

## **Delay Factors Impacting Construction Projects in Sana'a-Yemen<sup>1</sup>**

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### **ABSTRACT**

In Yemen the delay in the implementation of construction projects has become a widespread phenomenon, especially in public projects This research intends to identify the most significant factors causing delay in construction projects in Sana'a- Yemen. A survey questionnaire was structured and distributed to architectural and structural engineers who were working in construction projects. The questionnaire included of 32 predefined causes, which were grouped into five major factors, managerial, financial, technical, materials & equipment and external factors. The relative importance index (RII) was determined and the causes were ranked within their groups and overall. The results showed that the group of financial factors ranked first among the five groups. The top five factors causing delay of construction projects in Sana'a - Yemen: (1) delay in receiving progress payments by contractors, (2) financial difficulties faced by clients, (3) inadequate experience of contractor/ consultants, (4) poor site management and supervision, and Lack of sufficient cash for project implementation, and (5) lack of sufficient cash for project implementation. This study highlights the importance of acknowledging the most significant factors and their causes leading to the delay overarching issues in order to achieve a successful implementation of construction projects.

**Keywords:** *Construction, Delay factors, Construction Projects, RII, Sana'a, Yemen*

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## INTRODUCTION

Construction industry is considered to be a major contributor as well as an integral ingredient of the development of economies especially developing ones, yet many construction projects experience extensive delays as well as a noticeable stumbling and thereby exceeds the projects' initial time and cost estimated (Hussin et al., 2017). Moreover, as construction projects get larger and more complex, clients are also increasingly demanding higher standards whenever it comes to their preferences of the products and services provided in the world of the real-estate (Chan et al., 2004). Meanwhile, cost, time, and quality have increasingly become the main features of competition in the business world. According to Hoonakker et al., (2010) rapid growth and competitiveness have made the industries and organizations throughout the world adapt "Quality" as a strategic weapon for market share, profitability enhancer of their organizations, and clients' sophisticated specifications fulfiller. Despite well-known research findings and decades of individuals and team expertise of project management, construction project outcomes continue disappointing the projects stakeholders (Bodicha, 2015).

According to previous studies, construction delay is not a local fact in Yemen only, but an international reality that often results in time overrun, cost overrun, disputes, litigation, and complete abandonment of projects (Fugar&Agyakwah-Baah, 2010). What is more, both public and private sectors' infrastructure investment in developing countries has been unstable over the last decade, with perennial infrastructure gap of USD 31 billion per year (Asante, 2014). This seeming instability in infrastructure delivery has been largely attributed to the obvious delays in project delivery (Fugar et al., 2010), which in most cases result in woefully construction cost and time escalations and, thus, to the projects failure. The failure of some projects and the complete shutdown of others indicate that there are also many hidden factors behind such scenarios in specific stages; even sometimes at the very beginning, some of which are project-related factor, project managerial factor, recourses-related factor, and external factor (Nallathiga et al., 2012).

Thus, an in-depth scan through the previous literatures shows a convergence in the causes of construction projects' delay in both developed and developing countries (Asante, 2014). Recent studies provided a comprehensive list of project delay factors, and they were expounded in terms of project factor, managerial factor, human factor, technical factor, materials and equipment factors, financial factor, and external factor (Desai &Desale, 2013; Doloï et al., 2012; Hasan et al., 2014).

Despite the fact that the three attributes in the so-called Iron Triangle which are cost, time, and quality are essential criteria for projects' success Hughes et al.,(2017) especially those characterized by having a high level of complexity, increased uncertainty and unlimited diversity, construction projects in Yemen are unfortunately stumbled and often beset with severe problems (Sultan, 2013; and Alaghbari et al., 2017).

The previous studies by (Sultan, 2005; Al-Seraji, 2010; Al-Fadhali, et al., 2016; Al-Fadhali, et al., 2018; Sultan and Alaghbari, 2017; Alaghbari, et al., 2017; Almaktar, et al., 2017; Al-Yousfi, 2018; Al-Sabahi, et al., 2014) indicated the problems of construction projects in Yemen, including delays and / or non-completion of projects. There is a remarkable gap between the construction needs and the domestic resources, which in turn result in complete failure to meet the increasing and the required demands. In addition, like other developing countries, the construction sector in Yemen is undeveloped where there is a remarkable gap between the construction needs and the domestic resources, which in turn result in complete failure to meet the increasing and the required demands.

The delay in the implementation of construction projects has become a widespread phenomenon, especially in public projects. The unstable status of Yemen raises atmosphere of frustrated expectations. The construction industry in Yemen is facing difficult economic and technical problems of low productivity, management difficulties, delays and excessive costs. The political instability and the civil war has negative direct flow-on effect on the national economy and the nation's socio-economic development (Sultan and Alaghbari 2017). According Alaghbari& Sultan (2015) and the construction industry in Yemen experiences project delays. This is also supported by Sultan (2005) who emphasized that construction projects in Yemen suffer from delays. Besides, Al-Seraji (2010) found that 91% of building projects experience delays. Due to such delays, contractors incur much costs and thus their profits decrease. In addition, this is confirmed by Issa et al., (2015) who reported that there are many large construction projects in Yemen, which suffer delays in project completion or in some cases suffer suspension or abandonment.

Consequently, This research is to identify factors causing delay of construction projects in order to bring them up to the surface, shed light on their impact and highlight their critical contribution to these overarching issues so to achieve a successful projects' implementation.

