



# Effect of Artificial Intelligence on The Maturity Levels of Building Information Modeling in The Syrian Construction Industry Letter

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## ABSTRACT

In view of the huge potential offered by artificial intelligence (AI) and with the consideration of complexity in the Architectural, engineering, and construction (AEC) industry, AI has a great ability to leverage different capabilities of other technologies to deal with building issues and improve the construction industry. Therefore, the integration between building information modeling (BIM) and AI-based technologies has become a hot topic for researchers in the last few years. This study aims to investigate the possibility of integrating AI with BIM to improve BIM adoption in Syria. To achieve this aim, a literature review was conducted, and an online questionnaire was created and analyzed using SPSS software. The results reveal the most beneficial AI-based technology to be integrated with BIM in the Syrian AEC industry. Furthermore, the predicted advantages and challenges were identified. This study provides a contribution by identifying the pathway to realize the achievable benefits of AI in the Syrian construction industry. It proposes a strategy to accelerate AI and BIM integration.

**Keywords:** Artificial Intelligence, BIM, construction industry, BIM integrated with AI, AI technologies, Syria.

## 1. Introduction

Complexity in construction projects is known as the predominant characteristic. No matter how to define it and what the reasons behind it, it requires relentless efforts to make the project reach its desired outcomes [1]. This complexity has been increasing due to the high requirements of modernity, and that made traditional methods no longer enough [2]. Nowadays, modern technology provides various solutions to handle different types of construction complexities as well as common building problems [3]. One such technology is BIM which is considered a renovation in the construction industry. It changed the way in which contractors, engineers, and all project stakeholders work and communicate, making the project's workflow more efficient [4]. BIM has even become more than just a developing technology, but an urgent need. According to the national BIM report (NBS) 2021, BIM adoption has been gradually increasing all over the world. People have even moved from the use of 3D modeling software towards better information management [5]. But besides BIM, AI is also transforming the construction industry. (Schia, 2019) defined AI AS "the ability of a machine to mimic intelligent human behavior" [6].

Actually, by automating several human tasks, AI can help to speed up the process, reduce human errors and increase efficiency. However, the use of AI in the construction industry is still new [6]. And there is a clear shortage of studies in this field [7]. There are four essential fields in which AI can be used in the construction industry, and that includes design and construction management, BIM to field, field to BIM, and using robotic applications in construction sites [8].

It is supposed that by 2030, 38–45% of construction jobs will be completed by AI automated analytics or robotics [9]. Recent studies show that the integration between BIM and AI can help BIM to reach its full potential [10], and The most efficient AI-based Technologies to be integrated in the construction industry are: Big data, Blockchain Technology, Augmented and Virtual reality (AR/VR), Automated generation of 3D Models, 3D printing modularization, Robotics, and Digital twin [11],[12], [13].

As far as Syria is concerned, BIM implementation has already started in Syrian construction projects [14],[15]. People have become more aware of BIM's importance. Although they believe in its potential to solve (75 to 100%) of

existing problems [16], most Syrian construction companies are still using the early level of BIM [17].

Shaban and Elhendawi, (2018) Identified the top factors hindering BIM implementation as follows: absence of BIM culture, The need to develop the design code, Cost of training, Intellectual property, Lack of qualified contractors and the difficulty of involving them in the early stages, compatibility problems between software platforms, contractual obstacles, no clear methodologies for project management [19].

However, in this study, We aim to survey the possibility of benefiting from AI's potential to enhance the level of BIM maturity in the Syrian construction industry. We focus on 5 AI-based Technology: Big data, Blockchain Technology, AR, Automated generation of 3D Models, and Robotics.

## 2. Research Methodology

Numerous recent studies have explored the level of BIM maturity within Syrian construction companies, providing valuable insights into the current state of the Syrian construction industry. The philosophy of this research is demonstrated through the understanding and application of existing knowledge about BIM, including its benefits and the impact of Artificial Intelligence on BIM maturity levels, which in turn informs and shapes the overall research methodology. In keeping with the objective and factual representation of the data collected and analysed, the methodology adopted for this research will use a mixed-method approach, combining both quantitative and qualitative data [19],[20] and [21]. The study adopts a descriptive approach and follows the design selected by the author, focusing on surveys and questionnaires as suggested by previous research. Initially, a literature review was conducted, followed by the development of an online questionnaire based on earlier studies, research assumptions, and the objectives of this research. The questionnaire is divided into three key sections:

