

Investigation on Reasons of Delay on Construction Projects in Khartoum State

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Received:03/05/2021

Accepted: 07/07/2021

ABSTRACT: The purpose of this study is to investigate and analyze the reasons of construction project delays in Khartoum State, Sudan, as well as the negative consequences of these delays and how to mitigate them. A questionnaire with 96 companies active in the construction industry was created for this objective the SPSS application was used to examine the data. The analysis concluded that the most significant causes of delay were contractors' financial difficulties, suppliers' or subcontractors' late payments, poor site management and supervision. The most serious consequences of the delay were time and expense overruns. Competent project managers, awarding bids to the right/experienced consultant and contractor, and proper project planning and scheduling were found to be the most effective methods for reducing construction delays. The paper offered multiple recommendations and solutions that serve as a guide for the project's various partners in order to ensure successful project management.

Keywords: *Delays; Effects; Minimizing; Project; Construction; contractor; Consultant; Client.*

المستخلص: تهدف هذه الورقة الى التحري عن أسباب تأخر مشروعات التشييد والاثار السلبية المترتبة على ذلك وطرق التقليل منها وذلك لمشاريع التشييد في ولاية الخرطوم بالسودان. من اجل ذلك تم تصميم استبيان شمل 96 شركة عاملة في مجال التشييد. تم تحليل المعلومات باستخدام برنامج SPSS. كانت أهم أسباب التأخير هي: الصعوبات المالية للمقاولين، وتأخير مدفوعات الموردين أو المقاولين من الباطن، وسوء إدارة الموقع والإشراف عليه. كانت أكثر الآثار السلبية للتأخير هي تجاوز الوقت وتجاوز التكلفة. وقد لوحظ أن اهم طرق تقليل تأخير البناء كانت: استخدام مدير مشروع مختص، ومنح العطاءات للمستشار والمقاول المناسب، والتخطيط والجدولة الجيدة للمشروع. شملت الورقة عدة مقترحات وحلول تصلح كدليل لأطراف المشروع المختلفة من أجل ادارة فعالة بغية انجاز المشاريع بنجاح.

INTRODUCTION

The construction business is one of the primary areas that contribute significantly to the growth of an economy. However, many projects incur significant delays, causing them to surpass their initial time and cost forecast ^[1].

A construction project delay is defined as "the time overrun either beyond the completion date stipulated in a contract or beyond the date agreed upon by the parties for project delivery." It is also a project that is running behind schedule, which is a regular issue in building project ^[3].

Delays in construction projects are one of the most typical issues, creating a slew of negative consequences for the project and its participants. As a result, identifying the underlying reasons of delay is critical in order to minimize and avoid delays and their associated cost ^[4].

Even when plans are meticulously developed, uncertainties and unforeseen events arise throughout project execution. Often, such incidents cause delays that have a negative impact on the project's execution and performance ^[10].

Construction project delays are a common occurrence. Almost always, they are accompanied with cost and time overruns. Construction project delays have a negative impact on contract parties (owner, contractor, consultant) in the form of increased combative relationships, distrust, litigation, arbitration, cash-flow issues, and a general sense of fear towards each other. As a result, defining the actual reasons of delay is critical in order to minimize and eliminate delays in any construction project ^[7].

When a building project is delayed, all stakeholders (even final users) may suffer. As a

result, defining the actual reasons of delays is critical in order to minimize and avoid delays in any construction project. It is critical that general management monitor project development in order to reduce the potential of delays ^[8].

Aims and Objectives of the Paper

The purpose of this article is to look into the key causes of delays, the effects of delays, and techniques for reducing delays in building projects in Khartoum State, Sudan. The following objectives have been identified to achieve these goals:

List and rate the root causes of construction project delays in Khartoum state.

Compare the causes of delay from the perspectives of contractors and consultants.

Assess the impact and repercussions of delays on time overrun, cost overrun, arbitration, disagreement, total abandonment, and digitation from the perspective of contractors and consultants.

