Barriers to implementing Common Data Environment (CDE) in the construction phase of BIM-based projects

Vendie Abma[1*], Aulia Rahma Nastiti[2,3], Fina Ramadhani [4]
[1,4] Department of Civil Engineering, Faculty of Civil Engineering and Planning, Universitas Islam Indonesia, Indonesia
[2] Bartlett School of Architecture, University College London, London, United Kingdom
[3] PT. Cakra Manggilingan, Jakarta, Indonesia

Article Info
***Article history*:**
Received:
November 14, 2024
Revised:
May 15, 2025
Accepted:
May 23, 2025
Available online:
June 12, 2025

***Keywords*:**
Common Data Environment
CDE
BIM
Construction phase
Barriers

Abstract
Implementing Building Information Modeling (BIM) has generally been proven to change how construction projects are managed and bring long-term efficiency, cost, and quality benefits. The Common Data Environment (CDE) platform is instrumental in fostering collaboration and coordination in implementing BIM. This study aims to examine the barriers to integrating the CDE in BIM-based construction management during the execution phase of construction projects. To achieve this goal, a survey questionnaire was created to collect feedback on engagement, the main barriers identified through comprehensive literature insights. Primary data was collected from the questionnaire in this project case study, and 14 respondents were directly involved in the project and had access to CDE. The final results show that the main barriers involved are the habits of the conventional system that exists in the company (the company's organizational culture). To effect a transformation toward sustainable buildings within the context of a digital construction culture, it is imperative that there be an increased emphasis on encouraging the adoption of this new paradigm. The results of this study will prove to be of the utmost importance for professionals in the construction industry, particularly those in Indonesia, who are in the process of adopting BIM.

Corresponding Author:
Corresponding Author's
Vendie Abma
vendie.abma@uii.ac.id

Introduction

It is expected that technological developments in the construction industry will enhance the quality of life sustainably, both in the present and in the future. The utilisation of digital transformation represents a key strategy for the realisation of sustainable construction development (Putra & Puri, 2024). Implementing Building Information Modelling (BIM) is an integral component of the broader adoption of digital transformation in the construction industry. BIM has been demonstrated to be an effective method for the reduction of adverse impacts on deliverables and data exchange within the construction industry (Chan et al., 2019; Wong & Gray, 2019). The utilisation of BIM also facilitates the integration of structural, architectural, and MEP work (Yudi et al., 2024), thereby establishing BIM as a pivotal factor in construction management. It offers a proficient approach for design and documentation while enhancing communication and collaboration (Hyarat et al., 2022).

The Indonesian government has initiated the adoption of BIM in the country's construction industry, recognising the potential benefits (Raflis et al., 2019). Furthermore, the Ministry of Public Works and Housing (PUPR) has issued guidelines for adopting BIM in 2018 (Sopaheluwakan & Adi, 2020; Utomo & Rohman, 2019). However, BIM implementation is still progressing slowly in terms of supporting its development and adoption (Puspita & Patriotika, 2021). In general, the implementation of BIM in construction projects still requires support from several key stakeholders, including the government (Zhafirah et al., 2023), academia (Maharika et al., 2020), construction companies (Ismail et al., 2022; Kiet et al., 2023), and senior managers (Oyarhossein et al., 2021). This issue is further compounded by the dearth of knowledge surrounding BIM implementation (Gustian et al., 2022), which can give rise to complications in communication and the potential loss of data, ultimately leading to underperformance in a project (Ozkan, 2021).

Effective communication facilitates fulfilling specific needs that are mutually acceptable to the parties involved. (Turakulovna et al., 2024). One of the strategies for enhancing communication and collaboration in the context of BIM implementation is the utilisation of a CDE (Radl & Kaiser, 2019). The CDE has been defined as a centralized communication network and information repository, the primary function of which is to gather, share, and manage data produced during the project lifecycle (Ozkan, 2021). Furthermore, the implementation of a CDE provides a quantifiable return on investment (ROI), including the reduction of time spent searching, validating, and accessing project information (Akob et al., 2019).