- i. The first part is an introduction explaining the research topic and its purpose.
- ii. The second part is general information about respondents and their organizations (their Academic specification, job title, experience, type of organizations, and the number of organizations employees).
- iii. The third part: respondents were asked to evaluate the level of BIM maturity in their organizations, what AI platforms they use, in which project phase the integration of AI and BIM is predicted to be more efficient, what the potential advantages of this integration, and what can hinder it. They were also asked to provide their opinion if AI can help to improve BIM maturity level and overcome the challenges of BIM implementation. And to rank AI-based technologies predicted to be more efficient among (Automated model generation, AR, blockchain, robotics, and Big Data) considering that number (1) refers to the most effective. Finally, they asked to rank the priorities for accelerating AI integration among (Establishing training courses in cooperation with external expertise, improving

the infrastructure to keep up with modernity requirements, enforcing BIM implementation in government projects, allocating a specialized budget to support technical development, encouraging scientific research) considering number (1) refers to the highest priority.

The data will be analyzed by using SPSS software (Statistical Package for the Social Sciences) was used to analyze data and develop useful information. The research community comprises specialists and various stakeholders involved in Syrian construction projects. The findings will be valuable to individuals, governmental and private entities engaged in the construction industry or seeking investment opportunities in the Architecture, Engineering, and Construction (AEC) sector in Syria. Additionally, the research will serve as a resource for scholars interested in exploring similar topics related to this field.

## 3. Results and Discussion

In order to gather data, the online questionnaire was shared on social media platforms and sent to some potential participants. The total number of responses was 32. The data were analyzed using SPSS software, and the results were arranged below according to the questionnaire structure.

### 3.1. General information about the respondents and their organization:

About (65.6%) of respondents graduated from an engineering college. While (34.4) hold a master's degree in engineering. Most of the respondents (59.4%) have an academic specification in Civil engineering, while Architecture Engineering came in second place with a rate of (31.25%), and Mechanical engineering in third place with a rate of (9.4%) of the respondents.

Most of the respondents (43.8%) have expertise in design while (21.9%) in project management, (18.8%) in supervising, (6.3%) in execution, and only (3.1%) in programming. However, (6.3%) have expertise in other fields, and according to their responses, that includes facility management, shown in Figure (1).

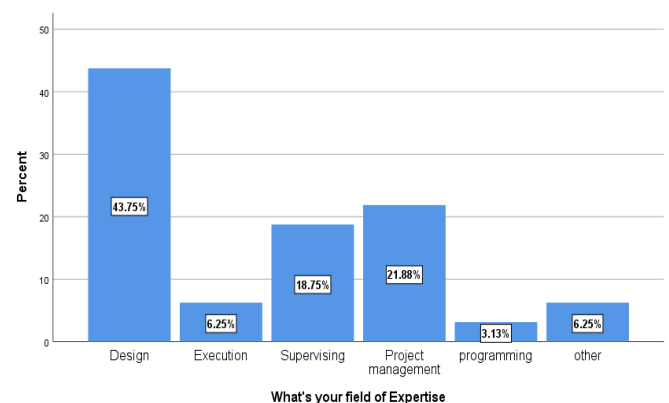


Figure 1. The respondents' field of expertise

From Table 2, (31.3%) have less than 3 years of professional experience, (25%) have (3 to 5) years, (25%) have more than 10 years of professional experience, and (18.8%) from (5 to 10) years.

Table 1: The respondents' level of professional experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 3 years	10	31.3	31.3	31.3
	3 - 5 years	8	25.0	25.0	56.3
	5 - 10 years	6	18.8	18.8	75.0
	More than 10 years	8	25.0	25.0	100.0
	Total	32	100.0	100.0	

**3.2. General information about organizations.**

Most of the respondents (56.3%) work in big organizations (More than 35 employees) while (25%) work in small organizations (less than 10 employees), and (18.8%) work in medium-sized organizations (from 10 to 35 employees).

(46.88%) of the respondents evaluate the level of BIM maturity in their organizations by BIM1 while (40,63% ) are still using BIM0 as shown in Figure (2).

