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RISK ANALYSIS OF SURAT METRO RAIL PROJECT: A REVIEW

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Abstract : Surat metro project is one type of major construction project. Because construction projects often result in delays and overruns, risk management in the industry has received more attention. Numerous industries' organizations have realized the growing importance of risk management, and many of them have traditional risk management departments to handle the dangers to which they are exposed or may be exposed in the future. This paper is discussing on an assessment of various risk involved in Surat Metro Rail Project and surrounding area, in that case to first identifying the risk factors based on that condition of to collect the data from different literature reviews and also conduct the questionnaire survey related to risk.

Keywords: **Risk management, construction project, risk identification, risk collection and analysis, risk evaluation response management process (risk treatment strategies), risk management.**

I. INTRODUCTION

The construction industry and construction businesses in India are no different from any other business or organization when it comes to the importance of risk management. Regardless of size, activity, or industry, this is essential to any organization.
The word 'risk' is used to convey different meanings and is synonymous used with term such as 'hazard' & 'uncertainty'.
One of the most significant global industries is the building sector. It has a major impact on a country's economic development. It is separated into three main sectors: real estate, infrastructure, and specific needs based on construction. In infrastructure projects, risk management plays a major role in project management.
Risk management may be accomplished through a variety of techniques, including identification, risk analysis, strategies, and mitigations. It is possible to quantify the effect and probability of these dangers. India is now experiencing severe traffic congestion, with everyday routes outside the city and high gridlock for those commuting within between the morning and evening hours. Going back and forth to and from home takes time out of a traveler's daily itinerary.
The government has challenges in organizing and carrying out the construction of an elevated metro rail track in a city that is already congested with high-rise buildings, little parking, few roadways, and heavy traffic.
There are significant hazards associated with the following processes: pre-casting, transportation, erection, section launching, operations, daily progress report, traffic and diversion, pile and cap construction, pier construction, and operations. Identifying risks, evaluating both quantitative and qualitative hazards, selecting the best course of action for managing risks, and tracking and reducing risks are all included in risk management.

II. STUDY NEED

Rapid economic growth has raised the need for public and private services and infrastructure in metropolitan areas worldwide. Numerous public construction projects have been started as a result, but they are very uncertain and risky because of their complexity and issues with land acquisition, utility diversion, approval of funds from government authorities and financial institutions, safety and environmental issues, and more.
India's construction industry has a number of difficulties, many of which can be linked to various risks and associated uncertainties. The ultimate goal of the project for the contractor and client is negatively impacted by time and expense overruns that result from inadequate risk management and risk acceptance throughout the execution and pre-execution stages.

III. Objective

1. To identify and study the risks.
2. To study risk analysis of Surat metro rail project.
3. To collect risk response for risk analysis process.
4. To make recommendations monitor and control risks or minimize the risk.

