The Important Roles of BIM in the Construction Industry in Vietnam: A Multi-approach Analysis

Pham Van Duong[1], Ta Van Phan[2]*, Nguyen Minh Ngoc[3], Nguyen Van Viet[4], Mai Vu[5]

[1] *Institute of Training and Technology,*
    Hanoi Architectural University, Km10, Nguyen Trai Str., Thanh Xuan Dist., Hanoi City, VIETNAM
[2] *Faculty of Civil Engineering*
    Thuyloi University, no.175, Tay Son Str., Dong Da Dist., Hanoi City, VIETNAM
[3] *Faculty of Urban Environmental and Infrastructural Engineering,*
    Hanoi Architectural University, Km10, Nguyen Trai Str., Thanh Xuan Dist., Hanoi City, VIETNAM
[4] *Investment Management and Basic Construction Department,*
    University Of Transport Technology, No. 54, Trieu Khuc Str., Thanh Xuan Dist., Hanoi City, VIETNAM
[5] *Faculty of Information Technology,*
    Hanoi Architectural University, Km10, Nguyen Trai Str., Thanh Xuan Dist., Hanoi City, VIETNAM

*Corresponding Author: phantv@tlu.edu.vn
DOI: https://doi.org/10.30880/ijscet.2024.15.04.013

Abstract

Building Information Modeling (BIM) is a good approach to solving problems in the construction projects, it plays an important role in developing strategy of the Vietnamese construction industry. This study aims to comprehensively analyze the role of BIM by collecting data and evaluating its impact on the industry. Specifically, this study examines legal documents related to BIM across different periods, surveys 150 construction jobs and 74 bidding documents to assess the demand for BIM process, and evaluates the practical benefits of BIM for construction projects. In addition, this study analyzed and clarified the effectiveness of applying BIM to construction projects compared to 2D technology. The findings elucidate BIM's roles in driving industry shifts, including alignment with new policies, trends in human resource training, and enhanced transparency in project management. Finally, this study provides insights into Vietnam's roadmap for BIM adoption in the construction sector through 2030 and beyond.

1. Introduction

Building Information Modeling (BIM) is a procedure utilizing three-dimensional model structures to enhance efficiency in construction projects [1] . Consequently, building information models surpass conventional 3D modeling by encompassing not only visual and material data of components but also include cost and time information [1- 3] . As summarized in recent research, BIM improves the existing communication process, offers a collaborative platform, and facilitates interoperability among many business domains. Moreover, successful use of BIM can augment performance and elevate productivity across the project lifecycle. Reports on BIM adoption indicate a 5% decrease in project construction duration, a 25% enhancement in worker efficiency, and a 5% reduction in investment value [1] .

The rate of BIM implementation in various countries has markedly increased, with the foremost adopters being the United States, United Kingdom, and Australia. These countries have advanced BIM to a high level of maturity, with legislation and standards that align with production processes. BIM development has proliferated

Int. J. of Sustainable Construction Engineering and Tech. Vol. 15 No. 4 (2024) p. 176-187

177

worldwide, with BIM associations and institutes established in Asia (e.g., The Hong Kong Institute of Building Information Modelling; Iran Building Information Modeling Association), Europe (e.g., The Czech BIM Council; Estonia Digital Construction Cluster), Africa (e.g., The South African BIM Institute), and Oceania (e.g., BIM Application Regulations in Australia) [4] .

Developing countries have also endeavored to adopt BIM by understanding and utilizing fundamental BIM standards [5] . The application rate of BIM in construction projects internationally is seen at a high level such as 69% in the UK, 90% in Germany, 50% in Singapore, etc. [6] [7] . In Vietnam, the application of BIM to projects remains limited. BIM is often implemented only in certain aspects of a project due to various technological and legal constraints, preventing its full integration [8] .

Currently, the Vietnamese government has shown significant interest in BIM and has been promoting its application nationwide. The Government established the National BIM Steering Committee in 2017 [9] ; this is an important milestone to boost BIM adoption in Vietnam. The supports of BIM software developers such as Autodesk and overseas country governments including the UK can aid BIM promotion [10-11] . BIM competitions, such as the ArchiCAD BIM Competition 2023 and 2024, have been organized to help students become more familiar with this innovative way of working [12] .

Construction enterprises in Vietnam are also actively adopting BIM in their projects (Fig. 1), BIM applications have seen the involvement of investors, construction consultants, and construction contractors (such as Vietnam Construction And Development Investment Consultants Join Stock Company, Bitexco Group and government agencies , etc.), consulting units (such as Vietnam National Construction Consultants, CDC Hanoi Joint Stock Company, PTW Vietnam Limited Company, R.E.E Mechanical & Electrical Engineering, Hanoi Construction Consultant & Urban Development Investment, JSC, etc.) and construction contractors (such as Hoa Binh Construction Group, Cotec Investment And Land - House Development Joint Stock Company, Construction Corporation No.1 Joint Stock Company, etc.) and so on [13] .
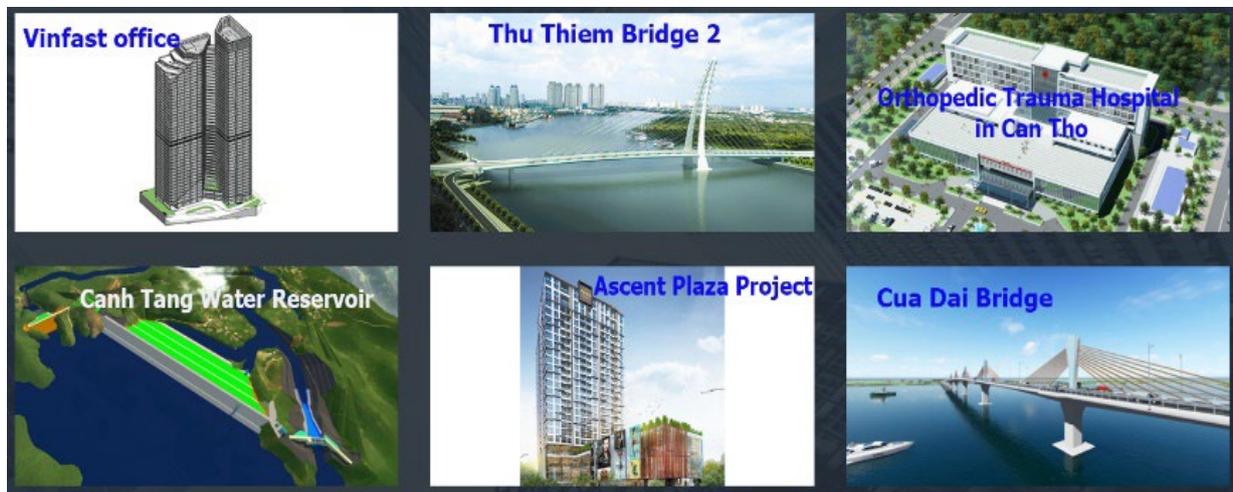
Fig. 1 *Some projects in Vietnam have used BIM process [14]*

