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Delays in Construction – An Empirical Study of Contractors' Perceptions in Pakistan Construction Industry

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Abstract
Delay is generally acknowledged as the most common, costly, complex and risky problem encountered in construction projects. Because of the overriding importance of time for both the Owner (in terms of performance) and the Contractor (in terms of money), it is the source of frequent disputes and claims leading to lawsuits. This paper attempts to identify the major causes of delays in construction projects in Pakistan through a structured survey. The primary aim is to identify the perceptions of contractors regarding the causes of delays and the allocation of responsibilities to the parties for each delay. The preliminary data for this research was collected through extensive literature review, which was aimed at identifying causes of delays that may be encountered in a construction project. Based on the findings, a check list for causes of delay is prepared, which was classified into nine broad categories depending on their nature and mode of occurrence. These are financial/ economic delays, design related delays, contract related delays, management/ administrative delays, construction site related delays, equipment related delays, labor related delays, material related delays, and subcontracted work related delays. Based on the survey findings, the frequency of occurrence and severity of each delay cause as indicated by contractors, the most critical delay causes under each category were identified and the share of responsibility was gauged. A delay value and a delay criticality index was used to identify the major delay causes in the industry which, in descending order of criticality, were found to be: change orders, labor productivity issues, poor site management and supervision, inspections/ audits, poor cost estimation & control, inadequate project scheduling, defective design, inefficient construction methods, delayed payments, and incomplete construction drawings. The percentage allocation of responsibility for overall delay causes, according to contractors' perceptions, was as follows: contractors = 48.75%, consultants = 17.5%, owners = 16.25%, government = 8.75%, and shared = 8.75%.

Key Words
Delay, Construction industry, Pakistan, Delay value, Criticality index

1. Introduction

Delays on construction projects are a universal phenomenon. They are almost always accompanied by cost and time overruns. Construction project delays have a debilitating effect on parties (owner, contractor, consultant) to a contract in terms of adversarial relationships, distrust, litigation, arbitration, cash-flow problems, and a general feeling of apprehension towards each other. Delays occur on almost every construction project but the magnitude of these delays varies considerably from project to project. Some projects are only a few days behind the schedule whereas the others are delayed over a year. So it is essential to define the actual causes of delays in order to minimize and avoid the delays in any construction project.

Empirical studies to determine the causes of delays in construction projects have been carried out in developed countries including the US and the UK. However, no such formal study has been carried out for the Pakistan Construction Industry, where project delays can be informally acknowledged as the most common, costly, complex and risky problem encountered in construction projects. Because of the overriding importance of time for both the Owner (in terms of performance) and the Contractor (in terms of money), it has been a source of frequent disputes and claims leading to lawsuits in the Pakistan Construction Industry. Delays caused by the client such as late submission of drawings and specifications, frequent change orders, and incorrect/inadequate site information generate claims from both the main contractors and subcontractors which many times entail lengthy court battles with huge financial repercussions. Delays caused by contractors can generally be attributed to poor managerial skills. Lack of planning and a poor understanding of accounting and financial principles have led to many contractors' downfall.

Proper allocation of responsibility for delay causes is essential in controlling delay. Generally speaking, the party causing the delay should be held responsible for its consequences but the situation is not that simple. Industry wide, there is a varied range of views for the causes and hence responsibility of time delays for engineering and construction projects. Some are attributable to a single party, others can be ascribed to several quarters and many relate more to systemic faults or deficiencies rather than to a group or groups. This is partly because delays do not always arise from a single catastrophic event. They frequently develop slowly during the course of work. Minor delays are generally overlooked until their cumulative effect becomes financially apparent. By the time a Contractor recognizes that there is a problem, many different parties and natural forces would have contributed to the situation. Owing to the wide nature and shared responsibility of delays, a contract is usually formulated to identify potential delay situations in advance and to define and fix obligations to preclude such controversies as may be generated by delays; delay is a common source of frequent disputes and claims which may lead to lawsuits if unresolved through contractual clauses. However, it is found in practice that not everything in the contract can be taken at face value and applied in cookbook fashion. Circumstances play a great deal in determining which clause(s) will be applied to a particular delay claim. Also, contract law encompasses concepts of reasonableness and fair dealing, implied obligations and warranties, constructive acceleration, etc. A good general understanding of the principles involved and the operation of the applicable clauses are essential to help make appropriate decisions and take the proper action in those delay situations. For instance, in a large and complex project there will be a certain amount of give and take policy among the parties competing for the same time and space. Time, energy, and money must not be diverted in pursuing claims and disputes over minor delays, disruptions, and interferences.

