First Libyan International Conference on Engineering Sciences & Applications (FLICESA_LA)
13 – 15 March 2023, Tripoli – Libya

The Potential of Implementing Building Information Modeling (BIM) in Libyan Construction Industry

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***Abstract*—The implementation of Building Information Modeling (BIM) in the Libyan construction industry is still in its early stages. However, there is a growing interest in BIM among industry professionals due to its potential to improve project efficiency, reduce errors, and enhance collaboration between project stakeholders. There is potential for significant growth in the future as industry professionals become more familiar with BIM and its benefits and as the government and industry associations take steps to promote its adoption. This study investigates the potential of Building Information Modeling (BIM) implementation and the barriers to non-implement BIM in the Libyan construction sector. 500 questionnaires were sent out via online survey, and 101 completed questionnaires were returned and analyzed using the mean index and ranking method as part of the investigation. The study's findings indicated that BIM currently can be used in the design and operation stages, and it is strongly advised that might be implemented for all phases of Libyan building over the project lifecycle.**

Keywords—BIM, Construction stages, BIM application, BIM barriers

I. INTRODUCTION

Building projects become more complicated and challenging to manage [1] and it has been evolving quickly in response to the projects' rising complexity [2]. Building Information Modeling (BIM), which has gained popularity in academic and industrial circles as the new CAD paradigm, has seen a significant change in the construction sector over the past ten years [3]. Although BIM is new to the construction business, it is not in the world of construction [4]. BIM become the most popular new method of handling building design, construction, and maintenance now [5].

Building Information Modeling (BIM) is a digital technology that has revolutionized the construction industry worldwide [6]. In Libya, the implementation of BIM is still at an early stage, but there is a growing interest in technology among industry professionals. The construction industry in Libya has traditionally relied on traditional 2D CAD drawings, and the implementation of BIM is considered a major shift in the industry [7]. One of the main drivers for BIM implementation in Libya is the government's focus on modernizing the construction industry and improving infrastructure [8].

However, there are still several challenges to widespread BIM implementation in Libya. These include a lack of awareness and understanding of BIM among industry professionals, limited access to BIM software and training, and a lack of standardization in the industry [9].

To address these challenges, the Libyan government and industry associations can play a significant role in promoting BIM adoption by providing incentives for companies that adopt BIM, offering training programs for professionals, and establishing BIM standards and guidelines.

II. LITERATURE REVIEW

Building Information Modeling (BIM) is a digital tool used in the construction industry to create and manage a building's physical and functional characteristics throughout its lifecycle. BIM can be used in various stages of the construction process to improve communication, reduce errors, and increase productivity [10]. Here are some of the applications of BIM in different stages of construction:

A. Pre-Construction Stage:

BIM can be used in the pre-construction stage to create a virtual model of the building, including its site, structure, systems, and components. This can help identify potential conflicts and design errors early on, reducing the risk of delays and rework. BIM can also be used to generate accurate cost estimates and material quantities, allowing for more accurate project budgeting [11].

B. Construction Stage:

During the construction stage, BIM can be used to coordinate and manage the building process. The digital model can be used to plan and schedule construction activities, assign tasks to workers, and track progress in real-time [12]. This can help reduce the risk of delays and improve the efficiency of the construction process.

C. Operations and Maintenance Stage:

After construction is complete, BIM can be used to manage the building's operations and maintenance. The digital model can be used to store and organize information about the building's systems, components, and maintenance history.

This can help reduce maintenance costs, improve asset management, and extend the life of the building [13].

D. Renovation and Demolition Stage:

BIM can also be used during renovation and demolition projects to help plan and coordinate the work [14]. The digital model can be used to identify and assess the impact of proposed changes, including their cost, schedule, and effect on the building's systems and components.

Overall, BIM is a versatile tool that can be used throughout the entire lifecycle of a building, from design to demolition [15]. Its applications include everything from planning and coordination to cost estimation, asset management, and maintenance [16].

