

Construction Projects Delay Causes- Economical and Industrial Effect

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Abstract - Construction projects always exposed to delay. This problem is global problem. Many studies have conducted to analyse delay in construction projects. Most of the research work conducted in delaying construction projects aimed to measure and rank the direct delays that project faced during its life. These studies conducted in different countries with different technical, economical and contractual conditions. In this study, an extensive review of previous research work in delay causes definition and ranking conducted. The objective of this study is to analyse the effect of changing economical and construction environmental conditions on occurrence of delay causes and their importance. This study analysed results of some of previous researches conducted all over the world. This analysis revealed that the economical, contractual and technical factors have highly effect on the delay causes ranking in developing countries, while the project characteristics have the high influence in developed countries. Three delay causes are common in all studies in all economical situations that have highly effect on delay occurrence. These delay causes are shortage of materials, shortage of labours, and problems gained from suppliers and subcontractors. Any effort to mitigate delay occurrence in construction projects should consider this result into consideration.

Keywords: *Construction projects, Construction delays, causes of delays, effect of economic conditions, comparative analysis*

INTRODUCTION

Poor time completion performance well known as an international problem. In a study for World Bank conducted in 1990, figures showed that for the 1627 projects completed between 1974 and 1988 the overrun varied from 50% to 80% of the original duration. In Canada, Semple et al 1994 showed that over 70% of high-rise building in Western Canada experienced time overrun. In Australia, the results of a survey of 400 completed building projects showed that only one contract in eight completed on or before the date originally expected and the overall average extra time taken exceeded 40% of the original, Kaka and Price, 1991. In the developing countries, the problem may be worse; in Turkey, Arditi et al 1985 survey of 258 public projects in Turkey showed that 44% overran from the original duration and in Saudi Arabia it is found that the percentage of delayed projects in Saudi Arabia varied from 35% to 84%, Al-Gafly 1995. Even green buildings also exposed to delays, 32.29% of the green construction projects completed behind schedule - Hwang and Leong 2013.

As described above, the problem of delays in construction projects is significant and a global problem. In this research, a comparative analysis for previous research works to evaluate economical and construction industry characteristics on imported delay causes occurrence.

RESEARCH OBJECTIVE

Construction industry should evaluate causes of delay and try to prevent their occurrence and to mitigate their effects in case of occurrence. This research aims to evaluate the differences of economical, technical and contractual conditions on occurrence of important construction project delay causes.

Research Methodology:

To achieve this objective, the work will pass through these steps:

Gathering results of research work conducted in delay causes

Analysing the research work results

Put comparison criteria for conducted research work

Analysis for the comparison of conducted research work results

Many of previous studies regarding delay causes measuring and ranking conducted in globally. More than 20 published research work were extensively analysed to check the effect of difference of construction industry and economical situation effect on rank of delay causes.

Most of these studies discussed in Soliman 2006. Table 1 describes summary of the previous researches. The table contains comparison of the used sampling techniques, the participants, and the research methodology.

Table 1: Previous research work in delay causes and ranking

Authors	Country	Year	Project Owner	Project Type	Method of Data Gathering	Participants & No of Participants	No. Delay causes	Delay causes ranking techniques	Groups Rank Agreement technique
Baldwin et al	USA	1971	N/A	N/A	Mailed questionnaire	Contractors& (101) architects (100) & engineers (99)	17	Severity Index	Rank Agreement Factor
Sullivan and Harris	UK	1986	N/A	Big Civil Projects	Interview Questionnaire	Contractors (12), clients (3) and consultant (4)	16	Average frequency	
Al-Khalil Al-Ghafly,	Saudi Arabia	1999	Public	Water and Sewage Projects	Mailed questionnaire	Owners (10), Consultants (12) & Contractors (23)	60	Importance Index	Coefficient of concordance
Ogunlana et al 1996	Thailand	1996	Private	High rise buildings	Interview Questionnaire	12 project sites- not defined numbers for each respondents	25	Percentage	
Kumaraswamy and Chan	Hong Kong	1998	Public & Private	Civil and Building Projects	Mailed questionnaire	Owner (50), consultants (49) and contractors (48)	83	RII relative importance index	Rank Agreement Factor
Frimpong et al	Ghana	2003	Public	Ground water Projects	Mailed questionnaire	Owners (28), Consultants (19) & Contractors (25)	26	Relative Importance Weight (RIW)	The Kendall's Coefficient of Concordance
Zayed and Kalavagunta	Canada	2005	N/A	Industrial, heavy, residential and building construction	Questionnaire	Not defined	22	AHP	

