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A SYSTEMATIC APPROACH FOR EVALUATION OF RISK MANAGEMENT IN ROAD CONSTRUCTION PROJECTS - A MODEL STUDY

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ABSTRACT

Generally, infrastructure projects carrya substantial risk. Mainly, this paper points out the risks related to the road construction projects in India. As India is a rapidly growing country to meet the transportation needs, road construction projects are given major importance. This paper focuses on identifying thecommon risks in infrastructure projects. Almost 44 major risks were identified through arigorous literature survey. Out of which top 13 most common risks are collected by aquestionnaire survey of construction professionals. Their opinions are analyzed by using SPSS software. The data are given weightage based on importance and probability of occurrence and are ranked accordingly. This data helps the project manager to better estimate the priority of risks and helps them in developing proper mitigation measures at the initial stage of the project itself to save cost and time.

Key words: Risk Management, Infrastructure, Road Construction, Risk Identification, SPSS.

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1. INTRODUCTION

The combination of the probability of an event and its impact on the project objectives is termed as the risk. Most of the studies have said that the road construction projects have higher risks associated with them than other construction projects because the road construction projects are spread over a wider geographic area and are also facing a threat from the underground conditions. The benefits of the risk management include identifying and analyzing the risks beforehand and adopting appropriate measures and process of improving the construction resulting in better management. This process aims in identifying the potential risks associated with a project and responding to those risks. Risk management is a key to helping the project participant like the contractor or developer, client, consultant and the suppliers to meet their commitments and minimization of negative impacts on the construction cost performed in relation to the time, money and quality of the objectives.

2. DESCRIPTION OF STUDY AREA

The risk management is multi-dimensional as there are a number of factors affecting the overall project. The lack of proper planning and the associated uncertainty of expected outcomes leads to either better or worst conditions which are known as risk. Types of risks can be categorized as external risk, internal risk, curtail risk and political risk, social and safety risk etc,

2.1. Project risk

Risk management involves the identification of influencing factors which impacts project cost and duration, measuring and mitigating them. Riskier the activity, the costlier will be the consequences. In case a wrong decision is taken it helps in decidingwhether to share risk with insurance companies or not. Risk cannot be totally avoided but it can be reduced.

2.2. Determination of risk

Till now there are two methods available for risk identification which are qualitative and quantitative. Qualitative analysis depends on statistics to calculate the impact of occurrence and impact of risk. Another method generates values for probability distribution based on the Monte Carlo simulation, in which process of the project is arranged in increasing and decreasing order and then calculating the risks associated with each process and listing the controls that may exist for each risk.

3. OBJECTIVES

1. To identify the various risk associated with road construction projects from critical literature study.
2. To analyze their likelihood of occurrence and their impact on the project.
3. Suggestion of effective ways of overcoming risk.

4. METHODOLOGY

The aim of this research is to study the complete risk management on the road construction project. In this process, there is the list of risks involved in the road construction projects which are identified and defining the most significant risks through the evaluation process.
Mainly the research is based on three phases
Phase I: Identifying the risk
Phase II: Evaluating the risk
Phase III: Analysing through SPSS Software

In the identification of the risks, we can identify the 44 risks and list it out. The identified risks should be grouped as the categories like Technical risk, Financial risk, Site risk, Commercial risk, Political risk, Socio-economical risks and Environmental risks. A pilot survey is done on these types of risk. A questionnaire survey is conducted to better understand the risks and their impacts. The questionnaire survey is analysed using SPSS (Statistical Package for the Social Sciences) software to get better clarity. Based on the results from SPSS software we can analyze the most highly affected factor and maximum occurring risk and adopt measures to minimize the risk occurrence.

5. STEPS IN RISK MANAGEMENT

5.1. Identifying the risk

For identifying the risks in risk management, it involves several steps or methods such as questionnaire, organizations record, flow charts, professional expertise, and onsite investigations.

5.2. Analyzing the risk

Firstly, we can identify the possible threats and then estimate the likelihood of their occurrence.
Steps to analyzing the risk include:
Step 1: Select an area of operation for analysing the risks.
Step 2: Describe the risk exposure.
Step 3: Detail the facts from the records of the previous loses.
Step 4: Probability of risk should be assessed.
Step 5: Indicate the risk controls which already exists.
Step 6: Maximum financial consequences of the risk should be estimated.
Step 7: Assess and calculate the total financial impact of the risk exposure.
Step 8: Risk management response should be determined.