IV. STUDY SCOPE

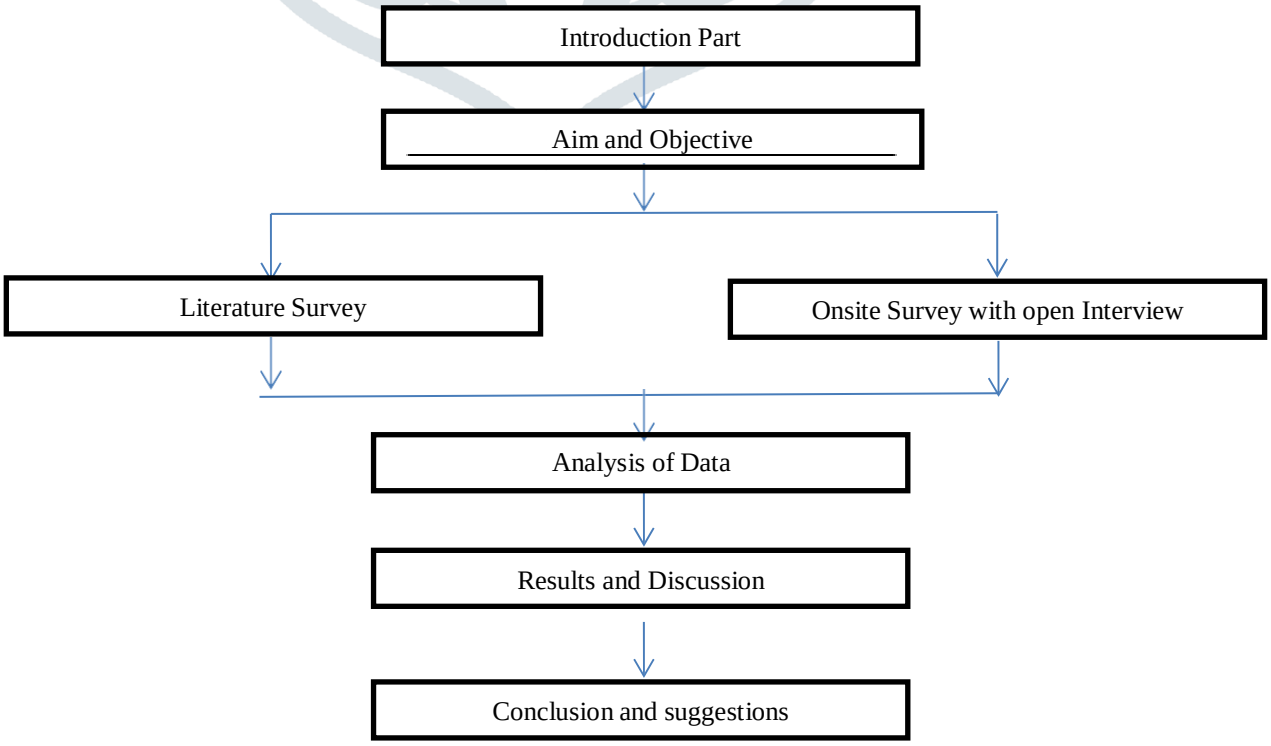
A risk analysis for a metro rail project is a crucial aspect that defines the boundaries' and objective of the study. It outlines what the study will cover and helps stakeholders understand the focus and limitations of the risk analysis. Here are some key elements to consider when defining the scope of the study for risk analysis in a metro rail project:

1. **Project Overview**
2. **Risk Categories**
3. **Project Phases**
4. **Geographical and Environmental Considerations**
5. **Risk Identification**
6. **Data Sources**
7. **Timeframe**
8. **Assessment Criteria**
9. **Mitigation Strategies**
10. **Reporting and Documentation**

By clearly defining the scope of the risk analysis for surat the metro rail project, stakeholders can better understand the objectives and limitations of the study, ultimately contributing to more effective risk management throughout the project lifecycle.

V. Methods of Research

- Literature Review: Previous studies on risk analysis and risk assessment conducted by various researchers were reviewed.
- Questionnaire préparation : The questionnaires were prepared as per literature review elevated corridor surat metro rail projects.
- Data Collection & Data Analysis: The persons now or formerly involved in the project, as well as authorities of metro projects, offer the data collection for the risk involved in infrastructure projects, such as the construction of the metro train in Surat.
- Conclusion.



VI. Literature Review

Sinto K A, Ms Saranya S May 2019: The Metro rail project encompasses a spectrum of risks including financial, construction, labor, political, client, and stakeholder risks. However, this study predominantly focuses on material risks, labor, and resource risks. This paper's main goals are to investigate the many kinds of risks that are present in construction projects, especially infrastructure projects, and to assess the variables that affect risk management in these kinds of undertakings. To address the expansive scope of construction, the study employed the unstructured interview method, interviewing key personnel closely associated with the Cochin metro rail project. Based on the responses gathered, a relative importance index scale was devised, facilitating analysis and providing an overview of risk management within the Cochin metro rail project.

Shubham patil, Prof. Saharkar U R. Prof. H. H. Salunkhe Dec 2019: the risk may be available between the metro projects from Katraj to Agricultural College via Swargate and surrounding area through various parameters. To analysis the date and questionnaire survey by using RII system. The relative relevance of each risk-affected component may be ascertained using the Relative relevance Index approach. Effective risk management is crucial to the success of project management, particularly for large-scale undertakings. There are two different methods of the construction of metro rail one is elevated metro i.e. above ground level at some height and second is underground metro. Risk Identification, Risk Classification, Risk Analysis, and Risk Response are the steps in the risk management process. In Metro project this paper only focus on Financial, technical, construction and socio-technological-environmental-surrounding risk. For this project onsite survey and open interview was conducted to finalize the risk.