III. METHODOLOGY

The literature research was likely conducted by searching for and reviewing existing academic articles, reports, and other relevant publications on the topic of BIM applications during the construction phases. This would have allowed the researchers to gather information and data from a variety of sources to establish a foundation of knowledge on the subject.

The questionnaire survey was likely designed to gather more specific information on the use of BIM applications during the construction phases from individuals and organizations involved in the construction industry. The survey questions would have been based on the research objectives and the information gathered through the literature research [17]. The survey could have been administered online or in person, depending on the preferences of the researchers and the target population [18].

The combination of literature research and a questionnaire survey is a common and effective method for collecting data in many fields of research, as it allows for a comprehensive review of existing knowledge and the gathering of new, specific data from individuals or organizations.

A Likert Scale is a type of survey question that asks respondents to indicate their level of agreement or disagreement with a statement [19]. The scale typically ranges from strongly agree to strongly disagree, with a range of values in between (e.g., 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree). In this case, the Likert Scale had ordinal values ranging from 1 to 5.

The researchers used several methods of analysis to interpret the data collected through the Likert Scale. The mean index was used to calculate the average response for each question on the survey. The standard deviation was used to measure the spread of the responses, indicating how much agreement or disagreement there was among the respondents. Likert Scale questions and various methods of analysis provided the researchers with a detailed and informative understanding of the attitudes and opinions of the survey respondents on the topic of BIM application during construction stages.

IV. RESULT AND ANALYSIS

The questionnaire was distributed to construction industry players who had experience in this area and the distribution was targeted to specific construction players in Libya. However, it is important to note that the sample of respondents should be representative of the population of interest to ensure the validity and reliability of the results.

The questionnaire was distributed via Google Form through email. Google Forms is a popular online survey tool that allows for the creation and distribution of surveys through email, social media, or other online platforms. The use of an online survey tool like Google Forms can make it easier to distribute the questionnaire to a large number of respondents and to collect and manage the responses.

A. Demographic Information

Demographic information is an important aspect of many research studies, as it can provide valuable insights into the perspectives and experiences of the respondents and how these may relate to the topic being studied which table I show the experience and responded background.

TABLE I. DEMOGRAPHIC INFORMATION

Demographic Information	Percentage %
Firm Type	
Architecture Firm	10%
Contractor Firm	18%
Consultant Firm	25%
Government Agencies	19%
Education Sector	20%
Others	8%
Profession Title	
Architect	32%
Civil Engineer	43%
Project Manager	10%
IT Engineer	2%
M&E Engineer	4%
Academic	9%
Construction Experience	
1-3 Years	22%
3-6 Years	14%
6-9 Years	10%
More than 9 Years	54%

According to Table I, this summarizes all of the responses, consultants made up the largest percentage of respondents (25%) in this study, followed by respondents from the architecture (10%), government (19%), contractor (18%), and other (8%) sectors. 32% of respondents reported having an architect as their work title, while 10% reported having a project manager. According to Table I, structural and civil engineers made up 43% of respondents, whereas solely academic respondents made up 9%.

Respondent's past experiences 101 respondents from diverse construction experience levels completed the distributed survey in its entirety. 54% of respondents with construction experience had worked in the field for more than nine years, while 22% had worked in it for more than three years.

B. BIM Application

The study examined the potential using of BIM applications across different construction stages, and Table II presents the ranking of these applications. The study found that the design stage has the highest ranking, while the Renovation and Demolition stage has the lowest ranking.

Additionally, it appears that there is potential for BIM in the operation stage, with exciting building.

