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University of Diyala
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Using Genetic Algorithm to Improve Contractual Procedures For Construction Project in Iraq

A Thesis Submitted to the Council of College of Engineering University of Diyala in Partial Fulfillment of the Requirements for the Degree of Master of Science in Civil Engineering

By

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بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

﴿ يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ وَاللَّهُ بِمَا تَعْمَلُونَ خَبِيرٌ ﴾

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We certify that the thesis entitled "**Using Genetic Algorithm to Improve " Contractual Procedures For Construction Project in Iraq**

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Date:

DEDICATION

To the pure soul of my brother, may God bless him in his mercy and enter him into his vast gardens

To the one who supported me all my life, my beloved mother and father

To those who compete with the rain in gifts

And precedes modesty in the attributes of my dear husband Abu Ayman.

To my souls, my dear daughters, Russell, Taiba, Mayar, and my dear son Ayman, whom I have always shortened for the sake of my studies.

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LIST OF ABBREVIATIONS

Abbreviations	……..……. Explanation
AE	……....Architecture, Engineering and Construction
BOOT	……..……Build-Own-Operate-Transfer
BVPRs	……Best Value Performance Reviews
BVPIs	……..Best Value performance Indicators
BVPPs	……Best Value Performance Plans
BVPRs	……Best Value Performance Reviews
(ESVM model)	…….Enforced Support Vector Machine-based model
CSC	……. Contractor Selection Criteria
GA	……Genetic Algorithm
GDP	…….Gross Domestic Product
ICE	…… Institution of Civil Engineers
JCT	……..Joint Contracts Tribunal
PPA	…….Pupluic procurement Act
PPR	…….Pupluic procurement Reguiation
PLS	…….Partial Least Squares
MPA	……..Maximum Price Assured
NEC	…….New Engineering Contract
SBD	……Standard Bidding Documents
SME	…….Small and Medium Sized Enterprises
SPSS	……..Social Science Package

ABSTRACT

The contract management is the systematic and successful administration of contract formulation, implementation, and analysis with the aim of maximizing financial and organizational efficiency while lowering risk. The construction industry is hampered by the selection of inadequate contractors and by the use of inadequate contract formats across numerous ministries and time periods., It causes further issues in the project's later stages, especially in the construction stage , which has the largest and most important effect on the success of completing the project and one of the main problems is the incorrect application of the new Standard Bidding Document (SBD) in projects and the lack of these documents to certain criteria that lead to project success ,as the referral process should be the high efficiency firms. Accordingly, the goal of this research is to investigate the application of the new standard bidding documents (SBD) in Iraq construction projects and the lack of these documents to certain criteria that lead to project success. To get this, data were collected using documentary analysis plans, interviews, and questionnaires. With a 200 completed questionnaire form, the results showed that the implementation method and contract type have the most influential in terms of the interrelation between the factors of SBD with contracting or projects procedure. Furthermore, the SBD contractor selection criteria do not take into account the project type, whether it is a construction or infrastructure project, the absence of vibration weights. To avoid these problems, an integrated risk management plan must be developed for each stage of the project. The proposed system for managing the contracting procedure through an electronic system and use genetic algorithm to select the best solution for every problems. The most repeated solution was modifying on SBD , therefor the author suggest for two type of documents which are New Engineering Contract (NEC) and the Joint Contract Turbinal (jct).

CHAPTER ONE

INTRODUCTION

1.1 General

Construction is unique from other industries in that it has its own set of characteristics. It is disjointed, subject to economic and political situations, and prone to failure. Furthermore, due to the relative ease of access, a huge number of contracting businesses compete fiercely in the market, resulting in employment losses for all of them.

The pre-construction contracting method is one of the most important phases of the construction process since it considers the project's motor, where all language, requirement specifications, and selecting the accountable for project execution can be done. The proposal, tendering, contractor selection, contract terms and the conditions are all part of this step. The construction contracting industry has the second highest loss rate of any industry, owing to a variety of issues such as hiring the wrong contractor, establishing insufficient contract terms and conditions, ensuring that the quantity set in the tendering procedure matches the actual quantity, and delaying payment from the owner to the contractor, among others.

1.2 Justifications of the study

The construction sector suffers from the selection of in efficiency contractors and in efficiency contract formats in various ministries and periods, which leads to subsequent problems in the later stages of the project, particularly in the construction stage, and one of the main problems is the incorrect application of the new standard bidding document in projects and the lack of these documents to certain criteria that lead to project success, thus the justifiable justification as follow:

1- The SBD for contractor selection lacks successful criteria for the contractor selection, and the majority of ministries do not even use the SBD criteria.

2- The lack of appropriate contract forms that are compatible with various project types.

