DELAY CLAIMS - A BIM AND TEXT MINING APPROACH

By

Akram Hammam Mohamed Hammam

A Thesis Submitted to the
Faculty of Engineering at Cairo University
In Partial Fulfillment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY
In
Structural Engineering Department

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2018

DELAY CLAIMS - A BIM AND TEXT MINING APPROACH

By

Akram Hammam Mohamed Hammam

A Thesis Submitted to the
Faculty of Engineering at Cairo University
In Partial Fulfillment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY
In
Structural Engineering Department

Under the Supervision of

Prof. Dr. Moheeb El Said

……..

Professor
Structural Engineering Department
Faculty of Engineering, Cairo University

Dr. Omar El Anwar

……..

Associate Professor
Structural Engineering Department
Faculty of Engineering, Cairo University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2018

DELAY CLAIMS - A BIM AND TEXT MINING APPROACH

By

Akram Hammam Mohamed Hammam

A Thesis Submitted to the
Faculty of Engineering at Cairo University
In Partial Fulfillment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY
In

Structural Engineering Department

Approved by the
Examining Committee

_____
Prof. Dr. Moheeb El Said, Thesis Main Advisor

_____
Prof. Dr. Mohamed Mahdy Marzouk

_____
Prof. Dr. Emad El Said El Beltagy
- Faculty of Engineering, Mansoura University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2018

Engineer's Name: Akram Hammam Mohamed Ham
Date of Birth: 17/05/1967
Nationality: Egyptian
E-mail: akramhammam@hotmail.com
Phone: ……..
Address: …….
Registration Date: 01/10/2012
Awarding Date: …./…./……..
Degree: Doctor of Philosophy
Department: Structural Department
(Construction Management)

Insert photo here

Supervisors:

Prof. Dr. Moheeb El Said
Dr. Omar El-Anwar

Examiners:

Prof. Dr Emad El Said El Beltagy (External examiner)
Prof. Dr Mohamed El Mahdy (Internal Examiner)
Prof. Dr Moheeb El Said (Thesis main advisor)
Dr Omar El Anwar (Member)

Title of Thesis:

Delay Claims - A BIM and Text Mining Approach

Key Words:
Delay Claims; Text Mining; BIM; Data Mining

Summary:

The rising complexity of current construction projects led by an increasing demand from project owners to implement fast-track programmes has led to a surge in the number of claims and disputes. The significant rise in Construction records and data resulted in Claimants and Defendants to experience difficulties to provide credible evidence to substantiate their claims. The aim of this thesis proposes a two-fold process to enhance the delay claim process by introducing; 1) a new methodology for the automatic text classification of project delay claims documents that utilize the activity and Work Breakdown Structure keywords of a given path of a delay event (DE) to train and further predict unlabeled project documents, where Multinomial-Naïve Bayes (MNB) Classification is selected as the supervised learning algorithm; and 2) develop an algorithm to link the delay event related 4DBIM objects with the respective classified documents by extending the non-proprietary Industry Foundation Class (IFC) Schema of a dynamic property set to include delay-related attributes. The proposed two-fold methodology has been implemented on a series of delay claims events in a project; the implementation of the two-stage methodology enhanced the overall performance and efficiency of the delay claim assessment process.

Acknowledgements

To Allah, foremost I bow, for he granted me the ability to complete this work.

I wish to present my deepest acknowledgement to my Professor Dr Moheeb El Said for his significant guidance, support and wise advice and who has followed the development of this thesis closely till it reached fruition.

I also acknowledge the valuable support, guidance, continuous direction and encouragement of Dr Omar El Anwar during the preparation of this thesis.

I also acknowledge the contribution of the upper management of my company who facilitated the application of my case study with broad-minded high spirits.

Dedication

I dedicate this thesis in memory of my Father, Dr Hammam, who inspired me through his dedication to academic research; to my Mother, Dr Ragaa; to my Wife, Ghada; to my Daughter Jaida and Son Adham, who have shared with me throughout the years, my anguish and hard working days and nights to finalise this work.

Table of Contents

List of Tables

List of Figures

Abstract

The significant rise in the scope and complexity of construction projects characterises the current construction industry. The introduction of highly advanced building systems entailed an increase in coordination and planning influenced by increasing demand from project owners to implement fast-track programmes. This has led to a surge in the number of claims and disputes, with opposing parties experiencing impediments in providing credible evidence to substantiate their claims. The aim of this thesis is to introduce a new methodology for the automatic text classification of project delay claims documents to enhance efficiency in the management of the delay claim process. The proposed two-stage methodology utilizes the activity and Work Breakdown Structure keywords of a given path of a delay event (DE) to 1) train and further predict unlabeled project documents, where Multinomial-Naïve Bayes (MNB) Classification is selected as the supervised learning algorithm; and 2) develop an algorithm to link the delay event related BIM objects with the respective classified documents by extending the non-proprietary Industry Foundation (IFC) Schema of a dynamic property set to include delay-related attributes.