## **CONSTRUCTION INDUSTRY**

Mostly, construction industry is by default an intricate, fragmented, diversified and schedule driven sector that involves many stakeholders with potential challenges (Gamil et al.,2017). Considered as a source of concern to both public and private sector clients, this industry in many parts of the world suffers from countless problems such as workmanship defects, time and cost overrun, poor quality, ...etc (Enshassi, et al.,2009).

Over the past decades, there has been no full agreement on the term "construction industry" which indicates that this term comprises a wide spectrum of multi-aspects. Consequently, from numerous reviewed studies, the construction industry is a highly dynamic sector that occupies a very

important position in the development of a country as well as a growing industry all over the world. It is a key contributor in the economy that generates both, employment and wealth (Sunjka& Jacob, 2013; Mahamid, 2013; Hwang & Leong, 2013; Behm, 2008).

Many studies have highlighted the essential contribution of the construction industry to national economic development. Some of those studies argued that the extent of the construction industry contribution is always obscure and others found out that the economy construction industry plays a vital role, which can be used as a regulator. Nonetheless, some tend to be different with their argument by assuming that the contribution is limited to be short term. There are also those who argued that it is the economic growth that drives the construction industry not otherwise (Ofori, 2015; Sultan, 2005; Sultan & Alaghbari, 2017; Alaghbari *et al.*, 2017).

### **Construction Industry in Yemen**

The construction projects in Yemen are drastically undergoing a high risk prone, due to their intricate and dynamic environments. Consequently, such nature gives rise to an atmosphere of high probability and risks (Ahmad *et al.*, 2013; Issa *et al.*, 2015).

The construction projects in Yemen have represented the fourth largest employer of the workforce in the country, between to 9 and 10% of the working inhabitants, the average yearly increase rate of the sector is almost 5.4%, effectively contributing to the economic development in Yemen. With the comparatively large volume of investments currently in this sector as well as a probable increase in foreign funding from World Bank and other donor agencies for developmental projects, the demand for services in this sector is bonded to increment steadily (Ahmed *et al.*, 2013; Al-Sabahi *et al.* 2014).

According to CIA World Fact Book, (2017), Yemen is a low-income country that faces difficult long-term challenges to stabilizing and growing its economy especially since the beginning of the current conflict that ensued the ongoing war against the country that commenced in 2015 and has aggravated those issues. Furthermore, as the case for most developing countries, Sultan, (2013) assumed that there are many serious problems associated with the construction industry in Yemen as he believes that there is a dire need for improved construction techniques, management practices and legislative reforms.

### **Delay in Construction Project**

In construction, delay is considered as one of the unfavourable cases in the construction industry; it has a negative effect on the project success in terms of quality, cost and time. According to Alaghbari *et al.*, (2007) "a standout amongst the most critical issues in the construction industry is delays". They further indicated that, delay is one of the most critical and complex challenges

found in construction projects. In addition to that, they presumed that, delays occur in every construction project and the huge impact of these delays varies considerably from project to another. Some projects are only a few days behind schedule; some are delayed by over a year. Hence, to demonstrate deeply the adverse effect of delay issues on the project in terms of time overrun, cost overrun and poor quality, below are selected reviews which present some data concerning these three aspects;

### ***Time Overrun***

Sunjka et al., (2013) have suggested that if there is time extension added to the original deadline of the completion of a project, the project is believed to have undergone time overrun. From their side Al-Ageeli et al., (2016) found that time overrun leads to making an extension in the project deadline, which means additional cost, additional administrative work and delay in the province of services to the building users. To illustrate, a survey conducted by Al-Momani, (2000) in Jordan on 130 public projects came up the finding that delays occurred in 106 (82%) of the projects.

### ***Cost Overrun***

As pointed out by Azhar et al., (2008) cost is a major aspect that is taken in account through the construction process, yet many projects fail to complete the project within the cost range assumed initially. In Al-Hazim, (2015), cost overrun is defined as a cost increase or budget overrun, which involves unexpected cost incurred in excess of the budget amount due to the underestimation of the actual cost budgeting of the undertaken project.

### ***Poor Quality***

Currently, because construction projects are becoming larger in scale and more intricate, clients always demand higher specifications to be established in the products and services provided in the real-estate area. Therefore, quality has always been demanded as a major feature of competition in the business world (Hoonakker et al., 2010).

### **Types of Delay**

According to Alaghbari, (2005) and Alaghbari et al., (2007) delay is categorized into four types: 1- Excusable non-compensable delays. 2- Non- excusable delays. 3- Excusable compensable delays. 4- Concurrent delays. Whereas Dinakar, (2014) has categorized it into three types: 1- Critical and noncritical. 2- Excusable and Non-excusable 3- Compensable and non-compensable. However, Hamzah et al., (2011) have categorized delay types into two types: 1- non-excusable delays 2- excusable delays. Briefly, excusable non-compensable delays are those, which are beyond the control of both the owner and the contractor. Excusable compensable delays are delays

caused by the project owner (client). Non-excusable delays are those that are the responsibility of the contractor. Concurrent delays are those caused by both the owner and the contractor as shown in Figure (1) (Hamzah et al., 2011; Alaghbari et al., 2007).

