Analysing Delays of Construction Projects in India: Causes and Effects

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Abstract

Construction delays are common problems in civil engineering project in India. These problems occur commonly during project life-time leading to disputes and legal action. Therefore, it is necessary to study and analyzed causes of construction delays. The opinion of construction experts was obtained through interviews. Subsequently, a questionnaire survey was prepared. A questionnaire survey is conducted to consider the time performance of construction projects in India to identify the causes of delay and their important index for delay factors could be computed. A total 78 causes of delay were identified during the research. The delay factors were grouped into eight major groups. The top-10 list was dominated by factors related to the contractor, owner and the project group. However, three owner group factors and consultant group factors, late progress payment, financial problems of owner, and improper study of design affects estimated quantity, were the first three factors on the list, which also had a high impact on the three project objectives. The remaining factors on the list were poor qualification of the contractor technical staff and project team, poor terrain condition, conflict between contractor and consultant, Poor site arrangement, management, and supervision, lacks of involvement of design team during construction stage, delay in obtaining permits from provincial/municipality, and distribution to public activities. Recommendations to manage the delay factors were presented. Significant relationships, between the delay factors and the three project objectives also were observed and discussed.
Keywords: Construction Projects, Important Index, Delay Time, Cost and Quality

I. INTRODUCTION

Construction delays are very common in most projects everywhere in the world. Delay could be defined as an act or event that extends the time required to performance the tasks under a contract. It usually shows up as additional days of work or as delayed start of an activity (G. Sweis et al 2007).

According to Assaf et al (2006) in construction, delay could be defined as the time overrun either beyond completion date specified in contract, or beyond the date that the parties agreed upon for delivery of a project. It is a project slipping over its planned schedule and is considered as common problem on construction projects.

This study is an attempt to fill the gap by carrying out research on the delay analysis of infrastructure projects with a focus on examining the factors that influence delays and their effects on project time, cost, and quality. The target respondents were engineers from contractor and consultant firms involved in construction projects.

Time, cost and quality are the basic of successful construction which include also the safety and it environment. Time and cost had parallel relationship which the increasing of the time will make the increasing of the cost. Then, the controlled of time is really important for avoid any loss to the contractor. The time that already discuss is the period which is the schedule for the activities from beginning until finish the process of planning.

II. OBJECTIVES OF THE STUDY

The main objectives of this study include the following:

- To identify the causes of delays in construction project in the India;
- To identify the importance of the delay causes from consultants and contractors perspective; and
- To test the agreement on the ranking of the importance of the causes of delay between contractors and consultants.

III. DELAYS IN CONSTRUCTION PROJECTS: A LITERATURE REVIEW

According to Atkinson 1999, over the past 50 years, time, cost, and quality have increase into inextricably associated to the ability of the achievement of project management. This is sometimes not amazing, since over the same period these criteria have generally been included in the details of project management. The three factors remain in study stress.

In the project life series, the most important factors disturbing the conclusion of a project commonly exist in at the early stages. At this location, effect should be based on expert economic decision with due appearance for enough financing, common public and regulatory atmosphere, and industrialized considerations (Hendrickson and Au, 2003).

Predicting and understanding the problems in front of they take place, careful study to keep away from any of them and adopting suitable product when they really come into reality is expected when fore-knowledge of which challenges are most expected to take location in construction projects is existing.

A. Causes of Delay in Construction Project

A delay is take place the construction industry in which a contractor, consultant, or client jointly or independently present to the reorganization of a project's completion time as specific in the contract document (Albinu and Jagboro 2002). According to Mahamid et al. (2012), delays in construction projects are a universal phenomenon. Delays happen to small and large projects in developing and developed nations, and are usually accompanied by cost overruns. Delay generally has a harmful effect on clients, contractors, and consultants in terms of project progress, relationships, and communication among parties, and on financial aspects, which sometimes may develop into serious disputes or legal battles in court (Semple et al. 1994; Yates and Epstein 2006). It is normal for construction projects to face problems during the project implementation, and delay is one of the major problems. Delay is a problem that should be addressed properly before it grows and sincerely affects project time, cost, and quality. Moreover, it also will contribute to a detrimental relationship between those involved in the project. Disputes in construction projects are limited not only to local companies. They also may involve foreign firms, as many large construction projects are multinational projects and sometimes are funded by international funding organizations. Serious disputes and legal actions send damaging signals to foreign investors and companies, thereby slowing down the nation's infrastructure development.

