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A study of the current implementation of cloud-based BIM technology in the Egyptian AEC industry

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ABSTRACT

The AEC industry in Egypt is remarkably adopting cloud-based BIM technology at a fast pace, which eases effective information transfer among stakeholders and supports collaboration, communication, and real-time information sharing among project participants. This research aims to explore the actual status of using state-of-the-art cloud-based BIM technology during the construction process and to identify the obstacles facing its adoption. To achieve the research objectives, the researcher used quantitative and analytical approaches to reach conclusions. The researcher conducted the filed study in Egypt and was limited to those who have experience in using cloud BIM applications during the construction process, the study explores the adoption status of cloud-based BIM in Egypt, furthermore, benefits and barriers were identified and analyzed. Findings also prompt the suggestion of an action plan that enhances the adoption of cloud-based BIM technology in the industry.

Keywords: Cloud-based BIM, communications management, stakeholders' involvement, AEC industry

1. Introduction

Due to the complexity and fragmented nature of the construction industry, data sharing and communication during the lifecycle of a construction project among project stakeholders within various disciplines remains a challenging and often unresolved issue. The fragmentation among software tools and stakeholders results in a set of significant team collaboration issues (Alreshidi *et al.*, 2016). Given the large number of stakeholders involved, the relationships between them are rapidly evolving and are often regulated by agreements. The construction sector has begun to adopt cloud-based BIM technology for stakeholders' collaboration (Mohanaraj *et al.,* 2021) this technology has led to better data communication and real-time collaboration between stakeholders throughout the project life cycle, from conceptual design to detailed construction stages (Onungwa *et al.,* 2021).

Adopting Cloud BIM applications has been shown to provide a lot of benefits, including real-time information sharing, higher stakeholder involvement, efficient communication, and time/cost/risk reduction. However, high implementation costs, lack of awareness among stakeholders, lack of trust in data security and privacy, fear of change, lack of regulations for BIM adoption in Egypt and more elements were noted as major challenges facing its adoption in the industry (Mohanaraj *et al.,* 2021; Abanda *et al.,* 2018; Elabd and Khodeir, 2018).

The primary objective of the study is to assess the current implementation of cloud-based BIM applications in communication management during the project construction process and to enhance this implementation in the Egyptian industry by developing an action plan that overcomes barriers and promotes benefits. This will be accomplished by conducting the following secondary objectives:

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- Assessing the current application of cloud base BIM in the AEC industry in Egypt.
- Investigating the benefits gained and barriers facing the adoption of cloud BIM technology.
- Proposing an integrated action plan.

2. Materials and Methods

As mentioned in the introduction, the study aims mainly to assess and evaluate the current implementation of cloud-based BIM applications in communication activities during the project construction process and to develop an action plan. To attain the objectives of the research, the researcher used analytical, quantitative and deductive approaches to reach conclusions. The research methodology can be summarized as follow:

- An Online Desk study to explore the state-of-the-art cloud BIM applications and to Investigate the benefits gained and barriers facing the adoption of this technology.
- Designing a survey questionnaire to investigate the current application of cloud base BIM technology in the AEC industry in Egypt.
- Obtaining results and processing analysis.
- Introducing an integrated action plan.

2.1. Survey questionnaire

The study was limited to BIM experts/users in the AEC industry in Egypt working in consulting and contracting entities dealing with construction projects. Given that this study aims to evaluate the current practice of cloud-based BIM technology in Egypt, thus A quantitative approach was adopted which is more reliable to capture the statistics. A survey questionnaire was designed using Survey Monkey online survey software. The questionnaire consisted of a combination of both open and close end questions. Closed-end questions varied between multiple choice, checklists, matrix/rating scale and ranking. Questions were Organized into four consecutive sections as shown in Table 1.

Table 1: Questionnaire survey organization.

