

Relative Importance Index of Delay Factors in Construction Industry: Case of Dubai

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Abstract: *One of the largest industries in the United Arab Emirates is the construction industry, a complex and entails versatile participants. Multi-disciplinary participants work hand in hand to achieve a completed successful project. However, several hindrances occur such as delays in the completion of the construction. Delay in constructions are common in engineering projects worldwide leading to claims, increased project time and increased project cost. The objective of this study is to review the delay factors worldwide, identify and rank them in project construction in the UAE. Based on a survey instrument conducted to assess the importance of these factors using relative importance index, the results showed that the changes in design during construction, lack of funds and owners slow decision making are the most significant causes of delay in the UAE. These findings benefits the construction sector in the UAE thus providing insight for the construction practitioners, project owners and researchers to improve deliverables, productivity and overall performance of civil construction projects in UAE.*

Keywords: Construction industry in UAE, Delays, Relative Importance Index

I. INTRODUCTION

Ranking the significance of delay factors by project supervisors empowers recognizable proof of the most essential factors that causes delay and helps them to look for best option arrangements (Alwi and Hampson, 2003). It is highly imperative to research and identify delay causes so as to reduce and eliminate the delays and their repercussions (Majid, 2006). This research focus on investigating the main causes behind construction delays in the UAE through a survey instrument. The aim of the client and the construction team involved is to deliver a successful project at the end of the stipulated construction period within cost and contract terms. The impacts of delays on projects have been investigated by researchers to be a major cause of construction project failure which are caused by all the parties involved in construction and by external factors such as weather, economic and political situations.

Importance of the construction industry

In 2006, the number of contractor workers in the UAE was estimated to be 16,000 where 12,000 are highly active and practicing (Arshi and faridi 2006). Project constructions include homes, schools, hospital, commercial and business infrastructure, airports, roads and bridges. They have both positive and negative impact on communities in general. Construction industry is a strategic segment in economic development. In a recent report by the National Association of Home Builders, economic impact, from building just a hundred of single family homes with an average estimate of 378,000 dollars, would produce 26.7 million dollars in local income, 3.6 million dollars in revenues and in an estimate of 394 employment opportunity for the local community in a single year.

The construction and rework of roads brings boost to economy and improves transport networks by drastically minimizing the distance, thus reduction in fuel consumption and vehicle degradation and the value of the constructions properties surrounding these infrastructures increases.

However, waking up from sleep at 6 AM to sounds due to construction equipments, inconvenience of blocked roads impact negatively our daily life. Construction adds significantly to the high emission of pollutants to the environment causing a decrease in water quality and deterioration of natural environment. Delays in the execution of projects distress customers, owners, contractors, and consultants (Semple et al. 1994; Yates and Epstein 2006).

Construction Management

There are a number of jobs to be done by any project planner ranging from: planning, cost estimation, quality check to contract, risk, safety and time management. If a project manager endeavors that all these tasks are correctly implemented into the construction project, this would ensure that the project runs to good results. Time management ensures that all activities on the construction are documented into specific time frame to meet project deadline. An efficient cost management ensures that the construction project remains within planned budget and avoid facing funds challenges and would accelerate the construction project to be completed on time. It is of high importance that construction management to be regarded as a serious tool for the success of any type of construction project.

Consequences of delay

Delays in project construction is risky and leads to claims, disputes and even to legal issues and lawsuits. A delay project influences time and money as well, which are the backbone of the economy. Delays have been the main source of continuous disputes and fracas, at times disturbing the lawful activity (Anastasopoulos et al. 2011). Owner, client, contractor and external related sources of delay lead to hard financial situations which impact all the parties in the project construction.

