DELAY ANALYSIS FRAMEWORK FOR RESIDENTIAL BUILDING CONSTRUCTION IN ABU DHABI, UNITED ARAB EMIRATES

SHAHNAZ ALI ABDALLA MOHAMED

A thesis submitted in fulfilment of the
requirements for the award of the degree of
Doctor of Philosophy

Razak Faculty of Technology and Informatics
Universiti Teknologi Malaysia

JANUARY 2023

DEDICATION

To my beloved Mother, Father, Husband and Daughters

To the dedicated Assoc. Prof. Ts. Dr. Mohamad Syazli Fathi

To the dedicated Prof. Dr. Astuty binti Amrin

To the dedicated Dr. Abdul Ghadir Mahmoud.

ACKNOWLEDGEMENT

I would like to thank my supervisors Assoc. Prof. Dr. Mohamad Syazli Fathi and Prof. Dr. Astuty binti Amrin for all the technical support they extended to me during my study. I would also like to thank all the individuals that have contributed directly and indirectly to the completion of this research. Also, my thanks go to the members of UTM for their assistance and support during my PhD study journey. Finally, I should not forget to thank my friends for their continuous encouragement and support.

ABSTRACT

The delay analysis framework consolidates diverse techniques and methods to achieve automated schedule analysis and damage calculation. The aim of this study is to develop a delay analysis framework to improve the claim processes for residential construction projects in Abu Dhabi (UAE). Previous research shows that 50% of the construction projects in the UAE encountered delays and were not completed on time. Delay Analysis Method (DAM) has been used in the construction industry to analyse the causes and effects of delays and plays a significant part of the claim process. The objectives of the study are to identify the current practices of Delay Analysis Method for residential building construction claims in the UAE, analyse the challenges of this method and determine the selection practices for the claims. The focus of the study is to develop an appropriate delay analysis framework in order to improve claim processes in residential construction projects. The research involved five case studies including one community villa project and four residential building projects in Abu Dhabi, UAE. The research instruments used were interviews and surveys involving 200 project stakeholders (consultants and contractors) who are working in residential construction projects in Abu Dhabi, UAE. Thematic analysis was applied to analyse the interviews with the consultants and the data was analysed using NVivo software. Meanwhile, the quantitative data from the survey was analysed using descriptive statistical analysis. The research found that most of the participants (179=83.3%) usually used Windows/Time Impact Analysis. The participants indicated that lack of adequate project information is a consistent obstacle. Majority of them (168=85.28%) indicated that contractual requirements are a strong factor for selecting an effective delay analysis method/technique. To develop the delay analysis framework, most of them revealed that using a suitable Delay Analysis Method and skilled delay analysts will save time, cost and effort. The findings from this study contribute to the body of knowledge as the framework produced is pertinent for future studies that explore ways to overcome the obstacles of delay analysis in order to improve claim processes for a wide range of projects in Abu Dhabi.

ABSTRAK

Rangka kerja analisis kelewatan menyatukan pelbagai teknik dan kaedah untuk mencapai analisis jadual automatik dan pengiraan kerosakan. Matlamat kajian ini adalah membangunkan rangka kerja analisis kelewatan untuk menambah baik proses tuntutan bagi projek pembinaan kediaman di Abu Dhabi (UAE). Penyelidikan sebelum ini menunjukkan bahawa 50% daripada projek pembinaan di UAE menghadapi masalah kelewatan dan tidak disiapkan tepat pada masanya. Kaedah Analisis Kelewatan (DAM) telah digunakan dalam industri pembinaan untuk menganalisis punca dan kesan kelewatan dan memainkan peranan penting dalam proses tuntutan. Objektif kajian ini adalah mengenal pasti amalan semasa Kaedah Analisis Kelewatan untuk tuntutan pembinaan bangunan kediaman di UAE, menganalisis cabaran kaedah ini dan menentukan amalan pemilihan untuk tuntutan. Fokus kajian adalah membangunkan rangka kerja analisis kelewatan yang sesuai untuk menambah baik proses tuntutan dalam projek pembinaan kediaman. Penyelidikan ini melibatkan lima kajian kes termasuk satu projek vila komuniti dan empat projek bangunan kediaman di Abu Dhabi, UAE. Instrumen kajian yang digunakan ialah temu bual dan tinjauan yang melibatkan 200 pihak berkepentingan projek (perunding dan kontraktor) yang bekerja dalam projek pembinaan kediaman di Abu Dhabi, UAE. Analisis tematik telah digunakan untuk menganalisis temu bual dengan perunding dan data dianalisis menggunakan perisian NVivo. Data kuantitatif melalui tinjauan pula, telah dianalisis menggunakan analisis statistik deskriptif. Kajian ini mendapati kebanyakan peserta (179=83.3%) menggunakan Analisis Kesan Masa/Windows. Para peserta menunjukkan bahawa kekurangan maklumat projek yang mencukupi adalah halangan yang konsisten. Majoriti daripada mereka (168=85.28%) menunjukkan keperluan kontrak adalah faktor yang kukuh untuk memilih kaedah/teknik analisis kelewatan yang berkesan. Untuk membangunkan rangka kerja analisis kelewatan, kebanyakan mereka mendedahkan bahawa penggunaan Kaedah Analisis Kelewatan yang sesuai dan penganalisis kelewatan mahir berupaya menjimatkan masa, kos dan usaha. Dapatan daripada kajian ini menyumbang kepada badan pengetahuan kerana rangka kerja yang dihasilkan adalah relevan untuk kajian masa depan yang meneroka cara mengatasi halangan-halangan analisis kelewatan untuk menambah baik proses tuntutan pelbagai projek di Abu Dhabi.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AACEI	-	Association for the Advancement of Cost Engineering International
BIM	-	Building Information Model
CTC	-	Civil Transaction Code
CD	-	Concurrent Delay
CCD	-	Contractor Caused Delay
CP	-	Critical Path
CPM	-	Critical Path Method
CPM	-	Critical-Path-Method
DAMs	-	Delay Analysis Methodologies
DAMSA	-	Delay Analysis Methodologies Selection Advisor
EF	-	Early Finish
ES	-	Early Start
EDAM	-	Effect Based Delay Analysis Method
EPS	-	Enterprise Project Structure
ELM	-	Equal Liability Method
EIC	-	Event Identity Concept
EC	-	Excusable Compensable
EC	-	Excusable Compensable
EN	-	Excusable Non-Compensable
EOT	-	Extension of Time
FIDIC	-	Fédération Internationale Des Ingénieurs Conseils
AACE	-	International Primavera Project Management
IDWAT	-	Isolated Daily Window Analysis Technique
IDT	-	Isolated Delay Type
LF	-	Late Finish
LS	-	Late Start
LD	-	Liquidated Damages
MIDT	-	Modified Isolated Delay Technique
NE	-	Non - Excusable Delays

NCD	-	Non-Concurrent Delay
SQL	-	Oracle and Microsoft Server
OBS	-	Organizational Breakdown Structures
OCD	-	Owner Caused Delay
PSP	-	Planning and Scheduling Professional
P6	-	Primavera Project Management
P3	-	Primavera Project Planner
SCL	-	Society of Construction Low
SD	-	System Dynamic Technique
TOC	-	Taking Over Certificate
TPCD	-	Third Party-Caused Delays
TIA	-	Time Impact Analysis
TIA	-	Time Impact Analysis
TF	-	Total Float
WBS	-	Work Breakdown Structures

