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Quantitative Assessment of Impact Factors for Palarivattom, Kundanoor and Vyttila Flyovers

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Abstract: ***Environmental and social impacts are common in construction industry and create major concerns for project performance. Environmental impacts are caused by many factors. The aim of this paper is to identify impact factors on three flyovers: Palarivattom, Kundanoor and Vyttila and analyze these factors with the relative importance index method. For this purpose, 24 different environmental factors were identified, categorized into three major groups through detailed literature review and interviews with experts from the construction industry. The relative importance of these impact factors was quantified by the relative importance index method. The ranking of the factors and groups were demonstrated according to their importance level on impacts. According to the case study results, the factors and groups contributing the most to impact factors (those needing attention) were discussed, and some recommendations were made to minimize and control these impacts in major construction projects.***

Keywords: EIA, Relative Importance Index (RII), Flyovers, Impact Assessment

1. Introduction

Environmental protection is an important issue throughout the world. Compared with other industries, construction is a main source of environmental pollution. Building construction and operations have a massive direct and indirect effect on the environment. Pollution sources from the construction process include harmful gases, noise, and dust, solid and liquid waste. This issue has prompted many construction participants to attempt to control the impacts of their activities by adopting environmental management systems.

Enhancing the identification of the major environmental impacts of construction processes will help to improve the effectiveness of environmental management systems. The determination of major environmental impacts will assist to consider a range of on-site measures in order to mitigate them. The environmental impacts across construction processes consists of ecosystems impact, natural resources impact, and public impact.

2. Research Objectives

This research deals with analysis and mitigation of various impacts and risk in flyover construction and aims to identify the key problems in critical areas of construction project, which have the potential to become major roadblocks in the progress of any project. The study identifies, classify of various risks and environmental impacts in a construction project, and suggests methods to mitigate risks in construction projects.

The primary objectives of the study are listed below:

- To study various risks and environmental impacts in a flyover project
- To identify the key problems in the critical areas of flyover projects which have the potential to become major road blocks in the progress of any project
- To classify various risks and environmental impacts in a project according to the relevance
- To analyze each impact individually using Relative Analysis
- Recommend plan and procedures to manage the consequences.
- To propose effective mitigation measures of the adverse impacts from the bridge construction in the project area.
- Providing practical suggestions.

3. Scope of the Study

The impact assessment work plan describes the approach to the impact assessment and facilitates discussions as to the appropriate ways to evaluate current and future risks for the project.

- It provides a systematic evaluation of almost all significant environmental consequences of a developmental project.
- It can force the policy makers to reconsider the project proposals.
- It can be used to ensure regional planning for sustainable development.
- It provides possible alternate development options against identified environmental impacts.
- It seeks public participation in decision making.
- Estimates potential human health environmental risks posed by current and potential future conditions assuming no future remediation.
- Facilitates discussions as to the appropriate ways to evaluate future and current risks.
- Any discrepancies on discussion may be addressed before the risks are calculated and the report is prepared.

- Provides a systematic approach to control and elimination of accidents at work.
- Establishes the bio-geo-physical and socio-economic conditions of the project area.

4. Literature Review

Over the past decade, efforts have been made to evaluate the environmental loads of construction projects. With the growing interest in sustainable construction, it has gained importance to evaluate the environmental impact of construction practices. Many researchers have conducted studies on the environmental evaluation of infrastructure projects.

Penadés-Plà V. *et al.* (2020) in paper "Environmental and Social Impact Assessment of Optimized Post-Tensioned Concrete Road Bridges" showed that it carried out a complete life cycle assessment of three bridges: two box-section post-tensioned concrete road bridges, with different initial and maintenance characteristics, sustainability and a pre-stressed concrete precast bridge. For this purpose, the environmental and social pillars were evaluated following the LCA methodology.

Liu C. et al. (2019) in paper "Life-Cycle Assessment of Concrete Dam Construction: Comparison of Environmental Impact of Rock-Filled and Conventional Concrete" showed that a hybrid LCA model is applied in this study to evaluate the environmental load of a dam's lifetime and compare the environmental impact of RFC relative to CC throughout the life cycle of a dam, which fills the gap of the environmental evaluation and comparison on dam constructions in the planning phase.

