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CAUSES OF TIME OVERRUNS IN THE CONSTRUCTION INDUSTRY IN EGYPT

Abdussalam Shibani^{*1}, Omar Mahadel², Dyaa Hassan³, Araz Agha⁴, Messaoud Saidani⁵

^{*1,2,3,4}School of Energy, Construction and Environment, Coventry University, UK.

ABSTRACT

The construction industry sector has ranked third after the tourism and communications sectors in 2017 in the contribution toward the Egyptian economy. Moreover, it was found that the construction industry's contribution to the GDP of Egypt was 4.8%. Even though, there are several reasons to study the time overruns problem in the construction industry, especially in Egypt; however, there is not a sufficient amount of research that was conducted on this topic. Therefore, the aim of the research is to investigate the main causes of time overruns in the construction industry in Egypt in the last ten years. The research methodology in this study is the pragmatic paradigm using mixed design method in collecting data. A list was conducted using RII including the top 10 causes of delays in Egypt's construction industry from previous Egyptian literature regarding the topic. An online survey was distributed to industry experts and answered by 29 respondents to provide the probability and impact of each risk from previous literature. After that, the data was analysed and validated through phone interviews with 3 industry professionals representing different stakeholders. Thus, the top ten causes of time overruns in Egypt's construction industry are as follow: (1) Currency Sinking in 2017, (2) Financial problems of completed work by client, (3) Covid-19 (Corona Virus) pandemic in 2020, (4) Changes of scope/ Design by owner during construction, (5) Contractor's problems in financing the project alongside with Improper planning and scheduling of project (6) Poor supervision of the site by contractor, (7) Unqualified workforce/ Lack of experience by contractor, (8) Various shapes of bribes to continue the works, (9) Tendering strategies and (10) Low quality of construction materials causing re-doing the work. The list was compared with the top 10 causes from a study that represented the problem in the period 2001-2010. Thus, there is 50% interference between the causes of delays between this decade and the previous one. From the stakeholders' perspective, there was not many alterations to the given list. Moreover, the Covid-19 pandemic has affected the construction projects in Egypt; however, the experts are optimistic in the next days that the pandemic will not have the same effects as the previous period.

I. INTRODUCTION

According to Ofori (2012), the construction industry has contributed significantly in several nations across the globe. It happens to affect the socio-political and economical aspects of these countries. According to Oxford Business Group (2017), in Egypt, the construction industry sector has ranked third after the tourism and communications sectors in 2017 in the contribution towards the Egyptian economy; moreover, a 10.3% increase compared to the preceding year was recorded as an output of the construction industry to the Egyptian economy in 2016. According to Amin and Abanda (2019), after reviewing Bank Audi (2016) report, it was found that the construction industry contribution in the Gross Domestic Product (GDP) of Egypt was 4.8%. Furthermore, according to Ceicdata (2020), trends illustrate the significant increase in the contribution of the construction industry into the Egyptian economy in the last 10 years.

The duration is a crucial part of any construction project leading to an efficient construction program, which by its turn will lead to effective cost management (Ofori 2012). According to Asiedu et al. (2017), the ultimate aim of any construction project is to be executed within the estimated budget, expected duration and required level of quality. However, it is difficult to achieve these three targets within any construction project. Durdyev and Hosseini (2018) also stated that the completion of any project depends crucially on finishing the project within its scheduled timeframe and that not complying with this factor will lead definitely to time overruns; leading to project performance defects. Furthermore, it was found that there is a relationship between the time and cost overruns and the desired level quality; thus, the more defects in the project cost and time, the lower the quality level (Larsen et al. 2016). According to Hossen et al. (2015), project delays could lead to different project related obstacles; for instance: disputes could arise between project parties, cost overruns for either the client or the contractor. These are some of the reasons to study time overruns in construction projects generally.

Aziz (2013) studied the effect of the Egyptian Revolution 2011 on the construction projects duration and found that the strikes due to the revolutions were ranked as the 63rd cause of time overruns. This represents the effect of the Egyptian revolution on the construction industry. In addition to the Egyptian revolution 2011, several political, economic and social events occurred in the last decade; for instance: the Egyptian revolution/ coup 2013, the Egyptian currency sinking in 2017 and the Covid-19 pandemic in 2020. These events might have their positive or negative effects on the construction industry in Egypt. These reasons emphasise how crucial it is to study time overruns problem in Egypt construction projects, to avoid its potential risks.

Several studies were undertaken to research the factors that cause time overruns in the construction industry all over the globe. Until 2016, Aziz and Abdel-Hakam (2016) found that this problem was researched 113 times in several countries across the world. This emphasises the importance of this matter. Overview

Marzouk and El-Rasas (2014) have found two definitions for the time overrun problem in the construction industry based on previous studies. Assaf and Al-Hejji (2005) conducted the first definition as a delay after an agreed date that was defined in a contract between two or more parties to deliver the project. Aziz and Abdel-Hakam (2016) used this definition. Sweis et al. (2008) adapted the second definition of the delays problem where a construction delay was defined as an occasion where the project duration should be extended beyond an agreed date between parties leading to cost overruns.

Assaf and Al-Hejji (2005) defined the time overrun in construction depending on different stakeholders' perspectives. Thus, from a client point of view, a delay is defined as a loss of revenue due to the low productivity rates of the project resources. As for the contractor, Assaf and Al-Hejji (2005) defined the time overrun as a cost overrun due to the longer working hours, in addition higher labour and material costs leading to project delays. Therefore, time overruns and cost overruns are related.

A study performed in 2017, indicated that 70% of the construction projects in the world confronted delays in their durations (Gebrehiwet and Luo 2017). Moreover, several contractors and consultants from the construction industry found that 50% of the cost overruns they confront are originated from 10% to 30% of the time overruns they face (Gebrehiwet and Luo 2017).

In 2016, Aziz and Abdel-Hakam (2016) investigated the causes of time overruns in general construction projects all over the world. The sample of this study included 16 different countries. It was found that depending of the location of the country, the causes of time overruns were changing. Aziz and Abdel-Hakam (2016) stated that the number of causes of delays in construction industry varied from 7 to 113 causes in 16 different countries around the world. For instance, in Malaysia, the research studies found 113 causes of delays in the country's construction industry. On the contrary, in Hong Kong, the causes of time overruns in their construction industry was found to be 7 causes only according to their research (Aziz and Abdel-Hakam 2016). A bar chart was conducted in Aziz and Abdel-Hakam (2016) study to illustrate the number of causes of time overruns in different construction industry sectors as shown in Figure 1.

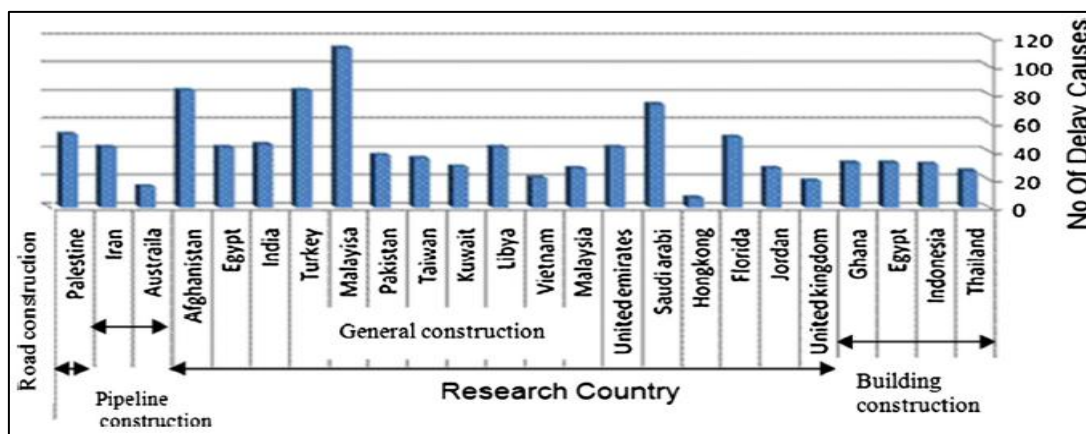


Fig.-1: Number of Delay Causes in Different Construction Industries around the World Based on Aziz and Abdel-Hakam (2016) Study

II. CAUSES OF TIME OVERRUNS IN CONSTRUCTION PROJECTS

As mentioned before, the research on the factors causing time overruns in construction projects has been researched intensively in numerous countries around the world (Aziz and Abdel-Hakam 2016). Therefore, in this section, previous international literature has been investigated to explore the causes of time overruns in construction projects in various countries around the world.