The current study is therefore aimed at collecting, compiling and analyzing the perceptions of construction industry professionals in Pakistan as to the major causes of delays in projects and the allocation of responsibility to these delay causes. Contracting organizations are chosen for this study since they are the most involved participants in construction projects who are either responsible for causing delays (and as such may also contribute to mitigating delays) or are mostly affected by the delay consequences in terms of financial loss or even bankruptcy. Another important reason for selecting contractors is that the perceptions described by the contractors with respect to delay causes and responsibility allocation will aid in developing a baseline that might be used to evaluate the perceptions of owners and consultants, who otherwise might have the tendency of shifting the entire blame to the contractors, owing to the degree of involvement of the latter in project proceedings.

2. Prior Research

No prior research has been done in Pakistan on the identification of delay causes or allocation of responsibility. However, extensive research has been conducted in developed as well as developing countries to this effect, which helped formulating the survey for the current research. Few of the important relevant research findings as to the causes and effects of delays are summarized below.

A detailed study by the NSW Royal Commission into Productivity in the Building Industry (1992) of 20 commercial high-rise buildings with a total design and construct value of over A$2.0 billion found 22 specific causes of time overrun. Weather, industrial disputation, client scope changes and variations, and consultant problems were some of the ones occurring with the highest frequency. (Ogunlana and Promkuntong, 1996) studied the delays in building projects in Thailand, as an example of developing economies. They concluded that the problems of the construction industry in developing economies could be nested in three layers: (1) problem of shortages or inadequacies in industry infrastructure, mainly supply of resources; (2) problems caused by clients and consultants; and (3) problems caused by incompetence of contractors. (Kumaraswamy, 1998) surveyed the causes of construction delays in Hong

Kong as seen by clients, contractors and consultants, and examined the factors affecting productivity. The survey revealed differences in perceptions of the relative significance of factors between the three groups, indicative of their experiences, possible prejudices and lack of effective communication. (Mansfield et al., 1994) studied the causes of delay and cost overrun in construction projects in Nigeria. The results showed that the most important factors are financing and payment for completed works, poor contract management, changes in site conditions, shortage of material, and improper planning. (Assaf et al., 1995) studied the causes of delay in large building construction projects in Saudi Arabia. The most important causes of delay included approval of shop drawings, delays in payments to contractors and the resulting cash-flow problems during construction, design changes, conflicts in work schedules of subcontractors, slow decision making and executive bureaucracy in the owners' organizations, design errors, labor shortage and inadequate labor skills. (Mezher and Tawil, 1998) conducted a survey of the causes of delays in the construction industry in Lebanon from the viewpoint of owners, contractors and architectural/engineering firms. It was found that owners had more concerns with regard to financial issues; contractors regarded contractual relationships the most important, while consultants considered project management issues to be the most important causes of delays. (Al-Momani, 2000) conducted a quantitative analysis of construction delays by examining the records of 130 public building projects constructed in Jordan during the period of 1990-1997. The researcher presented regression models of the relationship between actual and planned project duration for different types of building facilities. The analysis also included the reported frequencies of time extensions for the different causes of delays. The researcher concluded that the main causes of delay in construction projects relate to designers, user changes, weather, site conditions, late deliveries, economic conditions, and increase in quantities. (Chalabi and Camp, 2000) conducted a review on project delays in developing countries during planning and construction stages. In their study they found that the delay and cost overruns of construction projects are dependent entirely on the very early stages of the project. (Fereig and Qaddumi, 1984) in their study on the construction experience of the Arabian Gulf demonstrate the various components of the planning, controlling and productivity on construction delay. Their primary purpose is to alert the reader to the deviation from the project plans.

(Battaineh, 1999) evaluated the progress reports of 164 building and 28 highway projects constructed during the period 1996-1999 in Jordan. The results indicate that delays are extensive: the average ratio of actual completion time to the planned contract duration is 160.5% for road projects and 120.3% for building projects.

(Leishman, 1991) presented the legal consequences of delays in construction. (Herbsman et al., 1995) studied the effect of delays on cost and quality.

(Wilson, 1982) examined the role of the owner and architect/engineer's roles in the prevention and resolution of construction claims. Wilson also summarized the causes of construction claims which include: extra work, project delays and acceleration, lack of management, limited site access and change in work schedule.

3. Objectives and Scope

The research work reported in this paper is part of an on-going research project under Pakistan-US Science and Technology Cooperative Program (STCP), with funds provided jointly by the United States Agency for International Development (USAID), USA and Ministry of Science and Technology (MoST), Pakistan. The above-mentioned project has four main objectives:

1. Assess the current state of Pakistan construction industry through quantitative research with specific reference to the status of construction management education, research and practice.
2. Develop a strategic model for the improvement and strengthening of construction management education, research and practice in Pakistan.
3. Devise a framework to standardize the construction industry practices for achieving improved performance on cost, time, quality, productivity and safety.
4. Capacity building of academia, industry, owners and government in the area of construction management so as to improve the overall efficiency and productivity of the construction industry.