I. Literature Review

According to Prakash Rao (2016), delay can be defined as a situation when the contractor, consultant and client jointly or separately contributed to the non-completion of the project within agreed contract period. Also defined as a circumstance in which any of the stakeholder add to the delay of a project's completion time as stipulated in the agreement report (Aibinu and Jagboro 2002). As indicated by Mahamid et al. (2012), delays happen to both low budget and high budget projects in both developing and developed countries. The investigation of delays can concentrate on a particular stakeholder, contractual worker, advisor, consultant, or proprietor/owner—or can cover more than one construction party from where a correlation of the points of views can be carried out by securing each party advantage since stakeholders have distinctive perspectives (El-Sayegh and Mansour 2015). Further, investigation of delays might begin from the inside association of the contractor as the agent working on the project, or they can originate from any components outside the contractual worker firm that impact the project execution. Delays that originate from outside the contractual worker's firm can be started by the proprietor, designers, consultants, or different temporary workers required in the construction project (Bramble and Callahan 1999).

Causes of delays in construction projects are different from country to another, from a particular project to another. Jergeas (2008) surveyed global senior project ownership, procurements in engineering, and construction industries in Canada, the United States, the United Kingdom, Norway, Germany, Spain, Chile, India, and Australia. In light of these investigations, the causes for cost overrun and schedule overrun were due to: *unreasonable cost and schedule estimates, incomplete scope definition and inappropriate project methodologies*. Numerous researchers had identified the factors that lead to the causes of delays in different countries:

Turkey

Delays in Turkey were initially studied by Arditi, Akan and Gurdamar (1985) which deduced that the primary driver of delays were lack of *construction materials*. Another study was led by Gündüz et al. (2013) which distinguished 83 delay factors in nine noteworthy classifications. The most critical reasons for delays were *project planning, poor site management and change orders*.

Zambia

Kaliba et al. 2009, in his study on road construction project in Zambia demonstrated that significant delays were caused by the *clients* and were related to *contract alteration and financial issues* such as late instalment.

Hong Kong

In the Hong Kong construction industry, the practitioners admitted their fault as they were behind major cause of delay: Client/owner group made a confession of unrealistic project contract duration. The consultant group recognized the problem of *poor site management*, the contractors admitted *shortcomings in capital resources*.

Indonesia

Indonesian project construction experienced delays essentially because of *poor planning and material shortages* (Kaming et al., 1997).

Thailand

Ogunlana and Promkuntong (1989) found that the issues confronted by the project construction in creating economies like Thailand could be: *insufficiencies in industry framework* such as supply of assets.

Palestine

A review by Mahamid et al. (2012), Enshassi et al.(2007) on construction projects in Palestine revealed five main sources of delays: *political circumstance*, the division of the West Bank and limited development, *granting a project to the most minimal offer value*, *delay in advance instalments by the proprietor*, and *lack of equipment*.

Malaysia

As indicated by Abdul Kadir et al. (2005), the most critical delay factors were *lack of material, late submission of drawings and poor site management*. Hamzah et al. (2011) highlighted other factors including *labor productivity, material delivery and inflation*.

Nigeria

Material procurements and poor technical support are the two top-positioned issues as indicated by Ogunlana and Olomolaiye (1989). A survey completed by contractors, consultants and owner associations recognized that poor contract administration, *deficiencies in materials*, wrong cost estimation, and *general market fluctuations* were the main sources of delay in Nigeria (Mansfield, 1994).

Iran

Fallahnejad (2013) led a study to distinguish and rank the reasons for delays in gas pipeline construction projects in Iran. In light of responses from 23 consultants in projects executions of oil/gas pipeline projects, 10 most critical reasons for project delay from 44 components were identified which are *imported materials, unrealistic project time, exploration of land, change orders, contractual worker strategies, instalment payments to contractors, getting grants and permits, late conveyance of requested materials, and contractor workers cash flows*.

Ghana

Fugar and Agyakwah-Baah (2010) explored the main ten most imperative components creating delay are: *delay in respecting instalment authentications, underestimation of the cost of activities, underestimation of intricacy of project, trouble in getting to bank credit, poor supervision, lack of materials, increasing in the expense of materials, and poor site administration*. Frimpong et. al. (2003) researched the reason of delay groundwater project from 1970 to 1999 using questionnaire towards

privately and government owned organizations. The consequence of the review uncovered that *cost overruns, scheduled instalment troubles from organizations; poor contractual worker administration; material procurement; and acceleration of material costs* are the fundamental driver of delays.