Table 1: Previous research work in delay causes and ranking - continue

Soliman	Kuwait	2010	N/A	N/A	Interview Questionnaire	Owners (5), Consultants (16) & Contractors (9)	30	Importance Index	Rank Agreement Factor
Abdel-Razek et al	Egypt	2008	N/A	Buildings	Interview then Questionnaire	Owners (22), Consultants (23) & Contractors (29)	32	Importance Index	Spearman Correlation Coefficient
Shebob Et al	Libya	2012	N/A	Buildings	Mailed questionnaire	Owners (28), Consultants (20) & Contractors (24)	75	Importance Index	
Shebob Et al	UK	2013	N/A	Buildings	Mailed questionnaire	Owners (12), Consultants (19) & Contractors (13)	75	Importance Index	
Haseeb et al	Pakistan	2011	N/A	Large projects	Questionnaire	120 participants	37	Mean then critical index	
Tommy et al	Hong Kong	2006	Public	N/A	Mailed questionnaire	Owners (55), Consultants (48) & Contractors (48)	30	RII relative importance index	Rank Agreement Factor
Kaliba et al	Zambia	2009	Public	Road	Mailed questionnaire	Total number of 60 -	14	Weighted average	
Faridi and el-sayegh	UAE	2006	N/A	N/A	Mailed questionnaire	Contractors (52) & consultants (46)	44	RII relative importance index	Spearman Correlation Coefficient

Table 1: Previous research work in delay causes and ranking continue

Ayudhya	Singapore	2011	N/A	Building & residential	Mailed questionnaire	Owners (14), Consultants (20) & Contractors (40)	35	Severity Index	Spearman Correlation Coefficient
Tabtabi	Kuwait	2002	Public	Housing and building	Mailed questionnaire	Owners (23), Consultants (8) & Contractors (17)	53	RII relative importance index	Rank Agreement Factor
Sambasivan & Soon	Malaysia	2007	Public & Private	N/A	Mailed questionnaire	Owners (67), Consultants (48) & Contractors (35)	28	RII relative importance index	Spearman Correlation Coefficient
Assaf & Al-Hejji	Saudi Arabia	2006	Public	N/A	Mailed questionnaire	Owners (15), Consultants (19) & Contractors (23)	73	Importance Index	Spearman Correlation Coefficient
Ahmed et al	USA	2003	N/A	N/A	Mailed questionnaire	Contractors (35)	50	Weighted average	

PREVIOUS RESEARCH WORK ANALYSIS

In this section, analyse for previous research work from these points:

Method of data gathering

Table 1 shows that all data gathered mainly gathered through questionnaire. These questionnaires distributed for participants who are working in construction industry. The questionnaire may be mailed or interview questionnaire.

Delay causes and groups

Some of researches used number of delay causes in one group, others categorised the delay causes into number of groups varied from four as in Zayed and Kalavagunta, 2005 and 9 groups as in Assaf et al 1995. The number of used surveyed delay causes varied from 30 delay causes as in Soliman 2010 and 83 delay causes as in Kumaraswamy, and Daniel 1998.

It is important to notice that the surveyed delay causes may be different in wording but similar in meanings. Some of researches used different meanings for the delay causes, some used the word "delay causes", and others used "delay factors" and "delay contributors". Although there is different in wording in these terms, the meaning is almost the same and the usage of researchers for the wording is almost the same.

Participant's categories:

In previous studies, many participants are groups based on their employers. In all construction industry the main groups that are ruling the project are:

Project owners. This group contains who own the project and/or who are responsible for finance and leading project during construction time. Delaying project submittal to owner will prevent owner of project usage and lose lot of money. This group of participants contains project owners, clients and developers.