Considering the importance of analyzing delays in construction, many studies have been carried out to identify the factors that contribute to their causes. Some focus on general construction projects (Sweis et al. 2008; El Razek et al. 2008; Sambavisan and Soon 2007; Lo et al. 2006; Chan and Kumaraswamy 1997), whereas others focus specifically on large projects (Haseeb 2011; Toor and Ogunlana 2008; Assaf and Al-Hejji 2006). Some have an interest in building projects (Fugar and Agyakwah-Baah 2010; Wiguna and Scott 2006; Al-Momani 2000; Odeyinka and Yusif 1997; Ogunlana et al. 1996; Assaf et al. 1995), and a few in road construction projects (El-Sayegh and Mansour 2015; Anastasopoulos et al. 2011; Mahamid et al. 2012; Kaliba et al. 2009). The analysis of delays can focus on a specific party involved in the project—a contractor, consultant, or owner—or the study can face more than one party in its investigation in which a evaluation of the perspectives can be conducted. The large number of research papers on the idea of delays does not mean that the topic is saturated. It does, however, indicate the significance of the topic in the construction industry and the individuality of construction projects; therefore, it is a topic worth exploring.

The problems of delay can create from the internal association of the contractor as the perpetrator of the project, or they can come from any factors outside the contractor firm that influence the project implementation development. Delays that are triggered by the internal association of the contractor, such as mismanagement or technical issues in the implementation of the project, are under the dependability of the contractor. The roles and responsibilities of parties involved in the project define their own perspectives on the delay factors.

Delays are common in all types of projects. According to Alaghbari et al. (2007), they generally are recognized as a costly, complex, and risky problem. Because of the prevailing importance of time for both the owner and the contractor, delays have been the source of frequent disputes and claims, sometimes leading to legal action (Anastasopoulos et al. 2011). Majid (2006) stated that delays can be minimized when their causes are identified. Despite several studies on cost overruns since Arditi et al. (1985), the definition of cost increase is not always clear cut. Flyvbjerg et al. (2002) defined cost increase as the gap between the actual cost and the estimated cost. That is, actual cost is the accounted project cost after completion, and estimated cost is the budgeted or forecasted project cost at the time of decision to start the project.

Looking into how the literature defines quality provides answers that are less clear. According to Flynn et al. (1994), quality is the distinction between input (the quality of management) and output (the quality of performance). Fujimoto (1989) and Voss and Blackmon (1994) described internal performance as conforming to required specifications; Fynes and De Burca (2005) defined external performance as the level of quality in use of the end product.

The level of success at project completion is thus based not only on time- and cost-based empirical criteria but also on an individual weighting of time, cost, and quality. Liu and Walker (1998) placed project success definitions in three categories: (1) "project goals," (2) "satisfaction of the claimant(s)," and (3) "perception and awareness of different claimant(s)." Project goals are those for contract agreed time, cost, and quality. Long et al. (2004) defined a successful project as one that is completed within the agreed contract budget and deadline, in accordance with required specifications, and to the satisfaction of stakeholders. Similar related definition were used by Avots (1969), Gaddis (1959), Handa and Adas (1996), Kerzner (1998), Morris and Hough (1987), Olsen (1971), Trauner (1993), Tuman (1983, 1986), and Williams (1993).

B. Effect of Delay Factors on Time, Cost, and Quality

The performance of a construction project generally can be measured according to the three project objectives of cost, time, and quality. Therefore, the impact of any risks to the project also should be reflected in these three factors. From this perspective, the effects of the delay factors on time, cost, and quality were examined to identify the factors that significantly influence each objective.

Because construction projects are outdoor construction projects, floods, which expose construction work to water for a long period, have a substantial impact on quality. Therefore, flooding was positioned at the top of the list. These two delay factors were considered to have slightly less effect on cost compared to the other two project objectives. This finding is similar to the finding of Larsen et al. (2015) in their research on public construction projects in Denmark, in which weather is the second top factor affecting time, cost, and quality.

