ICCEPM 2024 https://dx.doi.org/10.6106/ICCEPM.2024.1129
The 10th International Conference on Construction Engineering and Project Management
Jul. 29-Aug.1, 2024, Sapporo

Identifying barriers of BIM implementation in ODA projects in Vietnam

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Abstract: Official Development Assistance (ODA) is widely known as an essential source for socio-economics of development of developing countries, especially in the infrastructure sector. Since 2023, the use of BIM is regarded as a mandatory task for public-funded projects including ODA projects in Vietnam. However, ODA projects require a coordination in project management and implementation between the lenders and the borrowers which are different in BIM standards and/or guidelines. This obviously causes barriers for the implementation of ODA projects. This study aims to deal with the problem by identifying key barriers for BIM implementation in Japan ODA projects in Vietnam. To serve the purpose, data from non-BIM ODA projects is firstly analysed to identify problems that can be handled by BIM. Next, problems obtained from BIM-applied projects were considered to identify needed aspects for BIM application in ODA projects in Vietnam. Finally, the incompatibility between Vietnam's BIM guidelines and related regulations is investigated to identify barriers to BIM implementation in ODA projects in Vietnam. Findings showed that the key barriers include problems related to BIM content, stages of applying BIM to project, BIM cost, BIM guidance documents, and the capability of executing agencies.

Key words: ODA project, BIM, Vietnam's BIM guideline

1. INTRODUCTION

Official Development Assistance (ODA) significantly influences and plays an important part in the growth of developing countries' economies, including Vietnam [1]. In particular, infrastructure is the driving force for economic growth, so it is the sector that receives the most significant proportion of ODA in Vietnam [2]. ODA capital provides a solution to the limited budget of the local government and the need for advanced technology when developing infrastructure.

In accordance with the booming of information technology, Building Information Modelling (BIM) is becoming a global trend with the benefits it brings to the construction industry [3]. The application of BIM was not only observed in developed countries, such as the UK, the US and Singapore [4], but also in developing countries including Vietnam. According to Decision No. 258/QD-TTg "Approving roadmap for applying building information model (BIM) in construction" dated March 17, 2023, Vietnam has enforced policies on application of BIM in the public-funded projects in construction sector. Considered as public projects, ODA projects are required to apply BIM in Vietnam.

However, the application of BIM in different countries has many differences related to guidelines, processes, technology, and human resources to implement and manage project information [5]. This issue is obviously a barrier to BIM application in ODA projects because ODA projects involve

coordination between the lending country and the borrowing country as well as the coordination between local implementing units and international contractors in project implementation.

In a few studies considering problem of BIM application in ODA projects, there is a study of Japan International Cooperation Agency (JICA) conducting a survey to collect data on BIM for ODA projects. The study team conducted a survey about the situation of BIM implementation in Japan, Singapore, Taiwan, the Philippines, and Indonesia. They surveyed several ODA projects that have BIM application to identify effects and issues of the introduction of BIM/CIM, based on that a BIM/CIM utilization handbook is established [6]. However, the BIM capacity survey only focuses on organizations, companies (in Singapore) and units participating in ODA projects (the Philippines and Indonesia). In addition, the local context of the borrowers has not been considered in the study.

This study aims to identify key barriers of BIM implementation in Japanese ODA projects in Vietnam. To serve this purpose, data from non-BIM ODA projects is first analysed to identify problems that can be handled by BIM. Next, problems obtained from BIM-applied projects were considered to identify needed aspects for BIM application in ODA projects in Vietnam. Finally, the incompatibility between Vietnam's BIM guidelines and related regulations is investigated to identify key barriers to BIM implementation in ODA projects in Vietnam.

2. METHODOLOGY

To serve the purpose of this study, data obtained from post-project evaluation reports of non-BIM ODA projects and BIM-applied projects in Vietnam was used for analyses. First, data of non-BIM ODA projects was considered to identify problems that can be handled by BIM as well as related barriers. The outcome of the non-BIM ODA project analyses will be combined with the outcome of the non-ODA BIM-applied project analyses to identify aspects that require BIM application in ODA projects. Finally, an examination on the incompatibility between the BIM-required aspects and Vietnam's guidelines and regulations to identify barriers of BIM implementation in ODA projects in Vietnam. The research framework is presented in Figure 1

