Appraisal of risk factors affecting performance on road projects

[1]Chipozya Kosta Tembo, [2]Shastry Hamusuku, [3]Franco Muleya

[1]Associate Professor, [2]Quantity Surveyor, [3]Associate Professor
[1,3] Department of Construction Economics,
[1]Copperbelt University, Kitwe, Zambia
[1] chipozya@yahoo.co.uk , [2]shastryhamsk97@gmail.com, [3] Muleyaf@yahoo.co.uk

***Abstract*—Road construction is the economic driver of many economies, especially in developing countries. For this reason, the Zambian government has prioritized road construction for the last twelve years. Road construction is usually complex and experiences more risks than most construction projects. The resultant effects of risks on road projects are cost escalation, time overruns, quality shortfalls, and project abandonment. A positivist approach was used to uncover the risks faced, the impacts, and the severity of the risks. A questionnaire survey was conducted for contractors involved in road construction in the Zambian Construction Industry and consultants in the public and private sectors. A total of 62 questionnaires were sent to the contractors,' private consulting bodies, and public consultants. The sampling for contractors was through snowballing and purposive sampling for consultants engaged in road construction. In total, the received responses were 33, with 23 being from consultants and 10 from contractors. The analysis was done through descriptive statistics and the relative importance index. The results established that risks are prevalent within the Zambian road sector, as more than 85% of the risks on the questionnaire were noted to be above the average R.I.I. in their frequency of occurrence and severity, indicating their prevalence. The top five of the risks are inflation rate fluctuation, exchange rate fluctuation, delayed payment, delayed subcontracted work and delayed approvals. The consequences of the risks showed that the R.I.I. was above the average, thus showing just how dire they are. The top three consequences of experienced risks are cost overruns, project abandonment and time overruns. The prevalence of risks necessitates better risk management by all project participants, especially for managerial risk during the construction phase, which is mainly internal.**

***Index Terms*— Impacts, nature, road, risks factors, risk owner severity, Zambia.** *(key words)*

I. INTRODUCTION

Successful project performance is generally viewed as the ability to finish a project by the outlined project deliverables. Traditionally, the deliverables of interest are the right quality, budget, and timeline. However, the deliverables are usually not met due to risks that may be political, environmental, social, technological, legal, or economic (Smith, Merna & Jobling, 2014). The construction industry is very poor when dealing with risks, which results in many projects failing to meet time schedules, targets, budgets, and sometimes even the scope of work (Hassen, 2017). Adugna (2017) and Kumar, Sheikh, and Asadi (2017), among others, have found that road construction faces more risks than any other type of construction. This is attributed to how road construction projects are spread over a wider geographic area and face threats from underground conditions and how they are exposed to the weather conditions compared to other construction projects. Additionally, long project durations make road projects sensitive to environmental changes and they utilize large amounts of resources (Kumar, Sheikh and Asadi, 2017; Simon, 2017; Alemayehu, 2018).

Road project delays are adverse in developing countries, affecting road infrastructure development within these countries (Sánchez et al., 2020). Amoatey and Okanta (2017), found that 70% of 48 road projects built in Ghana experienced delays, with an average time overrun of 17 months. Another case is Palestine, where Mahamid (2013) examined 101 road projects and determined an average delay of 48%. Because of how prevalent delays are in the construction industry, most researchers have been led to study them (Mahamid, 2013b). Coming to Zambia, Mumba et al (2008) and Auditor General (2021) found that several projects were not completed within the stipulated schedule and budget. It is, therefore, essential to know the risks affecting performance in the road sector. Several research has been conducted on risks affecting roads, and it is clear that the risks do not remain the same over time and are different from project to project, and from country to county yet some are prevalent (Perera, Dhanasinghe and Rameezdeen, 2009; Kaliba, Muya and Mumba, 2009; Chileshe and Babajide, 2014; Mashwama, Mushatu and Aigbavboa, 2018).

Out of a national budget of ZMW 46.7 billion in 2015, the Zambian government set aside ZMW 5.6 billion for road infrastructure development and maintenance. In 2022 the budget allocation to the sector was 54.4 billion, 64.5 billion in 2023 and 76.3 billion in 2024. These present 8.7%, 8.5% and 8.3% of the total national budget respectively. On 31 December 2016, it was found that the construction of 8000 kilometres of road under the road program Link Zambia 8000 under the Zambian government had only managed to have 692.83 kilometres of road opened to traffic instead of 4168.39 kilometres of the 27 projects that were assigned in 2012. In 2024, most of these road projects still need to be completed to an extent or are performing poorly and need to be redone. Therefore, this research highlights the risks faced in proposing meaningful solutions. This research, therefore sought firstly, to establish risk factors prevalent in road construction, secondly, to identify the severe impacts resulting from the road factors, the road sector and lastly, to propose ways in which the risk factors in road construction can be mitigated

The following section reviews the literature on the different types of risk in road projects. Subsequently, the methodology for the study is given. A presentation of the results and analysis of the results follows. A discussion of the findings given the existent literature is then presented. A conclusion is provided and proposals for future research are outlined.

