Benefit and Challenge of Integrating BIM With GIS In Iraqi Construction Projects

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Abstract: Building management has become more complicated because there has been a growing number of people and Documentation involved. As a result, there can be several different formats and forms of information that need to be gathered, exchanged and recorded throughout the building process. That makes the need to develop the work of BIM and GIS together is very importance, when geographic information system (GIS) provides external modeling for city (map, geographic Information… etc.) and building information modeling (BIM) is providing internal modeling (3d modeling, material properties and its quantities, etc. for building. Also, GIS is an important tool for combining both spatial data and non-spatial data of the construction project in one environment. So, this study aims to highlight on these important techniques to interest from their features in the construction projects, in this paper shows the integration between BIM and GIS and shows benefit, challenge and motivation factor for adoption these techniques in Iraqi project sector. From the point of view, GIS will complement BIM to create a systemic platform for building management.

Keywords: BIM, GIS, Project management, planning, spatial data, non-spatial data

1. Introduction
Due to its diverse features and functions, BIM and GIS are highly used platforms in building, but each platform lacks significant features provided by the other platform. GIS provides topological (georeferenced) details, for example, that can be used to analyze 3D, spatial analyze and query the difference between two different points, compute paths and define the best location [1]. BIM is unable to carry out such analysis, on the other hand, but offers a comprehensive database of the object-oriented, parametric details for the building and represents it in a 3D model, which GIS lacks [2]. BIM integration with GIS is an area commonly recognized by engineering, construction and architecture (AEC) as a result of technological advances that have enriched the construction industry in years, enabling stakeholders to gather, manipulate, update and communicate information during the construction projects lifecycle [3]. BIM is an intermediary of interoperability between industry actors, thus increasing its popularity with customers [4]. GIS, on the other hand, visualizes and analyzes the locale of Geospatial sciences and management of natural resources by combining various spatial and data attributes and by deriving information using various methods and models of spatial analysis [5]. This paves the way for geometrically saving spatial features or data that is referenced by map projections and coordinates. Over the years, GIS has been used with 2D mapping to analyze data across large areas [5]; [6]. In addition, as a result of technological developments, the principles of the 2D GIS are now applied to more complex 3D spatial data documentation, visualization and analysis.
The integration of GIS and BIM is the synthesis of the two frameworks for visualization and analysis. A series of articles on GIS-BIM integration have recently been presented [1]; [8]; [9]. For example, [1] carried out a critical analysis at data level of GIS and BIM integration and focused more on the following: 1. Identify the most important integration models and highlight their power and limitations; 2. Taking into account the ability of other models; 3. Future advice on GIS and BIM data integration: Similarly, [8], the current status of GIS and BIM integration was examined with a focus on the different causes of integrated methods and parameters affecting the selection of Initiative, Versatility, Extension and Effectiveness (EEEF) methods. Likewise, [9] checked the application of GIS and BIM in the AEC industry from a time-based statistics point of view, with a special emphasis on the skills of GIS and BIM integrations, mathematical modeling and data processing. However, to give a better picture of integration, analysis was carried out and its main components were clearly understood. This research explored the probability of working together on these two strategies.

2. Benefit and barriers of the BIM use

BIM can help in all phases of the lifecycle of the project. [10] Summarizes the main advantages of the BIM uses for different stakeholders of a building project in Table 1.

Table 1 Benefits of BIM technology during the building life cycle (Adapted from [10])

| A. Preconstruction (benefits to the owner) |
|------------------------------------------|
| - Expense forecasts dependent on quantity takeoffs. |
| - Reduced financial risk: the construction model requires cost forecasts at an early stage and also verifies whether the project will fulfill the client's financial resources. |
| - Improve building energy and lighting efficiency based on BIM design and analysis. |
| - Have a shorter curriculum for the whole project. |

| B. design |
|----------|
| - Previous and more precise concept visualization. |
| - Easier updates and corrections. |
| - Generation of detailed and reliable 2D drawings in all design stages. |
| - Previous partnership between various design disciplines. |
| - Cost estimate extraction during the design stage. |
| - Improved energy efficiency and sustainability: 2D instruments only permit energy analysis at the end of the build, which limits the versatility of changing. |