Saudi Arabia

Saudi Arabia managed to deliver just 31 out of 76 projects on the planned time in the water and sewage construction area between 1985 and 1994 (Danial 2016).

In the Eastern Province of Saudi Arabia it was accounted that 59% of project construction during the time of 1985–90 were delayed Al-Khalil and Al-Ghafly (1999). Assaf and Al-Hejji (2006) found that around 70% of the activities experienced time extension while recognizing 56 primary drivers of delays in Saudi Arabia construction project and their relative significance. From the perspective of the contractors, most vital delay components were: *planning and endorsement of shop drawings, delays in contractual worker's advance, instalment by proprietors and configuration changes*. From the perspective of the draftsmen and designers the *money issues amid development, the connection amongst subcontractors and the moderate basic leadership procedure of the proprietor*.

Vietnam

Vietnam raised its capabilities up in the field of project construction since 2000. It has the historical backdrop of incredible wars, strange equipment and obscure war gear might be found on construction sites. The several and long years of fighting that occurred in Vietnam has rigged their lands all over with war and battle equipment's which is a major cause of *delay in land preparation and site acquisitions* (Assaf and Al hejji 2006).

Lebanon

Mezher and Tawil (1998) led a review on the reasons for delay in project construction industry in Lebanon from the view of proprietors and owners and contractors. It was found that the proprietors had more worries as to *budgetary issues*; contractors emphasized *authoritative relationship* as the most vital, while consultant considered *project management issues* to be the most essential causes for delay.

India

Concentrating on the Indian construction industry, Iyer and Jha (2005) recognized project achievement and failure characteristics and their properties. While the achievement components are for the most part connected to work force and great management practices, disappointment credits are predominately connected to the *cost and time execution* of projects. Based on an interview carried out with 10 Singaporean firms working in the Indian market, Ling and Hoi (2006) reported one of the key components recognized was the prerequisite for *careful planning* and management backup from local experts and *cultural differences*.

Pakistan

Two dam projects were investigated where delays were caused by *changing the design* of the project (expanding the height and width of the dam) brought about a critical increment in the cost of the project according to Danial (2016).

Jordan

While Odeh and Battaineh (2002) specified "*contractual worker experience*" as a vital cause of delays in Jordan, Sweis G., et al. (2008) researched the reasons for delays and did not consider this factor in the same country.

Egypt

According to Marzouk et al (2017), the contractors agreed that the most important cause of delays are in *receiving design documents* needed to start the construction process and the preparation of the *workshop drawing process*, delay in the preparation stage owing to unavailability of resources and inexperienced management. Abd El-Razek et al. (2008) based on importance index and Spearman's rank arrived at a conclusion that distinctive construction stakeholders don't agree on the relative significance of different elements of delays. However, it was deduced that the most critical reasons for delays were *contractual worker's income, instalment by proprietor to contractors, outline changes by proprietor and non-proficient construction workers and contract organization*.

UAE

Construction industry commitment to GDP is evaluated to be 14 percent in UAE, however, according to Faridi and El-Sayegh (2006), more than half of project constructions encounter delays in UAE and are due to *approvals of construction drawings, poor preplanning and slow leadership decision making* and all these delay factors are owner related delays. Mohammed Ruqaishi and Hamdi A. Bashir (2015) researched further UAE construction industry constraints to be *poor site management and poor supervision by contractors, problems with subcontractors, inadequate planning, scheduling of projects by contractors and poor management of contractors' schedules*.

UK

Olawale and Sun (2010) conducted a review in the UK to discover inhibiting factors relates to *time and cost overruns*. In light of a study of 250 construction project organization, the survey announced management strategies of five key hindering components: *plan changes, risk and vulnerabilities, wrong estimation, complexities and non-execution of subcontractors*.

USA

Tafazzoli et al (2017) argued that the main causes of delay are owner collaboration with the construction team, *quality of design*, and *communication among parties*.

Research Methodology

This study utilized a survey questionnaire of UAE construction engineers, consultants and contractors and postgraduate students working in the construction and who are enrolled at the University of Wollongong in Dubai carried out between May 2017 and July 2017 pursuing a higher degree in engineering management. Copies of questionnaires were distributed to potential respondents by hand. A sample of 35 respondents were successfully collected.