Surveys of BIM applications in Vietnam show that the application rate of Autodesk products (Revit, Navisworks) accounts for the majority with 56% of the responses [17]; for a separate survey in Lam Dong province, this rate reached 91% [18] ; this rate is very large compared to the general survey in the world (41.6%) [19] . The general survey shows that design consultants are the organizations with the highest rate of BIM in their work (Fig. 2). Besides, BIM training in Vietnam is also playing a role in promoting the application of BIM in practice, with training units of universities (such as Hanoi University of Civil Engineering, Ho Chi Minh City University of Technology, Da Nang University of Science and Technology, etc.), external training units (such as BIM Hanoi Solutions Company Limited, HSD Vietnam Co., Ltd, Point Group Architectural Construction Co., Ltd, BIM Hanoi Solutions Company Limited, etc.) and BIM self-study programs on online platforms (such as www.youtube.com, www.hocrevit.vn, etc.). Additionally, new hires in construction companies have identified "understanding or proficiency in BIM" as an advantage.
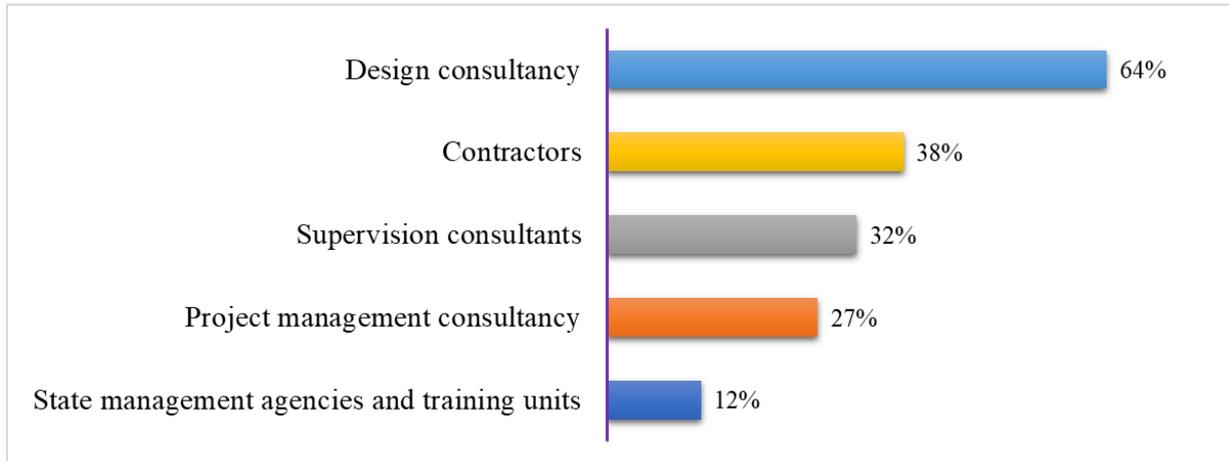
Fig. 2 *Survey of BIM application in construction fields [13]*

Currently, the application of BIM has been clearly defined by the Government in the national legal document system, this has been shown in Decision No. 258/QD-TTg of the Prime Minister (Mar. 2023) approving the roadmap for applying BIM in construction activities and mandatory application of BIM for new construction investment projects. The roadmap is implemented in 2 phases from 2023 to 2025 and phase 2 from 2025 to 2030 for construction projects from level 2 and above. The stages of the BIM Development Roadmap were marked from 2017 with the Prime Minister's Decision 2500/, which demonstrated the government's interest in BIM process (Fig. 3).
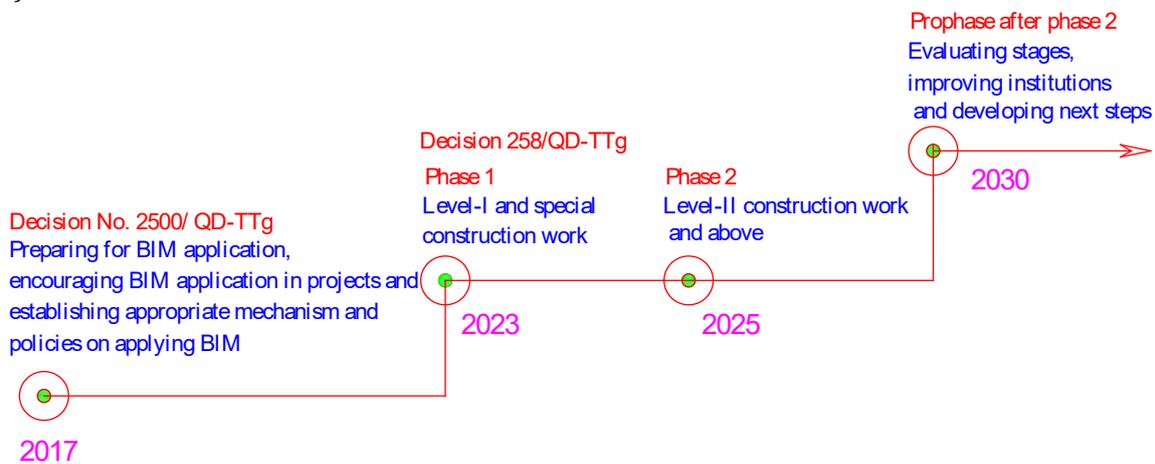

Fig. 3 *Roadmap for applying BIM in Vietnam*

National guidelines for project implementation in accordance with the BIM process are also incorporated into publications and training programs across provinces and cities nationwide (Hoa Binh province - Feb. 2024, Quang Ninh province - June 2024, Lam Dong province – Oct. 2023, Vinh Phuc province – May 2023, Ha Tinh province – Oct. 2023, Quang Ngai province – Apr. 2023, Hanoi city – Oct. 2023, etc.)[14] .