II. RISKS AND ROAD CONSTRUCTION

A risk is an uncertain event or condition that, if it occurs, has a positive or negative effect on project deliverables (PMI, 2017). A risk has a cause and, if it happens, a consequence which, if uncontrolled, would typically result in a negative effect. The risk factors can come from within the project (internal) or outside (external). The internal risks emanate from project stakeholders such as the client, consultants, project managers, contractors and others involved. External risks would result from activities typically not within the control of the project participants, such as social, political, legal, environmental, and other risks. Various researchers have researched risks factors affecting construction (Adugna, 2017; Kumar, Sheikh and Asadi, 2017; Alemayehu, 2018) Perera, Danaine and Rameezdeen, 2009; Muya, Kaliba and Mumba, 2013; Chileshe and Babajide, 2014; Mashwama, Mushatu and Aigbavboa, 2018; Barlish, De Marco and Thaheem, 2013). (Barlish, De Marco and Thaheem, (2013) identified the causal factors resulting in a quality shortfall, cost and time overruns in construction projects. Moreover, risks change due to economic, political and other related conditions (Barlish, 2013; Smith, 2014). This, therefore, motivates the need to investigate risk factors affecting road projects nearly ten years later.

III. RISKS IN ROAD CONSTRUCTION

Several researchers globally have researched risk factors affecting roads. The risks affecting road construction have various risk owners. Furthermore, risk sources for the various risk owners could include political, environmental, social, technical, legal, economic, design, managerial, etc. Specific examples of identified risks in the Zambia Road sector are highlighted.

Internal Risks

Internal risks that a company faces or projects from within its organization arise during the normal operations of the company or project (Beers, 2020). Internal risks may be categorized as client-induced/related risks, design risks, job-site-related risks, sub-contractor-related risks, and operational and managerial risks. These will now be discussed in turn.

Client-induced/related risks and job site risks

Client-related risks occur as a result of the client's action or inactivity. These risks include delays in payments, lack of funding, requirement changes and variations, lack of communication and coordination and difficulties in site acquisition (Barlish, De Marco and Jamaluddin Thaheem, 2013). Client-induced risks can be seen in the Zambian road sector, such as in 2019, when the contractor A.V.I.C. abandoned the C400 road project in the Copperbelt province in Kitwe due to a lack of funding (Phiri, 2019). Aside from the client, the risks can be related to the job site. Jobsite risks involve inconsistent site conditions, poor accessibility to the site, bad road conditions and geological conditions (Barlish, De Marco and Jamaluddin Thaheem, 2013). These are risks that have adverse effects on the project objectives. Road construction projects are vulnerable to variations, as they must contend with varying and intricate site conditions, adverse weather and an extensive geographic terrain (Perera, Dhanasinghe and Rameezdeen, 2009), resulting in a risky project.

Design risks and other consultant-related risks

Barlish, De Marco and Thaheem, 2013 (2013) identify poor and incomplete drawings, inadequate specifications, design scope changes, errors and omissions and documents not issued on time as design-related risks. Mkuni (2016) opined that the Zambian road sector was known to overrun the design schedule. (2013) also found that scope changes were among the factors that led to cost overruns in the Zambian road sector. An example of a project that encountered such risks happened on the Upgrading of Road D769 from Mumbwa / Itezhi-tezhi Junction on M009 to Itezhi-tezhi (109km), including 2.2 km of the Ikonkaile to Itezhi-tezhi boma access Road in Central Province. In this project, it was found that the contractor mobilized the site without designs (Mkuni, 2016). Mkuni (2016) observed that this indicated that time needed to be improved for design review as the contractor was always waiting for designs. Additionally, the contractor fully mobilized the site with all essential equipment, some of which was hired as there was no design yet the equipment was kept idly on the site, making the contractor encounter costs that had to be offset by the client in the final analysis. Other risks with design are under-designing and under-specification, which would result in better-quality products.

Contractors and Subcontractor related risks

Risks associated with subcontractors include delays in subcontracting works, poor projects or plan schedules and low productivity or low quality (Barlish, De Marco and Jamaluddin Thaheem, 2013). The main contractor may also experience these. In road construction projects, this can be seen from the findings given by Mumba, 2008; Kaliba, Muya and Mumba (2009) regarding Zambia, where it was opined that most road projects are poorly planned as they tend to not go according to planned schedule as cost overruns, poor quality and time overruns are prevalent.