Designer / consultant/ A/E. This group contains the technical personnel who are responsible for project technical design and producing technical and contract drawings before or during construction period. In traditional contracting, the designer is responsible for completing all the design work before bidding and awarding stage. Project delaying will prevent realising project technical staff, keep them until project finish, and hence increase consultant costs. This group contains consultants, architects, engineers, quantity surveyors and A/E.

Contractors, constructors. This group is responsible for all the execution works and translating drawings and technical instruction given by consultants until complete and submit project to employer. Many drawbacks recorded from project delay in contractor point of view such as financial arrangement, bad reputation, and ability of contractor to project financial and releasing contractors' resource to use in different project. This group contains contractors and employees for contractors.

Surveyed Project types

Many of researches defined the project types either public or private finance. The project type surveyed contains all project types such as civil projects, building projects, road projects, water and sewage projects, high-rise buildings, underground projects and industry projects

Most of delay causes are common and difference of project types has no great effect of delay causes difference.

Methods of sampling analysis and results

All conducted researches in this area asked construction personnel to evaluate the importance level of delay cause based on his experience. The level of importance presented to participants in different levels such as very important, important, average, has moderate importance, and has no importance. Many techniques used to rank delay causes. Baldwin, 1971 proposed severity index to evaluate and rank delay causes. The severity index is an index that adds what is above average ranking only. The techniques used in previous studies as shown in Table 1 are:

Severity index

Average or mean values

Importance index

AHP

Because of the difference of participants point of view and different of their objectives, most of past research work used a parameter to evaluate level of agreement between participant evaluation for delay causes. Table 1 shows the used parameters to evaluate level of agreement. These parameters were:

Rank agreement factor

Spearman correlation coefficient

DISCUSSION

The used delay causes, groups of causes and ranking methods were different from a research to another. There are three problems to get a common analysis for previous research results, which are:

Most of researches results were from different participants' categories and these categories are different in opinions and objectives. In all conducted research works, the participants were belonging to different groups based on their employer. It is obvious that the three groups have different objectives, and when they asked to determine the causes of delays, they often blamed the other groups. This statement proven from all previous studies. The groups' difference in perceptions may be influenced by:

The wording of the delay causes in questionnaire and this might affect the increase in 'buck passing' by different groups.

It suggested that the apparent collective biases displayed by the different groups as they often directed the blame for delays to other groups. This could discourage a search for the root causes of delays and their solution.

The used delay causes in previous research work have different phrasing in spite of they are close or in similar meanings.

The previous studies have done in different places with different number of delay causes. For example, a delay cause may be ranked 9th in a study of 35 delay causes, while it is ranked 3rd in a study of 16 delay causes, so it is not easy to compare the delay cause ranking in different groups and numbers.

To deal with the first problem, an absolute ranking considered for previous studies in spite of changing in participants' groups ranking. For example in Soliman study - 2010, contractor financial problems ranked second from consultants' judgement, contractors ranked this delay cause as sixth. An absolute value calculated by adding the two values of ranks to represent an absolute value for both groups. A revised rank will be resulted by using the resulted absolute values as shown in table 2.

To deal with the second problem, the similar wording or nearly meaning words put as one delay cause. Sometimes the delay cause put in a research as "equipment breakdown" others used "breakdown equipment "others uses" delay resulted from equipment breakdown". These delay causes are dealt as one cause "equipment breakdown" and for the same situation.

To deal with the third problem, the study result ranking for the delay causes can assumed as five rank categories:

Top ranked delay cause, (T)

High ranked delay cause (H)

Average ranked delay cause (A)

Low ranked and (L)

Not important or not effective delay cause (N)

The resulted delay cause ranked divided into these five ranks. If the delay cause was in the top 20% of the delay cause ranking, it assumed as top ranked. If the delay cause rank was on the least 20 % of the delay cause ranked, it assumed as no importance delay cause. Based on the above assumptions, table (2) can be resulted for Soliman [10]. The same procedure applied for other mentioned studies.

