The Open Transportation Journal

Content list available at: https://opentransportationjournal.com

RESEARCH ARTICLE

Analysis of Risk Factors associated with Railway Projects in Tanzania

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Abstract:

Aims:

The study aimed to analyze the key risk factors associated with railway projects in Tanzania.

Background:

The occurrence of risks in large construction projects implemented in Tanzania has become a topic of debate in this era. Implemented and ongoing railway projects face many challenges, including changes in the project scope, schedule delays, and cost overruns.

Objective:

The objectives of this study were to (i) examine the risk factors associated with construction projects, (ii) determine and rank the key risk factors of railway projects in Tanzania depending on their probability of occurrence and degree of impact, and (iii) recommend appropriate measures to reduce the occurrence of these risks and their impacts.

Methods:

This study involves a questionnaire survey of 24 risk factors that were identified from the literature. Statistical analysis of data was conducted, and risk factors were ranked based on their mean scores.

Results:

The results showed that the top ten risk factors in preference of occurrence are: delayed payments; cost overrun; political pressure; design changes; inadequate project planning; price fluctuation; bureaucracy; changes in the scope of work; quality and performance control; and delay in land acquisition. The results also indicated that delayed payment; cost overrun; political pressure; financial bankruptcy; delay in land acquisition; poor performance of contractors and consultants; inadequate project planning; quality and performance control; inappropriate contract awards; and price fluctuation are the top ten significant risks in terms of impact on project performance.

Conclusion:

The findings presented in this study can provide significant insights regarding adequate pre-project planning, effective risk management, and other measures that can be taken to reduce the risk impact.

Keywords: Risks factors, Railway projects, Construction projects, Risk management, Purposive sampling, Reliability test.

Article History	Received: April 30, 2023	Revised: June 06, 2023	Accepted: July 13, 2023

1. INTRODUCTION

The construction industry plays a vital role in national economic development. The public sector's construction industry directly affects the global economy; it is a strategic field that makes a tangible contribution to the economic growth of developing countries. Nationwide, the construction sector is considered one of the most dynamic and promising sectors of the national economy, as it provides the necessary infrastructure, strengthens other sectors, and reduces unemployment [1]. However, the performance of this important industry is highly influenced by various factors that, if not considered in the earlier stages of every project, can result in unsuccessful implementation. Achieving project goals and objectives depends on various factors, one of which is

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effective risk management practices.

The occurrence of risks in large projects implemented in Tanzania has become a topic of debate in this era. This is because implementing megaprojects faces many challenges regarding resources, funding, environment, and management [2]. Despite experiencing these persistent problems, the Tanzanian construction industry has not implemented risk assessment and management practices (RAMP) at a satisfactory level that can indicate the willingness of the industry to overcome these challenges. A study [3] claims that the major problems behind unsuccessful RAMP implementation in Tanzania include awareness of risk management processes, lack of experience, and lack of information.

Expected benefits from infrastructure developed in Tanzania and many other developing countries have been obstructed by mismanagement of construction projects, resulting in a lack of value for money. Rwezaura [4] points out that to obtain value for money invested in construction projects, much consideration must be put into ensuring that experienced experts consider and perform all risk management phases. The reason why effective management of all phases of a project is highly encouraged is that the performance of every stage has an impact on the general performance of a project. Conversely, experience shows that project implementing agencies put much effort into the execution phase, which results in a high chance of many risks as there was no effective risk assessment at the initial stages. According to Schieg [5], successful risk management involves all areas, processes, and parties of the project; each individual must be committed and have risk awareness. Buzzetto *et al.*, [6] advocate that procurement is the most challenging stage of the project lifecycle, which requires great attention to ensure that the project succeeds from the preliminary stage to the end. It is also highlighted in the study [7] that the most significant risk factors in railway projects originated from design works; therefore, an emphasis should be put on using experienced professionals in design works and conducting an effective geotechnical investigation.

Unfortunately, despite the Tanzanian government's efforts in project risk management ineffective risk management has been a persisting challenge in many projects that are implemented, which is why some projects experience schedule delays [8]. Furthermore, projects fail to complete at a reasonable cost owing to changes or insufficient budgets, disputes that arise, and ambiguities among the parties, which are common occurrences in African projects, including those in Tanzania [9]. It should be noted that any risks, such as disputes, payment delays, and poor contractual management, are attractive for project delays. Moreover, the top causes of delays in construction projects are price fluctuations or inflation, government bureaucracy, and inadequate payments by the fundraiser or government [10].

