



Proposing a Methodology to Measure and Develop BIM Maturity in Syria

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Abstract

In the last decade, the projects of the Architectural, Engineering, and Construction Industry (AEC) in Syria faced endless difficulties and problems, in addition to the intense competition between the construction sector companies. This prompted many companies to want to adopt best practices to reach their goals, therefore any work organization should have a clear vision of what it wants to achieve, for what purpose, and how? Building Information Modeling (BIM) around the world has proven its ability to solve all the problems facing engineering projects. Unfortunately, AEC companies despite all that great value did not use BIM. For many reasons, mainly: there is no comprehensive descriptive approach that explains how to apply it and a mechanism that shows how to measure and develop it within companies, in addition to their fear of adopting modern technologies that push them to need new engineering competencies because of not realizing its importance. The purpose of this research is to propose a methodology to measure and develop BIM maturity in Syria in general. In addition, to assess the level of maturity of our institutional BIM through the BIMM maturity matrix in particular. This is done by applying the most important models for measuring maturity around the world on a number of Syrian AEC companies in the private and public sectors. Analyzing the performance of BIM in it, comparing the results, and assessing the level of institutional maturity. Then conducting analyses and comparisons based on these conclusions and making additional recommendations and proposals to develop the matrix in accordance with practical reality in order to reach the optimal and integrated level for construction projects

Keywords: Building Information Modelin; BIM Maturity; BIM Maturity Matrix; Construction Projects; Syrian Companies

1. Introduction

The crucial need for innovative sophisticated, and complex AEC industry projects with in-depth details makes traditional methods inappropriate for the completion of projects with the desired efficiency [1]. AEC Industry around the world faces many challenges coming from technical, organizational, and management problems for construction projects [2].

The adoption of BIM has increased in the past few years [4] to solve huge problems related to AEC industry projects take advantage of BIM features and improve project performance and efficiency [7]. BIM features cannot be limited, its application provides benefits at all levels, so that its effect reaches to improve the behavior of stakeholders, and also leads to strengthening relations between them,

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reducing conflicts, eliminating conflicts of interest, and allowing knowledge sharing between them in the project [8].

Despite all this, the level of BIM adoption is still much lower than expected [9]. Therefore, we must seek to raise the level of its adoption as an important station that has performed great services we should benefit from. BIM has become one of the most important aids in design and implementation, and its use has spread in many Countries where Lithuania has reached BIM2 implementation maturity level, which proves the ability of the Lithuanian AEC industry to move maturity to Level 2 [10]. As well as the United States, which is one of the most adopting BIM countries in the world reinforced the importance of BIM Champions (Change Leaders) whose work is to evaluate the implementation of BIM and control the level of its development as their strategy included it as part of its action plan. Those champions proved to be a key element in measuring and evaluating needs to enable the implementation of BIM [11].

And by speaking of developing countries, Syria has a good percentage of the Middle East countries in the field of adopting new technologies and systems. Despite the war, which constituted a greater impetus in rebuilding, and the keeping pace with technology development has become mandatory for the construction sector, in addition to the aiming to improve project productivity and provide a high level of craftsmanship in construction work, as we have seen in countries adopting BIM technology.

About Syrian AEC industry, based on previous studies, it was found that it faces a number of problems such as schedule delays, budget increases, low quality, efficiency and performance, and poor productivity [12]. Complex analysis of the problems revealed that BIM is the magic system for solving more than 70% of AEC industry problems [13]. Now it is witnessing the shift from CAD to BIM so it should be encouraged by the government, other related companies and individual expertise to spread it as much as possible [14]. As well as improving the performance of BIM within companies using the BIM³ maturity matrix [2].

A six-step methodology was introduced to implement BIM: raising awareness; desired benefits; hardware for BIM application, corporate capacity; identifying obstacles; remove obstacles [15]. The most significant barriers to adopting BIM were personal issues associated with resistance to change and lack of proper BIM awareness [16], in addition to lack of experience, most engineers had no experience working on projects based on new technology and methodology [17]. The most influential drivers are the availability of trained professionals to handle the tools, affordability of BIM software and technology awareness among stakeholders [18].

Now, there is a new plan to prepare a new generation of engineers who are qualified to apply this technology and fully aware of BIM, so making it easier for engineers to develop their work and meet the requirements of their companies. This will also help enhance the reputation of education and help spread BIM among universities and for other engineering competencies [19]. In addition to the need of use a clear approach so companies can check the list of proposed BIM maturity competencies and measure this maturity to implement BIM effectively. Researchers and practitioners have made many efforts to define models and standards for BIM implementation with the aim of reaching an appropriate model for the BIM implementation methodology and its development [10].