The five point Likert scale ranging from 1 (very low importance) to 5 (very high importance) is used to quantify and measure a given response. The level of importance of each factor is established by comparing Relative Importance index (RII) for each of the Factors as follows:

$$Relative\ Index_x = \left(\sum_{i=1}^5 w_i f_{x,i} \right) * \frac{100}{A.n}$$

where:

w_i= weights given to the ith possible response (1=very low to 5= very high)

A= the highest weight (5 in this case); n= the total number of responses.

f_{x,i}=response frequency (number of respondents answering a specified response)

x refers to a specified factor

First, 38 causes of delay identified from researched literature were compiled and grouped into 6 main sources of delays: *External factors; owners; design stage of the project construction; contractors; consultants; and delays due to the project itself.* The items corresponding to each of the 6 dimensions are listed in table 1.

Questionnaire Design

The questionnaire is designed to investigate the major cause of delays in project construction and includes:

- Respondents background information,
- Rating the delays' items from 1 to 5 in total 38 items related to the 6 dimensions as listed in table 1.

Survey Results and Analysis

Sample description

Approximately 52% of the respondents had 2 to 5 years of construction experience, 27% had 5 to 10 years and 14% had 10 to 15 years in the UAE. Approximately 33% of the respondents had performed green field project construction, 14% are involved in rework, and 20% of the respondents had experience in road transportation and hotel constructions and 5% are involved with project construction demolition.

Table 1 shows the ranking results of the respondents' response using the importance index of the 38 survey items representing the major sources of delays.

Table 1 Rankings of the sources of delays based on the survey

Construct	No	Item Scale	Item Relative Importance Index	Item Rank	Factor Relative Importance Index	Factor Rank	Level
External factors (E)	1	Economic and market conditions	0.71	15	0.67	4	Moderate
	2	price instabilities	0.67	19			
	3	Government policies and Changes in legislation employment	0.65	22			
	4	Accidents and unforeseen circumstance	0.81	3			
	5	Opposition of neighboring community	0.41	38			
	6	Inconsistent site condition and difficulty in site acquisition,	0.65	22			
	7	changes in material and labour cost, weather and natural disaster	0.81	3			
Project factors (P)	8	disputes among professionals	0.45	37	0.58	6	Moderate
	9	poor interdisciplinary communication	0.55	35			
	10	complexity of project	0.8	5			
	11	lack of harmony among parties	0.5	36			
Owner factors (O)	12	change orders	0.79	7	0.74	1	High
	13	changes in specifications	0.8	5			
	14	errors and omissions in contract documents	0.75	12			
	15	poorly written contracts	0.65	21			
	16	low price of contracts due to high compensations	0.59	32			
	17	funds payment delays and shortage of funds	0.82	2			
	18	suspension of work	0.77	9			
Design factors (D)	19	improper briefing by clients and miscommunication	0.79	7	0.71	2	High
	20	designs not conforming to statutory regulation	0.62	28			
	21	specifications and drawing inconsistencies	0.75	12			
	22	innappropriate use of design softwares	0.58	33			
	23	lack of design details	0.69	18			
	24	changing designs during construction	0.85	1			
Contractor factors (C)	25	inadequate contractor experience	0.73	14	0.64	5	Moderate
	26	Scheduling and planning problems	0.67	19			
	27	lack of site supervision and slow site clearance	0.6	29			
	28	slow decision making process	0.6	29			
	29	labour shortage and inadequate labour skills	0.63	27			
	30	hiring new professionals	0.56	34			
	31	bad quality of contractors work	0.65	22			
	32	lack of equipment and equipment breakdown	0.7	17			
Consultant factors (S)	33	preparation and approvals of shop drawings	0.64	26	0.69	3	High
	34	delays in approval of major changes	0.71	16			
	35	poor communication between parties	0.6	29			
	36	lack of consultant experience	0.65	22			
	37	planning errors and accidents	0.77	9			
	38	estimating errors and scheduling errors	0.75	11			

The survey analysis reveal the following: The first major cause of delay is due to the *change in design* (RII=0.85) The major delay cause by owner is due to *changes orders* (RII=0.82). The major delay cause by external factors is due to *accidents and unforeseen circumstances* (RII=0.81) and *changes in labor cost* (RII=0.81). The major delay cause by project related factors is *complexity of project* (RII=0.80). The major delay cause by consultant related factor is *planning errors* (RII=0.77). None of the

delays related to contractor is ranked among the top 20.