Operational and managerial risks

Management or operational risks refer to the destructive, ineffective or underperformance of management, be it financially, ethically, or otherwise, whereas operational risks refer to the uncertainties and hazards that a company faces when it attempts to do its day-to-day business activities within a given field or industry (Chen, 2020; Segal, 2020). Such risks were noticed in the Zambian road sector when the Mongu-Kalabo project in the western province was abandoned due to poor risk management (Mumba, 2008). Additionally, Mkuni (2016) noted that some rehabilitated road projects were the Kawambwa-Mushota-Luwingu road and the Chisembe-Chibote-Chief Chama Roads in Luapula Province, which exhibited poor managerial practices.

External Risks

External risks are outside the project manager's and other project participants' control but may affect the project's direction (Khodeir and Mohamed, 2015). The contractor and other project participants can only do so much to avoid these risks from occurring, at least reduce their effects or provide solutions for the effects on the project. External risks include political, financial/economic risks,

sociocultural risks, technological/technical risks, legal/regulatory risks, environmental risks and acts of God (Barlish et al, 2013; Smith, 2014). These will now be discussed briefly.

Political risks

Charnaud, Clark and Bennet (2016) described political risks as generic concepts that address the risks to investments and contracts from political change or instability. They include changes in government, changes in the legislation regarding employment, war and civil disputes, labour strikes and corruption and bribes (Barlish et al, 2013). Alamgir et al. (2017) reported that a study of 500 World Bank-financed projects for the period 2000 - 2010 with a road component concluded that one-quarter of all projects in low - to middle-income countries had severe allegations of fraud, corruption and collusion, collectively tainting US$14 billion in investments due to political reasons. Alamgir et al. (2017) further stated that, on average, per-unit road development costs were $30% higher in countries with political conflicts than those without conflicts. Cheelo et al. (2020) highlight the corruption in Zambia and further explain that the room for corruption is created by the over-design and over-specification of construction projects at inception.

Financial/economic risks

The nature of the construction industry has a lot to do with the vulnerability of projects in terms of financial risks (Kolhatkar and Dutta, 2013). An extreme competition, relatively low entry barriers, high uncertainties and risk involvements, and capricious construction volume fluctuations all lead to financial risks (Kolhatkar and Dutta, 2013). These risks include exchange rate fluctuation, inflation fluctuations, market competition, changes in demand, changes in tender prices, shortages in resources, or unavailability of materials. The study by Muya, Kaliba and Mumba (2013) found that inflation and financial processes were some of the causes of cost escalation and schedule overruns in the Zambian road sector. Kaliba, Muya and Mumba (2013) further stated that fully funded government projects faced 'Poor or erratic funding', contributing to poor outcomes on most projects. Poor funding, a financial risk, has been known to lead to the abandonment of road projects in Zambia (Tembo, 2018).

Socio-cultural risks

Socio-cultural risks deal with demographic changes, the opposition of neighbouring communities, criminal acts and conflicts due to cultural differences such as religion and language (Barlish, De Marco and Jamaluddin Thaheem, 2013), vandalism and theft. Such a risk was experienced in Zambia when Bandits in Kalulushi allegedly stole a front-end loader worth US$200,000 from the contractor engaged in upgrading the Kitwe-Chingola Road into a dual carriageway (Economy, 2014) as an example of a social risk.

Technical risks

These are risks where the changes on a project, system, or entire infrastructure do not work as anticipated when implemented (CAST, 2021). They include the obsolescence of current systems, new materials, investor technological advances and technological complexity (Barlish, et al, 2013). Chilongo and Mbetwa (2017) noted how many local contractors in Zambia need practical experience and hence need to acquire an array of skills, such as business and construction expertise, as they are expected to deal with strategic, technical and operational risks at various levels.

Legal/regulatory risks

These risks deal with the potential problems arising from contractual arrangements and legal frameworks in which the project is performed (Dehghania and Kargar, 2015). These risks include licenses, patent rights, lawsuits, subcontractors' performance and contractual failure (Khodeir and Mohamed, 2015). Non-compliance to these can result in lawsuits and delays.

Environmental risks

These are simply risks that affect the environment. Looking at the environmental impacts that come as a result of construction activities in Zambia, Musenga and Aigbavboa (2019) found the following environmental risks ranked from major to minor: Interference with the ecosystem, Increase in various types of pollution, Deforestation, Habitat destruction, Soil erosion, Depletion of non-renewable energy resources, Climate change, decrease in the availability of arable land, desertification, loss of marine life, and Decrease in the availability of land due to disposal of waste. From these impacts, it can be observed that construction activities create risks to the environment.

