# CHAPTER 60

## Enhancing Infrastructure through Public Private Partnership by Controlling and Managing Cost and Time Overrun

*Manas Ambavkar[1], Vaibhav Kharatmol[2], Parbhat Pandey[2] and Himanshu Bhople[2]*

**ABSTRACT**

One of the problems has been broadly the complexities of cost and time overruns in Public-Private Partnership (PPP) infrastructure projects, particularly in Maharashtra, India. As infrastructure development projects surge globally due to urbanization and economic growth, the successful implementation of these initiatives is often compromised by delays and budget excesses. This study aims to analyze the outcomes of PPP projects in Maharashtra, identify key factors contributing to overruns, and propose effective management strategies. Through a comprehensive literature review and data analysis from credible sources, the research highlights significant trends, revealing that a majority of road sector projects encounter both cost and time overruns, with 43.9% and 37.6% of projects affected, respectively. The findings underscore the necessity for improved project planning, resource allocation, and stakeholder collaboration to enhance the efficiency and sustainability of PPP infrastructure initiatives. Ultimately, this study offers actionable insights for policymakers and industry practitioners to optimize PPP frameworks, thereby fostering resilient infrastructure development that aligns with societal needs.

**Keywords:** Cost overruns; Time overruns; Infrastructure project; Stakeholder collaboration; Effective management strategies.

### 1.0 Introduction

Infrastructure development projects have increased significantly worldwide in recent years because to the increasing demands of population growth, urbanization, and economic advancement. These initiatives, which range from energy infrastructure to transportation networks, are vital in forming a country's socioeconomic environment. Despite, delays and cost overruns tend to impede the success of these types of projects, which bring enormous challenges to both private investors and public authorities. To overcome these challenges, public private partnerships, or PPPs, have proven to be an option. They offer a shared framework where public agencies and private companies collaborate for financing, building, and running infrastructure schemes.

[1]*Corresponding author; School of Construction, NICMAR University, Pune, Maharashtra, India (E-mail: P2370331@student.nicmar.ac.in)*
[2]*School of Construction, NICMAR University, Pune, Maharashtra, India*

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By harnessing the strength and expertise of both sectors, PPPs aim to encourage efficiency, minimize risk, deliver projects on time and within budget. Even if PPPs are potential, phenomenal performance must be accompanied by bold cost and schedule control. Slippage and cost blowouts may undermine public confidence, inflate project costs, and jeopardize the long-term sustainability of PPP projects. Because of this, it is very crucial to learn and practice effective cost and schedule control measures during the entire project lifecycle. Though a comprehensive understanding of the dynamics of PPPs and the critical factors influencing project outcomes, this research seeks to contribute to the advancement of infrastructure development by fostering collaboration, accountability, and efficiency in public private partnerships. By aligning interests, managing risks, and optimizing resources, stakeholders can unlock the full potential of PPPs to deliver sustainable and resilient infrastructure that meets the evolving needs of society

### 1.1 Research background

The conventional method of creating infrastructure, relying solely on government funding, often faces hindrances such as funding constraints, delays, and inefficiencies. Most countries are shifting towards Public-Private Partnerships (PPPs) as a viable solution for infrastructure investment to overcome these problems. PPPs entail working together for planning, financing, building, and operating infrastructure projects between the public and private institutions. PPPs bring a lot of advantages in the form of private funds, skills, and innovation but equally suffer from cost and schedule overruns.

### 1.2 Research objective

- To find out the outcomes of public private partnership projects of Maharashtra state in India.
- Analyse and control overruns.
- Identify the key factors contributing to cost overruns and delays in PPP infrastructure projects.

## 2.0 Methodology

Literature synthesis on PPP infrastructure, cost control, and delay informs theoretical innovation and research paths in need of further study through existing research. The systematic research framework, as founded in these findings, de-mystifies interdependencies among delay causes, cost overrun, and control. Second, an elaborate research design is developed to define data collection, sampling, and analysis techniques. Data is collected from Maharashtra infrastructure projects and secondary sources like project reports and government records. Patterns and major determinants of cost and time overruns are discerned through a systematic statistical analysis.