5.3. Evaluating and Ranking the risk

Evaluation of risk is done depending upon the identification of the amount and the impact of risk parameter in the project. Risk Ranking is also known as Relative Risk Ranking, Risk Indexing, and Risk Matrix and Filtering. Its intent is to provide sharper focus on the critical risks within a system, typically from a large and complex set of risk scenarios.

5.4. Monitoring and reviewing the risk

The ultimate aim is to remove or reduce the hazards of different risks which can be done by regular monitoring and it includes:

- Impact identification
- Identifying which is more harmful and how
- Making a decision based upon hazards of risk to eliminating
- Apply suitable solutions for the findings
- Apply mitigation measures after the incident

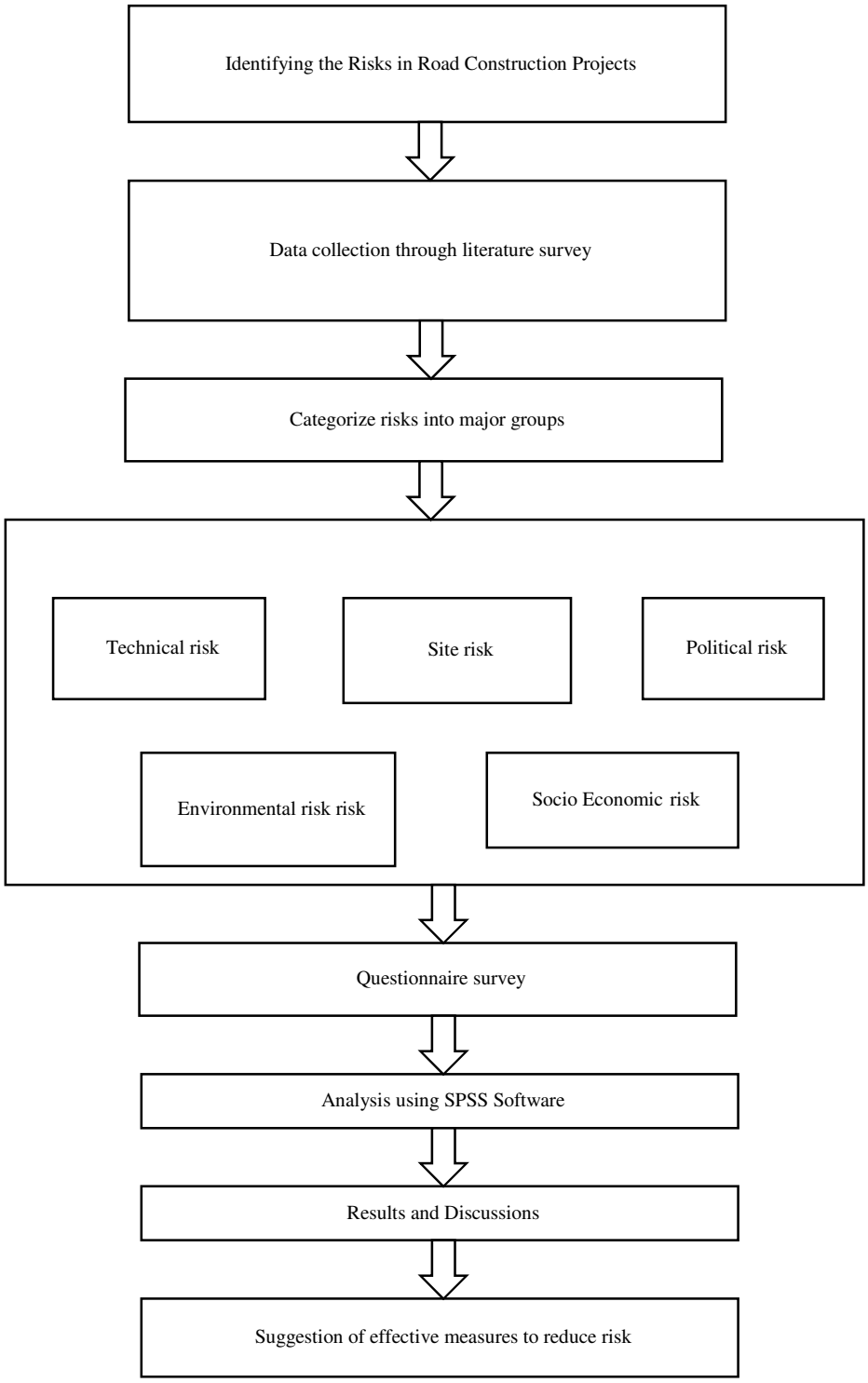

Figure 1 Flowcharts represents a detailed Methodology

6. QUESTIONNAIRE SURVEY AND RESULT ANALYSIS

A detailed questionnaire survey is prepared through critical literature review and a pilot survey. The reported participants in this study are the construction professionals, transportation department, A/E consulting companies, contractors, subcontractors, design firms, R&B department and the authorities of NHAI. A total of 44 risk factors were identified from the previous studies. They were grouped into 5 broad categories: Technical risk, Site risk, Political risk, Environmental risk and Socio-economic risk. The responders are provided with the information about the project as well as the pre-identified risk factors that are usually encountered in road construction projects. The impact assessment on road construction project are based on the Likert scale: very low, low, moderate, high, very high. These results are imported on the SPSS software for analyzing.

6.1. Technical risk