Frequent equipment breakdowns was one factor related to the contractors it are also effect for all three project objectives. This delay factor has a high impact on cost and time because it is positioned first in terms of its effect on cost, and second for its effect on time. However, the impact of this delay factor on quality was not as high as on the other two objectives. Another factor related to the contractors on poor qualifications of the contractor technical staff and project teams, was seen to have a more considerable impact on quality. This impact, to a serious degree, requires rework to rectify unacceptable work. Consequently, it will affect the expenses of the project as reflected in the delay factor rework because of unacceptable quality.

Because of the nature of road construction projects, thoughtful consideration of the ground condition and terrain. Therefore, the importance of this factor to the overall project performance was well understood and accepted. Another project-related factor, the land acquisition issue, also contributed significantly to achieving road construction projects on time.

Table – 1
Summary of previous studies on causes of delay in construction industry

Researchers	*Country*	*Major Causes of Delay*
Arditi, et al.(1985)	*Turkey*	– *Shortages of resources* – *Financial difficulties faced by public agencies and contractors* – *Organizational deficiencies* – *Delays in design work* – *Frequent change order/design* – *Considerable additional work*
Baldwin (1971)	*U.S.*	– *Inclement weather* – *Shortage of labour supply* – *Subcontracting system*
Okpala and Aniekwu (1988)	*Nigeria*	– *Shortage of materials* – *Failure to pay for completed works* – *Poor contract management*
Dlakwa and Culpin (1990)	*Nigeria*	– *Delay in payment by agencies to contractors* – *Fluctuations in materials labour and plant costs*
Mansfield et al. (1994)	*Nigeria*	– *Improper financial and payment arrangements'* – *Poor contract management* – *Shortages of materials* – *Inaccurate cost estimates* – *Fluctuations in cost*
Semple et al. (1995)	*Canada*	– *Increase in the scope of works* – *Inclement weather* – *Restricted access*
Assaf et al. (1995)	*Saudi Arabia*	– *Slow preparation and approval of shop drawing* – *Delays in payment to contractor* – *Changes of design/design error* – *Shortages of labour supply* – *Poor workmanship*
Ogal. unlana et (1996)	*Thailand*	– *Shortages of material* – *Changes of design* – *Liaison problems among the contracting parties*
Chan and KUmaraswamy (1996)	*Hong Kong*	– *Unforeseen ground conditions* – *Poor site management and supervision* – *Slow decision making by project teams* – *Client-initiated variations*
Al-Khall and Al-Ghafly (1999)	*Saudi Arabia*	– *Cash flow problems/financial difficulties* – *Difficulties in obtaining permits* – *"lowest bid wins" system*
Al-Momani (2000)	*Jordon*	– *Poor design* – *Changes order/design* – *Inclement weather* – *Unforeseen site conditions* – *Late delivery*
Mezher et al. (1998)	*Lebanon*	– *Owner had more concerns with regard to financial issues* – *Contractors regarded contractual relationships the most*

		important – *Consultants considered project management issues to be the most important causes of delay*
Koushki et al (2005)	*Kuwait*	– *Changing orders* – *Owners' financial constraints* – *Owners' lack of experience in the construction Business*
Faridi and El-Sayegh (2006)	*United Arab Emirates (UAE)*	– *Slow preparation and approval of drawings* – *Inadequate early planning of the project* – *Slowness of owner's decision making* – *Shortage of manpower* – *Poor site management and supervision* – *Low productivity of manpower*

IV. RESEARCH METHODOLOGY

This research is on the basis of a survey designed to gather all necessary information in an effective way. The survey presents 78 delay causes generated on the basis of related research work on construction delay together with input, revision, and modification by some construction parties. A questionnaire was developed to evaluate the importance index of the identified causes.

V. RESULTS ANALYSIS

A. Analysis of Overall Results

To analyze the data, an approach using the importance index (Assaf and Al-Hejji 2006) was adopted, in which initially it was necessary to calculate the importance index using formulas as follows:

$$\text{Important index (IMP.I.) (\%)} = \Sigma\, W/(A.N)$$

Where W = weighting given to each factor by the respondents which ranges from 1 to 4 where '1' is 'not important' and '4' is 'very important', A = highest weight (i.e. 4 in this case), and N = total number of respondents (i.e. 45 in this case).