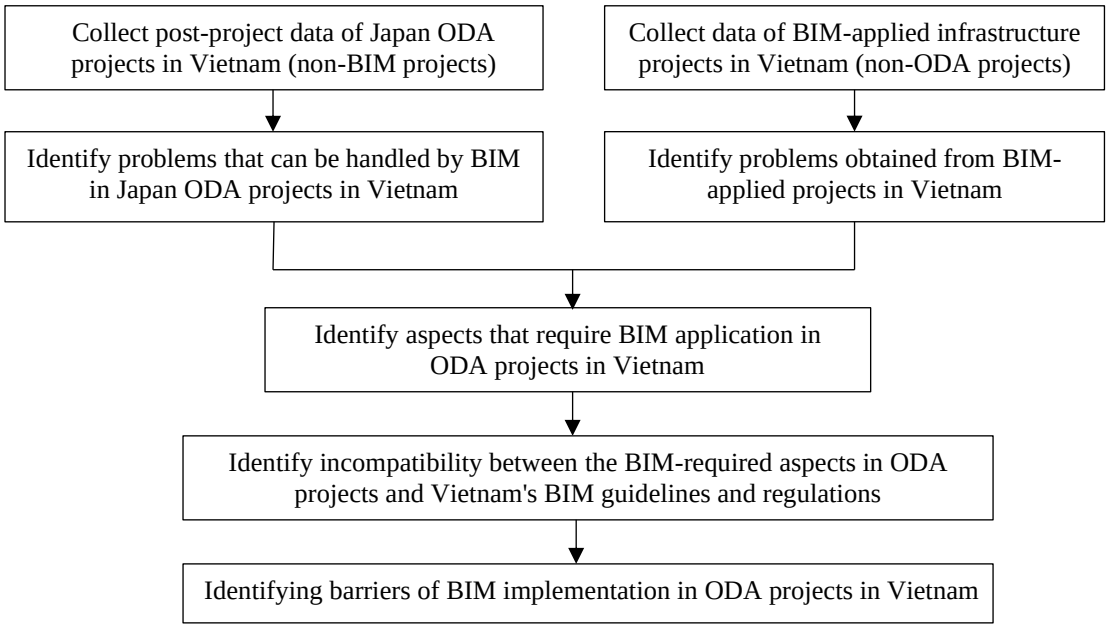

Figure 1. Research Framework

3. IDENTIFY PROBLEMS THAT CAN BE HANDLED BY BIM IN JAPAN ODA PROJECT PROBLEMS IN VIETNAM

Data of 20 Japan ODA projects in Vietnam was obtained from their post evaluation reports [7]. Problems contributing to schedule delays and/or cost overrun of each of the projects are summarized in phases of project implementation. Details of the problems are presented in Tables 1 and 2.

Table 1 shows that majority of the projects (17 per 20 projects) had problems with schedule delays but few of them (3 out of 20) had cost overrun. It should be noted that the reason explaining to the few projects having cost overrun while many suffering from delays is the variation of foreign exchange rates. In addition, the problems contributing to delays and/or cost overrun occur mainly in phases of project preparation and implementation, not in project operation and maintenance. In particular, during project implementation, 10 of 20 projects encountered problems in the preparation phase and 12 of 20 projects encountered problems in design, bidding and construction activities during the implementation phase.

In addition, based on benefits of BIM that are clarified in previous studies, further consideration was implemented to identify problems that can be handled by BIM. Details of the problems are summarized in Table 2.

Table 1. Problems contributing to schedule delays and/or cost overrun appeared in the investigated Japan ODA projects in Vietnam