Hasan I. *et al,* (2018) in paper "Environmental Impact Assessment: Integrated Evaluation of Bridge Construction Projects in Bangladesh" identifies the potential positive and negative environmental, social and economic impacts of the project.

Akanni P.O, Oke A. E. and Akpomiemie O.A. (2015) in paper **"**Impact of environmental factors on building project performance in Delta State, Nigeria" asserted that the identified variables categorized under six clusters of economic and financial, construction technology and resources, political, legal, social and cultural and physical factors, had been quantitatively analyzed and evaluated and their significant relationship with time and cost overruns had also been statistically established.

Gündüz M., Nielsen Y. and Özdemir M. (2013) in paper "Quantification of Delay Factors Using the Relative Importance Index Method for Construction Projects in Turkey" demonstrated that delays can be avoided or minimized when their causes are clearly identified.

5. Data Collection

Questionnaires survey was distributed to different persons living or working within 1 km radius of the flyover. Total questionnaires are gathered in two methods, firstly through personal interview, which was face-to-face process with the respondents and another method was through online survey with the aid of Google forms. The respondents are allowed to ask questions with a brief explanation for the ideas and contents of questionnaire, conducted. Result would show the present scenario of risk and impacts in bridge construction projects.

6. Methodology

This research is focusing on the intrinsic area of risk and environmental analysis, carrying out in a systematic manner. The literature review included academic journals, books and other published materials. The research methodology of the study included the process to classify the awareness on implementation of risk and environmental impact analysis in flyover construction projects. To provide a foundation, several structured questionnaires was developed, which was followed throughout the project. Extensive literature was reviewed in the form of academic journals, books and published content.

The following sequence was then decided. The various steps in analyzing are:

- Develop questionnaire to identify critical environmental impacts
- Identify survey participants
- Questionnaire survey & Interviews of selected participants
- Data analysis of survey by Relative Analysis
- Quantify impact of environmental factors on project
- Formulate the analysis guidelines based on the factors for Flyover construction projects
- Enumerate mitigation techniques.

5.1. Analysis Method

The relative importance index method (RII) was used herein to determine engineers', locals', shop owners' and residents' perceptions of the relative importance of the identified performance factors.Relative Importance Index (RII) is used to determine the relative importance of quality factors involved. The points of Likert scale used is equal to the value of W, weighting given to each factor by the respondent.

The RII was computed as

$$\text{RII} = \frac{\Sigma \text{W}}{A\ X\ N} \quad (1)$$

$(0 \leq \text{RII} \leq 1)$

where,

W - the weight given to each factor by the respondents and ranges from 1 to 5;

A - the highest weight = 5;

N - the total number of respondents

7. Data Analysis

60 questionnaires were distributed as follows: 18 to engineers formerly worked related to any of the flyovers and 42 to locals, shop owners and residents. The respondents were asked to indicate, based on their local experience the

level of importance of each one of the identified 24 factors of performance on a five-point Likert scale as: Highly Unlikely, Unlikely, Possible/Neutral, Likely and Highly Likely.

Table 1: RII and Rankings for each factor

Factor Group	*S.I*	*Impact Factors*	*RII*	*Rank*
Natural Resources	1	Transportation Resources	0.43	15
	2	Energy Consumption on Site	0.46	14
	3	Raw Material Consumption	0.463	13
	4	Resource Deterioration	0.48	10
Ecosystem	1	Noise Pollution	0.62	5
	2	Dust Generation with Construction Machinery	0.76	1
	3	Land Pollution	0.576	8
	4	Waterborne Suspended Substances such as Lead and Arsenic	0.37	19
	5	Air Pollution	0.596	6
	6	Operations with Vegetation Removal	0.59	7
	7	Emission Volatile of Organic Compounds (VOC) and CFC	0.32	24
	8	Generation of Inert Waste	0.426	16
	9	Operations with High Potential Soil Erosion	0.64	4
	10	Water Pollution	0.466	12
	11	Inert Water	0.36	20
	12	Chemical Pollution	0.356	21
	13	Landscape Alteration	0.43	2
	14	Toxic Generation	0.42	17
	15	Waterborne Toxicities	0.35	22
	16	Greenhouse Gas Emission	0.33	23
Public/ Socio-Cultural	1	Site Hygiene Condition	0.47	18
	2	Social Disruption	0.57	3
	3	Land Use	0.67	9
	4	Public Accidents	0.39	11

8. Results and Discussions

A wide range of panel was interviewed to rank the frequency of common environmental impacts across construction of the 3 flyovers: Kundanoor, Palarivattom and Vyttila in Kochi, Ernakulam based on the five-point Likert Scale. About 70 percent (n=42) of the interviewees had an experience of more than 1 year of residing in the locality, and approximately 30 percent (n=18) had less than 1 year of experience.

