Ranking of delay factors in multistory building projects by using statistical software

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Abstract— *Time is one of the major considerations throughout project management life cycle and can be regarded as one of the most important parameters of a project and the driving force of project success. Time delay is a very frequent phenomenon and is almost associated with nearly all constructing projects. However, little effort has been made to curtail the phenomenon, this research work attempts to identify, investigate, and rank factors perceived to affect delays in the Tamilnadu construction projects with respect to their relative importance so as to proffer possible ways of coping with this phenomenon. To achieve this objective, researcher invited practitioners and experts, comprising a statistically representative sample to participate in a structured questionnaire survey. Brain storming was taken into consideration, through which a number of delay factors were identified in construction projects. Totally, forty five (45) factors were short-listed to be made part of the questionnaire survey and were identified and categorized into nine (8) major categories. The survey was conducted with experts and representatives from private, public, and local general construction firms. The data were analyzed using statistically package of the social science (SPSS), ranking and simple percentages. According to the case study results, the most contributing factors and categories to delays were discussed, and some recommendations were made in order to minimize and control delays in construction projects. Also, this paper can serve as a guide for all construction parties with effective management in construction projects to achieve a competitive level of quality and a time effective.*

I. INTRODUCTION

In most countries, experience and the literature revealed that successful construction projects should be completed before project due dates and within budget. Therefore, causes of time delay are of critical importance to the profitability of most construction projects. Many researchers, in the literature, have identified these problems as factors that affect the delay in construction projects and will affect company's performance and overall economy of the country as well. The delay in construction projects by many factors is usually linked to the performance of time, cost, and quality. Meanwhile, identification and evaluating factors causing delay in construction projects have been carried out in the last decade; however, a deeper understanding is still needed to improve that.The outcomes can be used by not only local, but also international industry practitioners, who may be further interested in venturing into potential mega scale projects, but possess no prior practical knowledge of the construction industry specially construction firms in Egypt. The outcomes can help all practitioners to develop wider and deeper perspective of factors causing delay in construction projects and provide guidance to projects and construction managers for efficient solutions. The literature has identified several factors causing delay in construction projects that the researcher has explored in this study. This research ranks the factors causing delay in construction projects in Egypt and explores them by using statistical methods. The following sections present the literature review, research methodology, results with discussions, and conclusions with recommendations.

1. 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.

2. 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.

II. LITERATURE REVIEW

1. 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 delay and get finished years after there scheduled completion. The delay in land acquisition is an owner or client related delay factor that is an excusable type of delay.

2. 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

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

This paper aim to formalizing delay analysis methods commonly applied in practice employing the mathematical language**. The damages caused by a projects delay in compensated by the contractor in principles 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.

4. Towhid Pourrostam 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.

5. 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 analyzes 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.

6. 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.

7. 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.

8. 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 2012in 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.

9. 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.

10. Mohamed M. Marzouk and Tarek I. EI-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.

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 stake holders 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

INTRODUCTION OF SPSS

SPSS is a Windows based program that can be used to perform data entry and analysis and to create tables and graphs. SPSS is capable of handling large amounts of data and can perform all of the analyses covered in the text and much more. SPSS is commonly used in the Social Sciences and in the business world, so familiarity with this program should serve you well in the future. SPSS is updated often. This document was written around an earlier version, but the differences should not cause any problems. If you want to go further and learn much more about SPSS, I strongly recommend Andy Field's book (Field, 2009, *Discovering statistics using SPSS*). Those of us who have used software for years think that we know it all and don't pay a lot of attention to new features. I learned a huge amount from Andy's book.

RESULT OF SPSS

Sl.No.	Factors that the delay in construction	SPSS value	Rank
1.	Poor communication & co-ordination by owner and other parties	2.26	34
2.	Misunderstandings in technical dealing with tenders & contractors	2.40	19
3.	Conflict in joint ownership	2.17	38
4.	Delay in payment of completed work by owner	2.76	6
5.	Late revising and approving relevant documents by owner	2.48	12
6.	Less authority given to consultant to take decision	2.28	32
7.	Unclear and inadequate details in drawings	2.28	31
8.	Communication barriers faced by consultant	2.04	44
9.	Total quality management by consultant	2.23	39
10.	Inadequate site information given to consultant	2.40	24
11.	Ineffective planning and scheduling of project	2.57	12
12	Delay in preparation of shop drawing and material sample	2.37	19
13.	Delay in site mobilization	2.54	15
14.	Compatibility of contractor with new software's	2.26	37
15.	Risk analysis & management by contractor	2.35	26
16.	Source updating in the design engineering documents & related	2.43	32
17.	Shortage of construction materials in market	2.93	2
18.	Delay in material delivery	2.89	3
19.	Changes in quality of material	2.74	7
20.	Escalation of material prices	2.92	1
21.	Material damage in storage	2.42	22
22.	Slow process of material selection	2.57	12
23.	Shortage of labors	2.82	5
24.	Unqualified workforce	2.61	11
25.	Equipment availability and failure	2.44	17

Sl.No.	Factors	SPSS value	Rank
26.	Shortage of recent technology equipment	2.33	26
27.	Delay in equipment delivery	2.57	10
28.	Poor labor supply & labor productivity	2.64	8
29.	Traffic control at site	1.88	45
30.	Insufficient data collection and survey	2.21	41
31.	Accidents on site	2.29	35
32.	Rework due to error in construction	2.55	15
33.	Problem due to existing structures	2.45	23
34.	Unforeseen ground conditions	2.29	29
35.	Bad weather condition and poor lighting	2.24	39
36.	Environmental changes due to rainy and hot season	2.26	36
37.	Natural disasters (Earthquake, floods etc.,)	2.44	24
38.	Inclement weather effects	2.27	43
39.	Effects of subsurface conditions(soil, high water table etc.,)	2.33	29
40.	Changes in government regulation & laws	2.61	17
41.	Restriction due to site location	2.43	19
42.	Regulatory changes in building code	2.33	28
43.	Various issues in respective states	2.36	42
44.	Demonetization issue of financial problem	2.88	4
45.	Banking restriction	2.62	9

One-Sample Test
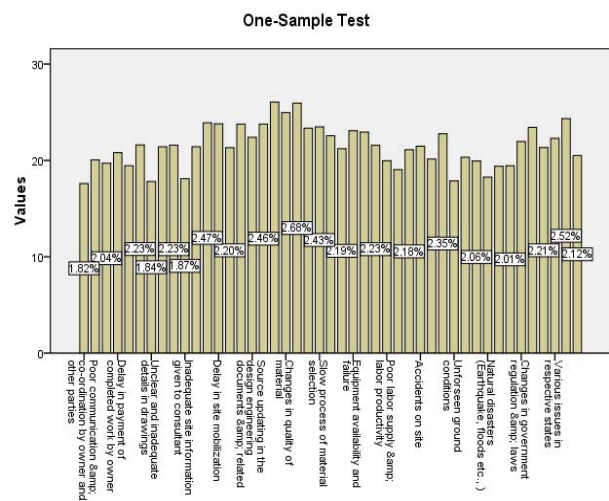
V.RECOMMENDATION AND CONCLUSION

According to abovementioned findings, following points can be recommended in order to minimize and control delays in construction projects: (1) Shortage of construction materials in market,(2) Escalation of material prices, (3) Delay in material delivery, (4) Demonization 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 (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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