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Projects Performance Management Using Building Information Modeling

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CHAPTER ONE
INTRODUCTION

Chapter one

Introduction

1.1 General

This chapter provides a general introduction to the research background, the research problem, and justifications, with an explanation of the research aim and objectives. In addition, research methodology, and previous studies are discussed.

Traditionally, the "iron" or "golden" triangle, which refers to achieving technical-related criteria, principally cost, time, and quality, has been used to describe project performance in a very limited way. (Gardiner & Stewart, 2000), The PMS domain has brought attention to the shortcomings of such a constrained definition of performance (Bourne et al., 2000)). It has been reported that in operational environments, the shortcomings of traditional PMS frameworks, which are concentrated on a small number of primarily financial-based measures (such as return on investment), lead to a failure to focus on continuous improvement and under-optimization of performance.(Ghalayini & Noble, 1996).

Early judgements are not possible with standard CAD planning; energy and performance evaluations are frequently carried out after the creation of architectural and construction design documents. (Azhar et al., 2009). Building information modeling (BIM) is a cutting-edge method that integrates a number of tools for evaluating a building's energy efficiency. (Najjar et al., 2017).

1.2 Research Problem and Justifications

The high amount of energy consumption demanded by buildings entails the worsening of several environmental issues. Therefore, actions to be taken to mitigate the effects is necessary. Using different alternative materials in the early design stage and in retrofitting existing buildings offers significant opportunities for reducing global energy consumption and greenhouse gas emissions.

The function of many buildings is being changed to suit the need. This is done by modifying the spaces in the building, often without planning and taking into account the use of spaces. This may affect the comfort of the building occupants. Therefore, the spaces must be studied and divided according to their function and conformity with international standards.

In learning settings, the acoustic environment is an important consideration. The design and performance of the acoustic conditions should be examined from the very beginning of the project in order to ensure that the acoustic comfort standards in educational buildings are met. Specialized software has often been used to analyze acoustic parameters.

1.3 Study Aim and Objectives

The research aim is to assess the building performance in terms of building spaces functionality, energy consumption and acoustic comfort using building projects performance tools. To achieving the current research aim, some objectives must be achieved as follows:

1. Analyzing the building in Autodesk insight 360 cloud to identify sustainable design options.

2. Study the role of BIM in analyzing energy performance as well as creates and evaluate design alternatives.
3. Investigating the capabilities offered by BIM technique in sound insulation.
4. Investigating the capabilities offered by BIM technique in area calculation.

1.4 Research Scope and Limitations

The scope of this study and its limitations include:

1. Case study: An educational building was selected which is The Power and Electronics Engineering Laboratories building.
2. This research focused mainly on Improve the functional aspect of the building.

1.4 Research Methodology

The research methodology mainly includes :

1. Theoretical Study: A literature review is conducted for previous studies related to the scope of research, including books, papers, thesis.

2. Practical Study:

The practical part of research includes the explorations for selected case study. After selecting the study case, the researcher made frequent visits to collect the data required to achieve the research methodology. It includes the following:

1. The case study selection and data collection, then modeling it using Revit 2021.

2. Analysis of building performance by using Autodesk Insight360 cloud to assess sustainable design options.
3. Export 3D BIM model to Autodesk Green Building Studio (GBS) for energy simulation and create and evaluate design alternatives.
4. Area calculations of the building to assess whether it meets the international standards for educational buildings or not.
5. Export the 3D BIM model to AcouBAT CYPE for acoustic analysis.

1.5 Review of Previous Studies

Table (1.1) summarizes the previous studies related to improve energy performance.

NO.	Researcher and country	The Work
<i>1</i>	(Feng & Lu, 2020) (UK)	<p>title "Integrating BIM with Building Performance Analysis in Project Life-Cycle: A Review and Future Directions"</p> <p>Aim: The aim of the study was to investigate the integration of BIM with building performance analysis in the project life-cycle.</p> <p>Methodology: The study conducted a systematic review of existing literature on BIM-based building performance analysis.</p> <p>Results: The study found that BIM has significant potential to enhance building performance analysis, but challenges related to data</p>

		management, interoperability, and user expertise need to be addressed to fully realize its benefits.
2	(Faaq et al., 2020) (Iraq)	<p>Title "Building Energy Management using BIM Technique: Iraq Construction Projects as A Case Study"</p> <p>Aim: The aim of the study was to evaluate the effectiveness of BIM in reducing energy consumption and greenhouse gas emissions in construction projects in Iraq.</p> <p>Methodology: The study used a case study approach and conducted energy simulations on a sample building to investigate the use of BIM for energy management.</p> <p>Results: The study found that BIM-based energy management can lead to significant reductions in energy consumption and greenhouse gas emissions, and can help designers optimize building performance during the design stage.</p>
		Title "Opportunity of Improving the Thermal Performance of a Highperformance University Building Based on Revit Software"