Since no accurate information regarding the extent of construction management application in the Pakistan construction industry was available, the first objective of the research project was set as the investigation of the adoption and implementation of construction management practices in Pakistan construction industry. While the

main objective of this paper is to present the perception of the contracting organizations regarding causes of delays and the allocation of responsibilities, the remaining research work will be reported in further papers.

It is expected that this study will be of a pioneering nature. For the local construction industry, this research has the potential of determining the major causes of delays which, when identified and their criticality (in terms of severity and likelihood) quantified, will provide the basis for developing appropriate delay response strategies.

4. Methodology

The research methodology consists of the following steps:

1. Development of a questionnaire to elicit information about causes and responsibility allocations for construction delays in Pakistan construction industry from the perception of construction contracting organizations.
2. Conducting questionnaire survey through postal mail and personal interviews.
3. Assessment of feedback from questionnaire survey to identify the major construction delays in Pakistan construction industry.

The steps are explained as follows.

A questionnaire was developed consisting of two parts – A and B. Part A consisted of respondent's personal information (e.g. work experience, position in company) and company information (e.g. types of construction works performed, years in business, annual volume of work, number of employees).

Part B consisted of a delays checklist which was prepared after extensive literature review. The literature review was done through books, conference proceedings, internet, and leading construction management and engineering journals. Through literature review, all the causes for delays that may be encountered in a construction project were identified and were classified into nine broad categories according to their nature and mode of occurrence. In total, 80 delay causes were identified and categorized as follows:

1. Financial/ Economic delays (3 causes)
2. Design related delays (12 causes)
3. Contract related delays (7 causes)
4. Management/ Administrative delays (18 causes)
5. Construction site related delays (14 causes)
6. Equipment related delays (8 causes)
7. Labor related delays (8 causes)
8. Material related delays (6 causes)
9. Subcontracted work related delays (4 causes)

The questionnaire was used to conduct personal interviews with representatives from 37 major contracting organizations working in major cities of Pakistan so as to get their feedback on construction delays. Almost all of the firms approached were large size organizations (based on their annual volume of work and number of employees). The questionnaires were completed by their project management who were involved in the project planning, executing, procurement and decision making processes. Almost all of them (more than 90%) had over 10 years of construction experience. On the basis of their position, education, work experience and professional background, it can be inferred that the respondents had adequate knowledge of the project management activities in their organizations.

The survey response is analyzed in the following section.

5. Analysis

This section deals with the analysis of the information gathered from the questionnaire survey and includes the identification of the critical causes of delays and responsibilities based on the delays checklist. The analysis and discussion about the questionnaire survey is organized in nine delay categories as identified in section 3 above.

5.1 Identification of Critical Delays

The critical causes of delays are presented in Tables 1 – 9. Each table organizes each category of delay (Finance/ Economic delays, Design related delays, Contract related delays, Management/ Administrative delays, Construction site related delays, Equipment related delays, Labor related delay, Material related delays, Subcontracted work related delays,) based on the frequency (likelihood) of occurrence and the severity of impact. The frequency of occurrence was rated on a scale of 1 to 5 with 1 having the lowest frequency of occurrence and 5 the highest. Likewise, the severity of impact was rated on a scale of 1 to 5 with 1 having the lowest severity and 5 the highest.

The numbers in the filled cells for frequency of occurrence and severity of impact indicate the mean (average) and modal values of responses for that option. The next cell in each category shows the delay for each delay cause, rated on a scale of 25, calculated as follows:

Delay Value = Mean Frequency of Occurrence x Mean Severity of Delay

To identify the delay criticality zone for each delay cause, a delay assessment matrix is generated as shown in Fig. 1 with delay criticality defined as: minor, moderate or major, as depicted in figure.