Problem statement

Construction projects can be delayed for a variety of reasons, and delays can have a considerable impact on the overall cost and timeliness of the project, as well as other negative consequences. Any deviations from the project objectives will almost probably add to project delays, with the resulting negative effects on project goals

When the causes of delays are identified, they can be minimized. Knowing the causes of any specific delays in building projects will aid in their .avoidance

This article intends to investigate the following issues:

What are the key causes of construction delays in Khartoum State-Sudan constructions projects?
What impact do these delays have on achieving successful construction management goals in Khartoum State, Sudan?

LITERATURE REVIEW

Delay causes in construction can be defined as events that occur during the project's life that cause the project, or any element of it, to take longer to complete than the original estimate. During the usual management process, one or more partners in the construction project can identify and document this delay. This is a direct delay that can be used to support claims from any side. There are underlying issues that may

contribute to the delay. These are the underlying causes of project delays ^[5].

Many scholars have investigated and identified the causes of building project delays. Mezher and Tawil (1998)^[6] undertook a review of the reasons of building delays in Lebanon, Owners were found to be more concerned with financial issues, contractors with contractual relationships, and consultants with project management issues as the most significant reasons of delays ^[12].

The success of building projects is largely determined by the achievement of the objectives outlined in the project specifications ^[11].

A successful project is completed in accordance with the pre-defined execution time, the project budget, and the quality demanded by the client, all while maintaining the workforce's safety ^[9].

For example, Assaf et al. (1995)^[5] investigated the causes of delays in large building construction projects in Saudi Arabia; they discovered that the most important causes of delay were the approval of shop drawings, delays in payment to contractors and the resulting cash problems during construction, design changes, conflicts in subcontractors' work schedules, slow decision making, and bureaucratic red tape.

According to the study, there are numerous causes of delay, including shop drawing approval, contractor payment delays, design changes, disputes in subcontractor work schedules, labor shortages and insufficient labor skills, and cash problems during construction ^[13].

Many studies have been conducted and techniques for reducing building project delays have been offered. Nguyen et al. (2004)^[2] identified five critical success factors that could be used to mitigate the effects of delays, which include a competent project manager, adequate funding until project completion, a multidisciplinary/competent project team, commitment to projects, and the availability of resources ^[10].

According to Al Saadi et al., the most significant causes of delay in each category are 'changes in project scope,' 'lack of communication between parties,' 'shortage of skilled labor,' 'mistakes during building,' and 'insufficient data gathering and survey before designing' ^[2].

According to Jamal M. (2016) ^[3], the major causes of delays in private projects in Jordan are a lack of manpower (skilled, semiskilled, and unskilled labor), a delay in the approval of contractor

submissions by the engineer, a lack of materials, and a relationship between the schedules of different subcontractors [6].

According to Ghanim, A.B (2015) [7], the most effective delay factors influencing time overruns in public projects in Iraq are: security measures, government changes in regulations and bureaucracy, official and non-official holidays, low performance of lowest bidder contractors in the government tendering system, design and changes by owner, design changes by consultants, and delay in progress.

Pujitha. D. et al [8] discover that labor is the most common reason of delay in Sri Lankan building construction projects, followed by contractor and material, while consultant and external linked causes are less prominent. Both the client and the contractor identified labor-related issues as potential sources of delay.

However, according to the expert, the majority of construction delays are caused by material, contractor, and labor issues. Working permit issues, conflicts in sub-contractor schedules, labor shortages, personal conflicts among labors, difficulties in financing project by contractor, delay in progress payments by client, delay in furnishing and delivering the site, frequent change of sub-contractors are the major causes of delay.

RESEARCH METHODOLOGY

The primary data was gained through surveys, while the secondary data was gleaned from the literature. Furthermore, this paper discusses the various components of the questionnaires. The approach adopted for this study included a thorough literature review, a questionnaire survey of construction project stakeholders in Khartoum, Sudan, and a statistical analysis of the survey results (SPSS).

To achieve the research objectives, information about the causes of delays, the impacts of delays, and ways for minimizing delays was acquired from various sources, and the following steps were taken.

- A thorough review of the literature.
- Survey Questionnaire
- Compilation of data from the questionnaire survey.
- Sorting and arranging the preceding data

- Using a statistical program (SPSS), I analyzed the data to determine the mean, standard deviation, variance, and so on.