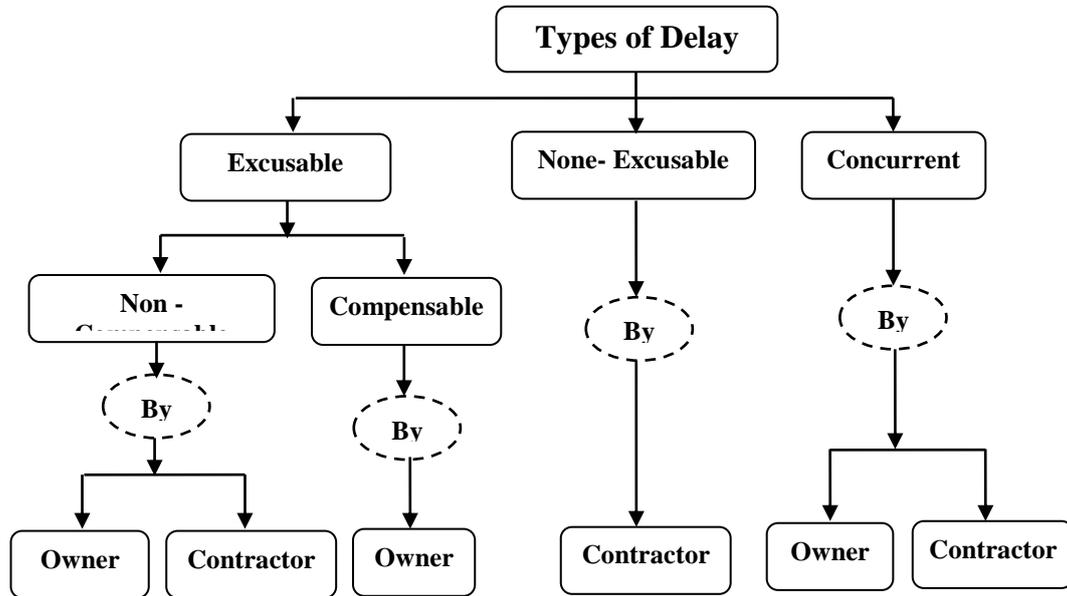


Figure (1): Types of Delay

**Causes of Delays**

In construction projects, there are two main types of causes causing delays in construction projects which are external causes and internal causes. The internal cause of delay includes the causes coming about from four parties involved in the project. These parties comprise the owner, designers, contractors, and consultants. However, other delays, which do not strike from the four mentioned parties, are based on external factors, for instance, delays caused by government, public and society problems, suppliers or natural conditions such as weather (Alaghbari et al., 2007) and (Hughes et al., 2017)

Fugar and Agyakwah-Baah (2010) clarified that the factors causing delay in construction projects are many and vary from country to country and from one circumstance to another. For example, Fugar and Agyakwah-Baah (2010) selected (32) causes of delay were analysed and grouped into nine major areas according to a slightly modified version of Assaf *et al.*'s (1995) classifications: materials, manpower, equipment, financing, environment, changes, government action, contractual relationships, and scheduling and controlling techniques. Moreover, Alaghbari *et al.*, (2007) selected (31) factors of delay which divided into four groups. These groups classified according to the responsibility of delay that will be happened in the project. The four groups were;

factors related to owner, factors related to contractor, factors related to consultant, and external factors.

The previous study in Yemen by; Ahmed *et al.*, (2013) and Issa *et al.*, (2015) who selected (54) risk factors which affecting time and cost in construction projects in Yemen. These factors were collected from both literature review and a survey that was conducted to construction practitioners in Yemen and these factors were divided into ten groups.

Al-Seraji (2010) identified (78) factors causing delays in the construction projects in Yemen. Al-Fadhali *et al.*, (2018) clarified that (37) influential factors in construction industry of Yemen were selected and divided into four groups based on how each of the factors related to construction projects parties. These groups were; consultant related factors, contractor related factors, owner related factors and designer related factors. Al-Fadhali *et al.*, (2017) designed a questionnaire based on (70) factors found in the literature which was reduced in a pilot study to 54 factors of influential factors affecting construction project completion related to internal stakeholders. These internal stakeholders influential factors were; (consultant influential factors, contractor influential factors, owner influential factors, designer influential factors, subcontractor influential factors, supplier influential factors and labour influential factors).

### ***Most Influential Factors and Causes of Delay***

In this research, after reviewing almost 100 similar studies from different countries regarding the delay factors, a total of seventy-two causes were extracted. However, delay factors were classified into seven major (groups) categories with different levels of significance to different parties. These categories were, project-related factors, managerial factors, financial factors, human related factors, technical factors, material and equipment factors, and external factors.

A pilot study was done based on the opinions of 12 experts specialists in construction projects to improve the list of delay causes and to select the most important causes which resulted in reducing the causes to 32. Moreover, these 32 causes were classified into five major groups which were; managerial factors (16 causes), financial factors (4 causes), technical factors (4 causes), material and equipment factors (3 causes), and external factors (5 causes). These causes were classified according to their nature in the work and not according to the responsibility of the project parties. Consequently, these five groups and thirty-two causes were acknowledged as the most commonplace causes in Yemen. These causes are summarized in Table (1).

**Table 1. Summary of the most important factors causing delay in construction projects**

<b>Previous Studies</b>	<b>Groups</b>	<b>Causes</b>
(Alaghbari et al., 2007; Sambasivan&	Managerial Factor	- Poor Site Management and Improper Management. - Variation of orders/changes of scope during construction.

