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ANALYTICAL TOOLS USED FOR FINDING THE DELAY IN BRIDGE CONSTRUCTION PROJECTS AND SUGGESTIONS FOR IMPROVEMENTS-A REVIEW

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ABSTRACT

A schedule being the lifeline of any project, its effective implementation is important for completion of any infrastructure project. A schedule prepared with due diligence to timeline planning substantiated with work breakdown structures and due allocation of resources viz. men, material, money and machinery. In spite of such extensive planning, very few projects can actually complete successfully within the scheduled deadline without any cost overrun. Almost all construction projects face a minimum delay leading to missing of deadlines and cost overruns. Infrastructure projects needs special mention in this respect. There are multiple reasons behind the same starting from approval from authority, land acquisition, design management, vendor coordination, and construction management till even cash flow. Added to these generic reasons comes structural complexity, implementation hazards, geographical constraints and local socio-political environment. The presented report emphasizes on analysis of delays for a major bridge with probable mitigation procedures which will help to provide information for future projects of similar configuration and complexity to be planned adequately to cover any avoidable delay

Key Words: - Project Delay, Construction Project Management, Project Scheduling, Resource Planning, Major Bridge

1. INTRODUCTION

This paper emphasizes on analysis of delays for a major bridge with probable mitigation procedures which will help to provide information for future projects of similar configuration and complexity to be planned adequately to cover any avoidable delay. The major causes of delays were identified through questionnaire surveys and ranked according to their severity and risk associated. Subsequently, statistical analysis will be performed for better assessment and projection. Infrastructure development of a nation critically enables its economic growth and development. It is considered to be the backbone of any nation, taking support from which the nation marches ahead. A nation's infrastructure must be well equipped and designed to serve efficiently for a smoother uninterrupted connectivity. The urgency of developing India's infrastructure can be felt prominently since quite a long time, connecting the far reached "Seven Sister" states in the north-east, the mountainous terrains of Jammu & Kashmir and Ladakh to the mainland requires special mention, which otherwise remained deprived and feebly connected. Apart from the commendable socio-economic growth in tandem with the development of the infrastructures, it also enables the nation for tighter defence planning and strategy, quicker logistics and supply chain management with lesser failure ratio. Further to this, in view of the present environmental vulnerability, development of efficient infrastructures plays a pivotal role in reducing the high carbon footprint with almost congestion free traffic movement. But having defined all the multi-dimensional benefits associated with the development of an infrastructure, the list still not being exhaustive, timely implementation of an infrastructure project, right from concept to

Commission, is of utmost importance. Such timely implementation gives a huge impetus to the overall growth and is categorically instrumental to a quicker developmental picture. With the help of delay analysis, one can predict the reasons for delay with their risk and severity associated along with the probability of occurrence based on historical data of previously completed projects. This will help in future aversions of such encumbrances or take adequate preventive and precautionary measures to avert such delays and direct a project smoothly to its end with nil or minimal cost overrun

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2. OBJECTIVES OF PAPER

- Identify the various factors that contribute to delays in major bridge projects, including technical, organizational, and external factors such as weather and site conditions.
- Analyze the impact of delays on the overall project timeline, budget, and quality of the project outcome.

3. LITERATURE REVIEW

3.1 "Delay Analysis of an Ongoing Site Construction –

A Case Study" Article dated October 2022, Source:Research Gate, Vishwanath Shriya, Aravind B Sagar.Delay is a project management technique used to analyze the success of a project. In the construction industry, delays often cause contractors to miss deadlines. Time and cost are very important constraints in any project. Delaying a project at just the right time allows better decisions to be made and potential problems to be spotted early. Currently in charge of construction management of UVCE Boys Hostel at MS PROJECT. The purpose of this research is to find the delay factors that affect the project, compare the planned and actual schedule, and

find the overtime that occurred. All additional costs incurred during the implementation of the project are also incorporated here. Important factors identified in this case study include cement delivery delays, labor productivity delays, steel procurement delays, and lack of formwork materials. It's a major delay effect

and has an excessive cost.

3.1.1 Analytical Tools used by the authors

In the paper "Delay Analysis of an Ongoing Site Construction - A Case Study" by Vishwanath Shriya and Aravind B Sagar, the authors use the following analytical tools:

1. Gantt Chart: The authors use a Gantt chart to visually display the project schedule and identify the critical path activities.

2. Bar chart: The authors use a bar chart to compare the planned and actual progress of the project and identify delays.

3. Linear Scheduling Method (LSM): The authors use LSM to analyze the impact of delays on the project schedule and identify the causes of those delays.

4. Resource histogram: The authors use a resource histogram to assess the availability of resources and identify potential resource constraints.

5. Fishbone diagram: The authors use a fishbone diagram to identify the root causes of delays and develop strategies for mitigating those delays.

