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Department of Civil Engineering

Effect Of Building Information Modeling on The Building Design in Oil Project Sector

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 Construction Management

By

Evan Emad

(B.Sc. Civil Engineering ,2011)

Supervised by

Prof. Dr. Wadah Amer

Prof. Dr. Hafeth I.Naji

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بسم الله الرحمن الرحيم

آتُونِي زُبَرَ الْحَدِيدِ ۖ حَتَّىٰ إِذَا سَاوَىٰ بَيْنَ الصَّدَفَيْنِ قَالَ انْفُخُوا ۖ حَتَّىٰ إِذَا جَعَلَهُ نَارًا قَالَ آتُونِي أُفْرِغْ عَلَيْهِ قِطْرًا

سورة الكهف الاية﴿٩٦﴾

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I certify this thesis entitled "**Effect Of Building Information Modeling on The Building Design in Oil Project Sector"** was prepared by "**Evan Emad kadhim**" under my supervision in the civil Engineering Department in University of Diyala in partial fulfillment of the requirements for the degree of master of science in civil engineering.

Signature:

Name: Prof. Wadhah Amer Hatem (Ph.D.)

Prof. Hafiz Ibrahim Naji (Ph.D.)

(Supervisor)

Date: / / 2021

COMMITTEE DECISION

We certify that we have read the thesis entitled **Effect Of Building Information Modeling on The Building Design in Oil Project Sector**. We have examined the student (**Evan Emad kadhim**) in its content and what is related with it, and in our opinion, it is adequate as a thesis for the degree of Master of Science in Civil Engineering.

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Prof. Hatem Khaleefah Breesam (Ph.D	(Chairman) …….
Prof. Wadhah Amer Hatem (Ph.D.)	(Supervisor) …….
Prof. Hafiz Ibrahim Naji (Ph.D.)	(Supervisor) …….
Assist. Prof. Abbas Mahde Abd (Ph.D)	(Member) ……
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Prof. Dr. Wissam D.Salman	(Head of Department)……...

The thesis was ratified at the Council of College of Engineering/ University of Diyala.

Signature…….

Name: Prof. Dr. Anees A.Khadom

Dean of College Engineering / University of Diyala

Date:

Dedication

I dedicate my dissertation work to my family and many friends. A special feeling of gratitude to my loving parents, Faleh and Faten

whose words of encouragement and push for tenacity ring in my ears. My sisters have never left my side and are very special.thanks to

my brother Hassan who shared me this work and worked hard

I also dedicate this dissertation to my many friends who have supported me throughout the process.

Evan Emad

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Researcher

((Abstract))

The sector of oil is important for the country economic, community, and ecological agendas and therefore take an important role in the Iraq future, the managers who have the responsibility for activities planning and coordinating and for the same time obtaining the best cost, time, quality and human resources so that objectives of the project are finally obtained . Hence, any conflict in these projects lead to significant conflict and subsequent problems and especially in the design phase.

The research's key goal is to create a method to control the design process in the oil projects industry and reduce the design conflict using building information modeling. To attain the goal ,a review of the previous studies that manage the BIM and its use in oil sectors and methods in building projects. Studying issues of cost and duration, types, and influences that may affect the projects . Reviewing the artificial intelligence techniques and the stages of its processes and its usages in the building projects. Make a Field Study with open and closed surveys, build a system with particle swarm optimization , and finally build a case study with building information modeling (BIM).

The results showed that the design stage show the highest phase that cause problems in the projects. Using BIM will improve design quality (reducing conflicts / reducing redesign, managing changes in design. The highest reason is that the multiplicity of owners in the owner's organization , which mean the decision is been making by different person that represent the owner side which lead to conflict and change in the design. Technical reason’s consider the highest , as the most of the design changes are due to the conflict or miss in design by the designer and the unused of modern techniques.

Support vector machine (SVM) show higher performance with 70% in prediction of design change on oil projects.