One of the first research studies that had investigated the issues causing the time overruns problem in the construction projects, was a study done in the United States of America in 1971 (Głuszak and Leśniak 2015). The 1971 study found that the most common causes of time overruns in the United States construction industry consisted of: changes in weather, resources availability including labour and materials, equipment defects, design alterations, inadequate documentation of design documents, substructure conditions, imperfections in project implementation, financial problems, subcontractors' involvement problems and others (Głuszak and Leśniak 2015).

In South America, specifically in Cali, Colombia, Micán et al. (2013) analysed the schedule risks in a construction project using two methods. In Micán et al. (2013) research, the delay causes in Cali's housing construction projects were highlighted. Thus, the causes of schedule overruns according to the study were as follow: inadequate planning, insufficient resources, weather conditions, design defects, alterations in the design scope and other delay causes. Furthermore, the findings of this study indicated that the inadequate planning and the alterations in the design scope are the most critical causes due to their high likelihood of occurrence and impact on the project; in addition to the difficulty to discover those risks.

On the other side of the world, specifically in Perth, Western Australia, Wong and Vimonsatit (2012) studied the causes on schedule delays in Perth's construction projects. Unlike Cali's case study (Micán et al. 2013), the unavailability of skilful workers was the number one factor causing the time overrun problem in Perth. However, Micán et al. (2013) and Wong and Vimonsatit (2012) shared some other causes of schedule delays such as insufficient resources, inadequate planning and design defects. Financial problems and unforeseen substructure conditions were some common factors of the time overrun problem that were shared between Wong and Vimonsatit (2012) and the United States of America case study in 1971 as mentioned by Głuszak and Leśniak (2015). Wong and Vimonsatit (2012) introduced more causes of time overruns in Perth such as the lack of organisational experience by the consultant or the contractor, communication problems, poor vision for the project completion date and slow decision-making speed.

In Malaysia, a total number of 113 studies were performed until 2016 as mentioned before (Aziz and Abdel-Hakam 2016). Alaghbari et al. (2007) studied the causes of schedule overruns in Malaysia's construction industry. In this study, four rankings were conducted to identify those causes based on a classification consisting of the client, contractor, consultant and external reasons. A final ranking was identified based on the four rankings mentioned earlier. Thus, Alaghbari et al. (2007) final ranking included the following in order: problems financing the project by the client, financial problems by the contractors, slow decision-making process by the consultant and owner, late instructions by the consultant, insufficient materials on site and in market, lack of experience in managing the site, execution defects, consultant low level of experience and inadequate documentation.

In another place in Asia, specifically in Sabaragamuwa Province, Sri Lanka a city in a country in Southern Asia, Dolage and Rathnamali (2013) studied the causes of time overruns in Sri Lanka's construction projects especially in the implementation phase. A case study was conducted on the Department of Engineering Services (DOES) of Sabaragamuwa Provincial Council (SPC). The study found that 80% of the building construction projects handled by the DOES of SPC in Sri Lanka suffer from schedule delays. Dolage and Rathnamali (2013) classified and ranked the delay causes according to different stakeholders' perspectives and found 51 factors. Finally, an ultimate ranking was conducted to identify the top causes of time overruns in the implementation phase of Sri Lanka's construction projects. The causes included payment delays by the owner, inadequate planning, weather conditions, unavailability of skilful workers, insufficient labour resources, slow decision-making process, contractor lack of experience and others.

In western Asia, specifically in Iran, A study was undertaken by Samarghandi et al. (2016) studying the factors causing the cost and time overruns problem in the country's construction industry. Interviews were performed with industry professionals and industry governing organisations to find out the causes of this problem under four different categories. Samarghandi et al. (2016) classified the categories as the client, contractor, consultant and external reasons. The most common causes of delays in Iran's construction projects by the client included: unawareness of the inflation problem and lack of experience in budgeting the project in a timely manner. Samarghandi et al. (2016) found that the contractor's timeliest faults are inadequate planning and poor cash flow preparing. On the other hand, the consultant causes of delays included: poor documentation and lack of accuracy in the project's first draft. The external reasons included: out of date contract terms and poor budgeting of the project by the government. Furthermore, Samarghandi et al. (2016) found that the mean delay in Iran's construction industry per year is 5.9 months.

In Turkey, a transcontinental country between Asia and Europe, a study was conducted by Kazaz et al. (2012) to find the factors affecting the Turkish construction projects durations. A survey was sent to construction professionals to rank the top ten causes of time overruns in Turkey's construction projects based on the importance of each cause. Kazaz et al. (2012) final ranking included: changes in design and materials used in construction by the client, delay of payments, inadequate cash flow, problems financing the project by the contractor, low level of labour productivity, inadequate planning by the client, improper construction methods causing defects, changes in material prices due to currency fluctuations in Turkey and others. Furthermore, Kazaz et al. (2012) compared the findings of this study with eight other studies conducted on the same topic to find the differences between causes of time overruns in different nations. Abd El-Razek et al. (2008), which is an Egyptian study about causes of time overruns in Egypt's construction projects, had taken place in the comparison. It was found that both of Abd El-Razek et al. (2008) and Kazaz et al. (2012) shared six factors causing the time overruns problem.

Another study was performed in Europe, specifically in Poland, to investigate the causes of delays in construction projects based on clients' perspective. Głuszak and Leśniak (2015) undertook the study. A survey was conducted in Poland and its findings consisted of the following causes of delay in the construction industry from the client's point of view as follow: inadequate design documentation, lack of skilled workers, weather conditions, lack of experience in managing and supervising the works, internal conflicts and issues affecting the contractor's organisation performance, bureaucracy in attaining permits, inadequate planning and scheduling, financing problems by the client and shortage of equipment to progress works.

Shebob et al. (2012) studied the differences between the United Kingdom's (UK) construction industry and the Libyan construction industry. The study findings illustrated the differences in the delay times between both countries' industries showing that construction projects in Libya confronted delays by 41 to 46 days. On the other hand, in the UK, projects suffered an average of 34 to 38 days of time overruns in the country's construction projects. Furthermore, Shebob et al. (2012) introduced different causes of time overruns in both countries' industries based on different stakeholders' perspectives. Thus, in the UK, from the contractors' point of view, changes of prices of materials, changing the scope of work and conflicts between the main contractor and the sub-contractors were considered the top three factors to cause delays in the UK's construction industry. Shebob et al. (2012) found that the clients agreed with the contractors in the first factor, which is the changes of prices of materials; however, the clients had different opinions about the second and the third causes of delays in the UK's construction projects, which were: problems financing the project and economic issues including currency fluctuations. The consultants top three causes of the time overrun problem in the UK's construction industry were: weather conditions, changes in materials prices and changes in the project scope. Shebob et al. (2012) also ranked 100 causes of time overruns in the UK's construction industry.

Causes of time overruns in the Egyptian construction industry

Several studies were performed in Egypt regarding the research topic (Abd El-Razek et al. 2008; Aziz 2013; Marzouk and El-Rasas 2014; Aziz and Abdel-Hakam 2016) to investigate the causes of delays in construction projects in different time periods in Egypt.

Abd El-Razek et al. (2008) studied the implications of the time overrun problem in the building construction projects in Egypt based on the size and the sector of the project. Based on the literature review, Abd El-Razek et al. (2008) prepared a list of delays that were utilised in semi-structured interviews with professionals to identify the main causes of the time overruns problem in Egypt. After that, a questionnaire was prepared and sent to the industry professionals to validate the research findings. The final ranking which included 10 factors was concluded as follow: financial problems by the contractor, late progress payments by the client, changes in the scope by the client, partial payments for the contractor during the works, non-professional methods of construction, late arrival of materials on site, coordination problems between project parties, delays in decision-making processes by the client, coordination problems in the subcontractors schedules and delays in preparing shop drawings and material samples.