By addressing the requirement for openness in the planning, building, administration, and operation of construction projects, BIM is essential to the Vietnamese construction sector and ushers in a new era of growth. Although BIM currently faces numerous obstacles, its use has had a significant influence on the growth of Vietnam's construction sector [15] . The government has created a BIM development roadmap with detailed task content and dates. Practical issues still exist, though, necessitating additional research on BIM's effects on the building industry. To facilitate the continued use of BIM, it is vital to clarify its roles in the interim.

This study is based on the information on BIM application in construction projects to make the roles of BIM clearer. In addition, it highlighted the importance of BIM in the construction industry and project management activities in Vietnam. The study will analyse the legal databases on BIM, BIM market, human resources and the process of implementing E-government of Vietnam. The findings aim to clarify the role of BIM with aspects of construction industry development strategy, high-quality human resource development and transparency in project management.

Int. J. of Sustainable Construction Engineering and Tech. Vol. 15 No. 4 (2024) p. 176-187

179

2. Research Method

This study adopted a multi-approach analysis. Data was collected from two surveys. Discussions supplemented with legal documents and previous studies on BIM application. The data survey was conducted as follows:

- The first survey was conducted on the national bidding network with 74 bidding documents. This survey is based on government regulations, which is that from January 1, 2024, bidding projects will have to be implemented on the national bidding network system [16] .
- The second survey was on BIM-related jobs and the survey data was taken from 150 jobs posted on recruitment websites.
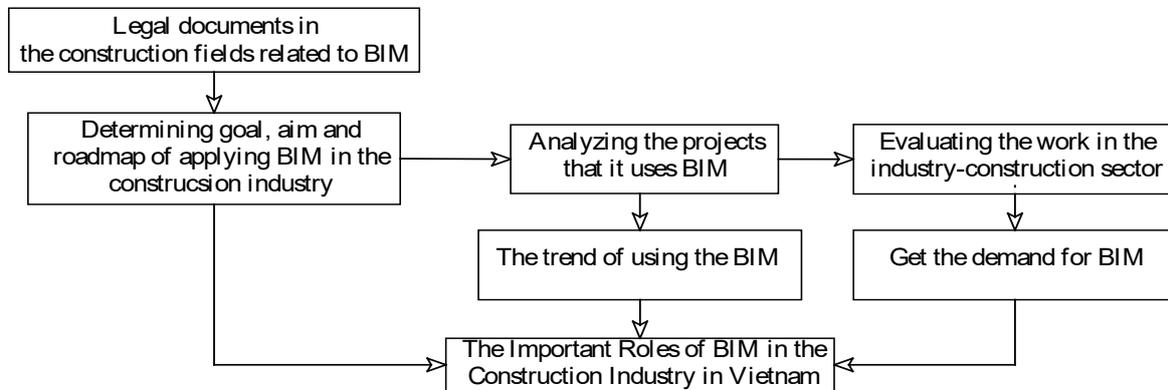

Fig. 4 *Structure of the research method*

To assess the role of BIM in Vietnam, the study employs several analysis and evaluation approaches (Fig. 4):

+ Survey and evaluation of legal documents on BIM in Vietnam. In which, issues from the Construction Law, Government Decrees, Circulars and decisions related to BIM process are considered. Analysed the government's requirements for BIM. In addition, affirm the position and role of BIM in the construction sector.

+ Survey of data on projects participating in bidding on the national bidding network system related to BIM. The projects were analysed for each type of construction, with a total of 74 bidding documents, of which one was cancelled. From the data of the national bidding network participation records, it is possible to assess the development of the BIM market.

+ Survey data on recruitment requirements of 150 construction jobs, including BIM-related jobs and non-BIM jobs to assess the need for BIM. Besides, it analyses the need to use BIM in different construction fields.

+ Survey and use data from other studies to demonstrate the roles of BIM in the Vietnamese construction industry.

This study serves as a guide, with an analysis of some specific points for the current development of BIM in Vietnam.

3. Research Results

3.1 From Legal and Regulatory Perspective

In order to promote the development of applying BIM process in construction field, the Government and authorities at all levels of ministries and provinces have deployed legal documents on BIM application for construction projects. Fully assessing the roadmap of BIM in Vietnam, the study presented legal documents in chronological order, including both expired and current documents. From there, there is a comprehensive view of the role of BIM in the Vietnamese construction industry. Some legal documents can be mentioned in Table 1:

**Table 1** *Legal documents and content guiding BIM implementation*

No.	Legal documents	Contents guiding BIM implementation
1.	Construction Law No. *50/2014/QH13* (June 18, 2014) and No. 62/2020/QH14 (June 30, 2020).	+ Basic principles in construction investment activities (Article 4) + Content of construction investment management (Article 66)
2.	Decree No. 32/2015/ND-CP (March 25, 2015) on cost management in construction investment	+ Costs for project management (Article 23). + Costs for construction investment consulting (Article 25)

180

Int. J. of Sustainable Construction Engineering and Tech. Vol. 15 No. 4 (2024) p. 176-187

