A Systematic Literature Review on Construction Management Productivity Enhancement by utilizing Business Information Modeling

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ABSTRACT

The systematic review of Business Information Modeling (BIM) plays a crucial role in understanding its significance and impact. This review allows for a comprehensive examination of the existing literature, highlighting the benefits, challenges, and success factors associated with BIM. There is a scarcity of studies dealing with this subject, and so a question about the most important advantages that will be obtained by the construction industry, especially the construction companies, as a result of the BIM application arises. Relevant previous studies were reviewed and their quality was evaluated using a systematic methodology. The current study was characterized by the use of the SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis technique. As far as is known, the current study is the first of its kind in the field of Iraqi project management. The results suggest that the BIM benefits include firm's growth, organizational performance, enhanced market value, employee motivation, and service quality.

Keywords-Business Information Modeling (BIM); construction industry; productivity improvement; systematic literature review

I. INTRODUCTION

A business information model is a systematic and visual depiction of a construction organization's business processes, entities, and information flows. Business Information Modeling (BIM) actively encourages the integration, standardization, and interoperability of information across diverse systems, creates a central warehouse with features for data entry, formatting, editing, storing, and updating throughout a project's life cycle to support businesses in implementing appropriate information management and guaranteeing that all data are available to support projects' proper implementation [1]. Aligned with the strategic goals of the construction organization, it fosters collaboration and facilitates continuous improvement. BIM is pivotal in comprehending, overseeing, and leveraging business information to enhance performance and attain desired outcomes in the construction sector. The identification, ranking, and allocation of the major risk variables affecting school construction projects in Iraq were conducted in [2] through a systematic examination of the literature. The BIM methodology addresses the design and development of data-intensive information technology and governing data by introducing a semantic business information model as a central point of reference. Creating and capturing value can be simply described as one of the BIM functions because information systems tend to offer management tools and support all users in their activities. Their use has become commonplace and an integral component of every activity [3]. Authors in [4] explored the BIM applications in the field of engineering management. Various scientific research steps were used and multiple sources of information were investigated, to review studies and research related to BIM and its importance and assets.

II. METHODOLOGY

This study acts as an addition to the scientific engineering management literature that is related to the BIM subject in terms of its impact and the gains it provides the construction sector with. Given that literature still requires further research on identifying the most crucial benefits emerging from the BIM application in the construction sector, this study aims to provide this type of exploration. Increasing productivity is a top priority for all businesses and organizations across the globe.

However, it is difficult to give a precise definition of the former or an algorithm to gauge its rise or fall because there are many variables and metrics to consider. Work scheduling directly affects productivity [5]. Enhancing productivity concerns is essential to the success of project management in the construction sector [6]. Previous studies indicate that there is an urgent need for more analytical and exploratory research on regulating the advantages, success factors, or the improved productivity caused by the application or non-application of BIM to the construction sector. The specific uses of BIM may differ based on the industry size and type. BIM allows businesses to better manage their information assets, streamline operations, and drive innovation and competitiveness. The current systematic review is based on answering the question raised in this study as well as on identifying, evaluating, and summarizing relevant previous studies using a systematic methodology. Within the framework of the current study is to explore and determine the most important gains that construction companies will obtain from the application of BIM. The systematic review process employed in this study went through several stages, which are analyzed below.

A. Identifying Relevant Literature

This step consists of identifying the basic databases, their sources, periods, terms, and keywords used when searching for literature related to the topic (benefits of BIM in improving productivity in the construction sector). With this regard, a preliminary survey was conducted and SciSpace [7] was finally chosen as the source database.

B. Primary Research Question

There is a limited number of studies that investigate the subject of BIM employment and its benefits regarding productivity. Understanding the significance of the productivity of employees in the building industry, may result in time and money savings [8]. The raised research question is: What is the impact of BIM in developing construction management and ameliorating productivity?

C. Topics to Include

After the basic database has been identified, the criteria that will be adopted in the inclusion of research within the literature must be determined. Among these criteria the following keywords for searching on the database can be found: Practice Management, Productivity Improvement, Business Information Modeling, Construction Information Management, Business Information Systems. The considered language was English and the publication period was confined between 2007 and 2023.