Nevertheless, only a few studies have examined and emphasized the implementation of CDE in BIM-based projects. One of the case studies of the UNU Yogyakarta project, for example, examined the implementation of a project that utilises BIM technology and adheres to the BIM protocol. The findings indicate that the project has implemented CDE by the security protocol standard (Putra & Puri, 2024). An analysis of the implementation of CDE on the project revealed that it was effectively implemented, fostering efficient coordination and collaboration (Ramadhani & Abma, 2023). A review of the case study is needed to identify and examine the barriers to CDE in BIM-based construction, as exemplified by UNU Yogyakarta.

BIM and CDE

BIM Implementation in Construction

BIM is a digital representation of the physical and functional characteristics of a facility that serves as a shared knowledge resource for information about the facility, becoming a reliable basis for decisions during the life cycle of a building (Hardin & McCool, 2015). The definition of BIM, as outlined in ISO 19650:2019, is a technology that provides a reliable basis for decision-making processes based on digital representations of the design process, from construction to operation. As stated by the PUPR (2020), the Indonesian government defines BIM as a system or technology that incorporates many crucial data points about the design, construction, and maintenance phases. Additionally, BIM seamlessly integrates within a three-dimensional modelling framework (Eynon, 2016).

The majority of contractors are aware of the positive impact that the implementation of BIM can have on environmental sustainability (Rahim et al., 2024). This indicates a promising awareness of BIM among those working in the construction sector. The implementation of BIM concepts can facilitate more effective budget planning and scheduling for contractors (Abma et al., 2024). To further advance awareness and knowledge of BIM in sustainable construction, it is perceived that more reliable information on the capabilities of BIM is required. It is therefore essential to enhance the proficiency with which contractors implement BIM and to assist them in the optimal allocation of critical resources (Kiet et al., 2023).

CDE Implementation

Following the regulations set by the Ministry of PUPR Regulation Number 9 of 2021 concerning the implementation of sustainable construction, the utilisation of BIM technology has been delineated within the context of collaboration and coordination through the CDE.

The utilisation of CDE has been demonstrated to confer several advantages concerning the sustainability of projects. The following list sets out some of the key benefits associated with the deployment of CDE (Kirby, 2022);

1. All information is collated in a single, accessible location.
2. This method minimizes the risk of errors.
3. The data is accessible anywhere and at any time.
4. It prevents data loss or incompleteness.
5. Data can be compiled for further analysis.
6. Project quality and efficiency are enhanced.

To facilitate the coordination of cooperative efforts within the CDE, it is imperative to ascertain the status of registered data objects or models following their respective planning status (Preidel et al., 2018). The CDE workflow is based on its stages, as follows:

1. *Work In Progress*
2. *Shared*
3. *Published*
4. *Archive*

The Shared segment of the CDE aims to guarantee that proposals for multidisciplinary designs and updates to models are consistently gathered and accurately communicated, and recipients are kept informed. (Shepherd, 2016). Safety considerations can be integrated into a construction project's design and life cycle in an efficient way (Manu et al., 2023).

Research Methods

A descriptive and questionnaire survey-based methodology was employed to identify and analyze the barriers encountered while using CDE in the BIM-based construction phase of projects. This applied research endeavour is poised to contribute significantly to this field's advancement. Furthermore, this study employs an exploratory approach, utilising both library-based research and field methods to gather the requisite information and data. Additionally, interviews with construction project management information systems experts were conducted to identify and confirm the implementation process and elucidate the findings.

The data in this study were collected through questionnaires from respondents who met the criteria of stakeholders or experts who were directly involved in using CDE as a means of coordination and collaboration on the UNU-Yogyakarta building project. The questionnaire survey was conducted with 14 respondents, who are all parties that have access to and are involved in the implementation of CDE.