In recent years, investigations and audit reports from the Controller and Auditor General (CAG) and Public Procurement and Regulatory Authority (PPRA) have shown that several projects conducted by Tanzanian government agencies, such as water supply and road construction, have not been performed satisfactorily [11]. Project achievements are limited by inadequate funding, planning, and pricing of the project; incapability of the contractor; fire; failure to select contractors and suppliers; inappropriate contract awards; insufficient delivery methods; and poor survey of the site [12]. In their study [13], Kullaya *et al.* state that in the past ten years, overspending has been one of the challenging problems in Tanzanian road construction projects.

The aforementioned studies addressed the importance of risk management in the construction industry and the impact of implementing RAMP. However, in the context of the Tanzanian construction industry, most studies have focused only on building and road projects. Owing to the increased government investment in other transport projects, particularly railways, there is a need to determine the risk factors associated with these projects and provide appropriate recommendations. Therefore, this study analyzes the key risks in railway projects in Tanzania. Therefore, this study was conducted to analyze risks associated with railway construction projects in Tanzania by answering the following three questions: (i) What are the risk factors associated with railway construction projects in Tanzania? (ii) How can the key risk factors of railway projects in Tanzania be determined and ranked based on their possibility of occurrence and degree of impact? (ii) How do various stakeholders perceive and prioritize the identified risks in railway construction projects in Tanzania?

2. LITERATURE REVIEW

Various Scholars have conducted studies on construction project risks and classified risks into different ways. For example, Gashaw and Jilcha [14] grouped risks into design, construction, management, resource, contractual and legal, and external risks. Boateng *et al.* [15] classified risks into social, technical, economic, environmental, and political risks. According to Damoah and Kumi [16], construction project risks can be categorized into leadership, management and administration practices, resources, and external forces. A study [17] conducted in Italy divided risks into internal and external risks. Kassem *et al.* [18] identified 13 main risk categories in construction projects in the oil and gas sector in Yemen. These categories are 1. Client-related 2. Contractor-related 3. Consultant-related 4. Feasibility study and design-related 5.Tendering and contract-related 6. Resource and material supply-related 7. Project management-related 8. Country economic-related 9. Political risk-related 10. Local people-related 11. Safety and environment-related 12. Security risk-related 13. Force majeure-related. Another study [19] identified seven groups of risks in freeway PPP projects: financial, legal, technical, environmental, social, force majeure, and organization and coordination.

The failure of construction projects can occur for various reasons, encompassing both internal and external factors. These failures can lead to cost overruns, schedule delays, compromised quality, and even complete project abandonment. To understand the key factors for construction project failure, a comprehensive review of the relevant literature was conducted. Shahhossein *et al.* [20] propose a methodology for identifying the root causes of construction project failure using Fault Tree

Analysis (FTA) and Linguistic Weighted Average (LWA) with the help of fuzzy theory. The study identifies financial concerns and shortcomings of the bidding process as the major causes of project failure. The study [14] was conducted on risk prioritization using a fuzzy analytic network process for the Addis-Djibouti railway construction project. Its results show that the right-of-way is the top risk with the highest impact on time and cost, followed by construction errors and incomplete contract details.

It is argued in [16] that political interference, delays in payment, partisan politics, bureaucracy, corruption, poor supervision, lack of commitment by project leaders, poor planning, starting more projects than the government can fund, and change in government are the top ten factors that contribute to government construction projects failure in Ghana. Another study conducted in Ghana [21] found that, of the 25 risk factors studied, five factors with a high probability of occurrence in construction projects include price fluctuations, delays in payment, inflation, quality and performance control, and poor financial markets. The critical factors containing failure and abandonment of public sector construction projects in Nigeria include effective monitoring, understanding of project mission, technical know-how of the project manager, support from top management, political risks, effective procurement process, provision of adequate finance by the client, and effective communication and information management by the design team [22].