| C. Construction and Fabrication |
|--------------------------------|
| - Usage of the production model for fabricated components: all the information to create an element that is already constructed in 3D are found in the BIM models. This makes automated manufacturing simpler, based directly on such components as walls, glass elements, precast elements |
| - Quick response to design changes: no time is lost when the changes in paper sketches are spread. |
| - Discovery of design mistakes and preconstruction omissions: all sketches (2D and 3D) are based on 3D models with less mistakes than 2D models.. |
| - Synchronized design and construction planning: 4D CAD allows you to see what the building looks like at any level of the implementation, essentially by temporary equipment / materials. |

| D. Post-Construction |
|----------------------|
| - Improved commissioning and transition of knowledge to the facility |
| - Better management and maintenance of installations: all systems specifics are included in the model |
| - Integration of management and operating systems |

And with all the advantages of BIM, some problems remain. Collecting data from different sources, such as electricians and plumbers, for example, constitutes a source of errors when this is combined [10]. Another problem can arise, such as contractual and legal hazards, such as who owns the model?
Who handles the BIM Model Update? And who is to blame for model imprecision? [11]. The lack of a framework can prevent its optimal growth[12]. The American Institute of Architects (AIA) a regulatory framework has been introduced for digital design applications like BIM. However, adopting BIM requires training the person. According to[13] that surveyed 70 people show that the biggest obstacle to implement BIM is the training, and it's going to cost so much person and time.

3. Application of GIS in Construction project Management

GIS is an acceptable technology to satisfy different construction project requirements. It can combine multiple data sets, databases, and different applications. GIS improves decision-making between developers, designers, and contractors [14]. Documented work, therefore, indicates that GIS helps the construction industry in many ways, for example [15]:

3.1 Subsurface Profile

[16] Suggested that GIS should be used to build a method to create profiles of subsurface from the log data. The well-listed database was created from a borehole array, and 3D subsurface was developed using GIS-based methods [17]. The study was an important step in the assessment and the planning of new building projects and suggested that GIS-based methodology is used to create a database for the analysis, design, and planning of foundations. As surface and subsurface conditions affect building methods and equipment selection, which, in turn, influence project costs and planning. Therefore, a study by [17] used GIS database management capacity to store descriptive soil data and link this data to the respective borehole locations.

3.2 Quantity Takeoffs and Construction Cost Estimation

[18] Suggested approach with Map / Info for quantity startups and cost estimates. Architectural drawing for quantity departures has been split into various layers called data layers. As the basic parameters, area and perimeter were used in GIS-based cost estimates. Thus, the data layers in AutoCAD were generated as polygons and transferred as a geometric cover to Map / Info. From the coverage are derived geometric details for spatial features such as co-ordinates, position, perimeters and spatial connections. The user enters topical data like I.D. Code, floor number, beam number, etc., [19] It proposed that GIS could be used more broadly for cost estimation by adding new scripts to the GIS environment for different cost estimate operations. For this reason ArcView was used, which uses a dynamic connection between spatial and attribute data.

3.3 Materials Layout at Construction Site

The Plan of Material, a GIS tool developed by [18] involves quantity startup preparation and material layout. The system uses thumb and experience rules to determine material storage area size and location. It helps the planner to plan quantities and to evaluate material layout design. The material plan developed through the use of a GIS environment incorporates forecasts into the dynamic material needs plan construction schedule. Based on information regarding the amount and location of materials required for the project, the proposed methodology determines the appropriate site for the storage of construction materials.

3.4 Construction Site Layout

The traditional approach to temporary layout (T.F.) includes the design of the layout of the site with drawings, prototypes, and 2D physical models. The design built is focused on the incomplete knowledge in the various formats. Such visual representations of T.F.s show inadequate and informative results. Since T.F.s should be close to their support activities to reduce travel time, they should investigate the role of GIS in this regard.