3.	Circular 06/2016/TT-BXD (March 10, 2016) on instructions for determining and managing costs in construction investment	Regulations on BIM application are a part of project management costs and construction investment consulting in the total construction investment (Article 3)
4.	Decision No. 79/QD-BXD (February 15, 2017) on announcing cost norms in project management and construction investment consulting	Instructions for determining consulting cost estimates for applying BIM in section XI in Part 2.
5.	Decision No. 1004/QD-BXD (July 31, 2020) on Approving the "Digital Transformation Plan for the Construction Industry for the period 2020-2025, orientation to 2030".	+ General goal of applying BIM in construction. + Establishing a process for receiving and managing BIM projects. + Training to improve BIM capacity, especially for students. + At least 20% of projects will apply BIM by 2030.
6.	Circular 12/2021/TT-BXD (August 21, 2021) on promulgation of construction norms and Circular 09/2024/TT-BXD (August 30, 2024).	Part 1, section 1 has instructions for determining the cost of applying BIM.
7.	Decree No. 15/2021/ND-CP (March 3, 2021) detailing a number of contents on project management in construction investment.	Article 6 describes BIM and digital solutions
8.	Decision No. *348/QD-BXD* (April 2, 2021) on publishing General Guidelines for applying BIM.	Includes the sequence and content of BIM application and Common Data Environments (CDE)
9.	Decision No. 347/QD-BXD (April 2, 2021) on publishing General Guidelines for applying BIM to civil works and urban technical infrastructure works	It clarifies the contents of BIM for construction projects and urban technical infrastructure projects (mechanical and electrical, water supply and drainage)
10.	Decision No. 258/QD-TTg (March 17, 2023) of the Prime Minister: Approving the Roadmap for applying Building Information Modeling (BIM) in construction activities	Notably, the division into 2 phases of applying BIM to construction projects (phase 1 is from 2023 to 2025 and phase 2 is from 2025 to 2030).
11.	Decision No. 179/QD-TTg (February 16, 2024) on Construction Industry Development Strategy to 2030, orientation to 2045.	+ Seizing the opportunities of the 4.0 industrial revolution and international integration. + Applying technology in construction investment management, design, construction, and project quality management. + Perfecting the system of regulations, standards, norms and construction unit prices. Encourage the application of new technology to improve construction investment efficiency. + Applying Geographic Information System (GIS), digital technologies and digital platforms in urban development planning and management. + Strong application of Building Information Model (B.I.M) in management, design and construction of works according to the approved roadmap.

Thus, the basic BIM legal documents have been fully issued by the Government, from regulations on establishing BIM models, project management to calculating costs of applying BIM to projects. However, during the implementation process, issues that arise about applying BIM in practice still need to be analyzed and shaped more.

Int. J. of Sustainable Construction Engineering and Tech. Vol. 15 No. 4 (2024) p. 176-187

181

3.2 Perspective of BIM Market

A survey of 150 construction industry vacancies on a number of websites (www.vietnamworks.com, www.topcv.vn, www.careerviet.vn, www.careerlink.vn, www.vietnamworks.com, www.vieclam24h.vn, www.vn.indeed.com, etc.) in Vietnam showed that (Fig. 5) the architectural field has the highest rate of BIM requirements (accounting for 48% of the survey), while the MEP field has the lowest rate of application (accounting for 21% of the survey). This reflects the important role BIM plays in the visual view of the project.
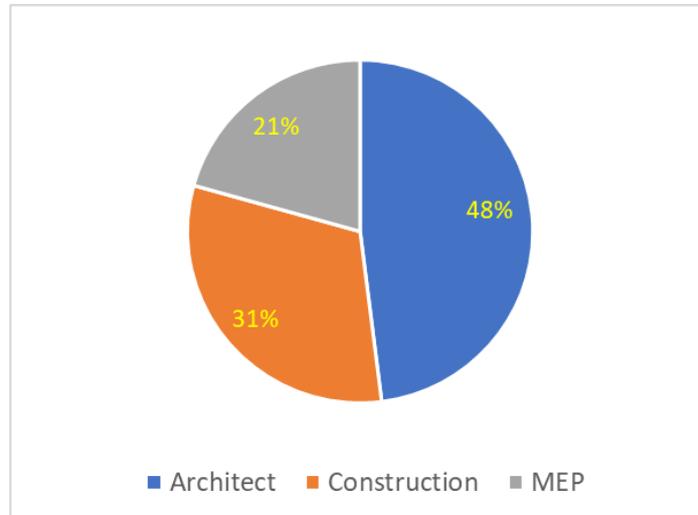
Fig. 5 *Percentage of construction sectors applying BIM*

In addition, the application of the new bidding law (Bidding Law 2023) also promotes the application of BIM, considering BIM as a priority tool in bidding documents. Survey research in the national bidding network (https://muasamcong.mpi.gov.vn/), statistics show that from 2022 to November 2024, there were 74 projects (including 1 project whose bidding was canceled) to apply BIM that were publicly bid (Fig. 6), with a variety of construction projects, such as traffic structures, high-rise buildings, electrical works, etc.
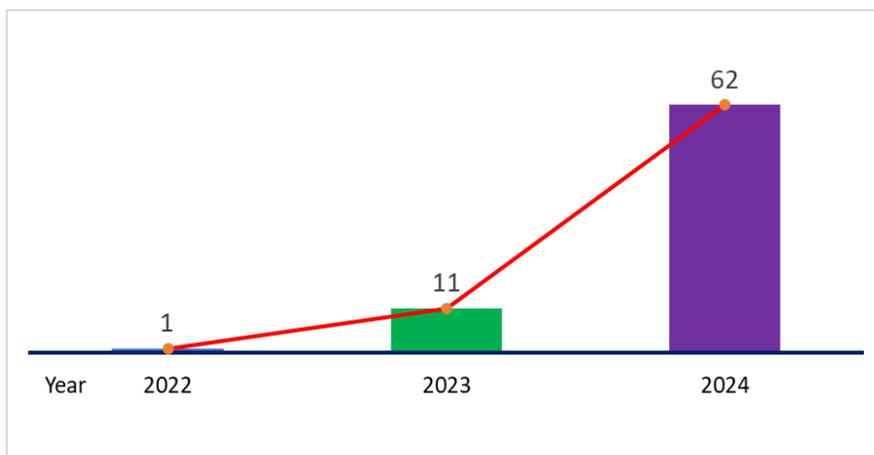
Fig. 6 *Projects using BIM in the National bidding network*