Acts of God

Acts of God include natural disasters, landslides and weather conditions such as wind and rains (Barlish, De Marco and Jamaluddin Thaheem, 2013). An example of such a risk would be what happened to the Mongu-Kalabo road in the western province of Zambia, where constructed sections of the road were washed away due to floods; although it was apparent that the feasibility study needed to take into account the possible effects of high-water levels, there was nothing that the project team could do to stop the floods (Mumba, 2008). The resultant effects of the risks have been given, with necessary examples. The following section discusses some of the consequences of the risks of road projects.

IV. Consequences Of Road Construction Risks

Common impacts and consequences on projects include cost overruns, time overruns and quality shortfalls, litigation, project abandonment, reworks and wastage of resources (Muya et al., 2013; Smith, 2014; Tembo, 2018). For road projects specifically, Guta (2017) noted that time overruns, poor quality and cost overruns were the most recognized consequences of risks. Muya, Kaliba, and Mumba (2013) identified cost, time and quality shortfalls as resultant effects of risks in Zambia. Different studies have shown that delays have adverse effects, impacts and consequences on projects, such as cost overruns, litigation or quality non-conformities, and it is for this reason that delay in construction projects is an essential issue in construction management (Thapanont, Santi and Pruethipong, 2018; Sánchez et al., 2020). Another consequence of risks is poor cost Performance. Silva (2014), through descriptive analysis, found that out of 738 contracts for road construction, only three presented no cost deviation, showing just how dire cost overruns are as consequences of risks. Similar observations have been noted on road projects in Zambia (Cheelo et al., 2020).

Banyenzaki (2016) found that road construction projects in Uganda were still associated with sub-standard work, loss of government funds and untimely completion of projects.

Despite lots of funds being set aside for monitoring and supervision in the budget for road projects, the roads were found to be of poor quality compared to those projects where no funds were set aside. (2020) noted that changes in scope, design changes or errors and quality deviation generally cause reworks. (2020) further found that reworks significantly impacted road infrastructure construction in South Africa. Adding to this, Simon (2017) explains that the use of inexperienced contractors in road construction led to most of them making errors during construction, and this, in turn, led to reworks, which is known to slow down the project's progress. Shimwambwa (2020) defined Project abandonment as the complete stopping of work on a project because it faces too many problems or issues, making it seem impossible to continue. This problem has been seen in Zambia, such as on the L400 road project that the contractor abandoned due to lack of payments, which is a financial risk (General News, 2015). Kaliba, Muya and Mumba (2013) add that project abandonment affects cost escalation in Zambian road projects. The same study found that in Indian road projects, lack of coordination between client and contractor, financial ability of the client, ambiguous client requirements and improper bidding processes were the prominent causes of delays, which led to claims. Muya, Kaliba and Mumba (2013) attributed claims to delayed payments, interest and standing time by contractors, which formed a significant part of the final total project cost. Looking at these scenarios, it is evident that claims lead to time and cost overruns on the project. Wastage of resources could be in the form of idle, labour plant or paying for inactivity. Similarly, poor managerial skills on the project manager's part result in the wastage of resources. When the person in charge is poorly managing the project, the rest of the team needs to catch up in proper project performance, leading to a waste of resources.

V. METHODOLOGY

This research took a positivist approach as the main idea was to know the risks faced, their severity, and their impacts on road projects. The strategy used to collect the quantitative data was a survey using self-administered questionnaires, as shown in Table 1. The respondents were road consultants in both the private and public sectors and contractors who had engaged in road construction in the past five years. The Road Development Agency (R.D.A.) is responsible for the road network in Zambia, which currently has 67,523 km of road (Raballand & Whitworth, 2014). R.D.A. is responsible for trunk (Motorway standard for long-distance travel), primary (intercity/inter-province/inter-territorial roads), district roads, urban roads (local authority roads) and primary feeder roads (a secondary road used to bring traffic to a major road). Only district and territorial roads were worked on during the period of study. From the list on the Road Development Agency website , only grade one contractors were engaged as principal contractors on road projects. From the total population of 27 contractors, two sampling methods were employed, snowballing and purposive sampling, to find out those who had worked on road projects.

Table 1: Respondents to the questionnaire

Respondent	Number Of Questionnaires distributed	Number Of Questionnaires Returned	Response Rate %
Public consultants	10	7	70.00%
Private consultants	25	16	69.60%
Contractors	27	10	37.00%
TOTAL	**62**	**33**	**53.23%**

The results collected were analysed using the relative importance index and descriptive statistics. The risks were ranked to uncover which ones were more frequent and severe in the Zambian road sector, and the risk impacts were ranked to know which ones severe on road projects. The Relative Importance Index (R.I.I.) was used to rank the risks and the risk impacts. The relative importance index is a statistical method used to determine the ranking of different factors (Hossen, Kang and Kim, 2015). Tembo et al. (2018) noted that the R.I.I. has a value in a range of 0 to 1 (0 not inclusive), meaning that the higher the R.I.I., the more frequent a risk occurs, the more severe a risk impact is on a project and the more the risk management practice is used in the sector. Below is the formula used for the R.I.I. as given by Shimwambwa (2020), who used it to rank the risk factors of project abandonment in the Zambian construction industry;

