IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology
Vol. 3, Issue 4, April 2016

Study of Delay Factors in Construction Projects

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Abstract: Construction Industry plays an important role in socio-economy development of any developing country. Construction time serves as a benchmark for assessing the performance of any project. Due to unexpected problems encountered during Conception, designing & construction phase often led to unwanted delay in project completion. A survey was conducted in Saudi Arabia to determine exact factors responsible for project delay. This was achieved by carrying a critical analysis of the literature and carrying out a questionnaires survey among consultants, project managers and engineers involved in construction projects and collecting their responses. The importance of Project owner's role, contractor related, Financing related, Materials related, Design documents have been cited as main delay factors. Causes of time and cost overruns comparison was done with various past researches done in Asia and Africa, which yielded 7 delay factors: Slowness and Lack of constraint; Incompetence; Design; Market and Estimate; Financial capability; Government; and Worker.

Keywords: Construction Industry, Construction time, Saudi Arabia, Project delay.

I. INTRODUCTION

The construction project consists of three phases namely: Conception, designing and Construction. Timely completion of projects is an indicator of efficient construction industry. Construction time" often serves as a benchmark for assessing the performance of a project and the efficiency of the project organisation.A project is said to be successful on timely completion. The time required to complete construction of projects is often more than specified time in Contract. These 'overruns' or, time extensions happens due to many reasons, such as designer changes or errors, economic conditions, resource availability and performance of project parties. Usually, majority of project delay occurs during Construction phase, where unforeseen factors (environmental concerns and restrictions, ground conditions etc) are always involved. Construction delays lead to increase in overall project cost, henceforth completing projects on time is beneficial to all parties involved in projects. Therefore, it is essential to identify the actual causes of delay in order to minimize and avoid the delays and their corresponding expenses.

Kumaraswamy and Chan (1995) enumerated a hierarchy of both quantitative and qualitative factors affecting the construction duration of a building project. Ashley et al. (1987) and Pinto and Slevin (1988) have investigated factors for evaluation of project success. Moreover, Chan and Kumaraswamy (1994) observed that a timely completed project is usually regarded as "successful", within budget and to the level of quality standard as specified by the client at the outset of the project.

In fact, the realisation of the present complex construction projects involves the co-operation and co-ordination of various parties including the clients, consultants, contractors, subcontractors, and suppliers (Cherns and Bryant,1984). The impacts of contractor selection methods and performance on project outcomes have been investigated by Russell and Skibniewski . However, the way in which the client organizes and manages the project will also exert a significant influence on subsequent project outcomes.

II. RESEARCH OBJECTIVE

The objective of study is to determine causes of delay in construction projects in Saudi Arabia. The study was carried out in Riyadh Province. the objective of this paper is to determine the most important causes of delay in building construction projects in Saudi Arabia.

This paper identifies the important delay factors, delay causes being categorised into eleven factors namely: Project related, owner related, Contractor elated (Technical, Reputations, management ability, Organization culture), Consultant related, Client related, Financing related, Design related, Plant/equipment related, Materials, Workforce (Manpower) related, External factors related.

III. CONSTRUCTION DELAY

The Construction delay may be defined as "the time overrun either beyond completion date specified in a contract, or beyond the project delivery date as agreed by parties" (Assaf and Al-Hejji, 2006). Zack (2003) defined delay as an "act or event which extends required time to perform or complete work of the contract manifests itself as additional days of work".

Several articles have discussed causes of delay in construction projects in numerous manners; some studies identified the main causes of delay in several countries for various project types, while other studies discussed the delay analysis methods and the proposed ways to mitigate delay. Chalabi and Camp (1984) conducted a review on project delays in developing countries during planning and

construction stages. In their study they found that the delay and cost overruns of construction projects are dependent entirely on the very early stages of the project

Noulmanee et al.(2000) studied delays causes in highway construction in Thailand and concluded that delays can be caused by all parties involved in projects. Main delay causes were: inadequacy of sub-contractors, organization that lacks sufficient resources, incomplete and unclear drawings and deficiencies between consultants and contractors. The study also suggested that delay can be minimized by discussions that lead to understanding.

Abd El-Razek et al. (2008) studied delay in building construction project in Egypt, a total number of 32 delay causes were selected grouped according to responsibility (contractor, consultant, owner and common responsibility) and categorized under 9 groups namely (financing, manpower, Changes, Contractual relationships, Environment, Equipment, Rules and regulations, Materials, Scheduling and Control). Each delay cause was measured on a Likert scale using four options: very important; important; somewhat important; and not important. On the basis of survey and overall results, they concluded that the most important causes were: financing by contractor during construction; delays in contractor's payment by owner; design changes by owner or his agent during construction; partial payments during construction; and non utilization of professional construction/contractual management. They also suggested that "a joint effort based on teamwork is required to mitigate delays".