The spearman's rank correlation was a non-parametric measure of statistical dependence between two variables. It offered an advantage of not requiring the normality assumption or homogeneity of variance assumption. The subjected can be compared, as results have one or two outliers, their influence can be negated. In this study, the relationship among different parties or factors was measured. A perfect spearman correlation of +1 or −1 occurred when each of the variables was a perfect monotone function of the other. A +1 indicated a perfect positive relationship among respondents, whereas-1 presented that there was a negative relationship among their respondents opinion. The spearman's rank correlation coefficient, r_s was used to measure and compare between the rankings of owners and main contractors for a single cause of delay. The coefficient can be computed as follows:

$$r_s = 1 - 6\Sigma\, d^2{}_1/N(N^2-1)$$

Where

r_s = Spearman's rank correlation coefficient between two parties,

d = the difference in ranking between ranks assigned to variables for each cause (owner and consultants, owner and contractors, consultant and contractors), and

N = The number of pairs of rank, equals to 45 and 4 for all the delay factor and eight the main categories of delays, respectively.

Table – 2
Important Index of Delay Factors

Sr. No.	*Category*	*Effects of Delay Factor on*	*Important index (%)*	*Over all Rank*
1	*Project*	*Award the project to the lowest bidder*	*20*	*53*
2	*Group*	*Disturbance to public activities*	*70.67*	*09*
3		*Limited construction area*	*56.00*	*25*
4		*Inconvenient site access*	*70.66*	*10*
5		*Poor ground condition*	*70.00*	*11*
6		*Poor terrain condition*	*75.34*	*04*
7		*Poor soil condition*	*63.34*	*20*
8		*Impact on people's land along the construction project*	*57.34*	*24*
9		*Accidents during construction*	*30.00*	*43*
10		*Ineffective penalties caused by delay*	*35.34*	*37*
11		*Long distance to borrow pits*	*34.00*	*38*
12		*Quantity increase over contract*	*42.66*	*33*
13		*Unreasonable project time frame*	*28.66*	*46*
14	*Owner*	*Late progress payment*	*78.00*	*01*
15	*Group*	*Late in decision making*	*67.34*	*14*
16		*Poor communication between owner and other parties*	*66.00*	*16*

17		*Financial problems of owner*	*77.34*	*02*
18		*Late in approving sample materials*	*70.66*	*10*
19		*Change orders during construction*	*40.66*	*34*
20		*Late in approving the site to contractor*	*48.00*	*31*
21		*Delay in issuing completion certificate*	*26.00*	*51*
22		*Undefined scope of working*	*48.66*	*31*
23		*Late land handover by owner*	*38.00*	*35*
24		*late issuing of approval documents by owner*	*32.66*	*42*
25	*Contractor*	*Difficulties in financing project*	*60.66*	*22*
26	*Group*	*Poor communication between contractor and other parties*	*69.34*	*12*
27		*Conflict between contractor and consultant*	*74.66*	*06*
28		*Poor site arrangement, management, and supervision*	*75.00*	*05*
29		*Inadequate contractor experience*	*52.66*	*29*
30		*Improper construction methods*	*34.00*	*38*
31		*Rework because of unaccepted quality*	*43.34*	*32*
32		*Ineffective construction schedule*	*27.34*	*49*
33		*Poor qualifications of the contractor technical staff and project team*	*76.00*	*03*
34		*Frequent change of subcontractor/suppliers*	*24.30*	*52*
35		*Lack of competent subcontractor/suppliers*	*32.66*	*41*
36		*Conflict between contractor and other parties*	*35.34*	*37*
37		*Delay in commencement*	*36.00*	*36*
38	*Materials*	*Frequent equipment breakdowns*	*62.00*	*21*
39	*And*	*Shortage of equipment, machinery, and tools*	*60.66*	*22*
40	*Equipment*	*Inadequate modern equipment*	*66.66*	*15*
41	*Group*	*Slow mobilization of equipment*	*67.34*	*14*
42		*Shortage of construction material*	*60.00*	*23*
43		*Change in types and specifications during construction*	*54.00*	*27*
44		*Slow delivery*	*32.66*	*41*
45		*Damage in storage while needed on site*	*64.00*	*18*
46	*Laborers*	*Personal conflict between laborers and management team*	*34.00*	*38*
47	*Group*	*Personal conflict among laborers*	*28.00*	*48*
48		*Low productivity of laborers*	*65.34*	*17*
49		*Unskillful equipment operator*	*59.34*	*23*
50		*Insufficient laborers*	*33.34*	*40*
51		*Personal conflict between laborers and management team*	*26.66*	*50*
52		*Labor injuries*	*20.00*	*53*
53		*Labor disputes and strikes*	*29.80*	*44*
54	*Consultant*	*Inflexibility of consultant*	*28.66*	*46*
55	*Group*	*Poor communication between consultant and other parties*	*34.00*	*39*
56		*Delay in performing inspection at construction site*	*32.66*	*41*
57		*Incapable inspectors*	*56.66*	*25*
58		*Lack of experience of consultant*	*70.00*	*11*
59		*Delay in approving major changes in the project*	*30.66*	*42*
60		*Incompetent project manager/team leader*	*66.66*	*15*
61		*Late sending progress claims to owner/client*	*64.66*	*19*
62		*Improper study of design affects estimated quantity*	*77.34*	*0 2*
63		*Insufficient inspectors*	*68.00*	*13*
64	*Design*	*Incomplete design*	*54.66*	*26*
65	*Group*	*Design changes during construction*	*69.34*	*12*
66		*Unclear and inadequate details in drawings*	*56.00*	*25*
67		*Lacks of involvement of design team during construction stage*	*73.34*	*07*
68		*Delay in approving drawing, specifications, or instructions*	*54.00*	*27*
69		*Mistakes or errors in design*	*52.66*	*29*
70	*External*	*Political situation*	*69.34*	*12*
71	*Factor*	*Fluctuation of exchange rate, material, equipment, machines*	*30.66*	*42*
72	*Group*	*Changing of bankers' policy for loans*	*38.00*	*35*
73		*Working during rainy season*	*48.66*	*30*
74		*Natural disaster*	*25.34*	*49*
75		*Changes in government regulations and laws*	*66.66*	*15*
76		*Delay in obtaining permits from provincial/municipality*	*73.33*	*08*
77		*Weather condition*	*29.33*	*45*
78		*Monopoly*	*53.33*	*28*