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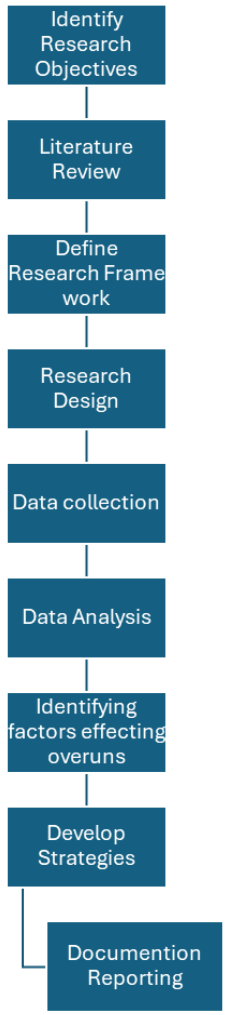
**Figure 1: Flowchart**




## 3.0 Literature Review

Rajan (2014) The research compares PPP and non-PPP road project cost and time overruns and finds that PPPs suffer more cost overruns while non-PPPs suffer more time overruns. This being other than that of developed economies suggests that developing nations such as India must develop PPP capabilities. Ramsey (2020) This article discusses US PPP transport project performance using the DBF and DBFOM approaches. Comparing the 75 projects (1995–2015), it identifies fewer cost and schedule modifications compared to traditional approaches, a topic that has been a missing link in the literature.

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Aziz (2007) This article analyses PPP application in infrastructure in the finance-based and service-based PPP models. By comparing the UK and British Columbia, it outlines success factors and provides guidelines against the backdrop of US challenges. Mevada (2017) This paper analyzes time and cost overruns in Indian megaprojects in terms of land acquisition delay, contractor capability, and contract complexity. It emphasizes policy, institutional, and project-level interventions for effective implementation and gives lessons on ideal risk sharing in Indian PPP projects. Singh (2018) This paper analyses PPP frequency in infrastructures by contrasting 313 national road projects. It concludes PPPs take shorter delays but higher cost overruns than government projects, with better quality but deficiencies in overall road services. Song (2018) This article discloses China's motivations for premature withdrawal of PPP projects and identifies 11 primary reasons of which government decision-making errors and payment defaults are the most common. It offers counterstrategies and practice suggestions to serve stakeholders and improve project management.

Vu (2016) This paper explores the possibility of cost overrun in Vietnam's road construction projects and concludes seven major causes based on expert judgment and regression analysis. The paper finds investment management, design alterations, land acquisition, and funding limitation as major causes. Kakati (2016) This article discusses PPP risk and management based on observation, interviews, and questionnaires. Case studies and expert opinions guide future research in the direction of ideal risk allocation.

Anago (2023) The paper addresses PPPs as one of the principal financial instruments for financing infrastructure in the economies of developing nations, specifically in the context of cost overruns. It applies TCT and Agency Theory and offers a three-step approach of avoiding cost overruns and enhancing PPPs. Belachew (2017) The writer discusses the rising use of PPPs in financing infrastructure in developing countries, with a focus on cost overrun concerns. Drawing from TCT and Agency Theory, the study presents a three-phase model to prevent cost overruns and facilitate PPP implementation.

Oyieyo (2018) The study examines cost overruns in Ethiopian road construction projects, assigning the causes to scope creep, failure in site management, and contract disputes. The study, using surveys, case studies, and statistical estimation, develops correlations between stakeholder perceptions of cost performance. Anastasopoulos (2014) The study identifies reasons for cost overrun in Ethiopia's Southern District Road projects using project management, risk evaluation, and contract analysis, and recommends further studies in delivery modes and risk management to improve efficiency.

