



Ministry of Higher Education
and Scientific Research

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College of Science



MANAGE THE CONSTRUCTION PROJECTS PROBLEMS USING EXPERT SYSTEM WITH PSO AND GSA ALGORITHMS

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by

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ
وَقُلْ اَعْمَلُوا فَسَيَرَى اللَّهُ عَمَلَكُمْ وَرَسُولُهُ
وَالْمُؤْمِنُونَ ۝

صدق الله العلي العظيم

[سورة التوبة 105]

Dedication

I dedicate this research

To the Prophet And the savior of the nation Muhammad Abdullah Abdul-Muttalib, To the Commander of the Believers Ali bin Abi Talib, To our Lord and queen Imam Al – Mahdi, To the mother of believers Fatima Zahra peace on them.

To my parents whose their prayers and words always inspired and encourage me to give more and pursuit of excellence

My Sisters and Brother , who always encourage me to give the best and supported me.

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ABSTRACT

Computer science researchers and statistics have established innovative techniques to achieve visions from sets of large disparate data. There are various kinds of data and from diverse sources, and of diverse quality. The computational tools applied to address jobs usually needs human complexity is generally termed 'Artificial Intelligence' (AI). As an area, AI has been for numerous years. Though, modern rises in the power of computing joined with rises in the obtainability and amount of data have to lead in a renaissance of interest in possible artificial intelligence applications .The aim of the research is to build an expert system that considers an effective to manage the construction projects problems in term of both time and cost through building an expert system to manage these problems by using the techniques: particle swarm optimization and gravitational search algorithm.

To accomplish the aim of the research, a theoretical study involve review the previous studies and field study that include open and closed questionnaire and finally , the expert system was built.

The results show that the construction phase considers very critical and has an impact of about 25% on cost and 20% on time and the interdependency between problem quite equal in the construction problems rather than pre-construction problems.

Designing the expert system is depending on the configuration of knowledge and the need for construction projects. This system is designed to provide a database for ant previously problems that have been occurred in the projects. PSO algorithm shows an effective tool in finding the best

solution in term of speed and method of searching while GSA is also an effective tool in finding the best solution to bet it requires more time.

All the velocity of the PSO is zero while the GSA is always more than zero which indicate the PSO is fast and also in the method of searching as seen in problem 7 and 9 the GSA take different way in finding the solution.

The recommendations are Conducting educational and training courses to implement an expert system in construction projects and Using the expert system in different problems and in a different phase and finally depending on this system find the solutions for future problems.

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LIST OF ABBREVIATION

Abbrev.	Total Name
AI	Artificial Intelligence
ES	Expert Sytem
GSA	Gravitational Search Algorithm
PSO	practical Swarm Optimization
CPI	Cost Performance Index

CHAPTER ONE

INTRODUCTION

Chapter one

Introduction

1.1 An Overview

The expert system in the world of the artificial intelligence is a system in the computer that has the ability to imitator or repeats the intelligence jobs of human in the field on the decision making like the expert human skill do. The problems with sophisticated level can be solved as the system use information about their range of expertise. Thus the expert system will be designed depending on this information. In order that the system becomes an equivalent to the human thinking and uses data that is explicit in the field. The tools are used to gain such a type of information and the questions are asked to one or more experts. The artificial intelligence is the main area and the expert system consider sub-area. The applications in which this type of system used are geology, law, medicine, politics, chemistry, and economics. Every place or field that require to make a decision, the expert system may be used. (Adamus, S. U., 2018).

The simulation of the human expert is the base of the expert system which the latter use methods of inference for a convinced procedure of knowledge that is named domain and the methods that are used are knowledge, evidence, and reasoning, to resolve the issues that require the capability of a human skilled. The rules are used in the same manner as the human as a specialized human uses heuristically accomplished rules to find and troubleshoot the issues and flaws. (Ekhtiyarzadeh, D., & Radfar, R., 2015).

The problems in the construction industry are complicated as the construction projects time and resource are numerous and need much recourse like worker, budget, tools and technical needs .Also the constraints of the project like cost, time and quality and therefore lead to fail to gain the anticipated results of the project, therefore the project consider risky. So the management of the projects , problems are important for the success of the project. (Al-Zubaidi, E. A., Naji, H. I., & Ali, R. H.,2017).

1.2 Thesis Justification

In Iraq, construction projects face many problems as the most projects are being constructed in an unstable environment in term of cost and time and thus project management has been failing to meet the expectations of the owner and contractor both and that creates the need to build a system able to solve these problems.