VI. IMPORTANCE OF DELAY FACTORS

The computation of the importance index is presented in Table 1. It is shown that the project group of late progress payment, which had the highest importance index (78.00), had an Outstanding index value compared to other delay factors. This factor had more than a 10-point difference from the second-ranked factor, financial problems of owner (77.34) and improper study of design affects estimated quantity (77.34), which indicated the high significance of the late progress payment in delaying construction work. Other external factors were supposed as low in importance, with an index below 60.0. Further discussion will focus on the top-10 delay factors.

Three project-related factors {poor qualification of the contractor technical staff and project team(76.00), poor site arrangement, management, and poor terrain condition(75.34), and supervision(75.00) }were in the top-10 lists of combined consultants and contractors. This indicates that concerns related to the project and external factors were taken equally into account by combined contractors and consultants.

Consultants also gave more weight to delays caused by contractors than did the contractors themselves, which is reasonable. Frequent equipment breakdown was ranked second by the consultants, but it was ranked fifth rank by contractors. Similarly, poor site arrangement, management, and supervision, which was ranked fourth rank by consultants, was placed seventh by the contractors. In total, five factors originated by the contractors were on the top- 10 list of the consultants. Conversely, there were only three factors on the contractors' list.

From the consultants' perspective, there were no causes of delays by owners on the top-10 list, but there were two concerns from the contractors' point of view: late progress payment (sixth) and financial problems of owner (ninth). This finding follows the logical practice in which contractors, in general, have a tendency to blame the owner or consultants for some delays or problems in the project, and vice versa. In this case, the contractors did not consider that the consultants contributed significantly to delays, as no factors from the consultants' side were on the top-10 list of contractors. The blame was allotted more to the owner that did not pay the interim payment on time, possibly because of financial or cash flow problems.