<p>Soon, 2007; Sunjka&amp; Jacob, 2013; Bangash, 2016; Hasan <i>et al.</i>, 2014; Polekaret <i>al.</i>, 2015; Eshofonie, 2008; Kökel, 2015; Shebobet <i>al.</i>, 2011;and Thunberg &amp; Persson, 2013).</p>		<ul style="list-style-type: none"> <li>- New instructions for additional work.</li> <li>- Poor communication and coordination between all project parties (owners, contractors &amp; sub- contractors, designers, consultants, labours, and suppliers).</li> <li>- Inadequate experience of contractor/ consultants.</li> <li>- Inadequate time-period estimation.</li> <li>- Lack of skilled labours.</li> <li>- Weak planning, control, and management by contractors.</li> <li>- Slow decision making and instruction.</li> <li>- Delay in getting work approval.</li> <li>- Late delivery of materials and/or equipment to site.</li> <li>- Shortage of construction materials in site.</li> <li>- Lack of commitment by contractors.</li> <li>- Delay in Payments for completed work.</li> <li>- Delay in receiving progress payments by Contractors.</li> <li>- Late payment from contractors to sub-contractors and/or to Materials and Equipment suppliers.</li> </ul>
<p>(Ametepeyet <i>al.</i>, 2015; Ansah, 2011; Abdul-Rahman <i>et al.</i>, 2011; Hasan <i>et al.</i>, 2014; Hussin&amp;Omran, 2011; Kapila &amp; Hendrickson, 2001; Alaghbariet <i>al.</i>, 2007; and Al-Najjar, 2008).</p>	<p>Financial Factor</p>	<ul style="list-style-type: none"> <li>- Variation/ change in prices.</li> <li>- High rate of inflation.</li> <li>- Financial difficulties faced by clients.</li> <li>- Lack of sufficient cash for project implementation.</li> </ul>
<p>(Hao <i>et al.</i>, 2008; Al-Najjar, 2008; Bangash, 2016; Vidaliset <i>al.</i>, 2002; and Stephen &amp; Paul, 2010).</p>	<p>Technical Factor</p>	<ul style="list-style-type: none"> <li>- Poor design/ Inappropriate design by project consultants.</li> <li>- Mistakes during the construction stage/ Rework due to mistakes during construction.</li> <li>- Changes in drawings and initial design.</li> <li>- Delays in producing design documents by project consultants.</li> </ul>
<p>(Abdul-Rahman <i>et al.</i>, 2013; and Bangash, 2016)</p>	<p>Material &amp; Equipment Factors</p>	<ul style="list-style-type: none"> <li>- Shortage of construction materials/ tools/ equipment in market.</li> <li>- Non-conformity of materials to standard specifications</li> <li>- Equipment breakdown.</li> </ul>
<p>(Ninikaset <i>al.</i>, 2014; Alaghbariet <i>al.</i>, 2007; Eshofonie, 2008; Fugar&amp;Agyakwah-Baah, 2010; and Asante, 2014).</p>	<p>External Factors</p>	<ul style="list-style-type: none"> <li>- Poor political condition (Crises, Armed conflict, Demonstrations).</li> <li>- Poor economic condition (Exchange rate, Fuel prices, Availability of materials and equipment).</li> <li>- Bad weather (Rain Season, High temperature).</li> <li>- Issues regarding permissions approvals by authorities concerned.</li> <li>- Official and religious holidays and the month of Ramadan (fasting month for Muslims) and its impact on productivity.</li> </ul>

## RESEARCH METHODS

A questionnaire survey method was followed which listed the selected most thirty two (32)

common causes that were then classified under five (5) main groups namely; managerial factor group, financial factor group, technical factor group, materials and equipment factors group, and external factors group. Then, the formulated questionnaire has been distributed by hand to various consultants in order to get their professional opinion based on their experience and real practice. Once the desired data was obtained, checked and sorted the data then analyzed using regression as well as correlation analyses to come up with the most significant causes leading to the delay in construction projects in order to draw a conclusion and to forward recommendations based on the findings of the research (Figure 2).

