

Assessment of construction delay in multistory building projects Assist of RII Method

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Abstract—Delays are one of the biggest problems in construction projects in developing countries, as cause a negative effects on the projects. Delays can be minimized only when their causes are identified. The aim of this paper is to identify the main causes of delay in construction projects. The literature related the field of causes of delay in construction projects has been reviewed over the last decade. A questionnaire survey was conducted to solicit the causes of delay from consultants, clients and contractors' viewpoint. This study identified 10 most important causes of delay from a list of 45 different causes of delay. The elements of this list has identified on the basis of literature review over the last decade. The perspective of contractors and consultants has been analyzed to rank the causes of delays based on their Relative Importance Index. The 10 most causes of delay were:

(1) Shortage of construction materials in market, (2) Escalation of material prices, (3) Delay in material delivery, (4) Demonetization issue of financial problem, (5) Shortage of labors, (6) Delay in payment of completed work by owner, (7) Changes in quality of material, (8) Poor labor supply & labor productivity, (9) Banking restriction, and (10) Unqualified workforce.

Keywords—causes of delay, Relative Importance Index, Construction projects.

I. INTRODUCTION

Delays are one of the biggest problems which construction firms face. The problem of delay in the construction industry is a global phenomenon. Therefore construction delays can be considered as time lag in completion of activities from a fixed time as per contract or they can be defined as late completion or late start of activities to the planned schedule or contract schedule. When project delay occurs it means project cannot be completed within stated time, which means there will be extensions of time required which will further result in fine, increased cost due to inflation, termination of

contract, court cases etc. or combinations of above stated factors. Delay can be seen as risk for the project and could be handled at inception stage or at least one can try to mitigate or minimize it. Risk is an integral part of a construction project; it is well known that no project is risk free. If risk is analyzed at inception or planning stage it could be managed, minimized, shared, mitigated or accepted to give some good results. Delay can be considered similar to risk or a type of risk; as no construction project is free from delays, delay is also integrated part of construction projects. It depends on size of project as well. Therefore it is expected to analyse and manage delay in same fashion as risk.

1.1 TYPES OF DELAYS

The following are the types of delays in construction projects;

- 1). Critical or Non critical delays
- 2). Excusable or Non Excusable delays
- 3). Compensable or Non Compensable delays
- 4). Concurrent or Non concurrent delays

1.1.1 Critical or Non critical

In simple words Critical delays are those which cause delay to entire project completion date while Non critical delays not necessarily affect the project completion date but affects progress. In all the projects delays are considered at the project completion date. Delays can be combination of small and big delays that occurred during the whole project. Therefore critical delays are taken more into consideration then noncritical delays

1.1.2 Excusable or Non Excusable delays

Excusable delays occurs due to events which are outside the control of contractor like heavy rains, storms, strikes, fire, client suggested changes,

differing site conditions, change of government policy or their intervention, stakeholder intervention etc., As name suggests these delays are such that they don't have any excuse or no excuse can be given for them. They arise due to carelessness or actions and inactions of contractors and subcontractors. For such delays no time extensions and monetary compensation is given to contractor if it has affected whole duration of project.

1.1.3 Compensable or Non Compensable delays

As name suggests excusable compensable delays are those in which contractor is entitled for extra payment (compensation) i.e. monetary compensation and time extension as well. But decision that a delay is compensable or non compensable is taken as per contract between client and contractor. Natural disasters or some reasons which are out of control are not considered.

1.1.4 Concurrent or Non concurrent delays

Concurrent delays which contains two or more excusable delays results in time extension. When compensable and non excusable delays are concurrent a time extension can be given or delay can be distributed between client and contractor.

1.2 AIM

The aim of this project is to identify the causes of delay in multistory building construction and how to be avoided and control based on the identified factors causing delay of construction process.