In 2013, after the Egyptian revolution in 2011, Aziz (2013) studied the causes of time overruns in the Egyptian construction industry to explore the differences before and after the revolution in the causes of this problem. Thus, the aim of this research was to rank the most significant factors causing the time overrun problem, especially after the Egyptian Revolution. A questionnaire with industry professionals and brain storming sessions were used to identify the research findings. Aziz (2013) categorised the causes of delays into nine different categories to identify 99 factors causing delays in Egypt's construction industry. Finally, an overall ranking of delays was conducted by Aziz (2013) using RII and consisting of the top twenty causes of time overruns in Egypt's construction industry. The factors included: late payments by the client, various shapes of bribes to continue the works, lack of equipment, inadequate planning and scheduling, unexperienced practices by the contractor, equipment failures, tendering strategies, world-wide financial problems, changes in scope of work and others. The factor 'Labour strikes due to revolutions' was ranked 63rd in the causes of delays in Egypt's construction projects and ranked 5th in the labour category out of 9 causes in this category.

Marzouk and El-Rasas (2014) studied the causes of time overruns in Egypt's construction industry using previous literature causes as a baseline. A questionnaire and interviews had taken place as well to obtain the study findings. In addition, a case study was taken into consideration and analysed using a statistical method called the analysis of variance ANOVA method to determine the relationship between the different causes. Furthermore, Marzouk and El-Rasas (2014) ranked the causes of delay based on three different indices, which were: frequency index, severity index and importance index. Thus, the top ten factors affecting the construction projects in Egypt's construction industry durations based on the importance index included: financial problems by the client, changes in scope of work by the client, substructure conditions, low levels of productivity of labours, inadequate planning and scheduling, financial problems by the contractor, tendering strategies, lack of materials in market, delays in the approval of design documents by the client and unexperienced workforce. Marzouk and El-Rasas (2014) added that the Egyptian revolution had delayed the duration of the project that was presented in the case study until the revolution had ended.

III. RESEARCH METHODOLOGY

Due to the nature of the research, which is concerned with the construction industry, the research question will be prioritised and the research objectives will assist answering the ultimate research questions to achieve the research aim (Mackenzie and Knipe 2006). Therefore, the research methodology paradigm that is followed in this research is the pragmatic research paradigm.

Research method

With accordance to (Mackenzie and Knipe 2006), due to the nature of the industry, observations of the construction industry will be needed. In addition, to achieve the aim and objectives of the research, quantitative analysis will be required to acquire some statistics related to the industry. Moreover, some calculations related to the risk assessment of the delays problem will be required to attain the top causes of the time overruns problem in Egypt's construction industry. However, due to the industry's nature, the acquired statistics will not be enough. Therefore, the experience of the industry experts will be required as well as a qualitative research approach to collect the data. Therefore, a mixed research method will be used for this research using both an

online survey as a quantitative research method and interviews as a qualitative research method to achieve the research findings.

Design of the questionnaire

An online survey was designed using Bristol Online Survey tool (BOS). The questionnaire consisted of four parts. The first part was about some basic information about the respondents including the type of the organisation they work for, their role in the organisation and their level of experience. The second part was concerned about the delays in the construction projects in general. Thus, the questions were about if some of the respondents faced delayed projects and how long the delays occurred with them. In addition, two general questions were asked to the respondents to provide their opinion about the approximate percentage of the delay in relation to the project duration in Egypt's construction projects and if there were any differences between the time overruns in the last decade compared with the period 2001-2010. The third part of the online survey was concerned about the political, economic and social events effects on the construction industry in Egypt with four different questions scaled from strongly disagree to strongly agree. The last part of the survey included twelve different risks collected from three different Egyptian studies, which were conducted in the last ten years. The twelve risks were presented to the respondents to assess them based on their probability of occurrence and their impact. In addition to the twelve risks, Covid-19 and the currency sinking in 2017 in Egypt were added to the list.

The twelve risks were adopted from three different Egyptian studies which were undertaken by Aziz (2013), Marzouk and El-Rasas (2014) and Aziz and Abdel-Hakam (2016). A RII was utilised to conduct a ranking of the top ten risks affecting the construction industry in the last ten years in Egypt from these studies.

Questionnaire population sample

According to Bartlett et al. (2001), the population sample of a research could be estimated using standard tables, however, the conditions that the research was conducted in could affect the sample size. Thus, due to the time limitation, the survey was distributed to 58 construction experts including: contractors, consultants and clients with different levels of experience from both the public and the private construction sectors in Egypt. Moreover, the questionnaire was distributed to the industry professionals using emails and personal contacts. Thirty respondents responded to the online survey questions and one response was excluded due to choosing multiple answers in one question with a response rate of 50%. According to Baruch and Holtom (2008), the average responsiveness rate of the questionnaires sent to individuals is 52.7% with a standard deviation of 20.4%. Therefore, 50% is considered a reliable response rate.

Questionnaire analysis techniques

The results of this questionnaire survey have been analysed by SPSS to check the reliability of the data using Cronbach's Alpha test (Tavakol and Dennick 2011). Microsoft Excel was used to conduct the ranking from the questionnaire results, by using the probability and impact of each risk to calculate the severity of the risk and rank the risks according to their severity from the highest to the lowest.

Design of the interviews' questions

Due to the limitation of time of the research and the global issues related to Covid-19, the phone interviews were found as a better and an easier method to utilise. In addition, Dimond (2012) found that the data that is collected from phone calls are more reliable due to its richness. Irvine (2010) added that the phone interviews' participants are more focused to deliver their knowledge and more comfort. Moreover, due to the travel restrictions because of the Covid-19 pandemic, it was found that phone calls would be the best method to conduct the interviews.

The interviews have taken the semi-structured format. The phone interviews consisted of three main parts that were the basic information and two main questions related to the time overrun problems in Egypt's construction industry. At the beginning of the interviews, a brief introduction was given about the researcher and the study. After that, the interviewee was asked about some basic information including the organisation type, the occupation and the years of experience. The first question of the second part was related to the ranking that has been determined throughout the questionnaire survey analysis. The question was a walkthrough the

twelve causes of delays in addition to the Covid-19 and the currency sinking in 2017 in Egypt and if there were any other reasons from the interviewee's perspective. The second question was about the severity of the Covid-19 problem in Egypt's construction industry's durations and if there are any other effects. The last question was about the differences in the overruns in the Egyptian construction industry between the periods 2001-2010 and 2011-2020.

Interviews strategy

With accordance to Burke and Miller (2001) approach to conduct a phone interview, three phases were undertaken to perform a successful interview. Thus, before the interview, the interview was scheduled and the interviewee was notified that the interview is confidential. During the interview, the interviewee had the freedom to talk and the interview length was pre-determined before the start of the interview. After finishing the interview, the data was revised before analysing it.

Interviews population sample

After analysing the data from the surveys, phone interviews were performed with three industry experts with various levels of experience. The first interviewee is a technical office engineer with four years of experience who works in a big size contracting company in Egypt. The second interviewee is a technical office engineer who works in the Ministry of Awqaf in Egypt and a former site engineer in the Ministry of Housing, Utilities and Urban Communities with a total of 33 years of experience. The third interviewee is an engineer with six years' experience, who owns a company that provides different services including contracting and consultancy services. The interviewees were named with a code to assure their confidentiality in the research as illustrated in Table 1.

Table-1: Interviewees Coding

<i>Code</i>	<i>Interviewee Description</i>	<i>Years of Experience</i>	<i>Organization</i>
<i>X1</i>	<i>Technical office engineer of a big size contractor organization</i>	<i>4</i>	<i>Contractor</i>
<i>X2</i>	<i>Technical office engineer in the Ministry of Awqaf</i>	<i>33</i>	<i>Client</i>
<i>X3</i>	<i>Owner engineer of a multi-services organization including contracting and consultancy</i>	<i>6</i>	<i>Contractor - Consultant</i>

Interviews analysis techniques

After collecting the data from the interviewees, the interviews have been recorded to be revised and to be ready for the analysis phase. Thus, in order to analyse the outputs of the interviews, thematic analysis was utilised.