The review of previous research found that the implementation level of BIM-based projects with CDE in this case study was 72.9%, so the barriers that influenced it can be identified. (Ramadhani & Abma, 2023). The questionnaire was developed with 15 variables that have been identified through literature review, project surveys, and interviews with relevant parties on the UNU Yogyakarta project. The objective of this questionnaire was to collect primary data on the UNU Yogyakarta project, which was then quantified using a Likert scale (Iba & Wardhana, 2024). This was done in order to ascertain the level of barriers that were perceived to be the greatest. To describe, analyse and assess the validity of the information, structured interviews with experts were conducted.

Results and Discussions

The following variables have been identified as potential barriers based on a comprehensive literature review and interviews with UNU Yogyakarta project officers. A total of 15 variables have been identified as potential barriers; however, further review is required to ascertain which of these are the most significant in the context of CDE implementation in BIM-based construction.

Table 1. Barriers in the implementation of BIM in the construction phase using CDE

Variable	Description
X1	The lack of training in the utilisation of the CDE platform
X2	The lack of co-operation between CDE platform users
X3	The lack of official documents that make references in using the CDE platform
X4	No monitoring from superiors on a regular basis
X5	Complex operational procedures
X6	Work habits of conventional system in the company (corporate organisational culture)
X7	The complexity of work is an barrier to the application of BIM in project management
X8	Managerial inconsistency in implementing BIM project management according to procedures
X9	Difficult to adjust to new technology
X10	The lack of understanding of BIM as a basis for implementation efficiency
X11	The lack of technical ability to utilise CDE during implementation
X12	The lack of supporting devices
X13	Unstable Internet connection affects access to the use of CDE
X14	The server is frequently inaccessible
X15	Limited data transfer due to system incompatibility

Subsequently, a survey was conducted using a questionnaire comprising 15 variables. The survey was completed by 14 respondents, all of whom are members of the CDE Project team and have access to and are involved in the observation, contribution, review, authorisation, and management of BIM digital data. The results of the questionnaire, which employed a Likert scale, were.

The achievement rate of the respondents (TCR) was calculated based on the results of the respondents' answers. A frequency analysis was conducted to determine the TCR value. This analysis involved calculating the Likert scale and the mean of the number of respondents' answers. The following steps were taken to calculate the TCR value.

$$TCR = (\text{Total Score})/Y \times 100\%$$

$$TCR = 52/70 \times 100\%$$

$$= 74.29\%$$

The overall results are presented in Table 2.

Table 2. Results of the questionnaire

	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	Total	Percent (%)
X1	5	2	4	4	4	4	4	4	4	4	3	4	3	3	52	**74,29%**
X2	4	2	4	4	4	2	5	4	4	3	3	3	3	3	48	68,57%
X3	5	2	5	4	4	4	4	4	4	3	3	3	3	4	52	74,29%
X4	5	2	4	4	2	2	3	4	4	3	3	3	2	2	43	61,43%
X5	4	2	4	3	4	4	3	3	4	4	3	4	2	3	47	67,14%
X6	5	2	5	4	4	4	5	4	5	3	3	4	3	4	55	**78,57%**
X7	5	2	5	4	4	2	4	4	3	4	3	3	3	3	49	70,00%

Table 2. Results of the questionnaire

	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	Total	Percent (%)
X8	5	2	3	3	4	4	4	4	5	4	2	3	2	4	49	70,00%
X9	5	2	4	3	4	2	4	3	5	3	3	4	2	2	46	65,71%
X10	5	2	5	4	4	4	3	4	4	4	3	4	2	4	52	**74,29%**
X11	5	2	4	4	4	4	3	4	4	4	3	4	2	4	51	**72,86%**
X12	3	2	4	3	2	4	4	4	5	4	4	3	1	2	45	64,29%
X13	3	2	2	3	4	4	4	4	5	3	3	3	2	4	46	65,71%
X14	2	2	2	2	2	3	3	5	3	3	3	3	2	3	38	54,29%
X15	4	2	2	4	2	4	3	4	4	4	3	3	2	2	43	61,43%