Table 2: absolute ranking and rank categorises for Soliman 2010 Study

Delay Causes	Rank for Parties (original study)		Absolute rank	Rank Category
	Consultant	Contractor		
Owner financial problems	1	5	6	T
Conflict between contractor and consultant	4	3	7	T
Contractor financial problems	2	6	8	T
Delaying of Contractor payments from owner	6	2	8	T
No Planning before start project	5	6	11	T
Shortage of technical staff	11	6	17	T
Inappropriate owner representative management style	13	4	17	H
submittal Delay of design documents from consultant	17	1	18	H
Unrealistic contract price	9	11	20	H
Design Changes	8	13	21	H
Unrealistic contract time	13	9	22	H
Delay of Material submittals or delivery	12	11	23	H
Inefficient management capability of contractor staff	3	21	24	A
Incompetence of planning and control from contractor staff	6	21	27	A

Unclear contract conditions	20	10	30	A
Shortage of equipment	18	15	33	A
Shortage of Construction Material	10	26	36	A
Shortage of skilled workers	15	21	36	L
Waiting Instructions from consultant	21	15	36	L
Shortage of laborers	18	20	38	L
Unexpected underground conditions	25	14	39	L
Reworks due to defects in construction materials	23	18	41	L
Permits and access facilitates	22	19	41	L
Variation order in extra quantities	16	27	43	N
Design details unclear	28	17	45	N
Equipment breakdown	26	24	50	N
Equipment low productivity	23	28	51	N
Weather conditions (Hot, Humidity,...)	29	25	54	N
Material and labor wage escalation (inflation)	27	29	56	N

To deal with the different places of research work, it is noticed that the causes of delays vary from one country to another and delay causes ranking is very sensitive to each country's economic and industrial condition. Globally countries can divide into three groups: developed, developing and fast economic growth countries. The previous research work divided into three main groups. This dividing is based on economic stability, economic capability, GDP, GNP, per capital income and availability of construction industry infrastructure. Construction industry infrastructure such as institutions to facilitate labor force, factories for building materials, factories of construction equipment, environment of financial supporting,... Developed countries group contains research works done in USA, Canada, UK, Hong Kong and Singapore. The second group contains countries with economic stability, sound financial bases, and have construction activities increasing growth, but poor in construction industry infrastructure. This group contains the studies from Kuwait, Saudi Arabia, Libya, UAE, Malaysia and Thailand. While the third group contains studies conducted in developing countries. Developing countries have unstable economic situation and poor construction, industry infrastructure. This group contains studies conducted in Egypt, Ghana, Zambia and Pakistan.

Table 3 shows the used previous studies and categorises groups: developed, fast growth and developing countries.

Table 3: studies groups as per economical and industry conditions

Group 1: Developed Countries		
USA	Baldwin et al 1971	Ahmed et al 2003
UK	Sullivan and Harris 1986	Shebob et al 2012
Canada	Zayed and Kalavagunta (2005)	
Singapore	Ayudhya 2011	
Hong Kong	Kumaraswamy and Chan (1998)	Tommy et al 2003
Group 2: Economic Growth Countries		
Kuwait	Soliman 2010	Tabtabi 2002
KSA	Al-Khalil, and Al-Ghafly, (1999)	Assaf, and Al-Hejji, (2006)
UAE	Motaleb, and Kishk, (2010)	
Libya	Shebob et al 2012	
Thailand	Ogunlana et al 1996	
Malaysia	Sambasivan and soon 2007	
Group 3: Developing countries		
Egypt	Abd El-Razek et al 2008	Marzouk et al 2014
Zambia	Kaliba et al 2009	
Ghana	Frimpong et al 2003	
Pakistan	Haseeb et al 2011	

As discussed earlier, the top (T) and highly (H) ranked delay causes for each group only listed. Research conducted in developed countries revealed that the top ranked delay causes for this group are:

Change orders
Foundation , unforeseen and ground conditions
Labor Supply
Shortage or Delay of Material submittals or delivery
Subcontractors
Waiting for Information
Weather condition
Poor site management and supervision
Necessary variations disputes/ conflicts
Building permits approval process
Changes in drawings and specifications