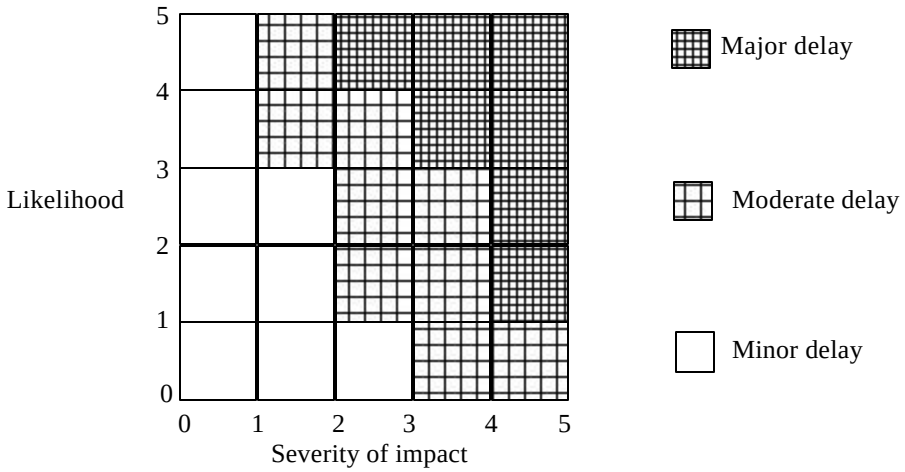

Fig. 1. Delay Assessment Matrix

Table 1. Critical Delays – Financial/ Economic

S. No.	Delay	Frequency of Occurrence (Scale of 5)		Severity of Impact (Scale of 5)		Delay Value[1]	Delay Criticality Zone[1]	Delay Criticality Index[2]
		Mean	Mode	Mean	Mode			
I	***Financial/ Economic delays***							
1	Delayed payments	3.08	3.00	3.03	5.00	9.33	Major	3
2	Financing problems	3.24	5.00	2.78	4.00	9.01	Moderate	2
3	Economic problems	2.72	2.00	3.17	4.00	8.62	Moderate	2

[1]based on mean values of frequency of occurrence and severity of impact
[2]for minor delay = 1, for moderate delay = 2, for major delay = 3

Table 2. Critical Delays – Design Related

S. No.	Delay	Frequency of Occurrence (Scale of 5)		Severity of Impact (Scale of 5)		Delay Value[1]	Delay Criticality Zone[1]	Delay Criticality Index[2]
		Mean	Mode	Mean	Mode			
II	***Design related delays***							
4	Incomplete/ Ambiguous drawings	3.07	3.00	2.73	5.00	8.38	Moderate	2
5	Incomplete/ Ambiguous specifications	2.56	1.00	2.03	3.00	5.20	Moderate	2
6	Inadequate site investigation reports	2.58	3.00	2.67	3.00	6.89	Moderate	2
7	Defective design	3.23	3.00	3.20	3.00	10.34	Major	3
8	Delayed design information	1.67	2.00	1.00	2.00	1.67	Minor	1
9	Construction drawings/ documents approval	2.58	3.00	2.43	3.00	6.27	Moderate	2
10	Inadequate design development	2.23	3.00	2.05	1.00	4.57	Moderate	2
11	Delayed approvals	2.82	3.00	1.25	2.00	3.53	Minor	1
12	Inadequate design support on site	2.60	2.00	2.08	2.00	5.41	Moderate	2
13	Delayed design decisions (during design development stage)	2.71	3.00	2.50	1.00	6.78	Moderate	2
14	Design changes	2.74	3.00	2.50	3.00	6.85	Moderate	2
15	Inadequate design review	2.43	2.00	2.19	4.00	5.32	Moderate	2

[1]based on mean values of frequency of occurrence and severity of impact
[2]for minor delay = 1, for moderate delay = 2, for major delay = 3

Table 3. Critical Delays – Contract Related

S. No.	Delay	Frequency of Occurrence (Scale of 5)		Severity of Impact (Scale of 5)		Delay Value[1]	Delay Criticality Zone[1]	Delay Criticality Index[2]
		Mean	Mode	Mean	Mode			
III	***Contract related delays***							
16	Contract clause misinterpretations	2.35	2.00	2.26	3.00	5.31	Moderate	2
17	Contract modifications	2.32	3.00	2.27	3.00	5.27	Moderate	2
18	Change orders	3.81	4.00	4.16	5.00	15.85	Major	3
19	Inadequate contract type	2.36	1.00	2.14	1.00	5.05	Moderate	2
20	Inappropriate contract terms/ conditions	2.70	2.00	2.96	2.00	7.99	Moderate	2
21	Claims/ Non-compensation	2.12	2.00	2.22	2.00	4.71	Moderate	2
22	Conflicts/ Arbitration/ Litigation	1.95	1.00	2.14	1.00	4.17	Moderate	2

[1]based on mean values of frequency of occurrence and severity of impact
[2]for minor delay = 1, for moderate delay = 2, for major delay = 3