LIST OF SYMBOLS

PD	-	As- Planned Duration
(AAD)	-	All-Events adjusted Duration
(CAD)n	-	Contractor Adjusted Duration
(i)	-	Day
(OAD)n	-	Owner Adjusted Duration
(TAD)n	-	Third-Party Adjusted Duration
°C	-	°C = 32 °F. The temperature
A	-	A-weighted frequency response
ADi-1	-	Actual Project Duration
B	-	Standards for values which indicates the direction of the relationship either positive or negative.
BDi	-	Baseline Duration
C	-	Confidence interval, expressed as a decimal (e.g. 0.04 = ±4)
D (i)	-	Delay
dB	-	Decibel
df	-	Degrees of Freedom
DiEC	-	Difference between impacted schedule and its Baseline schedule due to EC delays
DiEN	-	Difference between impacted schedule and its Baseline schedule due to EN delays
DiNE	-	Difference between impacted schedule and its Baseline schedule due to NE Delays
F	-	F-ratio or F-value
i: 0< i	-	Number of analysis periods
IDiEC	-	Impacted Schedule duration for analysis period i due to EC delays
IDiEN	-	Impacted schedule duration for analysis period i due to EN delays
Leq	-	Equivalent continuous noise level

Lmax, fast	-	The maximum level with A-weighted frequency response and Fast time constant
M	-	Means
MWh	-	Energy in Watt-Hours
N	-	Stands for total number of participants
n	-	Frequency
P	-	Percentage picking a choice, expressed as decimal
R	-	Correlation coefficient
R Contractor	-	Responsibility of Contractor due to NE delays
R Square	-	Shows the variance between the variables
R Owner	-	Responsibility of owner due to EC and EN delays
SD	-	Standard Deviations
SF(i)	-	Smallest Float
Sig	-	Significant value
SS	-	Sample Size
Std. Error	-	Standard error of the analysis
Z	-	Z value (e.g. 1.96 for 95% confidence level)

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Research Background

In order to achieve accurate schedule analysis and damage estimate, a delay analysis framework incorporates a number of methodologies (Abu-Osbeh, 2011). It is essential to combine framework for delay analysis substances to be assumed in a timely approach (Ibrahim Nasr, 2013). However, the increased complexity of current development projects and the project delays in the United Arab Emirates (UAE) mean that delays and cost exemptions have become common realities in the construction industry (Shabbar, 2017). Thus, researchers and practitioners have been inspired to use many methods to determine project delays and allocate the responsibility for them to the stakeholders (Sears, 2015).

Over the years, delay in construction projects have been a persistent source of concern in the construction industry. This has led construction practitioners and researchers to develop various approaches and techniques for identifying the major causes of these regular challenges (Fakunle, 2020). Construction industry development has not been achieved due to the numerous challenges it faces. Most of the difficulties affecting the construction industry worldwide are to do with project execution challenges. The common problems of low productivity, delays and cost overruns have been over-researched with very similar results (Gyadu-Asiedu, 2021).

Saudi Arabia suffers from some major problems that affect its role in building up the domestic economy. The study found that disagreements over contracts was one of the key delay causes in most of the residential building projects in Saudi Arabia (Mahamid, 2016). The construction industry in the UAE has improved as compared to the other Middle East Countries since it is linked with growing revenues from the Oil & Gas industry. Due to the current economic conditions in the UAE, the execution of

mega residential, commercial and infrastructure projects is handled by national and international contractors (Alhammadi, 2020).

Residential building projects in India have huge budget costs for customers and, because of an absence of commitment, residential building projects are not delivered as promised. Delay is one of the major problems confronting the Indian Construction Industry with more than 55% of residential building projects experiencing time overruns. Causes of late delivery include lack of skilled labour, variations in design, rework due to faults, cost increases, poor planning etc. Such challenges have a serious influence on residential building projects under development (Singh, 2018).

A study revealed that 70% of residential building projects in Saudi Arabia encountered delay, rising to 80% in Qatar (Memon, 2020). Today, residential projects are receiving considerable attention in order to supply the demand, and residential projects in the UAE are experiencing cost and time overrun concerns (Namous, 2021). Only 30% of residential construction projects are completed within the specified cost and schedule due to poor cost performance (Alhammadi, 2020).

Accurate analysis of delays and apportionment of responsibility is of utmost significance. Stakeholders in construction contracts regularly use various delay analysis methods and techniques to substantiate their entitlement to an extension of time or liquidated damages. Technical analyses of delays implemented by the parties afford different results, even if the parties implement similar delay analysis methods, due to the absence of accurate analysis (Bektas, 2021). The Society of Construction Law (SCL) in the UK has recognized some factors that must be considered in selecting a method of delay analysis that considers the circumstances related to the contracts, the nature of the delay events, the value of claims and the delay analyst's experience (Umar, 2020). In the USA, the Association for the Advancement of Cost Engineering International (AACEI) recommended using the Time Impact Analysis Method (TIA) for delay analysis (BDAIWI, 2018). For residential building projects in the UAE, delays and cost exemptions have become common realities. Thus, researchers and practitioners have been inspired to use many methods to determine project delays and

allocate the responsibility for them to the stakeholders (Johnson, 2020). However, the management of claims and delays is not compliant with international standards and best practices. Two delay analysis methods regularly used to settle claims for residential building projects in the UAE are Time Impact Analysis (TIA) and Impacted As-planned Schedule Analysis (Abdelhadi, 2019).

Delay analysis involves both simple and complex methods in presenting the delay claim, such as the Global Impact Technique (Perera, 2016), the Net Impact Technique (Alshammari, 2017), As-planned vs. As-built Schedule Analysis (Yusuwan & Adnan, 2013), Impacted As-planned Schedule Analysis (Braimah, 2013) and Collapsed 'But-for' As-built schedule analysis (Al-Gahtani, 2006). The current delay analysis frameworks do not address the impact of resource distribution and the delay analysis does not involve acceleration (Golnaraghi, 2011). Another delay analysis framework called the Integrated Forensic Delay Analysis Framework was developed by Muhamad (2011) to recognize delays, document their related information, resolve the consequence of delays on the work period and settle on responsibilities, determine damages and use the delay analysis method to decrease cost and time and improve accuracy.

The focus of this study is to develop an appropriate delay analysis framework in order to improve claim processes in residential construction projects. The research addresses five case studies including one community villas project and four residential building projects in Abu Dhabi, UAE. The research method involves interviews and a questionnaire survey sent to project stakeholders (consultants and contractors) working in residential construction projects in Abu Dhabi.

1.2 Problem Statement

Delays in completing residential building construction projects occur for various reasons worldwide and the United Arab Emirates (UAE) is no exception. Changes in the agreed scope of work, the financial challenges faced by the owners and their lack of experience were identified as the top three causes of time delays in a

survey of 450 private residential projects in Kuwait. Variations in design, payment delays, poor planning and scheduling, lack of site management by the contractor, labour shortages and contractor financial troubles were the causes of 70% of the delays in Saudi residential building projects (Johnson, 2020).

A research study conducted by Zaneldin (2020) identified the types, causes and frequency of construction claims for residential building in the UAE using data from 124 claims from a variety of projects. The data were analysed and the results indicate that "change orders" are the greatest frequent cause of claims with an importance index. of 55% while "delay occurred by owner" was ranked second with an importance index of 52.5%. "Planning errors" as a cause of claims was ranked last with an importance index of 32.7%.

In their research study, Abdelhadi and Bajracharya (2019) interviewed a total of eight skilled respondents from five diverse residential building projects in the UAE. The nominated participants were expert in providing a critical perception into the decision-making procedure implemented in practice to choose a delay analysis method. The analysis found that fifty of comes within the UAE encounter delays and don't seem to be completed on time. Furthermore, Motaleb (2013) found that a key challenge for UAE construction firms was the increasing rate of delays in projects. The absence of guidance concerning delay analysis methodologies has, to an extent, hampered improvements in the field of dispute resolution. It has, for example, led to delay analysis becoming an end in itself in huge disputes (Keane, 2015).