Section	Objective
Section 1	Participants' basic information.
Section 2	Investigates the BIM adoption status in the AEC industry in Egypt.
Section 3	Explore barriers facing the use of cloud-based BIM and list benefits gained.
Section 4	Exploring solutions and suggestions for better enhancing the use of cloud-based BIM technology.

The questionnaire was shared with participants through a web link and distributed on online social media platforms such as LinkedIn, Facebook, WhatsApp, and Messenger, and a message of invitation was delivered with the questionnaire stating that participants with a BIM usage background were only invited to take the survey. Following The distribution of the survey, 58 out of 108 participants only provided complete questionnaire forms, once results were collected data were exported into Microsoft Excel spreadsheets hence the data was conducted, and charts and graphs were produced.

3. Results and Discussion

Section 1: Participants' basic information.

Q1: Which of the following categories best describes your employer?

As shown in chart (1), 37.5% of the participants worked for consulting firms/organizations while 57.2% presented contracting firms and 5.3% freelancing BIM users. All representing reputable and existing firms in the Egyptian industry.

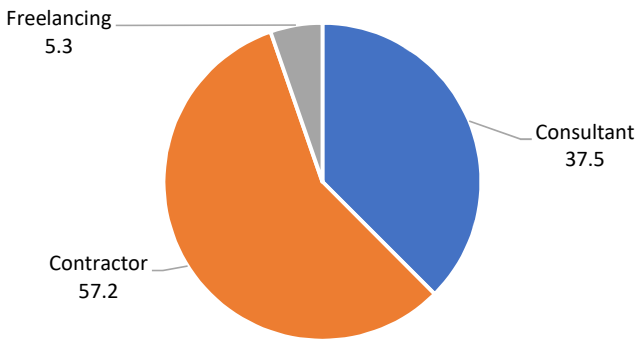


Chart 1: Participants type of organization

Q2: Chose the category that best describes your role in the construction process.

As shown in chart (2), 19.7% of the participants are related to the project management team,46.8% are designers from various disciplines,12.2% of site engineers, and 21.3% presents technical office engineers.

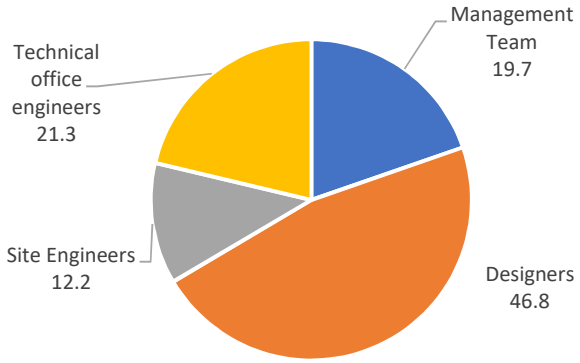


Chart 2: Personal field of work

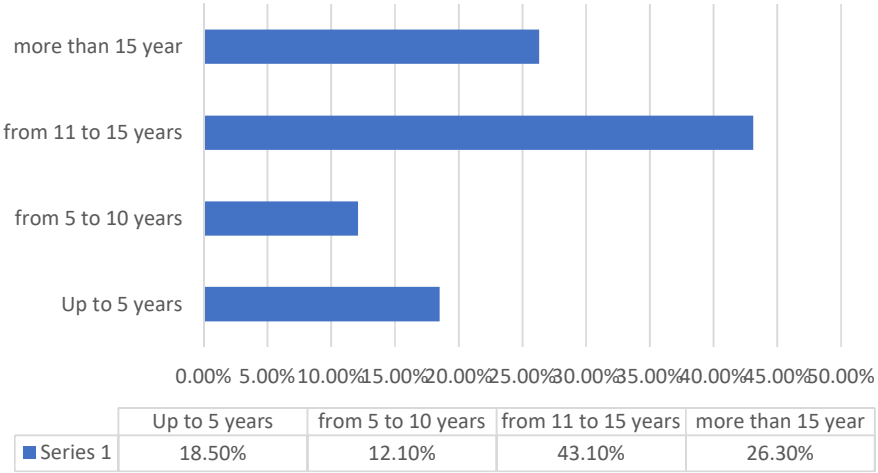


Chart 3: Personal years of experience

Q3: Your personal years of experience

Section 2: Investigating the BIM adoption status in the AEC industry in Egypt.
Q4: How long did your firm engage cloud-based BIM software/applications as a collaboration/communication tool between stakeholders?

