DEVELOPING AN INTEGRATED RISK MANAGEMENT SYSTEM FOR EVALUATING PPPs PROJECTS IN LIBYA

By
Eng. MAHMUD ALI OMAR ELHESSNAWI

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

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT

2018

DEVELOPING AN INTEGRATED RISK MANAGEMENT SYSTEM FOR EVALUATING PPPs PROJECTS IN LIBYA

By
Eng. MAHMOUD ALI OMAR ELHESSNAWI

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

Under the Supervision of

Prof. Dr. Mohamed Mahdy Marzouk

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

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2018

DEVELOPING AN INTEGRATED RISK MANAGEMENT SYSTEM FOR EVALUATING PPPs PROJECTS IN LIBYA

By
Eng. MAHMUD ALI OMAR ELHESSNAWI

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

Approved by the Examining Committee

Prof. Dr. Mohamed Mahdy Marzouk ..... Thesis Main Advisor
Professor of Construction Engineering and Management – Structural Engineering Department - Cairo University

Prof. Dr. Ayman Ezzat Othman..... External Examiner
Professor of Construction Engineering and Management – British University in Egypt

Dr. Mohamed Abd El Latif Bakry .... External Examiner
Former Manager of Strategic Management Department–Social Development Fund

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT

2018

Engineer : Mahmud Ali Omar Elhessnawi
Date of Birth : 10 / 1 /1982
Nationality : Libyan
E-mail : abusalah82@hotmail.com
Phone : 01001934843
Address : 32 App1-Group 109- AL rehab- Cairo

Registration Date : 1 / 10 / 2012
Awarding Date : / /
Degree : Doctor of Philosophy
Department : Structural Engineering
Supervisors : Prof. Dr. Mohammed Mahdy Marzouk
Examiners :
Prof. Dr. Mohamed Mahdy Marzouk – Cairo University (Thesis Main Supervisor)
Prof. Dr. Ayman Ezzat Othman – British University in Egypt (External Examiner)
Dr. Mohamed Abd El Latif Bakry –Social Development Fund (External Examiner)

Title of Thesis :

DEVELOPING AN INTEGRATED RISK MANAGEMENT SYSTEM FOR EVALUATING PPPs PROJECTS IN LIBYA

Key Words: Fault Tree - Neural Networks - Analytical Network Process - Public-Private Partnerships - Decision support system.

Summary:

The object of this thesis is to examine the PPPs infrastructure projects, and to highlight the key performance indicators (KPIs) to assess serviceability and the impact of the Socio-economic environment, that represent influential Key factors on private sector in development the PPPs infrastructure project. This thesis presents a framework for risk assessment and appraisal of PPP infrastructure projects throughout integrated system named risk assessment and appraisal of PPPs (RAA3P), which integrates several techniques as, Fault Tree, Neural Networks, and the Analytic Network Process. The Statistical Packages for Social Sciences (SPSS) program was used to analyze the questionnaire data, as well as a number of interviews with specialists in the study field. This system aimed to ensuring sustainable availability of project's returns that is essential for the development of PPPs infrastructure projects in Libya, considering different risks that may face in the environmental of uncertainty that exist in the life cycle process of these projects. The presented system in this thesis is capable of analyzing the most risks that oblique the PPPs projects, in addition to predicting the internal rate of return IRR of business model that associated with the funding methods, and suggestion the alternatives to improve PPP structure mechanism to in order to enhance the performance of PPP projects in Libya. Actual PPP infrastructure case study project is considered to exhibit the developed system and its significance.

The study concluded that, successful partnership between the public and private sectors in light of right decision-making depends on several factors. The most important factors are deep analysis of the economic feasibility of the project, and detailed risk analysis from all aspects of the project, technical, financial and technical, as well as political risks, in addition to the contractual partnerships between the project parties in terms of risk assignment as well as the good project's structure to fulfill the target return of the project.

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 and have cited them in the references section.

Name: Mahmud Ali Omar Elhessnawi Date: 21 / 11 /2018

Signature:

DEDICATION

This dissertation is dedicated to
my great Father, and my great Mother

Whom taught me the value of hard work, and to
my sincere wife Mrs. Mariam Abulgasem*,*
my lovely kids Haitham, and Ali
for their moral support, motivation, non-stop encouragement for this piece of work

ACKNOWLEDGEMENTS

My thanks first go to God Almighty who made all things possible and who indeed is my glory.

My Sincere thanks, gratitude and deep appreciation, go to my supervisor **Professor Dr. Mohamed Mahdy Marzouk** for his thoughtful supervision, insight, dedicated guidance, understanding and unfailing support which made the completion of this research project feasible. His helpful advice and constructive advice gave me the inspiration, moral support and encouragement of pushing for top quality work.

TABLE OF CONTENTS

DISCLAIMER ..... **I**
DEDICATION ..... **II**
ACKNOWLEDGEMENTS ..... **III**
TABLE OF CONTENT ..... **IV**
LIST OF TABLES ..... **VI**
LIST OF FIGURES ..... **VII**
ABSTRACT ..... **VIII**
CHAPTER 1: INTRODUCTION **1**
1.1 General 1
1.2 Problem Statement 1
1.3. Research Objectives 2
1.4 Scope and Limitation 3
1.5 Research Contributions 3
1.6 Research Methodology 3
1.7 Dissertation Organization 4
CHAPTER 2: LITERATURE REVIEW **6**
2.1 General 6
2.2 Public Private Partnerships 6
2.3 Generic PPPs Risk Identification 10
2.4 Contractual Structure of PPPs Project 12
2.5 Financial Viability in PPPs Project 15
2.6 Approaches to Risk Assessment in PPPs Project 18
2.7 Summary and Research Gap 27
CHAPTER 3: RESEARCH METHODOLGY **29**
3.1 General 29
3.2 System Architecture 29
3.3 Risks in PPPs Infrastructure Investment 35
3.4 Fault Tree Model Development (FTA) 36
3.4.1 Establishment of Typical Fault Tree 36
3.4.2 Fault Tree Analysis based on Probability 36
3.5 Methods used in Financing Infrastructure Projects 37
3.5.1 Project Debt Finance 38
3.5.2 Project Equity Finance 38
3.5.3 Development of PPPs Structure 39
3.5.4 Cash Flow Determinants Calculation Model 40
3.5.5 Risk Mitigation and Incentives for Infrastructure Finance 41
3.6 Financial Prediction Model Using Neural Networks (ANN) 43
3.7 Decision Making with the Analytic Network Process 44
3.7.1 Performance Measures Development 44
3.7.2 Outcomes of Measuring Performance 45
3.8 Development of Analytical Network Process (ANP) 45
3.9 Summary 47
CHAPTER 4: DEVELOPMENT OF RISK ASSESSMENT SYSTEM **49**
4.1 General 49
4.2 Data Collection Procedures 49
4.3 Identification of Risk Factors 50
4.4 Data analysis 50
4.5 Discussion of Critical Risks on PPPs Infrastructure Projects 51