Sustainable Development and Risk Management in Road Construction Industry in Nigeria

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Abstract

Civil Engineering projects which include road construction pose a significant amount of risk due to the several activities involved, its coverage over a wide expanse of land and threat from underground conditions. Risk is defined as the chance of something happening that will have an impact on objectives, and this can be either positive or negative. Risk in road construction stem from the conception till usage and has significant effect on any one of the aspects of a project namely cost, quality, time or scope of the project. In addition, sources of risk can be in terms of payment, security deposit and retention, time of commencement and completion, variation, delay and cost of delay and liquidated damages. Size can be one of the major causes of risk; so can changes in political or commercial planning. Early understanding of the risks involved in a project will help project managers to reduce its impacts and complete the project in a sustainable and more efficient manner. This can be achieved through proper Risk Management. Risk Management entails identification, analysis and application of methods to reduce the identified risk. This study focuses on sustainable risk management for road construction projects, taking South east geopolitical zone of Nigeria as case study. The method involved primary data collection using questionnaire survey and data analysis using statistical models. This study establishes that program evaluation review technique is the most effective risk management practice in Nigeria and conforms to sustainable development practices in addition to analytical hierarchy and probability impact methods. The study would help project managers understand anticipated risks in road projects, better estimate risks prior to the commencement of any project and allows them to develop proper mitigation measures at an early stage of a project.

1.0 INTRODUCTION

Risk is a function of the probability of an event occurring and the degree of damage that would result should it happen (EPA, 1996). Risk is defined as "the chance of something happening that will have an impact on objectives", meaning, risk can be either positive or negative. (Australia Social Economic and Environmental Handbook for Risk Assessment and Management, 2008). A common approach is to define risk as the combination of the probability (or likelihood) and consequence of an event (or outcome or result of exposure). This gives rise to the widely used concept of risk: *Risk = Probability x Consequence.*

All human endeavours involve risk. The success or failure of any venture depends on how managers deal with it. Construction industry is no exception (Thompson and Perry, 1992). The construction industry is considered to be subject to more risk than other industries. This is as a result of the complex and time-consuming process of design and construction as well as the great effort to coordinate multitudes of human resources, from different establishments, with different skills, objectives and interests (Othman, 2008). In addition, sources of risk can be in terms of payment, security deposit and retention, time of commencement and completion, variation, delay and cost of delay and liquidated damages. Size can be one of the major causes of risk; so can changes in political or commercial planning.

Risk management is not a singular process but a complex mix of multiple views, values, perceptions and qualitative or quantitative approaches. This means that sound risk management must involve components of stakeholder engagement, two-way communication and responsiveness. Risk management is one of the most vital procedures and capable way in coping with project risks and uncertainties. In order to rescue the poor reputation of construction industry in project performance, the right implementation of risk management is essential. With the implementation of risk management, the common problem in construction projects such as delay in project delivery, over - budget, unsatisfactory product quality, unsafe working environment etc. can be eliminated. Therefore, it could be argued that risk management is important especially during the decision making process with regard to risks (Lee Chun and Azlan, 2012).

Risk management is a core element of sustainable development. Sustainable development is normally assessed by reference to parallel progress in its "three pillars" - economic growth, human development and environmental protection. These three pillars of sustainability—social, economic and environmental—present various risks and thereby provide a complex and often inter-related mix of risks and opportunities that construction companies need to address. The challenge of sustainable development presents a variety of risks (and opportunities) for the construction industry. These need to be considered in light of social, environmental and economic risks to all stakeholders affected by construction—local communities, investors and shareholders, governments, indigenous groups, construction companies and so on. These pillars of sustainability are pivotal in understanding risks and the inter-relationships between them. Hence, this study has the following objectives:

1. Identify specific risk in road construction in Nigeria.
2. Highlight and evaluate the effectiveness of different risk management practices available in the construction industry in Nigeria.
3. Determine the most suitable method of handling road construction risk in Nigeria, for sustainable road delivery and management.
4. Determine the extent which risk management in road construction business in Nigeria conform to the concept of sustainable development.

2.0 LITERATURE REVIEW

"No construction project is risk free. Risk can be managed, minimized, shared, transferred or accepted. It cannot be ignored" (Latham 1994). Moreover, the construction industry is exposed to more risk and uncertainty than perhaps any other industry sector (Flanagan and Norman 1993). It involves numerous stakeholders, long production durations and an open production system, entailing significant interaction between internal and external environments. Such organizational and technological complexity generates enormous risks (Zou et al. 2007).

Chapman and Cooper (1983) outlined one of the earliest attempts to consider the need for structuring project risks and systematic approach, which integrates different tools and techniques, including PERT, decision trees and probability distributions. In a subsequent paper, Cooper et al. (1985), they present a method for analyzing project cost risk: risks being structured as 'risk breakdown structures' (RBS) where the top of the hierarchy represents project cost risk. Risk is modelled as a variation distribution of base estimate of cost. Kangari and Riggs (1989) illustrate the use of Fuzzy Sets Theory (FST) as a risk assessment tool; the earliest attempt to use FST to handle subjectivity issues in construction risk assessment.