As shown in chart (4), 7% of the participants were unable to identify the BIM adoption status in their organizations, while 4% only indicated more than 10 years.31% of the population answered from 6to10 to years and 58%answered less than 5 years. which indicates a significant shift towards cloud-based BIM applications during the past ten years, particularly over the past five years Egyptian construction industry.

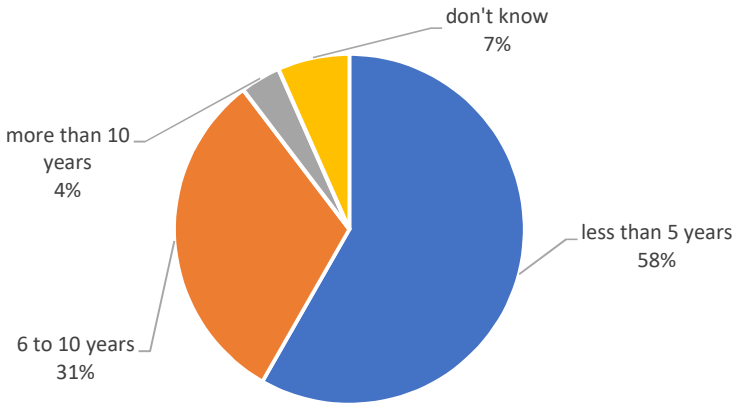


Chart 4: Cloud BIM adoption

Q5: What is the expert adoption status of cloud BIM at your company/office?

As for the replies to Q5, 17.65% of participants reported that their organization is still at the beginner level,35.29% indicated the intermediate level, and 17.41% believe their organization is at the expert level of cloud-BIM applications adoption. while 29.41% couldn't identify the expert level.

Q6: Which of the following BIM software does your organization/firm currently use for communication/collaboration during the construction process? Results as shown in chart (5).