The factors under technical risks which are being analyzed are as follows:

6.1.1. Owner changes

The owner might make changes last minute changes due to which the project will become paralyzed and there might be miscommunication between the parties involved which will result in unnecessary confusion and finally time overrun and cost over-run.

Table 1 Effect of Owner Changes on Risk

	Frequency	Percent	Valid Percent	Cumulative Percent
Very Low	8	38.1	38.1	38.1
Low	5	23.8	23.8	61.9
Moderate	4	19.0	19.0	81.0
High	4	19.0	19.0	100.0
Total	21	100.0	100.0	

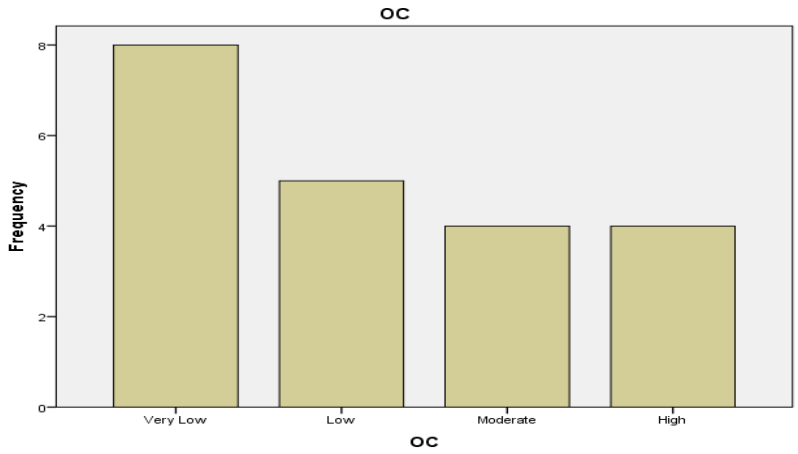

Figure 2 Bar chart on owner changes

More than 60 % respondents agree that the effect of owner change is mostly low to very low. Therefore, we can conclude that it has a negligible effect on the overall risk of the project. This maybe because the last-minute changes or owner transitions has been taken care of by efficient communication and proper management.

6.1.2. Inefficient Planning

Inefficient planning and improper scheduling may result in insufficient resources, non-availability of resources at the right time and place, loss of time, energy and money. With this loss of time and money risk also increases.

Table 2 Effect of Inefficient Planning on Risk

	Frequency	Percent	Valid Percent	Cumulative Percent
Very Low	5	23.8	23.8	23.8
Low	2	9.5	9.5	33.3
Moderate	3	14.3	14.3	47.6
High	6	28.6	28.6	76.2
Very High	5	23.8	23.8	100.0
Total	21	100.0	100.0	

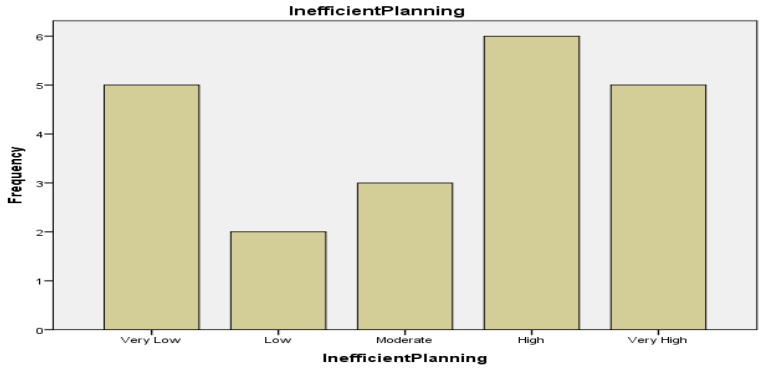

Figure 3 Bar chart on Inefficient Planning

More than 66 % of experts believed that the effect of inefficient planning on risk is moderate to very high, whereas 34 % of experts agreed to its effect being low to very low. Thus, we can conclude that this factor will have considerable effect on the overall project risk.