The research justification can be explained as follows:

- 1- The size of construction projects and its complexity require the existence of an integrated system.
- 2- The unstable environment of the construction projects requires a system that able to make decisions without the loss of time and cost.
- 3- The cost and time of finding the best solution for the construction projects problems is high and therefore its required an integrated system.

1.3 Thesis Hypothesis

Based on the earlier justifications in the hypothesis is formulated as below:

There is a necessity to build an expert system to manage the problems in the construction projects that reduce the cost and the time of the project.

1.4 Thesis Aim and Objectives

The aim of this thesis is to build an expert system and consider an effective to manage the construction projects problems in term of both time and cost. Achieving current aim, there are some objectives must be obtained as follows:

- 1- Investigation and identification of the problems in construction projects.
- 2- Determining the effect of these problems on cost and time of the construction projects.
- 3- Find the solutions for these problems with effect on both cost and time
- 4- Build an expert system to manage these problems by using the techniques: particle swarm optimization and gravitational search algorithm.

1.5 Thesis Scope

Major projects in the Diyala governorate, especially university of Diyala university projects will be taken due to its significant budgets from periods 2006-2014 in addition to the projects of ministry of

education and ministry of construction and housing , the type of project were building and from the owner and contactor point of view.

1.6 Thesis Methodology

The methodology of the research is embraced that involves three parts:

Part 1-The Study of the Theoretical

A scientific literature review that deal with the following:

- 1- Expert system concept and its application in various sector and approaches in construction projects.
- 2- Reviewing cost and time problems, kinds, and factors that may affect the projects .
- 3- Reviewing the artificial intelligence techniques and the steps of its procedures and its uses in the construction projects

Part 2- Field Study

The field study involves the following:

- 1- **Open Questionnaire** This part comprises making many experts interviews. These comprise managers and professors of the university, and other projects parts in the following ministries: The Ministry of Construction and Housing, The Ministry of Higher Education and Scientific Research and Ministry of Education. The interviews are conducted as they have a significant part in aiding the later stage, also questionnaire discussion was firstly set from the literature and as well as some adjustments that made on the form to

add different question with the assistance of the experts to ensure the success of the method and questions presented.

- 2- **Closed Questionnaire:** when the interviews are completed with the experts, the research problems were separated into numerous groups which include, identification of the effect of the problem on time and cost, finding the solutions for these problems and finding the effect of each solution.

Part 3- Building an Expert System

The expert system was built as the following:

- 1- **Knowledge Base:** This step includes the collection of a of accurate and precise data, information and past experience that necessary for building the system which is based on the previous steps that mention in the field study .
- 1- **Inference Engine:** This part includes a collection of rules and efficient procedures In the situation of knowledge-based, the knowledge is been obtained and manipulated by the inference engine to get a specific solution.
- 2- **User Interface:** The interaction is offered by the user interface among the ES user and the ES itself.

The flowchart of the thesis in figure (1.1) which show the steps that will be followed in this thesis.

