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Assessing the Risks of Infrastructure Investments in Sudan

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Abstract:
Infrastructure is essential to the functioning of society and the modern economy, as it consists of the physical structures and essential services that connect society and facilitate its orderly operation. Infrastructure has a direct impact on the quality of life for individuals, by providing access to a broad range of essential resources, including water and energy and other services such as, transportation and telecommunications.
Given its strategic importance and its impact on quality of life's success of an infrastructure projects are greatly influenced by proper management of the risks associated with the project.
The main aim of this study is to identify the major risks associated with the different phases of infrastructure investments in Sudan. This study is based on structured face to face interview with the sampled population using closed ended questionnaire. The collected data will be analyzed using Monte Carlo Simulation and one-way analysis of variance, ANOVA, to determine whether there are any statistically significant differences between the levels of the risks associated with the phases of infrastructure investments.
The results obtained from this study are expected to give clear indication of the risk management strategies, that help governments and companies manage risks more proactively and thus more effectively.

Keywords: *Infrastructure, investments, risk identification, risk assessment, risk mitigation, phases*

1. Introduction

Infrastructure originated in military parlance, referring to fixed facilities such as air bases(PN Edwards, 2010). However, it's not a new word; its origin can be traced back to 1887, when it was first used in England where it means subgrade, the native material underneath a constructed pavement or railway. The word is a combination of the Latin prefix "infra", meaning below, and "structure" (Encyclopedia, 2017,).

Today it has become a slippery term, often used to mean essentially any important, widely shared, human constructed resource (PN Edwards, 2010). The American Heritage Dictionary (2017) defines the term as; (1) an underlying base or foundation, especially for an organization or a system and (2) the basic facilities, services, and installations needed for the functioning of a community or society, such as transportation and communications systems, water and power lines, and public institutions including schools, post offices and others.

As well, Infrastructure is an input to a wide range of industries and an important driver of long-term growth, development and poverty reduction. Of course, this is channeled via; increased productivity, improved access to markets, reduced transaction cost, increased employment opportunities, enhanced asset utilization…. etc.(A.D.B, 2011
However, despite all the benefits of infrastructure, but still there are very few projects implemented successfully, due to the several types of risk which hinder their execution properly.

1.1. Historical Background of Sudan's Infrastructure

Infrastructure investments were recognized in Sudan in the mid-1970s as an increased emphasis was placed on economic development, and a substantial proportion of public investment funds were allocated for transport sector development. Some progress toward starting different infrastructural projects had been recognized by the beginning of the 1980s, but still further modernization and economic growth were required(Wikipedia, 2013).

However, currently Sudan's infrastructure is mainly represented in four sectors which are; telecommunication, power, transportation, and water sectors. With, Improvements in infrastructure in all parts of Sudan in recent years have had a strong impact on per capita growth, contributing 1.7 percentage points(M. Briceno-Garmendia, 2012).

Moreover, Sudan has invested heavily in recent years, with some notable achievements in telecommunication sector and Power sector as electricity generation capacity tripled in just a few years, but still service reliability remains an issue (M. Briceno-Garmendia, 2012).

On the other hand, Sudan's most pressing Infrastructure challenges lie in the water and transport sectors.
Most of Sudan lacks access to safe sources of water which have been compounded by large inefficiencies at the water utilities. While in transport sector (even though the road network almost doubled in length) a sizable share of the country lacks roads. There are a few well-developed internal corridors, but rural connectivity is almost nonexistent. Road density

is exceedingly low and traffic along most roads is sparse. Poor-quality roads drastically undermine the efficiency of transport services (Nations Encyclopedia, 2017).

