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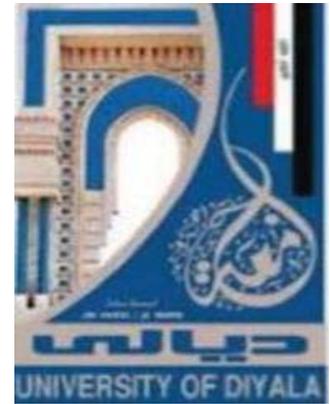
Using Building Information Model to Improve Planning Efficiency for Iraqi Construction Projects

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Chapter One

Introduction

1.1 General

Planning is the cornerstone of success in the construction process, especially for engineering projects, since it supplies data and productivity and manages all activities. Planning issues arise due to their use of conventional techniques across the construction stages, leading to severe planning inefficiencies. In addition, the complexity of the initial and design stages contributes to inaccurate cost and time estimates. The project managers who remain used to traditional methods have already had difficulties tackling the issue. Building Information Modeling (BIM) technology has recently appeared, providing significant benefits at all construction phases, exceptionally superior management of time, cost, quality, and others.

BIM technology is an essential tool in project management due to its effectiveness in managing design-phase issues, hence saving construction costs and wasted time (Tahir & et al, 2018). The facilities and above technology enabled a digital visualisation of the modelling of the necessary engineering data involved in the project, which includes parameter function, material properties, tables, quantities, and specifications, which are all stored with the prototype (one model with details, documentation, and comprehensive data) to levels of transparency for stakeholders and at all stages of the project (Politi R. R., 2018). Implementing this method provides several advantages for project stakeholders (visualisation, analysis options, sustainability, verification of quantities, cost estimation, site selection, representation of the schedule in a 4D model, and maintenance) (Azhar & et al, 2012).

Feasibility studies in BIM technology are very effective because of their many beneficial features towards green buildings and the manner of creating

them by offering more sustainable alternatives, supplying a schedule represented in a four-dimensional form, accessibility of comprehensive cost-benefit analysis, and other factors that make the work of the planning phase powerful (Munagala & Kone, 2020).

BIM technology impacts the project's time and cost by increasing the design phase's efficiency by performing multiple tasks for effective risk management, including risk plan and training syllabuses for project team members, and achieving a risk-free schedule (Abed, Hatem, & Jasim, 2019). A current communications plan is based on effective computer-mediated communication (CMC), that enhances collaboration between designers and stakeholders, as well as improves the efficiency of the design stage (Hatem, Kwan, & Miles, 2012). In addition, have advanced the documentation system (Majeed, Hatem, & Jasim, 2021), and conflict detection (Abd & Khamees, 2017). Compared to conventional projects, BIM provides a better basis for decision - making, particularly in design planning (Fazli & et al, 2014).

1.2 Research Problem and Justifications

There are already several issues associated with the planning of construction, which led to the adoption of building information modelling (BIM). The researcher provides all the necessary brief overview:

1. The inefficiencies of traditional project scheduling techniques are reflected in a two-dimensional (2D) form, and their completion requires significant effort.
2. Several delays have plagued the projects due to a lack of comprehension and shortcomings in the design process.

3. Frequent change orders result from inaccurate quantity estimations or design changes.

4. In other scenarios, a lack of monitoring and control is related to a lack of quality management specialists.

5. The adoption of BIM methods is to enhance construction planning is justified by its benefits. Project experts agreed that it increases planning efficiency by using a questionnaire designed to measure the effectiveness of BIM in construction planning.

1.3 Aims and Objectives

Enhancing the efficiency of construction planning in Iraqi projects is done by using Building Information Modeling (BIM) technology in the feasibility studies and design stages to fulfil the existing aim, the following objectives must be achieved:

1. Using early detection for clashes, design blunders, and conflicts to reduce rework and control change orders.

2. Increasing collaboration between stakeholders.

3. Optimising project scheduling by creating simulations between schedule and third dimension (3D) model.

4. Facilitating estimate quantities by automatically identifying them with their representation on the model and the ability to modify it.

5. Checking out model specifications by comparison of (BIM-actual) quantities to find the accuracy of BIM.

1.4 Research Scope and Limitations

The following underlines the limitations and scope of the research:

1. This research concentrated on using Revit (V-2022) and Navisworks Manage (V-2022) to achieve the previously mentioned aims.
2. Case study: The Directorate of Preparation and Training of the General Directorate of Education for Diyala governorate was selected to complete the research requirements.
3. This research undertaken only in the initial and planning stages.
4. This research concentrated on the main items for comparison, but did not take all the details yet.
5. Temporal limitation; it is just a one-year duration (2021-2022).