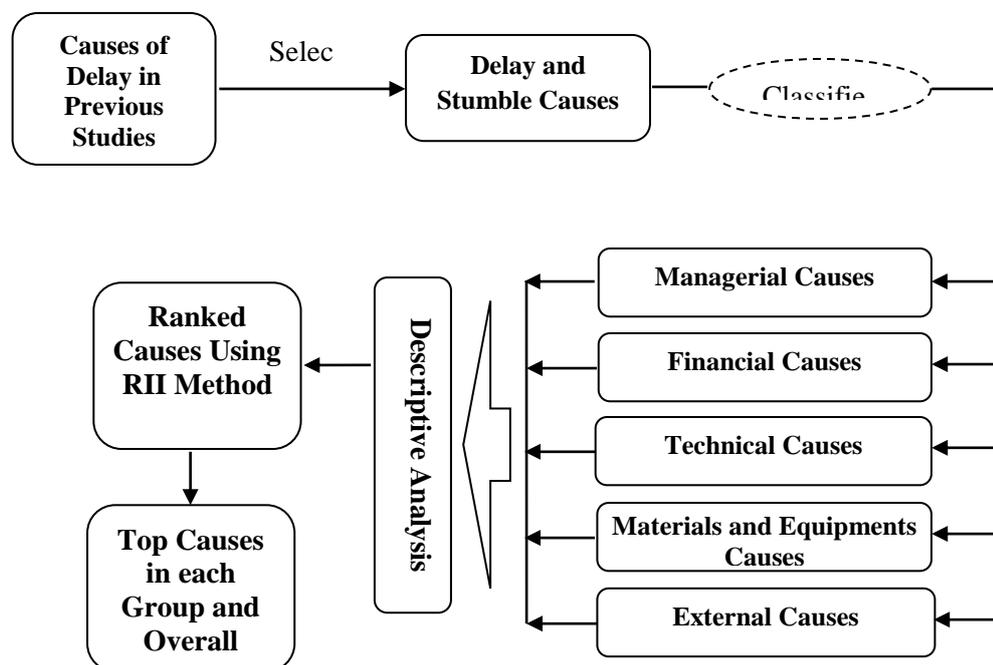


Figure (2). Research Design Diagram

### Data Collection

The questionnaire consisted mainly of two sections. The first section contains three parts which are Part (a) is about the respondent's background. Part (b) covers general information about the company and Part (c) includes general information about the Project. The second section also contains two parts; Part (a) is about time overrun in construction projects in Sana'a City and Part (b) contains (32) causes of the delay of constructing projects.

### Population and Sample Size

This research focused on the consultants in companies and authorities of the construction business

that are located within Sana'a city. It was decided to include in the survey the respondents working in Sana'a, but their companies and authorities have many projects in different parts of the country. This gives us the right to assume that the results of the survey reflect the peculiarities not only of the capital region, but also of other regions of Yemen.

The participants have been selected using a convenient sample technique. In this research, statistical equations were used in order to calculate the sample size for the consultants. According to Alaghbari et al., (2017) the formula shown in Eq. (1) was used:

$$n = \frac{m}{1 + \left(\frac{m-1}{N}\right)} \dots\dots\dots (1)$$

Where n, m, and N = the sample size of the limited, unlimited, and available population, respectively. The m is estimated by Eq. (2):

$$m = \frac{z^2 \times p \times (1 - p)}{\varepsilon^2} \dots\dots\dots (2)$$

Consequently, since some of the targeted consultants were not present during the distribution process, either they were laid off because of the shutdown of the work places they used to work at or were out of the country because of the war. Hence, from the equations, total number of population from different companies and authorities (N=469) and the representative sample size required is (m = 211) samples.

Therefore, to ensure that the sample size required was obtained, a total of (211) samples were distributed the questionnaire by hand. Only (133) questionnaires were received and (123) questionnaires of them were completed and used in the analyses that represented about 58.29%.

### Data Analysis Approach

For analysing data, the Relative Importance Index (RII) technique was used based on the following formula (Jarkas, 2015; Hafez et al., 2014; Alaghbari& Sultan 2015; Alaghbari et al., 2017):

$$RII (100\%) = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5(n_5 + n_4 + n_3 + n_2 + n_1)} * 100$$

Where: n1, n2, n3, n4 and n5,= the number of respondents who selected: (1) very low effect/ non effect (2) low effect (3) medium effect (4) high effect, and (5) very high effect. The weighting given to each factor by the respondents ranged from (1-5).

Answers of the first section are obtained by the appropriate choice of answer. In the second section, respondents were required to rate the factors affecting labour productivity on Likert- scale

from 1 (very low effect/ not effect) to 5 (very high effect). The RII was used to rank the delay causes impacting construction project as perceived by respondents and thus comparative analysis is possible. According to Nyoni and Bonga (2016), the RII technique is used to measure attitudes with respect to surveyed factors. Additionally, the groups RII were calculated by taking the average of factors RII in each group.

The Cronbach's alpha coefficient ( $\alpha$ ) was used to determine the questionnaire reliability and because items were measured through a scale (Likert scale), construction at the group level and reliability of each item at the individual level was evaluated. Cronbach's Alpha ( $\alpha$ ) of 0.943 was achieved, and the corrected scale composed of 32 structural survey questions, represented 32 delay causes that impacting the construction project in Sana'a, Yemen.

After the questionnaires were received, they were interred by coding and fed into the Statistical Packages for Social Sciences (SPSS version 21) for data aggregation and subsequent analysis. Consequently, the analysis used in this research were: descriptive analysis, and regression analysis.

## **RESULTS AND DISCUSSION**

Of all the challenges in the construction industry, "delay" is the most commonly detected item, which occurs in every construction project either in form of time overrun, cost overrun, or both, in which its extent varies considerably from project to another (Sambasivan & Soon 2007).

Therefore, this section discusses the results obtained by analyzing the delay factors for the sake of acknowledging the most significant causes leading to the delay overarching issues in order to achieve a successful implementation of construction projects. Accordingly, Tables (2-6) presented the results of the analysis of the causes selected which causing delay of construction projects in Sana'a, Yemen.

### ***Managerial Factor Group***

The results of managerial factor group were presented in Table (2), 16 managerial causes were identified and ranked in their impacting the delay in construction projects in Sana'a. With a RII of 77.8% "Delay in receiving progress payments by contractors" is ranked first cause in this factor group and also among all causes investigated. Thus, it is considered the most important cause of the delay impacting construction projects. With a RII of 74.4% "Inadequate experience of contractor/ consultants" is ranked the second in this group and third among all causes.