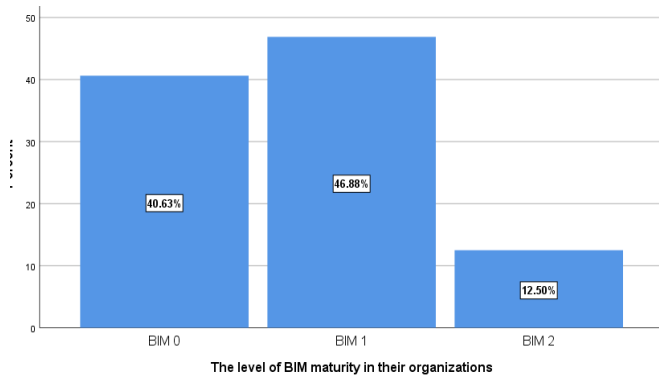


Figure 2. The level of BIM maturity in the respondents' organizations

**3.3. AI contribution to improving BIM maturity level in Syria**

Most respondents (78.13%) Agree that AI can help to overcome BIM implementation challenges in Syria while (21,88%) disagree. On the other hand, 40,63% of respondents believe that the integration of AI and BIM will be more efficient at both Planning and design phases, Figure 3. This result is a little bit similar to what was reported, they found that AI has a special effect at the planning phase [13].

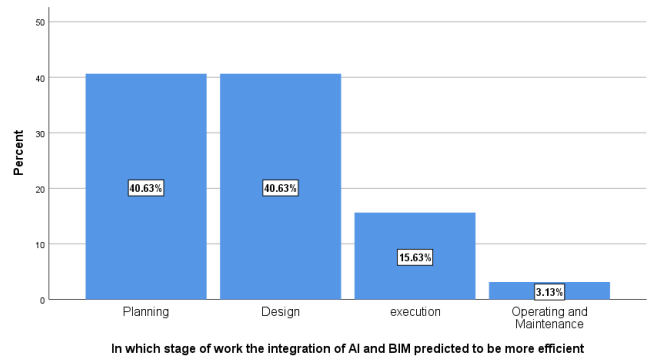


Figure 3. The project phases in which the integration of AI and BIM predicted to be more efficient

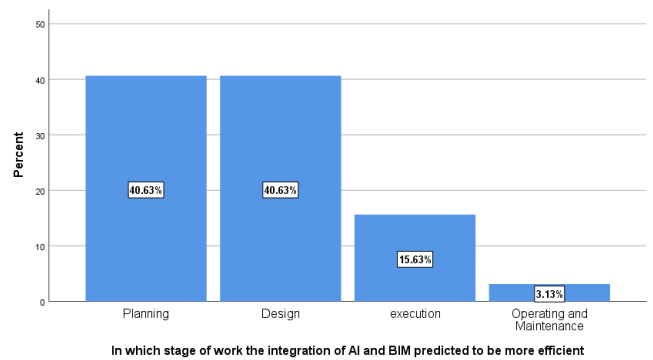


Figure 4. AI contribution to improving BIM maturity level in Syria.

Figure: 4 illustrated that, more than (60%) believe that AI can improve the BIM maturity level in the Syrian construction industry. But about (30%) find AI can't be helpful at the current stage or only has a limited effect.

**3.4. The predicted advantages of AI and BIM integration in the Syrian construction industry**

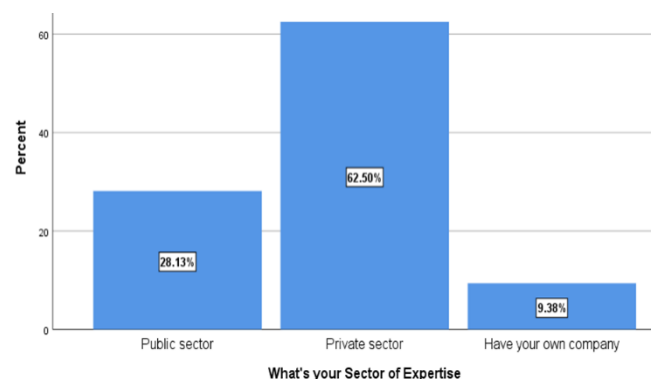


Figure 5. The predicted advantages of AI and BIM integration in the Syrian construction industry

According to Figure 5, We can identify the predicted advantages of AI and BIM integration as following:

- Save time and cost.
- Forecast potential risks
- Speed up the whole process.
- Improve the decision-making process.
- Increase productivity and safety at the construction sites.
- Level up BIM maturity.
- Provide a clear vision of the final product to all stakeholders.
- Improve quality and Reduce rework.
- Increase accuracy and efficiency.