Al-Momani (2000) investigated causes of delay in 130 public projects in Jordan. The main causes of delay identified were related to designer, user changes, weather, site conditions, late deliveries, economic conditions and increase in quantity (i.e. poor design and negligence of the owner, change orders, weather condition, site condition, late delivery, economic conditions, and increase in quantities are the main causes of delay). The study suggested that special attention to these delay factors will help industry practitioners in minimizing contract disputes. Also, delays have strong relationship with failure and ineffective performance of contractors.

Kaming et al. (1997) studied delay factors on 31 high-rise projects in Indonesia and found out that cost overruns occur more frequently and are more severe problem than time overruns. They observed that major factors influencing cost overruns are material cost increase due to inflation, inaccurate material estimation and degree of complexity. While, the most important factors causing time overruns are design changes, poor labor productivity, inadequate planning, and resource shortages.

Chan and Kumaraswamy (1997) conducted a survey in Hong Kong construction projects to evaluate the relative importance of 83 delay factors and found five main delay factors: poor risk management and supervision, unforeseen site conditions, slow decision making, client-initiated variations and work variations.

Chan and Kumaraswamy (1996) in their study observed that almost 70% of building projects were completed behind schedule. They further conducted a survey to investigate factors affecting project completion time, such as factors related to the project environment, the roles and responsibilities of participants ,managerial arrangements, human aspects, contract forms, planning and control systems. They identified 83 delay factors (general and applicable to most projects), grouped under eight major categories namely: (1) project-related; (2) client-related; (3) design team-related; (4) contractor-related; (5) materials; (6) labour; (7) plant/equipment; and (8) external factors. These factors represent some intrinsic project features, which are under the control of clients, consultants and contractors.

In their findings, they concluded that all three groups of practitioners in construction industry (Client, Consultant, Contractor) shared opinions that "poor site management and supervision", "unforeseen ground conditions", and "low speed of decision making involving all project teams" are the three most significant factors causing delays in local building works. The clients and consultants asserted to "lack of contractor experience in planning and supervision on site" as main source of delay, while the contractors controvert that many delays arise from "insufficient design experience of the consultants".

They suggested "employing pre-qualification methods of tenderers and selective tendering, rather open competitive tender", "comprehensive site investigation, accompanied by thorough and properly detailed design of groundwork and foundation before commencing construction", "clear and comprehensive contract documents to ensure proper communication amongst practitioners", complete and clear project brief from client to minimize variations (client/consultant initiated), and "establishment of construction time prediction model".

Kumaraswamy and Chan (1998) studied construction delays in Hong Kong. They observed difference in perceptions as to causes of delays by different groups of participants in building and civil engineering works. They suggested that biases of different industry groups might direct blame for delays to other groups.

IV. PROJECT DELAY STUDIES IN SAUDI ARABIA

The Delays in delivering construction projects on time can create major problems to clients and contractors. It has a serious impact on the financial commitment, image of the clients and the contractor and the impact on the environment. The delay in project delivery in Saudi Arabia is made worse due to sharp change in the price of the construction materials.

Ubaid (1991) discussed the performance of contractors as one of the major causes of delay. He considered 13 major measures related to contractor resources and capabilities. He identified contractor performance as one of the major causes of delay in project in Saudi Arabia.

Al-Barak (1993) discussed the main causes of failure in Saudi Arabian Construction industry by surveying 68 contractors and studying about 34 different causes of failure. The study concluded that lack of experience, poor

IARJSET
ISSN (Online) 2393-8021
ISSN (Print) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
Vol. 3, Issue 4, April 2016

estimation practices, bad decisions in regulating company's policy, and national slump in the economy are the severe factors.

Assaf et al. (1995) studied the main causes of delay in large building projects in Saudi Arabia. The survey covered a random sample of contractors, consultants, and owners. They grouped the delay causes (56 causes) into nine major groups: financing, materials, contractual relationships, changes, government relations, manpower, scheduling and control, equipment, and environment.

Al-Ghfly (2005) identified that, project owner involvement, contractor performance and the early design and planning of projects are important factors for the project delay in Saudi Arabia. The study discussed delay in public water and sewage projects. Sixty causes were identified and classified. He concluded the following: the delay occurred frequently in medium and large size projects, and considered severe in small projects. Important delay causes are related to owner involvement, contractor performance, and the early planning and design of the project. Important delay causes were found to be: financial problems, changes in the design and scope, delay in making decisions and approvals by owner, difficulties in obtaining work permit, and coordination and communication problems.