Pioneering its application in construction, Mustafa and Al-Bahar (1991) adopt the Analytic Hierarchy Process (AHP) to assess construction project risk. Becoming one of the most cited papers in the literature; it applied the concept of value and weight to assess risk probability and impact. The paper also evaluates the suitability of using AHP to assess construction project risk, delineating its limitations for such applications. Likewise, Dey et al. (1994) present a risk assessment methodology, based on AHP, which combined objective and subjective assessments; risk was also modelled as Probability-Impact (P-I). Riggs et al. (1994) propose an approach for quantifying and integrating technical, cost, and schedule risks as utility functions. AHP was used to assign probabilities to a decision tree: the option with the maximum utility was to be chosen. The

proposed model, however, could not be used to assess risk; it could only be used to assess the utilities of different 'risk scenarios'. AHP was also used by Zhi (1995) to assess the risk levels of overseas construction projects; the P-I model was adopted and AHP deployed with minor modification. The impact assessments fell within 0-1 instead of the AHP's formal 1-9 ordinal scale.

A stochastic model, which combines the randomness of the cost and the duration of a project activity, was developed by Tavares et al. (1998). Project risk was modelled as the probability of not meeting project objectives, i.e. duration and cost; however, no other objectives were considered. Mulholland and Christian (1999) use the PERT technique to develop a distribution of project duration. The variance of the duration distribution of a project is used to measure schedule risk: the larger the variance, the greater the risk associated with project duration.

Akintoye and Macleod (1997) and Raftery (1994) identified the current usage or risk management techniques in the construction industry. These include: risk premium, risk adjusted discount rate, subjective probability, decision analysis, sensitivity analysis, Monte Carlo simulation, stochastic dominance, Casper and Intuition. However, in a study conducted by Odeyinka (1987), it was found that one of the major methods of managing construction risk in the Nigerian Construction industry is through transfer to insurance companies.

In Odeyinka (2000) study which examined the sources of insurable construction risks perceived to be encountered in the Nigerian Construction Industry and the types of insurance policy employed in managing them. The study shows that, out of a myriad of insurable risks, great importance is placed on site security, construction risks, and health and welfare requirements. The Nigerian construction industry has various types of insurance policy available.

According to Sage (2009), sustainable development refers to the fulfilment of human needs through simultaneous socio-economic and technological progress and conservation of the earth's natural systems. Sustainable world progress is dependent upon continued economic, social, cultural, and technological progress. To achieve this, careful attention must also be paid to preservation of the earth's natural resources. Sustainable development is a term generally associated with the achievement of increased techno-economic growth coupled with preservation of the natural capital that is comprised of environmental and natural resources. It requires the development of enlightened institutions and infrastructure and appropriate management of risks, uncertainties, and information and knowledge imperfections to assure intergenerational equity, intra-generational equity, and conservation of the ability of earth's natural systems to serve humankind (Sage, 2009).

3.0 MATERIALS AND METHODS

The study was carried out in the south east geopolitical zone of Nigeria. The sample of the study comprised of staff and adhoc staff of the construction companies chosen using the random sampling method. The instrument used in the collection of data is a researcher developed questionnaire. It consist of two sections: the first section contains information on the demographic data of the respondents while the second section contains questions arranged in four clusters: A, B, C and D which is based on a five point scale rating of Very Great Extent (VGE), Great Extent (GE), Some Extent (SE), Little Extent (LE), No Extent (NE) scored 5, 4, 3, 2, and 1 respectively.

Cluster A sought answers to the specific risks in road construction in Nigeria. Cluster B provided answers to effectiveness of risk management practices available in construction industries. Cluster C sought answers to the most suitable method of handling risk in Nigeria while Cluster D provided answers to the extent which risk management in road construction business in Nigeria conform to the concept of sustainable development.

The data was administered to the respondents and collected from them by the researcher and 5 research assistants with whom the researcher had a day training so as to ensure that the questionnaires were distributed and collected within two weeks with minimal errors.

The research questions was analysed using mean (x) and standard deviation (SD) while t-test statistics was used to test the formulated hypotheses at 0.05 level of significance.

4.0 RESULTS

The questionnaires were analyzed using SPSS 17.0 software. The results obtained have been summarized in the table below. For the purposes of analyzing the results, values of 3.0 and above have been chosen to show to a large extent while values below 3.0 will imply a low extent.

Cluster A: To what extent are the following risks in construction business in Nigeria?

Table 1: Response to Cluster A

S/No	Item	X	Rank	Decision
1	Environmental Impact	4.04	**1st**	Large Extent
2	Waste Generation	3.44	**5th**	Large Extent
3	Negative Impact on Ecosystem	3.38	**6th**	Large Extent
4	Material Recycling	3.33	**7th**	Large Extent
5	Pollution Control	3.46	**4th**	Large Extent
6	Design	3.71	**2nd**	Large Extent
7	Sustainable Construction	3.62	**3rd**	Large Extent

Table 1 shows the response of respondents on severity of selected risks in the construction business. The result presented has Delayed Payment Challenge, Financial Risk and Design risk coming 1st, 2nd and 3rd respectively as major risks in road construction business.