In order to overcome this problem prior efficient planning and scheduling is required so that all necessary arrangements can be made as and when required. In order to ensure efficient planning, the expert opinions can be considered.

6.1.3. Resource

Resources should be managed at the right time at the right place. Misuse of the resources will lead to cost overrun.

Lack of resources will highly affect the technical risk. From the analysis, it is clear that the effect of resources is moderate to high therefore we can conclude that it has considerable effect on the overall risk of the project. There it is very important to ensure proper resource management.

Table 3 Effect of Resources on Risk

	Frequency	Percent	Valid Percent	Cumulative Percent
Very Low	2	9.5	9.5	9.5
Low	6	28.6	28.6	38.1
Moderate	4	19.0	19.0	57.1
High	7	33.3	33.3	90.5
Very High	2	9.5	9.5	100.0
Total	21	100.0	100.0	

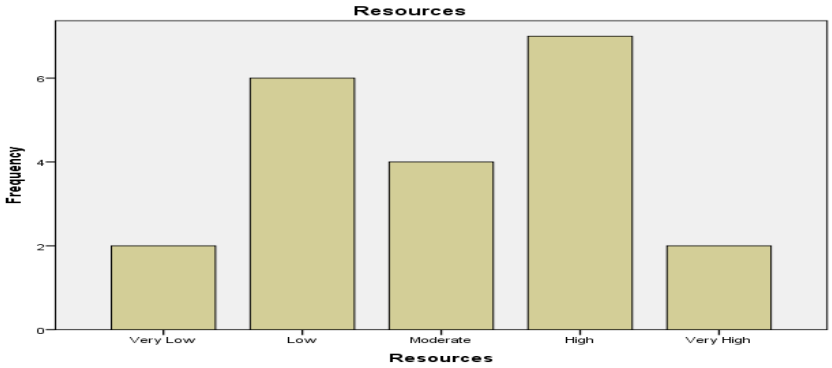

Figure 4 Bar chart on Resources

6.2. Site risk

6.2.1. Existing Traffic

Generally, in urbanizedareas, it is difficult to construct new projects as there are a number of obstructions to the progress of the work. The existing traffic on the proposed road will have to be stopped or diverted for undertaking the new construction.

Table 4 Effect of Existing Traffic on Risk

	Frequency	Percent	Valid Percent	Cumulative Percent
Very Low	5	23.8	23.8	23.8
Low	6	28.6	28.6	52.4
Moderate	4	19.0	19.0	71.4
High	6	28.6	28.6	100.0
Total	21	100.0	100.0	

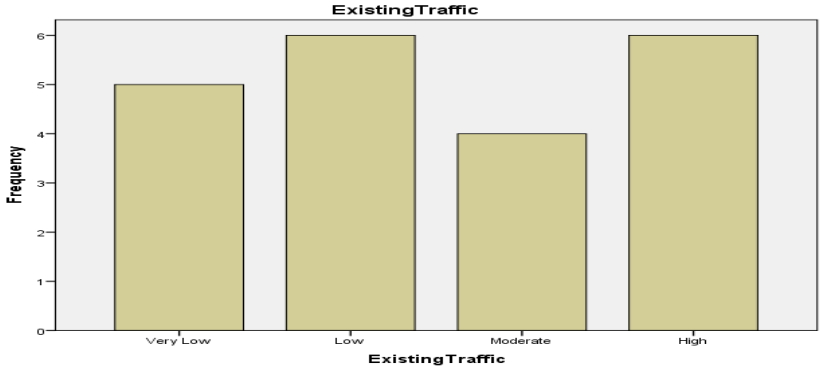

Figure 5 Bar chart on Existing Traffic

From the analysis, it is seen that 50 % respondents agreed very low to low and 50 % to moderate to high. Therefore, it is difficult to say about the effect of existing traffic on the overall project risk. Further analysis will have to be conducted to exactly undertint its effect.

6.2.2. Force Majeure

Unforeseen political authorities, local authorities and landlord pressures on constructional work will result in the permanent or temporary stoppage of the project.