2. Literature Review

It has become known that project management through integrated and balanced performance indicators will achieve a significant improvement in project performance. But until now, performance measurement and management is not used as a performance improvement tool in Syrian AEC projects, however, performance measurement is the first and essential step to enhance the performance of AEC projects [20].

Adopting BIM between Syrian engineers and the public and private sectors comes with result represents that 57% of the respondents consider themselves to be BIM model users, but they really know very little about it [2]. Despite this, 44% believe that Syria could be during the next five years. With an emphasis on the government's role in obligating the Application of BIM. Note that the most famous BIM tool among Syrian engineers is Revit [2].

About 61% of the respondents think that BIM can be useful in the design phase, while 21% of them indicated that Necessity of application BIM in the design and implementation phases [2].

Unfortunately, due to the lack of budget allocated to training and qualifying employees, or fear of the high cost to adopt this technology and use the software. 31% of employees rely on self-training, and only 24% of employees rely on self-training

They receive formal training in addition to their efforts [2].

The statistic was about the percentages of users BIM as shown in the figure:

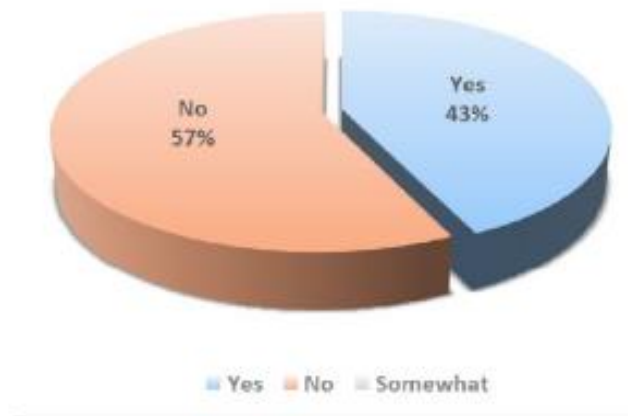


Figure 1: percentage of BIM users-2018-source [2]

The level of BIM maturity in Syrian companies is still at level 0, which means no implementation BIM in the company. Moreover, there is a lack of research related to BIM in the AEC industry in Syria and the awareness about BIM is very low [2]. Only 20% of advanced companies in the Middle East use BIM, as most professionals in this area still view BIM as an advanced AutoCAD tool; Plus, the fact that transitioning to new tools is always tough [6].

A set of questions focused on determining at any stage of the project life cycle can be applied BIM in the Syrian construction industry. The results are as shown in the figure 6: 61% of the respondents believe that BIM can be useful in the design phase, while 21% indicated that they could implement BIM in both the design and construction phases of a project. Unfortunately, 8% said it is impossible to use BIM now [6].

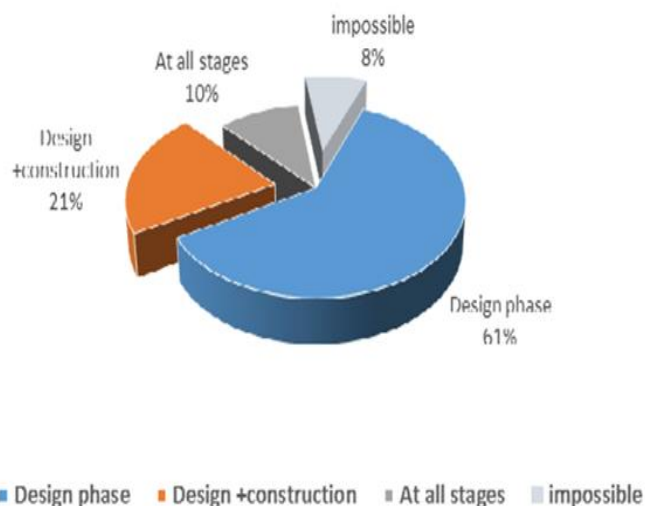


Figure 2: Best stage to apply BIM to Syrian construction industry, 2017, source [6]

37% of Respondents believe that BIM should be mandatory under the guidance of the government, and it is considered the main driver for the adoption of BIM, and the largest source of BIM experience gained from the university. While more than 22% believe that the designer is the main driver of adoption and convince others about the benefits of BIM as part of construction projects in Syria [5].

And according to vision 50% of the respondents that develop a special standard to deal with principles and techniques BIM is important, while 29% find it very important [5].