Most of the design conflicts were missing in elements which require to return the drawing and rework. As using BIM introduce many benefit regard quantity calculation as lead to reduce the cost about 30% , visual inspection , reporting and information availability. Finally , set of conclusion and recommendations were extracted from this research.

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LIST OF ABBREVIATIONS

ACRONYM	ABBREVIATIONS
OGPi	Oil and Gas Petrochemical Industry
AIA's	American Institute of Architects
AI	Artificial Intelligence
ANN	Artificial Neural Network

SVM	Support Vector Machine
BIM	Building Information Modeling
MENA	Middle East and North Africa Region

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CHAPTER ONE

INTRODUCTION

Chapter One

Introduction

1.1General

Any addition, deletion, or change to existing project design criteria, documentation, drawings, or specifications is referred to as a "Design Change." In big industrial undertakings, design modifications, whether voluntary or coerced, are common and unavoidable. Many project delays, cost overruns, and quality flaws can be linked to design modifications, which are occasionally adopted in the idea that they would benefit the project but have unintended negative consequences.

Since 1990, the oil sector as part of the Non-Building industry known as oil and gas petrochemical industry (OGPi) has been using Integrated Project Delivery (IPD) methodologies. “A project delivery method that integrates people, systems, business structures, and practices into a process that collaboratively harnesses the talents and insights of all participants to reduce waste and optimize efficiency through all phases of design, fabrication, and construction,” according to AIA's (American Institute of Architects) most recent definition of IPD.

Design changes, as well as their antecedents and effects, are known to be influenced by a range of factors, including project features, change type and timing, project team experience, and project management effectiveness, and may result in severe harm to oil projects.

1.2 Research Justifications

The Oil construction sector suffer from the inadequate design and design errors in the project which require rework and mostly time and cost overruns , the justification as follow :

1- Design errors in the oil project are difficulty to be solved and especially in the later stage.
2- The oil industry represent most of the risky industry and any change lead to cost and time overruns.
3- Delay in the correction of the design errors and the absence of modern techniques to complete drawing.

1.3 Research Limitations

The limitations of the research were , firstly the time limit was only one year as the time of the study was not enough and the project was in the oil industry and in the design stage in Iraq .

1.4 Research Aim and Objectives

The research's key goal is to create a method to control the design process in the oil projects industry and reduce the design errors using building information modeling , the following goals must be met:

1- Identify the main factors that lead to design errors.
2- Predict the effect of design errors on the performance.
3- Apply BIM to the design errors and how BIM can effectively manage them.

4- Develop a system in order to reduce the problems appearing in this stage and selection the optimal BIM function for each Problem by using Particle Swarm .

1.5 Research Methodology

To achieve the objective , the following research methodology was followed :

Theoretical study : this part include gathering information regarding the oil projects , design errors, BIM in the oil projects from book , journals and scientific publication.

Field work : the field work divided into two stage , the first one is by preparing a questionnaire for the design errors and what are the causes that lead to these errors and the second one is apply case study and modeled using BIM . the research methodology is summarized in figure (1-1).