The problems that frequently occur in delay analysis could influence the outcomes. These problems include the application of the software used for the delay analysis, the settlement of the concurrent delays and the assessment of delay pacing. Development is required to incorporate these problems in the delay analysis process (Braimah, 2013). Motaleb & Kishk (2010) indicated, "Delays were augmented in the corresponding years". A study conducted by Ibrahim (2013) found that delay analysis is one of the construction industry's problems. Also, it found that numerous researchers have established best practices to deal with this problem but not any of the existing approaches precisely address all of the four common delay problems:

concurrent delay, real time delay, pacing delay and acceleration. Therefore, this study is intended to develop a delay analysis framework that can be simply applied, is able to assign the delay liability, save cost and time and produce an accurate output.

In order to achieve accurate schedule analysis and damage estimate, a delay analysis framework incorporates a number of methodologies (Abu-Osbeh, 2011). However, most of the current techniques are not respond accurately to all of the common delay problems (Ibrahim, 2013). In the UAE, managing delays analysis is not compliant with international principles (Hegazy, 2012). Selection of the delay analysis method depends on the individual view of the delay analyst (Abdlhadi, 2015).

The problems with the delay analysis frameworks for claim process in the UAE are no different from those highlighted by several researchers. According to Abu Osbeh (2011), when the completion of a project is overdue, how to precisely analyse the effect of a delayed activity on the project is a major difficulty for project managers. Existing professional scheduling tools have usually been used to plan and control construction programs; however, they were not chosen for delay analysis which needs several calculation scenarios based on different opinions (Yang, 2017). The findings from numerous researchers showed that the output of delay analysis is often not predictable with one method not being applied commonly over another in all circumstances (Yousefi, 2016). Rustom (2012) found that there are many approaches for analysing the influence of delays on the program of work and merely some are well-recognized and comprehensively theorized to reflect delays and risks. There are several types of delay analysis approaches such as As-planned versus As-built, Collapsed As-built, Impacted As-planned and Time Impact Analysis (Maidi, 2020).

Furthermore, overcoming the ineffectiveness and shortages of the available delay analysis frameworks for a claim process for residential building projects is the motivation for this study. The Conceptual Delay Analysis Framework by Abdelhadi (2015) concentrated on the major recognized methods rather than the accurate delay analysis methods. The Integrated Framework Analysis developed by Golnaraghi (2011) is limited to eighteen common kinds of delay, while the Integrated Forensic Delay Analysis Framework by Abu Osbeh (2011) is complicated due to the

implementation of the Isolated Daily Window Analysis Technique (IDWAT Technique) to estimate delay impacts based on the Equal Liability Method (ELM Method).

1.3 Significance of the Study

The significance of this study includes the significance to the construction industry (residential building construction) and the significance to the body of knowledge, as discussed below.

(i) Significance to the Construction Industry (Residential Building Construction)

In the claims industry, selecting a delay analysis framework is critical. Contractors who are working in residential building construction in Abu Dhabi pay a lot of money to experts to verify their point utilizing delay analysis methodology, and they present it as a time extension to increase their profits. In the meantime, the client is attempting to apply alternative delay analysis approaches to ignore important realities, thereby escalating the contractor's argument. Developing a delay analysis framework for residential building construction in Abu Dhabi is crucial due to the absence of sufficient research into delay analysis in the UAE construction industry.

Furthermore, the developed delay analysis framework will support the delay analysts who are working in residential building projects for contractors, consultants and government firms, such as Abu Dhabi Municipality, to decrease the cost and time for the preparation and determination of a claim using a methodical approach and in a practical manner. Accordingly, the developed delay analysis framework will help to reduce the frequent delays in claim settlements. Therefore, it will improve the claim processes for residential construction projects in the UAE. This situation is attributable, in part, to a lack of research into, and understanding of, delay analysis

frameworks, which has also influenced the development of an appropriate delay analysis framework for building projects in the UAE.

(ii) Significance to the Body of Knowledge

Delay analysis and claim preparation is an expensive and time-consuming procedure that requires several documents in order to identify significant delays encountered throughout a project. Determining the amount of the delay for various parties, also known as delay/schedule analysis, is a challenging and time-consuming procedure that involves assigning responsibilities for project delays and determining the proportion of the delay for various stakeholders. The importance of developing a delay analysis framework is to provide the industry with a well-developed delay analysis framework that is easy to use, has a high ability to assign responsibilities for project delays, saves delay analysis costs, time, effort and resources, is able to deal with concurrent delays and produces accurate results. Realistic case studies from the construction industry will be used to validate the proposed delay analysis framework and improve its appeal. Also, if the suggested delay analysis framework gives accurate results when compared to manually acquired data, it will be more acceptable.

1.4 Research Questions

i. How can the current practices of delay analysis methodology for residential building construction claims in Abu Dhabi, UAE be identified?
ii. Why do contractors in Abu Dhabi, UAE face challenges in applying the current delay analysis methodology for residential building construction claims?
iii. How can the selection practices for a delay analysis methodology for residential building construction claims in Abu Dhabi, UAE be determined?
iv. How can the delay analysis framework for residential building construction claims in Abu Dhabi, UAE be developed and validated?

1.5 Aim of the Study

The aim of this research is to develop a delay analysis framework to improve the claim processes for residential construction projects in Abu Dhabi (UAE). The aim of the study was achieved by identifying the research objectives.

1.6 Research Objectives

i. To identify the current practices within the delay analysis methodology for residential building construction claims in Abu Dhabi, UAE.
ii. To analyse the challenges of a delay analysis methodology for residential building construction claims in Abu Dhabi, UAE.
iii. To determine the selection practices for a delay analysis methodology for residential building construction claims in Abu Dhabi, UAE.
iv. To develop and validate the delay analysis framework for residential building construction claims in Abu Dhabi, UAE.

1.7 Scope of the Study

The construction of residential structures, such as community villa development projects and residential tower projects, being carried out in the UAE is included in the study's scope. This offers a typical sample of the various sorts of construction delays that might affect a project.

For the development of a delay analysis framework in this study, a comprehensive literature review investigates the areas of construction claims to explore the common delay analysis frameworks. The methodology selected to achieve the research objectives comprises techniques including a questionnaire, interviews and five case studies. The aim of this research is to develop a delay analysis framework to improve the claim processes for residential construction projects in Abu Dhabi (UAE).

The aim of the study was achieved by identifying the research objectives. These objectives include identifying the current practices of delay analysis methodology for residential building construction claims in Abu Dhabi and analysing the challenges of delay analysis methodology. Furthermore, the questionnaire was used to meet the research objective for determining the selection practices for a delay analysis methodology in order to develop the delay analysis framework for residential building construction claims in Abu Dhabi.

The research was carried out in Abu Dhabi, the capital of the United Arab Emirates, and was based on the construction of residential buildings. The questionnaires were distributed to the contractor firms who are working in Abu Dhabi and Al Ain (a city in the Eastern Region of the Emirate of Abu Dhabi). The respondents from Al Ain were 4.5% (9 participants) of the total number of questionnaire participants (200) and the remaining respondents (189=94.5) were working in Abu Dhabi. Furthermore, the semi-structured interviews were conducted with the consultant firms working in Abu Dhabi and Al Ain. The respondents from Al Ain were 13.6% (27 participants) from the total number of semi-structured interview participants (200) and the remaining respondents (171=86.4) were working in Abu Dhabi. The five case study projects were located in Abu Dhabi. The semi-structured interviews were conducted in Abu Dhabi with 5 participants. The questionnaire respondents have experience, relevant skills and knowledge in the area of delay analysis and claims in Abu Dhabi. During the survey period, data were gathered from 200 contributors of varying nationalities from contractor companies in Abu Dhabi. The majority of participants were male and the largest nationality groups in the study were Indian, Egyptian, Pakistani and from various other countries. The participants were working in various residential buildings projects in Abu Dhabi. Section 4.2.1(Chapter.4) gives further demographic details for the questionnaire respondents. According to Sürücü (2020), qualified experts are crucial for the research results to be consistent and unbiased. Therefore, care should be taken when choosing experts and practitioners with extensive knowledge should be preferred for the measuring instrument that is intended to be developed.