Questionnaire Design:

The questionnaire was built around aspects that recognized and contributed to the causes of delays, the effects of delays, and the ways for minimizing delays. A questionnaire survey was created to measure the relative relevance of the causes and impacts of construction delays among contractors and consultants. The questionnaires are divided into sections, as shown below:

Section A: Company and Respondent Profile;

Section B: Causes of Construction Delays;

Section C: Effects of Construction Delays

Section D: Methods of minimizing construction delays.

Section A: Company and Respondent Profile

This area is used to gather information about the firm as well as the respondents. It contains the following items:

The respondent organization or company;

The position of the respondent in the company;

The experience of the respondent in the construction project;

The experience of the company in construction industry.

TABLE 1:THE FREQUENCY DISTRIBUTION FOR THE STUDY RESPONDENTS ACCORDING TO THE COMPANY TYPE

Company type	Number	Percent
Consultant	50	52.1
Contractors	46	47.9
Total	96	100.0

TABLE 2 :THE FREQUENCY DISTRIBUTION FOR THE STUDY RESPONDENTS ACCORDING TO THE POSITION IN THE COMPANY

Position	Number	Percent
Director	35	36.5
Site Manager	8	8.3
Project Manager	40	41.7
Engineer/Designer	13	13.5
Total	96	100.0

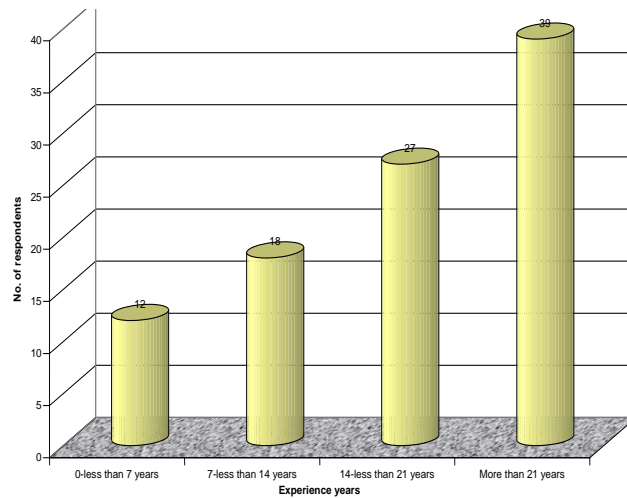


Fig 2 : The frequency distribution for the study respondents according to the experience years in Construction field

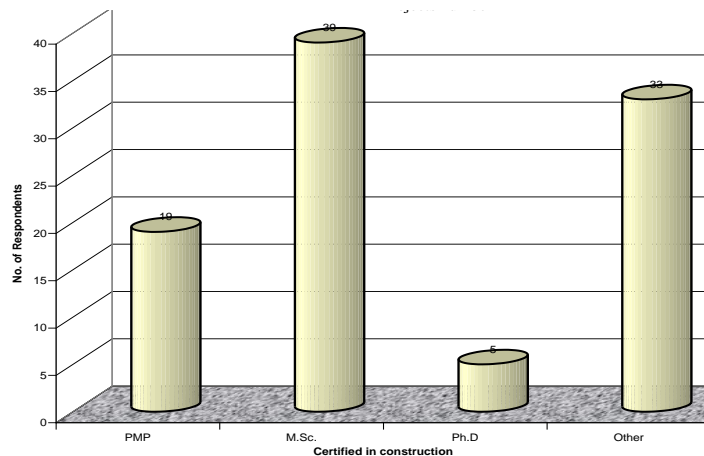


Fig 2 :The frequency distribution for the study respondents according to the certified in construction

Section B: Causes of Construction Delays

The purpose of this section is to gather information from the preceding literature review about the factors that contribute to the causes of construction delays. There are eight kinds of causes for delays in building projects, which encompass sixty aspects of delays. The questionnaire is primarily based on a Likert scale of five ordinal measurements ranging from 1 to 5 based on level of contribution. Each scale represents a different rating:

- (5) * Very high contribution;
- (4) * High contribution;
- (3) * Medium contribution;
- (2) * Low contribution; and
- (1) * Very low contribution.