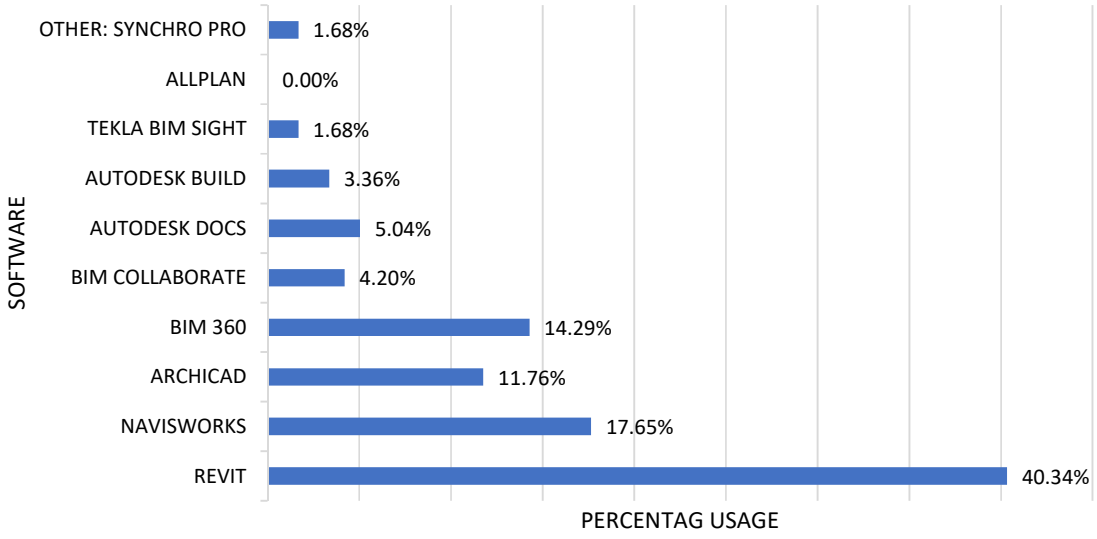


Chart 5: Frequently adopted applications in the industry

Q7: During the project construction/execution process, determine your use of cloud BIM applications in the following activities: Results as shown in table (2).

Table 2: Applications feature usage in project activities.

	Always	Sometimes	Never	out of my job scope
Model coordination (Publish, review, detect clashes)	37.50%	43.75%	0.00%	18.75%
Managing RFIs (initiate, manage, and respond)	50.00%	12.50%	18.75%	18.75%
Meetings agendas and minutes records	25.00%	37.50%	25.00%	12.50%
Virtual meetings	31.25%	25.00%	25.00%	18.75%
Generating progress reports	25.00%	37.50%	18.75%	18.75%
Managing emails	37.50%	18.75%	31.25%	12.50%
Track Progress with Markups	31.25%	37.50%	12.50%	18.75%
Project Schedules	18.75%	43.75%	25.00%	12.50%
Document management (Store, distribute, share, view, edit...)	43.75%	25.00%	18.75%	12.50%
Monitor progress	37.50%	31.25%	18.75%	12.50%
Account administration (Manage account level details and member permissions.)	37.50%	25.00%	12.50%	25.00%
Field management (Manage on-site communication of checklists, issues, and daily logs.)	25.00%	31.25%	18.75%	25.00%
Cost management (Track cost, coordinate change orders)	12.50%	56.25%	12.50%	18.75%
generating, editing, and sharing BOQs	31.25%	37.50%	12.50%	18.75%
Bid Boards	18.75%	12.50%	25.00%	43.75%

Preliminary questions Q6 and Q7 were followed by a set of open-ended questions concerning specified applications features and their usage in the Egyptian AEC industry, (Q8, Q9, Q10, and Q11) concluded the following results:

- Autodesk Revit ranked most used when it comes to 3d model generation and coordination between various disciplines, generating detailed 2d construction drawings, generating BOQs and schedules, and compatibility with several cloud-based platforms.
- Navisworks scored strong recommendations in clash detections, model review, model coordination and quantification.
- Autodesk BIM 360 ranked high in publishing, reviewing, and running clash detection on the project model, Using RFIs and submittals to collaborate with the project team. Control the on-site communication of issues, daily logs, and checklists.
- Autodesk Docs is strongly advised to enhance the construction process by publishing, reviewing, and approving all drawings, documents, and models.

Section 3: Explore barriers facing the use of cloud-based BIM and list benefits gained.

Q12: Arrange the following advantages gained by adopting cloud-BIM during the project construction phase. Begin with the most useful in your opinion: results obtained as shown in chart (6)