[20] built an ArcSite automated construction T.F. software system called ArcSite. The new computerized tool ArcSite consists of a GIS integrated with DBMS to assess the appropriate region to locate T.F.s. ArcSite incorporates the Information needed for T.F. locations and conducts a series of complicated space operations and database queries to find optimum sites that are hard to execute manually.
3.5 Real-Time Schedule Monitoring System

[21] Built an integrated timetable surveillance system using GIS to help building managers monitor the construction process for precast building buildings. A case study was performed where structural components were prefabricated and transported for installation to the workplace. Prefabricated structural components are regarded as an important operation for prefabricated buildings. Based on the installation schedule, the preparation for the prefabrication of structural elements and transport to the worksite shall be established. The study indicated that the use of GIS enhances the real-time system and construction control schedule and increases the performance of the building. A survey [22] and [23] involves GPS and GIS technology to eliminate building waste. GPS and GIS have been incorporated into the construction management system in such a way that managers at headquarters and building sites collect data in real-time to monitor cargoes going to sites to minimize waste generation.

3.6 Route-Planning

[24] A GIS-based framework has been developed to incorporate the Information needed for route planning. Two technology experiments are used: expert system and GIS to build this method, expert system to model the mechanism of human reasoning through a collection of predetermined rules, and GIS to provide data viewing capabilities. Obstacles such as current public utilities, bridges, canals, and roads greatly affect routes in metropolitan areas. A limited number of feasible crossing points may exist, and an optimal route may be chosen to avoid existing obstacles. The risk of damaging existing infrastructure decreases in a course. It also minimizes the cost of construction. [25] Addressed the development of a GIS system for automating the routing process and the construction of an underground energy supply system. The best routing paths are calculated using the Arc / Info GIS.

3.7 Topography Visualization

GIS is a powerful method for visualizing topographical site conditions. Building site modeling enables construction management and planning. The GIS visual simulation system (GVSS) developed by [26] is a tool that offers powerful preparation, viewing, querying, and the identification of logical errors in a model. Challenge facing GIS adoption. Even with all the benefits of GIS, there are some challenges. According to [27], the cycle of information management is disrupted at the larger level of the organization as a whole, and GIS teamwork is difficult. Incompatible data format, inconsistent quality management, and change controls, and lack of data security are the many challenges facing the transition from small semi-independent GIS teams into a hierarchical GIS enterprise. The availability of geospatial data of high quality depends on adequate support, resources, and appreciation of the institutional importance of efficient access to the data. A lack of resources and inadequate personnel in teams managing key geospatial data (infrastructure, climate, operations) frequently leads to misrepresented and improperly structured Information, which emergency managers might not be able to provide during a crisis.

4. Integrate of BIM with GIS

In this research, we focus on the integration process between the two systems due to the different work environments and outputs for both systems, where the model was converted from the virtual site to the real site and the real coordinates., the software used in BIM is Autodesk Revit and in GIS using ArcGISpro, beginning with the 2D survey, we have created the parametric model for the program BIM Autodesk Revit. The development of the project information model enables the arrangement of all information pertaining to each aspect in order to clearly identify the usage of the materials, the measurements, the degree of decline, the urgency of the operation, etc. The contribution of the details on buildings, Figure (1) shows the 3D model on Revit software.
Export BIM to GIS requires many steps to make BIM suitable for GIS environment, figure (2) shows the steps of integrate these techniques.

The researcher Remove all non-necessary elements from the Revit file to ensure the import process is quick by using pyRevit, this feature used because pyRevit is a working collection of tools written in IronPython which explores Revit’s scripting power and adds some cool features and ArcGIS entirely written by a python that lets ArcGIS easy read Revit file, as shown in Figure (3).
After the Revit file has been prepared, we import Revit file to ArcGISpro environment and Georeferencing building to real sites, as shown in figure (4).