Section C: Effects of Construction Delays

Respondents were asked to assess the individual effects of construction delays depending on frequency of occurrence, based on their personal judgment and work experience, for this part. In building projects, six impacts were identified: time overrun, cost overrun, dispute, arbitration, litigation, and total abandonment. The questionnaire is primarily based on a Likert scale of five ordinal measurements ranging from 1 to 5 based on level of contribution. Each scale represents a different rating:

- (5) * Always;
- (4) * Mostly;
- (3) * Sometimes;
- (2) * Seldom; and
- (1) * Never.

TABLE 3: THE STATISTICAL RELIABILITY AND VALIDITY OF THE PRE-TEST SAMPLE ABOUT THE STUDY QUESTIONNAIRE

Section	Reliability	Validity
B	0.74	0.86
C	0.80	0.89
D	0.77	0.88
Overall questionnaire	0.72	0.85

Questionnaire Distribution:

The prepared questionnaire forms were given to a select group of 100 respondents. About fifty sets are distributed to contractors chosen at random from a list of construction companies in Khartoum, Sudan, and fifty sets are distributed to consultants chosen at random from a list of the Organizing Council for Consultancy Firms in Khartoum, Sudan.

Data Analysis

The goal of this data study was to evaluate the relative relevance of the numerous components that contribute to construction delay causes, impacts, and techniques of construction delay correction. The data analysis process is divided into three steps:

1. Calculating the relative importance index (RII).
2. Ranking of factors in each category based on relative importance index.
3. Assess the degree of correlation between the two groups in terms of rating the criteria.

Relative Important Index

According to Odeh and Battaineh (2002), the Relative Importance Index (RII) was calculated to establish the ranking of several elements from the perspective of contractors and consultants.

$$RII = (\sum W_i) / \sum X_i \quad (1)$$

Where:

I = response category index = 1,2,3,4, and 5 for: Section B: Very high contribution, High contribution, medium contribution, Low contribution, and very low contribution, respectively; and Section C: Always, Mostly, Sometimes, Seldom, and Never frequency, respectively; and (Section D: Very high effect, High effect, medium effect, Low effect, and very low effect respectively); W_i = The weight assigned to i^{th} response = 1, 2, 3, 4, 5, respectively, X_i = Frequency of the i^{th} response given as percentage of the total responses for each factor.

The Spearman’s Rank Correlation Coefficient Test

The Spearman’s Rank correlation coefficient is a measure of association between two groups of respondents, in this case, and the variables were measured on an ordinal scale. To establish whether there is a significant correlation between the ranking of elements that cause delays, the effects of delays, and strategies of minimizing construction delays from the perspective of contractors and consultants, the Spearman’s Rank correlation coefficient was obtained as follows:

$$r_s = 1 - (6 \sum d^2) / N(N^2 - 1) \quad (2)$$

where:

r_s = Spearman’s rank correlation coefficient; d = the difference in ranking between the contractors and consultants; and N = the number of variables, respectively. The association between the ranking of contractors and consultants is verified by a hypothesis testing at 95% significance where $Z = r_s * \text{square root } (N - 1)$.

A hypothesis test is required to determine whether the two groups are in agreement or disagreement on ranking factors. The null hypothesis is: H_0 : There is no major agreement in the ranks between the two groups. Hypothesis alternative: H_1 : Ranking agreement between the two groups.

DATA ANALYSIS RESULTS AND DISCUSSIONS

Causes of delays sub-groups

Sixty reasons of delays were identified and divided into eight sub-groups, as shown below:

- Contractor-related organization (9 causes)
- Client-focused group (8 causes)
- Consultant-related organization (6 causes)
- Materials-related organization (8 causes)
- Labor-related organization (8 causes)
- Equipment-related sub-group (7 causes)
- Financially oriented group (7 causes)
- External environmental group (7 causes)

Causes of Delays Groups

Based on data analysis, a total of sixty elements of delay causes were divided into eight sub-groups. As shown in Tables 4 and 5, the sub-groups were sorted between two groups of respondents: contractors and consultants.