Table 5 Effect of Force Majeure on Risk

	Frequency	Percent	Valid Percent	Cumulative Percent
Very Low	3	14.3	14.3	14.3
Low	2	9.5	9.5	23.8
Moderate	14	66.7	66.7	90.5
High	2	9.5	9.5	100.0
Total	21	100.0	100.0	

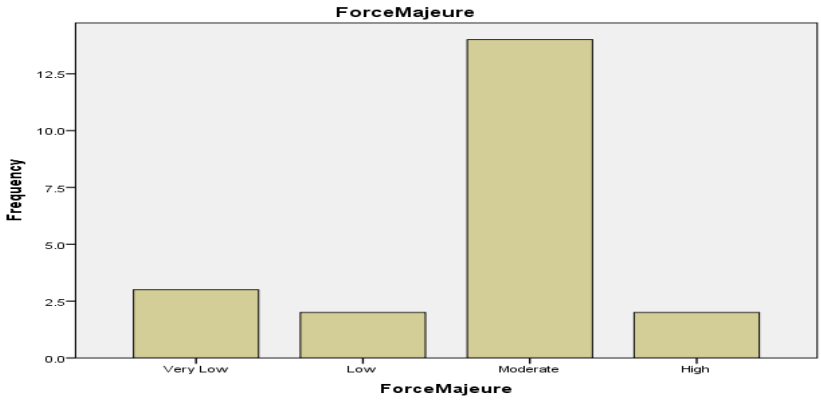

Figure 6 Bar chart on Force Majeure

67% of respondents agreed that force Majeure moderately contributes the risk. It is clear that force majeure effect is moderate to high effect on the overall risk of the project. In order to prevent this risk from arising, all legal documents and sanctions required form various government and non-government organization/ parties must be obtained beforehand in a proper legal manner.

6.2.3. Unforeseen soil conditions

Quicksand or rehabilitated sand or damped sands may delay the work since soil improving techniques will have to be carried out in order to improve the soil strength and bearing capacity so that it can support the structure. Also, if the soil conditions are not known and the structure is constructed without undertaking soil improvement techniques then there is always a risk of the structure partially/completely collapsing, cracking or sinking.

Table 6 Effect of Unforeseen soil conditions on Risk

	Frequency	Percent	Valid Percent	Cumulative Percent
Very Low	4	19.0	19.0	19.0
Low	1	4.8	4.8	23.8
Moderate	8	38.1	38.1	61.9
High	4	19.0	19.0	81.0
Very High	4	19.0	19.0	100.0
Total	21	100.0	100.0	

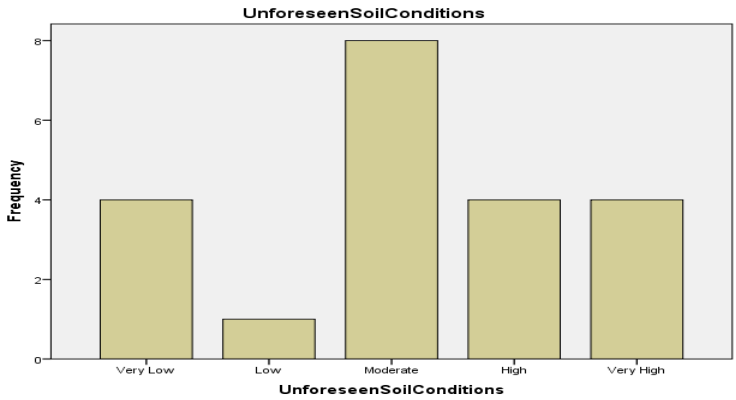

Figure 7 Bar chart on unforeseen soil conditions

76 % of respondents agreed that the effect of unforeseen soil conditions is moderate to very high and will contribute to risk, if they occur. Therefore, we can conclude that it has a substantial effect on the overall risk of the project. In order to minimize this risk, it is important to conduct a detailed soil investigation and the soil profile has to be thoroughly studied before designing the substructure. The substructure design must be based on the soil profile.

6.3. Political risk

6.3.1. Government relations

Improper government relations result in rejection of NOC's.