The results of the percentage level of barriers in the implementation of CDE in the implementation of BIM-based projects as a whole can be seen in Figure 1 below:

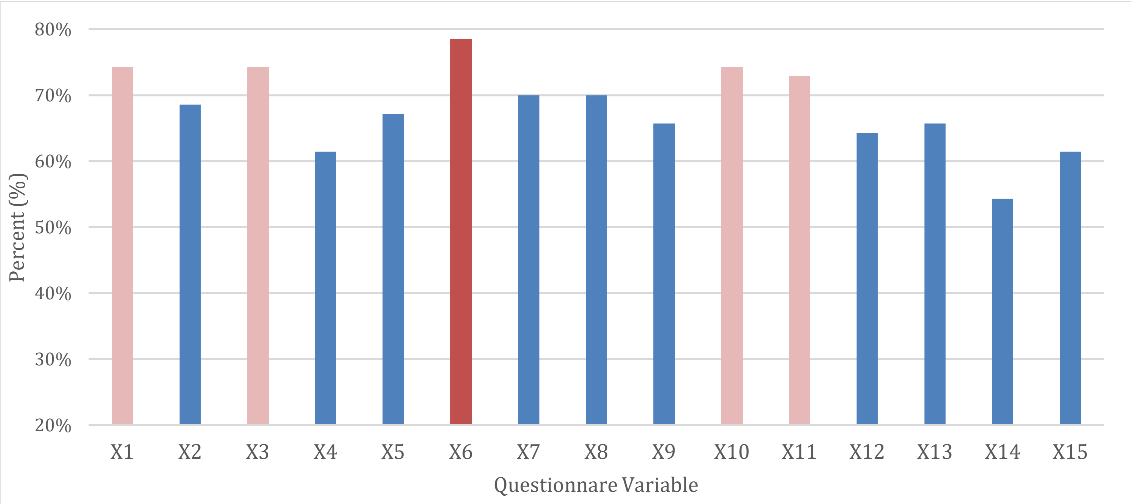

Figure 1. Level of barriers to CDE implementation

The recapitulation results of the 15 barriers identified indicate a value above 50%, which signifies that all variables act as barriers in the implementation of CDE on the UNU Yogyakarta project during the construction stage. Figure 1 illustrates the discrepancy in the outcomes of each variable, with Variable X6 exhibiting the highest percentage. This indicates that Variable X6 represents the primary barriers to implementing CDE. The variable in question pertains to the work habits of the company's traditional organisational culture.

The analysis indicates that the five highest levels of respondents' achievements in the barriers to implementing CDE are as follows.

1. The work habits of the conventional in the company (company organisational culture) – X6
2. The lack of training in the use of CDE– X1
3. The lack of official documents that refer to the use of the CDE platform – X3
4. The lack of understanding of BIM as a basis for efficient implementation – X10
5. The lack of technical ability to utilise CDE during implementation – X11

During the interviews with the project's BIM manager, it became apparent that not all information can be entered directly into CDE. A considerable amount of information is processed conventionally. However, this information will eventually be entered into CDE for administration. It cannot be entered into CDE during the coordination process because not all parties have access to the CDE platform due to limited user accounts. In addition, there are barriers where human resources find it difficult to adjust to changes in technological transformation. This results in the approval of addendums in the process, which still uses conventional methods, but later, the whole will still be entered into CDE. This finding is consistent and in line with the analysis results, which indicated that the work habits associated with the previous system in the company (corporate organisational culture) were the primary barrier variable. This requires the readiness of all personnel to change the mindset of the organisation with new technology.

The UNU Yogyakarta project has generally implemented CDE with meticulous preparation, utilizing the BIM coordination scheme through the CDE platform as illustrated in Figure 2.