TABLE 4 : THE RESULTS OF MAJOR DELAYS GROUPS

No	Factors	Consultant		Contractors		Overall	
		RII	Rank	RII	Rank	Mean	Rank
1	Contractors	0.71	1	0.76	3	3.75	1
2	External environment	0.69	3	0.80	1	3.74	2
3	Labours	0.67	5	0.78	2	3.63	3
4	Materials	0.68	4	0.71	5	3.49	4
5	Consultant	0.70	2	0.67	8	3.46	5
6	Equipments	0.61	7	0.72	4	3.34	6
7	Finance	0.62	6	0.69	6	3.27	7
8	Client	0.58	8	0.68	7	3.1	8

TABLE 5: RANKING OF TOP TEN FACTORS THAT CAUSES DELAYS

No	Effect	Consultant	Contractors	Sub-Group	Over all	
		RII	RII		Mean	Rank
1	Contractors' financial difficulties.	0.89	0.81	Financial	4.25	1
2	Delay payments of suppliers or subcontractors.	0.90	0.79	Financial	4.23	2
3	Poor site management and supervision.	0.86	0.73	Contractor	4.14	3
4	Inaccurate time estimate.	0.85	0.78	Contractor	4.08	4
5	Inaccurate cost estimate.	0.84	0.77	Contractor	4.03	5
6	Frequent equipment breakdown.	0.92	0.75	Equipments	3.97	6
7	Delay in progress payments by owner.	0.76	0.79	Client	3.88	7
8	Labor productivity.	0.71	0.83	Labor	3.85	8
9	Escalation of material prices.	0.71	0.82	Materials	3.82	9
10	Improper project planning and scheduling.	0.77	0.75	Contractor	3.80	10

Ranking of Top Ten

Factors that Cause Delay

The most essential components that contribute to the causes of delays were identified through analysis. Table 5 shows the top twenty factors that were determined.

Result of Effects of Delays

As indicated in Table 6, six significant consequences of delays were identified as the preliminary inquiry based on a literature review and some interviews with practitioners.

DISCUSSION

Main factors of delays

The purpose of this report is to identify, assess, and categorize the reasons of project delays in the Khartoum construction industry into eight primary groupings (contractor, consultant, client, material, equipment, financial, labours, and external). These identification and assessment are done out using primary and secondary data gathering methods, as well as statistical approaches for validation.

It was feasible to evaluate the most important sources of delays that influenced project duration based on the ranking of the causes of delays. To that end, the RII of the sixty factors that contributed to the causes of delays in construction

projects were identified, ranked, and analyzed in order to identify the most important factors that contribute to the causes of delays. Analysis was performed to determine the top ten factors of overall ranking factors that cause delays, as shown in Table 5.

Table 5 shows that financial difficulties of the contractor, late payments of suppliers or subcontractors, frequent equipment breakdown, inaccurate time estimate, and inaccurate cost estimate were among the top five most important factors that contributed to the causes of construction project delays in Khartoum State.

TABLE 6 :THE RESULT OF RANKING OF EFFECTS OF DELAYS

No	Effects	Consul tant	Contract or	Over all	
		RII	RII	Mea n	Ran k
1	Time overruns.	0.82	0.76	3.95	1
2	Cost overrun	0.80	0.78	3.92	2
3	Dispute.	0.73	0.60	3.33	3
4	Total Abandon	0.56	0.54	2.75	4
5	Arbitration	0.57	0.50	2.68	5
6	Litigation.	0.53	0.46	2.48	6

