

# Identification of Causes and Minimization of Delays in Highway Projects of Pakistan

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## ABSTRACT

The problem of delay in construction industry is a regular phenomenon worldwide, and construction industry of Pakistan has no exception, particularly in highways projects. Delay can be described as the extension of time to complete the construction project. The aim of this paper is to identify main causes of delays in highway projects of Pakistan, and to determine mitigating measures for the identified causes. The research method of this study is based on literature review, questionnaire survey and semi structured interview. From in-depth literature review, twenty-six common causes of delay were found. A questionnaire survey was carried out among construction professionals of highway projects. The causes of delay in highways projects were ranked referring to their Mean values. A semi structured interview was carried out to determine mitigation measures for the top ten causes of delays. The data gathered from questionnaire survey was analyzed using SPSS (Statistical Package for the Social Sciences) while, data collected through semi structured interviews was analyzed using Nvivo software. The findings of this study are expected to be useful for construction parties, to mitigate the delays in highway construction projects of Pakistan.

**Key Words:** Construction, Highway Projects, Delays, Causes, Mitigation Measures.

## 1. INTRODUCTION

The timely completion of construction projects is one of the most important aspect of projects success. However, delay is one of the main issues in construction industry [1]. According to Honrao et. al. [2] “construction delay is the difference between a project’s original contract period at the time of bidding and its overall final contract period at the end of the construction project”. Delay can results in many negative effects on construction project such as time overrun, cost overrun, low productivity, acceleration losses, contract termination,

poor quality, and disputes among construction stake holders [3-4].

From the literature review it is observed that globally many construction projects face the issue of delays. Construction projects in developed countries like USA are also affected by delays [5]. Similarly, construction projects in UK also face the problem delays [6]. Moura et. al. [7] stated that 40% projects in Portugal construction industry experienced delay. Long et al. [8] interviewed 87

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construction experts, it was confirmed by the interviewees that delay is regular issue in Thailand construction projects. In Malaysia Endut et. al. [9] investigated the problem of delay in 359 sampled construction projects from both public and private sector. The findings of the study showed that in public sector only 20.5% projects were completed within specified time, while in private sector 33.35% projected were finished in scheduled time period. Falqui [10] studied delay in 2379 construction projects in Saudi Arabia and reported that almost 952 (40%) of the projects suffered from delay. In Oman, Alnuaimi et. al. [11] conducted a survey in stakeholders of construction projects and concluded that almost 40% of the respondents agreed that their projects were affected by delay. Emam et. al. [12] examined the issue of delay in infrastructure projects in Qatar. Results of study showed that 80% of projects experienced delay with average range of 25%. Mahamid [13] studied delay in construction projects in Palestine and found that 76% of the sampled projects suffered from delay. According to Omoregie and Radford [14] delay is a major problem in construction projects in Nigeria. Sambasivan and Soon [15] examined delay in Malaysian construction projects and reported that about 17.3% of the public projects experienced delay.

Like other countries, delay is one of the prime problem in construction industry of Pakistan. This is also confirmed by Sohu et. al. [16] that construction projects in Pakistan are facing the problem of delays, specifically in highway projects. Study carried out by Bangash [17], investigated delays in construction industry of Pakistan and revealed that majority of the projects were 11-30% delayed from their scheduled time.

Various studies have been carried out on construction delays and most of the studies focused on identifying factors of delay. However, little attention has been paid on mitigation measures for the identified causes. Further, causes of delay vary from country to country and compare

to project types [1,18]. There is a strong need to explore the cause of delays in highways projects, and to find ways to cope with the problem of construction delays. Thus the objectives of this study are:

- (1) To identify main causes of delay in highways project of Pakistan.
- (2) To determine mitigation measures for the identified causes of construction delays.

## **2. LITERATURE REVIEW**

Many researches were carried out on causes of delays in different types of construction projects and as a results a number of causes of construction delays were found in previous studies. Tafazzoli et. al. [5] investigated factors causing delays in construction projects of USA by conducting a nationwide survey and determined the critical level of 27 causes of delays. The results of the survey indicates that top causative factors of delays were modifications in the scope of project, delay in decision making, errors in design, delay in approval of design documents, unrealistic project schedule, poor communication among construction parties, delay in progress payment by the clients, inadequate contractor experience, poor site management, and mistakes in construction. Moura et. al. [7] detected most significant factors initiating delays in construction industry of Portugal, namely: financial problems of contractors, variation in prices of materials, and poor site supervision and management by the contractor. Kikwasi [3] indicated most important causes of delay in construction projects in Tanzania by carrying out a questionnaire survey among construction practitioners. The study findings showed that main causes of delay were frequent changes in design, delayed payment to suppliers, improper project management, lack of coordination among construction stakeholders involved in the project, and incompetent

