

# Analysis of Delay in Construction In Multistoreyed Residential Buildings

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## ABSTRACT

Construction delay is a global phenomena and creates major concerns for Project performance. Delay means late completion of work as compared to agreed contract duration. The aim of this paper is to identify delay factors, its effects and to analyse these factors by Relative Importance Method. It can either be avoided or minimised only when its causes, and effects are identified when it occurs into our projects. It will have adverse consequences on the project objectives in terms of time, cost and Quality.

A detailed literature reviews, interviews with experts from Construction industry, internal survey questionnaires and Civil Engineering Journals show that Contractors and Consultants agreed that Owner Interference, inadequate Contractor experience, Financing & Payments, Labour Productivity, Slow Decision Making, Improper Planning & Scheduling, untimely Supply of Free issue Materials by Owner, Poor Communication & Coordination, Inefficient Site Management, Discrepancies & Mistakes in Drawings and Contract Documents.

The study also revealed that the time over-run and cost over-run were the frequent effects of delay. It is hoped that these findings will guide to Improve the performance in Construction industry and will be useful foundation for the research in the area of project delays and mitigation measures.

**Keywords:** Construction Delay, Causes of Delay, Effects of Delay, Relative Importance Index Method, Mitigation Plan.

## 1. Introduction

Time is an essence of Construction. Mathematically delays are functions of time. Project success is basically to gain the project objectives that are classically defined by the need to complete a project on time within the budget and with appropriate quality. Hence any disruption to the project objectives will certainly contribute to the project delays with its specified adverse effects. Delays are costly and often result in disruption of work, loss of productivity, late abandonment, termination of contract, disputes, and third party claims. According to delay categories that were Contractor Related, Client Related, Consultant Related, Labour Related, Material Related, Equipment Related, Incidental Factors Related, Design Related, and Project Related. The result of this study also identified Six major effects of delay that were time over-run, cost over-run, disputes, arbitration, total abandonment and litigation. Time over-run and cost over-run were the frequent effects of delay. According to S. A. Assaf Al (2006) linked the contractor related and labour related causes of delays to the probable time over runs in construction projects in Saudi Arabia whereas Odeh and Battaineh (2002) linked the contractor related causes to the probable disputes occurring in construction project in Jordan. It is widely accepted that the schedule of a Construction project plays a key role in project Management due to its influence on the project success (Luu et al 2009). Delays can give rise to dissatisfaction to all parties involved (Majid 2006). This

research aimed to identify delay factors, its quantification, by Relative Importance Index Method., its ranking , most effective delay factors and make conclusion & recommendation..

## 2 :-Literature Review

Delay is one of the biggest problems often experienced on the construction sites. Construction delay is a critical function in construction projects. Construction industry is facing with a lot of problems among which delay is in project execution. It has been researched that delay is a major setback in construction industry .The problem of delays in the construction industry is a global phenomenon.An extensive literature review has been done for carrying out the research work.The details of various references and inferences from those references are discussed below.

Al momani conducted a quantitative analysis of construction delays by examining the records of 130 public building projects constructed in Jordan during the period during 1996-1997 the researcher presented regression models of relationship between actual and planned projects, duration for different types of building facilities, the analysis also included the reported frequencies of time extensions for the different causes of delays .The researchers concluded that the main causes of delay in construction projects related to designers uses changes site condition, late deliveries, economic condition and increase in quantities however searched condition can be misleading first they include causes which are limited to those for which contractors are entitled to time extension.The analysis does not cover causes of delay for which the contractor is responsible such as those related to labour and equipment planning and site management construction methods adequacy and capability of contractor. Second they are based on the reported number of prime extensions not on the extent of delay attributed to different causes of delay.Despite the moderate weather in Jordan for example it was figured among major causes of delay because a time extension was granted for all public projects under construction in winter of 1991 as a result of unprecedented severe storm that had a very low probability of occurrence.

(2) Bramble and Callahan in 1987 have defined that a delay is the time during which some part of the construction project has been extended or not performed due to an unanticipated circumstance. Delay has become endemic & is imperative to create awareness as it adversely affect project delivery in Nigeria .