Table 4. Critical Delays – Management/ Administrative

S. No.	Delay	Frequency of Occurrence (Scale of 5)		Severity of Impact (Scale of 5)		Delay Value[1]	Delay Criticality Zone[1]	Delay Criticality Index[2]
		Mean	Mode	Mean	Mode			
IV	***Management/ Administrative delays***							
23	Owner approvals	2.36	2.00	2.41	4.00	5.69	Moderate	2
24	Permits/ Licenses	1.92	1.00	1.54	1.00	2.96	Minor	1
25	Poor productivity estimation	2.16	2.00	2.15	5.00	4.64	Moderate	2
26	Poor cost estimation & control	3.34	3.00	3.65	5.00	12.19	Major	3
27	Inadequate site layout planning	2.39	2.00	2.05	3.00	4.90	Moderate	2
28	Poor site management and supervision	3.69	3.00	3.67	4.00	13.54	Major	3
29	Staffing problems	3.03	3.00	2.77	4.00	8.39	Moderate	2
30	Poor managerial/ leadership skills	2.72	4.00	2.50	4.00	6.80	Moderate	2
31	Inadequate project planning	2.74	2.00	3.65	4.00	10.00	Moderate	2
32	Inadequate project scheduling	3.05	2.00	3.40	4.00	10.37	Major	3
33	Lack of Coordination on Site	2.68	2.00	3.10	4.00	8.31	Moderate	2
34	External interruptions	2.18	1.00	1.69	1.00	3.68	Minor	1
35	Project management review/ approvals	1.65	1.00	1.58	1.00	2.61	Minor	1
36	Land acquisition issues	2.17	1.00	2.40	1.00	5.21	Moderate	2
37	Political influence	1.79	1.00	1.65	1.00	2.95	Minor	1
38	Changes in law and regulation (safety, design etc)	1.72	1.00	1.36	1.00	2.34	Minor	1
39	Code related delays	1.45	1.00	1.12	1.00	1.62	Minor	1
40	Law and order issues	2.04	1.00	1.87	1.00	3.81	Minor	1

[1]based on mean values of frequency of occurrence and severity of impact
[2]for minor delay = 1, for moderate delay = 2, for major delay = 3

Table 5. Critical Delays – Construction Site Related

S. No.	Delay	Frequency of Occurrence (Scale of 5)		Severity of Impact (Scale of 5)		Delay Value[1]	Delay Criticality Zone[1]	Delay Criticality Index[2]
		Mean	Mode	Mean	Mode			
V	***Construction site related delays***							
41	Work suspensions	2.24	1.00	2.18	1.00	4.88	Moderate	2
42	Lack of protection of completed work	2.05	1.00	1.42	1.00	2.91	Minor	1
43	Local practices delays	2.09	2.00	1.75	1.00	3.66	Minor	1
44	Incorrect/ Inadequate site information	2.65	2.00	2.50	3.00	6.63	Moderate	2
45	Inspections/ Audits	3.40	3.00	3.62	4.00	12.31	Major	3
46	Poor assessment of subsurface soil conditions	2.44	3.00	3.77	4.00	9.20	Moderate	2
47	Defective work	2.78	2.00	3.20	3.00	8.90	Moderate	2
48	Inefficient methods	3.24	3.00	3.17	3.00	10.27	Major	3
49	Damage to structure	1.56	1.00	2.84	2.00	4.43	Moderate	2
50	Construction mistakes	2.87	3.00	2.88	4.00	8.27	Moderate	2
51	Incomplete construction drawings	3.03	3.00	3.03	3.00	9.18	Major	3
52	Weather related delays	2.08	2.00	1.89	2.00	3.93	Minor	1
53	Working in remote location	2.67	3.00	2.02	1.00	5.39	Moderate	2
54	Acts of God e.g. earthquake, flood, wind	1.77	2.00	2.28	1.00	4.04	Moderate	2

[1]based on mean values of frequency of occurrence and severity of impact
[2]for minor delay = 1, for moderate delay = 2, for major delay = 3

Table 6. Critical Delays – Equipment Related

S. No.	Delay	Frequency of Occurrence (Scale of 5)		Severity of Impact (Scale of 5)		Delay Value[1]	Delay Criticality Zone[1]	Delay Criticality Index[2]
		Mean	Mode	Mean	Mode			
VI	***Equipment related delays***							
55	Lack of technology	2.21	1.00	1.89	2.00	4.18	Minor	1
56	Equipment breakdown	3.06	4.00	2.43	1.00	7.44	Moderate	2
57	Equipment transportation delays	2.91	3.00	2.28	4.00	6.63	Moderate	2
58	Lack of hiring services	2.54	3.00	1.78	1.00	4.52	Minor	1
59	Shortage of equipment	3.06	3.00	2.38	2.00	7.28	Moderate	2
60	Equipment import issues	2.61	3.00	2.25	4.00	5.87	Moderate	2
61	Low equipment productivity	2.91	3.00	2.04	3.00	5.94	Moderate	2
62	Unskilled operators	2.76	2.00	2.00	2.00	5.52	Moderate	2

[1]based on mean values of frequency of occurrence and severity of impact
[2]for minor delay = 1, for moderate delay = 2, for major delay = 3