When the planning was necessary, the queries can be made in one building or all housing complex buildings. All tables can be modified inside ArcGIS. If any attribute of the timelines is updated, the table concerned can be exported in the.xls format and reimported in the REVIT format to update the GIS-modified parametric model information.

The ability to define components that primarily involve intervention using the parametric model and the relevant urban context, permits us to consider and evaluate the important economic, logistical and operational aspects of the intervention and also optimize the management of safety measures in the restoration work environment (with the right choice of equipment, tools, transfer work and procedures).

In order to provide a flexible and productive tool for the multiple knowledge needs of a broad property management public administration, the results of our work allow for different levels of detail and
scope on the housing project. To that end, all the records obtained on the buildings have been archived in the GIS. Job schedules, static checks, certifications for device compliance, etc. have their proper place in the GIS database.

5. Results and discussion of the questionnaire

This section shows and discusses the main outputs obtained from the Analysis of the questionnaire by using SPSS V.26. Upon the date of closed the survey, 53 of 78 respondents were finished completed answers, the result of the reliability of the questionnaire is in a good limit and the value of Alpha for the questionnaire equal to 0.877. The results of the questionnaire are provided in the following section with a brief analysis of each section.

5.1 Personal information: In order to determine the percentage of participants are belong to, their Qualification, job title, their experience, and what are projects that they worked with? The Information gathered in this section will be vital in terms of performing Analysis through sample stratification. The following shows that; when they were asked about their academic Qualification, the answers in Table 2 shows that the percentage of Bachelor (52%), Master (43%), Ph.D. (5%).

| academic Qualification | Number of Participants | % Total |
|------------------------|------------------------|---------|
| Bachelor               | 22                     | 41.5%   |
| Master                 | 24                     | 45.3%   |
| Ph.D.                  | 7                      | 13.2%   |
| total of column        | 53                     | 100%    |

5.2 Awareness level of knowledge and usage of BIM and GIS

In a questionnaire, several questions were asked to know the Information and experience of respondents in BIM and BIM with the GIS model especially, it was as shown below: When respondents asked about the technique used in your organization, the answers were as shown in figure (5), the percentage of BIM usage 68%, GIS 28%, and both technique 4%. The result shows the BIM technique more use in the Iraqi construction sector.

![Figure 5. The response about the usage of BIM and GIS technique in Iraqi organizations](image)

When respondents asked about the software used to inform the BIM and GIS technique, the answers were as shown in figure (6). The results show that the most used software in BIM is AutoCAD, and the more software used in GIS is the ArcGIS desktop.
When respondents asked about the knowledge in the integration of BIM and GIS, the answers were as shown in Figure 7.

From the above respondents, answers show that weak used of BIM and GIS software; although the efficiency of Revit and ArcGISpro in the project management but the organization in the Iraqi sector uses AutoCAD instead of Revit, Revit software is easier to uses in design, redesign and estimate quantities, ArcGISpro uses in the case study collect between the 2D,3D layers in one database and ArcGISdesktop lacks these capabilities, this probably due to the ignorance of the benefits of uses BIM and GIS together in the Iraqi construction sector and don't find any support from the public sector. The results showed mild, not very optimistic, and not very pessimistic anticipations for the implementation of BIM and GIS in Iraq, and also showed that youth have high awareness in BIM than older engineers.

Figure 6. Respondents Answer about Their usage of BIM and GIS software

Figure 7. responds answer about the knowledge in the integration of BIM and GIS.
5.3 **BIM and GIS Potential Benefits Analysis**

This part outlines 13 items, six items were representing the potential benefit of BIM, and seven items were representing the potential benefit of BIM with GIS from the literature review. After the respondents' expression of opinion was analyzed, and their findings extracted, and these findings included Relative importance Index RII, Mean, and standard deviation.