Guangwu Liu, Fengxiaa Luo, and Gang Zing March 2014: Based on global safety risk management theories, the Guangzhou Metro Corporation (GMC) has developed a standardized method for safety risk management in metro rail transportation projects. Standards from safety risk management files, tailored for every project by the Ministry of Housing and Urban-Rural Development of the People's Republic of China, are incorporated into this system. This approach has been implemented in several Chinese cities and has shown to be successful in guaranteeing project and personnel safety as well as raising the participants' overall safety risk management competency. This accomplishment considerably protects workers during construction, lowers financial losses, shortens project timelines, and protects the city's resources and environment. Essentially, this safety risk management system's effective execution provides a useful example.

Prathmesh Dinkar Patil and Prof Ashish Waghmare March 2022: Numerous risk management-related elements have been investigated, and the findings are discussed in relation to the risk reduction of the Mumbai Metro construction project. There are about eighteen dangers associated with the top Mumbai metro area, which are divided into three categories: high, medium, and low. Market risk and land acquisition delays are among the elements that contribute most to this risk. Financial risk and planned risk are among the reasons that contribute to medium risk. Safety risk, planning, and third-party liability risk are among the factors that contribute to low risk.

Manvinder Singha and Debasis Sarkarb Nov 2017: This work seeks to provide risk mitigation methods (detection tools) for all important operations inside an Project using Fuzzy Failure Mode and Effect Analysis (FMEA) for elevated corridor metro rail and to quantify risk severity using Fuzzy Earned Value Management (EVM). Systematic approaches like FMEA and EVM are helpful in detecting hazards related to project activities. To capture the interconnection of input factors like probability, effect, and risk detection for particular operations, fuzzy logic is included into EVM and FMEA. The study concludes that a variety of activities have very high to high risk severity and Risk Priority variety (RPN) values, indicating that they are exceedingly dangerous across approaches. Feasibility and DPR, land transfer, tender and contract award, planning of the building programme, girder launch, and required span activities are some of these activities.

VII. Project Specifics

Any region's growth is anchored by the Surat Metro Transit System, which provides mobility and accessibility while enabling the smooth functioning of both urban and rural regions. One notable transit project in Gujarat is the metro rail line that runs through the city of Surat.

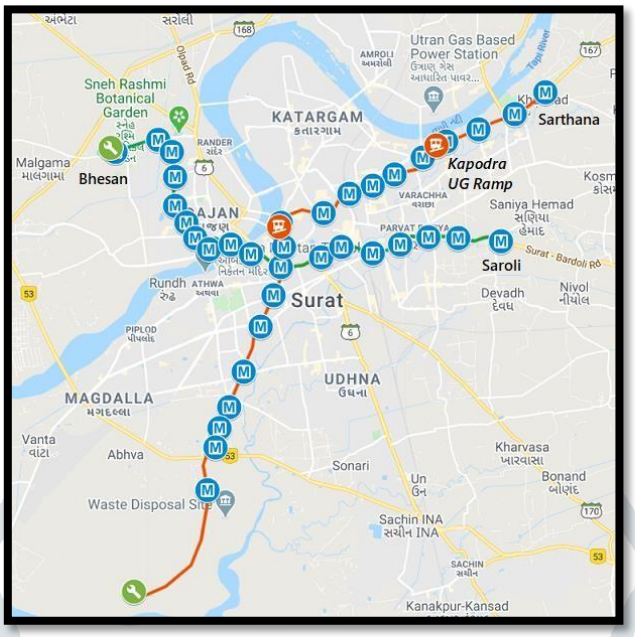
- Dream City (khajod) – Kamraj (Sarthana) (28.90 kms)
- Bhesan - Umbhel (26.30 kms)
- Majura Gate –Karamala (ved) (15.80 kms)

The East-Waste and North-South lines make up the first phase of the metro. Elevated platform and subterranean stations make up the total of thirty-eight, 38 planned stations.