contractors. In Qatar, Emam et. al. [12] examined the factors which led to delay in infrastructure projects. A questionnaire survey was conducted among 37 construction professionals involved in handling of infrastructure projects. The findings of the survey showed that main causes of delays are changes in design, ineffective planning and scheduling, changes in scope of project, under estimated project schedule, and shortage of skilled labour. In Palestine, Enshassi et. al. [19] studied factors leading to delays in construction projects. A questionnaire was distributed to contractors, the results of the survey showed that main causes of delays were fluctuation in prices of materials, delay in materials supply to construction site, slow permits by local authorities, incompetent sub-contractors, and design changes. Shehu et. al. [20] conducted a field survey in 205 construction experts comprised of 105 consultants, 51 contractors, and 49 clients to identify causes of delay in Malaysian construction industry. The results of the survey showed that main five causes were financial problems faced by the contractor, delay in materials delivery, fluctuation in materials prices, unavailability of materials, and Un-expected site condition. In Vietnam, Long et. al. [8] looked at the causative factors of delays in large construction projects through quantitative approach. The study identified that most important cause of construction delays were, poor site monitoring, poor project management and financial problem of owners. Alinaitwe et. al. [21] investigated the factors of delay in public construction projects in Uganda, the findings of the study revealed that major three causative factors of delay were modifications to the scope of project, late payments, and deficient monitoring of site. Assaf et. al. [22] studied the factors leading to delay of large construction projects in Saudi Arabia, by circulating a questionnaire in construction practitioners. Analysis of the survey showed that main factors of construction delay were assigning contract to lowest bidder, insufficient project planning,

financial problems of clients, variation orders, and unavailability of site workers.

Based on the above studies twenty-six common causes of delays in construction projects were identified, as listed below:

- (1) Change in the scope of project
- (2) Delay in decision making
- (3) Errors in design
- (4) Delay in approval of design documents
- (5) Unrealistic project schedule
- (6) Poor communication among construction parties
- (7) Delay in payment by the clients
- (8) Inadequate contractor experience
- (9) Poor site management
- (10) Mistakes in construction
- (11) Financial problems of contractors
- (12) Price variation of materials
- (13) Poor site supervision and management
- (14) Delayed payment to suppliers by contractors
- (15) Poor project management
- (16) Delay in materials delivery
- (17) Shortage of materials,
- (18) Un-expected site condition
- (19) Slow permits by local authorities
- (20) Lack of equipments
- (21) Lack of consultant experience
- (22) Financial problems of client
- (23) Lack of experience of sub-contractor
- (24) Inadequate experience of designers
- (25) Poor contract management
- (26) Labour absenteeism.

### 3. RESEARCH METHODOLOGY

This study used combination of questionnaire survey and semi structured interviews to achieve two objectives of the study. The research method of this study is listed below:

- (1) A detailed literature review was carried out on construction delays, through which twenty-six common causes of delays in construction projects were identified. The identified common causes were used as a base for the design of questionnaire survey.
- (2) A questionnaire was comprised of two sections, Section A and Section B. Section A was aimed to obtain general information of the survey respondents while, Section B included the causes of construction delays. A five point Likert Scale was used for determining significance level of causes of construction delays. The numeric values of likert scale were: 1 = “not significant”, 2 = “slightly significant”, 3= “moderately significant”, 4 “very significant”, And 5 = “extremely significant”.
- (3) Pilot study was carried out, to check relevancy of causes of delays given in questionnaire to highway projects of Pakistan. Total thirty respondents participated in the pilot study. For relevancy of causes to highway projects, cut-off scale is adopted from Muhwezi et. al. [23] as presented in Table 1.

TABLE 1. CUT OFF SCALE OF CAUSES OF CONSTRUCTION DELAYS

| Mean Score | Level of Relevancy |
|------------|--------------------|
| <3         | Non Relevant       |
| 3-5        | Relevant           |

In the analysis of pilot study, the “mean values” of all causes of construction delays were above 3, thus the causes listed in questionnaire were relevant to highway projects of Pakistan.