IV. ANALYSIS AND DISCUSSION

To prepare the online survey's last part, the last ten years published Egyptian studies were taken into consideration which were: Aziz (2013), Marzouk and El-Rasas (2014) and Aziz and Abdel-Hakam (2016) research papers. 35 risks were selected from the top risks that were provided in each of those studies. The chosen risks had been ranked according to the RII. However, the two of the three studies included the top twenty factors causing the time overrun problem, which were Aziz (2013) and Aziz and Abdel-Hakam (2016) studies. Marzouk and El-Rasas (2014) research provided the ranking of the top ten factors only. Therefore, a weighted factor using the RII was utilised to rank the top causes of the time overrun problem in Egypt's construction projects.

The fifty risks that were acquired from the three research papers were reduced to 35 risks due to the interference of the factors in the 3 research papers. Thus, to unify the criteria of the ranking, a point-based system was utilised to assess each ranking as illustrated in Table 4-1 and Table 4-2. For instance, the ranking of the risk 'Changes of scope/ Design by owner during construction' had the 17th place out of 20 in Aziz (2013) and Aziz and Abdel-Hakam (2016) studies, unlike Marzouk and El-Rasas (2014) study which ranked this factor as the 2nd out of 10 risks in the study. Therefore, the points of this risk as illustrated in Table 4-2 in Aziz (2013) and Aziz and Abdel-Hakam (2016) studies equals to 4. In Marzouk and El-Rasas (2014) study, the weight equals to 9 as illustrated in Table 4-1, however, this weight will be multiplied by 2 to equal 18 in this study to unify the

ranking criteria. Therefore, the total weight of the risk in the three studies equals to the total summation of the points that is 4+18+4=26. After that, the risks have been sorted in descending order based on the weight to obtain the final ranking from the 3 research papers. The full ranking which consisted of the top 26 causes of delays with 35 risks from the previous Egyptian studies in the last 10 years.

Table-2: Weighting System for Marzouk and El-Rasas (2014) study

Rank	1	2	3	4	5	6	7	8	9	10
Weight	10	9	8	7	6	5	4	3	2	1

Table-3: Weighting System for Aziz (2013) and Aziz and Abdel-Hakam (2016) studies

Rank	1	2	3	4	5	6	7	8	9	10
Weight	20	19	18	17	16	15	14	13	12	11
Continue Rank	11	12	13	14	15	16	17	18	19	20
Continue Weight	10	9	8	7	6	5	4	3	2	1

Table III: Top 10 Causes of Time Overruns in Egypt's Construction Industry According to Previous Literature

Rank	Delay Factor Description	Aziz (2013) Rank		Marzouk and El-Rasas (2014) Rank		Aziz and Abdel-Hakam (2016) Rank		RII
		Rank	Weight	Rank	Weight#2	Rank	Weight	
1	Financial problems of completed work by client	1	20	1	20	1	20	60
2	Equipment shortage on site	3	18	-	0	2	19	37
3	Unqualified workforce/ Lack of experience by contractor	12	9	10	2	3	18	29
3	Improper planning and scheduling of project	4	17	5	12	-	0	29
4	Poor supervision of the site by contractor	5	16	-	0	10	11	27
5	Changes of scope/ Design by owner during construction	17	4	2	18	17	4	26
6	Contractor's problems in financing the project	6	15	6	10	-	0	25
7	Failure of equipment	13	8	-	0	5	16	24
8	Lack of construction materials in market	-	0	8	6	4	17	23
9	Tendering strategies	8	13	7	8	-	0	21
10	Low quality of construction materials causing re-doing the work	7	14	-	0	16	5	19
10	Various shapes of bribes to continue the works	2	19	-	0	-	0	19

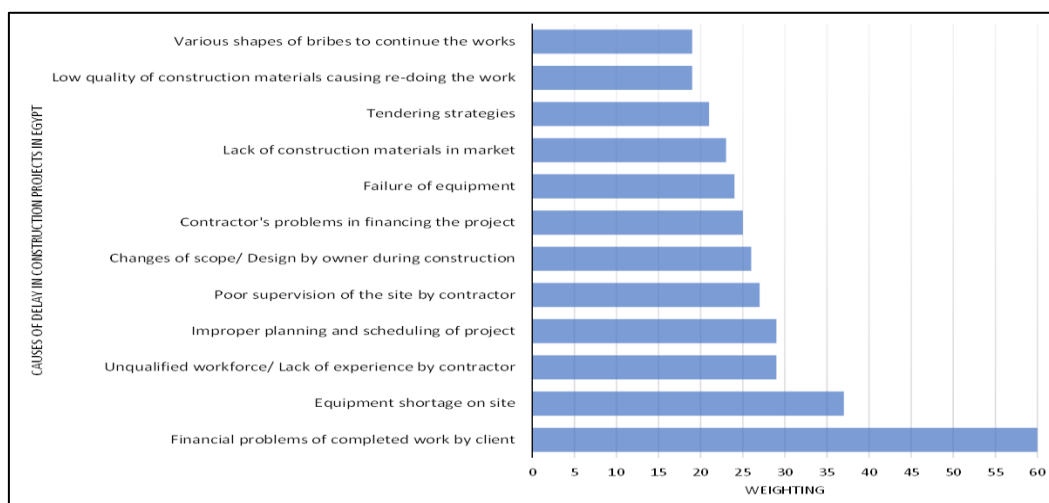


Fig-2: Top 10 Causes of Time Overruns in Egypt's Construction Industry According to Previous Literature Graph

Thus, the top ten causes of delays based on the previous literature are illustrated in Table 4-3 and Figure 4-1 and in the following order: (1) Financial problems of completed work by client, (2) Equipment shortage on site, (3) Unqualified workforce/ Lack of experience by contractor and Improper planning and scheduling, (4) Poor supervision of the site by contractor, (5) Changes of scope/design by owner during construction, (6) Contractor's problems in financing the project, (7) Failure of equipment, (8) Lack of construction materials on site, (9) Tendering strategies and (10). Low quality of construction materials causing re-doing the work and Various shapes of bribes to continue the works.

Analysis of the online survey data

According to the responses provided in the questionnaire, the population sample illustrates that most of the respondents works in a contractor firm and the least number of respondents work in a client organisation as presented. Moreover, Figure 4-3 illustrates the distribution of the participants in various roles of the construction industry showing approximately equal distribution. The years of professional experience of the participants in this survey varied from 0 to more than 15 years of experience with more participants from the 0-5 and the +16 years of experience population as illustrated in Figure.