No	Project name (non-BIM project)	Behind Schedule	Cost Overrun	Project Preparation	Project Implementation		
					Design	Bidding	Construction
1	Nhat Tan Bridge (Vietnam-Japan Friendship Bridge) Construction Project			✓	✓	✓	
2	Noi Bai International Airport to Nhat Tan Bridge Connecting Road Construction Project			✓	✓		
3	Red River Bridge Construction Project	✓		✓			
4	Hanoi City Ring Road No.3 Construction Project	✓				✓	
5	New National Highway No.3 and Regional Road Network Project		✓	✓		✓	
6	Saigon East-West Highway Construction Project	✓	✓	✓	✓	✓	✓
7	Third National Highway No.1 Bridge Rehabilitation Project	✓	✓	✓	✓	✓	✓
8	Transport Sector Loan for National Road Network Improvement	✓		✓	✓		✓
9	Bai Chay Bridge Construction Project	✓		✓	✓	✓	✓
10	Hai Van Tunnel Construction Project	✓					✓
11	Cuu Long (Can Tho) Bridge Construction Project	✓					✓
12	Binh Bridge Construction Project	✓				✓	
13	National Highway No. 10 Improvement Project	✓					✓
14	National Highway No.18 Improvement Project	✓		✓	✓	✓	✓
15	Terminal 2 Construction Project in Noi Bai International Airport	✓					
16	Cai Mep-Thi Vai International Port Construction Project	✓			✓	✓	✓
17	Tan Son Nhat International Airport Terminal Construction	✓			✓		
18	Haiphong Port Rehabilitation Project	✓			✓	✓	✓
19	Da Nang Port Improvement Project	✓		✓	✓	✓	✓
20	Cai Lan Port Expansion Project	✓			✓	✓	✓
	Number of projects	**17/20**	**3/20**	**10/20**	**12/20**	**12/20**	**12/20**

As can be seen from Table 2, in the preparation phase, there were 6 problems obtained from the investigated projects, mainly related to land acquisition and resettlement activities. Among them, problems No. 3, 4, 6 (see Table 2) are proposed to be handled by BIM. These problems can be solved by existing condition modelling combined with Geographical Information System (GIS). Moreover,

BIM and GIS integration for infrastructure in this phase has potential benefits in improving the quality of planning and design work [8], ensuring reliability of feasibility studies as well as determining the volume of land acquisition quickly and accurately.

Table 2. Details of problems appeared in 20 Japan ODA projects in Vietnam

Phases	Activity	Problems	Project No.
Project Preparation	The land acquisition & resettlement	1. Resident's non-cooperation	(1), (2), (5), (14)
		2. Delays in administrative procedures	(3), (6), (8), (19)
		3. The less reliable feasibility study report*	(7)
		4. Time-consuming for the asset inventories*	(1), (2)
		5. Time-consuming removal of existing facilities	(1), (2)
		6. Redesign requires additional land acquisition*	(9)
Project Implementation	Design	7.Changes in plan/scope*	(2), (6), (14), (17), (18), (19)
		8.The revision of regulations and standards	(16)
		9.The change in structure*	(1), (8), (16)
		10.The change in construction method*	(1), (6), (7), (8), (17), (20)
		11.Technical capacity of local consultants	(8), (9), (19)
	Bidding	12.Rules and procedures	(1), (12), (9), (19)
		13.The tender failed	(4), (5), (7), (16)
		14.Delay in approving the bid evaluation*	(14), (18), (20)
		15.Contract negotiation time is extended*	(6)
	Construction Implementation	16. Volume arising *	(6), (13), (14), (18), (20)
		17. Delay in identifying the causes and repair work*	(6)
		18. Technical problems*	(9), (10), (11), (16)
		19. Approval for changing construction methods*	(14)
		20. Capacity of local contractors	(7), (8), (10), (13), (19)
		21. Delay in progress of construction (Multi - tiered structure includes contractors and subcontractors) *	(20)

*Note: * problems that can be handled by BIM*

In the implementation phase, of the design step, problems no. 7, 9 and 10 can be handled by BIM. This is because that BIM application in detailed design will bring benefits in improving design quality, supporting design-related decision making, analysing and detecting conflicts, and reducing the need for modifications by designers due to perceive project details through modelling [9]. In addition, of the bidding step, problems no. 14, 15 are reasonable for BIM because BIM provides a strong database of model information and product specifications. This improves and speeds up the process of evaluating bids, and is able to respond quickly to design changes (if any) [10]. Finally, of the construction step, problems 16, 17, 19, 21 can be handled by BIM. In particular, BIM application contributes to a better understanding of construction details through stimulation and/or visualization models as well as clear sequence of construction activities and/or elimination of errors. It can further support the decision making process through functions of estimating, coordinating and planning during the construction process [11].

In addition, Figure 2 showed that BIM application cannot handle all existing problems in projects No. 3, 4, 5, 12 and 15. There are 6 out of 20 projects that BIM can handle 50% of the problems, 3 out of 20 projects that BIM can handle more than a half of the problems, and only 4 out of 20 projects that BIM can handle all of the problems. This implies that BIM can not solve all the existing problems.