A significant relative RII index is one of the techniques used in data analysis. The purpose of its use is to provide a rank for each item in a specific part of the questionnaire. The relative importance index is used to give the rank of each item in a given part in the survey to evaluate the ranks of potential benefits from BIM and BIM with GIS, the Relative important index obtained from the participant's answers was determined for each item and rated from the highest to the lowest. When two items or more are the same relative important index, then depend on mean and standard deviation, were highest-ranked based on the highest mean and lowest standard deviation. See Table (4) and (5) shows the results.

\[ RII = \frac{\sum W}{(A \times N)} \]  

When:

- **W**: Represents the weight given to each part by respondents and ranging from 1 to 5
- **A**: Represents the biggest weight (which equals 5)
- **N**: Represents the total number of respondents

According to [29] level of importance as follow in table (3):

| RII     | Importance level |
|---------|------------------|
| 1 ≥RII > 0.8 | High             |
| 0.8 ≥RII > 0.4 | High-medium     |
| 0.6 ≥RII > 0.2 | Medium          |
| 0.4 ≥RII > 0.0 | Medium-Low      |

**Table 3 Importance level**

| No. | BIM benefit                                                                 |
|-----|-----------------------------------------------------------------------------|
| 1   | C_A1. Early detection of design errors and conflicts between disciplines, and  |
|     | thus reduce the impact of these errors                                      |
| 2   | C_A2. Automatic linkage between all disciplines, so that any change in a    |
|     | major appears in the rest of the disciplines at the design stage            |
| 3   | C_A3. It increases the ability of cooperation between the project parties,  |
|     | which makes it an effective model.                                          |
| 4   | C_A4. Minimizing change orders.                                             |
| 5   | C_A5. Presenting the project visually to the project parties increases their |
|     | understanding and perception and improves the decision-making mechanism    |
| 6   | C_A6. High accuracy and speed                                               |

| No. | Mean | SD  | RII | Rank |
|-----|------|-----|-----|------|
| 1   | 4.02 | 0.971 | 0.803 | 3.0  |
| 2   | 4.00 | 1.038 | 0.800 | 4.5  |
| 3   | 3.94 | 0.929 | 0.788 | 6.0  |
| 4   | 4.09 | 0.766 | 0.818 | 2.0  |
| 5   | 4.00 | 0.760 | 0.800 | 4.5  |
| 6   | 4.11 | 0.776 | 0.822 | 1.0  |
calculating quantities

The results showed that the "High accuracy and speed in calculating quantities" is, according to respondents, the largest potential benefit from BIM (RII=0.822, mean=4.11, SD=0.776), and within high importance level. Consider one of the most important features offered by BIM.

The second rank of BIM potential benefits was "Minimizing change orders" with (RII=0.818, mean=4.09, SD=0.766), and within high importance level. The change orders have a significant impact on increasing the cost and time of the project, according to the point of view of respondents.

The lowest-ranking benefit is "It increases the ability of cooperation between the project parties, which makes it an effective model "according to the point of view of respondents.

Table 5. Rank of Potential Benefits from BIM with GIS according to RII, Mean, SD

| No. | BIM and GIS benefit                                                                 | Mean | SD    | RII  | Rank |
|-----|------------------------------------------------------------------------------------|------|-------|------|------|
| 1   | C_B1. Create a database for all project stages                                      | 3.72 | 1.133 | 0.683| 6.0  |
| 2   | C_B2. Documentation of all project phases in one database                           | 4.09 | 0.815 | 0.739| 2.0  |
| 3   | C_B3. An effective tool in the decision support process because it is based on database | 3.70 | 0.992 | 0.739| 4.0  |
| 4   | C_B4. The combination of these technologies enables the 3D models to be combined with their real location | 4.02 | 0.720 | 0.656| 7.0  |
| 5   | C_B5. Linking 3D models to their real location facilitates the planning of temporary roads and so forth in the real site of construction | 4.28 | 0.690 | 0.856| 1.0  |
| 6   | C_B6. Analyze the roads and choose the shortest and best road                         | 3.81 | 0.982 | 0.762| 3.0  |
| 7   | C_B7. Increase the quality of planning and management work                             | 3.66 | 1.091 | 0.732| 5.0  |

The results showed that the "Linking 3D models to their real location facilitate planning of temporary roads and so forth in the real site of construction" is the highest potential benefit from BIM with GIS according to respondents, with (RII=0.856, mean=4.28, SD=0.690), and within high importance level. Consider one of the most important features offered by the BIM with GIS.

