



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكرو فيلم

بسم الله الرحمن الرحيم



HANAA ALY



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم



شبكة المعلومات الجامعية التوثيق الإلكتروني والميكروفيلم



HANAA ALY



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات



يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار



HANAA ALY



Cairo University

Selecting Standard Form of Construction Contracts using Text Analysis and Multi Criteria Decision-Making Techniques

By

Yasmine Mokhtar Hassan Elkhayat

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the Requirements
for the Degree of
MASTER OF SCIENCE
In
STRUCTURAL ENGINEERING

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2021

Selecting Standard Form of Construction Contracts using Text Analysis and Multi Criteria Decision-Making Techniques

By

Yasmine Mokhtar Hassan Elkhayat

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the Requirements
for the Degree of
MASTER OF SCIENCE
In
STRUCTURAL ENGINEERING

Under the Supervision of

Prof. Mohamed Mahdy Marzouk

Professor of Construction Engineering and Management
Structural Engineering Department
Faculty of Engineering, Cairo University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2021

Selecting Standard Form of Construction Contracts using Text Analysis and Multi Criteria Decision-Making Techniques

By

Yasmine Mokhtar Hassan Elkhayat

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the Requirements
for the Degree of
MASTER OF SCIENCE
In
STRUCTURAL ENGINEERING

Approved by the examining committee:

Prof. Dr. Mohamed Mahdy Marzouk,

Professor of Construction Engineering and Management - Structural Engineering Department –
Cairo University

Thesis Main Advisor

Dr. Ahmed Fathi Waly,

Associate Professor– Architectural Engineering Department- Faculty of Engineering at Mataria –
Helwan University

External Examiner

Dr. Ahmed Mohamed El-Dokhmasey,

Procurement Director – Al Ezz Flat Steel Co.

External Examiner

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2021

Engineer's Name: Yasmine Mokhtar Hassan Elkhayat
Date of Birth: 22/10/1994
Nationality: Egyptian
E-mail: yasmineelkhayat@yahoo.com
Phone: 01005707245
Address: Sheikh Zayed, Giza, Cairo
Registration Date: 01/10/2018
Awarding Date:/....../2021
Degree: Master of Science
Department: Structural Engineering
Supervisors: Prof. Mohamed Mahdy Marzouk – Cairo University
Examiners:



Prof. Mohamed Mahdy Marzouk (Thesis main advisor)
Dr. Ahmed Fathi Waly – Helwan University (External Examiner)
Dr. Ahmed Mohamed El-Dokhmasey – Al Ezz Flat Steel Co. (External Examiner)

Title of Thesis:

Selecting Standard Form of Construction Contracts using Text Analysis and Multi Criteria Decision-Making Techniques

Keywords:

Standard form of construction contracts, Text Analysis, Multi-Criteria Decision-Making, AHP, TOPSIS.

Summary:

Delivering successful projects is a quite challenging task that requires establishing a well-drafted contract between the parties that fulfills all the parties' needs through setting balanced rights and obligations between them. Standard Forms of Construction Contracts (SFCCs) are international standard forms that are used in construction projects to set all the contractual related issues that may take place during the course of the project. Furthermore, identifying the main causes of construction conflicts is the key to overcome these problems. Therefore, this research identifies five main aspects with fifteen sub-aspects that are considered the factors affecting contract selection. This research analyzes three of the most commonly used SFCCs; FIDIC Red Book 2017, JCT Standard Building Contract with Quantities 2016, and NEC4 Engineering and Construction Contract. Firstly, contract analysis is performed using a text analysis tool to extract hidden information found in unstructured data. Afterward, the clauses and provisions of the three SFCCs are compared based on the output of the text analysis process. Accordingly, forty-nine questions are developed to assist the user in selecting the most suitable SFCC based on a hybrid Multi-Criteria Decision-Making model. Finally, a recommendation system is developed to advise the user for some tips to be considered in the contract formation stage.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Yasmine Mokhtar Elkhayat

Date: .././...

Signature:

Acknowledgment

First of all, I would like to express my gratitude to Almighty Allah for enabling me the strength and opportunity to complete this thesis, all praises to Allah for his blessings. I would like to express my extreme gratitude to thank my supervisor, Professor Mohamed Mahdy Marzouk for his endless and continuous effort, support, patience, and guidance in my M.Sc. research. I could not have completed this degree without Prof. Mohamed Mahdy Marzouk. I would like to express my sincere appreciation to my father; the person who raised me eager to learn, and taught me how to think and achieve goals. His constant inspiration and guidance kept me focused and motivated to achieve goals. Thank you, my dad, for raising me and loving me the way you did. Special thanks for my mother, my one and only best friend, the one who always stands by my side since my early days. Thank you so much for your support and unconditional love. No words can describe how much I love you. I could not reach any of my goals without you standing by my side and your exuberant smile that is full of love and pride. I would like to thank my husband, Dr. Mohamed Enaba, for his endless effort and support. Honestly, his presence, love, care, and support while encouraging me to succeed were a crucial motive for me to finish this thesis. Thank you, Mohamed, for standing by my side. Finally, I would like to thank my little one Hamza; may Allah protect you and bless you my dear to see you the best person in the world, Mum loves you Hamza.