Table 3 presents the percentage of problems that BIM can handle according to the content of the BIM application for each of the project phases. Among the 20 projects listed at Table 2, there are five projects encounted problems in all phases included project preparation, detailed design and construction. Therefore, the percentage of problems that BIM can handle according to the BIM application content for each the project phases is considered for these five projects. According to Table 3, on one hand, if BIM is used for project preparation and detailed design and bidding, it can only handle at max of 50%

of the project problems. If BIM is used for project preparation, detailed design, bidding and construction, it can handle up to 83% of project issues. This suggested that the full benefits of BIM cannot be obtained if it is restricted to 3D models in design phase. This further insists that BIM application in all project stages might be needed.

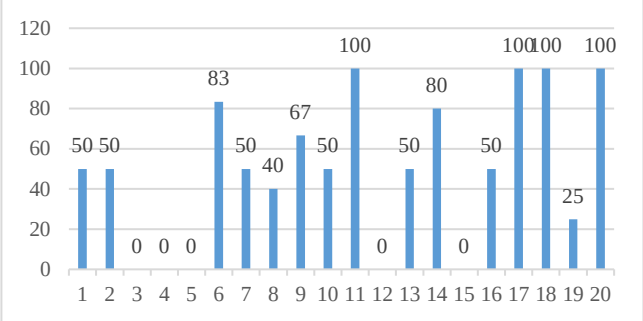

Figure 2. Percentage of problems that BIM can handle in each of the investigated projects

Table 3. Percentage of problems that can be handled by BIM

No	Stages of BIM adoption	
	Design	Design and Construction
6	50% (3/6)	83% (5/6)
7	50% (2/4)	50% (2/4)
9	25% (1/4)	50% (2/4)
14	40% (2/5)	80% (4/5)
19	20% (1/5)	20% (1/5)

Notably, ODA projects are usually for sea ports, roads, bridges, rails, airports and other infrastructures. And these projects usually have long operation and maintenance phase with huge related costs [12]. BIM benefits for these projects are mainly in the operation stage. As such, BIM applications to ODA projects requires a careful consideration of the operation phase.

In addition, all 20 projects listed in Table 2 are implemented in the form of Design - Bidding - Construction. In this form, the owner has two contracts: one with the design consultant and one with the contractor [13]. This can cause conflicts in BIM applications between parties. This form also requires the owner's high BIM capacity to control contracts with consultants and contractors.

4. IDENTIFY PROBLEMS OBTAINED FROM BIM-APPLIED PROJECTS IN VIETNAM

This section identifies problems obtained from BIM-applied infrastructure projects in Vietnam. The investigated projects are presented in Table 4. It is unfortunate that they are non-ODA projects.

Table 4. A summary of BIM-applied infrastructure projects in Vietnam (non-ODA projects)

Project name	BIM adoption stage	BIM applications	Problems
Thu Thiem 2 Bridge [14]	Engineering Design	3D Model; Conflict analysis; Establish overall schedule and construction costs according to schedule - 5D	Problems in the model
Construction of passenger terminal T2-Phu Bai International Airport	Basic Design	Modelling for Architectural, Structural and MEP departments with LOD200 level; Detect problems early in Basic Design phase	Problems in policy mechanisms, implementation costs, documentation
Cua Dai Bridge	Design - Construction	Design Phase: Existing Condition Modelling; Modelling from design data; Simulate the overall project construction plan. Construction Phase: Check construction technical drawings; Establish construction schedule based on the model; Site Utilization Planning; As-built model	Problems in policy mechanisms, implementation costs, CDE, software

Table 4 showed that the BIM application in the investigated projects was mainly with 3D models. The application is intermittently at certain stages. Because the application is not systematic, it is impossible to measure the BIM benefits of these projects. According to these projects' documents, only qualitative assessments of BIM benefits were provided. In sum, it is generally noted that the BIM benefits are unclear although the project costs are actually increased due to additional costs of BIM. In particular,

there are existing problems related to policy mechanisms, differences in BIM capacity of the project stakeholders, the immature BIM guidelines (Phu Bai and Cua Dai projects) and the mismatch between BIM guidelines of Finland and the practice of Vietnam (Thu Thiem 2 Bridge).