TABLE II. BIM APPLICATION IN LIBYAN CONSTRUCTION

No	BIM Application		
1	**Construction stages**	**Mean Value**	**Rank**
1.1	Design	3.96	1
1.2	Operation	3.77	2
1.3	Construction	3.50	3
1.4	Plan	3.01	4
1.5	Renovation and Demolition	2.94	5
2	**BIM Software**	**Percentage %**	**Rank**
2.1	Revit Suite	53%	1
2.2	ArchiCAD	19%	2
2.3	Others	14%	3
2.4	Bentley System	9%	4
2.5	Tekla /Robot	5%	5

These findings can provide valuable insights into the current state and potential future direction of BIM implementation in the Libyan construction industry. The high ranking of BIM applications in the design stage may suggest that BIM is already widely used in this stage, while the low ranking in the construction stage may indicate that there is room for improvement and increased adoption of BIM in this stage. The potential for BIM in the operation stage may also suggest opportunities for future growth and development in this area.

C. BIM Barriers

The implementation of Building Information Modeling (BIM) in the Libyan construction industry may face several barriers, which can hinder its widespread adoption and effective use. Some of the common barriers to BIM implementation in the Libyan construction industry may include as showing in the table III.

TABLE III. BIM BARRIES IN LIBYAN CONSTRUCTION

3	The barriers	Mean Value	Rank
3.1	Lack of Awareness	3.64	1
3.2	Cost	3.49	2
3.3	Lack of Government Support	3.45	3
3.4	Lack of Standards	2.91	4
3.5	Limited IT Infrastructure	2.86	5
3.6	Resistance to Change	2.80	6

Lack of Awareness: One of the main barriers to BIM implementation in Libya is the lack of awareness and knowledge about BIM among stakeholders in the construction industry. Many construction professionals, including architects, engineers, and contractors, may not fully understand the benefits of BIM or how to use it effectively.

Cost: BIM implementation requires significant investment in software, hardware, and training, which can be a barrier for small and medium-sized construction companies in Libya. The cost of BIM implementation can also be a challenge for government agencies and other public sector organizations.

Lack of Government Support: The lack of government support for BIM implementation can also be a barrier to adoption. Government support can help to provide resources, funding, and incentives for construction companies to adopt BIM and invest in training and development.

Lack of Standards: The absence of national or industry-wide BIM standards in Libya can also be a barrier to implementation. Without standardized practices, BIM implementation can be fragmented and inconsistent, making it difficult to share information and collaborate effectively.

Limited IT Infrastructure: The lack of adequate IT infrastructure, including high-speed internet and computer hardware, can also be a barrier to BIM implementation in Libya. Without access to modern technology, stakeholders may struggle to use BIM effectively or collaborate with others.

Resistance to Change: Some stakeholders in the Libyan construction industry may be resistant to change and may prefer to continue using traditional methods of construction. This can hinder the adoption of BIM, even if it offers significant benefits over traditional methods.

The successful implementation of BIM in the Libyan construction industry will require addressing these and other barriers through a combination of education, training, investment, and government support. By overcoming these barriers, BIM can help to improve efficiency, reduce costs, and enhance the quality of construction projects in Libya

V. CONCLUSION

The Building Information Modeling (BIM) has the potential to transform the Libyan construction industry by improving collaboration, reducing errors, and enhancing project efficiency. However, the successful implementation of BIM in Libya requires addressing several barriers, including the lack of awareness and knowledge about BIM, the cost of implementation, resistance to change, the absence of national or industry-wide standards, limited IT infrastructure, and the lack of government support.

Despite these challenges, the results of this study suggest that there is a good potential for BIM in the Libyan construction industry, particularly in the design stage, and that stakeholders in the industry should work together to overcome the barriers to adoption. The leverage of BIM benefits to improve construction project outcomes, reduce costs, and enhance the quality of buildings and infrastructure in Libya.

In summary, the successful implementation of BIM in the Libyan construction industry requires a comprehensive approach that addresses the barriers to adoption and promotes education, training, investment, and government support. With a concerted effort by all stakeholders in the industry, BIM has the potential to revolutionize the way that construction projects are planned, designed, and built in Libya.