Table of Contents

Disclaimer	i
Acknowledgment.....	ii
Table of Contents	iii
List of Figures.....	vii
List of Tables	ix
Abstract.....	xi
1 Chapter 1: Introduction.....	1
1.1 General	1
1.2 Problem Statement	1
1.3 Research Objectives	2
1.4 Research Methodology.....	3
1.5 Research Scope and Limitations	4
1.6 Thesis Organization:	4
2 Chapter 2: Literature Review	6
2.1 General	6
2.2 Root Causes of Conflicts, Claims, and Disputes.....	6
2.3 Proactive Avoidance of Claims and Disputes	10
2.4 Major Contractual Aspects Affecting Construction Projects.....	11
2.4.1 Contract Formation and Structure	11
2.4.2 Collaboration and Partnering.....	11
2.4.3 Integrated Project Delivery.....	12
2.4.4 Dealing with Uncertainties	12
2.4.5 Contract Readability	13
2.4.6 Early Warnings	15

2.4.7 Building Information Modeling.....	16
2.5 Importance of Contract Standardization	17
2.6 Text Mining and Analysis	19
2.7 Text Visualization	23
2.8 Sentiment Analysis.....	25
2.9 Content Analysis	25
2.10 Multi-Criteria Decision-Making Techniques	26
2.11 Summary and Research Gap	29
3 Chapter 3: Contract Text Analysis	30
3.1 General	30
3.2 Analyzed Standard Forms of Construction Contract	30
3.2.1 FIDIC Red Book 2017 Edition.....	30
3.2.2 JCT Standard Building Contract with Quantities	32
3.2.3 NEC4 Engineering and Construction Contract	36
3.3 Text Analysis of Analyzed Standard Forms	39
3.3.1 Readability Aspect.....	40
3.3.2 Sharing Common Goals Aspect	44
3.3.3 Loss and Reward Aspect	54
3.3.4 Dealing with Uncertainties Aspect	58
3.3.5 Suspension by Parties Aspect	63
3.4 Summary	66
4 Chapter 4: Comparison of Analyzed Standard Forms	68
4.1 General	68
4.2 Readability Aspect Analysis	68
4.2.1 Clarity Feature	68
4.2.2 Simplicity Feature.....	70
4.2.3 Flexibility Feature.....	70

4.3 Sharing Common Goals Aspect Analysis	71
4.3.1 Collaboration Feature	71
4.3.2 Early Warning Feature.....	73
4.3.3 Automation and Building Information Modeling (BIM) Feature	75
4.3.4 Value Engineering Feature	76
4.4 Loss and Reward Aspect Analysis	77
4.4.1 Delay/Liquidated Damages Feature	78
4.4.2 Bonuses and Incentives Feature	81
4.4.3 Key Performance Indicators (KPIs) Feature	81
4.5 Dealing with Uncertainties Aspect Analysis.....	83
4.5.1 Risk Management Feature	84
4.5.2 Force Majeure and Unforeseeable Conditions Feature	85
4.6 Suspension by Parties Aspect Analysis.....	87
4.6.1 Suspension by Employer Feature	87
4.6.2 Suspension by Contractor Feature	89
4.7 Summary	91
5 Chapter 5: Model Development	92
5.1 General	92
5.2 Selection Criteria.....	92
5.3 Estimating Criteria Weights	96
5.4 Selecting Standard Form using TOPSIS	100
5.5 Model Recommendation System	103
5.6 Model Verification	104
5.7 Model Validation.....	107
5.8 Summary	109
6 Chapter 6: Conclusion and Recommendations.....	110
6.1 Research Conclusion	110

6.2 Research Contributions	111
6.3 Recommendations for Future Research	111
7 References.....	112

List of Figures

Chapter 1:

Figure 1-1: Research Methodology	4
--	---

Chapter 2:

Figure 2-1: Relation between conflicts, claims and disputes [2]	7
Figure 2-2: Potentials of construction disputes [4]	7
Figure 2-3: Summary of main causes of claims and disputes in the construction industry [2,3,4,8,9]	10
Figure 2-4: Main objectives of construction partnering [19]	12
Figure 2-5: Most commonly used readability formulas [23]	14
Figure 2-6: Venn diagram for seven fields of text mining [37]	20
Figure 2-7: Text analysis procedures [36,37 and 38]	20
Figure 2-8: Importance of contract mining in delivering successful project [38]	21
Figure 2-9: Main applications of visualization technology [46]	23
Figure 2-10: Text visualization using tag cloud [46]	24
Figure 2-11: Example of word tree text visualization using text clustering [39]	24
Figure 2-12: Visualization of text clustering [39]	25
Figure 2-13: Decision making techniques [54]	29

Chapter 3:

Figure 3-1: Structure of FIDIC Red Book 2017	35
Figure 3-2: Structure of JCT SBC/Q 2016	36
Figure 3-3: Structure of NEC4 ECC	38
Figure 3-4: SFCC Text analysis procedures	39
Figure 3-5: SFCC Words Statistics	42
Figure 3-6: Context of Early Warning in NEC4	49
Figure 3-7: Word tree of the term "Payless" under NEC4	50
Figure 3-8: Bubble lines visualization of automation and BIM terms	52
Figure 3-9: Stacked visualization of Value Engineering terms	52
Figure 3-10: Context analysis of Liquidated Damages terms	55
Figure 3-11: Text analysis of Bonuses terms	56
Figure 3-12: Context analysis of KPIs terms	57

Figure 3-13: Trends visualizations of risk and insurance terms in FIDIC 2017.....	59
Figure 3-14: Trends visualizations of risk and insurance terms in JCT 2016	60
Figure 3-15: Trends visualizations of risk and insurance terms in NEC4	60
Figure 3-16: Mandala visualization of unforeseeable conditions and force majeure	62
Figure 3-17: Context analysis of suspension by both parties	65
Figure 3-18: Context of Suspension Terms	66
Chapter 4:	
Figure 4-1: Flesch Reading Ease Score for SFCCs	69
Figure 4-2 Flesh Kincaid Grade Level for SFCCs.....	70
Chapter 5:	
Figure 5-1: AHP Interface	99
Figure 5-2: Sample of model recommendations	103
Figure 5-3: Model Recommendation System	104
Figure 5-4: Modified Recommendation System.....	107