Identification of factors responsible for Delay in constructions of bridges _A Review
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ABSTRACT
Delay in construction is a common situation globally, construction delays occur due to several factors. Delays are mainly because of geographical factors, type of construction and type of management, lack of competence, conflicts between stakeholders, Disaster / natural calamities, budget and economy, pandemics environmental clearance issues, labour shortages, improper site management etc. studies on delay in constructions majorly focus on delay factors and its associated risks and its mitigation measures regionally and globally. The present paper highlights on the bridge construction delay its causes and effects by reviewing case studies and literature across the globe.

Key words: delay, construction of bridge, delay factors, causes effects

1 Introduction
Construction is an activity involving science, engineering and technology, environment and humans to create facilities to benefit society, country and the world for improved standard of living and economical outreach. The significant feature of construction is, it is unique, highly immobile and most complex. It involves more cost and necessitate unique considerations and adaptability in the industry. The construction activity is a process which involves more than one component for its existence, process and completion. Often these are interdependent and causes lot of impact, if there is disturbance or delay in any one of the component.

Construction delay refers to slow down of the whole process or creation activity which hinders growth and development. Construction delays continues to be persisting issue globally, as there is major investment in this sector it hinders the economy of the country. Major global construction projects, like Berlin Brandenburg Airport and Burj Khalifa, have faced significant delays due to various factors, while in India, projects like Hyderabad Metro Rail and Mumbai Coastal Road have faced delays due to issues like land acquisition, environmental clearances, and pandemics.

Construction projects include construction of buildings, Infrastructures like Roads, Bridges, and Flyovers etc. Investigations have been carried out to study delay in construction of bridges which includes RoB's, girder bridges etc. The major factors about delays and its impact can be summarized as shown in the figure 1

![Figure 1 Delay components and impacts](image-url)
Dynamics of construction of Bridge project delays

Projects involving motorable bridge construction understanding the factors contributing to delays is of significance importance. Recent research, have revealed critical relationships that explains the dynamics of project delays. The components for relationship study of bridge delay includes 1. Project size 2.Work allocation to contractors 3.frequency of project manager changes 4. Impact of low bid percentages. The significance of each of the factors has been prioritized as shown in the figure 2.

From the above factors the following needs to be understood

Size of the projects delay in schedule: project size is inversely proportional to delay in most of the cases, it means to say that, bigger the projects lesser is the schedule overrun. A balanced work distribution will lead to less delay which means that work allocation is directly proportional to delay.

Lower bid estimates vs delay in schedule: Lower engineering cost estimates for a project directly affects the schedule due to difficulty in mobilization of the project due to low budgets.

Work allocation Vs Delays in schedule: work allocation directly impacts the schedule, a balanced allocation of the work leads to a speedy progress.

Project management Vs delay: consistent project leadership impacts the delay of the project. The frequency of change in leadership is directly proportional to delays.

The above findings helps in understanding different factors affecting delays in bridge construction. By recognising and solving these issues delays in construction of bridges can be managed.

2 Literature review

The following literature review summarises the major findings for causes of delays in various types of constructions globally. These findings can infer many reasons for delays in construction which includes construction of bridges also.

<table>
<thead>
<tr>
<th>Sl.no</th>
<th>Research /Year</th>
<th>Location</th>
<th>Findings</th>
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<tbody>
<tr>
<td>1</td>
<td>Arditi et al. (1985)</td>
<td>Turkey</td>
<td>Contractors 34.6% average, public agencies delay 43.6%. of projects completed on time only 22% during 1975 delays of projects up to 4 years around 18 projects</td>
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<td>2</td>
<td>Mansfield et al. (1994)</td>
<td>Nigeria</td>
<td>Over 9 highway projects delayed and delays ranging from 92% to 343%</td>
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<td>3</td>
<td>Chan and Kumaraswamy</td>
<td>Hong Kong</td>
<td>Overall delays exceeds in which 20% – On schedule</td>
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<td>4</td>
<td>Assaf et al. (2006) Saudi Arabia - Delays reported Contractors: 76% informed delay of 10%-30%. - Consultants: 56% informed delay of 10%-30%. - 25% of consultants informed delay of 30%-50%.</td>
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<td>5</td>
<td>Elinwa and Joshua (2001) Nigeria - Overall delay of 80%-90% in Nigeria.</td>
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<td>7</td>
<td>Koushiki et al. (2005) Kuwait - More than 56% of projects lacked completion. – Around 54% delayed by over 4 months. - One-third delayed by more than 6 months.</td>
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<td>8</td>
<td>Flyvbjerg et al. (2004) Global Cost overruns and time delay studies and 9 out of 10 projects under delay</td>
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<td>9</td>
<td>Le-Hoa et al. (2008) Vietnam Major delays due to poor project management, major design changes.</td>
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<td>10</td>
<td>Singh (2009) India Institutional and contractual failures major reasons for delay</td>
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<td>11</td>
<td>Fugar and Baah (2010) Ghana Major reason for delay is due to financial constraints</td>
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<td>12</td>
<td>Patil et al. (2013) India land acquisition, environmental impact, financial closure, site management, supervision</td>
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<td>13</td>
<td>Dutta and Dutta (2015) Bangladesh - Main causes: project size, organizational failures, economic factors</td>
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<td>14</td>
<td>India (as of May 2016) India - 30.66% of 1076 projects costing INR 1.5 Billion or more were delayed. - Trend showed no significant improvement in project delays over 15 years.</td>
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<tr>
<td>15</td>
<td>Patil et al. (2013) India land acquisition, environmental impact, financial closure, site management, supervision etc.</td>
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Suwal, A., & Shrestha, S. K. (2016). Focuses on delay in ROB (Road Over Bridge) construction in India, which is very crucial for traffic management and accident prevention the paper also mentions majority of ROB projects face delays and cost overruns which has a major impact on the citizens. The paper talks about necessity of ROB’s and difficulty in execution of ROB projects and delays in construction adds to the problems.