The data obtained from the questionnaires for the contractors' point of view were examined to fulfil the study objectives. These objectives include identifying the current practices of delay analysis methodology for residential building construction claims in Abu Dhabi and analysing the challenges of delay analysis methodology. Furthermore, the questionnaire was used to meet the research objective for determining the selection practices for a delay analysis methodology in order to develop the delay analysis framework for residential building construction claims in Abu Dhabi.

In Abu Dhabi, a study by El-Sayegh (2020) aimed to identify and assess the major causes of delays in residential building construction in Abu Dhabi and weigh the effectiveness of the methods used for delay analysis. A questionnaire was then developed and distributed to 150 construction professionals. The majority of participants had between 5 to 10 years' experience and 50% of participants were from contractor firms in Abu Dhabi. The respondents for the semi-structured interviews in this study were knowledgeable and expert about the claims concerning residential building construction in Abu Dhabi. Data was gathered from 200 participants of different nationalities from consultant companies in Abu Dhabi. The majority of participants were male and the largest nationality groups in the study were Indian, Egyptian, Sudanese and from various other countries. The participants were working in various residential projects in Abu Dhabi (high-rise buildings, community buildings and construction of villas). The majority of participants were working as Delay Analysts and Planning Managers. Section 4.3.1.6 gives further demographic details for semi-structured interview participants. The data obtained from the semi-structured interviews for the consultant's point of view was examined to fulfil the study objectives. Furthermore, the semi-structured interviews were conducted to meet the research objective for determining the selection practices for a delay analysis methodology in order to develop the delay analysis framework for residential building construction claims in Abu Dhabi.

In Abu Dhabi, a study by Johnson (2020) aimed to provide a better understanding and equalized perception about the challenges of the delay analysis methodology for residential building construction in Abu Dhabi. In Johnson's study, a semi-structured interview was conducted concurrently with eight well-experienced

construction professionals from various well-known and established organizations. The participants included two clients, two design consultants, one project management consultant (PMC), one cost management consultant (CMC) and two main contractors.

The five case studies in this study were chosen to represent common types of residential buildings in Abu Dhabi. The five case studies include four projects for Residential Buildings (Towers) and one project for the construction of Community Villas. Semi-structured interviews were conducted with 5 participants nominated from the five projects and the semi structure interviews were conducted with the contractor for each project. Data were gathered from 5 participants of varying nationalities. The contractor's respondent in project No. 1 who participated in the current study is a Delay Analyst with an overall experience of 20 years in delay analysis practice.

The contractor's respondent from project No. 2 is a Planning Manager with an overall experience of 25 years in delay analysis practice. The contractor's respondent of project No. 3 is a Senior Planning Engineer with an overall experience of 20 years in delay analysis practice. The contractor's respondent from project No. 4 is a Senior Planning Engineer with an overall experience of 20 years in delay analysis practice. The contractor's respondent from project No. 5 is a Senior Planning Engineer with an overall experience of 15 years in delay analysis practice. Section 5.7.1 provides further demographic details on the semi-structured interview participants for the five case studies.

The data obtained from the semi-structured interviews for the contractor's point of view in the five case studies were examined to fulfil the study objectives. Furthermore, the semi-structured interviews were conducted to meet the research objective for determining the selection practices for a delay analysis methodology in order to develop a delay analysis framework for residential building construction claims in Abu Dhabi. Moreover, the study invited five SME participants to meet the fourth objective of the study "To validate the delay analysis framework for residential building construction claims in Abu Dhabi". The data were collected from three SMEs and analysed as shown in section 6.4.2.

The research is limited to residential building projects, such as community villas and residential towers, which serve as an example of projects that face various types of delays during construction, such as compensable (EC), excusable non-compensable (EN), non-excusable delays (NE) and concurrent delays. The survey gathered input and opinions from industry specialists including contractors and consultants who have worked in construction firms in the UAE. In addition, the study solely used data from case studies in the UAE's residential building sector. As a result, the results are confined to the UAE and related residential building projects only. However, this research was based on limited case studies and conclusions can be applied to the same cases or similar case situations. Geographic constraints are considered as another limitation. The research was limited to the UAEs' construction market only. The study did not cover the Middle East and other GCC countries in a broader context.

The aim of this study is to develop a delay analysis framework to improve the claim processes for residential construction projects in Abu Dhabi (UAE). The aim of the study was achieved by identifying the research objectives. A delay analysis framework is built around five criteria: ease of use, ability to assign responsibilities for project delays, the cost, time, effort and resources saved during delay analysis, coping with concurrent delays and application limits.

1.8 Research Methodology

Several measures were taken in order to establish an integrated framework for delay analysis. A comprehensive literature review of construction claims was conducted to study the common delay analysis frameworks. According to Randolph (2018), the goal of conducting a literature review is to provide a framework for relating new discoveries to previous findings in a dissertation's discussion section. Without first identifying the state of previous research, it is hard to determine how new research advances previous study. A qualitative research study involves data collection using instruments such as surveys and semi-structured interviews (Hancock, 2021) to explore the different delay analysis methodologies and to determine the obstacles

facing the contractors in the application of the current delay analysis methodologies. This study included input from industry experts such as contractors and consultants that have worked for construction companies in the UAE as delay analysts, planning engineers and planning managers and were nominated based on their skill, information and experience with delay analysis processes.

Using a literature review, questionnaire, semi-structured interviews and case studies, this study investigated the factors for defining effective delay analysis procedures and evaluating the capability of the delay analysis methodology. In order to achieve accurate schedule analysis and damage estimate, a delay analysis framework incorporates a number of methodologies (Abu-Osbeh, 2011). The research focused on various delay analysis techniques and adopted those that have the capability to solve the obstacles facing the application of the available delay analysis frameworks. Upon interpreting the outcome from the literature review, questionnaires, semi-structured interviews and case studies, the study consolidated the effective delay analysis techniques into a new framework including classification of the common delays, guidelines on delay analysis, performing the delay analysis strategies and calculating the delay damages and liability. A delay analysis framework is established and applied to estimate the influence of diverse sorts of delay on the project period and to allocate responsibility among diverse parties. Then the study built the new delay analysis framework through case studies. Finally, the developed delay analysis framework was validated.

1.9 Thesis Structure

Chapter 1 addresses the research background, the problem statement, the importance of this research, the research objectives, research questions, research scope, limitations and the research structure. Chapter 2 addresses the diverse delay analysis approaches applied by contractors in Abu Dhabi and other countries. In particular, it identifies the obstacles facing contractors in the application of the current delay analysis approaches. By reviewing the literature from the UAE, American and

European contexts, the aim is to provide a solid background for the theoretical concepts of the research areas.

Chapter 3 describes the research methodology which covers the data collection methods through a questionnaire, interviews and five case studies. It discusses the technique for selecting the sample, the sample size and the sampling details as well as the research reliability and validity. The chapter also sheds light on various statistical techniques that have been adopted by the researcher to analyse the data gathered through the questionnaire, interviews and the five case studies. Chapter 4 addresses the data collection and analysis which includes the questionnaire responses from several construction firms in Abu Dhabi. The data analysis helps establish a comparison tool showing the implementation of the current delay analysis approaches in Abu Dhabi and identifying the obstacles that contractors face in using them.

Chapter 5 addresses the data collection and analysis for the semi-structured interviews from several consultant firms in Abu Dhabi. The interviews enabled the collection of substantive views, opinions, perceptions and attitudes on the delay analysis approaches for residential building in Abu Dhabi and provided the flexibility to adapt the questions as necessary. There were sufficient responses from the field.

The key findings from the literature review, five case studies, questionnaires and interviews are discussed in Chapter 6 to ensure that the research objectives and variables were satisfied and the findings validated. The framework development technique, containing framework structures and mechanisms, is also presented in Chapter 6. It explains how the framework works and shows the results. The performance of the framework is also validated in Chapter 6 using physically calculated case studies, some of which were applied in prior researches. Finally, Chapter 7 concludes with a summary of the major scientific accomplishments, a discussion of the limits and makes recommendations for upcoming research.