- (4) After pilot study, the questionnaire was distributed to randomly 200 construction practitioners working in highway projects of Pakistan. However, total 140 questionnaires were received back, in which 130 were valid responses and considered for further analysis. The response rate for the questionnaire survey was 70%. The demographic characteristics of the respondents for final questionnaire are shown in Table 2. The data gathered in questionnaire survey was analyzed using SPSS. “Mean Value” is used to rank the causes of delays in highway projects of Pakistan.

The mean score was calculated using SPSS software.

- (5) Semi structured interviews, were carried out with non-randomly selected construction experts, in order to determined mitigation measures for the main ten causes of delays, which were identified by questionnaire survey. In this study, 15 interviewees were selected. The interviews were recorded using digital voice recorder. Later on data was analyzed with the help of Nvivo software. The detailed information of interviewees is presented in Table 3.

### 4. DATA ANALYSIS

#### 4.1 Main Causes of Construction Delays

For analysis of the questionnaire survey SPSS version 20 were used. The Cronbach’s alpha coefficient ( $\alpha$ ) was used to check the reliability of collected data from questionnaire survey. The reliability test result is shown in Table 4.

TABLE 2. INFORMATION OF INTERVIEWEES

| Respondent's profile     | Responses | %     |
|--------------------------|-----------|-------|
| Profession of Respondent |           |       |
| Client                   | 40        | 30.77 |
| Contractor               | 60        | 46.15 |
| Consultants              | 30        | 23.08 |
| Total                    | 130       | 100%  |
| Education Level          |           |       |
| Diploma                  | 42        | 32.30 |
| Bachelor degree          | 60        | 46.15 |
| Master                   | 28        | 21.55 |
| Total                    | 130       | 100%  |
| Working Experience       |           |       |
| Less than 10 years       | 25        | 19.23 |
| 10-20 years              | 73        | 56.15 |
| More than 20 years       | 32        | 24.62 |
| Total                    | 130       | 100%  |

TABLE 3. DEMOGRAPHY OF INTERVIEWEES

| Interviewee | Role                        | Organization | Working Experience in Years |
|-------------|-----------------------------|--------------|-----------------------------|
| 1           | Director                    | Client       | 25                          |
| 2           | Managing Director           | Contractor   | 20                          |
| 3           | Project Manager             | Contractor   | 24                          |
| 4           | Director                    | Client       | 23                          |
| 5           | Managing Director           | Contractor   | 21                          |
| 6           | Resident Engineer           | Consultant   | 16                          |
| 7           | Project Engineer            | Contractor   | 18                          |
| 8           | Director                    | Client       | 24                          |
| 9           | Resident Engineer           | Consultant   | 15                          |
| 10          | Project Manager             | Contractor   | 17                          |
| 11          | Deputy Director             | Client       | 20                          |
| 12          | Construction Engineer       | Contractor   | 10                          |
| 13          | Assistant Resident Engineer | Consultant   | 10                          |
| 14          | Project Manager             | Contractor   | 22                          |
| 15          | Assistant Resident Engineer | Consultant   | 12                          |

According to Wai et. al. [24] the Cronbach's alpha value should be higher than 0.7, Table 4 shows that Cronbach's alpha is above 0.7, thus the gathered data of questionnaire survey is valid. Table 5 shows the Mean Score of the causes of delays in highway projects, the

causes have been assigned ranks in relation to their Mean Score.

**TABLE 4. RELIABILITY STATISTICS**

|                  |                 |
|------------------|-----------------|
| Cronbach's Alpha | Number of Items |
| 0.816            | 26              |

**TABLE 5. RANKING OF CAUSES OF DELAY IN HIGHWAY PROJECTS**

| Causes  | Mean Score | Rank |
|---|------------|------|
| Poor site management                          | 4.63       | 1    |
| Inadequate contractor experience              | 4.55       | 2    |
| Poor communication among construction parties | 4.50       | 3    |
| Price variation of materials                  | 4.48       | 4    |
| Errors in design                              | 4.46       | 5    |
| Improper planning                             | 4.42       | 6    |
| Shortage of materials                         | 4.33       | 7    |
| Poor contract management                      | 4.21       | 8    |
| Slow permits by local authorities             | 3.85       | 9    |
| Change in the scope of project                | 3.83       | 10   |
| Delay in payment by the clients               | 3.73       | 11   |
| Financial problems of contractors             | 3.71       | 12   |
| Poor project management                       | 3.62       | 13   |
| Unrealistic project schedule                  | 3.58       | 14   |
| Delay in approval of design documents         | 3.56       | 15   |
| Mistakes in construction                      | 3.50       | 16   |
| Un-expected site condition                    | 3.44       | 17   |
| Delayed payment to suppliers by contractors   | 3.42       | 18   |
| Lack of consultant experience                 | 3.38       | 19   |
| Lack of equipments.                           | 3.34       | 20   |
| Financial problems of client                  | 3.32       | 21   |
| Delay in decision making                      | 3.30       | 22   |
| Delay in materials delivery,                  | 3.26       | 23   |
| Lack of experience of sub-contractor,         | 3.25       | 24   |
| Inadequate experience of designers,           | 3.06       | 25   |
| Labour Absenteeism                            | 3.03       | 26   |