Table 7 Effect of Government relations on Risk

	Frequency	Percent	Valid Percent	Cumulative Percent
Very Low	4	19.0	19.0	19.0
Low	5	23.8	23.8	42.9
Moderate	8	38.1	38.1	81.0
High	2	9.5	9.5	90.5
Very High	2	9.5	9.5	100.0
Total	21	100.0	100.0	

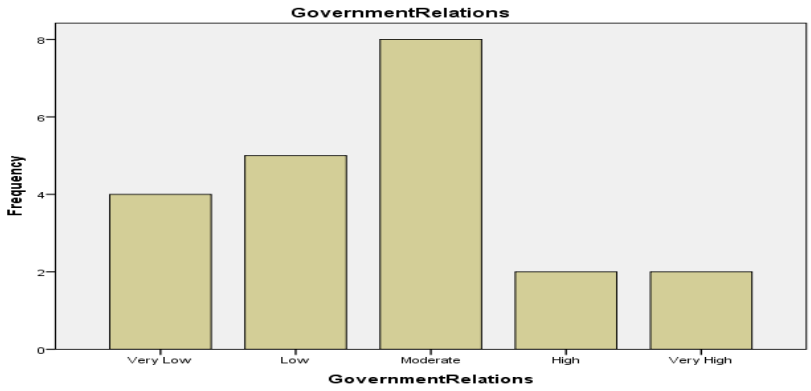

Figure 8 Bar chart on Government Relations

81 % of experts agreed that government relations do not affect the political risk. From the analysis, it is clear that the effect of government relations is very low to moderate therefore we can conclude that it has a negligible effect on the overall risk of the project. If all legal documents and sanctions form various government and non-government organization/ parties are acquired in a proper legal manner through proper channels, then this risk can be eliminated.

6.3.2. Threat of war

During the period of wars, the flow of money decreases, which increases the project duration.

Table 8 Effect of Threat of War on Risk

	Frequency	Percent	Valid Percent	Cumulative Percent
Very Low	8	38.1	38.1	38.1
Low	6	28.6	28.6	66.7
Moderate	4	19.0	19.0	85.7
High	1	4.8	4.8	90.5
Very High	2	9.5	9.5	100.0
Total	21	100.0	100.0	

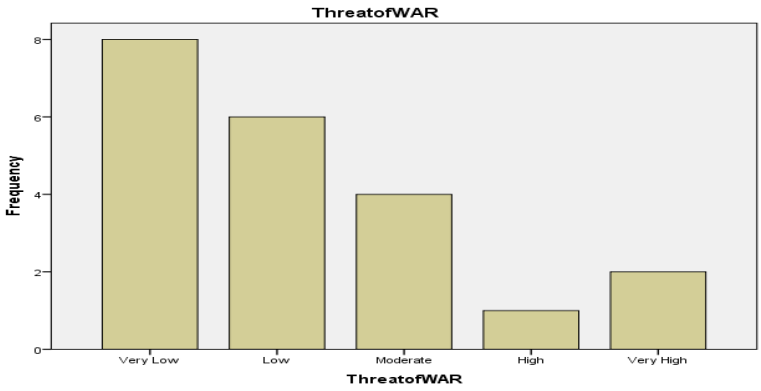

Figure 9 Bar chart on Threat of War

From the analysis, 86 % of the respondents agreed and it is clear that the effect of the threat of war is very low to moderate therefore we can conclude that it has a negligible effect on the overall risk of the project.

6.3.3. Changes in rules and regulations

When Changes in rules and regulations occur allegations with NOC's are bound to happen. Almost 50% of the people responded that these changes will moderately effect project risk due to which they have to considered as considerable risk. However, no prior precaution can be taken in this case since this is unpredictable.

Table 9 Effect of Changes in Rules and Regulations on Risk

	Frequency	Percent	Valid Percent	Cumulative Percent
Very Low	4	19.0	19.0	19.0
Low	2	9.5	9.5	28.6
Moderate	10	47.6	47.6	76.2
High	4	19.0	19.0	95.2
Very High	1	4.8	4.8	100.0
Total	21	100.0	100.0	

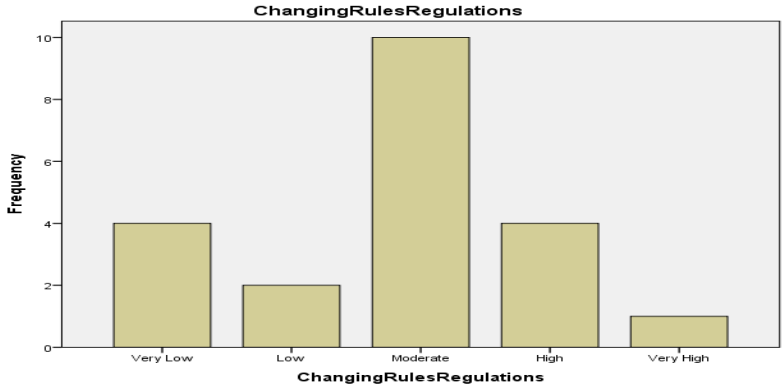

Figure 10 Bar chart on Changing Rules and Regulations

6.4. Environmental risk*:*

6.4.1. Site contamination

Waste and dust pollution cause delay of work progress since labours find it difficult to work and operate equipment's in a polluted environment. Site contamination does not affect the environmental risk because it contributes moderately. From the analysis, it is clear that 76 % of the respondents have agreed that the effect of site contamination is low to moderate therefore we can conclude that it has a negligible effect on the overall risk of the project.