Process quality during construction projects in Pakistan is influenced by the selection of an appropriate contractor, supervision by owner representatives, management leadership, teamwork, and quality of drawings and specifications received from designers [23]. It is also argued by Nawaz *et al.* [24] that the factors preventing project success include scope changes, project budget overruns, schedule delays, unfulfilled quality standards, technical specifications not followed, and complaints and claims. Kassem *et al.* [18] adopted a case study methodology to investigate the risk factors in construction projects in oil and gas processing facilities in Yemen. The authors collected data through interviews, document analysis, and site visits. Their study found that internal risks are the greatest influential factors in construction projects in the oil and gas sector, followed by changes during construction projects, government instability, incorrect project cost estimation, government delay in decision-making, incorrect project schedule estimation, and political situation and war in the country. A study [25] employed a comprehensive review of the literature and expert opinions to identify and analyze critical risk factors specific to international construction projects in India. Its findings highlight several major risk factors, including inadequate project planning, poor project feasibility assessment, insufficient experience in international projects, cultural differences, political and regulatory uncertainties, and lack of effective communication and coordination among stakeholders.

According to a study [26], project costs, time, and quality are the key indicators determining the success of a project, which means that when delays occur during the implementation phase, the achievement of project goals and objectives is limited. The risk of delay affects clients, consultants, contractors, mistrust, cash flow, and litigation. Project risks increase delays as they tend to change the implementation schedule, a factor that limits project milestones. A competent project management team ensures that all risks are identified, assessed, evaluated, shared, or measured to avoid their impact on quality, cost, and time [27]. For developing countries like Tanzania, managing all project risks is complex. A study [28] explains that developing countries are challenged with risks in the implemented construction megaprojects owing to limited funds for implementation, poor technologies, adequacy of equipment, limited experience, increasing unnecessary costs, and changing weather conditions. This study [29] revealed that the inflation rate is neglected by most developing countries when implementing various construction projects; however, it is highly beneficial. Project budgeting and all economic matters diverge from including inflation rate impacts, a factor leading to project cost overruns, particularly in labor payments, machinery hire, and material building prices. It is recommended that budgeting employs inflation rate principles to eradicate project cost overrun challenges. Recent studies conducted in Tanzania [13, 30, 31] have identified schedule delays, variation orders, and cost overruns as serious problems affecting road project performance. The studies highlighted financial problems, selection of incompetent contractors, poor site management during project execution, weather conditions, differing site conditions, changes in design, poor scheduling, unavailability of equipment, lack of communication, and unrealistic work programs as significant factors.

After reviewing the literature, 24 risk variables categorized into 7 groups (Table **1**) were found to be relevant to the Tanzanian construction industry and were therefore selected for use in this study.

Table 1. Categorized risk variables selected for this study.

Risk Categories	Selected Risk Variables
Financial and economic risks	Financial bankruptcy
	Delayed payments
	Cost overrun
	Inflation
	Price fluctuation
Resource risks	Productivity of labour and plants
	Defective materials and materials shortage

(Table 1) contd.....

Risk Categories	Selected Risk Variables
Technical risks	Design changes
	Changes in the scope of work
	Inadequate project planning
	Inappropriate contract awards
	Poor communication among the project team
Environmental risks	Bad weather conditions
	Grounds conditions and contaminants
Managerial risks	Poor performance of contractors and consultants
	Quality and performance control
	Lack of commitment
	Delay in land acquisition
	Accidents and injuries
	Theft on site
Government and Political risks	Political pressure/interference
	Bureaucracy
Legal risks	Ambiguities in contract formation
	Claims and disputes

3. MATERIALS AND METHODS

3.1. Sample and Data

The study uses both primary and secondary data to obtain useful information related to key risks in large construction projects in Tanzania. A literature review was conducted to identify the key risk factors identified in other studies in developing countries. A total of 24 variables were selected for use in this study based on their relevance to the Tanzanian construction environment. The variables were categorized into 7 groups. The questionnaire survey was designed to collect data from construction practitioners working with contractors, consultants, and clients. The study adopted a purposive sampling technique to obtain data from the targeted respondents who could offer useful information about the study and unique information difficult to obtain from unrelated individuals. These respondents were professionals working on railway projects, including architects, quantity surveyors, engineers, project managers, and deputy project managers, as they experienced various risks associated with key risks in railway projects. Delice [32] argued that purposive sampling techniques involved spotting and choosing qualified participants who were familiar with the subject. It is mostly adopted for matters that require a detailed analysis of the data for the most efficient use of limited resources. Online questionnaires were distributed to 100 respondents *via* email and social media, and 77 responses (77%) were received and used for analysis. The survey was conducted from 4th February to 20th March 2023.