Furthermore, a survey on the national bidding network also showed that transportation projects have the largest BIM requirements (accounting for 51.2%) and about 15.1% are construction projects (Fig. 7). This indicates that housing construction projects are still limited in applying BIM, but with the current BIM application roadmap, the BIM application rate among construction sectors will still fluctuate and BIM application will increase.
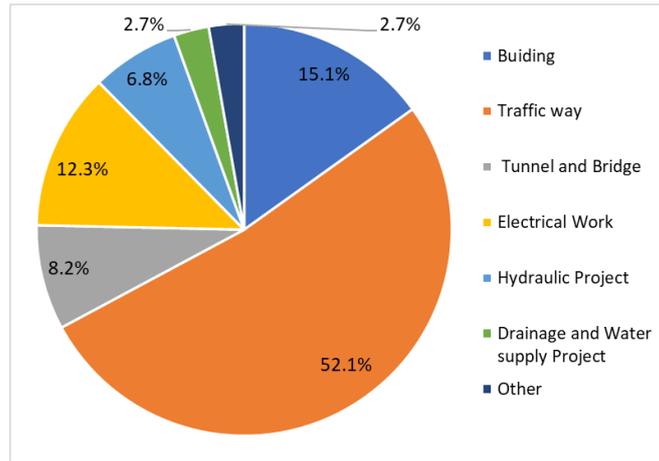
182

Int. J. of Sustainable Construction Engineering and Tech. Vol. 15 No. 4 (2024) p. 176-187

Fig. 7 *Percentage of project types are applying BIM in the national bidding network system*

In addition, the benefits of BIM have been shown in many studies, such as reducing the time to take off the volume of construction projects from 80% to 87% [8] . Design time is reduced by about 40%, project costs can be reduced by about 2% [20] . Surveys of companies and contractors show that 73% agree with reducing conflicts, 28% with good cost control, 73% with reducing errors and mistakes in the project and 19% agree with reducing construction costs [21] . Construction projects in Vietnam, when applying BIM, have also brought practical benefits, which can be seen in reducing construction costs (12% of project value), reducing time to prepare feasibility study project reports (from 17-22% of time), reducing construction time from 12% to 15% [22].

Reviewing analysis reports on applying BIM to construction works, it shows that the VietinBank Tower Project detected and handled 1,500 conflicts before implementing the construction phase; the Cheeky factory project (Investor Procter & Gamble, SEA) shortened the progress by 10%; the Park Hill 6 project reduced 8% of rework; the Tan Son Nhat airport domestic terminal parking lot project, Ho Chi Minh City controlled the accuracy of the volume to 95%, etc. [4]

Thus, the application of BIM in construction projects shows real benefits, especially ensuring stability during the construction phase and reducing construction costs. The construction context with the application of BIM in the current development stage. Vietnam has many advantages and benefits to promote BIM to go deep into improving the construction system.

3.3 The Demand for BIM Adoption in Construction Projects

A survey of 150 construction industry vacancies showed that BIM skill requirements accounted for 19.6%, AutoCAD skill requirements were 74.5% (Fig. 8). This shows that traditional skills still dominate, BIM skills are still not emphasized, especially in working on a construction site.
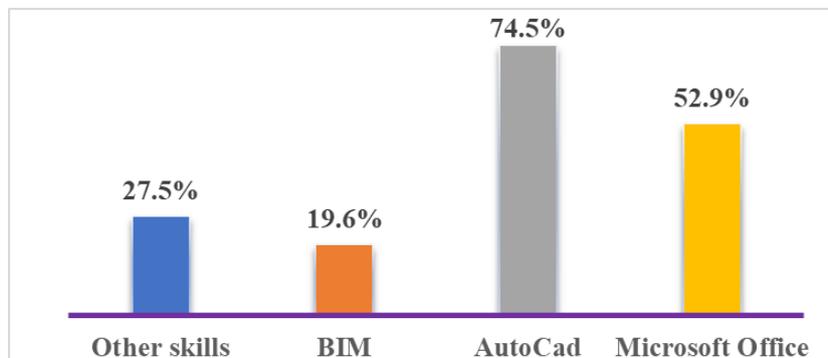

Fig. 8 *Rate of required skills of construction industry candidates*

The other survey shows that the demand for human resources for BIM in Vietnam is quite large (accounting for 46% of the survey [23]). In addition, in terms of recruitment at large corporations, knowledge or proficiency in BIM is required as a key skill or an advantage in competing for job positions [4] .

The value of Vietnam's construction industry is forecast to reach 94.93 billion USD by 2026, a growth rate of 7.4% to 8% [24]. The urbanization rate is forecast to be 45% in 2025 and 50% in 2030 (according to Decision

Int. J. of Sustainable Construction Engineering and Tech. Vol. 15 No. 4 (2024) p. 176-187

183

143/QD-BXD dated March 8, 2023), therefore, each year we must add about 70 million square meters of urban housing. Furthermore, the current construction demand in Vietnam is very large, and the need for high-quality human resources is also sought after by large companies. In particular, in construction, BIM human resources are the core factors for the company's development, which is consistent with the rules of market development in Vietnam.

3.4 Perspective of the Differences Between BIM and Traditional 2D Technology

Both BIM process and 2D drawings serve as tools for representing construction projects. However, they differ in their format and the information they convey. With the current 4.0 technology revolution, the application of technology in the construction field has taken place in all aspects. It can be seen that BIM process is an upgrade of traditional 2D technology and in BIM, in addition to containing the data attributes of 2D technology, it also includes many other information about structure, composition and materials. Furthermore, it is possible to integrate both spatial and temporal content.

In view of traditional project management based on 2D drawings, the data is stored according to paper drawings and documents with legal confirmation from competent authorities. Drawings are conventionally based on lines and symbols, Describing the structure, components and shape of the building using 2D drawings, it is difficult to visualize and determine the entire space of the building. Data statistics also rely on measuring the size of cubes, so it is difficult to ensure accuracy, errors in statistics and actual construction are very large (A survey of the Kinh Do building in Hanoi City, with a height of 8 floors, found that the error in framework statistics could be up to 41.8% in the foundation [23]).