D. Topics to Exclude

A research protocol must be developed before the execution of any systematic literature review to identify exclusion topics such as, repetition in titles, no relative subject, generic BIM studies, aiming to focus on studies directly addressing BIM's influence on practice management and productivity.

III. DATA EXTRACTION AND ANALYSIS

After identifying the relevant studies, data must be extracted from them. The main purpose of the current analysis is to integrate the findings derived from different studies to answer the research question, rather than constructing a mere collection of previous researches. At this stage, earlier studies were collected from SciSpace. A total of 27 studies were initially considered. After duplicate (6) and irrelevant (10) study removal, 11 studies were reviewed. In the last stage of audit, it was found that one of them was repeated, so it was excluded. Therefore, 10 past studies were finally contemplated in total. The summary of the reviewed previous studies can be noticed in Table I.

TABLE I. REVIEW SUMMARY

Ref.	Objectives	Results
[9]	BIM for process integration in the mold-making industry is designed. To accomplish smooth information flows and business process automation, crucial business processes must be integrated and a process-oriented business information model is suggested.	The system's implementation and advantages are presented. The results may help mold manufacturing businesses to accomplish business process automation and concurrency, as well as business process integration, streamlining, and maximizing information exchange.
[10]	The study proposes an analytical framework for modeling business processes to achieve both operational and goal integrity.	The use of BIM for structuring and formalizing business needs in big data-intensive projects is proposed. The assessment of BIM is based on a sizable banking data warehouse project. The study also demonstrates how BIM can be utilized in large data landscapes and data science activities, demonstrating its suitability outside traditional setups.
[11]	A technique for modeling the dynamics and structure of intricate corporate information supply chains using a process approach is presented.	The simulation software package comprises an execution engine, a knowledge base, a process library, and a model database. The study offers a useful tool for risk analysis, planning, optimization, assessment, and management in commercial information supply chains.
[12]	BIM is explored regarding data warehouses and big data governance	BIM is suitable for data warehouse, big data, and data science projects.
[13]	The study emphasizes how crucial project management abilities are to IT initiatives, especially those involving business informatics.	To complete a project, excellent communication skills and the application of best practices and project management concepts are essential.
[14]	A BIM method for EIS is proposed.	The proposed method helps EIS development teams gain comprehensive knowledge.
[15]	The proposed Early-warning Performance Monitoring System (EPMS) offers an alternative method for objective performance monitoring and forecasting by utilizing project progress data, a theoretical model, and an index for performance monitoring and forecasting.	Changes in the project execution environment can affect performance. The EPMS was successfully applied in a Korean construction project. It offered a way to objectively monitor and forecast project performance, even in circumstances data on performance indicators were lacking.

[16]	Project management techniques are used more often in modern industry to deliver work packages in a more regulated and cost-effective manner while maximizing the utilization of human resources to satisfy client demands and gain a competitive edge. The behavioral competencies of project, program, and portfolio managers as well as the significance of information modeling and technology in project management are highlighted. The difficulties and peculiarities of the industry project management in Croatia are addressed.	Leadership is regarded as the most crucial behavioral project management competency, with teamwork and self-management following. Relationships and engagement, conflict and crisis, negotiation, and resourcefulness have less effect on the successful completion of a project.
[17]	This study examines how information systems, Human Resource Management (HRM), and decision-making impact competitiveness and sustainable corporate performance in a transitional economy.	Decision-making and HRM have a moderately beneficial impact on business performance, but information systems have a large positive influence. The study also discovered a favorable relationship between competitiveness and sustainable business performance. The study sheds light on the variables that may affect competitiveness and sustainable corporate performance in a transitional economy.
[18]	The study's objectives were to determine the advantages of methodical Construction Information Management (CIM) and how it may inspire building firms.	Company expansion, organizational performance, increased market value, employee motivation, and high-quality services are among the advantages of CIM. The use of modern technology in CIM is also emphasized as a means of improving building design, productivity, and project planning. Construction businesses should use a well-organized CIM system to increase dedication to the project, enhance professional collaboration among workers, and provide clarity on the information required at each project stage.