1.5 Research Methodology

The research methodology consists basically of two parts, as follows;

A) **Theoretical area:** This part provides the most prominent concepts on construction planning and the adaptation of building information modelling technology in construction planning, as well as the benefits obtained from a review of the related literature and previous studies. In addition to issues related to planning.

B) **Practical area:** this part offers overview of the experimental work, as follows:

1- Designing a preliminary questionnaire to measure the role of building information modelling technology in improving construction planning.

2- using SPSS program to analyse the responses to the statistical questionnaire.

3- Selecting case study, and the data (2D drawings in PDF, schedule, change orders, and bill of quantities (BOQ)) were collected.

4- Using Autodesk Rivet 2022 to create a 3D model of the case study.

5- Investigating the issues related to the planning stage (feasibility study, design).

6- Preparing the schedule in Primavera P6 version 21.

7- Integrating between 3D model and scheduling in (Navisworks manage 2022) to ready for simulation in 4D.

8- Calculating the quantification automatically in Navisworks manage 2022.

9- Conducting the Clash detection between the architectural and civil model in Navisworks manage 2022.

10- Conduct the questionnaire in three groups to find differences in efficiencies between traditional and BIM techniques, benefits of BIM, and the awareness of BIM, which evaluate the proposed system.

11- Finally, the fundamental conclusion, recommendations, and future studies are reviewed. The researcher designs the conceptual flowchart as indicates in the succeeding figure (1.1).
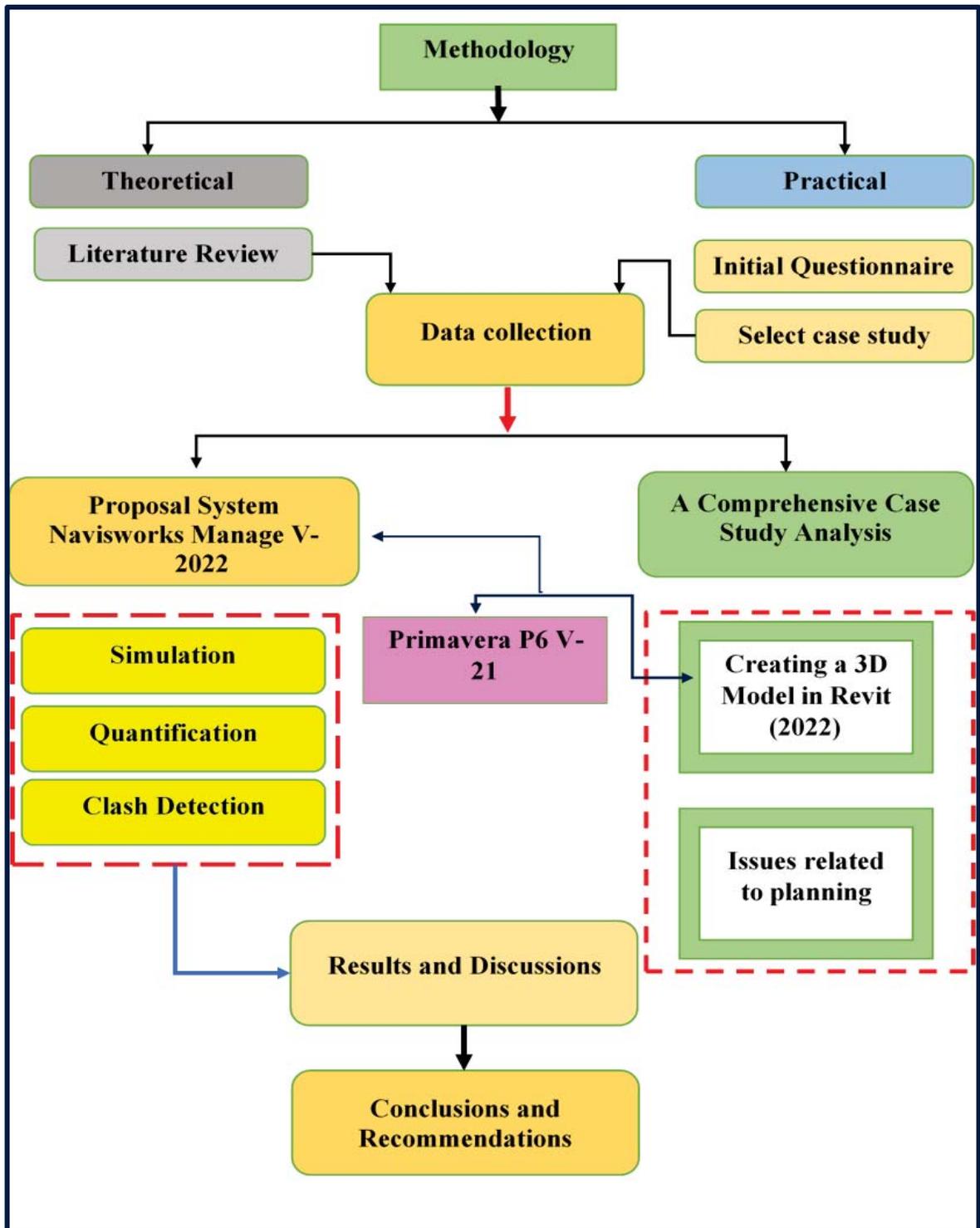
Figure (1-1) Research Methodology. (Researcher)