(3) According to Chan and Kumaraswamy in 1998 , timely delivery of project within budget and to the level of quality standard specified by the client is an index of successful project delivery .

(4) Sweis et al in 2008 studied the causes of delay in residential projects in Jordan and concluded that financial difficulties faced by the contractor and too many change orders by the owner are the leading causes of construction delays .

(5) Faridi et al in 2006 noted that delays in the completion of construction project is one of the most recurring problem and it is common global phenomenon .

(6) Pourrostan et al in 2011 contested the conventional opinion that delays have costly , risky and undesirable consequences on project success in terms of time, cost , quality and safety.

(7) Carnell in 2008 defined delay as an event that causes extended time to complete all or put of a project which time overrun .

(8) Mezhar et al in 1998 conducted a survey on the causes of delay in the construction industry in Lebanon from the perspective of the clients , contractors and architectural / engineering firms. It was found that clients are most concerned with financial issues , contractors considered contractual relationship as the most important and consultant considered project management issues as the most important causes of delay .

- (9) AbdEi-Raza et al in 2008 in a similar study in Egypt found that the most important causes of delay are financing by contractors during the construction , delays in contractors payment by owner , design changes by owner and partial payments .
- (10) Assaf and Al Hejjiin 2006 conducted a time performance survey of different types of construction project in Saudi Arabia to determine causes of delay and their importance.
- (11) Assaf et al in 1995 studies causes of delay in large building projects in Saudi Arabia and their relative importance and reported that among 56 causes of delays included in the survey . The contractors , owners and architects / engineers interviewed all ranked financing group delay factors the highest. According to contractors the most important delay factors were preparation and approval of shop drawings , delays in contractors progress payment by owners & design changes by owners.
- (12) Ayman in 2000 investigated the causes of delay on 130 public projects in Jordan .The projects included residential, office and administration buildings , school buildings , medical centres and communication facilities.The result indicated that the main causes of delay in construction of public projects relate to designers , users changes , weather , site conditions , late deliveries, economic conditions and increase in quantity .
- (13 ) Odeh and Battainethin 2002 reported that among the top 10 most important causes of delays in construction projects with traditional type contracts in Jordan where from the viewpoint of contractors and consultants , owner interference inadequate contractor experience , financing and payments , labour productivity , slow decision making , improper planning and subcontractors and recommended on improving enforcing liquidated damage clauses and offering incentives for early completion of project.
- (14) Sambasvian and Soon in 2007 identified the delay factors and their impacts on project completion in the Malaysian construction industry .
- (15)Alaghbari. in 2007 indicated that from a list of 31 factors , clients , contractors , consultants agreed that financial problem were the main factors and coordination problems were the 2<sup>nd</sup> most important factor causing delays in construction projects in Malaysia.
- (16)Leishman presented the legal consequences of delays in construction .
- (17) Herbsman et al studied the effect of delays on cost and quality .
- (18) Yates developed a decision supported system for construction delays analysis called DAS.The main categories of delays in DAS include engineering , equipment , external delays , labour management , material, owner, sub contractors& weather .
- (19) Ogunlana et al in 2008 studied the delays in building projects in Thailand as an example of developing economics. They concluded that the problems of the construction industry in developing economics can be nested in 3 layers (a) problem of shortages , inadequacies in industry infrastructure and mainly supply of resources. (b) problem caused by clients and consultants ( c) problems caused by i

### 3 :-Research Methodology

The study adopts a Survey Research Technique through a self constructed questionnaire titled "" An Assessment of Delay factors and its effect in building Construction projects in India is developed in order to assess the perceptions of different parties involved in building Construction process for the evaluation of frequency of occurrence and importance of the identified factors. The research instrument is divided into three major parts. The first part solicits information on the socio- economic characteristics of the respondents. In the second part, the research instrument asked questions on causative factors of Construction Delays in building Construction based on four identified factors for Delays namely Client Related, Consultant Related , Contractor Related and incidental factors Related. In third part the research instrument seeks information on the most important and frequent effects of buildings Construction delay based on some identified factors.

The random selection technique is employed in the selection of respondents. A total of ,260 questionnaires were distributed among the respondents from different building Constrection firms. Out of 260 questionnaires distributed ,234 valid questionnaires were retrieved back from the respondents representing a response rate of 90%.