By benefiting from the experiences of other countries, the plan of Macedonia to adopt BIM according to plan of action and strategy extending over a period of three years. The proposed road map aims to adopt BIM aims to attract the attention of public authorities to be the first in modeling the national construction sector in order to keep pace with developed countries. This map should also serve as a basis and document for defining the digital transformation process gradually and for authorizing all responsible parties to take their role in the process. The document is structured by summarizing successful best practices of developed countries and presents a system for structuring actions that can lead to achieving the set objectives in collaboration with all relevant stakeholders in the public and private sectors [21].

3. Research Importance

The fact that Arab Library lacks comprehensive references that help practitioners in the construction industry to identify this important approach, so it must:

- Develop a specific methodology for measuring and developing BIM that helps cement the facts and guides all practitioners and stakeholders to successful implementation. Note that the past few years have resulted in several attempts by decision makers to apply BIM, and many attempts to adopt modeling as a work method for many engineering offices and companies. Many of these attempts have failed, especially when companies adopt BIM as a modeling process only.

- Evaluating the level of institutional BIM maturity in the Syrian construction industry and identifying the most important challenges facing its adoption.

- Identifying BIM maturity obstacles in Syria, which plays an important and influential role on the maturity level in the companies of the public and private sectors.

- Use a comprehensive measuring tool to perform BIM in companies by applying BIM Maturity Analysis Matrix (BIm3) as a cognitive tool aimed at defining the current Building Information Modeling maturity on a number of engineering companies in the public and private sectors. Whereas, BIM Maturity includes many components of the BIM Framework in order to measure performance and improve it.
- Analyze the results drawn, highlight tangible weaknesses and provide appropriate solutions.
- Submit additional proposals to develop the matrix in line with practical reality.
- Reaching a set of proposals, which expected, if we adopted we would reach an advanced level of adoption BIM facilities to improve and develop the performance of companies and engineering performance with all its specializations. In addition, reach an advanced level of BIM maturity in it, which guarantees its continuity and success of its projects in light of digital change and global competition.

Thus, it is necessary Having BIM planning team in each company to contribute to the development of its performance by developing a comprehensive plan for the application BIM in all phases of the project and a mechanism to measure its maturity and development.

4. BIM in Syria

Recently, studies have developed that are concerned with applying BIM, as many companies have begun to realize the importance of technological tools that are able to apply an integrated methodology that helps in managing construction projects in the various stages of the project.

The main factors affecting adoption BIM in Syria According to previous studies:

Obstacles and challenges that hinder BIM implementation are classified in economic, technical, regulatory and legal challenges human kind, and the risks associated with using a new technology [10], and they agreed on:

- Introducing BIM into university curricula will introduce a new generation of BIM experts from Syrian engineers.
- Support from the Syrian government is the main driver for BIM adoption.
- Designers play an important role in embracing and convincing other project parties of the benefits of BIM at all stages of the project life cycle.
- Preparing a time plan for training unqualified employees.
- provide standard Dealing with principles and techniques BIM [10].

Moreover, the absence of meaningful guidance for BIM adoption hinders organizations in implementing BIM. The successful implementation of BIM requires determining the current standing of companies in several aspects, such as the qualifications, capabilities and willingness of employees to migrate to this new system [22].

Moreover, it requires participants to have adequate knowledge to apply it, in addition to the adequate level of using technology and their readiness for development [17]. In addition to the management's desire to adopt it and its willingness to set a special budget to improve reality to better levels that help in adopting and benefiting from BIM technology.

5. BIM Maturity

Many researchers have tried to define maturity in different ways. According to [23], the definition of maturity was "the extent to which a process is defined, managed, measured, controlled, and effective."

BIM levels indicate the level of maturity for BIM implementation in a company. Moreover, BIM outcomes differ according to the level of BIM as there are four levels of BIM maturity [24]. And excellent BIM performance at any BIM maturity level will guide companies or projects to advance their BIM implementation to the subsequent BIM maturity level [25]. In any case, the level of knowledge and adoption of BIM in the Syrian engineering companies is low and expected to rise in the next five years to the second level [2].

BIM Maturity Index developed by analyzing then integrating several models from different industries. Dr. Succar developed (BIm3) maturity matrix as a cognitive tool that integrates several components of the BIM framework for the purpose of performance measurement and improvement [3]. Measurement provides the basis for a company to assess its progress towards achieving planned goals helps identify areas of strength and weakness and decides on predictions for the future.