5. ASPECTS THAT REQUIRED BIM IN JAPAN ODA PROJECTS IN VIETNAM

Recommends aspects for BIM implementation in ODA projects in Vietnam were identified based on the analyses results of non-BIM ODA projects and BIM-applied projects in Vietnam. They are as the followings.

(1) Aspect related to the content and stages of applying BIM to projects: To clarify the benefits of BIM in ODA projects in phases, especially in the operation phase.
(2) Aspect related to BIM costs**:** BIM costs need to be determined during the project preparation phase and included in the Feasibility Study as a basis for the loan request. In addition, at the bidding stage, BIM costs need to be determined in the bidding package price and serve as a basis for evaluating BIM costs in the bids of consultants and contractors. Therefore, there is an urgent need to have detailed regulations and guiding documents for determining BIM costs when implementing projects in Vietnam.
(3) Aspect related to BIM guidance documents**:** There needs to have detailed guidelines on applying BIM to infrastructure projects. These guidelines should be consistent with the local practice.
(4) Aspect related to the executing agency capacity: During the project implementation, Vietnam agencies are responsible for the project implementation phase. JICA is responsible for supervision tasks. Therefore, it is necessary to consider the BIM capacity of related stakeholders in ODA projects.

6. IDENTIFY INCOMPATIBILITY BETWEEN ASPECTS OF BIM IN ODA PROJECTS AND VIETNAM'S BIM GUIDELINES AND REGULATIONS

Corresponding to the aspects recommended in section 5, the section considers the existing BIM guidelines and regulations in Vietnam to identify barriers for BIM application in Japan ODA projects in Viet Nam. The incompatibilities between BIM-applied ODA project aspects and the Vietnam's BIM guidelines and regulations are identified and presented in Figure 4.

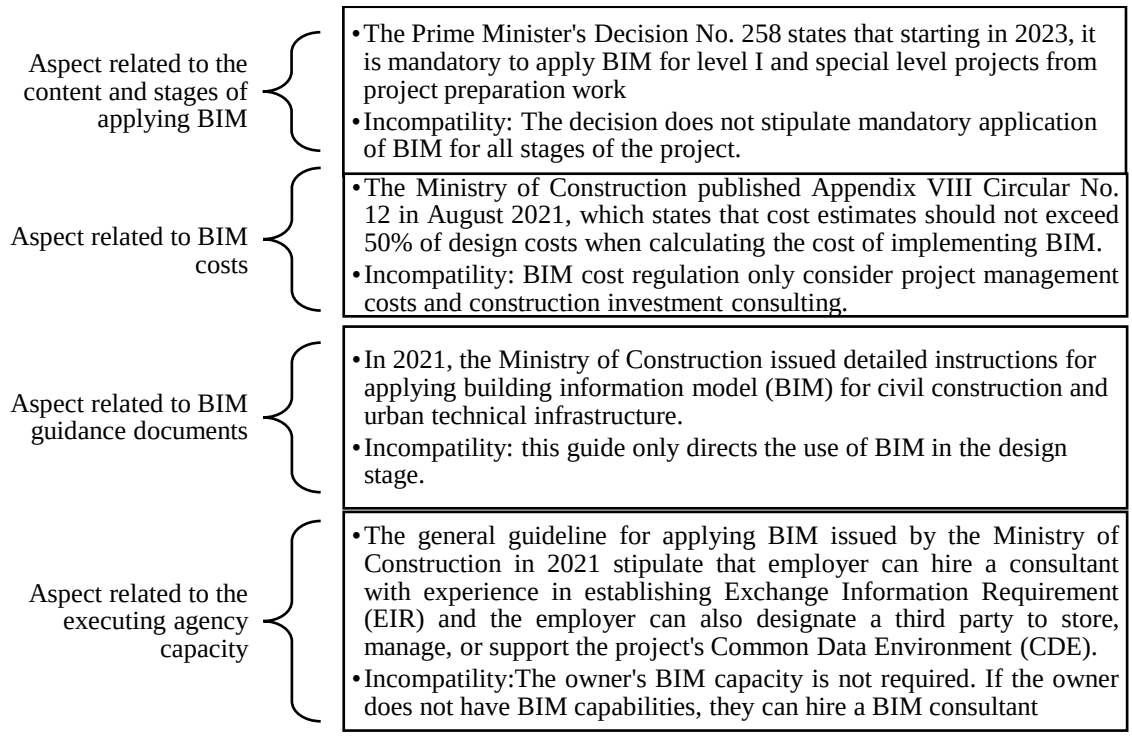

Figure 4. Incompatibilities between BIM-applied ODA project aspects and Vietnam's BIM guidelines and regulations

7. IDENTIFYING BARRIERS OF BIM IMPLEMENTATION IN ODA PROJECTS IN VIETNAM

Based on the incompatibility identified in section 6, the section identifies key barriers in applying BIM to Japan ODA projects. These barriers are as the followings.