Assaf and Al-Hejji (2005) investigated time performance of different types of construction projects in Saudi Arabia to determine the causes of delay and their important according to each of the project participants, owner, consultant and contractor. The investigation included a field survey of 23 construction contractors, 19 consultants and 15 owners. They concluded, based on the owner's specification, that the main delays are related to contractors and labours. Owners and contractors both indicated that ineffective planning and scheduling by contractor is one of the delay to the project; poor management, poor site management and supervision by contractor.

Assaf and Al-Hejji (2006) studied delay causes in large construction projects in Saudi Arabia. Most of the contractors (76%) indicated that average time overrun is between 10% and 30% of original duration, while about 56% of the consultants specified the same percentage. 25% of the consultants indicated from 30% to 50% average time overrun. Owners opined that delay causes are related to contractor and labors. The study observed that owners and consultants realize lowest bidder as the highest frequent delay factor, while, contractors considered owner related delay factors as severe ones. Both owners and consultants specify labor and contractor related causes as the severe and important sources of delay, while, contractors indicate that the important sources of delay in construction projects are owners and consultants.

The study recommended to owners ("Timely payment to contractor, minimum change in order during construction, timely reviewing and approving of design documents, checking resources and capability of contractor"), contractors (" sufficient number of labors, managing financial resources, proper planning and scheduling, better site management and supervision"), and consultants ("timely reviewing and approving design documents, flexibility in evaluating contractor works").

V. RESEARCH METHODOLGY

The Quantitative questionnaires were used to provide a large number of responses from the Saudi construction sector at reasonable time and cost. The distributed questionnaire was designed to identify the Saudi public construction sectors current factors causing Time overruns/Project delay. The main aim was to provide a detailed assessment of experience and understanding of these factors.

These are main three objectives fulfilled by quantitative study:

1. To identify knowledge and understanding of project completion in construction organisations.
2. To explore and identify delay factors in construction industry.

Field data was collected from project owners, construction industry consultants, contractors and Working engineers. The collected (quantitative) data were gathered from the construction industry in Riyadh province, KSA.

Present research introduced identification of delay factors. 95 causes of delay were identified through literature review. These delay factors were categorised into eleven factors namely: Project related, owner related, Contractor elated (Technical, Reputations, management ability, Organization culture), Consultant related, Client related, Financing related, Design related, Plant/equipment related, Materials, Workforce (Manpower) related, External factors related.

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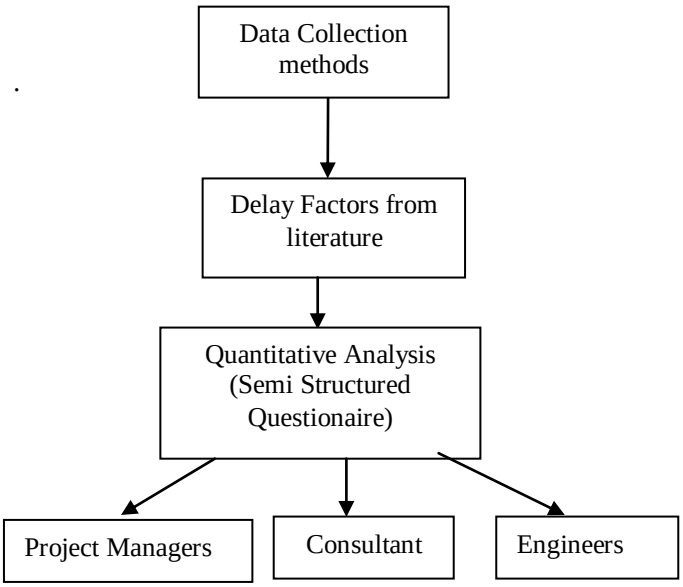

Fig. 1: Data Collection Methods

A questionnaire was developed to evaluate frequency of occurrence, severity and importance of identified delay causes.

Each factor was given weight according to their significance, as marked by respondents.

IARJSET
ISSN (Online) 2393-8021
ISSN (Print) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
Vol. 3, Issue 4, April 2016

TABLE 1: Delay factors weightage

Factor	Weightage
Extremely Significant	5
Very Significant	4
Moderately Significant	3
Slightly Significant	2
Not Significant	1

VI. RESULTS AND DISCUSSIONS

The main findings of the quantitative data analysis was that the main problems facing construction industry in Saudi Arabia is the delay in the project. Project delay costs have increased sharply and have impacted on the initial costing of the project.