However, in developing countries, the important causes of delays for this group are:

Contractor financial & cash flow problems
Conflict and lack of communication between parties
Design errors, mistakes and Changes
Equipment availability and failure
Difficulties in planning and scheduling
Inadequate contractor experience
Inappropriate owner representative management style
Labor and technical staff un-availability
shortage of materials and material management problems
Owner financial problems
Slowdown of the owner decision making
Subcontractors

The important causes of delays in the fast economic growth countries listed as following:

Contractor financial & cash flow problems
Change orders
Deficiencies in contractors organisation & management
Design changes & modifications
Difficulties in planning and scheduling
Disputes and claims
Shortage or delay of material submittals or delivery of imported materials
Inflation
shortage of labour supply & qualified & technical workers
Owner financial problems
Poor contract management
Subcontractors and suppliers
Weather condition

Seventeen delay causes ranked as top and highly ranked delay causes globally around the world for the three groups. Table 4 shows the top delay causes for the tree groups.

Only three delay causes have ranked as important in all countries, which are:

shortage of materials – materials availability
labour and technical staff availability
subcontractors related problems

Table 4: important common delay causes in the three groups of economical situation

no		A	B	C
1	Change orders			
2	Conflict and lack of communication between parties			
3	Contractor financial & cash flow problems			
4	Deficiencies in contractors organisation & management			
5	Design changes & modifications & errors			
6	Difficulties in planning and scheduling			
7	Disputes , claims and cnflicts			
8	Equipment availability and failure			
9	Foundation , unforeseen and ground conditions			
10	Inappropriate owner representative management style			
11	Inflation			
12	Labor and technical staff unavailibility			
13	Owner financial problems			
14	shortage of materials & delivery and materials management problems			
15	Slowdown of the owner decision making			
16	Subcontractors and suppliers			
17	Weather condition			

A = developed countries
 B = fast economical countries
 C = developing countries

These three delay causes are the main resources for construction industry. While the construction management delay causes (design changes and difficulty in planning and scheduling) have been highly ranked in developing and fast economical countries while have no high effect on developed countries. The financial situation have been recorded as highly ranked in fast economical economy and developing counties while it has no high effect on developed countries.

The difference in importance or influence of delay causes between developed countries and the developing countries is mainly due to the construction industry environment. In developed countries, the industry infrastructure is available in terms of construction material factories, training institutions, technical institutions and public funds. In developing countries, there is shortage of construction industry infrastructure. Most of construction materials and equipment still imported from outside the country. The shortage of funding, especially from the public sector is noticeable in most of the developing countries.

It should noticed that the construction economic and industry environment have high influence of time performance in construction projects.

Delay causes in the developed countries is related to the project conditions more than the micro conditions, while micro conditions have more influence in developed countries To enhance time performance and mitigate delay occurrence, it is recommended to enhance construction industry infrastructure, contacting procedures, funding organization and facilities and relationship between projects parties should be revised especially in developing countries.

To enhance time performance and mitigate delay occurrence in developed countries, it is recommend concentrating in revising project contracting more than micro and general environment changes.

CONCLUSION

Most of the previous delay analysis studies conducted globally aimed to determine the causes of delay and rank them. These studies conducted mainly by asking construction industry personnel to use their own judgement to rank or assess the importance of a set of predefined causes of delay. The delay causes ranking is different from a country to another. There were three problems to deal with previous studies results and to examine if there are common delay causes globally. These problems are the different economical situation for the countries that the studies conducted in, participants and number of delay causes surveyed. A procedure introduced to use the delay causes ranking results globally. The analysis of delay studies results revealed that the delay causes ranking is very sensitive to economic, contractual and technical status of the country status. The delay causes in the developed countries related mainly to the project conditions more than the micro conditions, while the delay causes in the developing countries related to the micro conditions such as materials availability, technical and funding availability. There are three delay causes seems to be common all over the world. These delay causes are shortage of materials, shortage of labours and problems resulted from suppliers and subcontractors. Any attempt to mitigate effect of delay causes should consider this result.

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