REFERENCES

Abdelhadi, Y. F. J (2015) *Common Delay Analysis Methods and Factors Influencing the Selection of Such Methods in Construction Projects in the UAE*. PhD Thesis, The British University in Dubai (BUiD), Dubai.

Abdelhadi, Y., Dulaimi, M. F., & Bajracharya, A. (2019) 'Factors Influencing the Selection of Delay Analysis Methods in Construction Projects in the UAE', *International Journal of Construction Management*, 19(4), 329-340.

Abdelrahman, H.H., ALSIDDIG, M.A. and OSMAN, M.A.M (2017) *Planning and Scheduling Professional Using Primavera P6 Case study (Ahmed Qasim Hospital)*. PhD Thesis, AlMughtaribeen University, Sudan

Abu Dhabi Business Centre (2022), *Trade License. A*bu Dhabi Business Centre Website, Retrieved August 8, 2022, from https://www.adbc.gov.ae/CitizenAccess/Cap/CapHome.aspx?module=Licenses&TabName=Licenses&ShowMyPermitList=N&SearchType=ByTradeName&target=tradename

Abu Dhabi Council for Economic Development (2016). *Real Estate Shows Positive Trends.* Abu Dhabi Council for Economic Development Website, Retrieved July20,2022,from https://www.adced.ae/sites/EN/mediacenter/EconomicReviewIssuesPDF/Issue134162013716530625825251l1_en.pdf

Abu Dhabi eGovernment Gateway (2013). *Abu Dhabi Emirate: Facts and Figure s*. Abu Dhabi eGovernment Gateway Website, Retrieved January 15, 2022, from <https://www.abudhabi.ae>

Abu Dhabi Digital Government (2018). *Housing for UAE Nationals.* Abu Dhabi Digital Government Website, Retrieved July 20, 2022, from https://www.abudhabi.ae/portal/public/en/homepage/housing-and-property/housing-for-uae-nationals

Abu Dhabi Urban Planning Council (UPC). (2011). *Abu Dhabi Vision 2030*. Abu Dhabi Urban Planning Council Website, Retrieved July 20, 2022, from http://www.upc.gov.ae

Abu Osbeh, M (2011) *Integrated Forensic Delay Analysis Framework for Construction Projects–Time and Cost Perspectives*, PhD Thesis, Concordia University Montreal, Quebec, Canada.

Alfakhri, A.Y., Ismail, A. and Khoiry, M.A., (2018) 'The Effects of Delays in Road Construction Projects in Tripoli, Libya', *International Journal of Technology*, *9*(4), pp.766-774.

Al-Gahtani, K.S. and Mohan, S.B., (2011) 'Delay Analysis Techniques Comparison', *Journal of Civil Engineering and Architecture*, *5*(8). pp. 740-747

Alhammadi, A.S.A.M. and Memon, A.H., (2020) 'Inhibiting Factors of Cost Performance in the UAE Construction Projects', *International Journal of Sustainable Construction Engineering and Technology*, 11(2), pp.126-132.

Alhojailan, M.I., (2012)'Thematic Analysis: A Critical Review of its Process and Evaluation', *West East Journal of Social Sciences*, 1(1), pp.39-47.

Ali, A.M.E.F. (2015) *A Study on Causes and Management of Claims in the Sudanese Construction Industry*, PhD Thesis, Sudan University of Science and Technology), Sudan.

Al-Mohammad, M. and Jamaludin, O.B., (2018) 'A Review of Causes of Delay in Construction Projects', *International Journal of Engineering & Technology*, 7(4), pp.5078-5083.

Alnaas, K.A.A., Khalil, A.H.H. and Nassar, G.E., (2014)'Guideline for Preparing Comprehensive Extension of Time (EOT) claim', *HBRC Journal*, 10(3), pp.308-316.

Alshammari, S., Al-Gahtani, K., Alhammad, I. and Braimah, N., (2017). A Systematic Method to Analyse Force Majeure in Construction Claims. *Buildings*, *7*(4), pp.1-22.

Alsuliman, J.A., (2019) 'Causes of Delay in Saudi Public Construction Projects', *Alexandria Engineering Journal*, *58*(2), pp.801-808.

Amending, Z.R. and Casita, C.B. (2018) ' Delays in Construction Project: A Review', *IPTEK Journal of Proceedings Series*, (6), pp.1-6.

Amoatey, C.T. and Ankrah, A.N.O., (2017) 'Exploring Critical Road Project Delay Factors in Ghana', *Journal of Facilities Management*, 15(2), pp.110-127.

Arifin, W.N., (2013) 'Introduction to Sample Size Calculation', *Education in Medicine Journal*, 5(2), pp.1-8

Arifin, W.N., (2018) 'A Web-Based Sample Size Calculator for Reliability Studies', *Education in Medicine Journal*, 10(3), pp.1-10

Asim, M., Srivastava, S.D. and Ahmad, S.A (2017) Analysis of Delays in Indian Real Sector Construction Projects and Their Impact on Overall Project Performance. *In NICMAR International Conference On Construction, Real Estate, Infrastructure and Project (CRIP) Management*.10-11November. Pune, India: IEE,1-127.

Baduge, S. and Jayasena, H.S(2012) Application of Concurrency in Delay Claims. *In World Construction Conference*. 28 – 30 June. Colombo, Sri Lanka: IEE, 69-78

Bagdonavicius, V., Kruopis, J., Nikulin, M.S. (2011) *Non-Parametric Tests for Complete Data*. Iste & Wiley: London & Hoboken.

Bala, J. (2016)'Contribution of SPSS in Social Sciences Research', *International Journal of Advanced Research in Computer Science*, 7(6), pp.250-254

BDAIWI, Y.M (2018) *Adopting FIDIC 2017 Red Book Extension of Time Procedure for Construction Projects in the UAE.* PhD Thesis, The British University in Dubai (BUiD), Dubai, UAE.

Bektas, S., Talat Birgonul, M.U.S.T.A.F.A. and Dikmen, I. (2021) 'Integrated Probabilistic Delay Analysis Method to Estimate Expected Outcome of Construction Delay Disputes', *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, 13(1), p.04520037.

Bell, E., Bryman, A. and Harley, B. (2018) *Business Research Methods*. 6th edn.UK: Oxford University Press.

Bell, J. and Waters, S. (2018) *Doing Your Research Project: A Guide for First-Time Researchers*.UK: McGraw-Hill Education.

Birgonul, M.T., Dikmen, I. and Bektas, S. (2015) 'Integrated Approach to Overcome Shortcomings in Current Delay Analysis Practices', *Journal of Construction Engineering and Management*, 141(4), p.04014088.

Birkby, G., Ponte, A. and Alderson, F. (2019) *Good Practice Guide: Extensions of Time*.1st edn. London: RIBA Publishing.

Boone, H.N. and Boone, D.A. (2012) 'Analysing Likert Data', *Journal of Extension*, 50(2), pp.1-5.

Braimah, N. (2013) 'Construction Delay Analysis Techniques—A Review of Application Issues and Improvement Needs', *Buildings*, 3(3), pp.506-531.

Braimah, N. (2014) 'Understanding Construction Delay Analysis and the Role of Preconstruction Programming'. *Journal of Management in Engineering*, 30(5), p.04014023.

Braun, V. and Clarke, V. (2012). *Thematic Analysis*. USA: American Psychological Association.

Bryman, A. (2016) *Social Research Methods*.5th edn. UK: Oxford University Press.

Burr, A. ed. (2016) *Delay and Disruption in Construction Contracts*. 5th edn. London: CRC Press.

Burr, A. ed. (2017) *Delay and Disruption in Construction Contracts: First Supplement*. 5th edn.UK: Taylor & Francis.