3.2. Measures of Variables

In this study, a four-point Likert scale method was used to collect observations from the respondents. The questionnaire consisted of two sections. Section 1 collected demographic information of the respondents, such as educational level, work experience, type of organization with which they work, and their positions at work. Section II was the main body with all 24 risk factors. The respondents were required to rate the probability of occurrence of each risk factor in railway projects on a four-point Likert scale (4 = very high, 3 = high, 2 = low, and 1 = very low). They were also asked to rate the impact of each risk factor on project performance on the same scale. Means and standard deviations were used in ranking variables. The pilot survey was done to verify the reliability and validity of the questionnaire. Reliability was measured with the justification from Hair *et al.* as cited in a study [33], that good reliability results should have a Cronbach's alpha value of >0.7. The calculated values for survey questions regarding "probability of occurrence" and "impact on railway projects performance" were 0.994 and 0.995 respectively; therefore, the measurements that were applied for analysis had acceptable reliability.

3.3. Data Analysis Procedure

This study employed a quantitative analysis of the data collected from the respondents. Apuke, in his study [34], argued that quantitative data are obtained with limited bias from the respondents. The measurement scales were arranged so that the respondents agreed or disagreed with the statements. These data are useful when the study focuses on measuring the understanding of a population regarding a certain phenomenon. Data were analyzed using the Statistical Package for Social Science Research (SPSS version 26.0). Means and standard deviations were adopted to present the data, and the risk factors were ranked in accordance with their mean values, where the means with the highest values were ranked first, while those with the lowest values were ranked last. A rank-based nonparametric test, the Kruskal-Wallis test, which was also used by Oko *et al*. [35] in a study of the same nature, was conducted to check whether contractors, consultants, and clients had different perceptions of the rating of both the likelihood of occurrence and the impact on project performance of the 24 risk factors.

Table 2. Background information of respondents.

Number of Respondents (N) = 77				
Characteristics	**Category**	**N**	**%**	**Cum %**
Education level	Bachelor's degree	60	77.9	77.9
	Master's degree	17	22.1	100.0
Position at job	Quantity surveyor	2	2.6	2.6
	Engineer	52	67.5	70.1
	Deputy Project Manager	1	1.3	71.4
	Project Manager	8	10.4	81.8
	Others	14	18.2	100.0
Experience	Less than 5 years	25	32.5	32.5
	5 - 9 years	34	44.2	76.6
	10 - 20 years	11	14.3	90.9
	Over 20 years	7	9.1	100.0
Type of organization	Contractors	16	20.8	20.8
	Consultants	15	19.5	40.3
	Clients	46	59.7	100.0

Table 3. Mean score assessment of risk factors based on probability of occurrence.

Risk Factors	Mean	Std. Deviation	Rank	Kruskal-Wallis Test (*p*-values)
Delayed payments	3.17	.768	1	.096
Cost overrun	3.13	.784	2	.172
Political pressure/interference	3.05	.958	3	.035
Design changes	2.86	1.009	4	.006
Inadequate project planning	2.86	.790	5	.386
Price fluctuation	2.86	.854	6	.108
Bureaucracy	2.77	.887	7	.198
Changes in the scope of work	2.74	.909	8	.010
Quality and performance control	2.71	.792	9	.240
Delay in land acquisition	2.71	.856	10	.569
Claims and disputes	2.70	.796	11	.084
Theft on site	2.68	.938	12	.190
Poor communication among the project team	2.66	.883	13	.114
Inflation	2.65	.943	14	.229
Lack of commitment	2.56	.966	15	.009
Productivity of labour and plants	2.55	.836	16	.082
Financial bankruptcy	2.53	.940	17	.159
Poor performance of contractors and consultants	2.51	.754	18	.108
Inappropriate contract awards	2.48	.940	19	.018
Defective materials and materials shortage	2.47	.821	20	.896
Bad weather conditions	2.47	.804	21	.112
Ambiguities in contract formation	2.47	.867	22	.513
Accidents and injuries	2.25	.845	23	.946
Ground conditions and contaminants	2.19	.744	24	.282

4. RESULTS AND DISCUSSION

4.1. Background Information of Respondents

In this subsection, the characteristics of the 77 respondents who participated in this study are analyzed and summarized in Table **2**. The analysis showed that 59.7% of the respondents were clients, 20.8% were contractors, and 19.5% were consultants. It was found that 77.9% of the respondents had a bachelor's degree, whereas 21.1% held a master's degree. Most respondents were engineers (67.5%), followed by project managers (10.4%); only 2.6% and 1.3% of the responses were collected from quantity surveyors and deputy project managers, respectively. The sample was dominated by respondents with work experience ranging from five to nine years (44.2%); 32.5% had work experience of less than five years, 14.3% had 10–20 years of work experience, and 9.1% had over 20 years of work experience.