Within this context, in 2017 the Ministry of Infrastructures has closed the Blue Nile Bridge which is linking Khartoum and Khartoum North for a quiet period of time. The Minister of Infrastructures and transport said all the studies and reports conducted on the bridge proved that the bridge needs full maintenance works. In addition to the existence of problems in railways, stressing that the bridge life expectancy has exceeded one hundred a matter which makes maintenance a must (Najat Ahmed, 2017)

1.2. Infrastructure Risks

Large infrastructure projects suffer from significant under management of risk in all stages of the project. Specifically, poor risk assessment and risk allocation, i.e., through contracts with the builders and financiers, early in the design phase of the project, which leads to higher materialized risks and private-financing shortages later on (Frank Beckers,2017)

Risk is also undermanaged in the later stages of infrastructure projects, destroying a significant share of their value. Crucially, project owners often fail to see that risks generated in one stage of the project can have a significant knock-on impact throughout its later stages.

The structuring and delivery of modern infrastructure projects is extremely complex. The long-term character of such projects requires a strategy that appropriately reflects the uncertainty, and huge variety of risks they are exposed to over their life cycles. Infrastructure projects also involve a large number of different stakeholders entering the project life cycle at different stages with different roles, responsibilities, risk-management capabilities and risk-bearing capacities, and often conflicting interests.

While the complexity of these projects requires division of roles and responsibilities among highly specialized players (such as contractors and operators), this leads to significant interface risks among the various stakeholders that materialize throughout the life cycle of the project, and these must be anticipated and managed from the outset(Frank Beckers,2017).

Consequently, infrastructure projects have become and will continue to become significantly larger and more complex. For these reasons, losses due to the cost of undermanaged risks will continue to increase. This will be exacerbated by an ongoing shortage of talent and experience—not only are projects more complex, but there are also more of them, which will create demand for more effective and more systematic approaches and solutions (Frank Beckers,2017).

1.3. Project Life Cycle Model

There are several stages in the life cycle of a project: (1) project selection, (2) planning, (3) execution, and (4) termination (Ruhl, 1988). The first phase, project selection**,** will vary among firms (Hormozi, Amir M. McMinn, RobertD.Nzeogwu, Okeleke, 2000). Each project must be evaluated to determine which is the best use of corporate funds (SAM, 2000). Each will have different risks, benefits, and costs, making the selection very difficult (SAM, 2000). The final decision should be based on the project's financial return and how well it assists the organization in achieving its long-run strategic objectives (Hormozi, AmirM. McMinn, RobertD. Nzeogwu, Okeleke, 2000).

Once a selection has been made, formal plans must be developed. The importance of thorough project planning cannot be overemphasized (SAM, 2000). The objective of this process is to develop a master plan that details how each asset of the organization will be used to accomplish the project's goals (Hormozi, AmirM. McMinn, Robert D. Nzeogwu, Okeleke, 2000). Thorough and aggressive planning will also increase the team's commitment to success (SAM, 2000).

The two most important components of the master plan are the project budget and the master schedule, which are developed from a detailed list of specific project tasks. The master plan should include measures for evaluating the progress of the project as well as guidelines for its termination (SAM, 2000).

During the execution phase, resources are consumed to complete the project. Throughout this period, the actual progress of the project, in terms of cost, schedule, and performance, is measured against the planned goals. The results of this monitoring process are assembled into status reports, which are then distributed to the project team and senior management (Hormozi, AmirM. McMinn, Robert D.Nzeogwu, Okeleke, 2000).

In the end, all projects both successful and unsuccessful will have to be terminated. During the termination phase the project's resources are redistributed, financial records are closed, and project personnel are reassigned. The organization's sensitivity to the concerns of the project team can have a lasting impact on their commitment and productivity (Hormozi, AmirM. McMinn, RobertD. Nzeogwu, Okeleke, 2000). Lastly, a final report, which discusses the project's successes and shortcomings, is prepared for senior management. This report can significantly influence how the organization manages projects in the future (SAM, 2000). The below figure explores the project life cycle model:

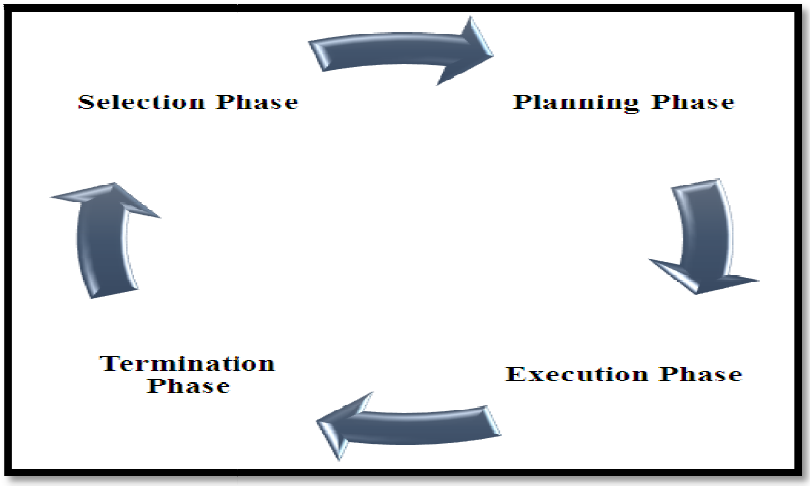

Figure 1: Project Life Cycle Model

1.4. Problem Statement

Despite the numerous benefits of infrastructure investments to any economy, still there are very few projects successfully implemented. However, large infrastructure projects suffer from significant under management of risk, throughout the different phases of the project, as the management of risk isn't properly accounted for in advance, which in turnstands as an obstacle for such projects and hinder their initiation and execution successfully.

Therefore, this research is intended to answer the following questions:

- What are the risks to which an infrastructure investment project is exposed?
- What is the potential cost of each of these risks?
- What are the different mechanisms that can be used to reduce their likelihood of occurrence?
- What encourages debt providers to finance such risky investments?

1.5. Significance of the Study

This research is conducted in order to develop a risk management framework for the different phases of infrastructure investments in Sudan ranging from, planning, development, construction and operational phase. Therefore, the results generated from this research will certainly be of help to:

- Policymakers in capturing their attention to the actual and potential risks that may affect the successful execution of infrastructure investments.
- Encourage the different debt providers (Banks, government)to finance such projects having noted all the risks in advance.
- Besides that, one of the most crucial academic contributions of such a study is expected to help in finding ways to strengthen engineering education, which is critical in the construction and maintenance of infrastructure investments. This involves creating and strengthening training activities, as well as creating new engineering schools.

1.6. Objectives of the Study

The general objective of this study is to:

Investigate the critical risks associated within frastructure investments in Sudan

1.7. More Specifically to

- Identify the major risks associated with the different phases of infrastructure investments
- Assess their probability of occurrence throughout the different phases of the project and their impact.
  Find out mechanisms to reduce their likelihood of occurring

1.8. Hypothesis

With regard to the research questions that have been set the following hypothesis should be tested:

- Infrastructure investments are likely to be affected by different types of risks ranging from, financialrisk, risk of defaulting on the obligations, regulatory risks, operational risk and other sort of risks that may hinder their execution properly.
- Poor identification of all possible tools that can be used in mitigating infrastructure risks in advance, will affects the execution of the basic infrastructural projects in Sudan.
- The execution of a feasibility study for infrastructural projects will identify the potential risks associated with those projects, and hence creates a mechanism to reduce their likelihood of occurring. As well, infrastructure risk

management actually requires a high degree of cooperation between the public and private sectors, particularly in the sharing of information about risks to infrastructure.

- Debt providers will agree to finance an infrastructure development project, if all project risks have been identified, analyzed, and effectively controlled or transferred in advance.

1.9. Conceptual Framework of the Study

The conceptual framework of this study has been developed based on the project development life cycle model. The research problem stated above involve investigating the different types of risk associated with the phases of infrastructure investments.