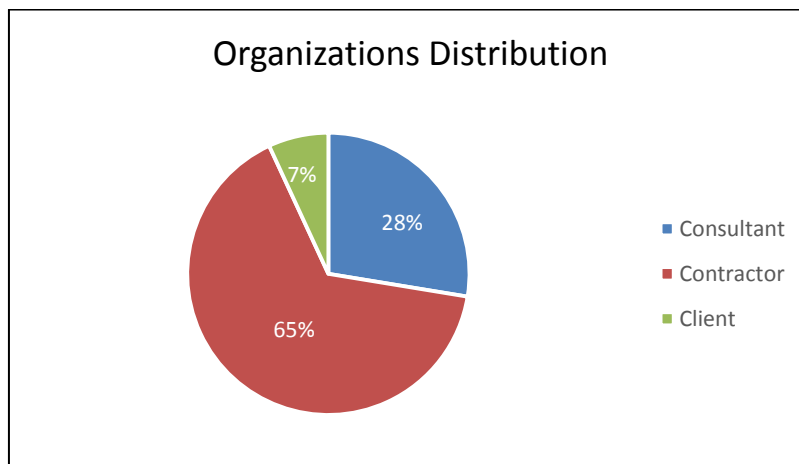


Fig.-5: Survey's Participants Organizational Firms

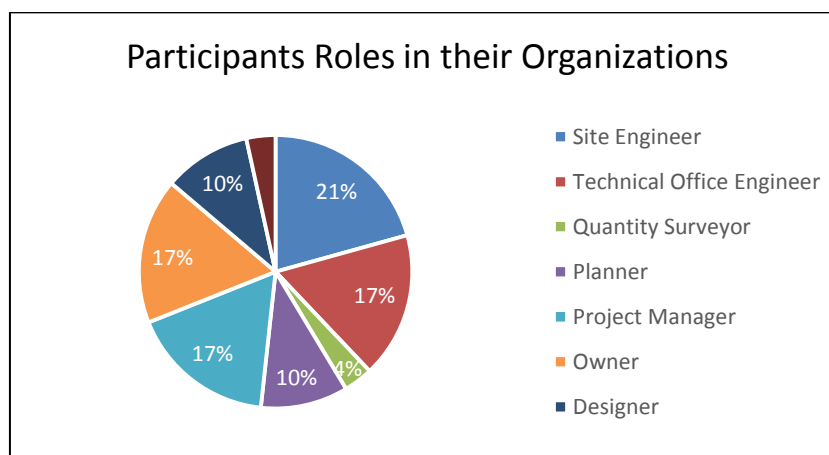


Fig.-6: Survey's Participants Roles in their Organizations

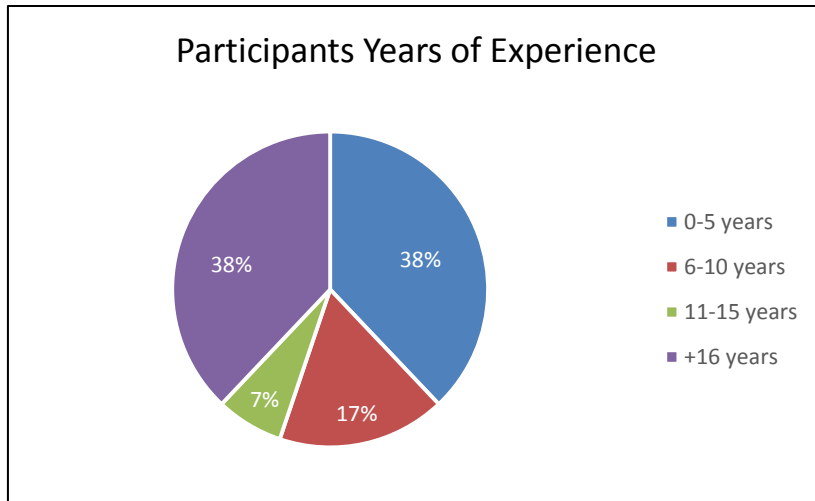


Fig.-7: Survey's Participants Years of Experience in Egypt

In the second part of the questionnaire, it was found that approximately 90% of the respondents have confronted time overruns in their years of experience. Approximately, half of the respondents that faced delays in their construction projects stated that they faced a project at least with delays more than 30% of the project original duration. In addition, approximately a quarter of the respondents that faced delays in their construction projects stated that they faced a project at least with delays more than 0% and less than 9% of the project original duration. The rest of the respondents have confronted time overruns between 10% and 29% of the project original duration.

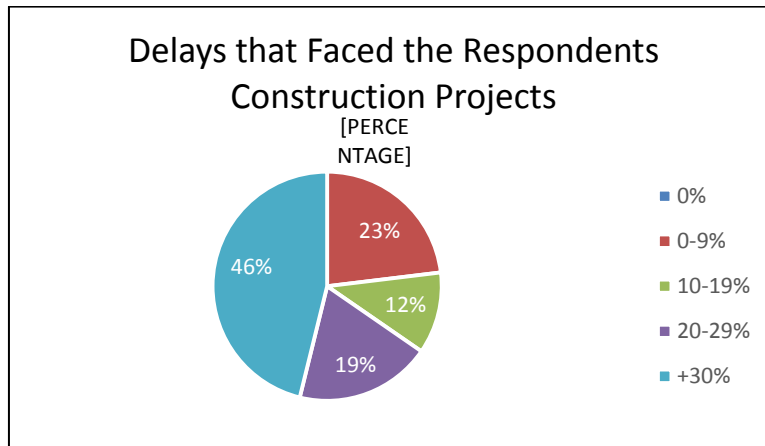


Fig.-8: Portion of Delays that Faced the Respondents in At Least One Project of the Original Duration

In general, the respondents were divided into three approximate equal categories to identify the delays as a portion of the project original duration. However, the respondents agreed that time overruns occur in construction projects in Egypt even if they did not face it before.

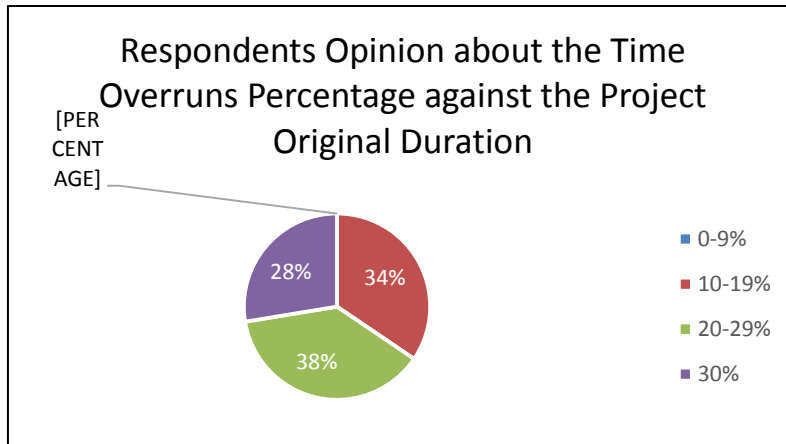


Fig.-9: Respondents Opinion about the Time Overruns Percentage against the Project Original Duration.

The last question of part 2 was asking about the participants' opinion about if the construction delays have changed between this decade and the previous one or not. 24 out of 29 respondents agreed that the delays causes have changed between these two periods in Egypt's construction projects.

Part 3 discussed the differences of the participants' opinions to effects of the political, economic and social events in Egypt of the construction industry durations. Based on the respondents' answers, it was found that for the political events in 2011 in Egypt, approximately 75% of the respondents believe that those events affected the construction projects durations. More details are presented in Figure 4-7. Similarly, for the political events that occurred in 2013, the statistics were not too different from the 2011 events where, approximately 75% of the participants agreed that the political events in 2013 affected the durations of the construction projects in this period as presented in Figure 4-8.

With accordance to the currency sinking that occurred in 2017 in Egypt, 16 out of 29 respondents strongly agreed that this problem affected the construction durations heavily. Six respondents agreed that the durations of the construction projects in Egypt were affected by this problem. Only two participants disagreed that the effect of the currency sinking on the construction projects in Egypt. Likewise, the Covid-19 pandemic has its share on the survey's questions. Most of the respondents either strongly agree or agree that the Covid-19 pandemic affected the durations of the construction projects in Egypt with approximately an accumulative 22 responses out of 29. Similar to the currency sinking in 2017, only 2 respondents disagreed that the Covid-19 pandemic has affected the construction projects durations negatively. More details regarding the responses on the currency sinking and the Covid-19 pandemic are presented

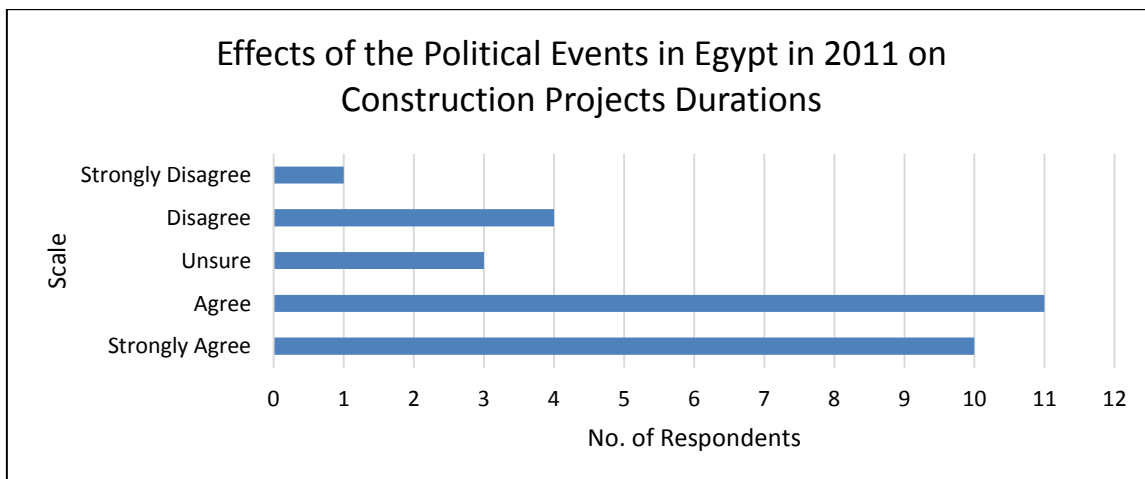


Fig.-: Effects of the Political Events in Egypt in 2011 on Construction Projects Durations.