Table 10 Effect of Site contamination on Risk

	Frequency	Percent	Valid Percent	Cumulative Percent
Very Low	2	9.5	9.5	23.8
Low	5	23.8	23.8	33.3
Moderate	8	38.1	38.1	71.4
High	3	14.3	14.3	85.7
Very High	3	14.3	14.3	100.0
Total	21	100.0	100.0	

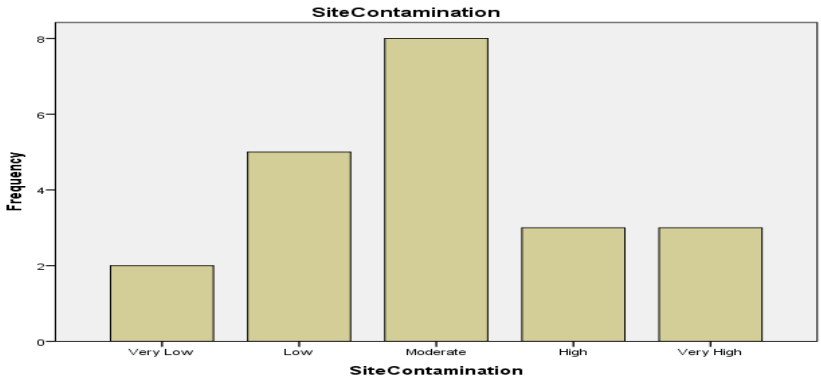

Figure 11 Bar chart on Site Contamination

6.4.2. Adverse climatic conditions

Extreme summer and winter can stop/delays the work due to the extreme temperatures and comforts of labor. Labourers find it very difficult to work in such conditions due to which their productivity will be very low which will directly result in cost and time overruns and their associated risks.

Table 11 Effect of Adverse Climatic Conditions on Risk

	Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Very Low	2	9.5	9.5	9.5
Low	7	33.3	33.3	42.9
Moderate	3	14.3	14.3	57.1
High	7	33.3	33.3	90.5
Very High	2	9.5	9.5	100.0
Total	21	100.0	100.0	

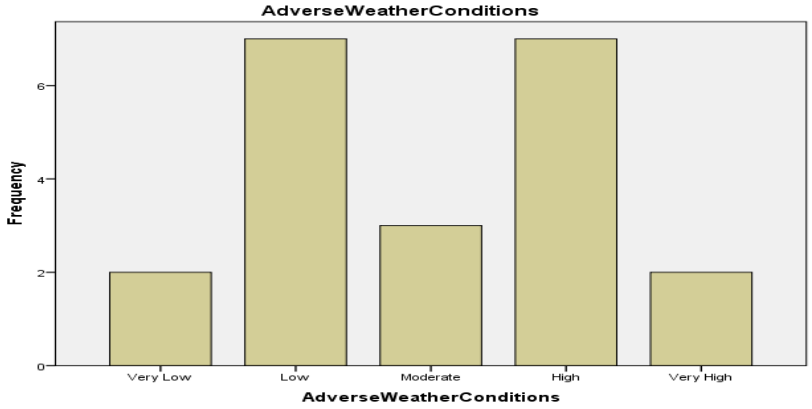

Figure 12 Bar chart on Adverse Weather Conditions

From the analysis, it is seen that 42.8% people agreed to very low to low affect and at the same time 42.8% agreed to high to very high effect. While 14.3% agreed to a moderate effect. Since the response is not clear we cannot comment on its effect on risk unless further data is collected and analysed.

6.5. Socio-economic risk

6.5.1. Criminal acts

Misuse of construction site for criminal activities may causesocio-economic risk.