3	<p>(Duarte et al., 2019)</p> <p>(Brazil)</p>	<p>In this study, the contribution of Revit software and its feature (Insight 360) to improve the buildings thermal performance is examined. The peak load for both cooling and heating has been determined to be 1.3, 0.4 MWh. BIM technology is used to investigate the possibility of improving an existing building. The results provide some options of enhancements.</p>
4	<p>(Franz & Messner, 2019)</p> <p>(Florida)</p>	<p>Title “Evaluating the Impact of Building Information Modeling on Project Performance ”</p> <p>Aim: A study will look at how BIM use uptake and BEP affect project performance across various project delivery techniques.</p> <p>Methodology: (1) Does increased BIM usage improve project performance as assessed by cost, schedule, and quality metrics? was the central research question that guided the study. And secondly, what part does BEP play in a project's successful BIM implementation? A multiple regression analysis was used to find the answers to these questions using information from more than</p>

		<p>200 projects. When project complexity was taken into account, the findings revealed a substantial positive association between BIM adoption and delivery speed, perceived facility quality, and team cohesion. There was no evidence to support the idea that the project team members' level of BEP participation moderated such associations.. Despite these key findings, this study revealed a need for a new approach for capturing process data across projects to enable more-detailed future analysis.</p> <p>Results: It might be possible to gain a better understanding of the value that these tools add to projects by switching to the collection of a more narrowly focused data set, targeted at the microlevel of BIM and BEP adoption and possibly lean construction techniques.</p>
5	(Aguilar-Aguilera et al., 2020)	<p>Title “Management of Acoustic Comfort in Learning Spaces Using Building Information Modelling (BIM)”</p> <p>Aim: The aim of the study was to evaluate the effectiveness of BIM in managing acoustic comfort in learning spaces.</p> <p>Methodology: The study used a case study approach and conducted acoustic simulations on a sample learning space to investigate the use of BIM for acoustic management.</p>

		<p>Results: The study found that BIM-based acoustic management can lead to significant improvements in acoustic comfort and can help designers optimize acoustic performance during the design stage.</p>
6	<p>Aguilar,2019</p> <p><i>Granada</i></p>	<p>Title ‘‘BIM-based framework for indoor acoustic conditioning in early stages of design‘</p> <p>Aim: The purpose of this study is to offer a framework for early design decision-making utilizing the BIM approach. The key acoustic parameters (absorption, insulation) may be estimated and taken into account during the project's design thanks to a software tool that has been integrated into BIM.</p> <p>Methodology: As a tool to enable an indoor acoustic optimization throughout the building design process, a framework connected with BIM is created. Through the use of this technology, several agents can cooperate during the performance-based design process. The acoustic behavior of the interior space is simulated using the data kept in the parametric BIM model. Autodesk Revit was used to create the framework.</p> <p>Results : Because the framework is integrated into the BIM software, errors resulting from the input of data from one software to another are avoided.</p>

		<p>Additionally, it only takes changing the construction element in the 3D model to evaluate a new solution. The main benefits of this proposal are: 1) reduced calculation time (reintroducing data is not necessary), 2) the results are visualized in the same design interface, 3) the results are similar to other software applications, and 4) the framework is integrated into the BIM software.</p>
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Abstract

The performance (or efficiency) of a building is a measurement of how well it performs in respect to predetermined criteria like physical, social, or environmental issues. For instance, factors like heat loss and energy usage may be used to gauge the physical efficiency of a structure. Adopting Building Information Modelling (BIM) in Building Performance Analysis (BPA) is becoming an emerging research area in the application of information technology in the Architecture, Engineering, and Construction (AEC) industry.

The research main objective is to assess the building performance in terms of energy consumption, acoustic performance and building spaces using BIM building projects performance tools.

A literature review and previous studies related to using BIM technology to improve building performance were studied at first by the researcher. In addition to this, one of the buildings at the University of Diyala, which is the Power and Electronics Engineering Laboratories building, was selected as a realistic case study to apply the research idea to. The researcher was able to use the tools provided by BIM technique (Autodesk Revit 2021, Autodesk Insight 360, Autodesk GBS, IFC Builder, and AcouBAT) to achieve the research objectives.

Case studies were analyzed, BIM technology was used to create data for actual spaces, and the data was then compared to internationally accepted standards for space management on campuses. Furthermore, it was found that there is no international standard that is listed for use in the division of these spaces, and there is a shortage of suitability for students, staff, and teaching staff.

The integration of the BIM model with the Building Performance Analysis tools and the use of different scenarios chosen to improve the energy and acoustic performance show that the use of BIM tools in assessing and

improving the building is very useful. It shows the best scenario that could be adopted to improve the current building.

For the energy performance analysis, the results show that the most important design parameters for reducing energy use intensity are HVAC systems, wall type, and orientation.

For the acoustic analysis, the BIM model was created using IFC Builder and analyzed using AcouBAT software. Three scenarios were used based on the software database to assess the acoustic performance.

Alternative construction materials that provide thermal insulation are advised since they significantly reduce energy consumption by reducing the amount of time that heating and cooling systems must run.

It is important to consider the acoustic performance of educational buildings, as it affects the comfort of the students.