However, Infrastructure risks vary across the life of the project, divided into the project development phase, the construction phase; and the operation and termination phases. Certain risks may only be present at certain stages of project finance, while others may be present at all stages. In this study, two variables can be identified;

- Phases of Infrastructure investments being the independent variable
- The type of infrastructure risk associated with a particular phase being the dependent variable

The below figure clarifies the conceptual framework of the study

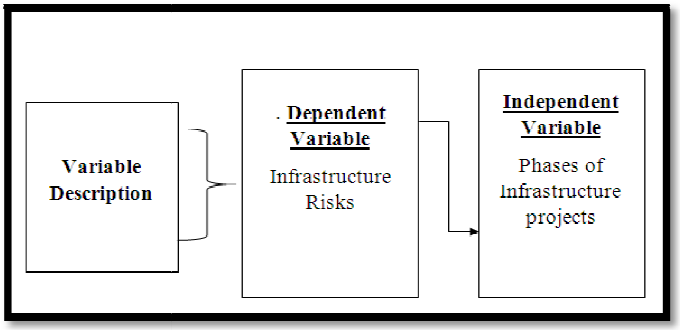

Figure 2: Conceptual Framework

2. Methodology

2.1. Research Design

This research will adopt a descriptive study. Descriptive studies are useful to assess the different types of risks associated with the phases of infrastructure projects.

2.2. Target Population And Sampling

The targeted population for the proposed research would include Debt providers (banks), and governmental organizations who are dealing with infrastructure investments such as Ministry of Infrastructure in Sudan.

However, since this population is overwhelming different sampling techniques would be used to develop the sample.

- First: The research will utilize stratified random sampling to select the participants. In this regard, the banks will be stratified according to their infrastructure financing activities to generate homogenous group. Specifically, the population will be grouped in to two strata; Commercial Banks, Specialized Banks.
- A sample of 34 banks (based on solving formula) will be chosen. The proportion of banks from the different infrastructure financing activities will be: 27 (0.79%) from commercial banks, 7 (0.21%) from specialized banks.
- Second: The research will utilize simple random sampling to select the participants from the Ministry of Infrastructure. A sample of 14 (based on solving formula) infrastructure policy makers out of 15 will be chosen.

2.3. Data Collection

Data collection will be done through structured face to face interview with the sampled population using closed ended questionnaire. Personnel administration of the survey helps to explain any unclear information to the participants as well as gaining a depth understanding on the present and potential types of risk associated with infrastructure investments in the country. However, before conducting the study, the following ethical issues will be taken in to consecration.

Ethical considerations: the respondents will be presented with an informed consent form whereby each respondent participating in the study will be expected to read, understand the purpose of the study, their roles and responsibilities as well as their rights during the study. Each respondent will be assigned a unique identifier to conceal their identities during the study. The questionnaire will also be subjected to peer reviewing and piloted to ascertain its effectiveness in getting the desired data for the proposed study. Also, the researcher will seek approval from relevant bodies and authority before undertaking the study.

2.4. Data Analysis

- Monte Carlo simulation will be used; it's a computerized mathematical technique that allows people to account for risk in quantitative analysis and decision making. Monte Carlo simulation furnishes the decision-maker with a range of possible outcomes and the probabilities they will occur for any choice of action. It shows the extreme possibilities, along with all possible consequences for middle-of-the-road decisions.
- The one-way analysis of variance (ANOVA) is used to determine whether there are any statistically significant differences between the levels of the risks associated with the phases of infrastructure investments.

2.5. Expected Outcomes

Risk specifically deals with the uncertainties inherent in any infrastructure projects. By identifying and evaluating these uncertainties, organizations are better placed to be able to make informed decisions and this will lead to fewer losses and more gains.

Therefore, the results obtained from this study are expected to give clear indication of the risk management strategies, that help governments and companies make these decision choices and manage risks more proactively and thus more effectively. Moreover, it will make success more likely by minimizing and eliminating negative risks, so as to meet the targeted objectives that will allow the stakeholders to maximize profit, and minimize expected activities that don't produce return to their investment.

No	Activity Name	Months											
		1	2	3	4	5	6	7	8	9	10	11	12
1	Reading Previous literature												
2	Refining the problem statement, objectives, research questions and hypothesis												
3	Design, Validate and test the interview template												
4	Data Collection												
5	Data Editing												
6	Data Analysis												
7	Report writing												

Table 1: Time Schedule

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