Phase-1 Surat Metro Corridor route length

No	Pathways	Under ground	Level	Total
I	Sarthana to dream city	6.48 km	15.16 km	21.17 km
II	Bhesan to saroli	-	18.73 km	18.73 km
Overall		6.48 km	33.89 km	40.34 km

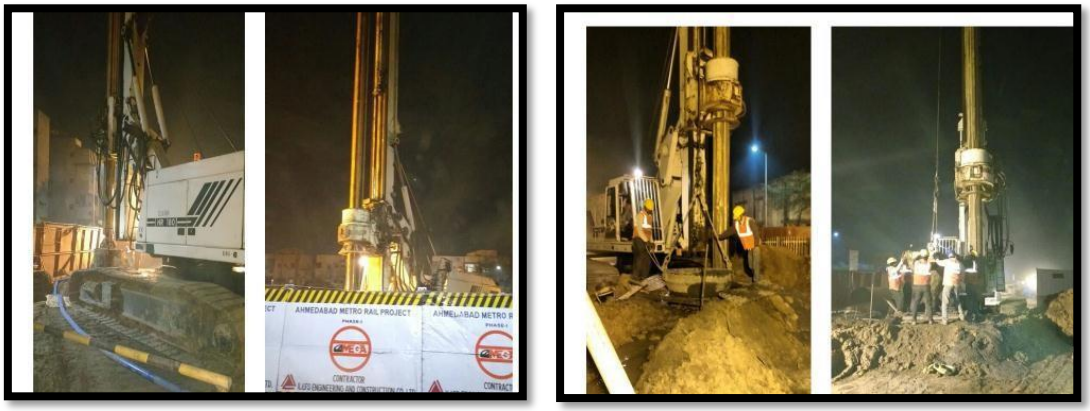
Second Phase, Majura Gate, Karamla (Ved). After assessing demand, the expansion to Karamala based on improvements to the road network and demand building may be taken into consideration. Extensions from Saroli-Umbhel and Sarthana-Kamrej/Vav can also be pursued in later stages.



Project Rout of Surat Metro

VIII. Project for the Elevated Metro Corridor in Ahmedabad: Case Study

- The case study considered for this paper is the development of the elevated corridor in Ahmedabad for metro train operations, which starts at the Gassyipur depot and finishes at Shreyas station.This corridor is covered by the 13.8 km North-South Metro line, which has four elevated stations (APMC, Jivraj, Rajiv Nagar, and Shreyas).
- The company IL & FS Company Limited is carrying out the building. There would be 136 piers and 550 piles built in all. Eleven sectors are typically needed to construct a single bridge between two nearby piers, with each sector weighing fifteen tonnes. The IL & FS Company plans to start building this portion of the viaduct, which will run from the Gassyipur depot to the Shreyas station, in around 1320 sections. Piling and pier construction was started by IL & FS Company Limited.
- The building of the Shreyas station to Gassyipur depot, excluding stations, is estimated to have cost 175 cores. The building phase of the project will take 38 months.
- The research methodology involved crafting a questionnaire to delineate the primary activities from project initiation to completion, followed by conducting surveys where inputs from experts engaged in metro rail corridor projects were utilized to determine the severity rankings of risks. Therefore, in order to finalize the questionnaire, rating scales, and responses, There were three or four rounds of talks with the chief engineer, consultants, and higher level metro employees (such as machine operators, foremen, supervisors, and engineers, in addition to site in charge, managers, and managers).
- The risk analysis was completed with regard to the degree of risk severity and the ranks of the quantitative and qualitative risk indicators.



Piling Activity - Concrete operations as well as rig operations.
(Trail: Gassyipur depot to Shreyas station via FS & IL)

IX. Questionnaire Preparation

The process of preparing a questionnaire involves identifying risks, which entails determining potential factors that could impact the project and recording their attributes. Stakeholders participating in risk identification activities may include the project manager, team members, designated risk management team (if applicable), clients, external subject matter experts, end users, additional project managers, stakeholders, and risk management specialists. Identifying risks is an iterative process, as new risks may emerge or become apparent as the project advances through its lifecycle.