Table - 3
Top-10 Delay Factors (Importance Index)

Rank	*Consultants*	*Contractor*	*Combined*
1	*Late in decision making(o)*	*poor terrain condition(p)*	*Late progress payment(o)*
2	*Financial problems of owner(o)*	*Late progress payment(o)*	*Financial problems of owner(o)*
3	*Poor communication between contractor and other parties(c)*	*Financial problems of owner(o)*	*Improper study of design affects estimated quantity(s)*
4	*Financial problems of owner(o)*	*conflict between contractor and consultant(c)*	*Poor qualification of the contractor technical staff and project team(c)*
5	*Poor qualification of the contractor technical staff and project team(c)*	*Poor site arrangement, management, and supervision(c)*	*Poor terrain condition(p)*
6	*Slow mobilization of equipment(m)*	*Inadequate modern equipment(m)*	*conflict between contractor and consultant(c)*
7	*Improper study of design affects estimated quantity(s)*	*Damage in storage while needed on site(m)*	*Poor site arrangement, management, and supervision(c)*
8	*Political situation(e)*	*Incompetent project manager/team leader(s)*	*lacks of involvement of design team during construction stage(d)*
9	*delay in obtaining permits from provincial/municipality(e)*	*Improper study of design affects estimated quantity(s)*	*delay in obtaining permits from provincial/municipality(e)*
10	*Late progress payment(o)*	*Insufficient inspectors(s)*	*distribution to public activities(p)*

Note: p = project group, o = owner group, c = contractor group, m = material and equipment group, s = consultant group, d = design group, e = external factor group.

A. Analysis of Overall Results by Delay Causes Groups

The group importance index was calculated as the average of the importance index for the delay factors in the group. For example, in the ''project group", the group importance index is the average of the importance indices of its constituting causes as follows; Award the project to the lowest bidder(20), Disturbance to public activities(70.67), Limited construction area(56.00), Inconvenient site access, Inconvenient site access(70.66), Poor ground condition(70.00), Poor terrain condition(75.34), Poor soil condition(63.34), Impact on people's land along the construction project(57.34), Accidents during construction(30.00), Ineffective penalties caused by delay(35.34), Long distance to borrow pits(34.00), Quantity increase over contract(42.66), and Unreasonable project time frame(28.66), resulting in an average of 50.31, which is its group importance index. The ranked groups of delay causes and their corresponding importance index are shown in table 4.

Table - 4
Group Importance Index for Overall Results

Rank	*Group of Delay Causes*	*Group Importance Index*
1	*Design group*	*60.00*
2	*Material and equipment group*	*58.42*
3	*Owner group*	*53.94*
4	*Consultant group*	*52.93*

5	*Project group*	*50.31*
6	*Contractor group*	*49.33*
7	*External factor group*	*48.29*
8	*Laborers group*	*37.06*

B. Effects of Delay Factors on Time, Cost, and Quality

The presentation of a construction project generally can be measured according to the three project objectives of time, cost, and quality. Therefore, the impact of any risks to the project also should be reflected in these three factors. From the mean values, it was shown that, in general, the respondents assigned more weight to the effect of time relative to cost and quality. This was reasonable, considering that delays are more related to time than to the other two project objectives. Hence, people in their opinion tended to communicate the effect of delay factors more to time than to cost or quality, which may not always be a true consideration.

The top-10 list for all three objectives in Table 5 is control by delay factors that are in the top-10 list of the importance index. This should make construction engineers aware that each objective may have assured unique factors that considerably control the purpose.

As shown in Table 5, disturbance to public activities again were ranked among the top listed delay factors, especially in affecting quality and time. Because construction projects are outdoor construction projects, disturbance to public activities, which expose construction work to public for a long period, have a substantial impact on quality. Therefore, disturbance to public activities was positioned at the top of the list. These two delay factors were considered to have slightly less effect on cost compared to the other two project objectives.