Table 7. Critical Delays – Labor Related

S. No.	Delay	Frequency of Occurrence (Scale of 5)		Severity of Impact (Scale of 5)		Delay Value[1]	Delay Criticality Zone[1]	Delay Criticality Index[2]
		Mean	Mode	Mean	Mode			
VII	***Labor Related Delays***							
63	Lack of qualified craftsmen	2.88	4.00	2.40	4.00	6.91	Moderate	2
64	Labor strikes	1.60	1.00	1.62	1.00	2.59	Minor	1
65	Labor injuries/ accidents	1.60	1.00	1.25	1.00	2.00	Minor	1
66	Labor Mobilization (on remote sites)	2.76	3.00	2.28	3.00	6.29	Moderate	2
67	Labor productivity issues	3.68	4.00	4.10	4.00	15.09	Major	3
68	Illegal immigrant foreign labor issues	1.64	2.00	1.13	2.00	1.85	Minor	1
69	Internal Labor issues (conflicts/politics)	1.61	1.00	1.03	1.00	1.66	Minor	1
70	Absenteeism	2.12	1.00	1.57	1.00	3.33	Moderate	2

[1]based on mean values of frequency of occurrence and severity of impact
[2]for minor delay = 1, for moderate delay = 2, for major delay = 3

Table 8. Critical Delays – Material Related

S. No.	Delay	Frequency of Occurrence (Scale of 5)		Severity of Impact (Scale of 5)		Delay Value[1]	Delay Criticality[1]	Delay Criticality Index[2]
		Mean	Mode	Mean	Mode			
VIII	***Material related delays***							
71	Material fabrication delays	3.00	2.93	2.82	2.00	8.46	Moderate	2
72	Material procurement delays	2.00	2.69	3.22	3.00	6.44	Moderate	2
73	Material quality non-conformance	2.26	1.00	1.93	1.00	4.36	Minor	1
74	Material Shortage	2.69	3.00	2.48	4.00	6.67	Moderate	2
75	Material Import delays (due to local non-availability)	2.22	3.00	1.86	3.00	4.13	Minor	1
76	Damage of material in storage	1.78	1.00	1.48	1.00	2.63	Minor	1

[1]based on mean values of frequency of occurrence and severity of impact
[2]for minor delay = 1, for moderate delay = 2, for major delay = 3

Table 9. Critical Delays – Subcontracted Work Related

S. No.	Delay	Frequency of Occurrence (Scale of 5)		Severity of Impact (Scale of 5)		Delay Value[1]	Delay Criticality[1]	Delay Criticality Index[2]
		Mean	Mode	Mean	Mode			
IX	***Subcontracted work related delays***							
77	Incompetent subcontractor	2.52	2.00	2.19	3.00	5.52	Moderate	2
78	Busy subcontractor	2.39	3.00	2.16	2.00	5.16	Moderate	2
79	Coordination problems	2.25	1.00	2.08	1.00	4.68	Moderate	2
80	Subcontractor resource related problems	2.86	2.00	2.41	4.00	6.89	Moderate	2

[1]based on mean values of frequency of occurrence and severity of impact
[2]for minor delay = 1, for moderate delay = 2, for major delay = 3

5.2 Identification of Responsibility

The identification of responsibilities is shown in Tables 10-18. The responsibility was rated among the parties that may be involved on a construction project starting from the Owner, Consultant, Contractor, and Government to Shared (Owner-Contractor, Owner-Consultant, etc). The identification was done based on the information gathered from the questionnaire survey and selecting the highest percentage in each item.

Table 10. Responsibility of Delay – Financial/ Economic

S. No.	Delay	Responsible Entity
I	***Financial/ Economic Delays***	
1	Delayed Payments	Owner
2	Financing problems	Owner
3	Economic problems	Owner
Responsibility distribution		Owner = 100%

Table 11. Responsibility of Delay – Design Related

S. No.	Delay	Responsible Entity
II	***Design Related Delays***	
4	Incomplete/ Ambiguous Drawings	Consultant
5	Incomplete/ Ambiguous Specifications	Consultant
6	Inadequate Site Investigation Reports	Consultant
7	Defective Design	Consultant
8	Delayed Design Information	Consultant
9	Construction Drawings/ Documents Approval	Consultant
10	Inadequate Design Development	Consultant
11	Delayed approvals	Consultant
12	Inadequate design support on site	Consultant
13	Design Decisions (during design development stage)	Consultant
14	Design Changes	Consultant
15	Inadequate Design Review	Consultant
Responsibility distribution		Consultant = 100%

Table 12. Responsibility of Delay – Contract Related

S. No.	Delay	Responsible Entity
III	***Contract Related Delays***	
16	Contract clause misinterpretations	Consultant
17	Contract modifications	Owner
18	Change Orders	Owner
19	Inadequate contract type	Owner
20	Inappropriate contract terms/ conditions	Owner
21	Claims/ Non-compensation	Owner
22	Conflicts/ Arbitration/ Litigation	Owner
Responsibility distribution		Owner = 85.71% Consultant = 14.29%

