

# CONSTRUCTION MONITORING AND CONTROL FOR INFRASTRUCTURE PROJECT: A REVIEW

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**Abstract:** Infrastructure Project delays adversely affect road and highway infrastructure development whereas; unfavorable consequences of project delays involve cost overrun, i.e. financial issues, contractual disputes as well as delays due to equipment / material issues. Despite these risks, delays are still a prevalent problem in construction management. The implementation of project management best practices is a dominant (in control) factor for the successful completion of any infrastructure project. This paper focuses on presenting a solution for the project delay issues as well as solution for the implementation of project management initiative in monitoring and control of infrastructure project. This study helps to forecast project performance periodically and propose solutions to minimize the schedule delays. Study focuses on projects where project completion in scheduled time is constraint.

**Key Words:** Delay causes, delay factor, road and highways, systematic review, integrated solutions.

## 1. INTRODUCTION

Infrastructure is a fundamental factor of the Global Competitiveness Index (GCI), so monitoring and control leads to identification of the issues regarding infrastructure project. Thus, finding solutions to those problems plays a vital role in the successful completion of infrastructure project. Significantly, project delays must be managed and mitigated before it grows and influences project cost performance. First step of mitigating delays is the identification of causes for proposing corrective actions. This paper seeks to answer the following questions: "What are the project management initiatives that are the most appropriate for engineering in monitoring and control of infrastructure projects?" To answer the researched questions, three objectives were set:

- I. Identification of problem
- II. Identify and mitigate the difficulty and fulfill the needs of the infrastructure project
- III. Verification of the adaptability of tools and techniques proposed in the pilot project using focus groups.

According to Jalal and Koosha, applying project management (PM) knowledge to infrastructure projects and their project-

driven organisation is inevitable for optimizing resources and increasing productivity. [Ref. 8]

This paper is organized as follows: In section 2, the literature review on project management improvement initiative that contributed to this review is presented. Section 3, presents the research Methodology used, Section 4, presents the research and discussion. Finally, section 5 presents the conclusion.

## 2. LITERATURE REVIEW

1. **Junyong Ahn et al [2011]** in this paper they have discussed about the requirement of fundamental changes in how projects are planned, developed, designed, monitored, controlled and constructed for success of complex transportation projects. This paper presents a successful bridge project to identify monitor and control techniques that were effectively used for project management. A case study for the Lewis and Clark Bridge Deck Replacement project was conducted to investigate techniques that were effectively used in this complex yet successful project. Effective tools for managing cost, schedule of the project, importance of public outreach, and usefulness of the public communication plan are some of the research findings.
2. **Nimesh Gujarati and Dr. B S Balagol [2016]** This paper has addressed problems like schedule delays and cost overruns that are commonly faced in the construction industry. An in-depth study of the RCC work in a residential project in Pune was carried out by tracking the project on a monthly basis. It also points out differences between traditional project monitoring methods and the Earned value Management (EVM) method, which is one of the most effective project controlling and monitoring system. Cost Performance Index (CPI), Schedule performance Index (SPI), Earn Value, Planned Value, Actual Cost, Cost Variance and Schedule Variance are some of the topics briefly illustrated in this paper. This study finds out project performance periodically using EVM and Primavera as performance measurement tools and also aims at suggesting various alternative solutions by controlling techniques to bring back the delayed

project back on scheduled time with minimum or no cost overruns.

3. **Mr. Karan Singh et al [2015]** in their paper presents a review of speciality of the understanding areas inclusive of scope management, making plans strategies, time, and fee manage strategies thinking about Real Estate projects. It is observed, the important motives of failure of a challenge is the wrong management & manage of changes, challenge time table and challenge fee. By curtailing those three vital factors any challenge is sure to achieve a holistic manner. This paper Preliminary focus is on scope management, time management, cost management & communication management.
4. **Sofia V. Carvalho et al [2017]** this paper emphasis on providing an answer for the implementation of Project control tasks in an Engineering and Construction organisation, which became at an organizational level of Project control adulthood. In this paper three dimensions have been taken into consideration for the improvement of this proposal: People and Organisational Knowledge; Processes, Tools and Techniques and General Management System. In this paper author suggests some techniques to redefine and organisational structure appropriate to projects and mappings of tools and techniques used in projects.
5. **Nilofur Abbasi et al [2014]** in their research paper have discussed three different case studies that are about projects which had to face failure. With the help of these three different case studies of project failures, it became evident that project failure is preventable with good project planning. When a project starts to fail there are techniques to recognize and trained project managers minimize the extend of project failure or recover the failed projects as early as possible. With the help of case study we will be able to learn the causes of failure of this project.
6. **Davinder Sandhu et al [2019]** the author of this paper emphasis on aspects like expeditious land acquisition, solving operational issues, revival of languishing projects and time bound resolution of disputes in an affordable manner. Better utilization of existing sources of funding and searching for new avenues is also a key requirement. Infrastructure project sector is confronted by a number of challenges i.e: completing demands leading to insufficient budgetary support and challenges in bidding process. Public Private Partnerships (PPPs) is the need of the hour. A streamlined operations, land acquisition and financing are the major focus of this paper.