Fig.-10: Effects of the Political Events in Egypt in 2013 on Construction Projects Durations

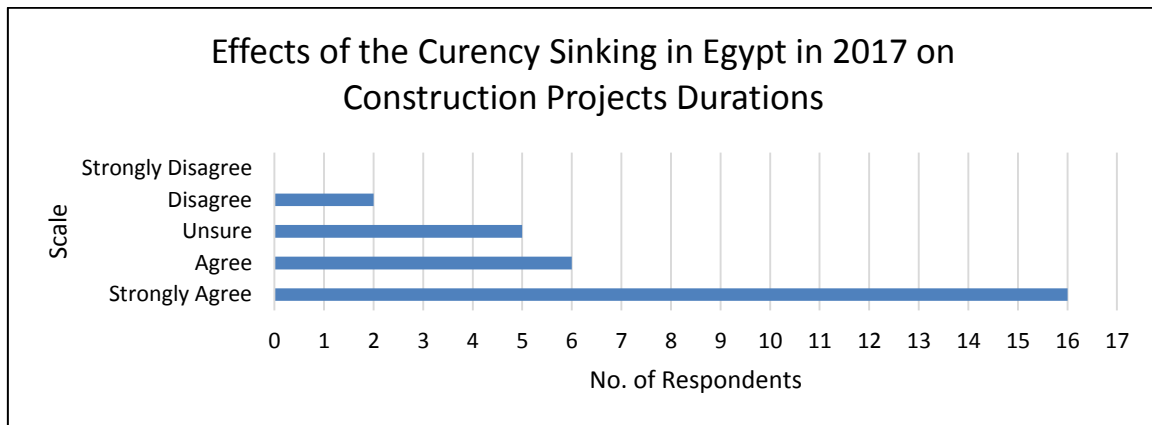


Fig.-11: Effects of the Currency Sinking in Egypt in 2017 on Construction Projects Durations

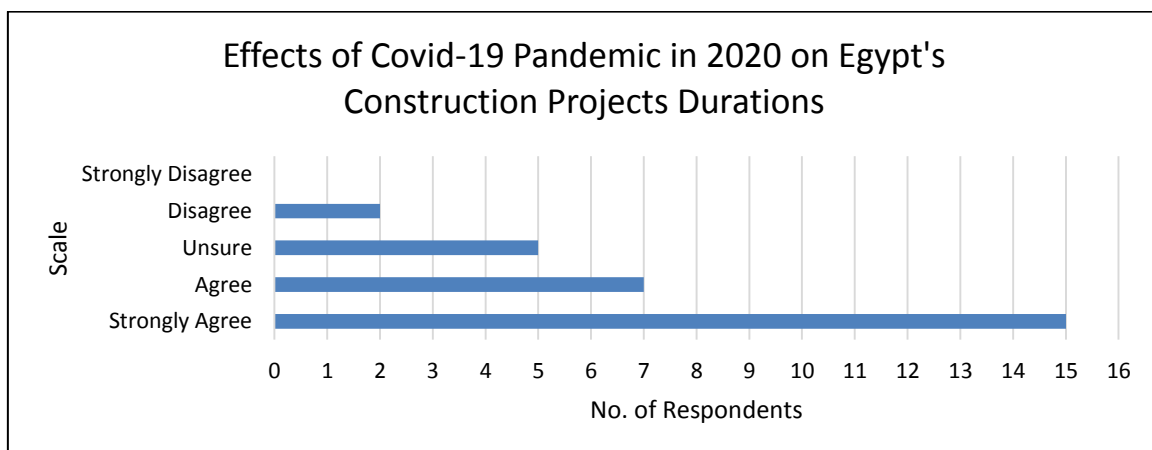


Fig.-12: Effects of Covid-19 Pandemic in 2020 on Egypt's Construction Projects Durations

In order to create the last part of the survey, the top 10 risks from the previous literature as illustrated in Table 4-3 were coded with an ID number. In addition, 'Covid-19' and 'Currency Sinking' were added due to their high impact according to the respondents' answers in the second part as mentioned before and because they were not introduced before in previous Egyptian studies on the same topic. The participants were asked to rank each risk in terms of its probability of occurrence and its impact using a Likert scale consisting of very high, high, moderate, low and very low.

Table.-4: Corresponding Values of the Probability and Impact Scale

<i>Scale</i>	<i>Very High</i>	<i>High</i>	<i>Moderate</i>	<i>Low</i>	<i>Very Low</i>
<i>Corresponding Value</i>	5	4	3	2	1

Each risk has its own figures in relation with the probability of occurrence and impact. Thus, to calculate the weighted mean probability of each risk, the corresponding scale value of each risk was used to weight the average number of responses and then divided by the total number of respondents, which is 29 as illustrated in the following equation:

$$W_p = \frac{\sum_{i=1}^5 Sc_i * n1_i}{29}$$

W_p : Weighted probability

Sc_i : Corresponding value to the scale illustrated in Table 4-4

$n1_i$: Number of participants that chosen the corresponding scale value illustrated in Table 4-4

Similarly, the weighted mean impact was calculated as the following equation illustrate:

Equation III-1: Weighted Impact

$$W_i = \frac{\sum_{i=1}^5 Sc_i * n2_i}{29}$$

W_i : Weighted impact

Sc_i : Corresponding value to the scale illustrated in Table 4-4

$n2_i$: Number of participants that chosen the corresponding scale value illustrated in Table 4-4

In order to attain the severity for each risk, the weighted probability was multiplied with the weighted impact as illustrated in Equation 4-3:

Equation III-2: Risk Severity

$$Risk\ Severity\ (S) = W_p * W_i$$

Thus, based on the severity of each risk, the ranking was conducted from the highest to the lowest severity for each risk to identify the top causes of time overruns in Egypt's construction industry as illustrated in Table 4-5.

According to Tavakol and Dennick (2011), to assure the reliability and internal consistency of the data, Cronbach's Alpha test was utilised on the questions. The Cronbach's Alpha value was equal to 0.883, which is within the 0.7 and 0.95. Therefore, the Cronbach's Alpha test figure is considered acceptable as illustrated in Figure 4-11.

Table-6: Top Causes of Time Overruns in Egypt's Construction Projects from the Survey

<i>ID</i>	<i>Description</i>	<i>Probability</i>	<i>Impact</i>	<i>Severity</i>	<i>Final Ranking</i>
14	<i>Currency Sinking in 2017</i>	4.138	4.034	16.694	1
1	<i>Financial problems of completed work by client</i>	4.069	4.034	16.416	2
13	<i>Covid-19 (Corona Virus) pandemic in 2020</i>	4.000	4.069	16.276	3
8	<i>Changes of scope/ Design by owner during construction</i>	3.897	4.034	15.721	4
2	<i>Contractor's problems in financing the project</i>	3.828	3.828	14.650	5
6	<i>Improper planning and scheduling of project</i>	3.828	3.828	14.650	5
7	<i>Poor supervision of the site by contractor</i>	3.690	3.828	14.122	6
5	<i>Unqualified workforce/ Lack of experience by contractor</i>	3.310	3.586	11.872	7
12	<i>Various shapes of bribes to continue the works</i>	3.414	3.345	11.419	8
11	<i>Tendering strategies</i>	3.448	3.310	11.415	9
10	<i>Low quality of construction materials causing re-doing the work</i>	3.241	3.448	11.117	10
9	<i>Lack of construction materials in market</i>	3.103	3.517	10.916	11
3	<i>Equipment shortage on site</i>	3.000	3.586	10.759	12
4	<i>Failure of equipment</i>	2.690	3.207	8.625	13

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.883	.880	32

Fig.-7: Cronbach's Alpha Test Results for the Online Survey Questions from SPSS

Table 4-6 illustrates a comparison that was performed between the current study rankings from the survey, which represents the period 2011-2020 data, and Abd El-Razek et al. (2008) study rankings which represents the period 2001-2010 due to the lack of the studies in this period.