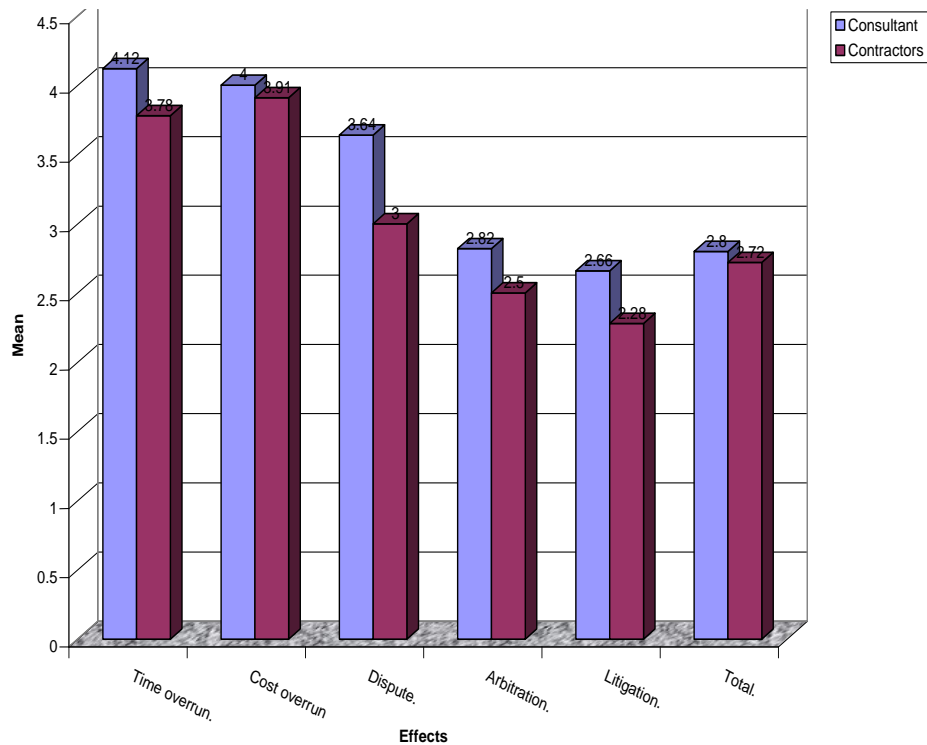


Fig. 3: Compare between Consultant and Contractors in Effects of delays

TABLE 7 :THE RESULT OF EFFECTS OF DELAYS

No	Effect	Consultant		Contractor		Spearmans Rank Coeff, $r_{h_0}(rs)$
		RII	Rank	RII	Rank	
1	Time overruns.	0.82	1	0.76	2	$r_s = 0.886$ P-value= 0.019 Thus H_o Reject
2	Cost overrun	0.80	2	0.78	1	
3	Dispute.	0.73	3	0.60	3	
4	Arbitration.	0.57	4	0.50	5	
5	Litigation.	0.53	6	0.46	6	
6	Total abandonment.	0.56	5	0.54	4	

Poor site management and supervision, owner delays in progress payments, labor productivity, material price escalation, and incorrect project planning and scheduling are among the top 10 issues ranked by both groups.

There are four contractor-related delays, two financial-related delays, and one customer, material, labor, and equipment-related delay among the top ten variables.

According to Table 5, eight factors fall under the category of non-excusable delays, namely, contractors' financial difficulties, late payments of suppliers or subcontractors, poor site management and supervision, inaccurate time estimate, inaccurate cost estimate, frequent equipment breakdown, labor productivity, and improper

project planning. and two elements fit under the category of excusable delays with compensation, namely, owner delay in progress payments and material price inflation.

Effects of Delay

As indicated in Table (1), six factors with negative effects were found and graded based on the mean value, which calculates the average indices of factors between contractor and consultant (6).

Time overrun and cost overrun were the most typical negative effects of delays in building projects in -Khartoum state-Sudan- from the perspective of the contractor and consultant, according to Table 6 and Fig 3.