Burr, A. and Castro, A.M. (2016) *Delay and Disruption in Construction Contracts*. 5th edn. London: Informa Law from Routledge.

Çevikbaş, M. and Işık, Z. (2021) ' An Overarching Review on Delay Analyses in Construction Projects', *Buildings*, 11(3), p.109.

Chenail, R.J. (2011) 'Interviewing the Investigator: Strategies for Addressing Instrumentation and Researcher Bias Concerns in Qualitative Research', *The Qualitative Report*, 16(1), p255-262.

Chen, L. and Luo, H. (2014) 'A BIM-Based Construction Quality Management Model and its Applications', *Automation in Construction*, 46, pp.64-73.

Chen, Y., Wang, W., Zhang, S. and You, J. (2018) 'Understanding the Multiple Functions of Construction Contracts: The Anatomy of FIDIC Model Contracts', *Construction Management and Economics*, 36(8), pp.472-485.

Chou, H.Y. and Yang, J.B. (2017) Preliminary evaluation of BIM-Based Approaches for Schedule Delay Analysis. *In IOP Conference Series: Materials Science and Engineering*.9-13October.Atlanta, US: IEEE, 062048

Chou, J.S. (2012) 'Comparison of Multipliable Classification Models to Forecast Project Dispute Resolutions', *Expert Systems with Applications*, 39(11), pp.10202-10211.

Clarke, V., Braun, V., & Hayfield, N. (2015) *Thematic analysis. Qualitative psychology: A practical guide to research methods*.3rd edn. London: Sage Publication Ltd.

Clifton, J. (2019) 'Using Conversation Analysis for Organisational Research: A case Study of Leadership-in-Action', *Communication Research and Practice, 5*(4), pp.342-357.

Creswell, J.W. and Creswell, J.D. (2017) *Research design: Qualitative, Quantitative, and Mixed Methods Approaches*. 3rd edn. London: Sage publications.

Davis, B.T. and Ibbs, W. (2017) ' Guidelines for Recovering Home Office Overhead Costs with Emphasis on the Eichleay Formula', *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, 9(1), p.04516009.

Dixit, S. and Sharma, K (2019) Factors Influencing Construction Time Delay on High Rise Projects in India. *Creative Construction Conference.*29June-2July. Budapest University of Technology and Economics, Hungary: IEEE, 329-334.

Durdyev, S. and Hosseini, M.R. (2019) ' Causes of Delays on Construction Projects: A Comprehensive List', *International Journal of Managing Projects in Business*, 13(1), pp.1-27

Durdyev, S., Omarov, M. and Ismail, S. (2017) 'Causes of Delay in Residential Construction Projects in Cambodia', *Cogent Engineering*, 4(1), p.1291117.

Dusso, N.S. and Bayeh, T.W. (2020) ' The Causes and Effects of Delay of Building Construction in Ethiopia, Southern Nation Nationalities of People Region in Gurage Zone (Case of Wolkite Town)', *Building Construction*, 12(1), pp.1-27

Eizeldin, M., Hegazy, M.H., Alhady, A. and Ashraf, S. (2022) ' Analysing Resource Allocation and Levelling in Construction Projects', *American Journal of Engineering Research (AJER)*,11(4), pp. 108-117.

El-adaway, I., Fawzy, S., Ahmed, M. and White, R. (2016) ' Administering Extension of Time Under National and International Standard Forms of Contracts: A Contractor's Perspective', *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, 8(2), p.04516001.

El-Sayegh, S., Ahmad, I., Aljanabi, M., Herzallah, R., Metry, S., & El-Ashwal, O. (2020) 'Construction Disputes in the UAE: Causes and Resolution Methods', *Buildings*, 10(10), p.171.

Fakunle, F.F. and Fashina, A.A.(2020) 'Major Delays in Construction Projects: A Global Overview', PM World Journal, 9, pp.1-15.

Fawzy, S.A. and El-Adaway, I.H. (2013) 'Contract Administration Guidelines for Effectively and Efficiently Applying Different Delay Analysis techniques Under World Bank–Funded Projects', *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, *5*(1), pp.35-44.

Fellows, R.F. and Liu, A.M (2021) *Research Methods for Construction*. New Jersey: Wiley-Blackwell.

Fowler Jr, F.J(2013) *Survey Research Methods*. 5th edn. London: Sage Publications.

Ghimire, S. and Mishra, A.K. (2019) 'Comparative Study of Prospective Delay Analysis Techniques (DATs)', *Saudi Journal of Civil Engineering*, 3(5), pp.84-95.

Golnaraghi, S (2011) *Development of Delays Claims Assessment Model.* PhD Thesis, Concordia University, Montreal.

Gyadu-Asiedu, W., Ampadu-Asiamah, A. and Fokuo-Kusi, A. (2021) 'A Framework for Systemic Sustainable Construction Industry Development (SSCID)', *Discover Sustainability*, *2*(1), pp.1-21.

Hafez, S.M. (2013) 'Simple Delay Analysis Methodologies Selection Advisor for Construction Practitioners (DAMSA)', *International Journal of Education and Research,*1(8), pp.1-8

Hancock, D.R. and Algozzine, B. (2021) *Doing Case Study Research: A Practical Guide for Beginning Researchers*.4th edn. New York: Teachers College Press.

Hasweh, H.N.K (2016) *Prolongation Cost as a Remedy for Construction Contracts Delays.* PhD Thesis, The British University in Dubai (BUiD), Dubai, UAE.

Hegazy, S. (2012) ' Delay Analysis Methodology in the UAE Construction Projects', *PM World Journal*, 1(2), pp.1-17.

Hegazy, S. (2012)', Delay Analysis Methodology in the UAE Construction Project: Delay Claims, Literature Review', *PM World Journal*, 1(2), pp.1-21.

Hilal, A.H. and Alabri, S.S. (2013)', Using NVivo for Data Analysis in Qualitative Research', *International Interdisciplinary Journal of Education*,4(2), pp.181-186.

Ibrahim Nasr. (2013) 'Simple Delay Analysis Methodologies Selection Advisor for Construction Practitioners (DAMSA)', *International Journal of Education and Research,*1(8), pp.1-8

Johnson RM, Babu RI. (2020) ' Time and Cost Overruns in the UAE Construction Industry: A Critical Analysis', *International Journal of Construction Management,* 20(5), pp. 402-11.

Keane, P.J. and Caletka, A.F(2015) *Delay Analysis in Construction Contracts*. Oxford, UK: Wiley Blackwell

Klee, L (2018) *International Construction Contract Law*.2nd edn. New Jersey: John Wiley & Sons.

Kog, Y.C. (2019) 'Construction Delays in Indonesia, Malaysia, Thailand, and Vietnam', *Practice Periodical on Structural Design and Construction*, 24(3), p.04019013.

Kothari, C.R(2020) *Research Methodology: Methods and Techniques*. New Delhi: New Age International

Kshaf, D.A., Mohamed, M.A. and El-Dash, K.M. (2022) 'The Major Problems Between Main Contractors and Subcontractors in Construction Projects in Egypt', *Ain Shams Engineering Journal*, 13(6), p.101813.

Kwatsima, S.A(2017) *An Investigation into the Causes of Delay in Large Construction Projects in Kenya.* PhD Thesis, COETEC, JKUAT, Kenya

Larsen, J.K., Shen, G.Q., Lindhard, S.M. and Brunoe, T.D. (2016)' Factors Affecting Schedule Delay, Cost Overrun, and Quality Level in Public Construction Projects', *Journal of Management in Engineering*, 32(1), p.04015032.

Larson-Hall, J(2015) *A guide to Doing Statistics in Second Language Research Using SPSS and R*.2nd edn. New York: Routledge.

Le, N., Chong, O. and Kashiwagi, D. (2021) 'Using the Best Value Approach to Improve Project Performance in the Vietnam Construction Industry', *Journal for the Advancement of Performance Information and Value*, 13(1), pp.8-8.