Table 12 Effect of Criminal Acts on Risk

	Frequency	Percent	Valid Percent	Cumulative Percent
Very Low	7	33.3	33.3	33.3
Low	7	33.3	33.3	66.7
Moderate	3	14.3	14.3	81.0
High	3	14.3	14.3	95.2
Very High	1	4.8	4.8	100.0
Total	21	100.0	100.0	

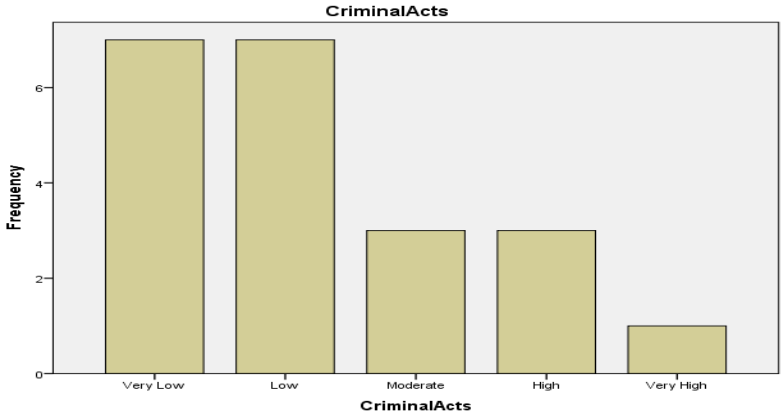

Figure 13 Bar chart on Criminal Acts

Almost 67 % of experts agreed that the effect of criminal acts on risk is very low to low, where 33 % of experts agreed to its effect being very high to moderate. Thus, we conclude that this factor may not have considerable effect on risk. This may also be because the respondents feel that such criminal activity on construction site is rare.

6.5.2. Bribes

Sudden unexpected termination of work due to some expectation of extra money by the local government for giving NOC's will cause some hindrance to the work and its progress.

Table 13 Effect of Bribes on Risk

	Frequency	Percent	Valid Percent	Cumulative Percent
Very Low	8	38.1	38.1	38.1
Low	7	33.3	33.3	71.4
Moderate	4	19.0	19.0	90.5
High	2	9.5	9.5	100.0
Total	21	100.0	100.0	

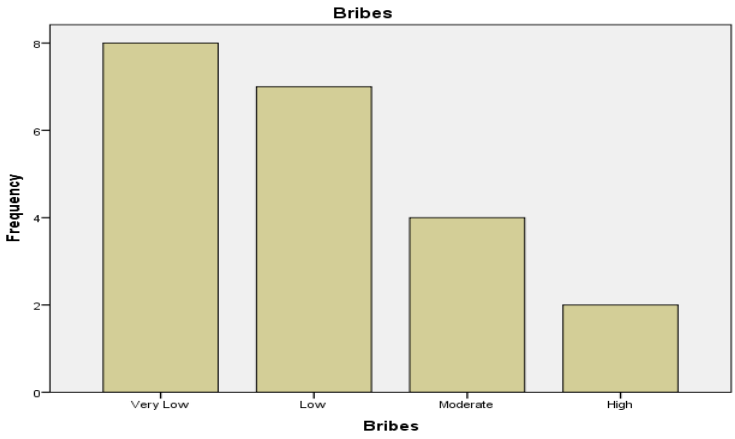

Figure 14 Bar chart on Bribes

From the analysis, it is clear that 72% of the respondents agreed the effect of bribes is very low therefore we can conclude that it has a negligible effect on the overall risk of the project.

7. CONCLUSION

Risk management in the road construction projects is an essential consideration for the completion of the project smoothly. This project identifies the risk influencing factors in road construction project, which are arranged as per the irrelative level of the significance. Assessment of risk in road construction projects is important. Assessing and identifying the risk is critical for the successful completion of the project. This study decides the key components of the risk in the construction industry. Mainly, a total 44 factors influencing risks in road constructions are analyzed through questionnaire survey. The response is analysed using SPSS software which identifies the most prominent risks and the extent to which each factor may affect the overall risk.

Factors such as Inefficient planning, Unforeseen soil conditions, Resources, Force majeure and Government issues contribute significantly to the overall risk. Political risk, Threat of war and Owner changes have considerably low impact on risk because the analysis shows their impact as being “very low” to “moderate”. Site conditions, Climatic conditions, Criminal acts, Bribes and Existing traffic can be concluded to have negligible impact on project risk. From risk analysis using SPSS it is understood which factors are affecting the project and what is their presumed impact.

Risk associated with planning and its changes can be avoided by proper and frequent updating of plans. To overcome traffic risk, suitable traffic diversion has to be provided. The risk due to site condition and climate can be reduced to some extent by using prefabricated construction. Political and government risks can be overcome by proper allocation of funds and strict monitoring of project activities. Risk due to soil conditions and other effected can be reduced by through site investigation before starting the project execution. Criminal and political risks can be reduced by taking the help of structured government bodies.

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