The second rank of BIM with GIS potential benefits was "Documentation of all project phases in one database" with (RII=0.818, mean=4.09, SD=0.815), and within high importance level. According to respondents.

The lowest-ranking benefit is "The combination of these technologies enables the 3D models to be combined with their real location "according to the point of view of respondents.

5.4 BIM and GIS Potential challenges Analysis

This part outline 12 items were representing the potential challenge facing BIM with GIS from the literature review. After the respondents expression of opinion was analyzed, and their findings extracted, according to relative importance index RII, Mean, and standard deviation.

A significant relative RII index is one of the techniques used in data analysis. The purpose of its use is to provide a rank for each item in a specific part of the questionnaire. The relative importance index is used to give the rank of each item in a given part in the survey to evaluate the ranks of potential challenges of BIM and GIS that obtained from participant's answers; the relative important index was calculated to each item and ranked from the highest to lowest. When two items or more are the same relative important index, then depend on mean and standard deviation,
where the highest-ranked based on the highest mean and lowest standard deviation. The result as Shawn in table 6.

**Table 6. Rank of BIM Potential Challenges Depending on RII, Mean, SD**

| No. | BIM and GIS challenge                                                                 | Mean  | SD   | RII  | Rank |
|-----|---------------------------------------------------------------------------------------|-------|------|------|------|
| 1   | D1. The initial cost to adopt these technologies                                       | 3.74  | .880 | 0.747| 6.5  |
| 2   | D2. Problems that result from interoperability                                        | 3.60  | 1.025| 0.721| 11.0 |
| 3   | D3. The time required to train staff on new technology and software takes a long time | 3.64  | .982 | 0.728| 10.0 |
| 4   | D4. Companies believe that have software more accurate for them than these technologies| 4.15  | .818 | 0.830| 2.0  |
| 5   | D5. The cost of purchasing advanced computers                                         | 3.74  | .964 | 0.747| 6.5  |
| 6   | D6. lack of protocol related to these technologies                                    | 3.55  | .972 | 0.709| 12.0 |
| 7   | D7. no real projects constructed in this technology in Iraq                           | 3.70  | 1.011| 0.739| 9.0  |
| 8   | D8. Cultural resistance in companies is prevented from adopting such technologies     | 4.11  | .800 | 0.822| 3.0  |
| 9   | D9. Fear that design model is not integrated and does not contain sufficient information to calculate quantities | 3.72  | .968 | 0.743| 8.0  |
| 10  | D10. The lack of qualified staffs to adopting this technology and the cost of hiring specialized staff | 4.06  | .663 | 0.811| 4.0  |
| 11  | D11. lack in contracts related to this technology                                      | 4.21  | .717 | 0.841| 1.0  |
| 12  | D12. The quality and efficiency of a computer used in design offices and construction companies | 3.58  | 1.027| 0.761| 5.0  |

The results showed that the” lack in contracts related to this technology” is the highest potential challenge for BIM and GIS, according to respondents, with (RII=0.841, mean=4.21, SD=0.717), and within high importance level. Consider one of the most important challenges facing BIM with GIS.

The second rank of BIM and GIS potential challenge was” Companies believe that have software more accurate for them than these technologies” with (RII=0.830, mean=4.15, SD=.818), and within high importance level. According to respondents.

The third rank of BIM and GIS potential challenge was” Cultural resistance in companies is prevented from adopting such technologies” with (RII=0.822, mean=4.11, SD=.800), and within high importance level. According to respondents.

The fourth rank of BIM and GIS potential challenge was” The lack of qualified staffs to adopting this technology and the cost of hiring specialized staff” with (RII=0.811, mean=4.06, SD=.663), and within high importance level. According to respondents.

The two lowest-ranking challenges are "lack of protocol related to these technologies "and "Problems that result from interoperability" according to the point of view of respondents.