Factor - Technical risk

- **Category**
  - Incomplete Design.
  - Insufficient specification.
  - Insufficient site investigation.
  - Shift in scope Construction methods as a result of the site's conditions.
  - Insufficient Resource availability on site.

Factor - Construction Risks

- **Category**
  - Labour strike on site.
  - Site situation changes.
  - Equipment fails on site.
  - Design alternate due to site condition or as per requirement Changes.

Factor - Socio- Political-Environmental -Surrounding Risks

- **Category**
  - Changes in laws and regulations for environmental protection or any other condition.
  - Language/Cultural barrier.
  - Requirement for permits and their approval.
  - Political Pressure.
  - Acquisition of Land.
  - Water Logging Problem in Rainy Season.
  - Vibration occurred below the structure due to work.
  - Insurance for all project and surrounding area.
  - Relocation risk of Project Surrounding People.
  - Natural Disasters Fighting system.
  - Traffic Diversion Problem during and after completion of project.
  - Historical Building.
  - Preservation problem during and after project.

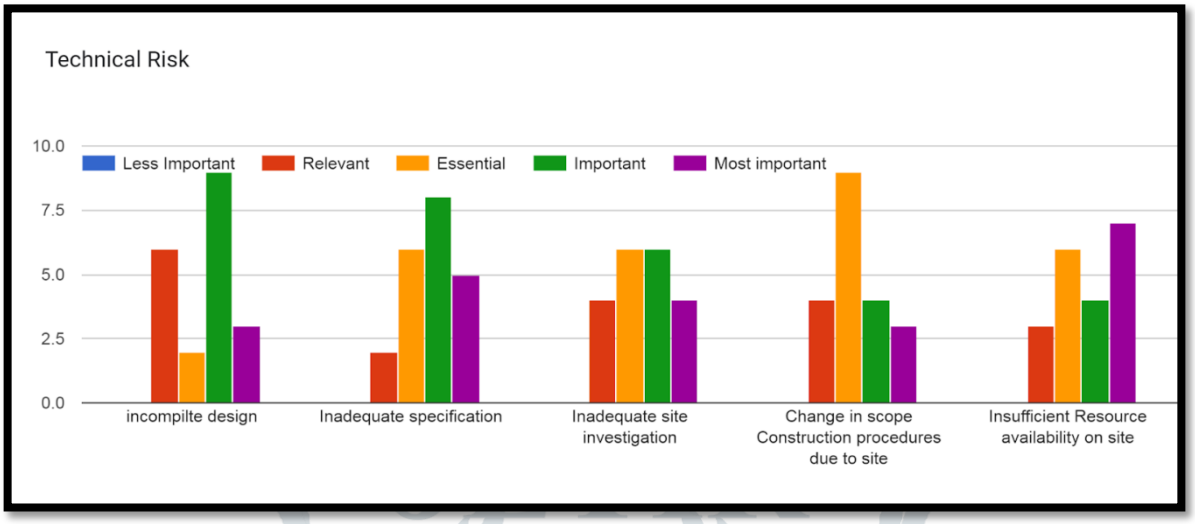
Factors - Financial Risks

- **Category**
  - Increased material cost due to delay.
  - Payment government delays by.
  - Improper estimation of project.
  - Taxes increase.