**3.5. The main obstacles of AI and BIM integration in the Syrian construction industry**

Table 3 outlines the main challenges of integrating artificial intelligence (AI) with Building Information Modelling (BIM), ranked by their frequency. It highlights common issues such as data compatibility, AI algorithm complexity, and computational demands, showing which obstacles are most frequently encountered. These challenges are really matching with the obstacles of BIM implementation reported by Shaban and Elhendawi, (2018) [19].

**Table 3.** The main obstacles of AI and BIM integration in the Syrian construction industry

Challenges	Percentage	Ranks
Internet Problems and old equipment	90.6%	1
Lack of qualified People and specialists.	84.4%	2
High costs of AI platforms and other required equipment	71.9%	3
Change resistance and legal challenges	68.8%	4

**3.6. The AI-based Technologies predicted to be more efficient in the Syrian construction industry.**

The arithmetic mean was calculated for each technology. Then they were ranked from the most to least effective, As shown in Table 4,

**Table 4.** The rank of AI-based technology according to their efficiency.

AI-based Tech	Mean	Ranks
AR	4.5313	1
Robotics	4.4375	2
Automated generations of BIM models	2.3750	3
Big Data	2.3125	4

Blockchain	1.3438	5
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**3.7. Identify work priorities to accelerating AI integration in the Syrian construction industry**

After conducting the arithmetic mean for each factor, the priorities ranked according to their importance as shown in Table 5,

**Table 5:** The rank of priorities according to their importance.

priorities	Mean	Ranks
Improving the infrastructure to keep up with the modernity requirements	4.3438	1
Establishing training courses	3.3438	2
Allocating Specialized budget to support technical development	2.8750	3
Enforcing BIM implementation in all governmental projects	2.2333	4
Encouraging scientific research	1.9375	5

**3.8. Propose a strategy to accelerating BIM and AI integration**

In comparing with BIM implementation requirements reported by (Shaban and Elhendawi, 2018), We can deduce a strategy to accelerate BIM And AI integration as following:

- Spread awareness about the importance of AI and BIM integration to improve the construction industry.
- Improve the infrastructure to keep up with the modernity requirements and that includes (devices, technical equipment, and internet issues).
- Hiring external experts to Provide large-scale training for construction organizations.
- Assign a specialized budget to invest in the engineering software industry.
- Encouraging practical research about AI applications in the construction industry.

**4. Conclusion**

In this study, Authors conducted a literature review and also an online questionnaire to achieve the research goals. The questionnaire respondents claimed that AI can help to level up the BIM maturity level in Syria, and the most efficient AI-Based technologies were ranked as (1)AR, (2)Robotics, (3)Automated generation of BIM models, (4)Big Data, (5)Blockchain. The respondents believe that the integration of AI and BIM will be more beneficial in both the planning and design phases. Although there are many predicted advantages of this integration, like, saving time and cost, forecasting potential risks from an early stage, improving quality and efficiency, and increasing Productivity and Safety at

construction sites, it's still difficult to achieve at the current stage. The results reveal that the obstacles to this integration are almost inseparable from those hindering BIM adoption. There is a clear lack of knowledge about AI, a lack of specialists, in addition to the technical problems, old equipment, old mentality, And the high costs of AI Platforms and other required equipment. This study developed a strategy to accelerate BIM And AI integration as follows: (1) Spread awareness about the importance of AI and BIM integration to improve the construction industry, (2) Improve infrastructure to keep up with the modernity requirements, and that includes (technical equipment, internet networks), (3)Hiring external experts to Provide large-scale training for construction organizations, (4) Assign a specialists budget to invest in the engineering software industry, (5) encouraging practical research about AI applications in the construction field.

### Future Recommendations

- 1- We recommend conducting more research about AI implementation in the Syrian construction industry. Research topics should deal with the integration of AI and BIM in the planning phase, design phase, and in construction sites.
- 2- More research should be done about what we ranked as the most efficient AI-based technologies to be integrated with BIM in Syria: BIM and AR, BIM and Robotics, and also the Automated generation of BIM models.
- 3- We highly recommend conducting practical research in this field whenever possible.

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