5.5 BIM motivation factors Analysis

This part outline 5 items were representing the motivation factor for adopting BIM with GIS from the literature review. After the respondents’ expression of opinion was analyzed, and their findings extracted, and these findings included Relative importance Index RII, Mean, and standard deviation.

A significant relative RII index is one of the techniques used in data analysis. The purpose of its use is to provide a rank for each item in a specific part of the questionnaire To determine the ranks of
motivational factors of BIM and GIS that obtained from participant's answers. In order to determine the ranks of motivational factors of BIM and GIS that obtained from participant's answers, the Relative important index was determined for each item and graded from the highest to the lowest. If two or more items are the same relative significant measure, the mean and standard deviation are determined where the highest-ranked based on the highest mean and lowest standard deviation. The result shown in table 7.

Table 7 Ranks of BIM Motivation Factors Depending on RII, Mean, and SD

| No. | BIM and GIS motivation factor                                                                 | Mean | SD    | RII   | Rank |
|-----|----------------------------------------------------------------------------------------------|------|-------|-------|------|
| 1   | E1. explain the importance of these programs during conference, workshops and seminars        | 4.25 | 0.853 | 0.849 | 1.0  |
| 2   | E2. teaching these programs in universities                                                   | 4.00 | 1.038 | 0.800 | 3.0  |
| 3   | E3. publish periodic report and paper to show their importance                                | 3.77 | 0.800 | 0.754 | 5.0  |
| 4   | E4. Government support in legislation and laws that encourage its use of these techniques     | 4.23 | 0.776 | 0.845 | 2.0  |
| 5   | E5. employ youth engineers in public and private sectors who have the ability to apply this technology | 3.87 | 0.962 | 0.773 | 4.0  |

The results showed that the "explain the importance of these programs during conferences, workshops, and seminars" is the highest motivation factor for the application of these techniques according to respondents, with (RII=0.849, mean=4.25, SD=0.853, high importance level). Consider one of the most important motivation factors for adopting BIM with GIS. The second rank of BIM and GIS motivation factor was "Government support in legislation and laws that encourage its use of these techniques" with (RII=0.845, mean=4.23, SD=0.776, high importance level) according to respondents. The lowest-ranking motivation factor is "publish periodic report and paper to show their importance" according to the point of view of respondents.

6. Implementation plan of BIM and GIS

The researcher proposed a conceptual framework for BIM and GIS implementation in the organization, see figure (8).

![Figure 8. conceptual framework for BIM and GIS implementation.](image-url)
In the paper, the challenges were drawn from the literature review and analyzed and ranked according to its importance. The action recommendation to overcome these challenges also derived from the literature review, interview, and personal consideration. The actions are based on the model of [30] "why, how, what" why we do that, how is the method used to carry out actions, and what to describe the outcomes.

7. Conclusions
This research also explored the direct relationship between the two techniques, also, benefits from that integration, and challenges facing this integration, and the motivation factor for adopting these techniques in the Iraqi construction sector. Also, the results showed mild, not very optimistic, and not very pessimistic anticipations for the implementation of BIM and GIS in Iraq, and also showed that youth have a high awareness of BIM than older engineers.

The results showed that the "High accuracy and speed in calculating quantities" is, according to respondents, the largest potential benefit from BIM. Consider one of the most important features offered by BIM, “Linking 3D models to their real location facilitates the planning of temporary roads and so forth in the real site of construction” is the highest potential benefit from BIM with GIS according to respondents. Consider one of the most important features offered by the BIM with GIS, "lack in contracts related to this technology" is the highest potential challenge for BIM and GIS, according to respondents. Consider one of the most important challenge facing of BIM with GIS, “explain the importance of these programs during conferences, workshops, and seminars” is the highest motivation factor for the application of these techniques according to respondents. Consider one of the most important motivation factors for adopting BIM with GIS. Finally, there is no question that the integrating of BIM and GIS would add a wide range of new functions to the existing Building management and tools of control used in the industry, all carried out in one single venue.

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