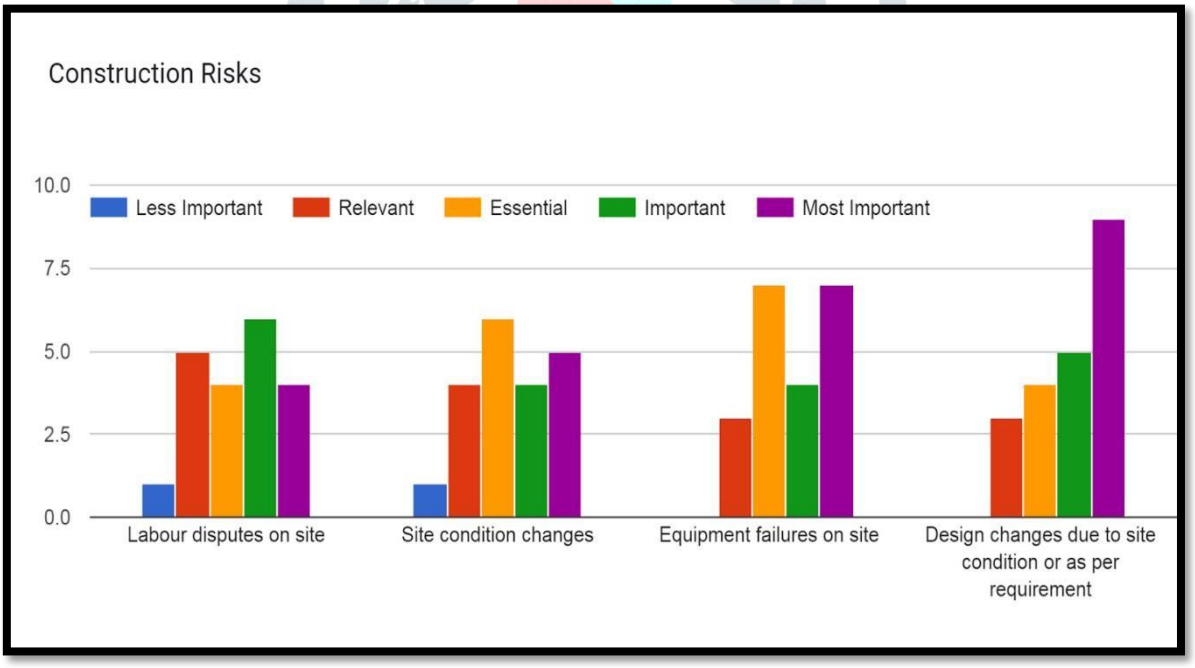
X. Data Collection

The purpose of this survey's questionnaire data was to rate the dangers mentioned above using an appropriate methodology. The survey questionnaire data consists of an abstract of four fundamental and theoretical risk factors—a mix of technical and socio-political, environmental, and surrounding risk-that have been examined in a number of research publications, review papers, and by observation.

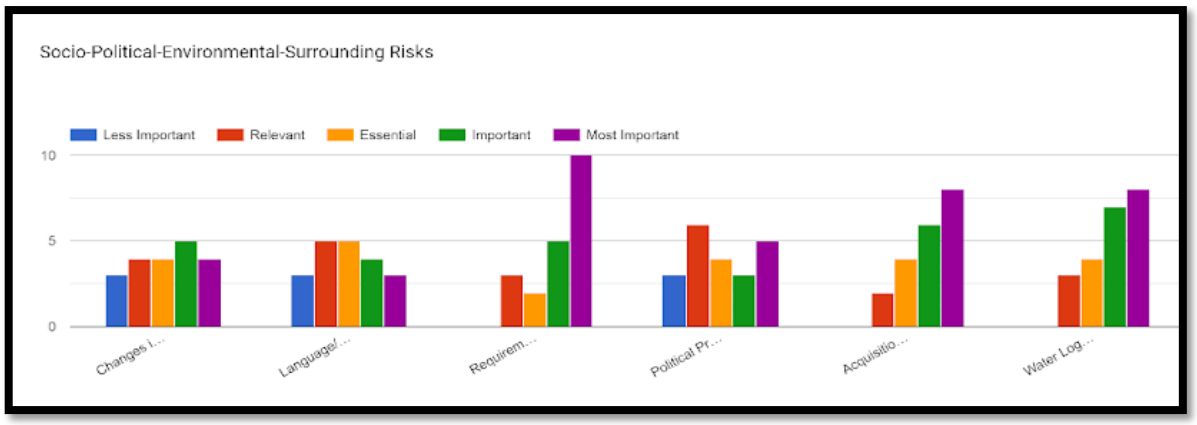
The categories for (1) Less Important, (2) Relevant, (3) Essential, (4) Important, and (5) Most Important require respondents to rate their responses. Many on-site and off-site technical personnel businesses working on the metro project, as well as adjacent local residents, received detailed questionnaires.