IV. RESULTS AND DISCUSSION

Similarities and differences are the essence of a systematic review. The goals of such a review are to summarize the results of previous relevant studies, to evaluate them using a clear logical structure, and to review these findings in an unbiased, organized, clear, and direct manner.

A. Similarities

The earlier reviewed studies bear some resemblance to our work, which will be presented in another paper. This resemblance can be detected in some of the statistical methods used.

- The considered studies used the descriptive approach due to its suitability to the nature of the problem. Often questionnaires were used as a means of collecting data.
- All studies demonstrated the positive impact of BIM and information management on the construction sector due to their ability to enhance and improve productivity.
- Some past studies attempted to discover the degree of stakeholders' commitment to professional and scientific standards for the application of BIM or information management in their companies and projects.

B. Differences

- This study represents the research community in the Iraqi building and construction sector, and is concentrated on the Ministry of Construction, Housing and Municipalities in the Republic of Iraq. The latter's tasks are to supervise the implementation of infrastructure projects.
- The research conducted was characterized by the employment of the SWOT analysis technique in assessing the reality of BIM, with identifying and diagnosing strengths, weaknesses, opportunities, and challenges. As far as is known, the current study is the first one coping with this topic in the field of Iraqi project management.

Table II illustrates a comparison between the current study and previous ones in terms of study objectives, study location, study limits, and the research gap we aim to cover.

TABLE II. COMPARISON WITH PREVIOUS STUDIES

Field	Previous studies	Our work
Place	Most earlier research was carried out in nations with a history in BIM and information management, particularly in Europe.	This study was conducted in the Republic of Iraq, which only recently began to apply the concept of BIM in the construction sector.
Subjects	Previous studies dealt with the concept of BIM and information management within a general holistic framework and focused on public projects such as IT projects.	This study focuses on an in-depth evaluation and analysis of the performance of BIM in the Iraqi construction sector, which requires specificity in the analysis, taking into account the size of projects, the scarcity of local technical resources, and the nature of infrastructure projects.
Objectives	Earlier studies focused on reviewing the benefits of information management and BIM and their relationship to the success or failure of companies or public projects. The performance evaluation was limited in IT projects.	An effort to highlight the role of BIM within construction institutions is made due to the importance of BIM in project management and enhaned productivity. The ability of BIM to achieve integration management and effective communication between the technical and administrative companies, its importance in overcoming risks, and the increasing productivity it brings are considered.

C. Benefits from Previous Works

- New ideas were generated about the method of scientific research by examining the theoretical framework of similar studies and their research methods. The literature review helped defining the research problem of this study.

Knowledge of the findings of past researches in the field of BIM was gained and was utilized in defining the research gap problem and the dimensions and fields of work. The particular study is not a repetition of previous ideas, but a renewal of knowledge, and an attempt to reach originality.

- Several sectors that can be benefited from our work were identified.
- The performance of BIM in construction companies was evaluated along with the main causes for its weak application and its role in the Iraqi construction sector by using the Root Cause Analysis Technique (RCAT).
- This work is a new addition to the field of knowledge in project management, as it addresses the basic points of BIM in a new and more in-depth manner.

V. CONCLUSION

The most important results of earlier studies related to this work were summarized and a set of conclusions were reached regarding the most crucial gains expected from the BIM application in construction companies to diagnose its impact and effectiveness on improving the competence of the construction and building sectors.

The correct application of BIM results in completing projects on time and in reducing the previously allocated costs. The former also allows continuous follow-up, reporting to senior management, and preparation of standard specifications, methodologies, and models for projects.

BIM needs human knowledge and technical capabilities to be combined and thus support the stakeholders' participation and enhance their understanding of the relationship between knowledge-sharing behaviors and of how they correspond to the functions of administrative units in companies.

This work attempts to close the research gap of identifying in practice BIM's important contribution to management and productivity improvement and to the success of the construction companies in the Iraqi construction industry.

Company expansion, organizational performance, increased market value, employee motivation, and high quality of service are all advantages generated from BIM employment.

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