4.2. Probability of Occurrence of Risk Factors in Railway Projects

Table **3** presents the responses of the participants when asked to rank the probability of occurrence of each risk factor in railway projects, and these responses are discussed below.

Delayed payment (mean score: 3.17) was ranked first among all the risk factors, followed by cost overruns (mean score: 3.13) ranked as the second, and political pressure/interference (mean score: 3.05) was ranked third. Design changes (mean score: 2.86) were ranked fourth, and the fifth-ranked factor was inadequate project planning (mean score: 2.86). Other risk factors are price fluctuation, bureaucracy, changes in scope of work, quality and performance control, and delays in land acquisition. These findings are similar to the findings of other previous studies conducted in different countries. In [16], political interference, delays in payment, partisan politics, bureaucracy, and corruption were ranked as the five most occurring risks in construction projects in Ghana. The study of Rostami and Oduoza [17] found that the key risks in the construction industry in Italy include delays in payments, client variations, design variations, inaccurate cost estimates, and tight project schedules.

As shown in Table **3**, the results of the Kruskal-Wallis test show that there was no agreement among the three groups (*i.e.* contractors, consultants, and clients) regarding the order of rankings of the five variables, namely, political pressure ($p = 0.035 < 0.05$), design changes ($p = 0.006 < 0.05$), changes in scope of work ($p = 0.010 < 0.05$), lack of commitment ($p = 0.09 < 0.05$), and inappropriate contract award ($p = 0.018 < 0.05$). Considering the fact that respondents' perceptions differ in only five variables, the null hypothesis, "there is no significant difference in the perceptions of contractors, consultants, and clients regarding the probability of occurrence of risks on railway projects," cannot be conclusively rejected.

Table **4** presents the overall mean scores of the risk categories and ranked according to their mean values. Overall, the most dominant risk categories are government and political, financial and economic, and technical risk categories. Contractors and clients had the same view of these three risk categories as they ranked them in the same order, while consultants' ranking order was financial and economic risks, legal risks, and government and political risks.

4.3. Impact of Risk Factors on Railway Project Performance

In this section, the researchers aim to understand the perceptions of railway project stakeholders regarding the level of impact of each risk factor on project performance.

Table **5** summarizes the ranking, in which the first ten factors in the list according to the degree of impact on project performance are: delayed payments (mean: 3.40), cost overruns (mean: 3.35), political pressure/interference (mean: 3.23), Financial bankruptcy (mean: 3.14), delay in land acquisition (mean: 3.03), poor performance of contractors and consultants (mean: 3.01), inadequate project planning (mean: 3.00), quality and performance control (mean: 2.99), inappropriate contract awards (mean score: 2.96), and price fluctuation (mean: 2.96). The results of the analysis suggest that some factors have a high probability of occurrence during project execution, but their impacts are not very high, and vice versa. For instance, the poor performance of contractors and consultants was ranked 18th (mean score = 2.51) on the probability of occurrence; however, regarding its impacts on project performance, it was ranked sixth (mean score = 3.01). In addition, respondents ranked financial bankruptcy (mean = 2.53) 17th in regard to likelihood of occurrence, whereas in terms of impact on project performance, they ranked it fourth (mean = 3.14).

Table 4. Ranking of risk categories based on probability of occurrence.

Risk Categories	Overall		Contractors		Consultants		Clients	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
Government and political	2.91	1	3.28	1	2.57	3	2.90	1
Financial and economic	2.87	2	3.16	2	2.65	1	2.83	2
Technical	2.72	3	3.14	3	2.36	4	2.69	3
Legal	2.58	4	2.84	4	2.60	2	2.49	6
Managerial	2.57	5	2.81	5	2.33	5	2.56	4
Resource	2.51	6	2.72	6	2.30	6	2.50	5
Environmental	2.33	7	2.56	7	2.07	7	2.34	7

Table 5. Mean score assessment of risk factors based on impact on railway projects performance.