A total number of 42 filled questionnaires were received, most of them were engineers (64.3%) followed by Consultant (21.4%). All the respondents were related to Construction industry.

TABLE 2: Respondents work Position

Work Position	Engineer	Consultant	Project Managers
Frequency	27	9	6
Percentage	64.3	21.4	14.3

The majority of respondents belonged to 26-30 years of age, (30.7 percent). Only 7.7 percent of the respondents were >50 years old.

TABLE 3: Classification of respondents by their age

Age	26-30 Years	31-35 Years	36-40 Years	41-50 Years	>50 Years
Frequency	15	9	6	9	3
Percentage	35.7	21.4	14.3	21.4	7.1

The vast majority of respondents had 5-10 years of work experience, i.e. 35.7 percent, while 21.4 percent have over 20 years experience.

TABLE 4: Respondents' years of experience

Experience	<5 Years	5-10 years	11-15 years	16-20 years	>20 years
Frequency	6	15	9	3	9
Percentage	14.3	35.7	21.4	7.1	21.4

The responses were analysed to find top 20 significant factors causing delays in construction projects.

Table 5 shows top 20 significant delay factors as cited by all respondents.

TABLE 5: Respondents responses to top 20 significant factors causing delays

Hypothesized factors	Rank
Slowness of owner decision making process	1
Delay in contractor's payment by owner	2
Delay in progress payment by owner	3
Change orders by owner during construction	4
Uncooperative owners	5
Long waiting time for approval of test samples of materials	6
Design changes by project owner or his agent during construction	7
Suspension of work by owner	8
Delay in selection of material due to various choice	9
Long waiting time for approval of drawings	10
Delay to furnish and deliver site to contractor by owner	11
Unrealistic contract durations imposed by client	12
Late in revising and approving design documents by owner	13
Lack of communication between client and contractor	14
Low speed of decision making involving all project teams	15
Proximity to big cities	16
Partial payment during construction	17
Financing by contractor during construction	18
Cash flow to subcontractor	20

"Slowness of owner decision making process" was found to be most important factor causing project delay, followed by "Delay in contractor's payment by owner", which clearly shows factors related to owner highly affects smooth running of any construction project.

Most of the consultants cited "Slowness of owner decision making process" as main delay factor, as decision making halts project progress by a great extent. It was followed by "Partial payment during construction", as financing always plays vital role in smooth running of any project.

Majority of Project managers cited "Slowness of owner decision making process" followed by "Delay in contractor's payment by owner" as main factors responsible for delay.

"Delay in contractor's payment by owner" and "Slowness of owner decision making process"" were ranked main cause of Project delay by majority of engineers.

Table 6 shows 20 main delay factors as identified by Consultants, Project Managers and Engineers.

DOI 10.17148/IARJSET.2016.3420

IARJSET
ISSN (Online) 2393-8021
ISSN (Print) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
Vol. 3, Issue 4, April 2016

TABLE 6: Delay Factors Ranking

Hypothesized Factors			
Rank	**Consultants**	**Project Managers**	**Engineers**
1	Slowness of owner decision making process	Slowness of owner decision making process	Delay in contractor's payment by owner
2	Partial payment during construction	Delay in contractor's payment by owner	Slowness of owner decision making process
3	Delay in progress payment by owner	Delay in progress payment by owner	Delay to furnish and deliver site to contractor by owner
4	Late in revising and approving design documents by owner	Original contract duration is short	Change orders by owner during construction
5	Type of Project (Government/Semi Govt./Private)	Change orders by owner during construction	Delay in progress payment by owner
6	Low speed of decision making involving all project teams	Late in revising and approving design documents by owner	Uncooperative owners
7	Change orders by owner during construction	Shortage of materials in markets	Long waiting time for approval of drawings
8	Lack of communication between client and contractor	Delay Penalties	Past management performance
9	Uncooperative owners	Long waiting time for approval of test samples of materials	Suspension of work by owner
10	Suspension of work by owner	Delay in selection of material due to various choice	Design changes by project owner or his agent during construction
11	Delay in contractor's payment by owner	Delay to furnish and deliver site to contractor by owner	Long waiting time for approval of test samples of materials
12	Cash flow to subcontractor	Cash flow to subcontractor	Delay in selection of material due to various choice
13	Unexpected foundation conditions encountered in field	Slow delivery of materials	Unrealistic contract durations imposed by client
14	Long waiting time for approval of test samples of materials	Inflexibility (Rigidity) of consultant	Poor coordination between consultant and other parties
15	Design changes by project owner or his agent during construction	Late in reviewing and approving design documents by consultant	Inflexibility (Rigidity) of consultant
16	Low speed of decision making within each project team	Number of direct workers available for the project	Lack of communication between client and contractor
17	Poor communication and coordination by owner and other parties	Contractor Relationship with suppliers	Low speed of decision making involving all project teams
18	Unrealistic contract durations imposed by client	Claims	Low speed of decision making within each project team
19	Financing by contractor during construction	Low speed of decision making within each project team	Shortage of materials in markets
20	Number of direct workers available for the project	Suspension of work by owner	Delays in design information