## 4.0 Data Collection and Analysis

The data collection process involved gathering relevant economic and infrastructural information from reliable sources such as the PPP (Public-Private Partnership) India website, CMIE (Centre for Monitoring Indian Economy) website, and CAPEX databases. These sources

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provide a comprehensive understanding of India's infrastructure development projects. We selected a time frame of 20 years i.e. 2004-2024. A total of 390 infrastructure projects were identified within the specified timeframe, which were further classified into different sectors, with each sector experiencing varying degrees of cost and time overruns.

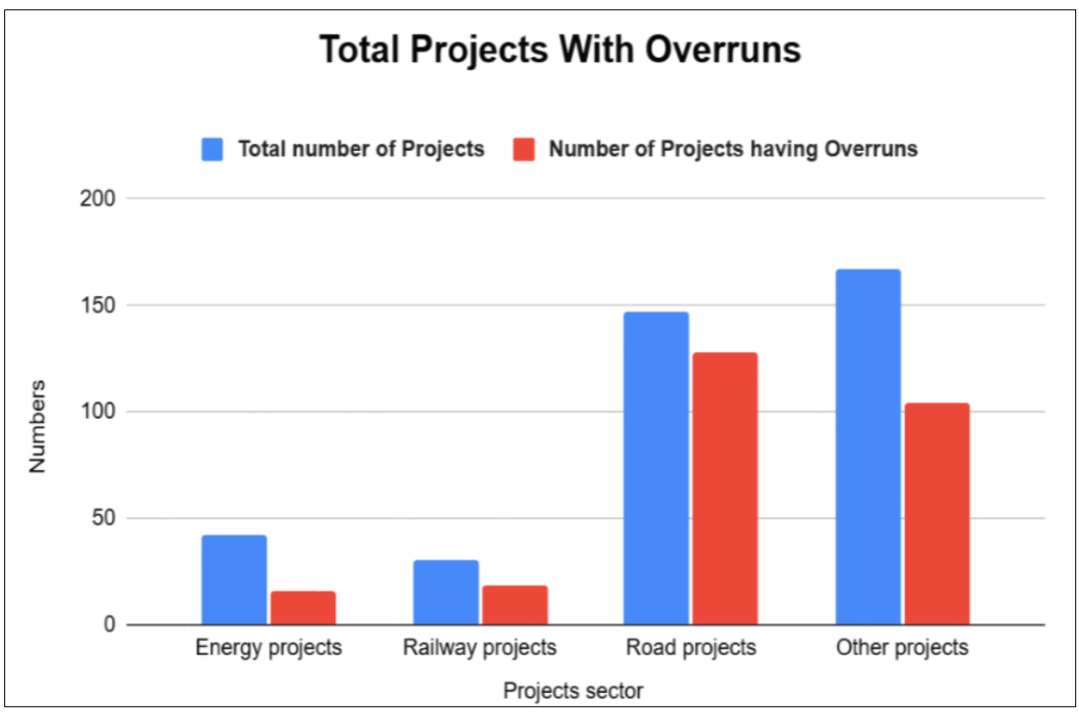
### 4.1 Data classification

The data collection process involved gathering detailed information on various projects, including their names, current status (active, completed, or under planning), and estimated investments. Project timelines and phases were documented to track progress and identify potential delays. Sector-specific information was also considered, covering areas such as transportation, energy, and water management.

### 4.2 Quantitative and qualitative analysis

Figure 2, The bar graph images provide a comparison between the overall project count and the ones running overruns with time and money in several spheres of infrastructure projects. The presentation of the data helps one to comprehend the degree of overruns in every area, therefore facilitating a sector-wise analysis of project performance. This graphical depiction is particularly useful for deciding which sector's time and cost overruns the most impact.