6. Study Case

Based on the most important tools for measuring the maturity of BIM, BIMM matrix [3]. And apply it to study the reality of BIM application in Syrian companies. Several engineering companies from the public and private sectors were visited to see their workflow mechanism, and to measure the extent of application of modern standards and technologies in projects designed or implemented by them. In an applied step to assess the current situation in order to advance BIM application level, successively we will discuss the results that we obtained and in light of them, a detailed methodology proposed to implement BIM in the company effectively, in addition to the most important recommendations.

6.1 Results

Table 1: Results of applying BIM³ into Syrian companies-2022- Author

| Company name (public sector) | maturity BIM level | | | | |
|----------------------------------------------------------|--------------------|---------|---------|------------|-----------|
| | initial | defined | managed | integrated | optimized |
| The General Company for Water Projects | × | | | | |
| Military housing company | × | | | | |
| Military construction company | × | | | | |
| Rapid and prefabricated construction company | | × | | | |
| The General Company for Roads and Bridges | | × | | | |
| General Company for Engineering Studies | | | × | | |
| The Public Corporation for Drinking Water and Sanitation | × | | | | |

| | | | | | |
|---------------------------------------|---|---|---|--|--|
| Construction implementation company | | × | | | |
| Company name (private sector) | | | | | |
| Asas Contracting Company Limited | × | | | | |
| Thiqa Trading and Contracting Company | | × | | | |
| Saqr Design and Construction Company | × | | | | |
| Asl Al-Katerji Company | | × | | | |
| CND Engineering Company | × | | | | |
| NYS Engineering Company | | × | | | |
| Kasbo Construction Company | × | | | | |
| Arvada Petroleum Company | | × | | | |
| JEO joint Engineering Office | | × | | | |
| BUILDERS engineering Company | | | × | | |
| Al-Bayda Construction Company | | × | | | |
| Syria BIM Company | | | × | | |
| Yamhad Contracting Company | | × | | | |
| Syriatel Company | | × | | | |
| Al Yusr Engineering Upgrading Company | | × | | | |
| Sharif Engineering Group | | × | | | |
| Dalal Trading Company | | × | | | |
| Damascus Management Company | | | × | | |
| SARC wash & Rehabilitation team | | | × | | |

Maturity level of engineering companies

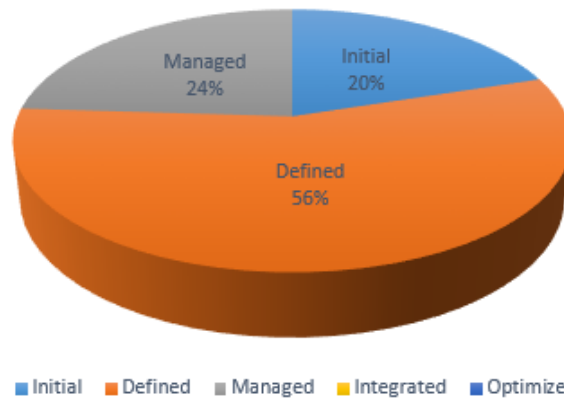


Figure 3: Maturity level of Syrian companies-2022- Author

For companies that have not yet used BIM systems and their level is initial, their opinion was taken regarding their desire to adopt it, and the majority of 87% had a desire to do so, and about 13% of them did not have the desire. The desire to adopt BIM was for several reasons:

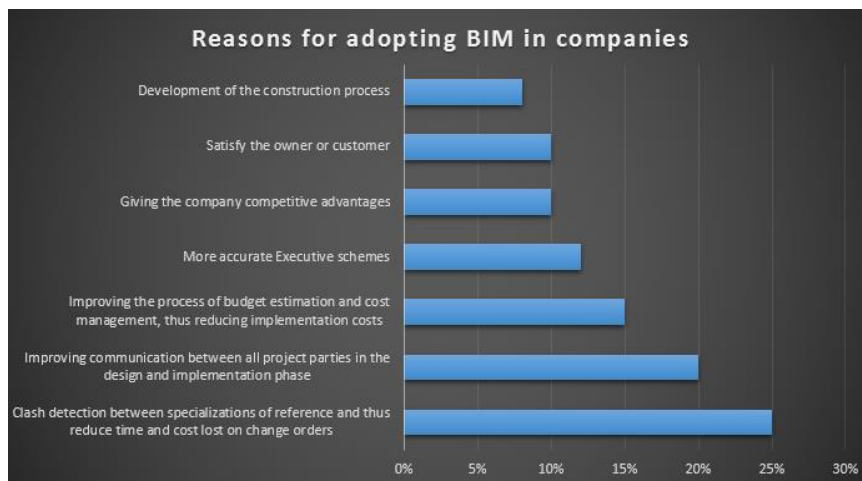


Figure 4: Companies Reasons for adopting BIM -2022- Author

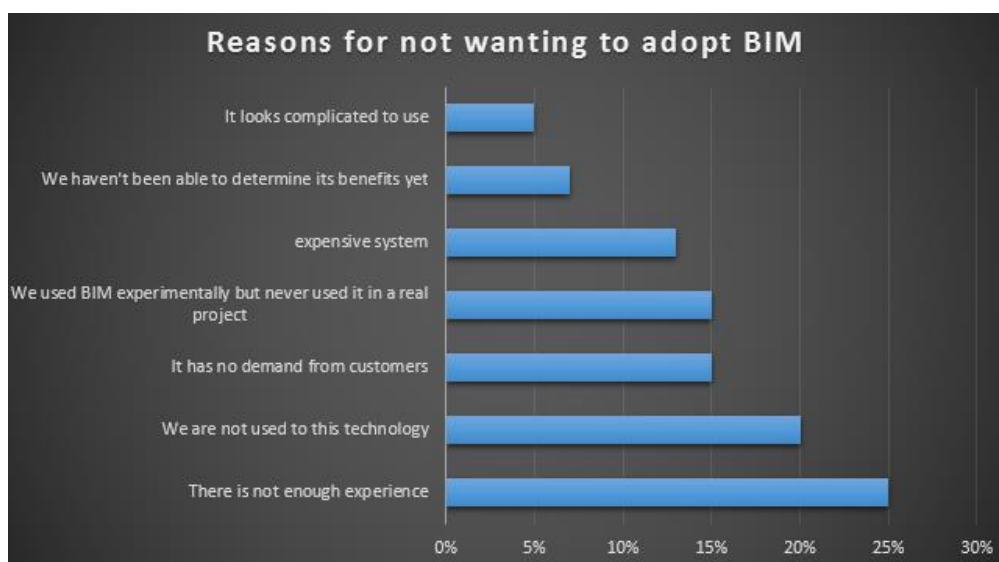


Figure 5: Reasons for lack of BIM adoption in companies -2022- Author

As the biggest obstacle to unwillingness to introduce BIM concept into the construction industry was the lack of sufficient expertise in this field. Therefore, we are fully aware of the lack of BIM technology experts. In addition to qualification and training programs to provide engineering companies with employees meet their needs.

When polling about the best features of BIM that companies want to use it, it turns out that:

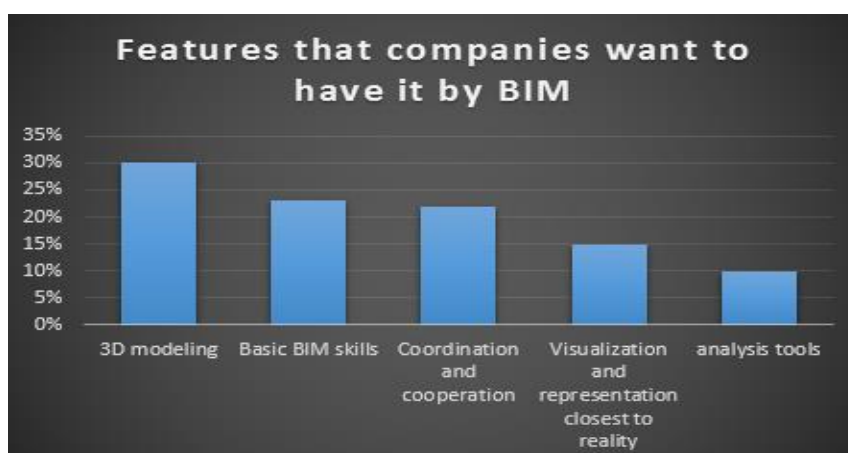


Figure 6: Features that companies want to have it by BIM-2022- Author

We find that 3D modeling (smart models) is one of the factors that companies most want to master and practice.

By smart model, we mean that the information is included within the virtual three-dimensional model. Some of this information is physical and includes the dimensions of the elements and their relative locations, while others are non-graphical and include their quantities and properties. Basic BIM skills are also very important for users. As well as coordination and cooperation between disciplines through composite models.