Followed by "Poor site management and supervision" which is ranked third in this group with a RII of 73.8% and fourth among all causes. Closely, with a RII of 73.6% "Slow decision making and instruction" which ranked fourth within this group and sixth overall causes. With RII of

63.8%, 63% and 62.6% “Delay in getting work approval”, “Late delivery of materials and/or equipment to site”, and “Shortage of construction materials in site” are ranked 14th, 15th and 16th in the end of this group, and 18th, 19th and 20th overall, respectively. Finally, with the average RII of 70%, the managerial factor group is ranked second among the five factor groups.

**Table 2. Ranking of Causes in Managerial Factor Group**

Rank	Causes	RII (%)
1	Delay in receiving progress payments by Contractors	77.8
2	Inadequate experience of contractor/ consultants	74.4
3	Poor site management and supervision	73.8
4	Slow decision making and instruction	73.6
5	Delay in Payments for completed work	72.6
6	Weak planning, control, and management by contractors	72.4
7	Inadequate time-period estimation	71.6
8	Lack of skilled labours	70.6
9	Late payment from contractors to sub-contractors and/or to Materials and Equipment suppliers.	70.2
10	Lack of commitment by contractors.	69.8
11	Poor communication and coordination between all project parties (owners, contractors & sub- contractors, designers, consultants, labours, and suppliers)	69.4
12	Variation of orders/changes of scope during construction	68.4
13	New instructions for additional work	67.2
14	Delay in getting work approval	63.8
15	Late delivery of materials and/or equipment to site	63
16	Shortage of construction materials in site	62.6
<b>Average for this group</b>		<b>70 %</b>

**Financial Factor Group**

Table (3) shows the ranking of the four causes listed under the financial factor group. With a RII of 77% “Financial difficulties faced by clients” is ranked first and most important cause in this factor group and second overall causes. Followed by “Lack of sufficient cash for project” which is ranked second in this group and fourth among all causes with a RII of 73.8%. On the other hand, with RII of 70.6% & 70.4% both causes “High rate of inflation” and " Variation/ change in prices" are ranked third and fourth in the last of this group. Moreover, both causes are ranked ninth and tenth among all causes, respectively. Finally, with the average RII of 73%, the financial factor group is ranked first among the five factor groups.

**Table 3. Ranking of Causes in Financial Factor Group**

Rank	Causes	RII (%)
1	Financial difficulties faced by clients	77
2	Lack of sufficient cash for project implementation	73.8

3	High rate of inflation	70.6
4	Variation/ change in prices	70.4
<b>Average for this group</b>		<b>73 %</b>

### ***Technical Factor Group***

The result of technical factor group ranking which included (4) causes, Table (4) shows that “Delays in producing design documents by project consultants” is ranked first within this group with a RII of 60.8% and 19th overall causes. Followed with a RII of 59.6% by “Changes in drawings and initial design” which is ranked second within this group and 22nd among all causes. While “Poor design/ Inappropriate design by project consultants” is ranked the last cause and fourth in this group and 24th among all causes with a RII of 58.4% .Finally, with the average RII of 59.4%, the technical factor group is ranked fourth among the five factor groups.

**Table 4. Ranking of Causes in Technical Factor Group**

<b>Rank</b>	<b>Causes</b>	<b>RII (%)</b>
1	Delays in producing design documents by project consultants	60.8
2	Changes in drawings and initial design	59.6
3	Mistakes during the construction stage/ Rework due to mistakes during construction	58.6
4	Poor design/ Inappropriate design by project consultants	58.4
<b>Average for this group</b>		<b>59.4 %</b>

### ***Materials & Equipments Factor Group***

Furthermore, for the materials & equipments factor group which included (3) causes, Table (5) reveals that “Non-conformity of materials to standard specifications” is ranked first with a RII of 60.4% and 20th overall causes. Closely, with a RII of 60.2% “Materials/ tools/ equipment in market” is ranked second with the group and 21st among all causes. The third and the last cause in this group with a RII of 58.2% is "Materials/ tools/ equipment in market". Finally, with the average RII of 59.6%, the materials and equipments factor group is ranked third among the five factor groups.

**Table 5. Ranking of Causes in Materials & Equipments Factor Group**

<b>Rank</b>	<b>Causes</b>	<b>RII (%)</b>
1	Non-conformity of materials to standard specifications	60.4
2	Equipment breakdown	60.2
3	Materials/ tools/ equipment in market	58.2
<b>Average for this group</b>		<b>59.6 %</b>

### ***External Factor Group***

The results of the (5) causes of external factor group presented in Table (6) shows that “Official and religious holidays and the month of Ramadan and its impact on productivity” is ranked first within this group and 26th overall causes with a RII of 56.4%. Followed with a RII of 54.6% by

“Issues regarding permissions approvals by authorities concerned” which is ranked second within this group and 27th overall causes. In the end of this group, with a RII of 43.8%, “Poor economic condition (Exchange rate, Fuel prices, Availability of materials and equipment)” is ranked fifth in this group and 30th and the last among all causes which causing delay or/ and stumbling of construction projects. Finally, with the average RII of 50.6%, the external factor group is ranked fifth and the last group among the five factor groups.

**Table 6. Ranking of External Factor**

Rank	Causes	RII (%)
1	Official and religious holidays and the month of Ramadan and its impact on productivity	56.4
2	Issues regarding permissions approvals by authorities concerned	54.6
3	Bad weather (Rain Season, High temperature)	53.8
4	Poor political condition (Crises, Armed conflict, Demonstrations)	44.6
5	Poor economic condition (Exchange rate, Fuel prices, Availability of materials and equipment)	43.8
<b>Average for this group</b>		<b>50.6 %</b>

As Tables (2-6) show, the results obtained demonstrate that all groups of factors have approximate average relative importance indices. The Financial factor group is ranked first with the highest average RII of 73%. This is followed by Managerial Factor group, which is ranked second with an average RII of 70%. Moreover, the groups of Materials & Equipment Factor and Technical Factor are ranked third and fourth with an average RII of 59.6% and 59.4%, respectively. The last group ranked is External Factor with an average RII score 50.6%.