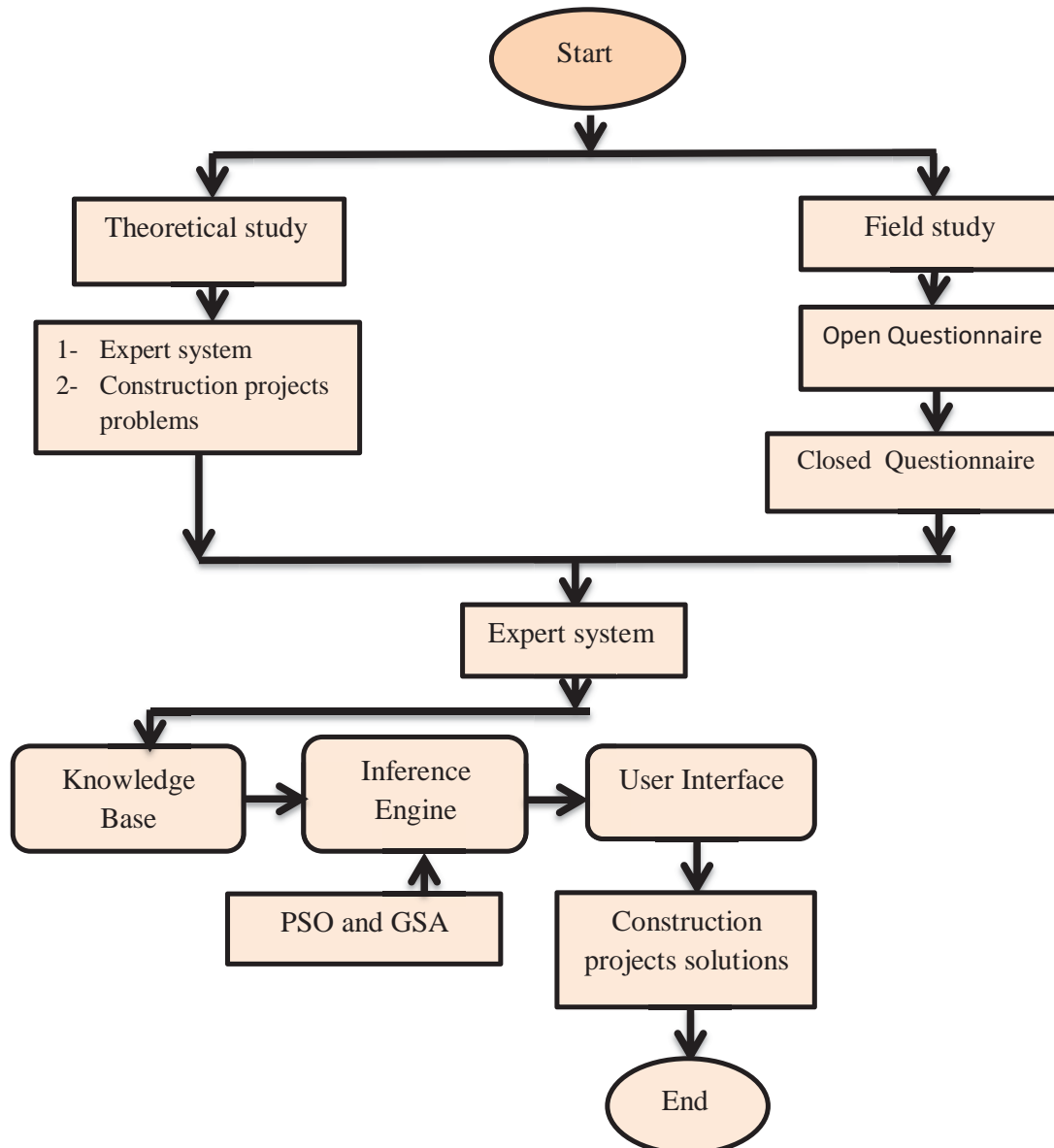


Figure (1.1) Methodology Flow Charts of the Research (Author)

1.7 Thesis Structure:

The research includes several chapters, which are:

Chapter One: This chapter includes a general introduction to the research, research problem, justifications, hypothesis, scope, research objectives, research methodology, the structure of the thesis and previous studies.

Chapter Two: This chapter deals with the projects definition, construction management, the stages adopted in the plan of action and its techniques. It also includes the time and cost problems and the techniques used to solve this problem.

Chapter Three: This chapter includes the data collection and how the data are been collected from the questionnaire and from the projects and its include various stages of the field survey. It includes the aspects related to the field questionnaire, the selection of the sample, the scheduling of the results obtained, the method of finding the qualitative assessment of the notification from the probability and impact calculation, and finally analyzing the results obtained from the field questionnaire.

Chapter Four: This chapter includes the steps in building the expert system and what's its elements and what each part of the system include.

Chapter Five: This chapter includes the results of the expert system and the results of PSO and GSA for pre and construction.

Chapter Six: This chapter contains a collection of the conclusions that gain by the researcher as well as recommendations and proposals for subsequent research.

1.8 Previous Studies

This section include several studies regarding the expert system in various field including construction and medicine to obtain a clear ideas of the studies in the fields of construction is little compared to other fields.

- 1- Z.A. Memon(2008): The author constructs ACPROM system that offers to back for the phase of investment implementation, the process of estimation the building progress works depending on project and documentation of the graphic, permitting to transfer the resultant databases to MS Project. It permits to combine: managerial drawings, digital images for the site of construction, photography of digital progress.
- 2- **M. Abdullahi, et al(2008):** The author build COMIX which is an ES with rule and frame that offers recommendations on mixes of normal weight concrete design. This system was implemented by the engineers of concrete, engineers of design, and consultants. The system was built in New Zealand was Central Laboratories.
- 3- **Shaheen, A. A., Fayek (2009):** Establishes how systems of fuzzy expert can be combined within models of discrete event simulation to improve their forming and capabilities of predictive for the applications of construction engineering. A suggested methodology is obtainable for information extracting from specialists to improve the rules of the fuzzy expert system. The produced fuzzy expert system is combined within the model of discrete event simulation to improve its capability of modeling by explicitly accounting for the various issues impacting certain activities simulation.
- 4- N. Ismail, et al(2009): The author , designed system for the evaluation of the pavement and rehabilitation as an instrument to support the engineers of the highway. Firstly, the system was established for the administration of the federal highway and the Illinois transportation department that offers sustained system support and development. The information is provided by the