The need for cooperation in order to apply simulation techniques in the construction industry is undoubtedly one of the most important features BIM. As early cooperation has great benefits in the project planning and construction processes, so building a model of origin is one of the most important means that guarantees deep cooperation between team members at all stages of the project.

We noticed the importance of existing BIM maturity measurement tool in every company because **Performance measurement is the first step to improving and managing performance**. Based on the results and according to the practical reality in the Syrian companies, we found these axes should be strengthened within the matrix structure in detail, given their importance in developing BIM maturity:

1-Education BIM: To follow the educational approach proposed to adopt BIM, identifying its phases and measuring its efficiency.

2-Rehabilitation and training: To obtain efficient human resources in BIM, determining the level of professionalism of the offered training and its sequence of stages, and measuring the benefit of the trainees through these qualifying courses.

Table 2: Adding axes to the matrix to suit practical reality -2022- Author

| Optimized | Integrated | Managed | Defined | Initial | Key Maturity Areas |
|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|------------------------------------|
| This methodology is constantly updated to match the technological advances that BIM keep pace with it | Putting forward a detailed, integrated and interrelated mechanism between all phases of the project | Existence of a systematic plan showing how to apply BIM in each level of project levels. | There is educational methodology of BIM importance and its benefits randomly | There is no educational approach proposed yet | BIM Education |
| Continuous updating of the training program and diligent research to constantly develop its methods | Qualify and train all stakeholders in the company or project at all BIM stages. | Providing training courses within the company's system for its employees as cooperative groups, and paying attention to qualifying a large number of Professional BIM users | The existence of a self- and individual training program to qualify a few cadres to apply BIM in its basic stages such as modeling | There is no human resource training in the company | Training and rehabilitation |

To develop a methodology for applying BIM in companies systematically:

Table 3: company work methodology -2022- Author

| Phases | Procedures in each phase |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Project initiation phase | <ul style="list-style-type: none"> -The need for a deep assessment of the maturity of knowledge management. -Assign senior management responsibility for developing BIM adoption plan. -Create an internal team of key managers responsible for implementing the plan, with cost, time and performance budgets to guide their performance. -Spread the culture and benefits of using technology |

| | |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | <ul style="list-style-type: none"> -Achieving employee satisfaction -Determine the type of deliverables that the company delivers. |
| contractual phase | Developing a contract obligating the application of BIM at all stages of the project, and developing the contract law to allow the contractor to participate in the design stage, in addition to creating binding laws that apply at all stages of the project. |
| Pre-design phase | <ul style="list-style-type: none"> -Improve collaboration using approved integrated project delivery in project contracting. -Define the project team. -Spreading a culture of shared responsibility among any group work. -Support project team collaboration. - Choosing utilities from software and communication methods to connect the work team to a unified information network that facilitates communication between the work team, while supporting integration between applications and various business flow tasks by creating open interfaces that allow the import of data related to creating a design, editing it, and exporting its data in different formats. -Preparing (BEP) that specifies the levels of detail required from each designer at each phase. -Defining the roles of the work team. |
| Design phase | <ul style="list-style-type: none"> -Clarifying the project in all aspects: economy, structure, energy, aesthetic, and functionality. -Determine the concept Design. -Adopting the IFC formula during modeling so that each specialty can work individually to save time. -Perform a virtual simulation of the building. -Programming bills of quantities to adjust themselves automatically when modifying data. -Avoid the problem of clashes by simulation. -Improve energy use and sustainability in the building. -Ensuring the integration of construction knowledge early in the design process and cooperation between multiple design disciplines, with an emphasis on the participation of the owner and contractor within this stage. |
| Implementation phase | <ul style="list-style-type: none"> - Employment of the design model in the process of construction by the implementation or contracting company at the work site. - Choosing an executive team capable of extracting digital information for implementation from the 3D model. -Transferring the mock-up of the project from the design phase to the implementation phase. - Communication between the parties to the project, which provides all participants with a clear set of instructions with continuous communication among them to master the work and complete it accurately according to the quality and time planned. -Monitoring and documenting data exchange processes, collecting data on a daily basis from completion reports. -Keep senior management informed of progress, problems, insights, etc. |
| post-implementation phase | <ul style="list-style-type: none"> -Achieve better facility management, operation, gathering information from the general contractor and MEP contractors about bundled materials, and maintenance information for systems in the building. -Link this information to the objects in the building model and thus be available for handover to the owner for use in their facilities management systems and check all systems then owner accept the project. |
| Project closing and feedback phase | <ul style="list-style-type: none"> -Archive documents for future uses. -Considering the knowledge acquired by individuals within the company as knowledge assets for the organization, collecting, archiving and teaching it to individuals within the company. -Develop a complete database for the project, its components, equipment and all its elements. - Using the initial results to educate and guide the continued adoption of BIM software and additional staff training. |

| | |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | -Extend the changes facilitated by BIM to new locations and functions within the company, and reflect these new processes in contractual documents with clients and business partners. |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Based on the work methodology, with measuring the maturity of BIM according to BIM³ matrix periodically as a follow-up and evaluation BIM implementation in the company.