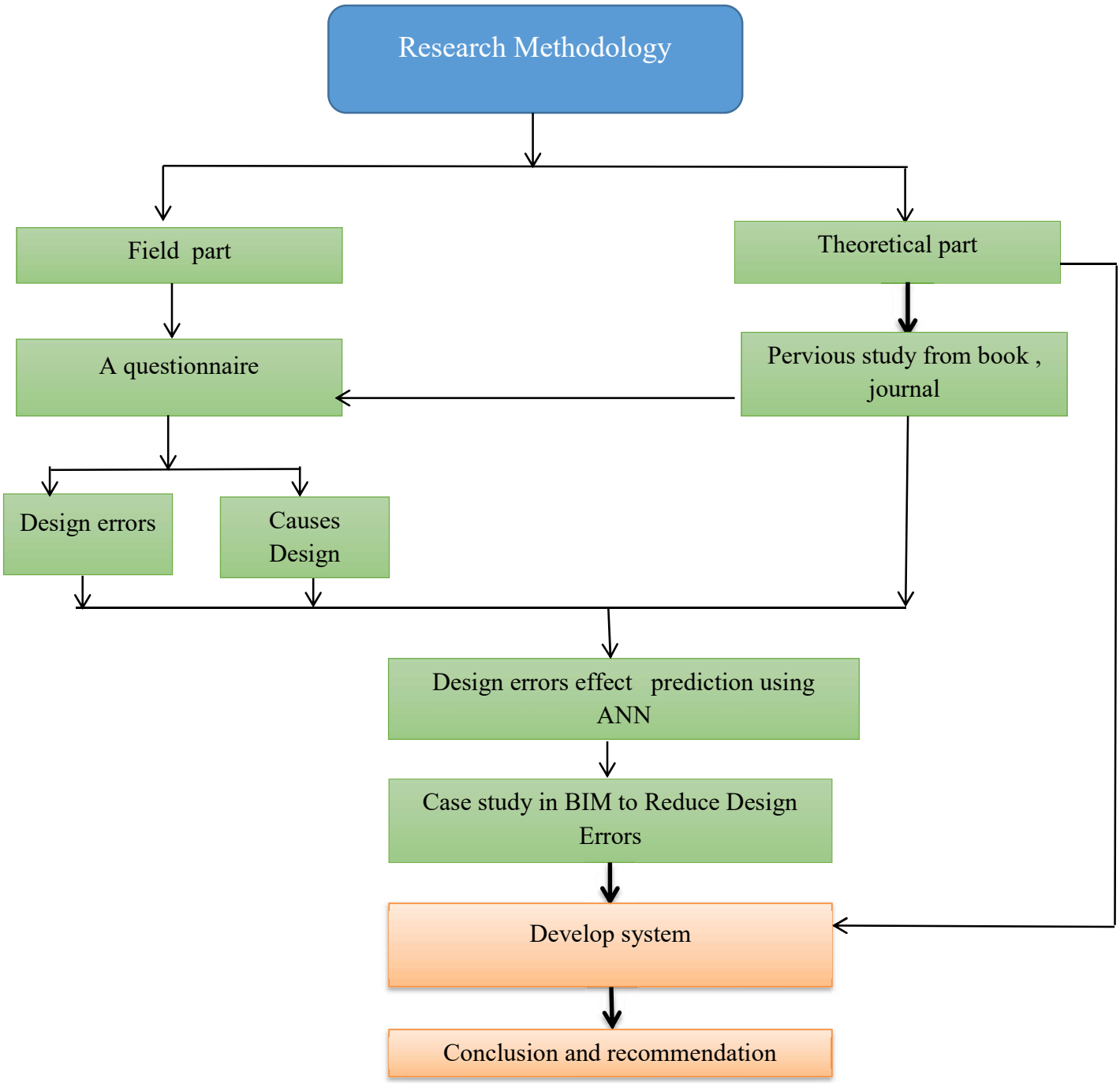

Figure (1-1) Research Methodology

1-6 Research Structure

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: This chapter aims to build a theoretical basis for oil projects and Building Information Modeling (BIM) concept based on previous studies and researches. This chapter including, oil projects , its definition, its phases with focusing on design phase, the problems encounter with these projects. The concept of BIM and its effect on the oil design phase

Chapter three: This chapter deals with the field study used in this research. The chapter includes a description of the research plan (research strategy), the study population, questionnaire design, questionnaire arbitration, reliability of the questionnaire, questionnaire distribution, finally a description of the research sample with questionnaire results.

Chapter four: This chapter will include the application of BIM in the oil project and how to reduce these design change errors.

Chapter five: In this chapter, PSO using MATLAB and its application in Oil projects will be explained. The particle swarm algorithm will be discussed with its concept, applications, and case study in the oil construction industry. Chapter six: this chapter include conclusions , recommendations and future studies of the research.