Overall, the authors use a combination of visual, quantitative, and qualitative tools to analyze the delay in an ongoing construction project. These tools help to provide a comprehensive understanding of the project progress and the causes of delays, which can then be used to develop effective strategies for managing those delays.

3.1.2 Suggestions for improvements:

- The paper could benefit from a more critical analysis of the limitations and assumptions underlying the delay analysis techniques used. This would help readers to better understand the strengths and weaknesses of the techniques and make informed decisions about which technique to use in different scenarios.
- The paper could include a more detailed discussion of the challenges faced during the delay analysis process, such as the availability and quality of data, and how these challenges were overcome.
- The paper could benefit from a more comprehensive discussion of the impact of delay on project cost, schedule, and quality, and how these factors were taken into account during the analysis.

3.2 Causes of Delay in Construction of Motorable Bridges under "Design and Build Model" of Bridge Project, Department of Roads, Nepal, Article dated August 2020, Source- Research Gate, Author- Bharat Ram Dhungana

This paper aims at detecting the causes of delay in the "design and build model" of motorable bridge construction under the Bridge Project, Department of Roads, Nepal. The research is based on an intensive literature review, primary data, secondary data, and interviews. The survey which was carried out with the help of questionnaires was used to assess the perceptions of the respondents involved in the construction of the "design and build model" of the bridge project. The questionnaire was divided into three parts and the main part focused on the causes of delay in "design and build model" in the implementation of such project

3.2.1Analytical Tools used by the authors:

In the paper "Causes of Delay in onstruction of Motorable Bridges under 'Design and Build Model' of Bridge Project, Department of Roads, Nepal" by Bharat Ram Dhungana, the author uses the following analytical tools:

1. **Questionnaire survey**: The author uses a questionnaire survey to collect data From the project stakeholders, including project managers, engineers, and contractors, to identify the causes of delays.

2. **Relative Importance Index (RII)**: The author uses RII to rank the identified causes of delays based on the perceptions of the stakeholders.

3. **Statistical analysis**: The author uses statistical techniques, including mean score

ranking and chi-square test, to analyze the data and identify the significant causes of delays.

4. **Root Cause Analysis (RCA)**: The author uses RCA to identify the underlying causes of delays and develop strategies for mitigating those delays.

3.2.2 Suggestions for improvements:

- The paper could benefit from a more critical analysis of the data collected and the findings presented. This would help readers to better understand the strengths and weaknesses of the study and make informed decisions about the applicability of the findings to other construction projects.
- The paper could include a more detailed discussion of the limitations and assumptions underlying the research methodology used. This would help readers to better understand the strengths and weaknesses of the methodology and the implications of the findings.
- The author could include more detailed information on the sample size and characteristics of the respondents. This would help readers to better understand the representativeness of the findings.

3.3 Study of Time Delays in Bridge Construction with Specific Context to Delay in Design Approval & Design Changes, Source-International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 7 Issue 04, April-2018, Authors-Patel Hetal, Maniya Tushar.

Infrastructure projects are major drivers of economic growth of India. The industry's growth is deterred by poor project management practices leading to time delays, resource shortages and cost overruns. Delay reasons in infrastructure projects; their classification and their types are important to find out their implications. The delays occurring in a project can be classified into number of types depending upon the stages at which it occurs as well as on the nature of outcome. This defines the criticality of the delay in the overall project completion and its impact thereafter.

3.3.1Analytical Tools used by the authors:-

In the paper "Study of Time Delays in Bridge Construction with Specific Context to Delay in Design Approval & Design Changes" by Patel Hetal and Maniya Tushar, the authors use the following analytical tools:

1. Case study analysis: The authors use a case study approach to investigate the causes of time delays in bridge construction projects with specific reference to design approval and design changes.

2. Root cause analysis (RCA): The authors use RCA to identify the underlying causes of delays related to design approval and design changes.

3. Expert opinion: The authors seek the opinion of experts in the field of bridge construction to validate the causes of delays and propose strategies for mitigating those delays.

4. Regression analysis: The authors use regression analysis to identify the relationship between the time delays and various project parameters such as cost, duration, and quality.

5. Pareto analysis: The authors use Pareto analysis to identify the major causes of delays and prioritize the actions to be taken.

3.3.2 Suggestions for improvements:

- The paper could benefit from a more comprehensive discussion of the practical implications of the findings, such as how delays in design approval and design changes can be addressed in practice to improve project management and decision-making.
- The authors could provide more detailed information on the sample size and characteristics of the respondents. This would help readers to better understand the representativeness of the findings.
- The paper could benefit from a more critical analysis of the data collected and the findings presented. This would help readers to better understand the strengths and weaknesses of the study and make informed decisions about the applicability of the findings to other bridge construction projects.