1.3 Aim and Objectives of the study

The research's key goal is to create a method to control the contracting process in the building industry, and in order to do so, the following goals must be met:

1- Identify the main factor that lead to contracting weakness in construction projects.

2- Develop a system to reduce the problems appearing in this stage and selection the optimal response for each problems by using genetic algorithm.

1.4 Research Limitation

The research includes two limitation frames:

•The research specializes in implementing the standard document for the implementation of works contracts for small and medium projects in Iraqi.

•This research covers the obligatory periods of SBD implementation (from 2016 to 2022).

1.5 Methodology of the study

To achieve the objective, the following research was followed:

Theoretical study: This part include gathering information regarding the contractor selection, contractor failures, smart contract and others regarding contracting procedures from book, journals and scientific publication.

Field work: the field work include preparing a questionnaire for the contracting failures in the construction project to determine their performance. The research methodology is summarized in figure (1-1).

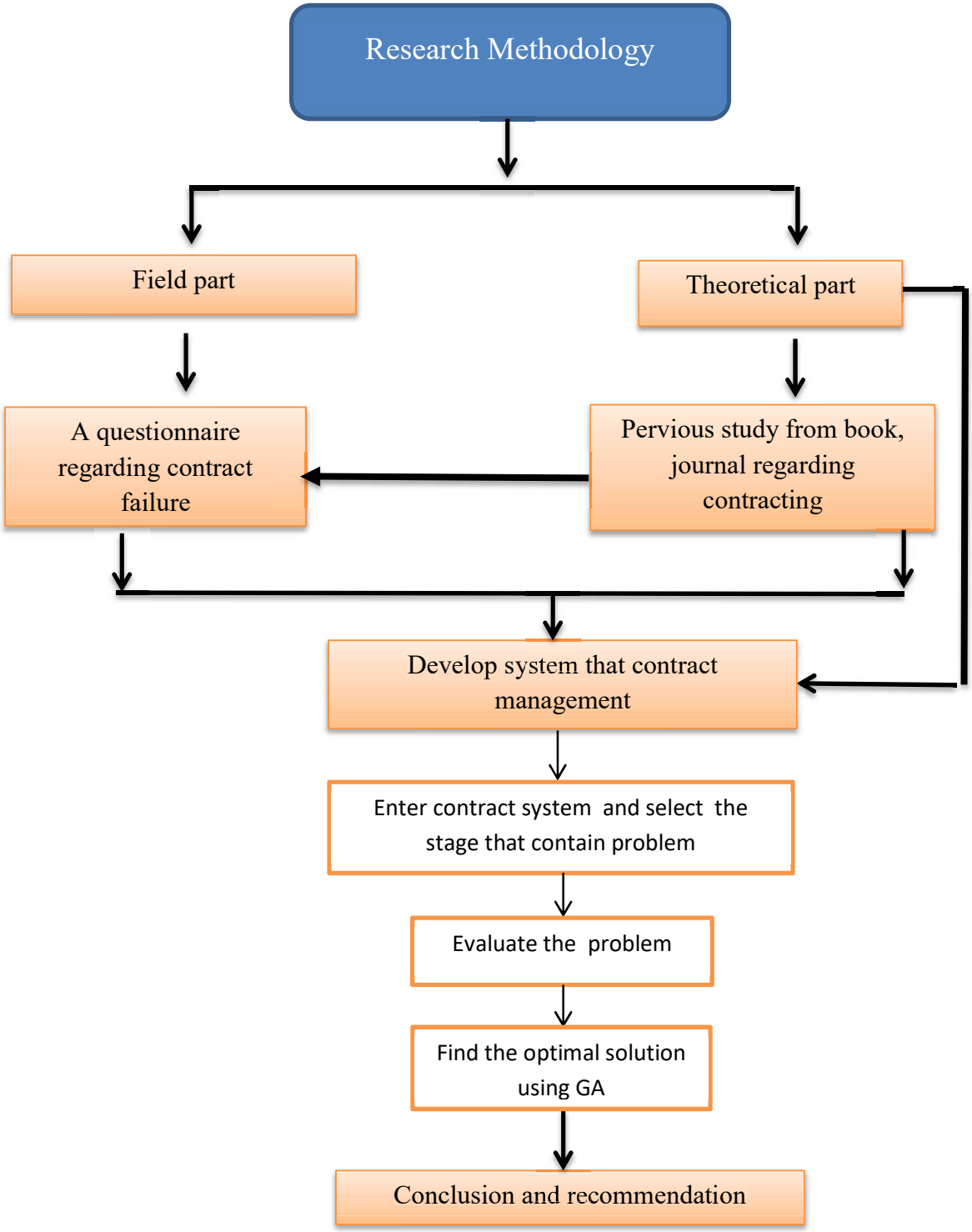

Figure (1-1) Research Methodology

1-6 Structure of the Study

The study is categorized into five chapters, as follows:

Chapter one: A general introduction to the study, the research challenge, justifications, theory, research goals, research methods, the thesis framework, and previous studies are all included in this chapter.