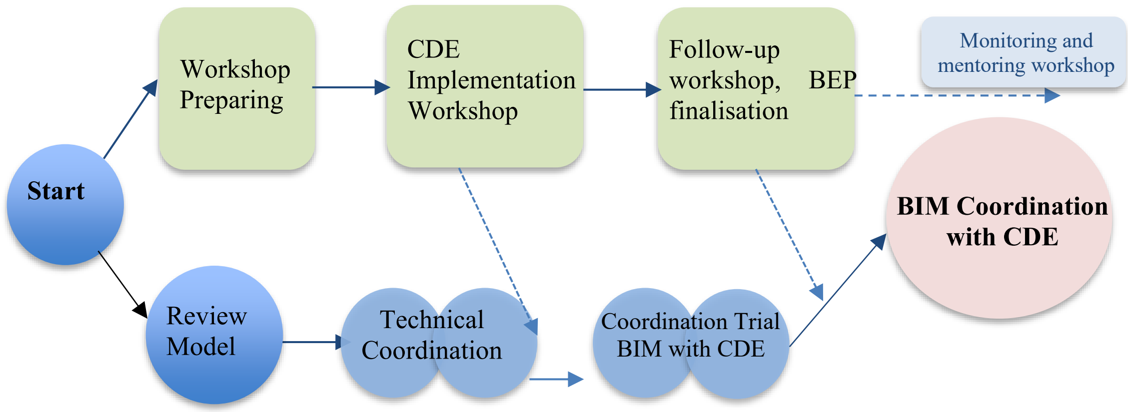

Figure 2. BIM Coordination Implementation Schematic

The framework was obtained from the construction site and implemented in BIM-based projects using CDE, which was confirmed through in-depth interviews with the UNU Yogyakarta project team. This is under the BIM implementation workflow as outlined in the PUPR BIM guide at the level of collaboration (PUPR, 2018).

Nevertheless, to surmount the five most significant barriers identified, defining a novel role for the BIM administrator within the context of construction management is essential. The BIM administrator is tasked with assuming responsibility for the management of administrative operations within the CDE (Putra & Puri, 2024). This finding is consistent with the results of the interview with the BIM Manager, who indicated that the Construction Management Consultant (MK) required an additional BIM administrator to alleviate the excessive workload of the BIM Manager, who was assigned multiple administrative responsibilities within the CDE. The interviews also revealed some overall barriers to the implementation of BIM and the use of CDE, including the need for large investments in human resources and equipment.

A comprehensive understanding of the barriers to CDE implementation in BIM-based projects is imperative to enhance project performance. The primary barriers pertain to the prevailing work habits within the company, which is a pivotal concern to encourage a transition from conventional to digital culture to ensure effective implementation. Moreover, effective implementation has been shown to enhance coordination efficiency (Ramadhani &

Abma, 2023) and optimize benefits, including enhancing time efficiency, improving project quality, fostering trust among parties, and reducing risk (Kori & Rito, 2020).

Based on the research findings, where the most significant barriers are the habit or culture in the organization, there is a need for improvement to achieve widespread implementation of BIM in the construction industry (Gustian et al., 2022). This result has been confirmed in interviews with project BIM managers, who stated that habits in the conventional system with manual methods are indeed the most significant barriers, as they are not accustomed to and not familiar with using the new BIM-based system with the CDE platform. In addition, one of the opportunities that can be done to improve implementation is through better education and training, to add experience and increase awareness of the benefits of implementation in the context of sustainable construction in the era of digital construction transformation.

Conclusions

An analysis of the 15 identified barrier variables in implementing BIM using CDE at the construction stage of the Nahdlatul Ulama University (UNU) project revealed that the most significant variable is X6, where the work habits of the conventional system in the company become barriers, with a barrier level of 78.57%. Considering these findings, it is imperative to provide greater encouragement to changing habits with the adoption of digital construction towards building sustainability.

Acknowledgement

We are grateful to the other Proyek Pembangunan Gedung Universitas Nahdlatul Ulama (UNU) Yogyakarta partners, especially PUPR, PT. PP Urban, and PT. Cakra Manggilingan Jaya, for their valuable contributions to the research data.