Risk Factors	Mean	Std. Deviation	Rank	Kruskal-Wallis Test (*p*-values)
Delayed payments	3.40	.748	1	.075
Cost overrun	3.35	.684	2	.133
Political pressure/interference	3.23	.902	3	.024
Financial bankruptcy	3.14	.838	4	.086
Delay in land acquisition	3.03	.858	5	.467

(Table 5) contd.....

Risk Factors	Mean	Std. Deviation	Rank	Kruskal-Wallis Test (*p*-values)
Poor performance of contractors and consultants	3.01	.866	6	.550
Inadequate project planning	3.00	.778	7	.774
Quality and performance control	2.99	.881	8	.537
Inappropriate contract awards	2.96	.880	9	.828
Price fluctuation	2.96	.865	10	.080
Bureaucracy	2.96	.880	11	.269
Defective materials and materials shortage	2.94	.817	12	.389
Inflation	2.91	.814	13	.429
Productivity of labour and plants	2.91	.798	14	.428
Lack of commitment	2.88	.888	15	.458
Changes in scope of work	2.88	.843	16	.283
Design changes	2.88	.888	17	.082
Claims and disputes	2.88	.827	18	.123
Theft on site	2.87	.894	19	.270
Poor communication amongst project team	2.86	.914	20	.378
Ambiguities in contract formation	2.84	.812	21	.536
Bad weather conditions	2.64	.793	22	.046
Accidents and injuries	2.55	.836	23	.235
Grounds conditions and contaminants	2.52	.788	24	.101

Table 6. Ranking of risk categories based on impact on railway projects performance.

Risk Categories	Overall		Contractors		Consultants		Clients	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
Financial and economic	3.15	1	3.41	2	3.35	1	3.00	1
Government and political	3.10	2	3.47	1	3.23	2	2.92	2
Resource	2.92	3	3.03	4	3.10	4	2.83	4
Technical	2.92	4	3.10	3	2.91	6	2.86	3
Managerial	2.89	5	2.96	5	3.09	5	2.80	5
Legal	2.86	6	2.78	7	3.17	3	2.80	6
Environmental	2.58	7	2.94	6	2.70	7	2.41	7

These findings suggest that most risks that occur during the implementation of construction projects tend to have a high impact on their performance. A better way to alleviate the degree of impact on a project is if the management team is aware of how to manage the impacts associated with each risk. Failure to have a proper plan on reducing the impact of common risks will have a highly negative impact on implementation. It is argued in [36] that, for any project risk to be treated well, it should already be predicted by project managers for a probability of occurrence; when it comes to the occurrence, its impacts are measurable. The study [37] concluded that the only way to overcome the impacts of common risks in construction projects is to determine the impacts before the risks occur. This implies that all project management groups, particularly contractors and consultants, are required to have good experience with the nature of the projects. A procuring entity must ensure that the most experienced contractors and consultants are shortlisted to procure the well-experienced contractors and consultants.

The Kruskal-Wallis test was conducted to test the hypothesis " there is no significant difference in the perceptions of contractors, consultants, and clients regarding the impact of risks on the performance of railway projects". As summarized in Table **5**, the test results show that there were agreements regarding the order of rankings of variables, except in only one variable; political pressure ($p = 0.024 < 0.05$). Considering that contractors, consultants, and clients failed to agree on only one variable "political pressure" the null hypothesis can not be conclusively rejected.

Table **6** shows the mean scores of risk categories and ranked based on their impact on project performance. Overall results show that "financial and economic risks" and "government and political risks" are the most significant risks impacting railway projects in Tanzania. All three groups agreed on ranking these risk categories.

CONCLUSION AND RECOMMENDATION

Transport infrastructure, the railway in particular, has a significant impact on the development of Tanznaia's economy due to the geographical nature of the country as it is surrounded by many landlocked countries which use the main ports of Tanzania for import-export activities. Railway projects are among the mega projects implemented by the Tanzanian government as a strategy for improving the transport infrastructure network. Therefore, determining the risk factors associated with these projects is important as it helps projects

implementing entities to prepare a risk management plan in accordance with the likelihood of occurrence of specific risks and their level of impact on project performance. The existing literature shows that numerous studies have been conducted to determine factors causing construction project failure. However, a few studies have focused on the construction risk factors of railway projects. Further, the literature review conducted in this research found no study focused on the risks of railway projects in Tanzania. Researchers in this study collected data through a questionnaire survey of 77 respondents, and as a result of statistical analysis, they ranked risks associated with railway projects in Tanzania. The results indicate that the prevailing risk categories are government and political, financial, economic, and technical risks.