$RII = RII = \Sigma W/ (A \times N)$ or $RII = (5n5 + 4n4 + 3n3 + 2n2 + 1n1) / 5 \times N$

Where;

- W represents the weighting assigned by each respondent from the Likert scale provided in the questionnaires. The number of respondents is multiplied by their Likert scaling.
- A represents the highest number on the Likert scale; in this case, that is 5.
- N represents the sample size.

n represents the respondents per scale; for example, if 12 respondents chose one on the Likert scale, then n represents 12..

VI. RESULTS

Response rate and reliability of data

The data collected for the risk factors is deemed reliable as a Cronbach Alpha of 0.992 was computed for the 30 items. Kothari (2014) notes that any Cronbach Alpha of 0.7 and above indicates that an instrument is reliable. The response rates are as shown in Table 1: 69:.6% for private consultants and 37% for contractors. For public sector consultants, the total population of consultants was not disclosed. An indication was given that each of Zambias' ten (10) provinces would have someone in charge; therefore, ten questionnaires were given for the ten provinces in Zambia. Seven responses were obtained from R.D.A., which oversees all road projects in Zambia. This provides a response rate of 70% and is deemed sufficient as the R.D.A. covers the whole country with the help of private consultants. The response rate for contractors was low because most of the addresses on the lists for the National Council of Construction were fake, as some did not exist, and in other instances, it was found that the parties had shifted or just never used the indicated addresses. This is unsurprising, as Tembo (2018) noted the same challenge for contractors.

Respondent information

All the respondents were male. For contractors, 40% belonged to the age group of 50 & over, 10% were to the age group 20 – 30 years old, 20% belonged to the age group 31- 40, and the remaining 30% belonged to those between 41 and 50. For the Consultants, 13.04% belonged to the age group between 20 and 30 years, 21.74% belonged to the age group between 31 and 40 years, 39.13% belonged to the age group between 41 and 50 years, and lastly, 26.09% belonged to the age group that is above 50 years old. Over half of the contractors (60%) had a bachelor's degree, 30% had a master's degree, and 10% had a doctorate. Of these, 70% were civil engineers, and 20% were project managers, with 10% coming from a business management/administration background. 100% of these were Grade 1 contractors in road works. Consultants' bachelor's degree holders accounted for 60.87%, 21.74% had master's degrees, and 17.39% had a doctorate. 56.52% of the consultants were civil engineers, 26.09% were project managers, and 17.39% were quantity surveyors.

Road construction involvement by consultants

All the respondents' contractors noted that they had been involved in the construction of territorial roads, with 80% also noting that they had been involved in the construction of district roads. 30% of the contractors noted that they had been involved in inter-territorial roads, while another 30% noted that they had been involved in tertiary roads.

For consultants in the private sector, their participation in road projects was as follows: during conceptualization, 57.14% of the consultants noted high participation, while 42.86% noted very high participation during the planning stage. During the planning stage, participation by the private consultants was as follows: 65.22% noted high participation, whereas 21.73% and 13.04% noted high and moderate participation. During the contractor selection stage, the levels of consultancy were found to be moderately high by 28.57% of the respondents, whereas 42.86% and 28.57% noted that it was high and very high, respectively. During the contractor mobilization stage, the extension of consultancy was moderate by 71.43% of the respondents, whereas the remaining 28.57% had high participation. During the design stage, consultant participation was very high for 69.57% of the consultants, and 21.74% and 8.70% found it to be high and moderate, respectively. Lastly, for the construction part, it was found that 8.70% noted that it was low, 39.13% noted that it was moderate, 30.44 noted that it was high, and 21.74% noted that it was very high. Most of the consultants had been involved in territorial and district roads, with only a few adding inter-territorial and tertiary roads. The highest involvement of private sector consultants is in the pre-contract phase. For public sector consultants, participation was noted from planning to construction phases of the road projects.