References

Abma, V., Farhana, A., & Rachmawati, S. (2024). Cash flow simulation planning based on building information modeling for construction projects. *AIP Conference Proceedings*, *3114*(1). https://doi.org/10.1063/5.0202242

Akob, Z., Zaidee, M., Hipni, A., & Koka, R. (2019). Coordination and Collaboration of Information for Pan Borneo Highway (Sarawak) via Common Data Environment (CDE). *IOP Conference Series: Materials Science and Engineering*, *512*(1). https://doi.org/10.1088/1757-899X/512/1/012001

Chan, D. W. M., Olawumi, T. O., & Ho, A. M. L. (2019). Perceived benefits of and barriers to Building Information Modelling (BIM) implementation in construction: The case of Hong Kong. *Journal of Building Engineering*, *25*(February), 100764. https://doi.org/10.1016/j.jobe.2019.100764

Eynon, J. (2016). *Construction Manager's BIM Handbook*.

Gustian, E., Milyardi, R., & Lesmana, C. (2022). Analysis of Benefits and Barriers Factors in the Implementation of Building Information Modeling (BIM) in Building Construction for Contractor. *Jurnal Teknik Sipil Dan Perencanaan*, *24*(2), 158–167. https://doi.org/10.15294/jtsp.v24i2.37026

Hardin, B., & McCool, D. (2015). *BIM and Construction Management*. John Wiley & Sons.

Hyarat, E., Hyarat, T., & Al Kuisi, M. (2022). Barriers to the Implementation of Building Information Modeling among Jordanian AEC Companies. *Buildings*, *12*(2). https://doi.org/10.3390/buildings12020150

Iba, Z., & Wardhana, A. (2024). *Operasionalisasi Variabel Skala Pengukuran dan Instrumen Penelitian Kuantitatif* (M. Pradana, Ed.; 1st ed.). Eureka Media Aksara. https://www.researchgate.net/publication/381613023

Ismail, N. A. A., Zulkifli, M. Z. A., Baharuddin, H. E. A., Ismail, W. N. W., & Mustapha, A. A. (2022). Challenges of Adopting Building Information Modelling (BIM) Technology amongst SME's Contractors in Malaysia. *IOP Conference Series: Earth and Environmental Science*, *1067*(1). https://doi.org/10.1088/1755-1315/1067/1/012047

Kiet, T. T., Kha, T. T., & Thuan, T. C. (2023). Analyzing problematic issues of building information modeling (BIM) implementation by contractors. *IOP Conference Series: Earth and Environmental Science*, *1226*(1). https://doi.org/10.1088/1755-1315/1226/1/012002

Kirby, M. (2022, July 18). What Is a Common Data Environment and How Is It Used In Construction? *Trimble Construction Articles*. https://constructible.trimble.com/construction-industry/what-is-a-common-data-environment-and-how-is-it-used-in-construction

Kori, M. R. P., & Rito, B. A. B. R. (2020). CDE (Common Data Environment) In Construction Projects-Evaluation of Application and Benefits in Case Studies. Sustainability in Architecture, 41–47 (in English).

Maharika, I. F., Irsan, A., Ismailiyah, S. A. A., Susanto, A., Abma, V., & Yuriandala, Y. (2020). Building Information Modelling (BIM) Adoption Model for Architectural Education. *Journal of Design and Built Environment*, *20*(3), 22–42. https://www.scopus.com

Manu, P., Gao, S., Bartolo, P. J. D. S., Francis, V., & Sawhney, A. (2023). *Handbook of Construction Safety, Health and Well-being in the Industry 4.0 Era*. https://doi.org/https://doi.org/10.1201/9781003213796

Oyarhossein, M. A., Hamid, S., Ghiasi, B., & Khiali, V. (2021). Identifying Barriers of Implementing BIM in Construction. *Technium*, *3*(6), 9–20. www.techniumscience.com

Ozkan, S. (2021). Identification of Common Data Environment Functions During Construction Phase of BIM-based Projects. *CIB W782021 Conference*, 253–262.