1.3 OBJECTIVES

- To find out the factors that causes construction projects delay.
- To investigate the effects of construction projects delay.
- To determine the risks associated with construction projects delay.
- To identify the relevant ways of eliminating or mitigating the delays of construction.

II. LITERATURE REVIEW

1. Towhid Pourroostam and Amiruddin Ismail (2012) "Causes and Effects of Delay in Iranian Construction Projects"

The aim of this paper is to identify 28 main causes and 6 effects of delay in Iranian construction projects. A questionnaire survey was conducted to solicit the causes of delay from consultants and contractors viewpoint. The perspective of contractors and consultants has been analyzed to rank the causes of delays based on their Relative Importance Index. Clients should make progress in payments to contractors on time, recruit competent project manager, and on time preparation and procurement of needed materials to the contractors.

2. Kasimu Alhaji Mohammed and Abubakar Danladi Isah (2012) "Causes of Delay in Nigeria Construction Industry"

The aim of this paper is to investigate the causes of delay in Nigeria construction industry. The data collected was analyzed in rating form to determine the most causes of delay in the construction projects. 150 questionnaires were distributed and only 127 questionnaires were filled correctly. Based on the mean value criterion, the first ranking seemed that improper planning, Lack of effective communication as the second ranked factor and Shortage of supply i.e. steel, concrete, etc. and Design Errors.

3. M. Haseeb, Xinhai-Lu, Aneesa Bibi, Maloof-ud-Dyian and Wahab Rabbani (2011) "Problems of Projects and Effects of Delays in the Construction Industry of Pakistan"

This paper covers the delay factors and causes of delay and some suggestion for reducing these delays in large construction projects in Pakistan. There were two part of the questionnaire, Part A, Part B. Part A asked about the respondent's personal information, where he is client, consultant, contractor, subcontractor etc. Part B asked about the information related to causes and factors of delay in large construction projects of Pakistan. Most factors related to consultant it is due to not understanding the client necessities, not having proper project information, absence of some detail in drawing etc.

4. Murali Sambasivan, Yau Wen Soon (2007) "Causes and effects of delays in Malaysian construction industry"

This study has also establishment an empirical relationship between each cause and effects. In this research we identify major causes of delay and categorized them as client-related, contractor – related, consultant – related, material-related, labor-related contract- related and external factors. Relatively importance index method. We also studied the empirical relationship between the causes and effects of delays. We isolated the causes of delay for each of effects .

5. Nitish Kumar and Peer Hilal Ahmad (2016) "A Study on Delay of Construction projects in India"

The development of country the construction the construction industry is the main ingredients for an economy. In India, most of the projects are executed through contracts which are generally not easy to comprehend. The primary objective during the construction process is to complete the project within budget, while meeting established quality requirements and other specification. Adopt new approaches to contracting, such as construction management & design-build type of contracts.

6. Musirikare Mihigo Amandin and Julius Warren Kule (2016) "Project Delay on Cost Overrun Risks: A

Study of Gasabo District Construction Projects Kigali, Rwanda”

The major causes of project delays and costs/risks that arise from project delays when implementing public construction projects. The study adopted a descriptive survey research design. Data were collected using open-ended questionnaire. This involved collecting data from construction project contractors, consultants or officers during the period starting from 2009 till 2012 in Gasabo, a district in Kigali, Rwanda. In addition, when construction projects’ expected or planned cost is increased, a simultaneous increase in their relative real cost must take place.

7. Mohamed M. Marzouk and Tarek I. El-Rasas (2014) “Analyzing delay causes in Egyptian construction projects”

This research presents a list of construction delay causes from literature. The feedback of construction experts was obtained through interviews. Statistical analysis is carried out using analysis of variance ANOVA method to test delay causes, obtained from the survey. The feedback of construction experts was obtained through interviews and surveys. Frequency Index, Severity Index, and Importance Index are calculated and according to the highest values of them the top ten delay causes analysis of construction projects in Egypt are determined.