The validation in this study yielded a cronbach's alpha of 0.891 . validation is internal consistency reliability measure via Statistical Package for Social sciences Software (SPSS) Technique..This study has three fold objective.First it examination the Socio-Economic Characteristics of the surveyed buildings professionals. Second it examination the factors causingdelay in building construction projects.Third it examines the effects of delay in building construction projects. To achieve the first objective,a descriptive analysis of items under the socio-economic characteristics was performed.The result was presented in table- 01. To achieve the second & third objective,data were subjected to analysts the relative importance index(rii) to identified causes and effects of delay according to the ranking of the attributes in terms of their criticality as perceived by the respondents was done by use of RII which was computed using equation --(1) below and the results of the analysis are presented in Tables (2 to 6)..The second objective was to examine factors causing delays in building construction.The factors identified were grouped into four categories namely client related delays,consultant related delays, contractor related delays and delays caused by incidental factors(Table 2--6).

#### 4:--Results And Discussion.

The analysis of data collected was accomplished by the use of Statistical Package for Social Science(SPSS) Software ,where the scores assigned to each factor by the respondents entered and consequently the responses from 234 questionnaires retrieved were subjected to Statistical analysis for further insight.The contribution of each of the factors to the identified Causes of delay examined and the ranking of the attributes in terms of their criticality as perceived by the respondents was done by use of use of Relative Importance Index((RII-) which was computed using eqn --- (1) below and the results of the analysis are presented in tables 2--6).

To determine the Relative ranking of the factors these scores were then transformed to importance indices based on the next formula.

Relative Importance Index ((RII) Method:-

$$RII = \frac{\sum W}{AN} = \frac{4n_4 + 3n_3 + 2n_2 + 1n_1}{4N} \quad \text{--- (1)}$$

where W=weight given to each factor by the respondents ranging from 1 to 4

$n_4$ = no of respondents for strongly agree

$n_3$ = no of respondents for agree

$n_2$ = no of respondents for strongly disagree

$n_1$ = no of respondents for disagree.

A=the highest weight

N=total no of sample respondents.

RII varies from zero to one.

Spear man correlation is a non parametric test that is used to measure the degree of association between two variables.It was developed by spearman,thus it is called spearman rank correlation .This test does not assume any assumption about the spearman's correlation coefficient method distribution of the data is appropriate correlation analysis where the variables are measured on a scale that is at least ordinal.

$RS = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$ .

RS = spearman's rank coefficient

d= difference between rank of contractor & consultant

n= no of variables

RS varied between 1 & -1.

It's high value indicates strong agreement between contractors & consultants. Ranking of contractor and consultant can be verified by a hypothesis testing at 95% ,significance where  $z = RS(\sqrt{N-1})$ .

Table 1 Socio-Economic Characteristics of respondents. It presents the profile of respondents.

	Q u a l i f i c a t i o n	Frequencies	% a g e
respondents Age Group	No Response	5	2.14
	30~35Years	75	32.05
	36~45Years	64	27.35
	41years & above	90	38.46
	Total	234	100.00
P r o f e s s i o n a l	A r c h i t e c t s	5	2.14
	Quantity Surveyors	34	14.53
	Engineers	40	17.09
	Surveyors	30	12.82
	Builders	80	34.19
	Total	234	100
Educational Qualification	RespondNo Response	5	2.14
	HND	25	10.68
	B-Sc	37	15.81
	PGD/MSc	155	66.24
	PHD	12	5.13
	Total	234	100

N a t u r e o f F i r m	Not Applicable	8	3.42
	Contracting	65	27.78
	Consultancy	89	38.03
	Total	234	100



Category of Registration (Federal)	N o R e s p o n s e	1 5 0	6 4 . 1 0
	Category B	50	21.37
	Category C	24	10.26
	Category E	10	4.27
	Total	234	100
Category of Registration (Estate)	N o R e s p o n s e	1 6 0	6 8 . 3 8
	Category A	24	10.25
	Category B	20	8.55
	Category ABC	20	8.55
	Category B,C	10	4.27
	Total	234	100
Type of project involved	N o r e s p o n s e	1 0	4 . 2 7
	Residential buildings	125	53.42
	Industrial building	30	12.8 2
	Institutional building	60	25.64
	Civil building	9	3.85
	Total	234	100
Years of working experience	N o r e s p o n s e	2 0	8 . 5 5
	1-5 years	40	17.09
	6-10 years	50	21.37
	11-15 years	76	32.48
	Over 20 years	48	20.51
	Total	234	100

Table 2

Client Related Delay in Constrction of Multi-Storeyed Residential Buildings .