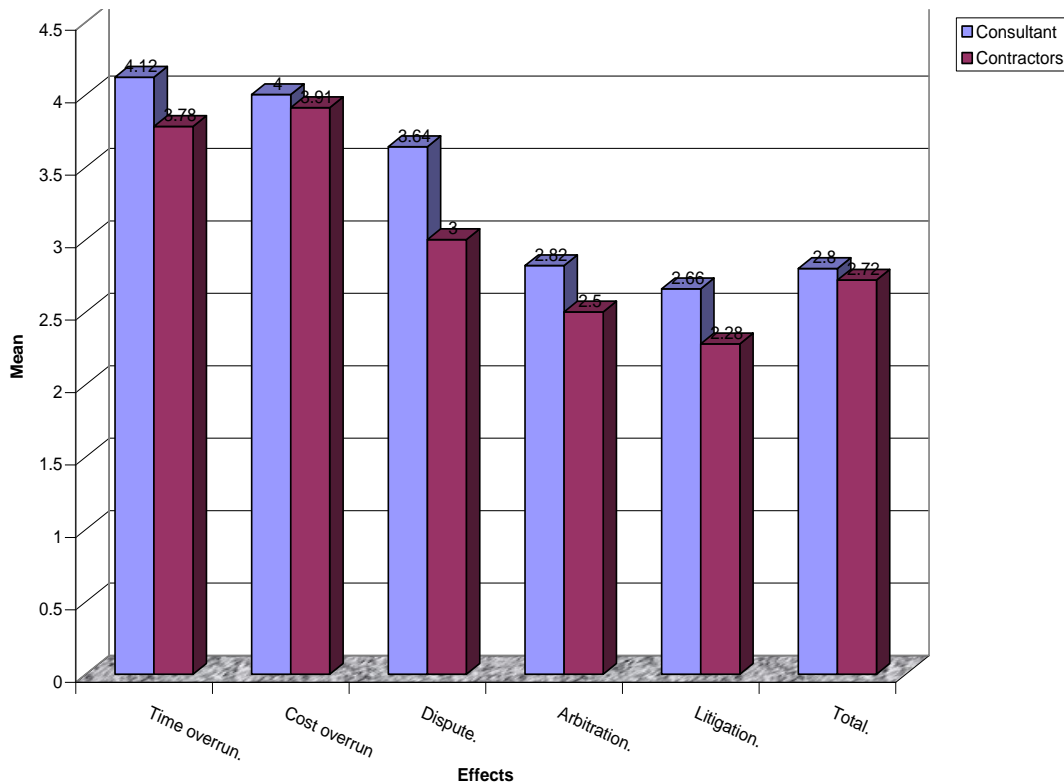


Fig 4 : Compare between Consultant and Contractors in Effects

Dispute was rated third, as seen in Table 6 and Figure 3. This is especially true because the three factors that cause delays discussed above that have a high influence on the causes of dispute, namely factors of incomplete drawing/detail design, poor design, design delay, and unforeseen ground condition, are not among the top ten most important factors that contribute to the causes of delays.

One of the most important things in preventing conflicts and lawsuits is to verify that the design is complete in all aspects before beginning construction work. Another aspect that can help to limit claims and disputes is adequate and well-conducted site investigations. Unforeseen situations may be detrimental to the overall project's aims if they are discovered at a late stage.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

This paper's aims have been met in three ways. The first was a listing and ranking of the root causes of construction project delays in Khartoum state, the second was a comparison of the causes of delay from contractors and consultants' perspectives, and the third was a gauging of the impact and effects of delays on time overrun, cost

overrun, arbitration, dispute, litigation, and total abandonment, from contractors and consultants' perspectives.

Major causes of construction delays

It may be stated that delays occur in Khartoum state construction projects, and the main variables driving construction delays are financial and contractor-related concerns. The main causes of construction delays in Khartoum state are financial challenges, such as contractor financial difficulties and supplier or subcontractor payment delays. Contractor-related factors include three of the top five reasons that cause delays: poor site management and supervision, inaccurate time estimates, and inaccurate cost estimates. Contractor-related sub-group delays were regarded as the most significant cause of delays among all sub-groups.

Negative Effects of construction delays

Building delays are a big problem in the Khartoum state construction industry, resulting in six major negative repercussions on a project: time overrun, cost overrun, dispute, arbitration, lawsuit, and ultimate abandonment. According to the findings of the questionnaire data analysis, the two most common negative effects of delays in construction

projects in Khartoum state were time overrun and cost overrun.

RECOMMENDATIONS

Based on the findings and conclusions of this research, the following solutions are made to aid in the avoidance of construction project delays and the enhancement of construction project delivery within the specified time frame:

1- Contractors must be able to oversee site activities for the efficient execution of work, plan their job well and offer the whole schedule to consultants/clients, and have a solid financial backing with strong communication and coordination with the other project partners.

2- Contractors who are significant project partners must also improve their management capabilities through training in order to complete projects on schedule. They must assist their personnel by offering resources for efficient project management on their various project sites.

3-It is advised that the consultants be experienced and qualified in order to provide appropriate training at the right moment, answer any contractor inquiries, and prevent any dispute between other parties in order to avoid time and expense overruns.

4- Clients should provide appropriate cash flow and regular contractor payments to avoid work suspension, which is a major factor influencing time overrun.

5 -Client payment delays have almost become the norm in Khartoum state projects. Insurance firms can view this as a potential danger and tailor a product to meet the needs of the situation. The writer believes that these insurance plans can address non-payment difficulties and ensure contractors' cash flow for timely project delivery.

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