**Figure 2: Comparison of Total Projects with Overrun Projects**

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### 4.3 Further analysis of the data we find out the delta % for cost change

The Delta Change Formula for Cost (ΔC) helps to determine the change in cost between two points in time or two scenarios. The formula is:

$$\Delta C = C_{new} - C_{old}$$

Where: ΔC\Delta C (ΔC) = Change in cost

Cnew = New or updated cost (after delay or changes)

Cold = Original or baseline cost (before delay or changes)

If we want to find the percentage change in cost, we can use:

$$\%\Delta C = [C_{new} - C_{old}]/C_{old} \times 100$$

**Figure 3: Delays with %ΔC**

| Project Id | Project name | Delay (months) | %Delta increase in project cost |
|---|---|---|---|
| A1 | Ahmednagar (Pravaranagar) Cogeneration Power Project | 38 | 61.78% |
| A2 | Chhatrapati Shivaji Maharaj Terminus (CSMT) World Class Railway Station Project | 25 | 36.11% |
| A3 | Thane-Mulund New Railway Station (New Thane) Project | 66 | 76.00% |
| A4 | Versova-Andheri-Ghatkopar Metro Rail Project | 48 | 83.40% |
| A5 | Pune Metro Rail Line 3 Project (Phase 2) | 41 | 4.61% |
| A6 | Chembur-Wadala-Jacob Circle Monorail Project | 95 | 87.22% |
| A7 | Dighi Port-Roha Railway Line Project | 168 | 60.00% |
| A8 | Dadar Terminus Modernisation Project | 78 | 650.00% |
| A9 | Kalmath-Zarap (NH-66) Four Lane Highway Project (Mumbai-Goa NH 66 Highway) | 53 | 39.83% |
| A10 | Aravali-Kante (NH-66) Four Lane Highway Project (Mumbai-Goa NH 66 Highway) (Package-7) | 70 | 90.10% |
| A11 | Kante-Waked (NH-66) Four Lane Highway Project (Mumbai-Goa NH 66 Highway) (Package-8) | 65 | 72.88% |
| A12 | Talgaon-Kalmath (NH-66) Four Laning Highway Project (Mumbai-Goa NH 66 Highway) (Package-10) | 109 | 7.22% |
| A13 | Amravati-Chikli (NH-6 or New NH-53) Four Laning Highway Project | 93 | 2.34% |
| A14 | Panvel-Indapur (NH-17) Four Laning Highway Project (Mumbai-Goa NH 66 Highway) (Package-1) | 127 | 45.33% |
| A15 | MP/Maharashtra border to Nagpur (NH-7) Four-Laning Highway Project | 82 | 68.41% |
| A16 | Pune-Satara (NH-4) (New NH-48) Six Laning Highway Project (Sagarmala) | 120 | 39.28% |
| A17 | Pune-Sholapur (NH-9) Section Four-Laning Highway Project (Package-I) | 66 | 95.67% |
| A18 | Ahmednagar-Mirajgaon-Karmala-Tembhurni (NH-516A) Four laning Highway Project | 125 | 120.36% |
| A19 | Bridge over Thane creek at Kalwa Project | 67 | 75.00% |
| A20 | JNPT Container Terminal (4) Project (Sagarmala, Gati Shakti) | 149 | 126.14% |
| A21 | Mumbai City New Cuffe Parade - Lodha Gardenia Residential Project | 93 | 156.10% |
| A22 | Versova-Andheri-Ghatkopar Metro Rail Project | 241 | 66.67% |
| A23 | JNPT Container Terminal Upgradation Project | 57 | 9.00% |
| A24 | Vijaydurg Port Project | 145 | 825.93% |

Figure 3, displays the calculated delta values for various projects, expressed as a percentage. This percentage-based representation highlights the extent of cost deviations by

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comparing the difference between the initial estimated costs and the actual incurred costs relative to the initial estimates. By presenting the delta values as percentages, it becomes easier to standardize and compare cost overruns across different projects, regardless of their scale or budget. This approach effectively illustrates the severity of cost overruns in a consistent and easily interpretable manner, enabling stakeholders to identify projects with the most significant percentage deviations.

**4.4 We used pearson's correlation**

Coefficient, which measures the linear relationship between two variables.

Pearson's Correlation Coefficient = CORREL (X, Y)

Where: X = Range of Time delay

Y = Range of cost overrun

The result will be a value between -1 and 1, indicating the strength and direction of the relationship. We got 0.18 as coefficient which means very low correlation. It means there are more factors involved. We conduct an extensive review of news articles, research papers, and industry reports to identify and analyse the key factors contributing to project delays and cost overruns. By examining credible sources, including academic studies, case studies, government publications, and expert analyses, we aim to gain a comprehensive understanding of the challenges faced in the project.