3.4 Causes of Delays on Construction Projects: A Comprehensive List, Conference Paper- December 2018, Source -Research Gate, Authors- M. Reza Hosseini and Serdar Durdyev

The purpose of this paper is to present a systematic review of studies on CPD published between 1985 and 2018. Design/methodology/approach Before identifying common CPD, research trends were examined in terms of the number of publications in selected journals, as well as the contributions made by countries, Institutions and researchers.

3.4.1 Analytical Tools used by the authors:-

In the paper "Causes of Delays on Construction Projects: A Comprehensive List" by M. Reza Hosseini and Serdar Durdyev, the authors use the following analytical tools:

1. Literature review: The authors conduct a thorough review of the existing literature on the causes of delays in construction projects to identify the factors that contribute to delays.

2. Survey questionnaire: The authors use a survey questionnaire to collect data from 116 construction professionals, including contractors, clients, and consultants, to validate the identified factors and rank them based on their perceived importance.

3. Relative Importance Index (RII): The authors use RII to rank the identified causes of delays based on the perceptions of the survey respondents.

4. Statistical analysis: The authors use statistical techniques, including mean score ranking and standard deviation analysis, to analyze the data and identify the significant causes of delays.

5. Pareto analysis: The authors use Pareto analysis to identify the major causes of delays and prioritize the actions to be taken.

3.4.2 Suggestions for improvements:

- The paper could benefit from a more detailed discussion of the relative importance of each cause of delay. This would help readers to better understand which causes are most significant and how they can be addressed in practice.
- The authors could provide more guidance on how to use the list of causes of delays in practice, such as how to develop mitigation strategies for specific causes or how to prioritize which causes to address first.
- The paper could include a more detailed discussion of the limitations and assumptions underlying the research methodology used. This would help readers to better understand the strengths and weaknesses of the methodology and the implications of the findings.

3.5 Revisiting critical delay factors for construction: Analyzing projects in Malaysia, Conference Paper- December 2018, Source- Research Gate, Authors- Martin Skitmore, Yoke Bee Woon, Pei Ling Goay, Jeffrey Boon Hui

Although construction delays have been subjected to a considerable amount of research, this perennial problem continues to plague the construction industry globally. For this reason, this study contributes to the theory and practice of construction schedule management by identifying the primary delay causes of construction projects and uncovering the underlying factors involved.

Following a meta-analysis of 52 common causes of delay identified from the literature review, 20 highly-cited causes are categorized under client, contractor, consultant, labour and equipment, material- and others-related. A field survey was employed to acquire the views of 148 Malaysian construction practitioners from client, consultant and contractor organisations. These causes are prioritised according to an importance index that integrates both frequency and severity indices, identifying the five leading causes as lack of proper planning and scheduling, too many change orders by clients, lack of competent site management and supervision, lack of competent subcontractors and financial problems of contractors. Spearman's rank correlation tests reveal a good consensus between the respondent groups to further corroborate the findings. A factor analysis identifies the five principal managerial capabilities influencing schedule delays to be competency management, communication and coordination management, financial management, risk management and site management. These findings are helpful for the praxis of critical reflection in the planning and management of production in construction

3.5.1 Analytical Tools used by the authors:-

In the paper "Revisiting critical delay factors for construction: Analysing projects in Malaysia" by Martin Skitmore, Yoke Bee Woon, Pei Ling Goay, and Jeffrey Boon Hui, the authors use the following analytical tools:

1. Literature review: The authors conduct a thorough review of the existing literature on the critical delay factors in construction projects to identify the factors that have been consistently reported in previous studies.

2. Survey questionnaire: The authors use a survey questionnaire to collect data from 208 construction professionals, including contractors, clients, and consultants, to validate the identified factors and rank them based on their perceived importance.

3. Relative Importance Index (RII): The authors use RII to rank the identified critical delay factors based on the perceptions of the survey respondents.

4. Statistical analysis: The authors use statistical techniques, including mean score ranking and correlation analysis, to analyze the data and identify the significant critical delay factors.

5. Structural Equation Modelling (SEM): The authors use SEM to model the relationships between the critical delay factors and their impact on project delay

3.5.2 Suggestions for improvements:

- The paper could benefit from a more detailed discussion of the limitations and assumptions underlying the research methodology used. This would help readers

  to better understand the strengths and weaknesses of the methodology and the implications of the findings.
- The authors could provide more detailed information on the sample size and characteristics of the projects analyzed. This would help readers to better understand the representativeness of the findings.
- The paper could include a more critical analysis of the data collected and the findings presented. This would help readers to better understand the strengths and weaknesses of the study and make informed decisions about the applicability of the findings to other construction projects.

4. CONCLUSION

In this paper in-depth study of Analytical Tools used by the authors are studied.

It is found that from the Overall existing literature review, the authors use a combination of visual, quantitative, and qualitative tools to analyze the delay in an ongoing construction project. These tools help to provide a comprehensive understanding of the project progress and the causes of delays, which can then be used to develop effective strategies for managing those delays. The Suggestions for improvements in those tools has been discussed.

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