Regarding the probability of occurrence, the results showed that the top ten risk factors are: delayed payments; cost overrun; political pressure; design changes; inadequate project planning; price fluctuation; bureaucracy; changes in the scope of work; quality and performance control; and delay in land acquisition. In addition, our results show that the three groups have different views on ranking five risk factors, namely: political pressure, design changes, changes in the scope of work, lack of commitment, and inappropriate contract award.

The results of risk impacts on project performance indicate that the top ten critical risk factors are delayed payment; cost overrun; political pressure; financial bankruptcy; delay in land acquisition; poor performance of contractors and consultants; inadequate project planning; quality and performance control; inappropriate contract awards; and price fluctuation. The results also indicate that there is no significant difference between the points of view of the groups (*i.e.* contractors, consultants, and clients), with the exception of one risk factor. The Kruskal-Wallis test found a significant differences between the groups for the "political pressure" which is a risk factor under the government and political risks category.

The findings presented in this study can provide significant insights regarding adequate pre-project planning, effective risk management, and other measures that can be taken to reduce the risk impact. Although this study focused on risk factors associated with railway projects in Tanzania, its findings may be useful to other infrastructure projects to be implemented in developing countries. These results will also be useful for local and foreign companies which plan to invest in infrastructure projects in developing countries.

For successful implementation of railway projects, the following recommendations are proposed:

(i) Considering that financial and economic risk factors of delayed payment and cost overruns are the key factors, it is important to improve project management practices. Risk assessment must be carefully conducted from the preliminary stages. It is highlighted in [38] that RAM (Reliability, Availability, and Maintainability) demonstration is essential during the planning, design, and implementation stages of railway projects to assess the system's reliability, availability, and maintainability characteristics.

(ii) Government should improve coordination and communication between government agencies involved in construction projects. Regular interdepartmental meetings, shared databases, and collaborative decision-making can help minimize bureaucratic delays and ensure a smoother process. Rewards can also be an effective tool when used as part of a broader anti-corruption strategy. Mario and Igor [39] argue that a balance between intrinsic and extrinsic rewards is necessary to improve job satisfaction and reduce corruption in the public sector.

(iii) Political interference is very common in most developing countries. Politician influence may affect project estimates and scope, resulting in cost overruns and delays. Government should establish robust mechanisms and processes that prioritize transparency, accountability, and professional expertise. Transparent procurement processes, independent regulatory bodies, and strengthened legal frameworks are among the important areas that the government should observe.

(iv) Strengthening institutional capacity to ensure decisions making in different aspects of railway projects are based on professional expertise. This can be achieved by investing in building the capacity of government institutions responsible for managing construction projects through training on project management, procurement procedures, and ethics. Workshops also can be an effective way of building capacity within organizations and government institutions; they provide opportunities for training, learning, and skill development in a focused and interactive environment. Authors in the study [40] propose using a risk management workshop as an approach to identify, evaluate, and manage risks in railway construction projects in Iran.

(v) Government partnering with private companies in railway construction projects through different PPP models might help to reduce some risks. According to Lee *et al.* [41], BTO-rs (Build-Transfer-Operate with Risk Sharing) can decrease public and private sectors costs and reduce risks; however, implementing a railway project with BTO-rs requires more meticulous preliminary examinations.

LIST OF ABBREVIATIONS

RAMP	=	Risk assessment and management practices
CAG	=	Controller and auditor general
PPRA	=	Public procurement and regulatory authority
LWA	=	Linguistic weighted average
FTA	=	Fault tree analysis

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

Not applicable.

FUNDING

This study was supported by the Ministry of Education of the Republic of Korea and National Research Foundation of Korea (NRF-2020S1A5C2A01092978).

CONFLICT OF INTEREST

The authors declare no conflict of interest financial or otherwise.

ACKNOWLEDGEMENTS

This study was supported by the Ministry of Education of the Republic of Korea and National Research Foundation of Korea.

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