Risks affecting road projects

Several risks impact road projects. These can be of various natures. Risks influencing road projects negatively are shown in Table 2. Table 2 shows the top 5 frequent risks: inflation fluctuation, exchange rate fluctuations, payment delays, Contractual Variations and Delays in subcontracted works. The top five severe risks are Inflation rate fluctuation, exchange rate fluctuations, payment delays, Delays in subcontracted works, late permits, and government approval. Additionally, contractors in open-ended

Table 2. Risk and risk impact ranking

NO.	RISK				FREQUENCY		SEVERITY	
		Mean	Std. Deviation	N	RII	RANK	RII	RANK
1	Inflation rate fluctuation	4.76	0.435	33	0.8970	2	0.9515	1
2	Exchange rate fluctuations	4.7	0.467	33	0.8849	3	0.9394	2
3	Payment delays	4.03	1.015	33	0.9576	1	0.8061	3
4	Delays in subcontracted works	2.97	0.847	33	0.7697	5	0.794	4
5	Late Permits and government approval	3.88	0.696	33	0.7636	6	0.7758	5
6	Contractual Variations	3.82	0.846	33	0.8303	4	0.7636	6
7	Poor accessibility to the site	3.79	1.083	33	0.5273	25	0.7576	7
8	Incomplete designs and scope	3.73	0.761	33	0.6849	8	0.7515	8
9	Changes in staff	3.73	0.911	33	0.7212	7	0.7455	9
10	Design/scope changes	3.58	0.867	33	0.6727	9	0.7152	10
11	Documents not issued on time	3.48	0.667	33	0.6424	12	0.709	11
12	Inclement weather condition	3.39	0.788	33	0.6546	10	0.6909	12
13	Funding changes/ bankruptcy	3.39	1.499	33	0.5636	19	0.6788	13
14	Inadequate specifications	3.3	0.81	33	0.5879	9	0.6606	14
15	Ill-defined project team responsibilities	3.27	0.719	33	0.6121	13	0.6545	15
16	Lack of competence & skills	3.27	0.944	33	0.5333	24	0.6485	16
17	Poor plan schedules	3.18	0.769	33	0.5939	16	0.6364	17
18	Low productivity	3.12	1.139	33	0.5515	21	0.6364	17
19	Difficulties in site acquisition	3.15	1.004	33	0.6000	15	0.6242	18
20	Errors and omissions	3.09	0.914	33	0.6061	14	0.6182	19

21	Wastage of resources	3.06	0.998	33	0.5758	18	0.6121	20
22	Differing ground conditions	3.06	0.966	33	0.6485	11	0.6121	20
23	Pollution & safety rules	3.03	0.81	33	0.5394	23	0.6061	21
24	Corruption and bribes	2.94	1.456	33	0.5152	26	0.5879	22
25	Labor strikes	2.94	0.899	33	0.5576	20	0.5879	22
26	Shortage of resources	2.88	0.65	33	0.6000	15	0.5758	23
27	Lack of coordination/ communication	2.97	0.951	33	0.5456	22	0.5333	24
28	Criminal acts	3.55	0.754	33	0.4424	28	0.4909	25
28	Poor Market competition	2.39	0.827	33	0.3940	29	0.4788	26
30	Conflicts due to differences in culture	2.42	0.867	33	0.4606	27	0.4242	27

questions added that there was much debt for road contractors in Zambia and that due to the projects' longevity and the kwacha instability, the exchange rate had been one of the defining risks of the road sector. One further went on to state how they lost about 12,000 USD on a road project on due to the drastic increase in material prices; another contractor stated that there is poor contract management by the client due to red tape and that it always takes many months for all road invoices to be signed off and for project decisions to be made, such as variations during which time payment and progress stalls.

From a consultant perspective, one with 11 – 15 years of experience in roads noted that risks are poorly handled as the focus is on speedily signing contracts with little emphasis on proper design and contractor selection. Moreover, poorly conceived projects suffer delays from changes. Another consultant noted that road construction in Zambia is poorly handled, mainly due to varied interpretations of risk allocation between clients and contractors.

Another consultant spoke of the risk situation by mentioning that the identification of risks before the commencement of construction is rarely done, and consideration is only made after an event. Other consultants agreed with the poor culture of handling risks, with one suggesting that risks could be handled better by identifying potential risks of a respective project and determining alternative ways of mitigating/allocating the risks through fostering good communication and coordination among the project stakeholders. Another suggested that that there should be a proper design by the proper allocation of time and resources to design and through professional design review. Furthermore, only contractors that are adequately qualified financially for the scale of the works should be offered. He further stated that constructing a well-designed road is simple and should be highly competitive and that cost escalation comes from poor project definition and changes in the employer's requirements. Two other consultants suggested that risk management should be included in the project cycle from project conception to site investigations before approving engineering designs.

Stage of risk handling and risk category

While risks commonly occur in the project's implementation phase, they' are better handled by one or all project members in an ideal stage of the project. The findings in Table 3 revealed that in the Zambian road sector, the client and consultants account for 43.33%, while the client and contractor can handle risks accounting for 33.33%. The risks that none of the parties can handle account for 6.67%, and contractor risks are 13.33%. The findings shows that the client can mitigate many risks throughout the project (50%), the construction stages (23.33%), and 26.67% of risks at the pre-contract stage. The nature of the risks faced are managerial (46.67%), technical, social, and economic (10%), while design risks account for 16.67%.