1.6 Research Arrangement

This research is divided into several chapters, and a brief overview of each chapter is mentioned below.

Chapter One: Introduction

Outlines the research's background, the research problem, and its justifications, aim and objectives, limitations and scope, and research methodologies. In addition to discussing previous studies.

Chapter Two: Literature Review

This chapter presents many concepts related to planning, starting with the concept of planning in project management and what is the project life cycle, providing an overview of planning and its types, construction planning, traditional planning methods, and ending with the role of BIM technology in planning and its benefits.

Chapter Three: Research Methodology

This chapter presents how the research justifications are conducted through a methodology in terms of designing a questionnaire to collect data, then analysis data in two ways (personal information analysis, statistical analysis) using the relative importance index (RII) of the improvements in BIM provided in construction planning.

Chapter Four: A Comprehensive Case Study Analysis

The main objective of this chapter is to highlight the planning issues associated with the mentioned case study. The process in this chapter was divided into three major sections: a simplified definition of the case studies, the motivations for identifying this case study, the technique and method of data collection, and the creation of a three-dimensional model using the Revit 2022 software to provide a realistic view of the case study, furthermore, highlighting the inefficient planning concerns, such as those in the feasibility studies and the design phase.

Chapter Five: Proposal BIM Techniques

This chapter covers the fundamental procedures for creating a four-dimensional model, modifying the schedule using Primavera, and exporting workflows from Revit and Primavera. Then import into the software Navisworks. Clarifying the simulation's overall design, measurement, and analysis of quantities, evaluating the accuracy of building information modelling technology in two methods (RMSE, Regression), and detecting model clashes.

Chapter Six: Evaluating Practical Aspect

This chapter contains a methodology consisting of designing a questionnaire to collect data, as well as analysing data through demographic and statistical data that measured the reliability and validity of correlation value, and the descriptive test using the relative index (RI) for each group are constructed. This chapter's initial purpose is to examine the results and discuss their relation to the research findings in chapters four and five.

Chapter Seven: Conclusions and Recommendations

The chapter shows the main conclusions and recommendations that increase this work's success as well as suggestion future studies that should be drawn to attention.

1.7 Previous Study.

Table (1.1) shows the related previous studies in terms of the current study.

Table 1.1) previous study and current study.

Previous Study		
No.	**Researcher and country**	**The work**
1	(Barati & et al, 2013) **(Malaysia)**	Title: "Enhancing Planning and Scheduling Program by Using Benefits of BIM-Based Applications ". This research study aims to present a system for utilising BIM applications to determine their effectiveness in improving planning and scheduling processes. In addition to aiding in the development of planning and scheduling skills. In order to fulfil the purpose of this study, a technique including the questionnaire distributed has been used. These questionnaires were then distributed to Singaporean companies whose projects employ Building Information Modeling technologies. About risks,

		producing event documentation, defining safety tasks, etc. The result shows support for construction planners in overcoming the challenges of schedules and work breakdown structure in their two-dimensional representation.
2	(Wang & Chien, 2014) **(Australia)**	Title: "The Use of BIM in Project Planning and Scheduling in the Australian Construction Industry." The researcher studied adopted BIM in the Australian construction planning and scheduling industry. Utilise the Combine quantifiable and qualitative methods. This study discovered that the awareness of BIM in the sectors was not as widespread as thought; however, the younger generation accepted them. The study found that the adopted BIM is mainly applied for visualisation, simulation, and planning progress tracking. The researcher recommended exchanging data and managing change systems to improve the efficiency of BIM in planning and scheduling projects.
3	(Politi R. R., 2018) **(Turkey)**	Title: "Project Planning and Management Using Building Information Modeling (BIM)." The core aim of the research is to establish a single project model applicable to all stakeholders and stages in the project. This research methodology has been selected to validate the benefits and use of nD BIM that examines project management challenges utilising the