The Survey Analysis of the Source by averaging the RII's of each construct shows that the riskiest source of delays comes from *owner (O)* followed by *design factors(D)* and the least risky source of delays comes from the *execution of the project (P)*.

Ranking major sources of delays as a function of working Experience

Further, the analysis included whether there is any significant difference in responses between those with less than 5 years' experience compared to those with more than 5 years of experience. Table 2 displays the top ranking sources of delays from the two groups of respondents. The spearman correlation of the 38 items rankings between the two groups reveals a weak correlation of 0.361.

Rank	Respondent < 5 years of working experience	Respondent ≥ 5 years of working experience
1	Government policies changes in legislation (E)	Complexity of projects (P)
2	Suspension of work (O)	Owner change orders (O)
3	Changes in materials and labour cost (E)	Changing design during construction (D)
4	Shortage of funds (O)	Changes in specification (O)
5	Accidents unforeseen circumstances (E)	Design improper briefing by clients (D)

From perspective of construction engineers with less than five years of construction, 3 delay items are related to the *External*, and 2 items are related to *Owner*. Whereas for the case of those respondents with more than five years working experience, two items are reacted to *External* and one to *Owner* and the others are *Design and Project* related.

Comparing rankings of similar study in the UAE with this Study

E.K Zaneldin (2006) in his study identified 26 roots of delays affecting project construction in UAE. Comparing the rankings of his study to ours, reveal some degree of consistency as shown in table 3. Both findings support that the major source of delays stem from the Owner factors (either because of shortage in capital and low bid contracts) and changes requested during the construction.

Rank	Causes of delays in UAE by E.K Zaneldin (2006)	Causes of delays in UAE by this study
1	Change or variation orders (O)	Changing in design during construction (D)
2	Delays caused by owners O)	Owners shortage of funds and slow decision making (O)
3	Changes by owners (O)	Changes in material and labor cost
4	Delay in payments by owners (O)	Owners changes in specifications (O)
5	Low price of contract due to competition (O)	Improper briefing by clients (D)

Limitations

While this review is among the few to give a full test of comparison between several researches on project construction, it is however limited by sample size as not many people targeted had responded. Another major limitation is the fact that large number of the participants had less than 5 years of construction experience. In the future SurveyMonkey will be used for

survey data collection. The tool is a trusted online medium allowing to survey targeted respondents electronically.

Conclusion and recommendations

Construction delay and time overrun is a serious issue in project construction. Many studies have developed interest in construction research but still major causes of delays are not well identified. Though, based on our literature review, there is a quite rich available research done worldwide but very few studies are done in the UAE. This study can be utilized to identify several issues in the project construction process in UAE. In the UAE *changes in design during construction, change orders, changes in material costs and changes in owner specification* ranked top as a source of delays. Most of the participants believe that *changes in materials and labor cost, complexity of the project, owner change orders and improper briefing by clients* are also top factors causing delays in the UAE. The reasons behind projects' delays are not common across countries, our findings revealed that certain high ranked factors in UAE are different from those in KSA construction projects .

Our recommendations that will help the UAE construction experts in limiting construction delays:

- Involve at the start of the project the project owner in the design process with a clear cost estimation.
- Give enough time for the design engineers to come up and complete drawing.
- Create an efficient quality control method that can be utilized during design processes to alleviate errors and discrepancies.
- A proper human resource management will help improve productivity at the same time labor skills
- There should be a proper incorporation of requirements for scheduling by the owners.
- Inflation can be described as the major cause of equipment and material cost. There should be a way prices to be adjusted.

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