NR – No response , SA – Strongly Agree, A – Agree , SD – Strongly Disagree, D - Disagree

Delay Factors	N R	S A	A	S D	D	Total	R I I	R a n k
	-	(4)	(3)	(2)	(1)			
Finance & Payments	-	1 5 0	7 0	1 4	0	2 3 4	0 . 8 9	1

Owner interference	- -	1 3 0	9 2	1 2	0	2 3 4	0 . 8 8	2
Selecting inappropriate Contractors/ Consultants	-	1 1 5	1 0 1	1 2	0 6	2 3 4	0 . 8 5	3
Late supply of free issue materials from Owner side	-	1 3 6	5 8	4 0	0	2 3 4	0 . 8 5	3
Delay in approving design & documents	- -	4 0	1 3 5	4 0	1 9	2 3 4	0 . 7 1	6
Slow Decision making	- -	7 2	1 0 2	4 2	1 8	2 3 4	0 . 7 4	4
Charge orders	3	6 1	1 1 0	3 2	2 8	2 3 4	0 . 7 1	6
Conflict between joint ownership	4	4 8	1 4 3	1 8	2 1	2 3 4	0 . 7 2	5
Suspension of work by owner	5	4 5	1 4 5	1 6	2 4	2 3 4	0 . 7 2	5
Lack of owner experience in Construction Projects	6	1 8	1 3 0	3 5	4 5	2 3 4	0 . 6 2	7

### 3:--- Consultant Related Delay factors in Construction of Multi-Storeyed Residential Buildings

Incomplete Drawings	-	9 7	137	0	0	2 3 4	0.85	1
Inadequate experience about Projects	-	9 0	130	1 4	0	2 3 4	0.83	2
Poor contractors pre qualification	-	1 1 0	7 5	3 9	1 0	2 3 4	0.80	3
Discrepancies & mistakes in design and drawing	-	5 0	176	5	3	2 3 4	0.79	4
Inadequate Project management assistance	-	8 0	100	3 9	1 5	2 3 4	0.76	5
Delay in performing inspection and testing	-	4 5	130	5 5	4	2 3 4	0.73	6
Conflicts of the drawing & specification	3	4 3	131	3 2	2 5	2 3 4	0.70	8
Improper Site Review	2 4	5 0	136	1 7	3	2 3 4	0.69	9
Delay in work approval	-	3 6	145	3 0	2 3	2 3 4	0.71	7
P o o r communication among	5	8 0	100	1 3	3 6	2 3 4	0.73	6
Inappropriate overall organizational structure	2 4	8 1	6 0	4 4	2 5	2 3 4	0.66	1 0
Inaccurate Site investigation	1 4	2 9	7 8	7 5	3 8	2 3 4	0.61	1 1





Table. 4:-Contractor Related Delay Factors in Constrection of Multi-Storeyed Residential Buildings

5:- Externality Related Delay Factors(incidental Factors) in Constrection of Multi- Storeyed Residential Buildings.	Delay. Factors	N	R	S	A	A	SD	D	Total	R	I	I	Rank		
		-		(4)		(3)	(2)	(1)							
	Improper planning & schedule problem	-		1	6	0	7	4	0	0	234	0	. 9 2	1	
	Incompetent project team	-		1	3	0	1	0	4	0	234	0	. 8 9	2	
	Poor site management and supervision	-		1	0	0	1	1	0	20	4	234	0	. 8 3	3
	Inadequate Contractor experience	-		6	0		1	5	9	0	15	234	0	. 7 8	4
	Frequent change of sub-contractor	-		5	0		1	5	0	30	4	234	0	. 7 6	6