## 4.2 Mitigation Measures for Main Causes of Delays

Following the analysis of the questionnaire survey results, the mitigation measures for top 10 causes of

delays were investigated by interviewing construction experts. Table 6 shows the mitigation measures for top 10 causes of delays, identified through thematic analysis of interviews data using Nvivo software.

**TABLE 6. MITIGATION MEASURES FOR TOP CAUSES OF CONSTRUCTION DELAYS**

| Causes  | Mitigation Measures  |
|---|--|
| Poor site management                          | Contractor should effectively handle unforeseen situations at site.                          |
|   | Proper monitoring of construction activities.  |
|   | Develop good working calibration among site's staff.   |
|   | Adequate training programs for staff working on site   |
| Inadequate contractor experience              | Select contractors having history of quality working.  |
|   | Select contractors having history of timely completion of projects.                          |
|   | Establishing effective communication between contractor and client.                          |
| Poor communication among construction parties | Arrange seminars, which highlights partner's responsibility.                                 |
|   | Construction stakeholders should participate in meetings.                                    |
|   | Establish rules and regulation for communication among construction parties.                 |
| Price variation of materials                  | Using domestic materials.  |
|   | Purchasing bulk of materials before starting construction activities.                        |
|   | Introduce effective contract with materials supplies.  |
| Errors in design                              | Client should actively participate in design phase.  |
|   | Appoint skilled design team.   |
|   | Proper survey of construction site.  |
| Improper planning                             | Before initiating project, client should plan strategically.                                 |
|   | Adequate site visit before tendering.  |
|   | Hire proficient staff at the planning section.   |
| Shortage of materials                         | Establish good working relationship with material suppliers.                                 |
|   | There should be proper communication between purchase and store sections.                    |
|   | Make possible proper estimate of required quantity of materials.                             |
| Poor contract management                      | Contracts should be granted on merit bases.  |
|   | Hire experienced consultant.   |
|   | Ensure contract documents are enough detailed.   |
| Slow permits by local authorities             | Make sure that project is complying with local authorities' development plan.                |
|   | Submit all required documents to local authority on time.                                    |
|   | Construction stake holders should maintain good working relationship with local authorities. |
| Change in the scope of project                | Proper assessment should be done before starting project.                                    |
|   | Climatic changes of site should be foreseen  |
|   | Ensure effective communication between consultant and client at the design stage.            |

### 4.3 Discussion

Analysis of the questionnaire survey results in determining top 10 causative factors delay in highway projects of Pakistan. Table 5, indicates that “poor site management” scored the highest mean value of 4.63 and ranked as a first cause of delay in highway projects. It was followed by “Inadequate contractor experience” and “poor communication among construction parties” which had 4.55 and 4.50 means scores respectively. Variation in prices of materials was ranked as fourth at 4.48 mean value while “errors in design” were ranked as the fifth cause of delays in highway projects of Pakistan.

Mitigation measures for top 10 critical causes were determined through interview sessions. For each critical cause a number of mitigation measures were determined. For most critical cause “poor site management” the mitigation measures were the following contractor should effectively handle unforeseen situations at site, proper monitoring of construction activities, develop good working collaboration among site’s staff, and adequate training programs for staff working on sites. Similar for second critical cause “Inadequate contractor experience” the controlling measures was to select contractors having history of quality construction working.

### 6. CONCLUSION

This study concludes that delay is one the main issue in highway projects. Using a questionnaire survey, 26 causes in highway projects of Pakistan were identified. The main causes were poor site management, inadequate contractor experience and poor

communication among construction stakeholders, price variation of materials, errors in design, improper planning, shortage of materials, poor contract management, slow permits by local authorities, and change in the scope of project. Semi structured interviews offered a rich source of information based on the experience of participants in relation to the controlling of delay causes. The findings of this study are envisioned to be useful contribution to construction industry of Pakistan, particularly highway projects, in mitigating delays.

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