From the above calculations, a 2D graph is plotted which is of Relative Importance Index (RII) vs. Impact factors.

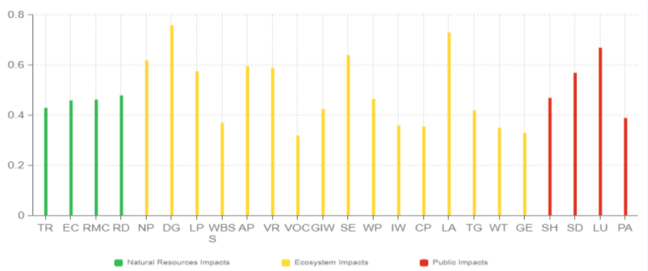

Figure 1: RII of Environmental Impact Factors

The environmental factors coming in the top 10 rank has high importance. These are the factors having high priority which are responsible for the environmental and social damages. So, by doing the analysis by Relative Importance Index (RII) analysis, it was observed that 10 impact factors from a total of 24 factors have top most effect on the 3 flyover projects.

Table 2: Most Important Impact Factors

Factors	*RII*	*Rank*
Dust Generation withConstruction Machinery	0.76	1
Landscape Alteration	0.73	2
Land Use	0.67	3
Operations with High Potential Soil Erosion	0.64	4
Noise pollution	0.62	5
Air Pollution	0.596	6
Operations with Vegetation Removal	0.59	7
Land pollution	0.576	8
Social Disruption	0.57	9
Resource deterioration	0.48	10

9. Conclusions

An extensive review of the 3 flyovers: Palarivattom, Vyttila and Kundanoor to identify major environmental impact factors is performed in the present study. Major environmental impact factors for the 3 flyover projects identified by the present study include: “Dust Generation with Construction Machinery”, “Landscape Alteration”, “Land Use”, “Operations with High Potential Soil Erosion”, “Noise pollution”, “Air Pollution”, “Operations with Vegetation Removal”, “Land pollution”, “Social Disruption” and “Resource deterioration”.

The findings of this study serve as a basis for making the following conclusions and recommendations:

- This work aims to propose a complete methodology to evaluate the environmental and social impact assessment of the flyovers in Kochi, Ernakulam using a small number of indicators.
- This methodology can be applied to other case studies. However, this study has potential limitations. One limitation is that results cannot be compared with other works as they use different methodologies.
- The results indicated that dust generation with construction machinery was the most important impact factor, as it has the first rank among all factors from the perspectives of locals, shop owners, residents and engineers.
- The results of this finding may be useful for Project managers who wish to carry out construction projects by taking cognizance of these variables especially those categorized under natural resources, ecosystem and public/ social-cultural clusters.

9.1 Recommendations

The top 10 impact factors are identified and the following are the respective recommendations provided for the constraints:

- Develop a plan. Make sure to include dust control methods, an application schedule, and application rates. For more resources on dust control plans, see this post: Dust Control Resources.

- Excavate immediately before construction instead of leaving soils exposed for months or years.
- There must be a comprehensive plan (aka master plan) that will satisfy objectives and prevent conflicts in future development, providing a blueprint for sustainable growth, while balancing social, economic, environmental, and aesthetic desires.
- Compost erosion control blanket should be used which combines nutrient-rich compost mixed with high-quality seed to create the perfect environment for quick vegetation establishment and slope stabilization.
- Schedule work during sociable hours rather than when residents are likely to be sleeping. For example, between 8 to 6pm on weekdays. We could also notify local residents of the working hours and keep them updated on the project.
- Adopt hybrid technology in place of diggers and excavators with diesel engines.
- Hire a certified arborist that works with construction projects and knows what builders are up against
- Construction material at the site and on the vehicles that carry them should be properly covered.
- Only working at reasonable times and restricting noisy activities to particular periods.

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Author Profile

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