Chapter two: In this chapter the researcher shows what are the construction contract, contract system, contractor selection and its performance in the construction project.

Chapter three: This chapter will include the factor that is related to the contracting failure first a questionnaire is formed in order to display the most reasons that lead to contract.

Chapter Four: This chapter is comprised of the proposed system for managing the contracting procedure by through an electronic system and use genetic algorithm to select the best solution for every problems.

Chapter Five: This chapter includes conclusions, recommendations and future work of the research.

1.7 Previous Studies

This section include the previous studies regarding the contracting procedure, the studies are divided into the following types, studies regarding contractor performance perdition, contractor selection, smart contract and reality captures techniques.

Table (1-1) Pervious Studies

Local Studies		
Researcher	**Country**	**The study**
Hassan S.(2020),	Iraq	This research identify the obstacle and weaknesses in the implementation of the SBDs in Iraq, specify the public and private sector experience in SBDs in Iraq, identify the impact of the mandatory implementation construction project.
(Abidali & Ali, 2018)	Iraq	This research investigated the performance of contractors in Iraq. The elements influencing the performance of contractors in building projects are identified and ranked. Using standardized questionnaires, a field survey of 45 Iraqi contractors working in construction contracting organizations (general and private sector) was conducted.
(Mohamed & Majeed, 2016)	Iraq	The purpose of this research is to investigate present pre-qualification methods in construction projects in governmental ministries and provinces, as well as to establish pre-qualification standards. This research was carried out through a practical study and a literature review of the subject matter relevant to the pre-qualification procedure, followed by a field survey.
(Al-Tmeemy, 2017)	Iraq	The purpose of this study is to look into the influence of hiring an inept contractor on project timelines. The factors for contractor selection

		that satisfy the Iraqi construction sector were also explored. Data were gathered utilizing substantial historical data from the Diyala Governorate database of 352 projects, as well as structured interviews with construction specialists from public organizations.
(Jasim, 2021)	Iraq	The goal of this research is to investigate how to evaluate contractor performance for construction projects, and how technical grounds (The Method Of Multiple Criteria Complex Proportional Assessment) can be used in the assessment of contractor performance for construction projects, through the identification of criteria used to select the best contractor in terms of performance, as well as determining the list of contractors to choose the optimal contractor of these terms.
International studies		
(Tserng et al., 2011)	Taiwan	This research proposes an enforced support vector machine-based model (ESVM model) for default prediction in the construction industry, employing all available firm-years data in our sample period to address the between-class imbalance.
(Deep et al., 2016)	India	The study takes a case-based approach, with the authors studying various projects that were awarded based on financial criteria. Finally, conclusions were reached by comparing contractor efficiency with progress, bid-to-project cost ratio, and other parameters.

(Mahamid, 2012)	Saudi Arabia	The primary goal of this article is to identify the factors that have the potential to cause a contractor's business failure in Palestine's West Bank and to assess their impact degree from the contractor's perspective.
(Konno, 2018)	Japan	This study investigates the association between construction job performance evaluations on Japanese public works projects and contractor characteristics. For the empirical study of data from Keishin, a pre-bid qualification review of public works and project performance-evaluation system after construction completion in Japan, a fixed-effects model and a panel regression model were utilized.
(Laing et al., 2015)	United Kingdom n	This article discusses a number of process stages required to incorporate laser scan data output into a BIM environment. Although point clouds can be imported into industry standard BIM software, in order to make the maximum use of the extremely accurate and often huge data files, some postprocessing and modeling is required.
(Almukhtar et al., 2021)	United Kingdom n	This study takes a proof-of-concept method, which exhibits the application of the technology in practice as well as solving the aforementioned concerns. According to the study, the quality of the data, also known as point cloud data, is still a serious concern because it is dependent on the distance between the target object and the 3D laser scanner's station. Furthermore, data quality

		is still highly dependent on data file sizes and the computational power of the processing system.
(Andrée et al., 2018)	Turkey	To study views regarding technology and collaborative working, a survey questionnaire was created and circulated. 117 responses were received from a range of professions across multiple organizations, including clients, principal contractors, consultants, and legal firms, with the majority coming from senior management or commercial personnel. Participants were divided into those who feel technology and innovation are crucial, interesting, and the future, and those who believe automation is impossible in such a complex industry as building.
(Hu et al., 2021)	China	This research examines the literature and internet resources on smart contract creation and execution from 2008 to 2020. We categorize the research into three categories: (1) design paradigms that provide examples and patterns for contract construction, (2) design tools that aid in the development of secure smart contracts, and (3) extensions and alternatives that improve the system's privacy or efficiency.