8. Alena Vasilyeva-Lyulina, Masamitsu Onishi and Kiyoshi Kobayashi (2015) “Delay Analysis Methods For Construction Projects: Mathematical Modelling”

This paper aims to formalise delay analysis methods commonly applied in practice employing the mathematical language. The damages caused by a project delay are compensated by the contractor in principle in the form of liquidated damage. Delay takes only three forms: 1. delay to commencement, 2. extended duration, 3. suspension during performance. Formalization of the delay analysis method. This study proposed a formal description of delay analysis methods that would be applicable to any types of them so that delay analysts can avoid any confusion caused by name approach.

9. Asish Ram and Dr. Pratheeba Paul (2015) “Study on Construction Sequence Delay for Road Infrastructure Projects”

Delays can lead to many negative effects such as lawsuits between owners and contractors, increased costs, loss of productivity and revenue, and contract termination. The gathered data are analyzed through Relative Importance Index (RII) and the delay causes are ranked as per their significance. Most of the government initiated infrastructure projects are delayed and get finished years after their scheduled completion. The delay in land acquisition is an owner or client related delay factor that is an excusable type of delay.

10. Megha Desai and Rajiv Bhatt (2013) “Critical Causes of Delay in Residential Construction Projects: Case Study of Central Gujarat Region of India”

This paper suggests an approach to carry out ranking of causes of delay by two different techniques: Relative importance index and Importance index based on degree of severity and degree of frequency and also discuss about the ranking of the causes. Delay on construction projects are a universal phenomenon. They are almost always accompanied by cost and time overrun. The delay in construction projects in India is studied through field survey. It studied frequency, severity and importance and relative importance of the causes of delay.

III. RESEARCH METHODOLOGY

This chapter comprises of the method and the design that was used to conduct the research. It’s a quantitative research in which the data was collected using questionnaires. The population was made of clients, contractors and consultants who were selected by random sampling and convenience sampling technique. There was collection of both primary and secondary data. The primary data was obtained using questionnaires while the secondary data was gathered from the literature. In addition this chapter also presents the questionnaire design, the different sections of the questionnaires, the scale as well as the pilot study that was conducted to ascertain the reliability of the questionnaire. Research methodology chosen for this study comprised of intensive literature review, mail questionnaire to building construction stakeholders in Sudan and a statistical analysis of the Survey.

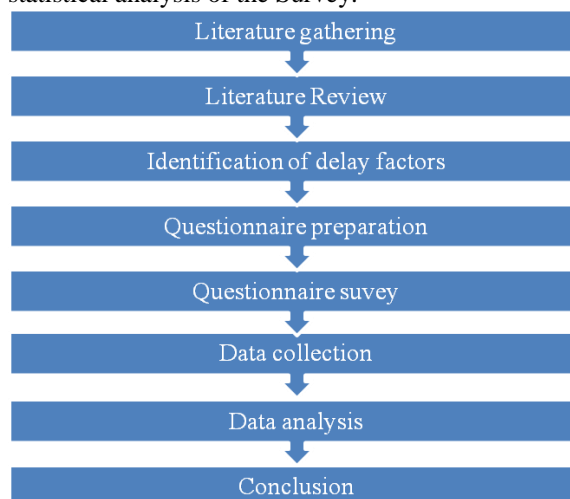


Fig1. METHODOLOGY CHART

3.1 RESEARCH DESIGN

The research was designed to get opinions from clients, consultants and contractors other construction related companies in regards to the factors causing delays, effects of delays, as well risks associated with construction delays. The possible causes, effects and risks of delays were identified from the literature and these factors were tested with the stakeholders of the Sudanese construction industry. A total of 45 delay factors were identified from the literature and stake holders of the indian construction industry were asked to give their opinion on these causes in the form of ranking. Also effects of construction projects delay were also identified from the literature and questions were designed according to these factors to get the opinion from stake holders of Sudanese construction industry. Similarly, risks factors associated with construction projects delays were also identified.