		BIM process through a selected case study. The results were supplied at the conceptual design phase, including BIM-based scheduling (4D), cost estimation (5D), sustainability (6D), and facility management (7D), in addition to allowing the design and execution of construction projects via a collaborative platform.
4	(Munagala & Kone, 2020) **(India)**	Title: "Feasibility study and implementation of BIM in small scale projects". This research focuses on feasibility studies and the growing practical issues associated with using BIM in small projects. Applying Revit, Navisworks, and ETABs, the researcher prepares BIM models for scheduling, managing, and estimating project costs, as described by the researcher. The result of this study assessed that the project's overall cost and time might be reduced by 20 to 30 percent and 80 percent, respectively.
5	(Pai & Shriwas, 2020) **(India)**	Title: "Time and Cost Planning of a Housing Construction Project Using Building Information Modelling". This study's core purpose is to develop 5D BIM for pre-construction modeling, planning, and construction project management through integrating and simulating 3D models, time, and cost aspects. It also compares traditional project implementation techniques with 5D

		BIM technology to estimate their accuracy and effectiveness. 5D BIM technology integrated the 3D model with time and cost in Navisworks. Outcomes provided clear visualisation during pre-construction, improved work sequences, requests for information (RFI), quality increases, and determining quantities.
6	(Nawaz & et al, 2021) **(Pakistan)**	Title: "BIM Adoption and Its Impact on Planning and Scheduling Influencing Mega Plan Projects- (CPEC-) Quantitative Approach". The purpose of this study is to analyse the impact of BIM models on effective planning and scheduling in the Pakistani construction projects. the researcher was Conduct the methodology of a questionnaire on the effect of BIM on improving planning process precision. in consideration of planning and scheduling as dependent variables and BIM as an independent variable.A questionnaire was distributed to planning engineers, project managers, and site engineers in the construction sector working on the CPEC (China-Pakistan Economic Corridor) projects. The researcher concluded that BIM technology is a significant planning and scheduling tools. The author suggested that BIM will not only assist proper planning, but also increase the performance rate of ECP projects in Pakistan.

Current study (2022)
The aim of this research is to make construction planning more efficient by using BIM technology in the initiation and design phases. A case study was selected in the Iraqi sector. A methodology was developed to investigate the issues that arise during the feasibility study and design stages, as well as the progress of a proposed system consisting of Revit software to create a 3D model and integration with the schedule via Autodesk Navisworks to establish a 4D model for (simulation, estimation quantities, collision detection) work. Lastly, a questionnaire was made to see how this technology has affected the Iraqi sector.

1.8 Summary

Describes in detail the research's context, the justification of the study, its motives, the purpose and objective, the boundaries and limitations, and methodology of the study, and identify previous study.

Abstract

Using Building Information Model to Improve Planning Efficiency for Iraqi Construction Projects

Researcher: Supervisor:

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Planning is the cornerstone of success in the construction process, since it supplies data, manages productivity, and coordinates all activities. Planning issues arise due to their use of conventional techniques leading to severe planning inefficiencies. The project managers who remain used the traditional methods had difficulties tackling the issue. Building Information Modeling (BIM) technology has recently emerged, providing significant benefits across all construction phases and exceptionally superior management of time, cost, quality……etc.

The research aims to enhance the efficiency of construction planning in Iraqi projects by using BIM in feasibility studies and design stages.

A methodology comprising a questionnaire are designed and distributed to project planning specialists. The results indicate that the Iraqi construction sector requires this technology to optimize project planning due to its many capabilities. On the other hand, a comprehensive analysis of a selected case study's utilization of conventional techniques is undertaken by obtaining valuable data at the planning stage. Moreover, issues with the design stages and feasibility studies are identified. The researcher conducted a proposed system while using Navisworks and the capabilities of BIM, which covered simulation tasks, automatically calculating quantities, and detecting clashes.

The researcher finds that there are shortcomings in the feasibility studies, including site selection, sustainability conditions, and ambiguous events. There is also a 6.42 percent increase in cost and multiple delays around 450 days, various conflicts, and lack of risk management. The proposal application enhances time management with 35%, and the schedule represents in four dimensions(4D). At the same time, the quantities automatically estimated, resulting in cost savings as well as a minimization in change orders and disagreements, which improves the design stage's accuracy by detecting clashes, an accuracy level of 99.95% using the regression coefficient.

Finally, the researcher arrives at a set of conclusions supported by the survey results along three primary axes. The efficiency of traditional planning is lower than BIM technology. BIM is received 86% of the importance index, whereas traditional approaches are received 59% of the same rating. The relative index of the agreement for measuring the benefits of BIM in construction planning, is 89%. The relative awareness index for measuring the degree and scope of awareness of BIM in construction planning, is 43%. As a result, using a survey and relying on the opinions of experts and engineers, the researcher concludes that BIM technology could be applied to the management of Iraqi projects, mainly to improve construction planning.