Table 3. Risk characteristics

No.	RISK	Stage of risk handling	Nature of risk	Risk category	Risk owner
1	Corruption and bribes	Throughout project	Internal	Social	Client and contractor
2	Labor strikes	Construction phase	External	Managerial	Client and contractor
3	Late Permits and government approval	Throughout project	External	Managerial	Client and contractor
4	Exchange rate fluctuations	Throughout project	External	Economic	Client and contractor
5	Inflation rate fluctuation	Throughout project	External	Economic	Contractor
6	Shortage of resources	Pre-contract phase	External	Managerial	Contractor
7	Poor Market competition	Pre-contract stage	External	Economic	None of the parties
8	Criminal acts	Throughout project	External	Social	Client and contractor
9	Conflicts due to differences in culture	Throughout project	External	Social	Project manager/contract administrator
10	Wastage of resources	Throughout project	Internal	managerial	Contractor
11	Pollution & safety rules	Construction stage	External	managerial	Contractor
12	Inclement weather condition	Construction	External	managerial	None of the parties
13	Contractual Variations	Throughout project	Internal	Design	Client/ consultants
14	Funding changes/ bankruptcy	Throughout project	Internal	Financial	Client/ contractors

15	Payment delays	Construction	Internal	Financial	Client/ consultant
16	Difficulties in site acquisition	Pre-contract stage	External	managerial	Client/consultant
17	Lack of coordination/ communication	Throughout project	Internal	managerial	Consultants/ project manager
18	Incomplete designs and scope	Pre-contract stage	Internal	Design	Client /Consultants
10	Inadequate specifications	Pre-contract stage	Internal	Design	Client /Consultants
20	Design/scope changes	Pre-contract stage	Internal	Design	Client /Consultants
21	Errors and omissions	Throughout project	Internal	Technical/ Design	Client /Consultants
22	Documents not issued on time	Construction stage	Internal	managerial	Client /Consultants
23	Differing ground conditions	Pre-contract stage	Internal	Technical	Client/Consultants
24	Poor accessibility to the site	Throughout project	Internal	managerial	Client/consultants
25	Delays in subcontracted works	Construction stage	Internal	managerial	contractor
26	Poor plan schedules	Throughout project	Internal	managerial	Client and contractor
27	Low productivity	Construction	Internal	Technical	contractor
28	Ill-defined project team responsibilities	Pre-contract stage	Internal	managerial	Client and contractor
29	Lack of competence & skills	Throughout project	Internal	managerial	Client and contractor
30	Changes in staff	Throughout project	Internal	managerial	Client and contractor

Nature and risk owner

In this context, the principle of risk owner is the party best able to handle, eliminate or minimize the risk among the project participants and/or between the project parties. In comparison, the nature of the risk refers to whether the risk is internal or external. The findings show that over half of the risks are internal (63.33%), and the rest are external (See Table 3).

Impact of risks

Table 4 shows impacts from the risk factors: cost overruns, project abandonment, time overruns and quality shortfalls. Cost is the overarching impact as each impact, in one way or the other, hinges on cost.

Table 4: Risk impact

RISK IMPACT	**SEVERITY OF THE IMPACT**	
	RII	*RANK*
Cost overruns	0.9152	1
Project abandonment	0.8970	2
Time overruns	0.8242	3
Quality shortfalls	0.7212	4
Wastage	0.5940	6
Rework	0.5940	5
Litigation	0.5818	7
Misallocation of resources	0.5273	8

VII. DISCUSSION

From Table 2, the risks found to be more prevalent and occurring more than the others were payment delays, inflation rate fluctuations, exchange rate fluctuations, variations and delays in subcontracted work, respectively. It is also seen that the severity of these risks is noted to be high, with inflation rate and fluctuations being the ones that affect projects the most, followed by exchange rate fluctuations, payment delays, delays in subcontracted work and late permits and government approval (6^{th} place in frequency of occurrence) respectively. From payment delays to inflation and exchange rate fluctuations, all respondent contractors (10) pointed out the extremes, with the frequency of occurrence always and the severity of them on the project also being very severe. Payment delays to contractors have been an ongoing issue in the Zambian road sector, with Kaliba, Muya and Mumba (2009) noting that they were among the most significant causes of cost escalation in road construction. Other scenarios are those from the literature review, such as the one by Mkuni (2016) in which the client failed to honor payments for certified works and the one where a contractor abandoned a road project in the Copperbelt province due to lack of payments, which is directly an extension of payment delays. At the same time, inflation and exchange rate fluctuation were noted by Kaliba, Muya and Mumba (2009) to be risks that lead to cost escalations, schedule overruns and quality. Inflation is directly linked to the exchange rate. As the exchange rate increases, the prices balloon in the country, affecting everything, the road sector included. Poor market competition, criminal acts, conflicts due to differences in culture, corruption, and lack of competence and skills were found to be the least occurring risks, respectively. Their severity on the projects was also low, except for lack of competence, which had a higher severity on the project (ranked 16 of the 30 risks). The results on corruption do not coincide with what was stated by Cheelo *et al.* (2020), who noted that Transparency International Zambia (T.I.Z.) is on record as having cited 'cadres' as a significant source of corruption in the construction sector in Zambia nor the results from Kaliba, Muya and Mumba (2009) that showed that corruption was one of the significant causes of quality shortfalls in road projects.