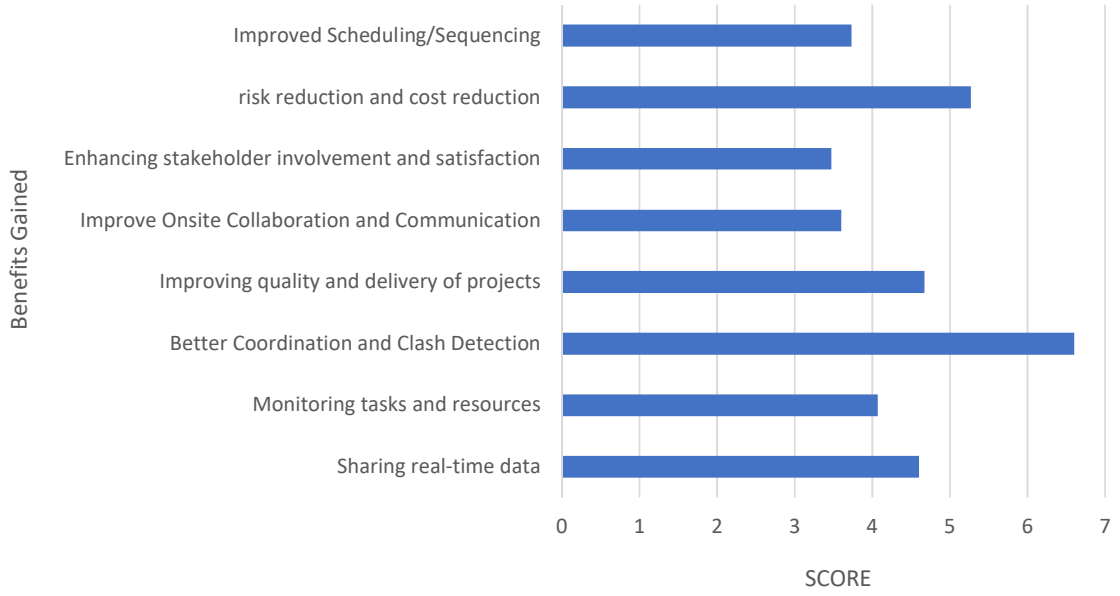


Chart 6: Arrangement of the key advantages of cloud BIM adoption from participants perspective

Q8: In your opinion, how significant are the following barriers facing cloud-BIM in the AEC industry in Egypt?

Results, as shown in table (3), high implementation costs, a shortage of expertise, and opposition to changing traditional methods, were the biggest obstacles to the industry's adoption of cloud BIM in the participants' perception.

Table 3: Barriers facing Cloud BIM adoption.

	Not a problem	Minor Problem	Serious problem	Don't know
High initial cost (hardware, software, training)	13.33%	26.67%	46.67%	13.33%
High running cost (maintenance, subscription fees, experts needed...)	0.00%	26.67%	53.33%	20.00%
Lack of motivation/resistance to change traditional methods	6.67%	33.33%	46.67%	13.33%
Lack of skills and professionals	6.67%	26.67%	53.33%	13.33%
Lack of trust in data security and privacy	26.67%	20.00%	33.33%	20.00%
Quality of Internet service	20.00%	26.67%	40.00%	13.33%
Other (please specify)				

Section 4: Exploring solutions and enhancing the study.

Q9: Do you agree that introducing classification for consultants and contractors based on their BIM expertise and proficiency, would be effective to improve the use of BIM technology?

Nearly 46% of participants agreed, according to the results displayed in chart (7), that classifying consultants and contractors according to their BIM expertise would result in a benefit.

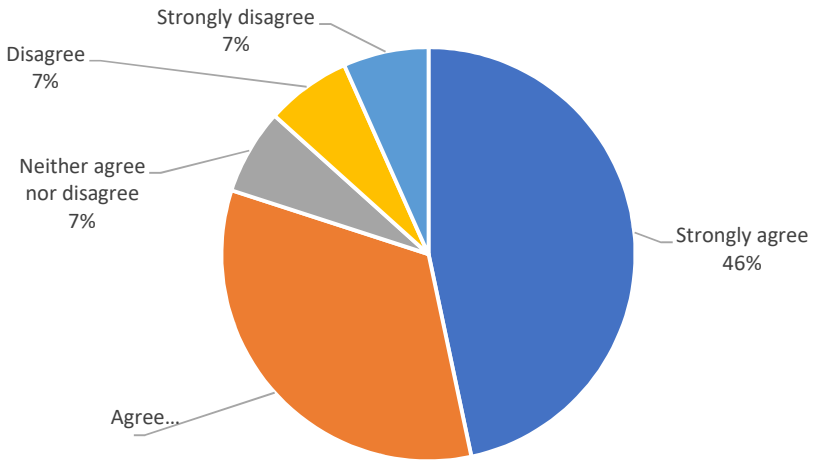


Chart 7: Contractors and consultants classification impact on adoption

Q10: Do you agree that clear BIM-related clauses in various types of contracts would be effective to improve the use of BIM technology?

