility study, planning and design of road infrastructural network (Okoro, 2019). Poor communication may also lead to disagreements, conflicts among project alliances, litigation, and further fragmentation of the construction fraternity.

Community and Residents actions

There has been records of community members, and residents around locations of specific road infrastructures having negative actions and influence on ongoing or completed road projects. These actions reduce the lifespan and sustainability of the road infrastructure. Some of these actions are but not limited to theft of materials such as laterites, crushed stones or gravel and erecting unplanned speed arrestors on the roads without the knowledge, permission, or approval of relevant authorities of the government and the contractor(Akanmu, Alabi, & Agboola, 2014).

Poor Maintenance Culture

Roads are expected to serve a specified duration in accordance with the design. The lifespan of any infrastructure would be reduced if periodic maintenance is not practiced on the said asset. Also, good maintenance culture reduces pollution, accident occurrence, increases travel time, maintains safety of environment, residence and people plying these roads through periodic repairs, and resurfacing(Puodziukas, Svarpliene, & Braga, 2016).

V. CONCLUSION AND RECOMMENDATIONS

Road project failure occurs when a road project is unable to achieve its purpose. The various agencies and parties involved in road construction carry out their tasks to ensure that roads constructed are within budget, on schedule, and according to the required specifications. Nevertheless, due to failure factors this plan, and expectations do not become a reality which has been a reason why the construction industry has been considered as one that doesn't satisfy its clients (in this case, the public) or deliver as expected. This study revealed that even though numerous determinants account for the occurrence of the failure factors in the extant literature, road project failure is majorly caused by Changes in the cost of services, delay in payment, design changes during construction, increase in quantities due to actual site conditions, lack of resources, inadequate skills, unfavorable environmental conditions, political interference, poor planning, corruption, procurement delays, poor work ethics, poor project management, budget overruns, poor risk and safety management, and poor communication between road

construction stakeholders are factors responsible for failure in road construction project without forgetting the actions of host community residents and importance of constant periodic maintenance schedule. Though, previous researchers have focused on one or a combination of these listed factors, this review has combined all these factors in a single study, enabling construction actors to have adequate information and framework to work with.

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