Lack of competence and skills being ranked lowly is also questionable because competence is seen through how a project is executed, and projects have been known to overrun time and cost, among other project objectives. It is ranked lowly because it questions the respondent's competence in a way. For criminal acts, it is more dependent on the security measures put in place; hence, its ranking qualifies. Poor market competition would be mostly visible to the parties not involved in projects, hence the results of low interpreting themselves.

Looking at Table 3, risks in the Zambian road sector are prevalent in that 0.5, which is supposed to be the average R.I.I., was exceeded by most of the risks in terms of occurrence and severity. Only three were below the average in the frequency and severity of the projects: poor market competition, criminal acts and conflicts due to cultural differences. This shows that risks are mishandled within the sector.

Some respondent consultants added some risks that they have encountered, with one mentioning delays from utility companies and ill-procurement of public works, which, from the rating given, the R.I.I. for the frequency of occurrence for the delays from utility companies is 0.6, and the severity on the project is 0.8. In contrast, for ill-procurement of public works, the R.I.I. for frequency of occurrence is 0.8 and 1 for the severity of the project. Another consultant mentioned terrible interpretation of the contract clauses, which had an R.I.I. of 0.6 for the frequency of occurrence and 0.8 for the severity.

To conclude, it can be seen through the prevalence of risks in the Zambian road sector show that the road sector is risk. This is congruent with the findings of Adugna 2017 Kumar, Sheikh and Asadi (2017) who note that the road sector faced more risks than any other construction activity. They further uncovered risks such as inefficient planning, unforeseen soil conditions, inadequate resources, force majeure and government issues being different findings of their study. This underscores that risk factors are context specific.

For the risk impacts, cost overruns or escalation was found to be the one that was more severe on projects. With risks such as exchange rate and inflation rate fluctuations, the project will likely exceed its initial cost, affecting its progress. Mumba, 2008; Kaliba, Muya and Mumba (2009) found that most of the Zambian projects exceeded their initial cost, and from the looks of it, the situation is still the same, and projects are affected in the end. Project abandonment was seen as the second impact of risks in the road sector, and it has been seen from the literature review how the L400 road project was abandoned in 2015, and in 2019, the C400 road was abandoned. Both were by the same contractor due to delays and non-payments, the most common risks in the road sector. The severity of project abandonment is high because if and when an unfinished project is abandoned, it will not be used as intended. Time overruns were third, and it shows just what Rivera, Baguec and Yeom 2020; Sánchez *et al.* (2020) noted that time overruns were a recurrent and persistent issue in road construction worldwide, especially in developing countries which from the results was confirmed and also seen from the research of Kaliba, Muya and Mumba (2009) who stated that they were normality in Zambia.

Looking at the discussed risk impacts and the others, it can be seen that they have very severe consequences for the project and the parties. All the risk impacts have an R.I.I. that is above the average (0.5). This indicates that risks that lead to these impacts have dire consequences for the projects.

VIII. Conclusion

Various risks are prevalent in the Zambian road sector, as the risks under investigation produced an R.I.I. of above 0.5. The top ten severe risks are Inflation rate fluctuation, exchange rate fluctuations, payment delays, delays in subcontracted works, late Permits and government approval, contractual Variations, poor accessibility to the site, and Incomplete design scope. The top ten frequent risks are Payment delays, Inflation rate fluctuation, Exchange rate fluctuations, Contractual Variations, Delays in subcontracted works, Late Permits and government approval, staff changes, Incomplete designs and scope, Design/scope changes, Inadequate specifications and Inclement weather condition with the top five severe risks being within these. The risks are mainly internal in nature and categorized as managerial. The risks can mainly be controlled throughout the project's duration. This implies that risk management needs to be active from inception to the close-out phase of a road project.

Additionally, more attention should be given to managerial risks. The most severe impact of these top ten risks eventuating is cost. This also implies that cost management should be very meticulous on these projects. For future research, a study should focus on project participants' challenges in managing these risks.

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