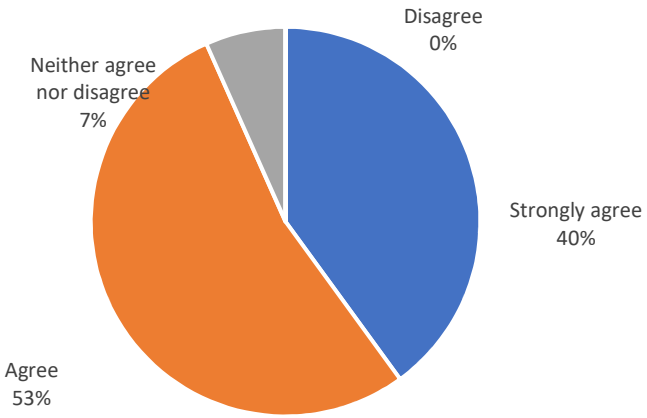
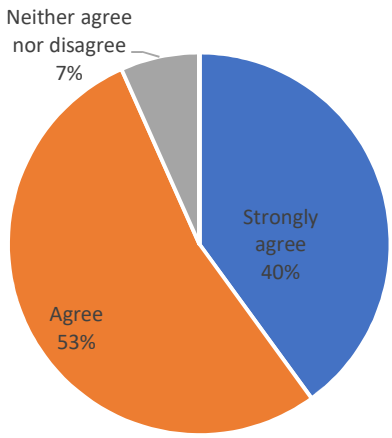


Chart 8: Impact of applying clear contractual clauses

Q11: Do you agree that gradual regulation codes shift towards the use of BIM technology, would be effective to enhance its adoption in the industry?



Q12: What guidelines do you follow in your company when it comes to the use of Cloud-BIM software?

Table 4: adopted guidelines.

Answer choices	Responses
National codes	33.53%
International codes	68.82%
Internal guidelines	11.76%
Other (please specify)	3.53%

Other: ISO19650 SERIES

Q13: Are you familiar with the term "cloud-based BIM"? (Simply, easy exchange of data and real-time collaboration, storing BIM information in the cloud means stakeholders can upload, access, and edit all their work from anywhere anytime).

Answer choices	Responses
Very familiar	50%
Somewhat familiar	25.6%
Not at all familiar	24.4%

Q14: Would you like to add any comments/information that would be helpful for this study? Various thoughts have been collected, many of which are similar and can be summed up as follows:

- Usually, cloud-based BIM is acquired by the project owners.
- Owners often provide relative licenses to the involved stakeholders mainly for the model-sharing modules.
- model coordination and design collaboration usually take place within the company servers.
- A gradual code shift towards requiring BIM is essential.
- Free software for economically challenged regions is crucial.
- More Engaging in academic courses would improve the quality of graduates.
- Applying BIM to construction documents should be mandatory by government authorities.
- The quality of internet service has a great impact on adoption.
- Training cadres and transferring knowledge between generations is essential.

Proposed action plan

The researcher proposes an integrated action plan that outlines the necessary actions to accomplish the objective of implementing cloud-based BIM technologies in communication and collaboration between stakeholders in an efficient manner. The main aim of the proposed plan is to enhance and Accelerate cloud-based Building Information Modeling (BIM) Adoption in the AEC industry in Egypt, by outlining the necessary actions required to accomplish the objective of technology implementation in the field of communication and collaboration between stakeholders in an efficient manner within a timeframe.