3.2 POPULATION AND POPULATION SIZE

The population was made of consultants, contractors with over 10years of experience in the construction industry and private clients or owners. Moreover all respondents had attained tertiary education. This implied the high position, lengthy years of work experience and educational background provided our respondents with enough knowledge of the construction industry with issues relating to causes, effects and risks of construction delay. The population size consisted of 100 respondents, which included 26 contractors, 24 consultants, 18 owner, 09 clients, 23 others. The population size was limited to this number to effectively maximize the time and cost allocated for the research since the questionnaires had many questions and will be time consuming which might discourage some respondents from participating. Also the wide nature of the questionnaire may not be within the competence of some construction stakeholders. However effective selection of the target respondents with high competence and experience proved to shield these weaknesses.

3.3 DATA COLLECTION

This is referred to as the gathering or the collection of information from customized target respondents to suitably answer the research questions or the research objectives or give answers to findings. In this study, the data was obtained using 2 different methods.

3.3.1 Primary data collection

The primary data refers the first hand information obtained by the researcher himself in his or her study. This information is made available for the first time only by the researcher. The information can be collected through direct personal

investigations, through respondents, and survey using questionnaires. The collection modes could also be through; emails, personal interview, phone interview and self-administered survey. The advantages of this method of data collection include; reliability and accuracy and moreover it is a better method for intensive investigation. On the other hand, the disadvantages will be high cost and too much time spent, and the method is not suitable for extensive enquiry. Because of the quantitative nature of our study, the primary data was collected in the survey by making use of questionnaires and also telephone interviews. The questionnaires were emailed to our target respondents who were expected to fill the soft copy of the questionnaires and returned them by emails.

3.3.2 Secondary data collection

The secondary data refers to that information which have already been collected, analyzed, documented and published by some other researchers or people. The researcher therefore uses this information to support his or her current study or findings. Obtaining this information is faster, less expensive, and vigorous activities such as surveys are not required. However, this information collected is not always available for free and will cost money, the information are not always enough, some are old or expired meanwhile some are false information. In this study, our secondary data was collected from academic online websites such as Emerald, online journals, School libraries and both published and unpublished articles.

3.4 QUESTIONNAIRES

In order to determine the perception of different stake holders in Sudan construction industry regarding factors causing delays, a questionnaire was developed. This was the main tool used to collect the data from our target respondents. The questionnaire was structured into 8 sections to meet all 4 research objectives.

For questions relating to mitigating risks due to construction delays, a total measures were identified from the literature and the questionnaires were design using the 5 point Likert scale to determine the effectiveness of each of these measures.

Table 1. Five Point Likert Scale

Extremely Significant	(5)
Very Significant	(4)
Moderately Significant	(3)
Slightly Significant	(2)
Not Significant	(1)

IV. DATA ANALYSIS AND RESULT

This chapter presents a series of statistical tests and analysis carried out for the factors of each of the sections. These include the causes of delay, effects of delay, the risks of delay as well as ways of mitigating delays. It also presents the results of the questionnaires which were carried out using Relative Important Index (RII).

To determine the relative ranking of the factors, mean values were then transformed to importance indices based on the formula:

$$RII = \frac{\sum w}{AN} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5N}$$

where, *w* is the weight given to each factor by the respondent, ranging from 1 to 5,

(*n1* = number of respondents for very unsatisfied ...
n5 = number of respondents for very satisfied)

A is the highest weight (i.e. 5 in the study) and *N* is the total number of samples.

The relative importance index ranks from 1 to 45. Weighted Mean, RII, and the ranking of the most important factors are presented later in Table 2.