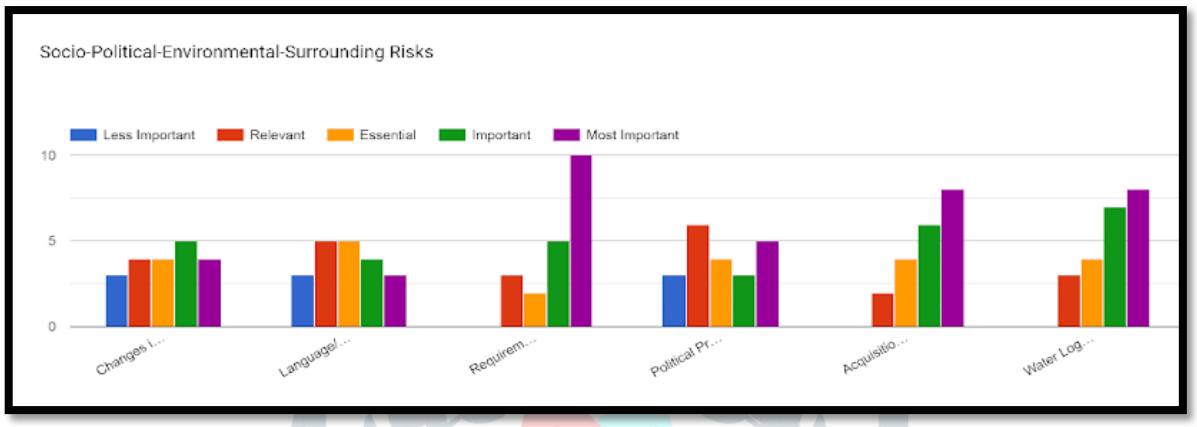


Factor -Technical risk

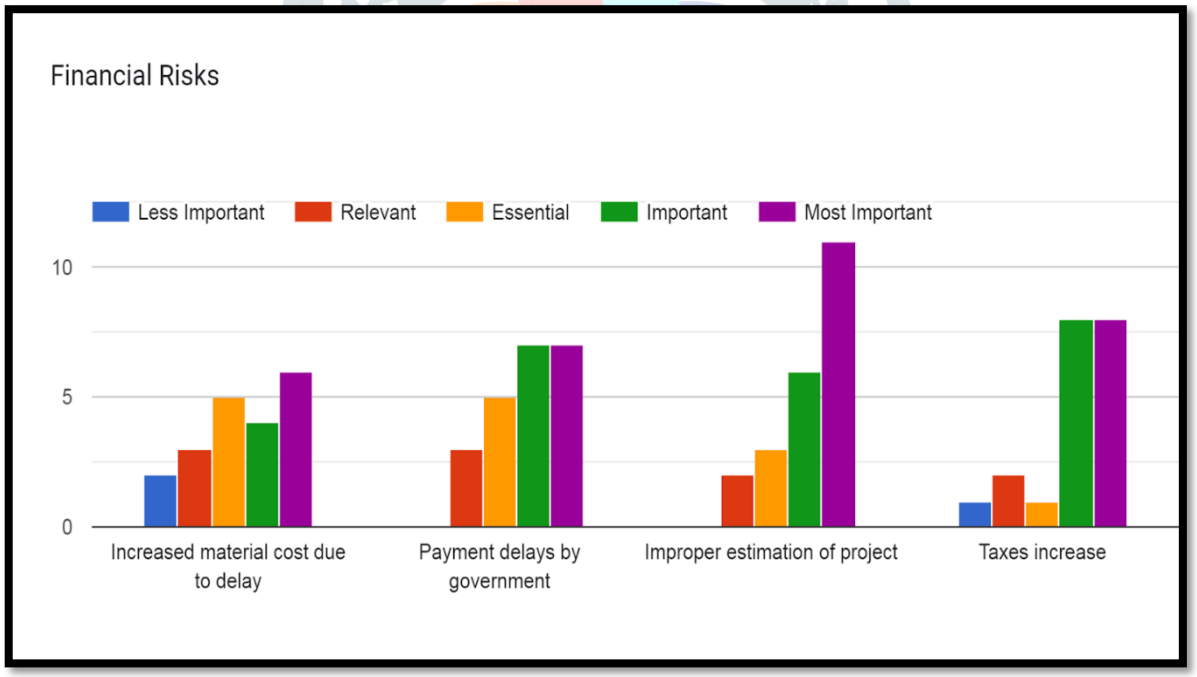


Factor - Construction Risks





Factor - Socio- Political-Environmental -Surrounding Risks



Factors - Financial Risks

XI. Data Analysis

Google forms and the Microsoft Excel software were used to analyses the respondents' input. These sections comprised the analysis, which was separated according to the questionnaire content: An examination of the Relative Importance Index (RII). Relative index analysis was used in this study to rank the criteria according to relative significance. The following formula may be used to get the relative index:

$$RII = \Sigma W / (A*N)$$

Where N is the total number of respondents, W is the weight that each component received from the respondents (which can range from 1 to 5), and A is the maximum weight (which, in this case, is 5). The greater the RII value, the more serious the risk aspects. We determined the average RII for the feedback above, and the risk variables are found above the average RII value.

Factors	Category	less important	Relevant	Essential	Important	Most Important	RII	RANK
Technical Risk	Incomplete design	2	15	9	14	12	0.673	15
	Inadequate specification	0	12	10	20	10	0.708	11
	Inadequate site investigation	0	6	21	16	9	0.708	11
	Change in scope Construction procedures due to site	2	7	17	18	8	0.688	12
	Insufficient Resource availability on site	0	6	13	20	13	0.754	6
Construction Risks	Labour disputes on site	3	12	11	16	10	0.669	16
	Site condition changes	2	12	18	9	11	0.658	17
	Equipment failures on site	0	7	18	14	13	0.727	10
	Design changes due to site condition or as per requirement	4	6	10	22	10	0.708	11
Socio-Political-Environmental-Surrounding Risks	Changes in laws and regulations for environmental protection or any other	6	9	12	18	7	0.642	18
	Language/Cultural barrier	3	13	16	11	9	0.638	19
	Requirement for permits and their approval	1	7	11	19	14	0.746	8
	Political Pressure	2	12	11	17	9	0.675	14
	Acquisition of Land	0	4	12	21	15	0.781	4
	Water Logging Problem in Rainy Season	1	6	6	20	19	0.792	3