Delay Factors	N	R	S	A	A	S	D	D	Total	R	I	I	Rank					
	-		(4)		(3)	(2)	(1)											
Force Majeure (Acts of God)	-		8	0	1	4	0	0	2	1	2	2	3	1	0	. 7 1	5	
N e g l i g e n c e	3		1	0	0	7	2	4	6	1	3	2	3	4	0	. 7 0	6	
Govt policies and changes	-		4	2		1	7	5	2		1	2	2	3	1	0	. 7 8	1
Unfavorable site condition	4		8	5		1	1	0	5		3	0	2	3	4	0	. 7 0	6
M a r k e t V a l u e	5		1	1	4	7	0	0			4	5	2	3	4	0	. 7 6	3
Fluctuation in prices of building	4		1	0	0	8	0	2	5	3	6	2	3	4	0	. 7 7	2	
B a d w e a t h e r	5		6	2		1	1	0	3	0	2	7	2	3	4	0	. 7 1	5
Global Financial crisis	5		4	9		1	3	6	1	7	2	7	2	3	4	0	. 7 1	5
Breakdown of plant /machinery	4		4	8		1	4	0	1	8	2	4	2	3	4	0	. 7 2	4

Site accidents	3	2	0	1	3	0	3	0	5	1	2	3	4	0.6	2	7
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6:--Project Related Delay Factors in Constriction of Multi-Storeyed Residential Buildings

Delay Factors	N R	S A	A	S D	D	Total	R I I	R a n k
	-	(4)	(3)	(2)	(1)			
Increase in final cost of project	6	1 5	1 2 7	3 3	5 1	2 3 4	0 . 6 2	1 3
Extension of time in project	1 7	8 0	1 1 0	2 0	7	2 3 4	0 . 6 4	1 1

Legal disputes between parties involved	3	7	0	2	6	3	5	0	2	3	4	0 . 4 6	1	5		
Wastage & under utilization of manpower/resources	4	9	0	1	0	0	3	5	5	2	3	4	0 . 7 8	1		
In effective Delay penalties	2	0	1	0	3	9	0	2	1	0	2	3	4	0 . 7 7	2	
Additional claims by main contractor	4	5	0	1	4	0	4	0	0	2	3	4	0 . 7 5	3		
Original contract duration is short	1	5	5	9	1	4	0	2	0	0	2	3	4	0 . 7 4	4	
Unfavorable contract clauses	3	7	0	9	9	6	0	0	0	2	3	4	0 . 7 4	4		
Increase overhead	8	6	8	1	0	5	5	0	3	2	3	4	0 . 7 4	4		
Escalation of material prices	4	8	0	9	0	3	5	2	5	2	3	4	0 . 7 3	5		
Complexity of project	3	5	6	4	1	3	0	5	0	2	3	4	0 . 7 0	7		
Late delivery of materials	6	5	7	1	0	1	7	0	0	2	3	4	0 . 7 2	6		
Poor quality of materials	3	3	7	8	8	5	2	4	1	4	2	3	4	0 . 6 7	8	
Unreliable supplier	5	3	9	9	5	8	0	1	5	2	3	4	0 . 6 6	9		
Shortage of materials	1	5	5	9	6	1	8	8	1	1	2	3	4	0 . 6 5	1	0
Poor Procurement of materials	3	5	3	4	2	5	4	0	0	2	3	4	0 . 6 3	1	2	
Distributed cash flow	4	0	1	5	8	0	9	5	4	2	3	4	0 . 5 3	1	4	

Delay is a major problem suffered by most of the Construction Projects although the causes of delay and its mitigation measures to avoid it has still not been fully understood by project Participants.

Efficient Owner, Consultant and Contractor can play important roles in resolving this critical problem. Proper site management, resource management, modern Construction Methodology, timely Payments, timely & complete issue of drawings, mutual Co-operation & co-ordination among all Participants are required to take Delay problem efficiently

Table 7.

( Conclusion of Delay Factors from Table 2 to Table 6).