Architectural, structural and electromechanical subjects are usually not taken at the same time. The project's architecture is deployed in advance, and the structural locations are pre-determined. The structure will then analyze and design the correct components. Next step, the electromechanical part will be deployed. Meanwhile, if there are errors or complexity in the shape of the project or inappropriate equipment locations, it will be very difficult to correct and change. The design change process also entails changes in all participating disciplines. Detecting conflicts is very difficult, leading to problems in the construction process and increasing costs in time and money.

Inaccurate determination of construction volume will lead to waste in construction, such as excess materials that cannot be reused (left over poured concrete), large inventory (not all materials used), a lot of construction waste increases the possibility of causing environmental pollution. Surveys in Vietnam show that up to 61.9% of surveys still use 2D technology for volume removal [23]. Therefore, the application of BIM process is still limited in the field of construction project analysis.

Key differences between BIM and traditional 2D technology are summarized in Table 2.

Table 2 *Explaining some issues between traditional 2D technology and BIM*

No.	Problems	2D	BIM
1.	Structural components/ construction works	A straight/curved line represents a cross-section of an object. It can be represented in 2D or 3D.	Represented in plan sections (2D), cube (3D) and accompanied by data information.
2.	Construction materials	List and describe materials	Material images, material information and simulation of the actual shape of the material.
3.	Identifying conflicts in design	It is very difficult to identify, because the components are shown on a 2D plane.	Listing conflicts of components and finding conflict locations to edit.
4.	Change design	It takes a long time; the process is complicated and requires written approval from relevant parties.	It can change quickly; changes are made directly on the project and project participants directly give comments for corrections.
5.	Materials statistics	Statistics by manual method, measuring and peeling volume using cubes.	Statistics according to components in the model can list details according to materials and the accuracy in data is very high.
6.	project management	Using paper tables and operation schedules determined by stage.	Simulating construction activities, order of construction steps and construction time.

		Forecasting the volume of construction materials has certain errors.	Determining the exact volume of materials at each construction time.
7.	Data environment	Paper data is large in volume and requires a lot of memorizations.	Establishing a common data environment (CDE) for all disciplines, which can participate in project processes anywhere and together.

From Table 2, it can be seen that applying BIM to construction projects will bring more practical benefits than the traditional way. However, this technology also poses many new difficulties and challenges for government agencies.

4. Discussing Roles of BIM in Vietnam's Construction Industry

4.1 Shaping the Strategy in the Construction Sector Development

BIM helps reshape the management structure in the construction industry, including the national policy and guidance mechanisms for the construction sector. Typically, the roadmap for applying BIM has been signed and issued by the Prime Minister (in Decision No. 258/QD-TTg). In addition, surveys on bidding projects applying BIM show that construction strategies have shifted significantly. BIM adoption has increased significantly (in 2024, the number of projects increased more than 5 times compared to 2023) and this trend continued to increase in the coming years (Fig. 6).

With the orientation of developing e-government, all fields and professions are processed online[25]. Besides, the digital revolution is also widely developed (marked by National Digital Transformation Day [26]). The system of legal documents on the construction sector continues to be issued and completed with policy institutions. Laws, decisions, circulars and Government guidelines on BIM have been issued to meet the practical needs of applying BIM (Table 1).

Furthermore, Realizing the benefits of applying BIM of investors, construction contractors, design units, etc. Apart from complying with regulations on applying BIM according to the Law, the benefits of BIM have attracted the attention of companies [13]. In particular, private companies have invested initial costs in BIM development because of the benefits BIM brings. A clear understanding of the construction model has ensured the benefits of designing a project management system, building a suitable schedule, reducing conflicts, limiting details that have to be reworked and specially making it convenient to change plans [22].

Thus, the development strategy of the construction industry has been shifting towards applying BIM processes, which helps modernize project implementation and it is in line with the development trend in the 4.0 revolution.

4.2 Reorienting the Trends of Training and Developing Human Resources in Construction

The current trend of BIM implementation, the reshaping of the training process for construction engineers, has received attention. The survey of the research team shows that the subject "Building Information Modeling (BIM)" has been added to the training program and it has been implemented in a number of universities in Vietnam, such as Hanoi Architectural University, Mien Tay Construction University and so on. At the same time, organize scientific research activities on BIM to create a nucleus for BIM development, e.g.: BIM Competition is held annually [12].

Currently, training on BIM is organized online or directly at training companies or training organizations at universities. BIM integration has been emphasized and encouraged to develop in the training fields of architecture, construction, water supply and drainage, electromechanics, etc.

In addition, the recruitment requirements of the construction industry have also encouraged candidates with BIM qualifications. Therefore, university students have also approached BIM and formed thinking about BIM development for future professions [27]. Besides, knowledge dissemination activities based on training sessions, seminars and BIM refresher courses in provinces and cities in Vietnam have also built the foundation for BIM human resource development [14] .

BIM process has also reshaped the current training trend, making BIM a mandatory subject for engineers in the construction, architecture and infrastructure engineering sectors.

Int. J. of Sustainable Construction Engineering and Tech. Vol. 15 No. 4 (2024) p. 176-187

185

4.3 Transparency in Project Management

One of the leading roles of BIM is transparency and minimizing errors, as well as saving costs before construction in construction projects. This includes clearly defining the structure of the building, construction materials and construction volume. Furthermore, conflicts are also detected and handled promptly [28]. The application of BIM to project work is highly appreciated, in which the intuitiveness and efficiency are highly appreciated [29].
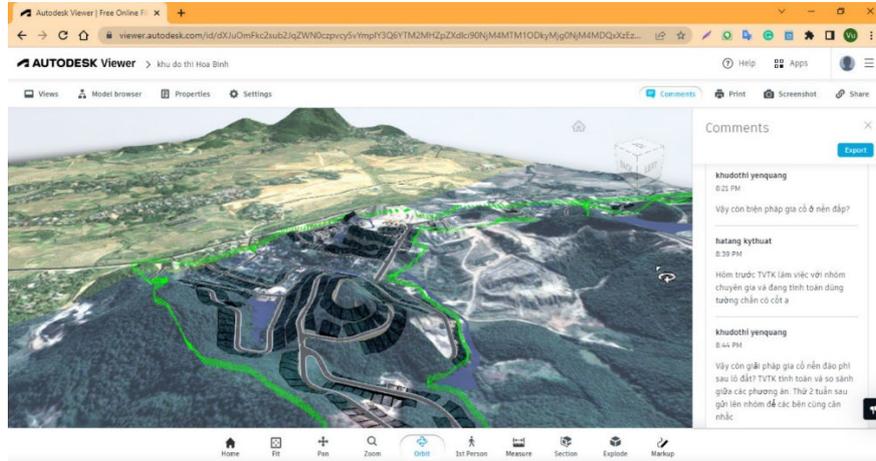
Fig. 9 *Online work exchange on Autodesk software company's Web platform about an urban infrastructure construction project of Yen Quang new urban area in Hoa Binh province, Vietnam.*