7. **Guillermo Mejia et al [2019]** this study aimed to: a) classify and determine the level of influence of the delay causes; b) find the relationship between delay causes and country's development; and c) propose recommendations for mitigating the most critical causes delays. this study proposes a frame of causes and mitigation actions as a contribution to the risk analysis of road projects in developing countries. This paper suggests that Project delay must be managed and mitigated before it grows and influences project cost performance.

### 3. METHODOLOGY

The researchers have described delay caused by different categories. The most critical delays are mentioned above in Table No.1 and they are ranked according to the severity of their delay category:

**Table No.1** - Delay caused by different categories

Delay categories	Rank
Financing issues	1
Operational issues	2
Equipment and Material issues	3
External influences issues	4
Project Planning issues	5
Contract management and skill issues	6
Design issues	7
Workforce/Labor issues	8

(Source: Delay causes in road infrastructure projects in developing countries by Guillermo Mejía)

In Financing Issues lacking cash could lead contractors to a critical situation that adversely affects the work progress, with a high chance of work disruption and delivery delays. [Ref.9].

In Operational issues, Road development process requires a number of approvals such as environmental clearance, forest clearance, railway clearance, etc. Each of these activities take considerable time and non-adherence to timelines result in cost overrun due to delays.

The researchers have found that under the category of equipment and material issues causes related to availability of construction materials, failures and maintenance of equipment as well as material management issues can be grouped together.

Under the category External Influence Issues it grouped factors with control outside of the project dominion, which could compromise the scheduled performance such as weather conditions, political/ economic risks at several stages of the project's lifecycle.

Causes related to other mainstream issues like Project Planning, Labor Issues, contract management issues and design issues are late approvals, design changes, errors/ omission of drawings and poor specifications. During construction time, several changes occur due to design failures, errors and incomplete information. Finally the author suggests that the low productivity of construction crew can adversely affect the duration of the project activities. Productivity can be affected by several factors such as training, skills, experience, motivation, delays in payments and wages, among others.

Case Study methods are approached by the several researchers to deal with the delays and disputes that occurs in infrastructure projects, According to the report prepared by KPMG on road and highway infrastructure project, Public Private Partnerships (PPPs) have been a major contributor to the success story of the roads and highway sector. The effectiveness, efficiency and acceptance of a PPP model hinges on appropriate risk allocation between the government and private developers.

Different suggestions have been brought into notice to deal with the different issues and risk managements. Mitigation actions for financial risk management include a) assure early and enough funding for the construction phase b) Provide economic resources to deal with unforeseen events along the construction time. c) Development of a comprehensive financial plan and cash flow.

Table No. 2 Framework for current funding challenges

KEY CHALLENGES IDENTIFIED		
<b>Increasing Cost</b>	Limited scope of fund raising through traditional routes	Waning interest of private sector in PPPs
SOLUTION LEVERS		
<b>Optimize costs across phases</b>	Existing sources-increased funding and new sources-to explore	Policy reforms including new PPP models

Recommendations to mitigate delays of due to equipment issues can be overcome by planning equipment maintenance program at the construction site, investing in new and reliable machinery and Proper planning procurement, transportation, storage and access to construction materials.

Recommendation and corrective measures for the issues of other delays include, shortening the time between planning and construction to avoid inflation problems, keeping up strong relationships and communication with government

agencies, implementing digital simulations such as BIM to support planning activities and Monitoring labor productivity at the construction site and implementing incentive strategies for early completion of activities.

The authors has performed in-depth comparative analysis on the existing methods of domestic and global perspective in road and highway infrastructure project. Global trends in infrastructure indicates increased focus on innovations, use of technology tools based on data and analytics to unlock operational efficiencies. In some countries like Canada, Singapore, etc focus is on creating multi model integration such as increasing use of green principles in road development and increasing use of big data analysis.

Fig.1 Problem/Solution/Benefits of Sao Paulo State Sustainable Transport Project



(Source: KPMG International Report; 2019)

4. RESULT AND DISCUSSIONS:

- The study found that, those causes related to financing issues were the most reported by the primary studies, followed by causes related to contract management, operational issues such as land acquisition.
- This review evaluated the most critical delay causes of road and highway infrastructure project and proposed the mitigation actions. It suggests a mutually exclusive categorization of delay causes based on project management topics and project stakeholders.
- Using EVM as performance measurement tool and also aims at suggesting various alternative solutions by controlling techniques to bring back the delayed project back on scheduled time. These alternative solutions will help project manager and contractor to take correct decisions and will also act as a decision making tool for higher authority or top management.
- Schedule Compression techniques like Crashing and Fast Tracking are used for finding the proposed solutions in infrastructure projects. Primavera is used as a monitoring and management tool for carrying up this study.

5. CONCLUSION

The study proposes three groups of recommendations for dealing with the most influencing delay causes for road infrastructure projects. The first group recommendations

may deal with financing issues and equipment/material issues. The second group recommendations are for mitigating causes related to external influence, planning issues, and contract management and skill influence. Finally the third group recommendations are for mitigating causes related to change management, design issues, site management, project characteristics, and workforce/labor issues.

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