ACKNOWLEDGMENT

The authors would like to thank and express gratitude to the BIM Libya organization which has been involved in this research with great cooperation to come out with these results and provide the necessary data which was very useful for Building information modeling.

REFERENCES

[1] A. Saleema, et al. "Software engineering for machine learning: A case study." 2019 IEEE/ACM 41st International Conference on Software Engineering: Software Engineering in Practice (ICSE-SEIP). IEEE, 2019.

[2] K. Ozan, B. Keskin, and B. Ozorhon. "Challenges and enablers in BIM-enabled digital transformation in mega projects: The Istanbul new airport project case study." Buildings 9.5 (2019): 115.

[3] Dainty, Andrew, et al. "BIM and the small construction firm: a critical perspective." Building research & information 45.6 (2017): 696-709.

[4] L. Junjie, and H. Yang. "A research on development of construction industrialization based on BIM technology under the background of Industry 4.0." MATEC Web of Conferences. Vol. 100. EDP Sciences, 2017.

[5] T. Matti, et al. "The effects of BIM and lean construction on design management practices." Procedia engineering 164 (2016): 567-574.

[6] A. F. Henry, et al. "A critical analysis of Building Information Modelling systems used in construction projects." Advances in Engineering Software 90 (2015): 183-201.

[7] E. O. Oluwatosin, and D. J. Oluwasuji. "An evaluation of training needs of the Nigerian construction professionals in adopting building information modelling." Journal of Construction in Developing Countries 24.2 (2019): 63-81.

[8] S. M. Duwaeb. Barriers and driving factors for implementing building information modelling (BIM) in Libya. MS thesis. Eastern Mediterranean University (EMU)-Doğu Akdeniz Üniversitesi (DAÜ), 2015.

[9] O. O. Ibrahim, et al. "Investigating the barriers to building information modeling (BIM) implementation within the Nigerian construction industry." Engineering, Construction and Architectural Management 27.10 (2020): 2931-2958.

[10] P. Daniela, et al. "Exploiting Internet of Things and building information modeling framework for management of cognitive buildings." 2016 IEEE International Smart Cities Conference (ISC2). IEEE, 2016.

[11] M. Anna, and I. Ptukhina. "BIM as an instrument of a conceptual project cost estimation." Proceedings of EECE 2019: Energy, Environmental and Construction Engineering 1. Springer International Publishing, 2020.

[12] J. Yishuo, et al. "Digital twin-enabled real-time synchronization for planning, scheduling, and execution in precast on-site assembly." Automation in Construction 141 (2022): 104397.

[13] M. Solla, et al. "Integration of BIM and Archibus for Facility Management (FM) in FKAAS, UTHM Building." IOP Conference Series: Earth and Environmental Science. Vol. 498. No. 1. IOP Publishing, 2020.

[14] C. Jack CP, J. Won, and M. Das. "Construction and demolition waste management using BIM technology." 23rd Ann. Conf. of the International Group for Lean Construction, Perth, Australia. 2015.

[15] H. Dongchen, M. Kalantari, and A. Rajabifard. "Building information modeling (BIM) for construction and demolition waste management in Australia: A research agenda." Sustainability 13.23 (2021): 12983.

[16] A. Salman. "Building information modeling (BIM): Trends, benefits, risks, and challenges for the AEC industry." Leadership and management in engineering 11.3 (2011): 241-252.

[17] R. Samar. "Research design and methods: A systematic review of research paradigms, sampling issues and instruments development." International Journal of Economics & Management Sciences 6.2 (2017): 1-5.

[18] M. S. D. P Nayak, and K. A. Narayan. "Strengths and weaknesses of online surveys." Technology 6.7 (2019): 0837-2405053138.

[19] W. Fern., G. L. Theodori, and A. E. Luloff. "Another look at Likert scales." Journal of Rural Social Sciences 31.3 (2016): 6.