Chandrasekaran Balaji Venkateswaran & Rajiah Murugasan. (2017) has studied ROB’s construction delays and highlights on time and cost over runs due to delay. A detailed methodology for delay studies is put forth which involves data collection from 69 project stake holders of various projects which resulted in identification of 29 key factors for delay. This information is then ranked based on their frequency, these factors are further agreed upon by the stakeholders after Spearman rank correlation. The factor analysis is being conducted to categorise these factors into groups such primary and secondary factors.

Keval J. Shah , Prof. M. R. Apte (2015) studied delays in bridge girders by investigating on site activities by comparing schedules. The research findings clear justified that delays are common in bridge constructions. Major factor for delay is due to poor project management by the contractor.

3 Critical case studies review has summarised the following
- Factors causing delays in developing countries are different from developed countries
- Project delays can be due internal or external sources
- Major project delays are related finances, weather, geography, manpower, design, stake holder dependency and change, planning, scheduling, etc.
- There is concern for schedule performance of construction projects irrespective of the socio economic status of any country
- Regional difference in delay causes, which means developing countries have common issues unlike the developing countries
- Use of innovative project management and construction technology and management is highlighted
Methodology for Delay analysis and mitigation of bridge constructions.

- Research framework
- Data collection about the delays from literature review, surveys/questionnaire
- Data analysis by conducting statistical assessments
- Identifying factor for time delay and cost overrun and categorisation of delays
- Perform quantitative analysis using statistical models to assess the impact of the various factors
- Study few classic cases of delay
- Propose mitigation measures

4 Research framework
The first step is to identify the research framework such as quantitative/qualitative approach

Data collection about the delays from literature review, surveys/questionnaire
It is one of the crucial steps in understanding and approaching solution in study of delays in construction of bridges. Data collection helps in understanding the past and present status of the project enables risk assessment of the project. Key aspects of data collections includes
a) Identification relevant data for delay studies like historical data, current project report and documents, progress reports, schedule of projects contractual and legal issue documents and detailed communications between stakeholders like minutes of the meetings, notices issued, revision of the contract etc.
b) Type of Data: qualitative and quantitative data Qualitative data includes reasons for delay, communications and challenges in the project, whereas quantitative data includes cost and expenditure, project scheduling, resource utilization etc.
c) Survey/interviews of the stake holders involved like contractors, builders, funding agencies, engineers, project managers, marketing, labour manager etc.
d) Site inspection reports can give lot of data and information on the present status and also the reasons for delay. The prevailing site conditions give lot of information on the time of delay, impacts of delay and its consequences.

The data collection for delay of bridge construction includes

Data analysis by conducting statistical assessments
Following are the Statistical Assessments for measuring Delays
- Statistical Package for the Social Sciences (SPSS)
- Conducting normality test on the delay data collected and arriving at skewness and Kurtosis values
Using the above methods the delay is measured for different project sizes and correlation between project characteristics and delays is arrived at.

Identifying factor for time delay and cost overrun and categorisation of delays
The key factors are identified based on the data collection, literature reviews and interviews, most common factors are as shown in fig 1
After the statistical analysis, refer few case studies to understand causes and consequences of delay. Then based on the research findings mitigation measures are proposed which is generally project specific.

Research gap
- Social network analysis to deep dive into causes of delays
- Analyse delay in structured manner in the form of frame works as shown in the Fig.1
• Address the delay issues with practical strategies and proactive measures and co-ordinated decision making by the involved stake holders in the project

5 Conclusion
In conclusion delays in construction of bridges is pervasive and is quite challenging in construction industry. Delays impact in terms of time cost and quality. The present study focuses on the need for considering few factors like project size, work allocation, project management and bid percentages for overcoming delay and propose measures. A systematic methodology to study and propose solutions to the delay in construction of bridges is clearly put forth.conventional methods of delay studies lack understanding of deeper causes of delay like social network and crowd data analysis, structured framework which can be researched further to arrive at proper mitigation measures in order to minimize the delays in construction of bridges

References