



Digital Issue Reporting in Model-Based Construction Projects

Downloaded from: <https://research.chalmers.se>, 2025-11-06 06:01 UTC

Citation for the original published paper (version of record):

Disney, O., Ljung, E., Roupé, M. et al (2025). Digital Issue Reporting in Model-Based Construction Projects. Lecture Notes in Civil Engineering, 2. http://dx.doi.org/10.1007/978-981-96-8765-7_7

N.B. When citing this work, cite the original published paper.

Digital Issue Reporting in Model-Based Construction Projects

Oliver Disney*, Efraim Ljung, Mattias Roupé, Mikael Johansson

Chalmers University of Technology, Sweden

*oliver.disney@chalmers.se

Abstract. Construction projects have traditionally been heavily document-based, with information exchanged through unstructured and unconnected channels, leading to fragmented and isolated data. However, this is changing with an approach known as Total BIM and the implementation of model-based construction processes, where BIM is legally binding, and construction workers create their own information. This shifts workers from merely consuming information in static documents, to creating valuable, timely data during construction. Previous research has not explored this new type of data due to the scarcity of model-based projects. Our paper addresses this gap by exploring how Total BIM can transform communication in the construction phase through digital issue reporting. Data from more than 27,000 issue reports across three projects were studied, showing considerable benefits and opportunities for creating structured data by connecting issues to BIM objects, with attached views and photos. However, our study also shows an overall lack of standardization, leading to issues frequently being mistakenly linked to wrong objects. Therefore, this paper suggests that a mindset shift is needed where the value of data created during the construction phase is understood. The Total BIM approach to issue reporting can bring us a step closer to gaining meaningful insights into the data that would not be feasible in traditional document-based projects.

Keywords: Building Information Modeling, Model-based construction, Digital construction, Information and communication technology, Issue reporting.

1 Introduction

Construction “documents” (often paper-based) have had a pivotal role in the communication and dissemination of project information among stakeholders [1]. However, as the construction industry remains one of the least digitized [2], it is challenging to manage the massive amounts of data contained in these documents. Construction documents have remained largely the same since the mid-20th century, but the way they are stored, managed, and distributed has undergone significant changes due to technological advancements [3]. In Sweden and Norway, a new digital approach to construction is emerging, Total BIM, where construction workers use model-based construction processes rather than paper-based documents [4]. Consequently, Total BIM may digitally transform communication through the use of digital issue reporting within projects and facilitate informed, data-driven decision making.

Construction projects, particularly the construction phase, are still today heavily document-based, where information is exchanged through unstructured or semi-structured channels [5]. For example,

quality inspections have traditionally been first written on paper and later transferred into Excel, Word and PDF documents, which is a time-consuming process [6]. Transferring data from paper-based documents to electronic documents is meant to create more structured data to improve their handling. However, this process typically involves replicating paper-based documents in electronic format, which may not be an optimal solution for creating the structured data that is desired [5]. Furthermore, as the construction industry transitions to more digital ways of working, the difference between unstructured and structured data becomes more of an issue [1].

BIM (Building Information Modeling) has been an important innovation for structuring and organizing information in construction projects [7]. However, design teams today work with a hybrid process to produce both drawings and BIM [4], because construction workers are used to working with information contained within drawings. These drawings are created at a set point in time [8] and whether they are digital or paper-based, they are static, meaning that the information contained within them is essentially filtered information that design teams have deemed most appropriate. As such, the data-rich BIM environment is inaccessible to those performing work on construction sites and work is performed using documents. Although BIM may exist on construction sites, it is usually only used for coordination or visualization purposes, as it cannot be trusted, since drawings are still legally binding [4]. Consequently, in document-based projects, information is usually shared through isolated and unstructured channels, such as meetings, reports, emails or phone calls [9]. This results in a fragmented data environment, where there is a lack of transparency, and it becomes difficult to reuse for learning purposes.