The researcher established a set of objectives to achieve the suggested plan's main goal and organized it sequentially. Which can be outlined as follows:

The action plan addresses the following groups of individuals as well as entities to which duties could be assigned based on their involvement in the procedure:

- Governorate authorities; Ministry of higher education and scientific research and Ministry of Housing, Utilities and Urban Communities
- Regulatory bodies; Engineering syndicate, and Egyptian Federation for Construction and building contractors.
- Educational institutions; public and private faculties and institutions, Scientific research centers, Housing and Building National Research center.
- Stakeholders; owners, consultants, contractors.
- Technology providers.

Table 5: Summary of the proposed action plan.

	Action	responsibilities	How to achieve
1	Country's general orientation towards better adoption.	- Prime minister. - Government. - Engaged ministries.	- Scientific research - Events, forums, and conferences. - Advertising campaigns - Social media campaigns
2	Increasing awareness among stakeholders	- Government. - Engaged ministries. - Consultants.	- Events - Workshops - Courses - Social media
3	Encouraging higher education and scientific research	- Government - Ministry of higher education and scientific research	- Introducing new course curriculums for graduate and postgraduate students. - Training stuff - Funding research - Conferences - Workshops
4	Licensing and classification for practitioners'	- Government. - Engineering syndicate. - Egyptian federation for construction and building contractors.	- Training - Examining - Evaluating - certifying

5	Building Codes shifting gradual shifting towards adoption.	- Government - Housing and Building National Research center	- Workshops - Comprehensive study - Issue materials
6	Application obligation in issuance of construction permit documents.	- Prime minister. - Government. - Ministry of Housing, Utilities and Urban Communities	- Obligation to use in issuance of buildings permit
7	Development of Contractual agreements	- Government - Contract specialists	- Further research - Introducing contractual cluses - Events and awareness.
8	Contribution of software and technology providers	- Software agencies and partners.	- Discounted and free versions for students. - Forums - Conferences - Workshops - Certification.

4. Conclusion

The use of BIM solutions based on cloud computing is growing rapidly in the Egyptian AEC market. Its use has proven crucial to attaining higher project quality, reducing risk, time management, and efficient stakeholder collaboration. Management of communication and collaboration between stakeholders in construction projects can be strongly enhanced using BIM applications based on common data platforms. Yet, providing solutions to the challenges that hinder this use and limit its advantages along with the development of current building codes and construction contracts that govern relations between stakeholders, training of cadres, and updating the classification of consulting offices and contracting companies based on their experience in this field, all are important factors and will be of great benefit to support this technology in Egypt. The proposed action plan puts into action all parties related to the industry; governmental authorities, stakeholders, and technology providers and assigns tasks that achieve the predetermined goals.

References

Abanda, F. H., D. Mzyece, A. H. Oti and M. B. Manjia, 2018. A Study of the Potential of Cloud/Mobile BIM for the Management of Construction Projects. Appl. Syst. Innov., 1(2), 9; https://doi.org/10.3390/asi1020009

Alreshidi, E., M. Mourshed, and Y. Rezgui, 2016, "State-of-the-Art and Future Directions of Cloud-based BIM Governance Solutions," in 16th International Conference on Computing in Civil and Building Engineering, Osaka, Japan.

Elabd, N. and L. Khodeir, 2018. Towards Enhancing Building Information Modelling Implementation in the Egyptian AEC industry, Egypt, Vol. 2 Issue 3 : First Proceedings of Al Azhar's 14th International Conference On: Engineering, Architecture and Technology.

Mohanaraj, R., P. Ganeshu and G. Mahendrarajah, 2021. Application of Cloud-Computing for the Internal Stakeholders' Collaborative Involvement in the Construction Industry: A Literature Review. Gari Winter Multidisciplinary Symposium, Colombo.

Onungwa, I., N. Uduma-Olugu and D. R. Shelden,2021 , "Cloud BIM Technology as a Means of Collaboration and Project Integration in Smart Cities. SAGE Open July-September, 1–9. https://doi.org/10.1177/21582440211033250.