Lihong, L (2011) Study on the Present Condition of Construction Claim and Counter Measure. *Procedia Engineering,*18-19August.Dali, China, 13pp.2837-2841.

Maguire, M. and Delahunt, B. (2017) 'Doing A Thematic Analysis: A practical, Step-By-Step Guide for Learning and Teaching Scholars', *All Ireland Journal of Higher Education*, 9(3), pp.1-14.

Mahamid, I. (2016) 'Micro and Macro Level of Dispute Causes in Residential Building Projects: Studies of Saudi Arabia', *Journal of King Saud University-Engineering Sciences*, 28(1), pp.12-20.

Maidi, M.N(2020) *Lean Construction and Delay Analysis Input in Delay Mitigation*. Master Thesis. University of Applied Science, Germany.

Marican, M.S.B.I (2014) *The Effect of Article 390 (2) Of the UAE Civil Code On Liquidated Damages Claims in The UAE Construction Industry*. PhD Thesis, The British University In Dubai (BUiD), Dubai, UAE.

Matseke, D.A. and Khatleli, N.T.H.A.T.I.S.I. (2021) 'Claims Management: Underlying Causes in Mega-Construction Projects. *Proceedings of International Structural Engineering and Construction*, *8*(1), pp.1-6.

Memon, A.Q., Memon, A.H. and Soomro, M.A (2020) 'Contractor's Perception on Factors Causing Cost Overrun in Construction Works of Pakistan', *International Journal of Sustainable Construction Engineering and Technology*, 11(3), pp.84-92.

Miller, C.W(2020) *An Investigation into Subject Matter Expert Elicitation in Cost Risk Analysis*. Master Thesis. Air Force Institute of Technology, Nigeria.

Mitchell, A. and Education, A.E (2018) A Review of Mixed Methods, Pragmatism and Abduction Techniques. *Proceedings of the European Conference on Research Methods for Business & Management Studies*. 12-13July.Italy, pp. 269-277.

Mohajan, H.K. (2017) 'Two Criteria for Good Measurements in Research: Validity and Reliability. *Annals of Spiru Haret University*, 17(4), pp.59-82.

Morris, T.A (2015) T*he Administration of Contractual Delay and Dispute Resolution In The UAE*. Master Thesis, The British University in Dubai (BUiD), Dubai, UAE.

Motaleb, O. and Kishk, M. (2013) 'An Investigation into The Risk of Construction Projects Delays in the UAE', *International Journal of Information Technology Project Management (IJITPM)*, 4(3), pp.50-65.

Muhamad, N.H., Mohammad, M.F., Ahmad, A.C. and Ibrahim, I.H. (2016) 'Delay analysis Methodologies (DAMs) in Delivering Quality Projects: Contractors and Consultants' Perceptions', *Procedia-Social and Behavioural Sciences*, 222(1), pp.121-131.

Munvar, C., Mengistu, D.G. and Mahesh, G. (2020) 'Concurrent Delay Analysis: Methods, Case Law, and Expert Perception', *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, 12(1), p.04519035.

Mydin, M.O., Sani, N.M., Salim, N.A. and Alias, N.M (2014) Assessment of Influential Causes of Construction Project Delay in Malaysian Private Housing from Developer's Viewpoint. *Emerging Technology for Sustainable Development Congress (ETSDC 2014)*. 5August. Bangi, Malaysia: IEEE, 01027.

Namous, E.A. and Al Battah, M (2021) Evaluating the Factors That Cause Cost and Time Overrun in the Residential Construction Projects in the UAE: Project

Manager Perspective. *Proceedings of the 8th Zero Energy Mass Custom Home International Conference*.26-28 October. Dubai, United Arab Emirates: IEEE, 26-28.

Nayak, J.K. and Singh, P. (2021) *Fundamentals of Research Methodology Problems and Prospects*. New Delhi: SSDN Publishers & Distributors.

Nayak, M.S.D.P. and Narayan, K.A. (2019) 'Strengths and Weakness of Online Surveys', *IOSR Journal of Humanities and Social Science*, 24(5), pp.31-38.

Nirwanto, R. (2014) 'Book Review: Questionnaires in Second Language Research', *Journal on English as a Foreign Language*, 4(2), pp.91-95.

Omoush, M.M. (2020) 'Assessing and Prioritizing The Critical Success Factors and Delays Of Project Management Implementation: Empirical Evidence At Construction Projects In Jordan', *International Journal of Business and Management*, 15(10), pp.1-13.

Palinkas, L.A., Horwitz, S.M., Green, C.A., Wisdom, J.P., Duan, N. and Hoagwood, K. (2015) 'Purposeful Sampling for Qualitative Data Collection and Analysis In Mixed Method Implementation Research', *Administration and Policy In Mental Health And Mental Health Services Research*, 42(5), pp.533-544.

Parry, A (2015) *The Improvement of Delay Analysis in The UK Construction Industry*. PhD Thesis, University of Northumbria, Newcastle, United Kingdom.

Perera, N.A., Sutrisna, M. and Yiu, T.W. (2016) ' Decision-Making Model for Selecting the Optimum Method of Delay Analysis in Construction Projects', *Journal of Management in Engineering*, 32(5), p.04016009.

Pushpakumari, M.N.A., Hadiwattege, C. and Withanage, K.T (2021) An Overview of Various Techniques and Approaches of Concurrent Delay Analysis in the Sri Lankan Construction Industry, *International Research Conference*.9-10September. Sri Lanka: IEEE,1-10.

Rahhal, A.Y(2013) *Entitlement to Extension of Time in Cases of Concurrent Delays Under the UAE Law*. PhD Thesis, The British University in Dubai (BUiD), Dubai,UAE.

Randolph, J (2018) 'A Guide to Writing the Dissertation Literature Review', *Anatolia: Turizm Arastirmalari Dergisi*, 29(2), pp.251-264.

Rashid, Y., Rashid, A., Warraich, M.A., Sabir, S.S. and Waseem, A (2019) 'Case Study Method: A Step-by-Step Guide for Business Researchers', *International journal of Qualitative Methods*, 18(1), pp.1-13.

Rathnayake, A. and Ranasinghe, M (2020) 'Evaluating Cost and Time Performance of Sri Lankan Construction Projects', *ENGINEER*, 53(03), pp.79-89.

Reem Investments (2019). Nalaya Villas. *Reem Investments Website*, Retrieved July 20,2022, from http://www.reeminvestments.com/reem-developers/nalaya/

Rezaee, M.J., Yousefi, S. and Chakrabortty, R.K (2019) 'Analysing Causal Relationships Between Delay Factors in Construction Projects: A Case Study of Iran', *International Journal of Managing Projects in Business*.14(2), pp.1-14

Roumeissa, S (2018) ' Identification of Factors Causing Delays in Construction Projects in Algeria', *European Journal of Engineering and Formal Sciences*, 1(1), pp.6-11.

Rubin, R.A (2016) *Review of Construction Schedule Delays by W. Stephen Dale and Robert M. D'Onofrio.* New York: Legal Works.

Rustom, R. (2012) 'Formulation of Generic Simulation Models for Analysing Construction Claims', *Construction Economics and Building*, 6(2), pp.11-19.

Salim, W.N. and Sujana, C.M(2020) Project Delay Analysis of High-rise Building Project in Jakarta. *IOP Conference Series: Earth and Environmental Science*. 18-20 September. Changsha, China: IEE, p. 012051.

Samarah, A. and Bekr, G.A. (2016) 'Causes and Effects of Delay in Public Construction Projects in Jordan', *American Journal of Engineering Research*, 5(5), pp.87-94.

Saunders, M., Lewis, P. and Thornhill, A., 2019. Research Methods for Business Students.

Scott, C.R. (2021) *Training Subject Matter Experts to Make Better Estimates*.8th edn. Harlow: Pearson.