Figure 4, Represents checklist has been prepared for the projects concerning the challenges they are encountering. To gather relevant data on the reasons behind these issues, we reviewed various news articles and research papers. The reference links for these sources are documented in our sheet. Based on our analysis, we have categorized the reasons into the following categories: Land Acquisition, Approval Delays, Design Changes, Site Conditions, Contractual Issues, and Financial Issues. The findings indicate that Financial Issues are associated with 5 projects, Contractual Issues with 2 projects, Approval Delays with 20 projects, Site Conditions with 6 projects, Design Changes with 5 projects, and Land Acquisition with 22 projects. To address these challenges, we have proposed a set of strategic solutions aimed at mitigating these issues for future projects. The strategies focus on improving the efficiency of land acquisition processes, streamlining approval procedures, by implementing these strategies, future projects may achieve better control over time and cost overruns, thereby enhancing overall project performance and efficiency.

**5.0 Strategies for Land Acquisition**

*Participatory Land Pooling (PLP)* is a land development mechanism used in Public-Private Partnership (PPP) projects in India. It is an alternative to traditional land acquisition and aims to involve landowners in the urban development process by pooling their land together for infrastructure and real estate projects.

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**Figure 4: Checkbox for Project Overruns Factors**

| Project ID | Project Names | Reason for delay | | | | | |
|---|---|---|---|---|---|---|---|
| | | Financial issues | Contract issue | Approvals | Site condition | Design | Land Acquisitions |
| A1 | Ahmednagar (Pravaranagar) Cogeneration Power Project | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| A2 | Chhatrapati Shivaji Maharaj Terminus (CSMT) World Class Railway Station Project | ☑ | ☑ | ☐ | ☐ | ☐ | ☑ |
| A3 | Thane-Mulund New Railway Station (New Thane) Project | ☑ | ☐ | ☑ | ☐ | ☐ | ☑ |
| A4 | Versova-Andheri-Ghatkopar Metro Rail Project | ☐ | ☐ | ☑ | ☑ | ☐ | ☑ |
| A5 | Pune Metro Rail Line 3 Project (Phase 2) | ☐ | ☐ | ☑ | ☑ | ☐ | ☑ |
| A6 | Chembur-Wadala-Jacob Circle Monorail Project | ☐ | ☑ | ☐ | ☐ | ☐ | ☑ |
| A7 | Dighi Port-Roha Railway Line Project | ☐ | ☐ | ☑ | ☐ | ☐ | ☑ |
| A8 | Dadar Terminus Modernisation Project | ☐ | ☐ | ☑ | ☐ | ☐ | ☑ |
| A9 | Kalmath-Zarap (NH-66) Four Lane Highway Project (Mumbai-Goa NH 66 Highway) | ☐ | ☐ | ☑ | ☐ | ☐ | ☑ |
| A10 | Aravali-Kante (NH-66) Four Lane Highway Project (Mumbai-Goa NH 66 Highway) (Package-7) | ☑ | ☑ | ☑ | ☐ | ☐ | ☑ |
| A11 | Kante-Waked (NH-66) Four Lane Highway Project (Mumbai-Goa NH 66 Highway) (Package-8) | ☐ | ☐ | ☑ | ☐ | ☐ | ☑ |
| A12 | Talgaon-Kalmath (NH-66) Four Laning Highway Project (Mumbai-Goa NH 66 Highway) (Package-10) | ☐ | ☐ | ☑ | ☐ | ☐ | ☑ |
| A13 | Amravati-Chikli (NH-6 or New NH-53) Four Laning Highway Project | ☐ | ☐ | ☐ | ☐ | ☐ | ☑ |
| A14 | Panvel-Indapur (NH-17) Four Laning Highway Project (Mumbai-Goa NH 66 Highway) (Package-1) | ☐ | ☐ | ☑ | ☐ | ☐ | ☑ |
| A15 | MP/Maharashtra border to Nagpur (NH-7) Four-Laning Highway Project | ☐ | ☐ | ☑ | ☑ | ☐ | ☐ |
| A16 | Pune-Satara (NH-4) (New NH-48) Six Laning Highway Project (Sagarmala) | ☐ | ☐ | ☑ | ☐ | ☐ | ☑ |
| A17 | Pune-Sholapur (NH-9) Section Four-Laning Highway Project (Package-I) | ☐ | ☐ | ☑ | ☑ | ☐ | ☑ |
| A18 | Ahmednagar-Mirajgaon-Kamala-Tembhurni (NH-516A) Four laning Highway Project | ☐ | ☐ | ☑ | ☑ | ☐ | ☑ |
| A19 | Bridge over Thane creek at Kalwa Project | ☐ | ☐ | ☑ | ☐ | ☐ | ☑ |
| A20 | JNPT Container Terminal (4) Project (Sagarmala, Gati Shakti) | ☐ | ☐ | ☑ | ☐ | ☑ | ☑ |
| A21 | Mumbai City New Cuffe Parade - Lodha Gardenia Residential Project | ☐ | ☐ | ☐ | ☐ | ☑ | ☑ |
| A22 | Versova-Andheri-Ghatkopar Metro Rail Project | ☑ | ☐ | ☑ | ☐ | ☑ | ☑ |
| A23 | JNPT Container Terminal Upgradation Project | ☐ | ☐ | ☑ | ☐ | ☑ | ☑ |
| A24 | Vijaydurg Port Project | ☑ | ☐ | ☑ | ☑ | ☑ | ☑ |
| | | 5 | 3 | 19 | 6 | 5 | 22 |