Table 13. Responsibility of Delay – Management/ Administrative

S. No.	Delay	Responsible Entity
IV	***Management/ Administrative Delays***	
23	Owner Approvals	Owner
24	Permits/ Licenses	Owner
25	Poor productivity estimation	Contractor
26	Poor cost estimation & control	Contractor
27	Inadequate Site Layout Planning	Contractor
28	Poor site management and supervision	Contractor
29	Staffing problems	Contractor
30	Poor Managerial/ Leadership Skills	Contractor
31	Inadequate Project Planning	Contractor
32	Inadequate Project Scheduling	Contractor
33	Lack of Coordination on Site	Contractor
34	External Interruptions	Owner
35	Project Management Review/ Approvals	Consultant
36	Land acquisition issues	Owner
37	Political influence	Government
38	Changes in law and regulation (safety, design etc)	Government
39	Code related delays	Government
40	Law and order issues	Government
Responsibility distribution		Owner = 22.22% Consultant = 11.11% Contractor = 50.00% Government = 16.67%

Table 14. Responsibility of Delay – Construction Site Related

S. No.	Delay	Responsible Entity
V	***Construction Site Related Delays***	
41	Work suspensions	Shared
42	Lack of protection of completed work	Contractor
43	Local practices delays	Contractor
44	Incorrect/ Inadequate site information	Shared
45	Inspections/ Audits	Contractor
46	Poor assessment of Subsurface Soil Conditions	Shared
47	Defective Work	Contractor
48	Inefficient Methods	Contractor
49	Damage to Structure	Contractor
50	Construction Mistakes	Contractor
51	Incomplete Construction Drawings	Contractor
52	Weather related delays	Shared
53	Working in remote location	Contractor
54	Acts of God e.g. earthquake, flood, wind	Shared
Responsibility distribution		Contractor = 64.29% Shared = 35.71%

Table 15. Responsibility of Delay – Equipment Related

S. No.	Delay	Responsible Entity
VI	***Equipment Related Delays***	
55	Lack of technology	Shared
56	Equipment breakdown	Contractor
57	Equipment transportation delays	Contractor
58	Lack of hiring services	Contractor
59	Shortage of equipment	Contractor
60	Equipment import issues	Government
61	Low equipment productivity	Contractor
62	Unskilled operators	Contractor
Responsibility distribution		Contractor = 75% Government = 12.5% Shared = 12.5%

Table 16. Responsibility of Delay – Labor Related

S. No.	Delay	Responsible Entity
VII	***Labor Related Delays***	
63	Lack of qualified craftsmen	Contractor
64	Labor strikes	Contractor
65	Labor injuries/ accidents	Contractor
66	Labor Mobilization (on remote sites)	Contractor
67	Labor productivity issues	Contractor
68	Illegal immigrant foreign labor issues	Government
69	Internal Labor issues (conflicts/politics)	Contractor
70	Absenteeism	Contractor
Responsibility distribution		Contractor = 87.5% Government = 12.5%

Table 17. Responsibility of Delay – Material Related

S. No.	Delay	Responsible Entity
VIII	***Material Related Delays***	
71	Material Fabrication Delays	Contractor
72	Material Procurement Delays	Contractor
73	Material Quality Non-Conformance	Contractor
74	Material shortage	Shared
75	Material Import Delays (due to local non-availability)	Government
76	Damage of material in storage	Contractor
Responsibility distribution		Contractor = 66.67% Shared = 16.67% Government = 16.67%

Table 18. Responsibility of Delay – Subcontracted Work Related

S. No.	Delay	Responsible Entity
IX	***Subcontracted Work Related Delays***	
77	Incompetent subcontractor	Contractor
78	Busy subcontractor	Contractor
79	Coordination problems	Contractor
80	Subcontractor resource related problems	Contractor
Responsibility distribution		Contractor = 100%

5.3 Summary of Analysis

After analyzing Tables 1 through 18, the major delay causes (with delay criticality indices = 3), ranked in descending order of criticality (based on delay values), are shown in Table 19. Table 19 also provides delay value, category, criticality ranking and responsibility for these major delay causes.