The coordination between members in the BIM application project is decentralized, with clear authority and responsibility. The tasks between the parties are also fully described in the project [30-31] and there is better information integration, improving the project process. Working together on a platform helps us to make decisions quickly and with consensus among the parties (Fig. 9).

BIM plays a very important role in lean construction, which is reflected in the BIM process and lean manufacturing philosophy [3]. This combination has brought significant benefits at all stages of the project, especially in the process of correcting design errors and resolving conflicts, while reducing the consultation process between parties in construction activities. BIM is a tool that helps the project to be sustainable and clear about the activities in different stages of the project [32].

Thus, BIM with its outstanding tools has helped to make the division of phases, work contents, coordination in design and project management clearer. Moreover, determining the workload and ensuring construction progress has also become more accurate. This shows that BIM helps the project to be more transparent in management.

5. Conclusions

The current state of the Vietnamese construction industry shows the urgent role of BIM, which is the key to ensuring transparency in the construction industry and reducing input costs, as well as establishing a clear management process. The demand for BIM in Vietnam is marked by the strong direction of the government through legal documents, in addition, the demand for BIM of manufacturing companies also affirms the position and role of BIM. Based on these observations, the following conclusions were made:

- BIM process plays a key role in the development of Vietnam's construction industry, with a clearly planned BIM application roadmap in 2 phases (from now to 2025 and from 2026 to 2030) that has properly oriented the development conditions of Vietnam's construction industry.
- The demand, market and benefits of BIM are the guiding factors in applying BIM in the construction sector.
- BIM has helped to make project organization transparent and promoted training needs from universities.
- BIM is a trend that is consistent with the shift in state management of the construction sector and meets the integration in the region and the world.

So governmental support and the commitment of construction investors, BIM process has been gradually developing and gaining traction in construction projects. In-depth studies on overcoming BIM barriers in the context of Vietnam will play a key role in the roadmap for BIM application. Thus, further comprehensive studies and strategic evaluations of BIM remain crucial for the development of Vietnam's construction industry.

Acknowledgement

Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

Study conception and design: *Ta Van Phan, Nguyen Minh Ngoc;* **Data collection:** *Mai Vu, Nguyen Van Viet;* **Analysis and interpretation of results:** *Pham Van Duong, Ta Van Phan, Nguyen Minh Ngoc;* **Draft manuscript preparation:** *Pham Van Duong, Ta Van Phan.*

References

[1]   ISO 19650-1; *Organization and Digitization of Information about Buildings and Civil Engineering Works, Including Building Information Modelling (BIM)-Information Management Using Building Information Modelling.* BSI: London, UK, 2018; Volume 1, pp. 1–34. Available online: https://www.iso.org/standard/68078.html (accessed on 18 October 2022).

[2]   Peniel Ang Soon Ern, Yong Yee Ooi, Yasser Yahya Al-Ashmori (2020). Comparative Study on the Perspective towards the Benefits and Hindrances of Implementing Building Information Modelling (BIM). *International Journal Of Sustainable Construction Engineering And Technology*, 11 (1), 194-205. https://doi.org/10.30880/ijscet.2020.11.01.019.

[3]   Nguyen Minh Ngoc, Nguyen Anh Dung, Tran Duy Hung, Tran Ngoc Thang (2024). Challenges of BIM Technology and Lean Theory in the Construction Industry in Vietnam. Engineering, *Technology & Applied Science Research*, 14 (5), 17548-17554. https://doi.org/10.48084/etasr.7810.

[4]   Nguyen Minh Ngoc (2019). BIM solution for design, construction and management in drainage and water supply of building. *Science Journal of Architecture and Construction*, 35, 58-63 (hard copy).

[5]   Hamma-adama, M.; Kouider, T. Comparative Analysis of BIM Adoption Efforts by Developed Countries as Precedent for New Adopter Countries. Curr. J. Appl. Sci. Technol. 2019, 36, 1–15.

[6]   Georgiadou, M.C (2019). An Overview of Benefits and Challenges of Building Information Modelling (BIM) Adoption in UK Residential Projects. *Constr. Innov.*, 19, 298–320. https://doi.org/10.1108/CI-04-2017-0030.

[7]   Bhatti, I.A.; Abdullah, A.H.; Nagapan, S.; Bhatti, N.B.; Sohu, S.; Jhatial, A.A (2018). Implementation of Building Information Modeling (BIM) in Pakistan Construction Industry. *Eng. Technol. Appl. Sci. Res.*, 8, 3199–3202. https://doi.org/10.48084/etasr.2145.

[8]   Nguyen Minh Ngoc, Tran Thanh Son (2019). Advantages, difficulties and challenges of applying BIM in the design and construction of water supply and drainage system for high buildings in Vietnam. *Proceedings of 2nd International Conference: BIM in Construction & Architecture*, Russia, 12–18. http://dx.doi.org/10.23968/BIMAC.2019.002

[9]   Minister of Construction (March 21, 2017). Decision 203/QD-BXD on the establishment of the Steering Committee for the implementation of the Project on applying Building Information Modeling (BIM) in construction activities and construction management and operation. https://moc.gov.vn/vn/tin-tuc/1176/20995/thanh-lap-ban-chi-dao-thuc-hien-de-an-ap-dung-mo-hinh-thong-tin-cong-trinh-bim.aspx

[10]   Institute of Construction Economics (06/09/2023). Institute of Construction Economics and Autodesk cooperate in digital transformation and Bim application in the construction industry in Vietnam. Retrieved September 06, 2020, from https://moc.gov.vn/tl/tin-tuc/77583/vien-kinh-te-xay-dung-va-autodesk-hop-tac-chuyen-doi-so-va-ung-dung-bim-trong-nganh-xay-dung-tai-viet-nam.aspx

[11]   Ministry of Construction (July 10, 2018). Vietnam, UK cooperate in building information model development. Retrieved July 10, 2018, from https://moc.gov.vn/vn/tin-tuc/1274/46092/vietnam--uk-cooperate-in-building-information-model-development.aspx

[12]   Greends (2024). *BIM Competition 2024.* https://greends.com.vn/archicad-bim-competition-2022/

[13]   Nguyen Tuan Anh (2023). The efficacy of Building Information Model (BIM) in small and medium-sized construction projects in Vietnam. *Journal Of Materials & Construction*, 13 (01), 67-76.