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*Community Land Trust (CLT)* is a non-profit, community-governed organization that trades to purchase, hold, and develop land for long-term community advantage rather than private speculation. CLTs seek to provide affordable housing, sustainable development, and equitable land use by disentangling land ownership from property ownership. In Public-Private Partnership (PPP) initiatives, CLTs operates as a vehicle of public interest to make sure land is kept affordable and available for public usage, most significant of which include housing, infrastructure, and city development.

*Land Readjustment (LR)* is a new land acquisition and urban development method where owners of land accumulate their land together for development purposes and, after the infrastructure is improved, receive part of the reorganized land with greater value. In Public-Private Partnership (PPP) projects, the technique is utilized to secure land for urbanization, urban growth, and township developments and secure landowners from the economic gains of the project.

## 6.0 Conclusion

The study exploring how Public-Private Partnerships (PPPs) may improve infrastructure while bringing costs and time overruns in check discusses some of the deepest difficulties and the possible solutions in the development of infrastructure. Findings reveal that considered for such PPP projects, a very high share would be going toward the road sector, with a considerable number of these seeing delays and cost escalations. Specifically, 43.9% of projects indicated time overruns, 37.6% reported from cost overruns, and only 11% of projects were completed on schedule and within the established budget. Among the causes of time and cost overruns are such issues as land acquisition and resettlement, licensing, and environmental approvals, contractual disputes, inflation, and financing bottlenecks. Additionally, project delays have been exacerbated by supply chain disruptions across the world, labour shortages, and technology integration problems.

It is indicated by weak correlation (0.2) that cost, and time overruns have probably resulted from other independent variables. Various complementary interventions have been envisioned to tackle such problems like Participatory Land Pooling (PLP), Community Land Trust (CLT), Land Readjustment (LR), and the AI-based environmental predictive model. There is evidence that these types of cutting-edge land management strategies have been used in such projects as Mumbai–Nagpur Expressway, Auroville CLT, and Amaravati Capital City Development. These strategic sorts of interventions could boost better efficiency, minimize risk, and enhance sustainable infrastructure development in PPP projects. The above-mentioned findings reinforce the rationale for a more structured approach in the project management of PPPs to extract the best value out of the available resources while also ensuring long-term viability.

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