In order to measure the extent to which the desired goals are achieved, a measurement model called performance indicator cards was proposed, which is considered one of the most important strategic management factors that contribute to the success of the company.

Table 4: Performance indicator cards -2022- Author

| Goals strategy | Goals | Scale | Performance indicators |
|----------------------------|--------------------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Clients | Achieving Clients satisfaction | Their number | Increasing the number of clients by a percentage set by the Higher Management of the company |
| | Gain new customers and achieve the loyalty of all stakeholders | percentage of errors in projects | Low errors by a percentage set by project managers |
| Financial dimension | Increasing productivity, and achieving profits | The number of tenders | Increasing the number of tenders awarded to the company by a percentage estimated by the Directors |
| | Marketing promotion of the company's reputation in the urban field | The rate of revenue growth | Increasing annual revenues and increasing profits by a percentage estimated by the financial management of the company |
| | Reducing project implementation costs | The rate Reducing | Low implementation cost by quantity engineers |
| | Spending rationalization | Change order costs & reduce waste of resources | Reducing the costs of wasted operations by a percentage set by the engineers in the financial department |
| Internal operations | Focus on developing the company's employees | Operational and planning problems | Decrease in problems, inconsistencies between specializations, and engineering errors, with a rate estimated by department managers |
| | New administrative system and change of employee relations policy | Cooperation between all disciplines | Recording a regular morning meeting on a daily basis, which enhances the friendly relationship between them |
| | Increasing the quality of services provided | ISO | Quality of services provided according to ISO |
| Learning and growth | Promote BIM culture in the corporate environment | Number of BIM supporters & administrative approvals | High percentage of administrators who are convinced of the importance of BIM |
| | Reward system and financial incentives commensurate with | employee satisfaction | Raising wages by a percentage estimated by the General Administration and the Finance Department |

| | | | |
|--|----------------------------------------------------------------------|-------------------------------|----------------------------------------------------------------------------------------------------------|
| | efforts to adopt new technology | | |
| | Raise staff competencies and develop their skills on BIM application | Executor's BIM maturity level | An increase in the efficiency of the company's employees according to the results of the maturity matrix |

6.2 Conclusion

- ✚ The adoption of BIM in private sector companies is better than in public sector
- ✚ BIM level that dominates private and public sector companies is BIM LEVEL=1
- ✚ In some companies BIM maturity level ranges between 1 and 2, but with the proposed plan to measure and develop BIM and implement the recommendations provided, BIM LEVEL = 2 will be reached.

6.3 Comparing results

According to the results of previous studies, BIM in Syria was still in 0 level. Thus there is significant progress because:

As a result of the companies' evaluation, it was found that Level 1 of BIM dominates the largest number of them:

- Where engineers use BIM tools like architectural and structural Revit.
- In addition to the belief of the company's employees in collaborative work, which is a basic principle of BIM.

In conclusion: companies need a lot of effort and work to get close to level 2, and this requires working according to a strategic plan according to a specific timetable and according to a strategic leadership decision from the upper levels of the company in order to lead the knowledge transformation in it towards applying BIM effectively.

7. Recommendations

7.1 Recommendations to enhance BIM maturity within engineering firms based on matrix measurement results:

Table 5: Recommendations to enhance BIM maturity -2022- Author

| Key Maturity Areas | | Recommendations |
|---------------------------------------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TECHNOLOGY based on Capability Set v5 | Software | Developing and unifying the programs used within all departments of the company, developing coordination of data between departments and individuals, and finding a unified mechanism for Support it |
| | Hardware | The devices used within the company's departments must be developed to suit the necessary programs and allocate the necessary budgets to replace old and damaged devices |