Table-8: Comparison between the Rankings of Abd El-Razek et al. (2008) Study and This study's Causes of Time Overruns in Egypt's Construction Industry.

<i>Risks</i>	<i>Abd El-Razek et al. (2008) study</i>	<i>Mahadel (2020)</i>
<i>Currency Sinking in 2017</i>	-	1
<i>Financial problems of completed work by client</i>	2	2
<i>Covid-19 (Corona Virus) pandemic in 2020</i>	-	3
<i>Changes of scope/ Design by owner during construction</i>	3	4
<i>Contractor's problems in financing the project</i>	1	5
<i>Improper planning and scheduling of project</i>	7	5
<i>Poor supervision of the site by contractor</i>	-	6
<i>Unqualified workforce/ Lack of experience by contractor</i>	5	7
<i>Various shapes of bribes to continue the works</i>	-	8
<i>Tendering strategies</i>	-	9
<i>Low quality of construction materials causing re-doing the work</i>	-	10
<i>Lack of construction materials in market</i>	6	11
<i>Equipment shortage on site</i>	-	12
<i>Failure of equipment</i>	-	13
<i>Partial payments during construction</i>	4	-
<i>Slow decision-making process</i>	8	-
<i>Subcontractors' schedules interference/ delays</i>	9	-
<i>Delays in preparation of shop drawings and material samples</i>	10	-

According to the comparison in Table 4-6, there is a 50% interference between the causes of delays between this decade and the previous one. The risks 'Improper planning and scheduling of project' and 'Unqualified workforce/ Lack of experience by contractor' have changed places showing that the improper planning and scheduling problem has increased in its severity. Moreover, the risk 'Financial problems of completed work by client' ranking did not change. However, the risk 'Lack of construction materials in market' place became out of the top ten causes of delays after being the sixth cause of delays in 2008. Another risk 'Partial payments during construction' is not in the list of the top ten causes of delays in the period between 2011 and 2020, even though it was the fourth in the period 2001-2008.

1.1 Interviews Analysis and Discussion

Three interviews were conducted with two main questions that were taken from the questionnaire results. The first question asked about the interviewee opinion if the causes of time overruns have changed between the periods 2001-2010 and 2001-2020, knowing that 90% of the respondents agreed that there is a difference. Thus, the responses were as follow:

"I do not agree with that because the main risks did not change, risks like currency sinking and Covid-19 are not usually repeatable" (Technical office engineer of a big size contractor organization - Egypt)

"I agree with the respondents. For instance, due to the global economic crisis in 2008, some construction materials (such as the reinforcement bars) price has changed significantly and then returned back to normal by the beginning of 2010. Unlike this period, the risks that happened in this decade starting from the Egyptian revolution in 2011 and ending by the Covid-19 pandemic have introduced us to a new set of risks that we could not imagine to happen" (Technical office engineer in the Ministry of Awqaf - Egypt)

"I agree with the 90% of the answers, due to the events that occurred in the last ten years including: the political events which affected the industry from 2011 until 2014, currency sinking which happened in 2017 with its effects that continued until 2018 and the Covid-19 pandemic. However, the Corona virus affected the industry

for about 6 months only and I think that it will not be a big issue in the coming days" (Owner engineer of a multi-services organization including contracting and consultancy – Egypt)

According to the respondents' review and the answers provided in Table 4-6, it is highly agreed between the interviewees that the causes of time overruns had changed between both periods. However, one of the interviewees who works in a big size contractor firm in Egypt does not agree with that, because from his point of view, risks such as currency sinking and Covid-19 are not usual risks to occur.

The second question that was asked to the interviewees was with regard to the ranking conducted from the survey. Thus, the ranking was sent to them and then, they were asked to look at the ranking and provide their opinion about the ranking if there are any alterations that should occur in this ranking. Thus, the answers were as follow:

"...the risk with ID: 7 should not be an issue because the consultants supervise the contractors works curiously making no room for mistakes. I think also that the risks with ID: 8 and 3 are related to the inadequate planning of the project. In mega projects, the learning curve increase; therefore, the unqualified workforce becomes qualified within the project duration, meaning that the end date of the project will not be affected significantly. So, the risk with ID: 5 is not a big problem. The risk with the ID: 9 should not be a problem in the construction industry nowadays. In general, after looking at the list, I think that everything is on its place except the risk with ID: 1 which should be in the first place" (Technical office engineer of a big size contractor organization - Egypt)

"...the Covid-19 pandemic should be the number one cause in 2020 due to the government orders to stay at home and to the curfew in April, May and June. These three months caused delays in continuing works including some effects such as transferring materials and labour to working sites." (Technical office engineer in the Ministry of Awqaf – Egypt)

An example also was given by the interviewee X2 regarding the changes in scope by the client stating: "... a project delayed before 2010 due to change of the whole design of a hospital in Mansoura City, Egypt...". (Technical office engineer in the Ministry of Awqaf – Egypt)

With regard to the risk with ID: 7 the interviewee stated that "... a mosque that started to be built in 2015, is not done yet even though, its duration was 3 years. That is because of the poor supervision of the contractor...". (Technical office engineer in the Ministry of Awqaf – Egypt)

For the risk with ID: 9 the interviewee could not see the probability of this risk occurring saying that: "...the construction materials are not low in the market, however, after the Covid-19 pandemic this risk became an issue...". (Technical office engineer in the Ministry of Awqaf – Egypt)

The interviewee concluded: "In general, the list is reasonable, but I would like to add the weather conditions in the third place. That is because the rainy conditions make the roads more clayey making the equipment difficult to move; in addition, some coastal areas in Egypt restrict heavy equipment to access those cities in the summer season. I would like also to add the following risk: 'improper storage of equipment' as the tenth cause of delays in the Egypt's construction projects." (Technical office engineer in the Ministry of Awqaf – Egypt)

"I think that the ranking is great, however I would like to remove the risk with ID: 7 because the consultants supervise the contractors intensively. Although the causes with risk IDs: 3 and 4 happens in Egypt, however they do not deserve to be on this list" (Owner engineer of a multi-services organization including contracting and consultancy – Egypt)

With accordance to the responses, it is found that the contractor and the multi-disciplinary contracting and consulting owner with codes X1 and X3 agreed that the risk 'Unqualified workforce/ Lack of experience by contractor' does not often occur in the Egyptian construction industry due to the stiff supervision of the consultants in Egypt's construction industry. On the contrary, the client representative with the code X2 has provided an example of delays occurring in Egypt's construction projects due to the lack of supervision of the client.

With regard to the Covid-19 pandemic, Interviewee X2 stated that due to the Covid-19 pandemic, the Egyptian government has applied a curfew for 3 months. Moreover, this affected some issues including late delivery of the

materials and transportation issues of the labours causing delays in the construction projects schedules. In addition, some factories that provide materials were closed causing a lack of construction materials in the market in this period. Yet, interviewee X3 stated that the construction industry in Egypt was affected for only 6 months starting from March 2020 and ending by September 2020. However, according to X3 responses, the works started booming again since September 2020 leading to a brighter future for the industry again.

The contractor representative X1 stated that the ranking is reliable except that the risk 'Financial problems of completed work by client' should come in the first place instead of the 'Currency sinking in 2017' risk. The top ten risks from the interview.