Table 2: Summary of Relative Importance Index and Rank for the causes of delay in construction projects

Sl.No.	Factors that the delay in construction	RII	Rank
1.	Poor communication & co-ordination by owner and other parties	0.460	34
2.	Misunderstandings in technical dealing with tenders & contractors	0.488	19
3.	Conflict in joint ownership	0.446	38
4.	Delay in payment of completed work by owner	0.560	6
5.	Late revising and approving relevant documents by owner	0.508	12
6.	Less authority given to consultant to take decision	0.462	32
7.	Unclear and inadequate details in drawings	0.464	31
8.	Communication barriers faced by consultant	0.416	44
9.	Total quality management by consultant	0.442	39
10.	Inadequate site information given to consultant	0.476	24
11.	Ineffective planning and scheduling of project	0.508	12
12.	Delay in preparation of shop drawing and material sample	0.488	19

13.	Delay in site mobilization	0.502	15
14.	Compatibility of contractor with new software's	0.450	37
15.	Risk analysis & management by contractor	0.474	26
16.	Source updating in the design engineering documents & related	0.462	32
17.	Shortage of construction materials in market	0.578	2
18.	Delay in material delivery	0.574	3
19.	Changes in quality of material	0.544	7
20.	Escalation of material prices	0.584	1
21.	Material damage in storage	0.486	22
22.	Slow process of material selection	0.508	12
23.	Shortage of labors	0.564	5
24.	Unqualified workforce	0.514	11
25.	Equipment availability and failure	0.496	17
26.	Shortage of recent technology equipment	0.474	26
27.	Delay in equipment delivery	0.518	10
28.	Poor labor supply & labor productivity	0.532	8
29.	Traffic control at site	0.376	45
30.	Insufficient data collection and survey	0.440	41
31.	Accidents on site	0.454	35
32.	Rework due to error in construction	0.502	15
33.	Problem due to existing structures	0.480	23
34.	Unforeseen ground conditions	0.466	29
35.	Bad weather condition and poor lighting	0.442	39
36.	Environmental changes due to rainy and hot season	0.452	36
37.	Natural disasters (Earthquake, floods etc.,)	0.476	24
38.	Inclement weather effects	0.424	43
39.	Effects of subsurface conditions(soil, high water table etc.,)	0.466	29
40.	Changes in government regulation & laws	0.496	17
41.	Restriction due to site location	0.488	19
42.	Regulatory changes in	0.472	28

	building code		
43.	Various issues in respective states	0.436	42
44.	Demonetization issue of financial problem	0.572	4
45.	Banking restriction	0.524	9

Table 3: Ten most important causes of delay in construction projects

Sl.No.	Factors that the delay in construction	RII	Rank
1.	Escalation of material prices	0.584	1
2.	Shortage of construction materials in market	0.578	2
3.	Delay in material delivery	0.574	3
4.	Demonetization issue of financial problem	0.572	4
5.	Shortage of labors	0.564	5
7.	Changes in quality of material	0.544	7
8.	Poor labor supply & labor productivity	0.532	8
9.	Banking restriction	0.524	9
10.	Delay in equipment delivery	0.518	10

V.RECOMMENDATION AND CONCLUSION

This study identified the causes of delay in construction projects. Projects investigated in this study included residential, office and administration buildings. A questionnaire survey was conducted to solicit the causes and effect of delay from consultants and contractors' viewpoint. Ten most causes of delay were: (1) Shortage of construction materials in market, (2) Escalation of material prices, (3) Delay in material delivery, (4) Demonetization issue of financial problem, (5) Shortage of labors, (6) Delay in payment of completed work by owner, (7) Changes in quality of material, (8) Poor labor supply & labor productivity, (9) Banking restriction, and (10) Unqualified workforce.

This paper has highlighted factors and the need to reduce delays by client, consultants and contractors. Clients should make progress in payments to contractors on time, recruit competent project manager, and on time preparation and procurement of needed materials to the contractors. Consultants have to try to manage the project professionally, complete and prepare design on time, using professional specialists and implementation of accurate per-design for minimizing future changes. Contractors need to

available source of finance during construction project, proper materials procurement, and developing human resources.

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