1.7 Previous Studies

This section include the previous studies regard the oil industry , design errors and using BIM to reduce Design errors

Table (1-1) Pervious Studies

Design errors studies		
Researcher	country	The study
(Bin Seddeeq et al., 2019)	Saudi Arabia	This paper endeavors to investigate the main causes of time and cost overrun in Saudi Arabian oil and gas construction projects. Thirty-eight causes of time and cost overrun were identified through the literature and an interview. Responses from 48 professionals based in the Eastern Province of Saudi Arabia were obtained. The respondents were solicited to evaluate the significance of the causes, which were then ranked and a test of agreement was conducted. All survey participants agreed that the five major causes of time and cost overrun, combined, were found to be “changing of design and scope by client during construction”
(Wilson & Odesola, 2017)	Nigeria	This study assesses the frequency of occurrence of design-related causes of rework and its influence on project performance in terms

		of cost and time. A survey research design approach was adopted which involved a stratified random sample of 500 contractors and 385 consultants.
(Afsharghotli & Yitmen, 2020)	Nigeria	The aim is to provide and introduce an artificial neural network through radial basis function (RBF) model to increase the level of perception and overall project performance during an early stages of project (design phase). The purpose is to create an insight evaluation on the level of impact of changes to the project during the design phase as an advanced supporting tool for decision makers.
(Yap & Skitmore, 2018)	Malaysian	his study aimed to identify the specific causes of design changes and their implications –cost performance of Malaysia-based building projects. A total of 39 causes were first identified through a comprehensive literature review and, in conjunction with 12 semi-structured interviews with experienced construction industry practitioners, then categorised into those originating from clients, consultants, contractors, site and external sources

BIM in Oil Projects		
(Abed et al., 2020)	Iraq	This study aims to improve the safety in the Iraqi oil projects, study the impact of applying this technology on the schedule time and cost. The research idea will be applied to one of the Iraqi oil and gas projects. The authors find out that the application of BIM technology leads to accurate identification and assessment of hazards, the ability in providing solutions to mitigate these hazards and solving all safety problems in early stages
(Fakhimi et al., 2017)	India	aims to explain capabilities of building information modeling when used for nonbuilding projects especially in the process plants and the oil, gas, and petrochemical projects. To achieve the mentioned goals, a widespread literature survey on adopting and implementing building information modeling in the architecture, engineering, and construction industry lifecycle including the benefits, barriers, and challenges, as well as expert interviews with oil, gas, and petrochemical industry firms were conducted. Finally, challenges and

		prerequisites that should be addressed before getting the full benefits of building information modeling in the oil, gas, and petrochemical industry are highlighted
BIM With Design Errors		
(Love et al., 2011)	Japan	In this article, the nature of errors is explained and the principal underlying causes identified with reference to the normative literature and the authors phenomenological research. A systemic model for reducing design errorss is presented and the enabling role of BIM discussed.
(Ham et al., 2018)	Korea	his paper proposes a basis for establishing building information modeling (BIM) investment strategies by quantifying the various costs associated with design errorss for errors prevention.
(Mehrbod et al., 2019)	Canada	The goal of this research is to better understand the causes of coordination issues and the factors that affect their resolution. Specifically, we developed a taxonomy of design coordination issues and an ontology that defines

		the relationships between physical, process, and model-based design issues. We applied the taxonomy to two case studies and analyzed the frequency of issue types, the distribution of issue types across disciplines, and the resolution rates of issue types.
(Hwang et al., 2019)	Singapore	BIM implementation is found to have a significant impact on reducing rework arising from owner change, design errors/omission, design change, and vendor errors/omission. The identified top three strategies to utilize BIM to reduce rework are "use of BIM throughout the design and construction phase," "design reviews, verifications, and audit to reduce system errorss," and "rework tracking system to prevent future occurrences of rework."

This study aim to define the influence of BIM in the oil projects during the design phase and how to reduce these errors.