Sears, S. K., Sears, G. A., Clough, R. H., Rounds, J. L., & Segner, R. O. (2015) *Construction Project Management*.6th edn. New Jersey: John Wiley & Sons.

Shabbar, H., Ullah, F., Ayub, B., Thaheem, M.J. and Gabriel, H.F. (2017) ' Empirical Evidence of Extension of Time in Construction Projects', *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, 9(3), p.04517008.

Shadid, M.S.R (2015) *Construction Claims Management in United Arab Emirates Construction Industry*. Master Thesis, Eastern Mediterranean University, Cyprus.

Shibani, A., Mahadel, O., Hassan, D., Agha, A. and Saidan, M. (2021) ' Causes of Time Overruns in the Construction Industry in Egypt', *International Research Journal of Modernization In Engineering Technology And Science (IRJMETS)*, 3(1), pp.510-531.

Siegmund, B. (2014) *Data Analysis: Statistical and Computational Methods for Scientists and Engineers*.4th edn. Switzerland: Springer Cham

Silverman, D. (2015) *Interpreting qualitative data*.5th edn. London: Sage Publications

Simpson, B. (2017) *Pragmatism: A philosophy of practice. The SAGE handbook of qualitative business and management research methods: History and traditions*. London: Sage Publications.

Singh, S., Bala, A., Dixit, S. and Varshney, D. (2018) ' Critical Analysis of Causes of Delay in Residential Construction Projects in India', *International Journal of Civil Engineering and Technology*, 9(1), pp.330-345.

Statistics Centre of Abu Dhabi. (2012). *Abu Dhabi Development Statistics 1960- 2010*. Abu Dhabi: Statistics Centre of Abu Dhabi.

Statistics Centre of Abu Dhabi. (2011). *Building Completion Statistics for Fourth Quarter2011*. Abu Dhabi: Statistics Centre of Abu Dhabi

Statistics Centre of Abu Dhabi. (2012). *Building Completion Statistics for Fourth Quarter2012*. Abu Dhabi: Statistics Centre of Abu Dhabi

Statistics Centre of Abu Dhabi. (2013). *Building Completion Statistics for Fourth Quarter2013*. Abu Dhabi: Statistics Centre of Abu Dhabi

Statistics Centre of Abu Dhabi. (2014). *Building Completion Statistics for Fourth Quarter2014*. Abu Dhabi: Statistics Centre of Abu Dhabi

Statistics Centre of Abu Dhabi. (2015). *Building Completion Statistics for Fourth Quarter2015*. Abu Dhabi: Statistics Centre of Abu Dhabi

Statistics Centre of Abu Dhabi. (2016). *Building Completion Statistics for Fourth Quarter2016*. Abu Dhabi: Statistics Centre of Abu Dhabi

Statistics Centre of Abu Dhabi. (2017). *Building Completion Statistics for Fourth Quarter2017*. Abu Dhabi: Statistics Centre of Abu Dhabi

Statistics Centre of Abu Dhabi. (2018). *Building Completion Statistics for Fourth Quarter2018*. Abu Dhabi: Statistics Centre of Abu Dhabi

Shahsavand, P., Marefat, A. and Parchamijalal, M. (2018) 'Causes of Delays in Construction Industry and Comparative Delay Analysis Techniques with SCL Protocol', *Engineering, Construction and Architectural Management*.25(4), pp. 497-533

Taber, K.S. (2018) 'The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education', *Research in Science Education*, 48(6), pp.1273-1296.

Tan, H.S.A(2010) Evaluating Extension of Time Claims. *W113-Special Track 18th CIB World Building Congress*. 10-13May 2010, Salford, United Kingdom: IEEE, 135-146.

Tarigan, A.P.M (2018) On the Delay Factors of the Private Construction Projects in Medan City. *IOP Conference Series: Earth and Environmental Science*. 11–12 October. Medan, Indonesia: IEEE, 012043

Terry, G., Hayfield, N., Clarke, V. and Braun, V. (2017) *The Sage handbook of qualitative research in psychology*.2nd edn. London: Sage Publications.

Tolmie, A., Muijs, D. and McAteer, E. (2011) *Quantitative methods in educational and social research using SPSS*. UK: McGraw-Hill Education.

Türkakın, O.H., Manisalı, E. and Arditi, D. (2020) 'Delay Analysis in Construction Projects with No Updated Work Schedules', *Engineering, Construction and Architectural Management*, 27(10), pp.2893-2909.

Umar, A.A., Rizeiqi, R.K. and Badr, A. (2020) 'Major Causes Assessment of Construction Delays', *Journal of Engineering, Project, and Production Management*, 10(3), pp.179-186.

Ur Rehman, G (2015) *Causes of Delay in Construction Projects in Abu Dhabi*. Master Thesis, The British University in Dubai (BUiD), Dubai, UAE.

Vogt, W.P., Gardner, D.C. and Haeffele, L.M. (2012) *When to Use What Research Design*. New York: Guilford Press.

Vu, T.Q., Pham, C.P., Nguyen, T.A., Nguyen, P.T., Phan, P.T. and NGUYEN, Q.L.H.T.T. (2020) ' Factors Influencing Cost Overruns in Construction Projects of International Contractors in Vietnam', *The Journal of Asian Finance, Economics, and Business*, 7(9), pp.389-400.

Xiao, Y. and Watson, M., (2019) 'Guidance on Conducting a Systematic Literature Review', *Journal of Planning Education and Research*, 39(1), pp.93-112.

Yang, J. and Kao, C. (2012) ' Critical Path Effect Based Delay Analysis Method for Construction Projects', *International Journal of Project Management*.30(3). pp.385–97.

Yang, J.B. and Teng, Y.L. (2017) ' Theoretical Development of Stochastic Delay Analysis and Forecast Method', *Journal of the Chinese Institute of Engineers*, 40(5), pp.391-400.

Yap, J.B.H., Goay, P.L., Woon, Y.B. and Skitmore, M. (2021) ' Revisiting Critical Delay Factors for Construction: Analysing Projects in Malaysia', *Alexandria Engineering Journal*, 60(1), pp.1717-1729.

Yin, R. K. (2013) *Case Study Research: Design and Methods*.3rd edn. London: Sage Publications.

Yousefi, V., Yakhchali, S.H., Khanzadi, M., Mehrabanfar, E. and Šaparauskas, J. (2016) 'Proposing A Neural Network Model to Predict Time and Cost Claims in Construction Projects', Journal *of Civil Engineering and Management*, 22(7), pp.967-978.

Yumna, S. A (2020) *How to Promote Mediation of Construction Disputes in The UAE*. PhD Thesis, The British University in Dubai (BUiD), Dubai, UAE.

Yusuwan, N. M. and Adnan, H (2013) Assessing Extension of Time Application in Malaysian Construction Industry: Views from professionals. *Asia Pacific International Conference on Environment-Behavior Studies*. 4-6 September, London: IEEE, 54-63.

Zaneldin, E.K.(2020) 'Investigating the Types, Causes and Severity of Claims in Construction Projects in the UAE', *International Journal of Construction Management*, 20(5), pp.385-401.

LIST OF PUBLICATIONS

Scopus Indexed Journal

1. **Abdalla Mohammed. S. A.,** Fathi M.S., *Effective Criteria for Selecting Delay. Analysis Methodologies for Construction Project in Abu Dhabi.* ASEAN Engineering Journal. ASEAN Engineering Journal ISSN: 2286-8151, Vol. 12(2), pp.101-109. Available: http://thedesignengineering.com/index.php/DE/article/view/9011 [**ISSN: 2286-8151**].
2. **Abdalla Mohammed. S. A.,** Fathi M.S., *Delay Analysis Methodologies Used by The Contractors for The Construction's Claim in Abu Dhabi*. Design Engineering Journal ISSN: 0011-9342 Vol. 2022: Issue 01 Year 2022. Available:http://thedesignengineering.com/index.php/DE/article/view/9011 [**ISSN: 0011-9342**].