The proposed methodology has been implemented on a series of delay claims events of a mega project; the implementation of the two-stage methodology 1) yielded promising results in the performance evaluation measures (precision, recall, and F1-Score) compared to similar text classification models using MNB; 2) extended the IFC schema to incorporate delay analysis attributes including stage-1 classified documents with the BIM objects pertaining to a specific delay event enhancing the overall performance and efficiency of the delay claim assessment process.

Chapter 1 : Introduction

1.1. Background

Disputes are unsettled claims arising between the Claimant and the Defendant after failure to reach an amicable settlement. From the different categories of contractual construction claims, delay and disruption claims are among the most complex to substantiate. The delay claims encompass different challenges involving the assimilation and detailed investigation of a vast number of documents pertaining and correlating them to the delay event under study, moreover delay claim consume time and cost consuming in current projects which are constrained by their budget and time.

As a result of these challenges, claims and disputes (Mediation, Arbitration, etc.) in the majority of project delivery systems (such as Design-Build, Engineering Procurement and Construction (EPC), etc.) have surged considerably. This surge was influenced by the failure of project parties to effectively manage their claim process. The failure may amount to substantial costs hindering the financial abilities of both parties.

1.2. Problem Statement

From the different categories of contractual construction claims, delay and disruption Claims are the most complex and most difficult to substantiate, requiring a well-established record keeping process in order to substantiate the Contractor's rights to claim. In delay claims, Claimant is required to demonstrate incurring delay and damage due to the different types of delay (excusable/non-excusable/neutral). Consequently, Contractors may experience substantial damages due to failure to substantiate their claims and provide sufficient evidence in a timely manner. The problems encountered during the delay claims process are summarized in the following subsections.

1.2.1. Background

Claimants incur significant losses in their pursuit to substantiate delay claims facing challenges to assimilate the vast amount of data from different sources (islands of information) and extracting credible information to their claim. Those challenges are time consuming and expensive, prone to errors, and result in inaccurate conclusions.

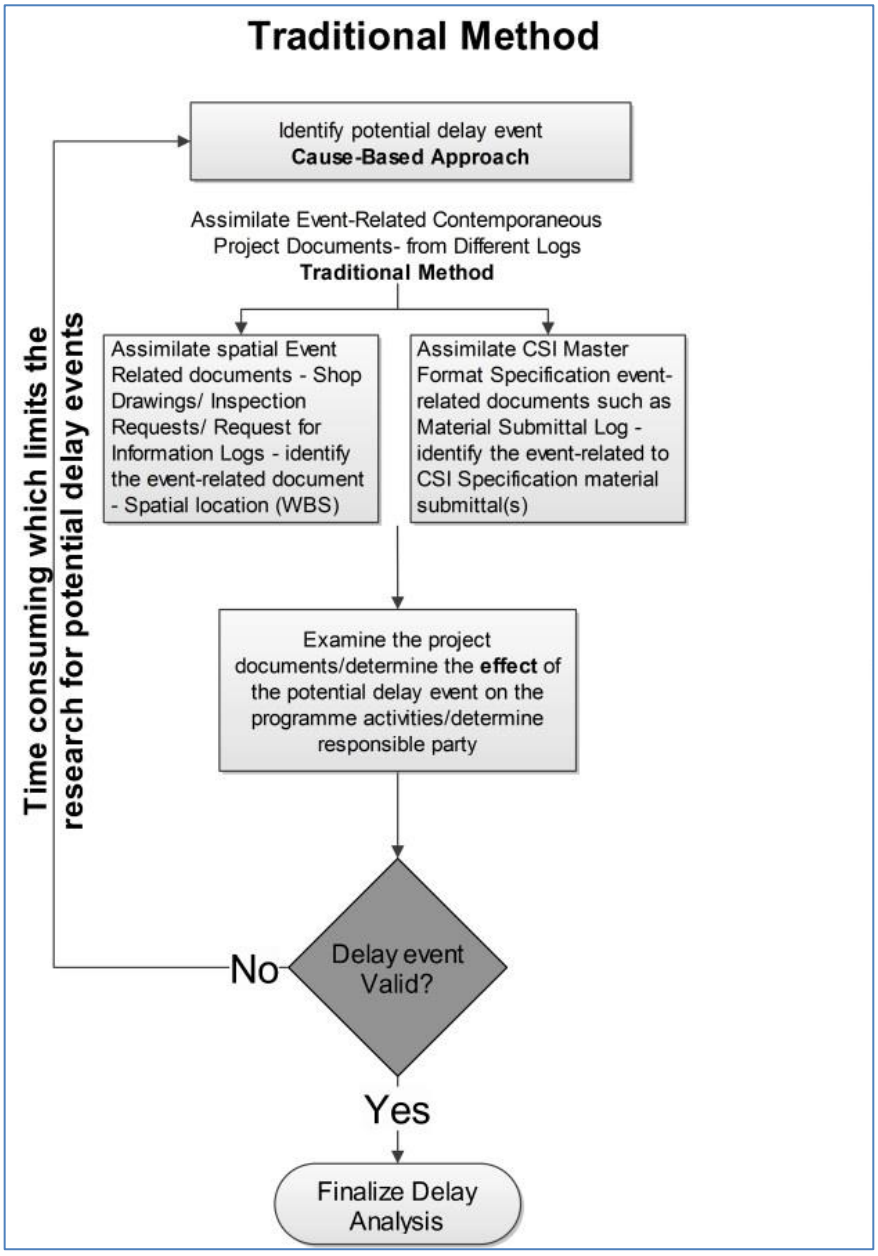

Figure 1.1 –Traditional claim evaluation process

As stated earlier, assimilating and comprehending a significant amount of data remains the most challenging stage of the claim process. In the traditional claim process shown in Figure 1.1, the following steps are carried out retrospectively:

1- ***Identification of potential delay events*** **-** In determining the delay events, whether by the Cause-Based or the Effect-Based approaches, a series of potential delay events are selected either from the updated time programme or initiated by an event separate from the programme such as a variation. Those potential events require further in-depth analysis to evaluate their criticality to the project.
2- ***Compliance with the notification provisions of the Contract*** – this step addresses the Claimant's compliance with the notification provisions of the claim and extension of time contract clauses.
3- ***Identification of the merit of the delay Claim*** – this is the most exhaustive, time and cost consuming step of the claim process. This step requires comprehending and collecting contemporaneous project records pertaining to the suspected delay event. The project records are assimilated from different sources and of different types. The different types of Project Records are categorized in this thesis as follows:
    a. Project Documents (**Task Dependent**) – Documents which could be assigned to a specific Work Breakdown Structure (WBS) or activity, e.g. letters, Time Programmes, Request For Information, Request for Inspection, Site Clarification Requests, Shop Drawings
    b. Project Documents (**Material Dependent**) – Documents which pertain only to the Type of Material, Specification, e.g. Material Submittals, Material Inspection Request etc.…
    c. Project Documents (**Time Dependent**) – Documents which cover a specific time duration daily, weekly or monthly reports.
    d. Project Geo-Tagged Photos – Photos which are tagged by their geographical location
4- ***Apportionment of Delay (Time and Cost)*** – This step involves the apportionment of the quantum of the delay (time and cost). This is calculated by implementing any of the delay analysis methodologies as per industry guidelines.

1.2.2. Classification of delay event-related documents

With the increase in size and complexity of current construction projects, claims - and in particular delay claims - involve a significant amount of forensic investigation. The investigations entail assimilation of event-related contemporaneous project records from different sources of information. It is established that even with well-documented projects supported by modern Document Management Systems (DMS) the challenge remained in adapting event-related documents to produce a credible conclusion within a fixed period of time and limited budget.

It can be observed from the ruling of numerous Court cases such as *Wharf Properties Ltd v Eric Cumine Associates, 1991* and *R.P. Wallace, Inc. v. United States, 63 Fed. Cl. 402, 2004; 2005* that the Claimants' failure to substantiate their claims was mainly attributed to their inability to provide contemporaneous records and evidence pertaining to the disputed delay event(s). As a result, Claimants encounter substantial losses due to their inability to provide substantiated evidence and credible information to substantiate their claims.

1.2.3. Extraction of Spatial Documents

The majority of construction documents are characterized by the spatial information which describes the specific location of the work, element or material described in the documents. For example, Material Submittal documents describe the material or equipment located at different locations of a project. On the other hand, Spatial Information in Foundation Shop Drawings is described differently than that of Architectural and MEP (Mechanical/Electrical/Plumbing) shop drawings.

Even with modern document management systems, Claimants experience challenges in the extraction of vital contemporaneous records that are vital documents pertaining to a specific spatial location. Such documents if overlooked jeopardize the integrity of the claim evaluation.

1.2.4. Efficiency of the Claim process

Delay claims are characterized by the substantial cost associated with their preparation. The high cost incurred by the Claimants and Defendants is often associated with the lengthy forensic research process in investigating evidence and substantiation of delay claims involving Claim Experts and Arbitrators to a project which is already complete. The lengthy forensic research process is attributed to the time required to extract event-related contemporaneous records for a potential delay event which may entitle the Claimant to an extension of Time. The Claimant could eventually conclude after extensive research that the potential delay event may provide an entitlement for extension of time. Due to the time and cost constraint associated with the forensic research, the Claimant's option to address several potential delay events is minimal and often overlooked.

1.3. Research Objectives

The objective of this research proposes a mechanism to enhance the efficiency of the delay claim development process by supporting a claimant's decision to retrospectively select a series of delay events with the highest success rate for demonstrating entitlement for an extension of time claim.

The proposed research objective aims to (1) develop a text mining algorithm that utilizes the delay event path of activities for the classification of contemporaneous project records; (2) extend the non-proprietary Industry Foundation (IFC) model to incorporate attributes characterizing delay claims to enable the integration of contemporaneous project records to the project Building Information Model.

Creation of the subject mechanism is expected to promote a non-traditional approach among claim industry specialists, enhancing and facilitating the delay claim process. The outcome of which is expected to result in significant cost and time savings associated with claim preparation.

To achieve the research objectives, a three-step approach is adopted in this research. For each step, the following list illustrates the main goals, underlying hypothesis, significance, as well as some of the key research questions expected to be answered.