Preidel, C., Borrmann, A., Mattern, H., König, M., & Schapke, S. E. (2018). Common data environment. In *Building Information Modeling: Technology Foundations and Industry Practice* (pp. 279–291). Springer International Publishing. https://doi.org/10.1007/978-3-319-92862-3_15

PUPR. (2018). Module 6-Workflow and BIM Implementation at Collaboration Level in Project Monitoring Process (in English).

Puspita, N. R., & Patriotika, F. (2021). BIM Implementation in Public Construction Projects in Indonesia. *IOP Conference Series: Materials Science and Engineering*, *1156*(1), 012008. https://doi.org/10.1088/1757-899x/1156/1/012008

Putra, A., & Puri, E. (2024). Study of Implementation of BIM Protocol Standards of the Ministry of PUPR 2020 Case Study: Nahdlatul Ulama University (UNU) Building Construction Project in Yogyakarta. Civil Engineering Journal, 31(1), 61–68 (in English).

https://doi.org/10.5614/jts.2024.31.1.7

Radl, J., & Kaiser, J. (2019). Benefits of Implementation of Common Data Environment (CDE) into Construction Projects. *IOP Conference Series: Materials Science and Engineering*, *471*(2). https://doi.org/10.1088/1757-899X/471/2/022021

Raflis, R., Yuwono, B. E., & Rayshanda, R. (2019). Manfaat Penggunaan Building Information Modelling (Bim) Pada Proyek Konstruksi Sebagai Media Komunikasi Stakeholders. *Indonesian Journal of Construction Engineering and Sustainable Development (Cesd)*, *1*(2), 62. https://doi.org/10.25105/cesd.v1i2.4197

Rahim, A. N. S., Syed Zakaria, S. S. A., Ishak, N., & Ibrahim, F. A. (2024). Building Information Modeling (BIM) application towards environmental sustainability. *IOP Conference Series: Earth and Environmental Science*, *1369*(1). https://doi.org/10.1088/1755-1315/1369/1/012001

Ramadhani, F., & Abma, V. (2023). Implementasi konsep bim pada tahap pelaksanaan dengan CDE-. *Civil Engineering, Environment, Disaster, and Risk Management Symposium (CEEDRIMS)*, 269–280.

Shepherd, D. (2016). *BIM MANAGEMENT HANDBOOK*. www.ribaenterprises.com

Sopaheluwakan, M. P., & Adi, T. J. W. (2020). Adoption and implementation of building information modeling (BIM) by the government in the Indonesian construction industry. *IOP Conference Series: Materials Science and Engineering*, *930*(1). https://doi.org/10.1088/1757-899X/930/1/012020

Turakulovna, S. E., Dilsore, M., & Turabaevna, I. G. (2024). *Barriers in Communication*. https://www.researchgate.net/publication/381488440

Utomo, F. R., & Rohman, M. A. (2019). The Barrier and Driver Factors of Building Information Modelling (BIM) Adoption in Indonesia: A Preliminary Survey. In *IPTEK Journal of Proceedings Series* (Issue 5).

Wong, S. Y., & Gray, J. (2019). Barriers to implementing Building Information Modelling (BIM) in the Malaysian construction industry. *IOP Conference Series: Materials Science and Engineering*, *495*(1). https://doi.org/10.1088/1757-899X/495/1/012002

Yudi, A., Bintang Wirawan, N., Rahma, S., Evilia Miranda, A., & Apriwelni, S. (2024). Structural evaluation and analysis of existing house renovation into shophouse based on Building Information Modeling. *Teknisia*, *29*(1), 1–13.

Zhafirah, H., Oktaviani, C. Z., & Maulina, F. (2023). Identifikasi Faktor Pendukung Dan Penghambat Adopsi Bim Oleh Kontraktor Di Provinsi Aceh. *Jurnal Rekayasa Sipil (JRS-Unand)*, *19*(1), 54. https://doi.org/10.25077/jrs.19.1.54-63.2023