(1) The content and stages of applying BIM to projects

It should be noted that most of employers and stakeholders are usually not interested in using BIM due to lack of capacity and hesitation to invest in a new technology, even when traditional methods are ineffective [15]. Therefore, mandatory BIM adoption policies are needed to promote BIM adoption. As analyzed in section 6, the related regulations in Vietnam only require BIM application from the preparation stage but do not stipulate the minimum content required to apply BIM for a project. This implies that projects only need to create a 3D model of the current state of the project or a basic design to meet the mandatory requirements for applying BIM to the project. This is not compatible with the goal of applying BIM in ODA projects that is to serve the operation phase. In addition, the infrastructure projects in Vietnam only focus on 3D modeling. None of them applied BIM throughout all project stages. The capacity of project owner in BIM-applied project management will become a key barrier for the BIM implementation.

(2) BIM costs

Regulations on BIM cost in Vietnam only consider project management costs and construction investment consulting. There are no BIM costs for other parties such as contractors and employers. In addition, this regulation does not apply to cases when BIM is applied in both construction and operation phases. In addition, according to the regulated cost specified in Appendix VIII Circular No. 12 in August 2021, the BIM costs are significantly lower than the possible actual costs of foreign contractors. This is obviously a barrier in selecting contractors and/or in negotiating project contracts between Vietnamese the executing agencies and foreign contractors.

(3) BIM guidance documents

The existing Vietnam BIM guidelines only provide guidance for the design stage. If BIM is applied to other project phases, it is required to refer to international BIM guidelines, thus causing difficulties in BIM implementation. In addition, according to the rules for Implementation of Special Provisions in Economic Cooperation (STEP) of the Japanese ODA Loan, Part 5 of the Conditions for Procurement of Consulting Services stipulates that the prime contractor in implementing project is a Japanese company. As such, when implementing BIM projects, Japan contractors may encounter difficulties in following Vietnam's BIM guidelines (in establishing EIR-Exchange Information Requirement, BEP-BIM executing Plan, MIDP-Master Information Delivery Plan, TIDP-Task Information Delivery Plan).

(4) The executing agency capacity

The existing Vietnam BIM guidelines encourage project owners to develop an overall EIR for the entire project if there are bidding packages applying individual BIM. In particular, the owners are allowed to organize or hire a consulting unit with experience in preparing EIR. However, in the actual practice of Vietnam, all of BIM-applied projects in Vietnam hire BIM consultants to set up EIR, thus the owners' BIM capacity is not required. Similarly, in case of CDE establishment, there is a third party to store, manage, or support the project's CDE. Therefore, the owners' capacity in BIM management and coordination with foreign contractors can be a major barrier, affecting the implementation of ODA projects in Vietnam.

8. CONCLUSION

This study can be considered as the first effort considering barriers for BIM application in ODA projects in Vietnam. Findings of this study showed two important notes. First, of the Vietnam perspective, the main barrier is to achieve a consensus that the goal of applying BIM of ODA projects is to serve the operation phase. Other key barriers for them are the project owners' BIM capacity, the issues of BIM costs, and the BIM guidelines applied to the entire project. Second, of the Japan

perspective, Japan contractors are facing problems related to BIM costs as well as the difficulties in following Vietnam BIM guidelines.

From the identified barriers, the study suggessted that there needs to be a change in the delivery information method of ODA projects. Methods such as the Design-Build or Construction Manager at Risk can be considered as an alternative to the Design-Bid-Build. The value of these methods is early collaboration between the contractor and design team during the design phase. ODA projects will be more feasible in applying BIM from design to construction and building a data system to serve BIM applications during the operation phase of the project. The feasibility, barriers, and benefits of these forms of implementing ODA projects in Vietnam can be considered in subsequent studies

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