The major delay factors as obtained from present study was compared with major Delay factors as cited by other researchers, who carried out Study in construction industries in Asia and Africa. The studies were mainly done on time overruns (time delay), cost overruns & Delay and cost overruns. The comparative study from other countries identified 7 delay factors: Slowness and Lack of constraint; Incompetence; Design; Market and Estimate; Financial capability; Government; and Worker.

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology
Vol. 3, Issue 4, April 2016

TABLE 7: Comparative Study of Delay Factors Ranking in various countries

	Major Causes (Top 5 factors)				
	1	**2**	**3**	**4**	**5**
Present Study *(2)*	Slowness of owner decision making process	Delay in contractor's payment by owner	Delay in progress payment by owner	Change orders by owner during construction	Uncooperative owners
Hongkong (Chan & Kumaraswamy,1996) ***(2)***	Poor site management and supervision	Unforseen ground conditions	Change orders by owner during construction	Delays in design information	Lack of communication between consultant and contractor
Egypt, (Al Razek etal.,2008) ***(2)***	Financing by contractor during construction	Delay in contractor payment by owner	Uncooperative owners	Partial Payment during construction	Non utilization of professional construction/ contractual management
Saudi Arabia (Assaf & Al-Hejji, 2005) ***(2)***	Type of project bidding and award	Shortage of Labors	Change orders by owner during construction	Delay in progress payment by owner	Ineffective planning & scheduling of project by contractor
Vietnam (Le-Hoai et al.,2007) ***(1)***	Poor site management and supervision	Poor project management assistance	Financial difficulties of owner	Financial difficulties of contractor	Design changes
Malaysia (Sambasivan,2007) ***(2)***	Improper planning	Site management	Inadequate contractor experience	Finance and payments of completed work	Subcontractors
South Korea (Acharya *et al*, 2006) ***(2)***	Public interruptions	Changed site conditions	Failure to provide site	Unrealistic time estimation	Design errors
Hong Kong (Lo,2006) ***(2)***	Inadequate resources due to contractor /lack of capital	Unforeseen ground conditions	Exceptionally low bids	Inexperienced contractor	Works in conflict with existing utilities
UAE (Faridi, 2006) ***(2)***	Preparation and approval of drawings	Inadequate early planning of the project	Slowness of owner's decision making process	Shortage of manpower	Poor supervision and poor site management
Jordan (Sweis, 2007) ***(2)***	Financial difficulties faced by the contractor	Too many change orders from owner	Poor planning & scheduling of project by contractor	Presence of unskilled labor	Shortage of technical professionals in contractor's organization
Kuwait (Koushki, 2005) ***(2)***	Change orders	Financial constraints	Owner's lack of experience	Materials	Weather
Kuwait (Koushki, 2005) ***(3)***	Contractor	Materials	Financial constraints	Change orders	Weather
Ghana (Frimpong, 2003) ***(1)***	Monthly payment difficulties	Poor contract management	Material procurement	Inflation	Contractor's financial Difficulties
Nigeria (Aibinu,2006) ***(2)***	Contractors' financial Difficulties	Clients' cash flow problem	Architects' incomplete drawing	Subcontractor's slow mobilization	Equipment breakdown and maintenance problem
Jordan (AlMomani,2000) ***(1)***	Poor design	Negligence of owner	Change orders	Weather condition	Site condition

(1): Delay and cost overruns; ***(2):*** Delay only; ***(3):*** Cost overrun only

DOI 10.17148/IARJSET.2016.3420

VII. CONCLUSION

The main delay factors that lead to Project overruns in our study are related to **"**Project owner's role, contractor related, Financing related, Materials related**,** Design documents". While, comparative studies from other countries cited 7 delay factors: Slowness and Lack of constraint; Incompetence; Design; Market and Estimate; Financial capability; Government; and Worker as most responsible for Time & cost overruns in Construction Projects.

ACKNOWLEDGEMENT

The authors are thankful to professional working in Construction Industry who helped in timely responding of questionnaires.

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