Table – 5
Top-10 Delay factor and Their Effect on Time, Cost, and Quality

Rank	*Time delay factor*	*Time mean*	*Cost delay factor*	*Cost mean*	*Quality delay factor*	*Quality mean*
1	*Improper construction methods*	*72.34*	*Shortage of equipment, machinery, and tools*	*78.00*	*Improper construction methods*	*78.66*
2	*Frequent equipment breakdown*	*71.34*	*Late in approving sample sample materials*	*77.34*	*Late in approving sample sample materials*	*76.00*
3	*Late in approving sample sample materials*	*71.34*	*Delay in performing inspection at construction site*	*77.34*	*Rework because of unaccepted quality*	*75.34*
4	*Limited construction area*	*70.00*	*Limited construction area*	*76.66*	*Poor qualification of the contractor technical staff and project team*	*75.34*
5	*Delay in performing inspection at construction site*	*69.34*	*Improper construction methods*	*76.66*	*Frequent equipment breakdown*	*75.34*
6	*Low productivity of laborers*	*69.34*	*Rework because of unaccepted quality*	*76.66*	*Shortage of equipment, machinery, and tools*	*75.34*
7	*Slow mobilization of equipment*	*68.66*	*Shortage of construction material*	*76.00*	*Distribution to public activities*	*74.66*
8	*Shortage of construction material*	*68.00*	*Incapable inspector*	*76.00*	*Shortage of construction material*	*74.66*
9	*Late land handover by owner*	*68.00*	*Late land handover by owner*	*76.00*	*Delay in performing inspection at construction site*	*74.66*
10	*Poor ground condition*	*67.34*	*Frequent equipment breakdown*	*76.00*	*Incapable inspector*	*74.66*

Late in approving sample materials was one factor related to the Owner group in the top-10 list of the importance index. Although Late in approving sample materials was positioned only as second in importance, this delay factor has a high impact on cost, quality and time (as explained in the previous subsection) because it is positioned second in terms of its effect on cost, third for its effect on time, and second for its effect on quality. Delay factor related to the contractors on the top-10 list of the importance index, poor qualifications of the contractor technical staff and project teams, was seen to have a more considerable impact on quality because it was in the sixth rank.

To obtain a more comprehensive understanding of the relationship between the importance index and the project objectives of cost, time, and quality, the relationships of the top-10 delay factors and their impact on these objectives were analyzed and are presented in Table 6. Overall, there were significant associations between the delay factors on time, cost, and quality. These results indicate that delay problems not only are about time, they also significantly affect the quality and cost of road construction projects.

Table – 6
Relationship between Top-10 Delay Factors and Time, Cost, and Quality

S. No.	*Delay Factor*	*Importance Index*	*Imp.I. in Time*	*Imp.I. in Cost*	*Imp.I. in Quality*
1	*Limited construction area*	*56.00*	*70.00*	*76.66*	*68.66*
2	*Poor ground condition*	*70.00*	*67.34*	*51.34*	*49.34*
3	*Late in approving sample materials*	*70.66*	*71.34*	*77.34*	*76.00*
4	*Late land handover by owner*	*38.00*	*68.00*	*76*	*74.66*

5	*Poor site arrangement, management, and supervision*	*75.00*	*58.66*	*64*	*64.00*
6	*Improper construction methods*	*34.00*	*72.66*	*76.66*	*78.66*
7	*Rework because of unaccepted quality*	*43.34*	*62.66*	*76.66*	*75.34*
8	*Frequent equipment breakdowns*	*62.00*	*71.34*	*76.00*	*75.34*
9	*Shortage of construction material*	*60.00*	*68.00*	*76.00*	*74.66*
10	*Incapable inspectors*	*70.00*	*52.00*	*76.00*	*74.66*

VII. CONCLUSIONS AND RECOMMENDATIONS

Causes of delay and its effect on time, cost, and quality in construction projects are always likely obstacles to project success. The study reported in this dissertation established that there are a number of causal factors which need to be sufficiently dealt with if time overrun, cost escalation, and quality shortfalls are to be minimized on construction projects.

A correlation coefficient between contractor and owner; owner and consultant; and contractor and consultant respectably 0.39, 0.89and 0.74. A correlation of the responses of each party showed the contractor and owner to have non matching opinions concerning the causes of delay, while the consultant held an intermediate position.

The study reported should be considered with some limitations in mind. The findings might vary from one construction project type to the other. However, the basic principles certainly encompass all forms of construction.

The results also reflect situations that would be present in public projects. Projects undertaken by the private sector might have other challenges that are different from the ones highlighted in this study.

In order to successfully address issues of time over, cost escalation, and quality shortfalls, the causal factors need to be understood. On the other hand, it is important to ensure that project delivery and client satisfactory enhancement factors are optimized. The result of the study reported in this dissertation can help project managers and owners to carefully monitor their projects by looking out especially for factors with high Factor Importance indices on projects.

Construction projects should be planned and managed meticulously throughout the stages; and relevant regularly institutions such as National Council for Construction(NCC), should consider having 'Construction Management' as formal qualification required of anyone to hold the position of 'Project Manager' on a construction project.

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