Table-9: Interviewee X1 Ranking of Causes of Time Overruns in Egypt's Construction Industry

ID	Description	Final Ranking
1	Financial problems of completed work by client	1
14	Currency Sinking in 2017	2
13	Covid-19 (Corona Virus) pandemic in 2020	3
8	Changes of scope/ Design by owner during construction	4
2	Contractor's problems in financing the project	5
6	Improper planning and scheduling of project	5
7	Poor supervision of the site by contractor	6
5	Unqualified workforce/ Lack of experience by contractor	7
12	Various shapes of bribes to continue the works	8
11	Tendering strategies	9
10	Low quality of construction materials causing re-doing the work	10

ID	Description	Final Ranking
14	Currency Sinking in 2017	1
1	Financial problems of completed work by client	2
13	Covid-19 (Corona Virus) pandemic in 2020	3
15	Weather Conditions	3
8	Changes of scope/ Design by owner during construction	4

The interviewee X2 who represents the client have added some alterations to the survey's ranking. The modifications included adding the weather conditions as the risk number three on the list alongside with the Covid-19 pandemic. Moreover, the interviewee X2 added the risk of 'Improper storage of equipment' as risk number sharing its place with current 10th place risk on the ranking provided from the survey.

Table-10: Interviewee X2 Ranking of Causes of Time Overruns in Egypt's Construction Industry

2	Contractor's problems in financing the project	5
6	Improper planning and scheduling of project	5
7	Poor supervision of the site by contractor	6
5	Unqualified workforce/ Lack of experience by contractor	7
12	Various shapes of bribes to continue the works	8
11	Tendering strategies	9
16	Improper storage of equipment	10
10	Low quality of construction materials causing re-doing the work	10

The last interviewee with the code X3, who represents the contractors and consultants due to the interviewee's nature of work, has only removed three causes of time overruns from the list without changing the positions of the risks in the ranking. The removed risks were 'Poor supervision of the site by contractor', 'Equipment shortage on site' and 'Failure of equipment'. Yet, the interviewee X3 believed that these risks occur in Egypt's construction industry, however, the interviewee X3 does not have the same severity as the other risks.

Table-11: Interviewee X3 Ranking of Causes of Time Overruns in Egypt's Construction Industry

<i>ID</i>	<i>Description</i>	<i>Final Ranking</i>
14	<i>Currency Sinking in 2017</i>	1
1	<i>Financial problems of completed work by client</i>	2
13	<i>Covid-19 (Corona Virus) pandemic in 2020</i>	3
8	<i>Changes of scope/ Design by owner during construction</i>	4
2	<i>Contractor's problems in financing the project</i>	5
6	<i>Improper planning and scheduling of project</i>	5
5	<i>Unqualified workforce/ Lack of experience by contractor</i>	6
12	<i>Various shapes of bribes to continue the works</i>	7
11	<i>Tendering strategies</i>	8
10	<i>Low quality of construction materials causing re-doing the work</i>	9
9	<i>Lack of construction materials in market</i>	10

Even though, each interviewee who represents a certain stakeholder or more provided their own ranking, these rankings are similar to each other in most of the reasons. This leads to the final ranking that is adopted from the survey's respondents which is as follow: (1) Currency Sinking in 2017, (2) Financial problems of completed work by client, (3) Covid-19 (Corona Virus) pandemic in 2020, (4) Changes of scope/ Design by owner during construction, (5) Contractor's problems in financing the project alongside with Improper planning and scheduling of project (6) Poor supervision of the site by contractor, (7) Unqualified workforce/ Lack of experience by contractor, (8) Various shapes of bribes to continue the works, (9) Tendering strategies and, (10) Low quality of construction materials causing re-doing the work. Table 4-10 illustrates the final ranking of the top causes of delays in Egypt's construction industry.

Table-12: Top 10 Causes of Time Overruns in the Construction Industry of Egypt

<i>ID</i>	<i>Description</i>	<i>Probability</i>	<i>Impact</i>	<i>Severity</i>	<i>Final Ranking</i>
14	<i>Currency Sinking in 2017</i>	4.138	4.034	16.694	1
1	<i>Financial problems of completed work by client</i>	4.069	4.034	16.416	2
13	<i>Covid-19 (Corona Virus) pandemic in 2020</i>	4.000	4.069	16.276	3
8	<i>Changes of scope/ Design by owner during construction</i>	3.897	4.034	15.721	4
2	<i>Contractor's problems in financing the project</i>	3.828	3.828	14.650	5
6	<i>Improper planning and scheduling of project</i>	3.828	3.828	14.650	5
7	<i>Poor supervision of the site by contractor</i>	3.690	3.828	14.122	6
5	<i>Unqualified workforce/ Lack of experience by contractor</i>	3.310	3.586	11.872	7
12	<i>Various shapes of bribes to continue the works</i>	3.414	3.345	11.419	8
11	<i>Tendering strategies</i>	3.448	3.310	11.415	9
10	<i>Low quality of construction materials causing re-doing the work</i>	3.241	3.448	11.117	10
9	<i>Lack of construction materials in market</i>	3.103	3.517	10.916	11
3	<i>Equipment shortage on site</i>	3.000	3.586	10.759	12
4	<i>Failure of equipment</i>	2.690	3.207	8.625	13

V. CONCLUSION

It was found that the top ten causes of time overruns in Egypt's construction industry are as follow: (1) Currency Sinking in 2017, (2) Financial problems of completed work by client, (3) Covid-19 (Corona Virus) pandemic in 2020, (4) Changes of scope/ Design by owner during construction, (5) Contractor's problems in financing the project alongside with Improper planning and scheduling of project (6) Poor supervision of the site by contractor, (7) Unqualified workforce/ Lack of experience by contractor, (8) Various shapes of bribes to continue the works, (9) Tendering strategies and (10) Low quality of construction materials causing re-doing the work. The interviewees who represented different stakeholders' opinions have almost agreed on most of the causes of time overruns as found from the survey with only very small changes on the list. It was also found as agreed from the survey, interviews and previous literature that the causes of delays have changed between the periods 2001-2010 and 2011-2020.

With regard to the Covid-19 pandemic effects on the construction industry, it was found from the previous literature that there is no sufficient research on this matter because it is very recent. However, the interviewees stated that due to the government curfew, the projects have suffered delays in this period because of difficulties in labour transportation, materials delivery and closed suppliers' factories. Even with these effects, an interviewee stated that the pandemic would not affect the construction projects in the coming days because the government and the people have learned to deal with the problem more efficiently.

Limitations

Due to the limited time that this research was conducted in, some issues have emerged. For instance, the sample size that was used in the online survey was not big with only 29 valid responses to the questionnaire. The survey was distributed to 58 participants with different organisations and different experience levels; however, most of the responses were from contractors and two age groups. Another limitation that was faced in this research was the Covid-19 pandemic. This led to conducting phone interviews instead of face-to-face interviews. Although the research studied the construction projects in Egypt, it did not study a specific sector in the construction of a specific size of projects.

Recommendations

Based on the research findings, it is recommended for the clients, contractors and consultants the following:

- With accordance to the risk 'financial risks of completed work by client', it was found that it placed the second risk in severity in the periods 2001-2010 and 2011-2020. Thus, the clients are recommended to try to solve this problem by using better methods of financing their projects.
- Yet, the risk 'Contractor's problems in financing the project' has ranked fifth in this study after being the first in Abd El-Razek et al. (2008) study which represents the period 2001-2010. However, it is still on the list. Therefore, the contractors are recommended to enhance their cash flow calculations to overcome this problem.
- The risk 'Tendering strategies was not on Abd El-Razek et al. (2008) list of the top causes of time overruns in Egypt's construction industry. However, it appeared in this research's list in the ninth place. Therefore, the consultants are recommended to find better methods of choosing the contractors based on the project nature.

With regard to future research, the following is recommended:

- To study the time overrun problem in more specified areas of construction projects instead of general construction projects. For instance, it is recommended to study the causes of this problem in mega construction projects in Egypt due to the mega projects that are being conducted in Egypt including the New Administrative Capital of Egypt.
- To study the effects of the Covid-19 pandemic in the construction industry in general and to provide solutions to learn how to deal with future pandemics.

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