[14]   National BIM Steering Committee (2017). *Information on using BIM in projects*. Ministry of Construction. https://bim.gov.vn/

[15]   The-Quan Nguyen, Dinh-Phong Nguyen (2021). Barriers in BIM Adoption and the Legal Considerations in Vietnam. *International Journal Of Sustainable Construction Engineering And Technology*, 12 (1), 283-295. https://doi.org/10.30880/ijscet.2021.12.01.027.

Int. J. of Sustainable Construction Engineering and Tech. Vol. 15 No. 4 (2024) p. 176-187

187

[16]   The national assembly (2023). Law on Bidding of Vietnam, no. 22/2023/Qh15. https://datafiles.chinhphu.vn/cpp/files/vbpq/2023/11/22-qh-15.signed.pdf

[17]   Nguyen Quoc Toan (2021). Applying BIM in construction safety management. *Journal of Construction*, 02, 46-49. https://vjol.info.vn/index.php/tcxd/article/download/57484/47982/

[18]   Tran Anh Tuan and Tran Tuan Kiet (2020). Assessing the overall awareness of using building information modelling (BIM) in construction industry in Lam Dong. *Yersin Journal of Science*, 18, 51-60. https://vjol.info.vn/index.php/YERSIN/article/view/62080

[19]   Burcin, B. G. and Samara, R (2010) The perceived value of building information modeling in the U.S building industries. *Journal of Information Technology in Construction*, 15, 185-201. https://www.itcon.org/papers/2010_15.content.02423.pdf

[20]   Salih S. (2012). *The Impact of BIM/VDC on ROI; Developing a Financial Model for Savings and ROI Calculation of Construction Projects*. Master of Science Thesis. KTH Royal Institute of Technology. Stockholm, 2012. 59 p. https://www.diva-portal.org/smash/get/diva2:546660/FULLTEXT01.pdf

[21]   Dodge Construction Network (2018). *The Business Value of BIM for Water Projects*. Smart market Report, 48 pages. https://www.construction.com/resource/business-value-bim-water-projects/

[22]   Nguyen Pham Quang Tu, Nguyen Quoc Bao (2024). Reality and trends of BIM application. *Journal of Construction*, 04, 16-21. https://tapchixaydung.vn/thuc-trang-va-xu-huong-ap-dung-bim-20201224000016997.html

[23]   Dao Huy Hoang (2022). Investigate and survey the preparation and management of estimates according to conventional methods in civil and industrial projects in Vietnam today. Propose a process to guide the application of building information modeling - BIM in the preparation and management of estimates. Summary report on economic non-business projects, Ministry of Construction, Vietnam (hardcopy) .

[24]   Nguyen Quoc Hau, Ngo Van Thuc, Nguyen Thi Kim Chi (2023). The current status of human resource in the field of construction and architecture in Vinh Long province - opportunity and challenge. Journal of construction, 3 (2023), 128-130. https://sti.vista.gov.vn/tw/Lists/TaiLieuKHCN/Attachments/352532/CVv21S32023128.pdf

[25]   Ministry of Information and Communications (2021). Report: Building an e-government development strategy towards digital government for the period 2021-2025, with a vision to 2030. Pages 85, Hanoi (2021). https://chinhphu.vn/?pageid=27160&docid=203403&tagid=6&type=1

[26]   Decision No. 505/QD-TTg (April 22, 2022) of the Prime Minister: Regarding National Digital Transformation Day (2022). Retrieved April 22, 2022, from https://vanban.chinhphu.vn/?pageid=27160&docid=205662

[27]   Riccardo Corrado, Meta Soy, Vichera Heang (2023). BIM and IFC: Awareness and Self-assessed knowledge from the perspective of Cambodian university students. *Ain Shams Engineering Journal*, 14 (2),101851. https://doi.org/10.1016/j.asej.2022.101851.

[28]   S. Azhar, M. Hein, B. Sketo (2013), Building information modeling (BIM): Benefits, risks and challenges for the AEC industry, *Leadership and Management in Engineering*, 11(3), 241-252. https://doi.org/10.1061/(ASCE)LM.1943-5630.0000127

[29]   Duy Khanh Ha, Trung Hieu Huynh (2020). Process of BIM application in the pre-construction phase for industrial building projects in Ho Chi Minh city. *Vietnam Journal of Science, Technology and Engineering*, 62 (8), 30-34. https://b.vjst.vn/index.php/ban_b/article/view/855

[30]   Yuting Lia and Mingxia Jing (2019). Application research of BIM technology in water supply and drainage engineering. *OP Conf. Series: Journal of Physics: Conf. Series,* 1168 (2019) 022045. https://doi.org/10.1088/1742-6596/1168/2/022045.

[31]   Aliah N. Nasuha, Rahimi A. Rahman, Ahmad Tarmizi Haron (2023). Design Coordination in BIM: Clash Resolution Process and Affecting Factors. *AIP Conference Proceedings* 2688, 030018. http://dx.doi.org/10.1063/5.0111616.

[32]   Rania Mohsen Aziz, Tark Ibrahim Nasreldin and Omnia Mamdouh Hashem (2024). The role of BIM as a lean tool in design phase. *Journal of Engineering and Applied Science*, 71:23. https://doi.org/10.1186/s44147-023-00340-3.