Most Effective Delay Factors Causing Delays in Building Construction

Serial No	Factors Causing Delays	Factor Group	R I I	Rank
1	Improper Planning & Schedule Problem	Contractor Related	0 . 9 2	1
2	Incompetent Project Team	Contractor Related	0 . 8 9	2
3	Finance & Payments	Client Related	0 . 8 9	2
4	Owner Interference	Client Related	0 . 8 8	3
5	Selecting inappropriate Contractor/Consultant	Client Related	0 . 8 5	4
6	Supervision of works by owner	Client Related	0 . 8 5	4
7	Incomplete Drawings ...	Consultant Related	0 . 8 5	4
8	Consultant inadequate experience about Project	Consultant Related	0 . 8 3	5
9	Poor Site Management & Supervision	Contractors Related	0 . 8 3	5
1 0	Poor Contractor pre quantification	Consultant Related	0 . 8 0	6
1 1	Discrepancies/mistakes in drawings and Contract documents	Consultant Related	0 . 7 9	7

1	2	Inadequate Contractor Experience	Contractor Related	0 . 7 8	8
1	3	Govt policies & Changes	Incidental Factor Related	0 . 7 8	8
1	4	Wastage & under utilization of manpower/Resources	Project Related	0 . 7 8	8
1	5	Ineffective Delay Penalties	Project Related	0 . 7 7	9



1	6	Fluctuation in prices of Buildings	Incidental Factor Related	0 . 7 7	9
1	7	Contractor insolvency	Contractor Related	0 . 7 7	9
1	8	Market Value	Incidental Factor Related	0 . 7 6	1 0
1	9	Labour Productivity	Contractor Related	0 . 7 6	1 0
2	0	Inappropriate Construction Method	Contractor Related	0 . 7 6	1 0
2	1	Lack of incentives/motivation to workers	Contractor Related	0 . 7 6	1 0
2	2	Frequent change of Sub Contractor ...	Contractor Related	0 . 7 6	1 0
2	3	Inadequate Project management assistance	Consultant Related	0 . 7 6	1 0
2	4	Equipment availability and Failures	Contractor Related	0 . 7 5	1 1
2	5	Additional claims by main contractor	Project Related	0 . 7 5	1 1
2	6	Slow Decision making	Client Related	0 . 7 4	1 2
2	7	Original Contract duration is Short	Project Related	0 . 7 4	1 2
2	8	increased Over Heads	Project Related	0 . 7 4	1 2



2	9	Unfavorable Contract Clauses	Project Related	0 . 7 4	1 2
3	0	Escalation of materials prices	Project Related	0 . 7 3	1 3
3	1	Poor Communication among Consultants/Parties involved	Consultant Related	0 . 7 3	1 3
3	2	Delay in performing inspection & testing	Consultant Related	0 . 7 3	1 3
3	3	Late delivery of materials	Project Related	0 . 7 2	1 4
3	4	Break down of plant / machinaries	Incidental Factor	0 . 7 2	1 4

### Recommendation :-

Despite the facts that the delays are inevitable, however they can be avoided or minimised when their causes are effectively identified and analysed. The aim of this study is to assess the causes and effects of delays in building construction projects so that appropriate mitigation measures are put in place. The finding of this research must be addressed by a joint effort of all participants in the construction industry. This calls for :

- 1:- According to findings from the study, cash flow problem ranked highest among the client caused Delays. Client should ensure enough cash flow, timely supply of free issue materials, engage competent Professionals, award the work to experienced Contractors, timely payments to Contractor, proper Communication & Coordination, Review of working progress, Financial Progress, Site Resources, work Methodology periodically, Offering incentives to Contractors for early completion of work.
2. Consultants should ensure for issuing complete Drawings & Contract documents, Proper Communication & Coordination, Review of working Progress, Financial Progress, Resources, Work Methodology periodically, award of work to experienced Contractor, Experienced representative of Consultant at site to resolve technical issues quickly, Proper monitoring.
3. Contractor should ensure for effective strategic planning, Proper planning & scheduling, efficient project team, monitoring of Productivity, resource management, Safety & risk management, QA/QC, Timely payment to labour & Staff, offer incentives to staffs for early completion of work, review of working progress, Financial Progress, Work Methodology periodically with his staff and Client & consultant.

4. Adopting new approaches to contracting such as design build Construction management type of contract. Such contracts reduce delay by limiting owner interference, improving the design and contractual relationship among all the parties.

After following above recommendation, the delay and cost may be kept under proper control and within budget and time.

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