| | | |
|-----------------------------------------------------------------------|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Network | Expanding the circle of users for the internal and external networks to include all employees within all departments with continuous evaluation of network performance |
| PROCESS based on Capability | Resources | Deciding on the obligation to share knowledge in a coordinated manner for all levels and monitoring its implementation, which is reflected in the incentive |
| | Activities & Workflows | Work on building clear models to define the roles and stages of work for each team member |
| | Products & Services | Developing model files to be emulated by specialists, evaluating the work of teams and the extent to which their work matches the established models, and constantly developing these models in line with the professionalism of employees |
| | Leadership & Management | Transforming ideas into reality by management |
| POLICY based on Capability | Preparatory | Determining clear methodologies and detailed plans for training on approved programs to gradually develop employees in line with the current knowledge of individuals |
| | Regulatory | Appointing specialists to create clear documentation standards, then disseminating these standards to everyone, then evaluating the results to make the necessary development |
| | Contractual | Develop standards related to defining rights and responsibilities associated with building information forms as a first step |
| STAGE STAG E 1 E 2 E 3 | Object-based modelling | The development of this part is related to the development of knowledge of the work team, the development of standards, and the gradual increase in coordination |
| | Modeling-based Collaboration | Preparing useful training methodologies within a clear time frame |
| | Network-based Integration | Preparation starts from the inside and gradually expands to include the participants and all project parties |
| Org. scale | Organizations | Integrated models must be prepared by specialists familiar with the company's business and objectives to suit all types of targeted projects |
| | Project Teams | Technology Champions can be leveraged to be change leaders with support from management and external professionals |

| | | |
|--|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Markets | Raising the level of coordination with stakeholders, and it is also possible to work on concluding agreements with them to raise the level of work within the field of BIM and to involve them in the process of change. |
|--|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

7.2 Recommendations with the aim of promoting the spread of BIM in Syrian construction industry:

1-Providing government support for BIM technology by issuing binding rules that require using it in major projects. With approvals and licenses from relevant government agencies, then start the gradual transition to generalize to the rest of the projects, and prepare specifications, codes and contracts regulating the use of technology in the construction sector.

2-In the beginning, it is necessary to raise the awareness of institutions and companies in Syria about the importance of BIM, through conferences, seminars, and practical examples of countries that have applied this technology. The difference between projects implemented using BIM and how such types of projects are controlled in terms of time, cost, reducing waste in materials, resolving conflicts, and increasing coordination between different disciplines.

3-Work to provide the infrastructure and metadata to provide the skills and competencies necessary to work in this field and at all levels that can contribute to promoting the application of BIM. Therefore, it is important for universities to play a key role in providing curricula and training programs specialized in the field of BIM to provide the sector with high capabilities that help spread This concept spreads true far from the clutter of use. We can mention here the unique experience of the Syrian Virtual University, which adopted the Master's program in Building Information Modeling Management, and the pioneering role it plays in this field.

4-Activating the role of the Society of Engineers and specialized institutions in raising awareness and disseminating BIM technology by holding workshops and training courses, conducting specialized conferences and holding events to include all construction sectors from planning, design, implementation, management, operation, maintenance and real estate developers. This requires conducting studies by educational institutions and research centers, which in turn can provide sufficient information to assist decision-makers and stakeholders in building informed and scientific decisions.

5-Coordinating efforts between stakeholders from universities, unions and institutions representing the construction sector to adopt a clear strategy on how to implement BIM according to an applicable timetable.

6-Creating the regulatory and legislative environment for adoption BIM and work on adopting modern contracting methods, adding basic standards to the terms of contracting contracts, so they include some aspects of the BIM system that help to adopt it and enhance the participation of project parties early in the project life cycle.

7-Working to spread a culture of accepting change, adopting modern technology because of its benefits to shareholders in the sector, and enhancing the competitiveness of companies; As well as keep abreast of recent developments in this field. For example: Preparing and encouraging companies in the construction sector to shift from using programs such as AutoCAD to programs that operate according to BIM technology. Through a gradual transition after completing all the necessary

preparations for the implementation of training, technical support, programs, and qualification of workers to accept the smooth transition.

8-Providing the material capabilities necessary to start applying BIM technology and technical support for institutions and stakeholders, such as starting at the government level, even if it is specific to a scope or to one of the departments, which invites and motivates other institutions to adopt this system.

9-As mentioned above, auxiliary trainings to apply BIM system must be included in the work mechanisms as a basic step before starting the project, in addition to long-term planning, in terms of focusing on the long-term benefits of training these cadres.

10-Supporting more studies related to BIM technology in all areas of the construction sector, such as design, operation and maintenance, and conducting comparative studies between projects built with current technology and similar ones in which BIM technology has been applied.

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