It is important to note that some other researchers have done similar work on this in different countries and have also found delayed payment challenge or financial challenge ranking first among other risks associated with construction business in Nigeria. For instance, Alaghbari *et al* , (2007) examined the factors that cause delay in construction projects in Malaysia and found financial factors to be the most common cause of delays. Again, Sambasivan and Soon (2007) concludes that Clients finance is an important of delay and risk in construction industries in Malaysia. Other risks identified by Sambasivan and Soon (2007) include: Design changes, shortage in materials, labor shortages, equipment availability and failure, contractor's poor site management and inexperience, problems with subcontractors and equipment availability and failure.

Furthermore, Koushki et al (2005) found major risks in Kuwait to include: Owner's financial constraints and changing designs. These findings show similarity with what is obtainable in the south east geopolitical zone of Nigeria which also may not differ across Nigeria. Going by the already set values for this study, it is important to note that all factors outlined in table 1 (excluding volcanic eruption and landslides which fall below 3.0) were accepted by respondents as risks affecting construction business in Nigeria. The study area is not known to experience volcanic eruptions and landslides and hence it is not surprising why it is not seen as risks by the respondents.

Cluster B: To what extent are the following risk management practices in construction industries in Nigeria effective?

Table 2: Response to Cluster B

S/No	Item	X	Rank	Decision
1	Environmental Impact	4.04	**1st**	Large Extent
2	Waste Generation	3.44	**5th**	Large Extent
3	Negative Impact on Ecosystem	3.38	**6th**	Large Extent
4	Material Recycling	3.33	**7th**	Large Extent
5	Pollution Control	3.46	**4th**	Large Extent
6	Design	3.71	**2nd**	Large Extent
7	Sustainable Construction	3.62	**3rd**	Large Extent

Table 2 shows the levels of agreement of respondents on the effectiveness of the itemized risk management practices in Construction industries in Nigeria. From the result, Program Evaluation Review Technique can be seen to be most effective, followed by Probability Impact Method and Analytical Hierarchy Process. It can also be seen that Transfer to Insurance Companies is the least effective in Nigeria and ineffective by the set values of this study.

Cluster C: To what extent is Insurance business the most suitable method of handling road construction risks in Nigeria?

Table 3: Response to Cluster C

S/No	Item	X	Rank	Decision
1	Environmental Impact	4.04	**1st**	Large Extent
2	Waste Generation	3.44	**5th**	Large Extent
3	Negative Impact on Ecosystem	3.38	**6th**	Large Extent
4	Material Recycling	3.33	**7th**	Large Extent
5	Pollution Control	3.46	**4th**	Large Extent
6	Design	3.71	**2nd**	Large Extent
7	Sustainable Construction	3.62	**3rd**	Large Extent

Table 3 shows respondents' level of agreement on the extent transfer of risks to insurance businesses, is the most suitable method for handling road construction risks in Nigeria. As observed, it is currently ineffective. While it is generally accepted that risk transfer is the most can be a cost effective way of managing risks (Surminski and Oramas-Dorta, 2014), it is not without its demerits which makes it ineffective in some countries. Arooz & Halwatura (2015) observed that even though insurance is one method used in Sri Lankan construction industry to manage risks; but sometimes insurance claims are disclaimed and payments denied by insurers as a result of technical exclusions existing within the policy or simply because policy claim conditions and procedures have not been strictly followed by the insured contractor. This is no different from the typical Nigerian system where insured parties are denied claims for reasons similar to the findings of Arooz & Halwatura (2015).

Cluster D: To what extent do risk management practices in road construction conform to the concept of sustainable development?

Table 4: Response to Cluster D

S/No	Item	X	Rank	Decision
1	Environmental Impact	4.04	**1st**	Large Extent
2	Waste Generation	3.44	**5th**	Large Extent
3	Negative Impact on Ecosystem	3.38	**6th**	Large Extent
4	Material Recycling	3.33	**7th**	Large Extent
5	Pollution Control	3.46	**4th**	Large Extent
6	Design	3.71	**2nd**	Large Extent
7	Sustainable Construction	3.62	**3rd**	Large Extent

Table 4 shows respondents' agreement on the extent itemized risk management practices conform to the concept of sustainable development. It is generally accepted that they all conform to the concept of sustainable development to a large extent.

5.0 CONCLUSION

This study has painstakingly investigated risk management practices and its sustainability in construction industries in south east geopolitical zone of Nigeria. It therefore finds the following:

1. Delayed payment challenge, financial risk, design risk, security risk, equipment productivity risk, kidnapping, community unrest, material supply challenges, and flood are all risks in construction industries in south east geopolitical zone of Nigeria.
2. Flood and volcanic eruptions are not risks in the construction industry in the study area.
3. Program Evaluation Review Technique is the most effective risk management practice in Nigeria.
4. Transfer of risks to Insurance businesses is ineffective in Nigeria currently.
5. Program Evaluation Review Technique, Analytical Hierarchy and Probability Impact Methods of risk management conform to sustainable development practices and hence they are recommended for use in management of risk in Nigeria.

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