**Regression Analysis**

Multiple linear regression has been applied to test the relation between the five groups of independent variables, which are managerial, financial, technical, materials and equipment, and external factors on the dependent variable "Time overrun" which caused because of delay and stumbling in construction projects.

**Table 7. R Square of the Proposed Model**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.951 <sup>a</sup>	.905	.900	.145

a. Predictors: (Constant), Managerial, External, Material, Finance, Technical

According to Table (7) the (R) Square value found to be very high, with a percentage of 90.5, which indicates a very good value.

**Table 8. Regression Analysis Result**

Model (1)	Unstandardized Coefficients		Standardized Coefficients	T	Sig
	B	Beta			
(Constant)	-1.096-	.063		-17.398	.000
Financial	.031	.019	.073	1.660	.100
Technical	.082	.021	.182	3.967	.000
Materials & Equipment	.082	.018	.196	4.541	.000
External	.270	.024	.503	11.345	.000
Managerial	.110	.030	.151	3.651	.000

a. Dependent Variable: Time overrun

Therefore, according to Table (8), financial factors group found that the only independent variable which has no significant impact on the dependent variable (Time Overrun) where predictive power P-Value was < 0.05.

### ***Top Delay Causes***

The overall perceived effects of the 32 causes surveyed are summarized in Table (9). The participants to the survey claimed that the listed factors are integrated and their effect has to be conceptualized in combination. As shown, the top ten factors listed in the ranking indicate their corresponding RII. These causes which have a great impact and causing delay in construction projects were contained eight managerial causes and four financial causes. For example, the "delay in receiving progress payments by contractors" was ranked the first among all causes of delay in construction projects in Sana'a. This result is consistent with Amoatey et al., (2015) in Ghana, Pourrostan and Ismail, (2011) in Iran, and Indhu, and Ajai, (2014) and Abdul-Rahman et al., (2009) in Malaysia. While, the result of the researches conducted by Tawil et al., (2013) in Malaysia, Marzouk and El-Rasas, (2014) in Egypt, and Adugna, (2015) in South Africa have all ranked the delay in payment statement as the second most significant factor causing the delay of construction projects. However, this cause was not in the top five factors of the research by Al-Seraji (2010) about factors causing delay in construction projects in Yemen. "Financial difficulties faced by clients" was ranked second in this research and however, in the researches done by Akinsiku and Akinsulire, (2012), Wong and Vimonsatit, (2012), while this cause was ranked as the second important cause by Ali et al., (2012) in Malaysia.

"Inadequate experience of contractor/ consultants" was ranked the third in this research. This result is consistent with the result of the research conducted by Adeyemi and Masalila, (2016) in Botswana who also ranked this cause as the third most significant cause. Closely, to the cause "poor qualification of project team members" which was ranked third in the research by Al-Seraji, (2010) in Yemen.

Two causes were ranked fourth among the top ten causes, the first was "Poor site management and supervision". However, this cause was ranked second in the research of Adeyemi and Masalila, (2016) in Botswana, the fifth in the research done by Haseeb et al., (2011) in Pakistan, the ninth in the research of Afshari et al., (2011) and the tenth in the research of Islam et al., (2015) in Bangladesh. Additionally, Al-Seraji, (2010) in Yemen ranked the cause "inadequate project management" as fifth. The second factor was ranked fourth was "Lack of sufficient cash for project implementation". However, this cause ranked eighth in the study of Albogamy et al., (2012) in Saudi Arabia.

"Slow decision making and instruction" was ranked fifth which is similar with the research result reveals by Pourrostan and Ismail, (2012) in Iran.

"Delay in Payments for completed work" was ranked sixth in this research, however; this cause was ranked fourth among the top ten causes by the study of Adeyemi and Masalila, (2016) in Botswana.

"Weak planning, control, and management by contractors" was ranked seventh in this study which is similar to the result of the research done by Fugar and Agyakwah-Baah, (2010) in Ghana.

"Inadequate time-period estimation" was ranked eighth in this research; however, this cause was ranked third by Cûlfiket *et al.*, (2014) in Turkey and fourth by Wong and Vimonsatit, (2012) in Western Australia, and sixth in the research conducted by Fugar and Agyakwah-Baah, (2010) in Ghana.

Two causes were ranked ninth in the top ten causes, the first was "Lack of skilled labours" whereas in the research of Wong and Vimonsatit, (2012) in western Australia this cause ranked first and the sixth in the study conducted by Islam *et al.*, (2015) in Bangladesh. The second cause ranked ninth was "High rate of inflation". Finally, "Variation/ change in prices" was ranked tenth. These last two causes in the top ten list have strong relationship with the financial causes which ranked first, second and fourth among the top ten causes.