Table 19. Major Delays – Various Categories

Delay Cause	Delay Value	Delay Category	Responsible Entity	Delay Criticality Ranking
Change orders	15.85	Contract Related Delays	Owner	1
Labor productivity issues	15.09	Labor Related Delays	Contractor	2
Poor site management and supervision	13.54	Management/ Administrative Delays	Contractor	3
Inspections/ Audits	12.31	Construction Site Related Delays	Contractor	4
Poor cost estimation & control	12.19	Management/ Administrative Delays	Contractor	5
Inadequate project scheduling	10.37	Management/ Administrative Delays	Contractor	6
Defective design	10.34	Design Related Delays	Consultant	7
Inefficient construction methods	10.27	Construction Site Related Delays	Contractor	8
Delayed payments	9.33	Financial/ Economic Delays	Owner	9
Incomplete construction drawings	9.18	Construction Site Related Delays	Contractor	10

Further assessment of Tables 1 to 18 – to identify delay criticality ranking of various categories of delays (based on a value of mean delay criticality index for each category) – results in Table 20. The table has been arranged in descending order of delay criticality and also provides the major responsible entity/ entities for each delay category.

Table 20. Delay Criticality Ranking - Various Categories

Category of Delay	Mean Delay Criticality Index[1]	Major Responsible Entity	Delay Criticality Ranking
Design related delays	2.56	Consultant (100%)	1
Financial/ Economic Delays	2.33	Owner (100%)	2
Contract related delays	2.14	Owner (85.71%)	3
Construction site related delays	2.00	Contractor (64.29%)	4
Subcontracted work related delays	2.00	Contractor (100%)	4
Management/ Administrative delays	1.78	No single major responsible entity (Contractor = 50%)	6
Equipment related delays	1.75	Contractor (75%)	7
Labor related delay	1.63	Contractor (87.5%)	8
Material related delays	1.50	Contractor (66.67%)	9

[1]Mean delay criticality index for a category is the sum of delay criticality indices for each delay cause in the category divided by total number of delay causes in the category

6. Conclusions and Recommendations

Delays can be minimized only when their causes are identified. Knowing the cause of any particular delay in a construction project would help avoiding the same. This research study was therefore, aimed at identifying the major causes of delays in construction projects in Pakistan through a survey, and quantifies the perceptions of contractors regarding the causes and responsible parties for the delays. Based on the results of the questionnaire survey, the following conclusions have been drawn.

The major delay causes (most critical delays) constitute 10 out of a total of 80 causes i.e. 12.5% of the total delays. The moderate delay causes constitute 49 out of a total of 80 causes i.e. 61.25%. Minor delays constitute the remaining 26.25%.

Based on the overall results, it can be concluded that the following is the ranking of responsibilities of the stakeholders from the most responsible (1) to the least responsible party (5):

1. Contractor = 48.75%
2. Consultant = 17.5%
3. Owner = 16.25%
4. Government = 8.75%
5. Shared = 8.75%

The top five (5) delay categories are:

1. Design related delays
2. Finance/ Economic delays
3. Contract related delays
4. Construction site related delays
5. Subcontracted work related delays

This is to say that delays due to causes in above categories share a major average (mean) position of importance, while other categories do not have the same average (mean) negative impact on project completion times as the above causes.

The top ten (10) most critical causes of delays (across the nine categories given above) are shown below. Their delay values (maximum 25) are given in parenthesis.

1. Change orders (15.85)
2. Labor productivity issues (15.09)
3. Poor site management and supervision (13.54)
4. Inspections/ Audits (12.31)
5. Poor cost estimation & control (12.19)
6. Inadequate project scheduling (10.37)
7. Defective design (10.34)
8. Inefficient construction methods (10.27)
9. Delayed payments (9.33)
10. Incomplete construction drawings (9.18)

Based on the overall results, we can conclude that the following is the ranking of responsibilities of the stakeholders from the most responsible (1) to the least responsible (5):

1. Contractor = 48.75%
2. Consultant = 17.5%
3. Owner = 16.25%
4. Government = 8.75%
5. Shared = 8.75%

In most of the cases, it is found that the contractors bear the responsibility for major delays. This is particularly true for equipment related delays, material related delays, labor related delays, construction site related delays, subcontracted work related delays and management delays. The consultants bear complete responsibility of design related delays. This is of course because they are directly in charge of the design process in conjunction with the owner of the project. The owners bear complete responsibility of financial/ economic delays as well as contract related delays. This is because payment delays, cash flow issues, contract selection, contract development, contract modifications, change orders are mostly generated at owners' end. Owners also contribute to a lesser significant extent to administrative delays. Government takes its share as a contributory to project delay mostly in terms of administrative and regulatory issues such as changes in laws and regulations, code related delays, law and order issues, and political issues. It is also important to note that Government is a major public owner in Pakistan and hence in case of public projects, where delay is a major concern, it takes a share of 26.25% instead of only 8.75%. Shared responsibility exists mostly in construction site related delays such as work suspensions, issues with subsurface soil conditions, weather related issues, and acts of God. Lack of technology and material shortage as contributory to delays are also considered by contractors as shared responsibility.

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