	Vibration occurred below the structure due to work	1	5	13	17	15	0.757	5
	Insurance for all project and surrounding area	0	7	14	16	15	0.750	7
	Relocation risk of Project Surrounding People	1	10	17	12	10	0.680	13
	Natural Disasters Fighting system	1	6	12	25	8	0.727	10
	Traffic Diversion Problem during and after completion of project	3	4	5	15	25	0.812	1
	Historical Building Preservation problem during and after project	3	4	6	16	23	0.800	2
Financial Risks	Increased material cost due to delay	2	10	12	19	9	0.688	12
	Payment delays by government	12	14	9	8	9	0.554	20
	Improper estimation of project	11	14	12	8	6	0.537	21
	Taxes increase	2	8	7	20	14	0.741	9

XII. Conclusion

a) Effective risk management in major projects is a critical component of project management success. There are two distinct approaches to building a metro rail system: elevated metro, which is built at a height above ground, and subterranean metro.
b) Risk identification, analysis, evaluation, response, and treatment are the steps in the risk management process. This article only focuses on the financial, technical, construction, socio-technological, environmental, and surrounding risks related to the Metro project in order to identify the components using likart's scale alone.
c) For this project onsite survey and open interview was conducted to finalize the risk.
d) As per feedback 2 are major risk factors, 21 are high medium factors, while 2 are medium factors of risk.

XIII. Work Limitation

The fact that the risk severity calculations rely on data from the questionnaire survey is a significant study drawback. The suggested integrated risk analysis may be strongly impacted by how well the replies were received. Nonetheless, this constraint is lessened by arranging brainstorming meetings in various places or areas. The questionnaire survey took a long time, as did the data computation that followed. Furthermore, field specialists in metro rail showed insufficient participation and enthusiasm in these kinds of endeavors.

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