**Table 9. Overall ranking of the Causes impacting delay of construction projects**

Rank	Causes	RII (%)	Factors group	Responsibility
1	Delay in receiving progress payments by Contractors	77.8	Managerial	Consultant/ Client
2	Financial difficulties faced by clients	77	Financial	Client

3	Inadequate experience of contractor/ consultants	74.4	Managerial	Consultant/ Client
4	Poor site management and supervision	73.8	Managerial	Contractor/Consultant
4	Lack of sufficient cash for project implementation	73.8	Financial	Client
5	Slow decision making and instruction	73.6	Managerial	Clients/ Consultant
6	Delay in Payments for completed work	72.6	Managerial	Client
7	Weak planning, control, and management by contractors	72.4	Managerial	Contractor
8	Inadequate time-period estimation	71.6	Managerial	Contractor/Consultant
9	Lack of skilled labours	70.6	Managerial	Contractor
9	High rate of inflation	70.6	Financial	External
10	Variation/ change in prices	70.4	Financial	External
11	Late payment from contractors to sub-contractors and/or to Materials and Equipment suppliers.	70.2	Managerial	Contractor
12	Lack of commitment by contractors.	69.8	Managerial	Contractor
13	Poor communication and coordination between all project parties (owners, contractors & sub-contractors, designers, consultants, labours, and suppliers)	69.4	Managerial	Client/ Contractor/ Consultant
14	Variation of orders/changes of scope during construction	68.4	Managerial	Consultant
15	New instructions for additional work	67.2	Managerial	Client/ Consultant
16	Delay in getting work approval	63.8	Managerial	Consultant
17	Late delivery of materials and/or equipment to site	63	Managerial	Contractor
18	Shortage of construction materials in site	62.6	Managerial	Contractor
19	Delays in producing design documents by consultants	60.8	Technical	Consultant
20	Non-conformity of materials to standard specifications	60.4	Materials & Equipments	Contractor
21	Equipment breakdown	60.2	Materials & Equipments	Contractor/ External
22	Changes in drawings and initial design	59.6	Technical	Consultant
23	Mistakes during the construction stage/ Rework due to mistakes during construction	58.6	Technical	Contractor
24	Poor design/ Inappropriate design by project consultants	58.4	Technical	Consultant
25	Materials/ tools/ equipment in market	58.2	Materials & Equipments	External
26	Official and religious holidays and the month of Ramadan and its impact on productivity	56.4	External	External
27	Issues regarding permissions approvals by authorities concerned	54.6	External	External
28	Bad weather (Rain Season, High temperature)	53.8	External	External
29	Poor political condition (Crises, Armed conflict, Demonstrations)	44.6	External	External
30	Poor economic condition (Exchange rate, Fuel prices, Availability of materials and equipment)	43.8	External	External

Finally, the present study reveals the most unpredicted outcome regarding the causes “Poor political condition (Crises, Armed conflict, Demonstrations)” and “Poor economic condition (Exchange rate, Fuel prices, Availability of materials and equipment)” ranking. In other words, these two causes ranked the last causes among all those acknowledged in this study with less significant causing delay of construction projects in Sana’a. Conversely, in a study conducted by Al-Ageeli and Alzobae, (2016), Enshassi et al., (2009) and Sunjka, and Jacob (2013), poor

political situation cause ranked first, and sixth in study by Adeyemi and Masalila (2016). Likewise, poor economic situation found to be ranked fourth in Malaysia (Abdul-Rahman et al., 2011), the fourth by Enshassi et al., (2009) and the seventh by Sunjka and Jacob (2013).

## **CONCLUSION AND RECOMMENDATIONS**

This research was initiated with the purpose of identifying the underlying factors contributing to the delay of construction projects in the capital city of Sana'a. Hence, (32) causes that were categorized into five factors namely: managerial factor, financial factor, technical factor, materials and equipment factors, and external factor.

The top ten causes were; (1) Delay in receiving progress payments by contractors, (2) Financial difficulties faced by clients, (3) Inadequate experience of contractor/ consultants, (4) "Poor site management and supervision", and "Lack of sufficient cash for project implementation", (5) Slow decision making and instruction, (6) Delay in Payments for completed work, (7) Weak planning, control, and management by contractors, (8) Inadequate time-period estimation, and (9) "Lack of skilled labours", and "High rate of inflation", and (10) Variation/ change in prices. However, the financial factors group was ranked first among all groups. Additionally, the financial factors group found that the only independent variable which has no significant impact on the dependent variable (Time Overrun) among the five independent variables groups.

Contrastingly, the summary of the conclusion that out of the top 10 causes, eight causes were from managerial factor group and four causes from the group of financial factor group, while there was not causes from other groups in the top 10 factors causing delay of construction projects in Sana'a, Yemen.

Based on the findings of this research, the following recommendations are progressive for adoption by the contractors, consultants as well as the owners of the construction industry; these recommendations are mainly comprised of the following:

1. Contractors must be committed to the progress payments to subcontractors on time as agreed to prevent the obstruction of the work on the project; later that would lead to project delay.
2. Clients should make prompt payments to the main contractor, so the latter can ensure that there is an adequate funding for the project to get going.
3. Consultants should also take more attention to the material specifications to insure their conformity to the standard specifications before the implementation stage so as to manage providing solutions and/ or modifications on the design documentations to avoid work postponing.

4. Engineering, architectural, and design documents should be submitted on the required time to be reviewed by the project team (client, main contractor and the project subcontractors) so as to receive their decide whether to implement or to modify, if necessary.
5. Finally, project's team management should prepare an adequate work schedule identifying the project main tasks along with the estimated duration for each task to avoid any complaints that might arise from the project labour.

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