In a Total BIM project, construction teams not only consume information received from design teams but also generate valuable data and information, such as dynamic 3D production-oriented views, 3D sectioning, and measurements. Unlike traditional projects, which rely on multiple channels for communication, a Total BIM project integrates communication and issue reporting into the same BIM platform as construction information. Thus, the BIM platform serves as a single source of project information, replacing unconnected and unstructured documents. By actively using model-based construction processes and integrating them with advanced communication tools, a new type of structured data is created during the construction phase. Therefore, the aim of this paper is to use a mixed-methods approach to explore how digital issue reporting is used in Total BIM projects, which so far have yet to be explored due to the rarity of model-based construction projects.

2 Frame of Reference

While international standards such as ISO 19650 provide a framework for managing information in construction projects, they lack specific details for practical implementation. Efficient information management is crucial to manage projects efficiently [9], but today there is a lack of established best practices for “document” control and management, which makes efficient management of information a significant challenge and an obstacle to improving productivity [1].

In the past 10 years, Common Data Environment (CDE) tools have been used to facilitate information management workflows in construction projects and to replace Electronic Document Management Systems (EDMS) [9]. According to the international standard ISO 19650 a CDE is a single source of information for any project, used for collecting, managing, and disseminating information [10]. As Turk et al. [11] stated, a CDE is usually a cloud-based common repository for all project information. In practice, a CDE is often where stakeholders upload, store and retrieve project documents, which can be digital documents or scanned paperwork. However, the traditional implementation of CDEs often makes it challenging to find specific information and maintain traceability [9, 12]. Therefore, as the construction phase of projects remains relatively document focused, CDEs are being used as Common ‘Document’ Environments, resembling EDMS of the past.

Construction documents typically include items such as drawings, specifications, contracts, risk assessments, correspondence, requests for information (RFI), quality controls and schedules. In addition to the documented information shared in CDEs, communication between stakeholders frequently occurs through multiple channels, where information is shared in meetings, emails, and phone calls [9]. The issue with these communication channels is that they lack transparency, are unconnected, and the information exchanged is typically only accessible to those involved in the discussions.

It has been claimed that BIM has the potential to address these issues and change the way the construction process is documented [1]. However, to transition from document-based information exchange

to model-based information exchange, further development of BIM software is required as it lacks the necessary features to accommodate construction process documentation [1, 12]. In traditional projects today, BIM-based collaboration frequently uses a CDE to support the information management process during project delivery [10], but due to software issues, these benefits have so far mostly been realized during the design phase and not yet the construction phase.

Lately there has been a shift towards integrating BIM-based issue management technologies into the construction phase, but current research lacks a comprehensive understanding of their impact [12]. Transitioning to digital issue management holds the potential to enhance content analysis, which has been challenging in document-centric platforms that typically rely on manual methods to analyze the content [6, 12].

Cusumano et al. [6] analyzed digital inspection data from 117 construction projects conducted between 2018 and 2021. Although the study focused on inspection data, it was found that all types of construction issues could be reported using a similar process. The findings indicated that digital reporting saved time, reduced costs and increased quality control. Additionally, it simplified administration by consolidating all information in one place. However, the study also revealed a need for increased standardization and improved data quality to enhance insights and enable comparisons between projects. Cusumano et al. [6] suggested that linking topics to BIM objects rather than locations on a drawing would aid the data analysis process.

Afzal et al. [12] found that the construction industry is shifting from paper and email-based management of RFIs to digital solutions. Nevertheless, several challenges were identified in BIM-based projects, such as a lack of standardization, interoperability issues, and a general deficiency in technical skills among construction workers. Additionally, the efficient management of RFIs today is hindered by a lack of structure [5] and the coexistence of documents and digital data [12]. Consequently, issues arising in construction projects today rarely serve as a reliable source for future decision-making [13]. This could be more effective if they were fully integrated into BIM [13], but such integration is challenging when construction workers rely on drawings rather than actively using BIM on construction sites.

In Total BIM projects, the BIM is legally binding, replacing traditional drawings [4]. Consequently, construction workers can use model-based construction processes instead of relying on drawings and documents [14]. Site workers can dynamically create and extract information from BIM on mobile devices [14]. With this innovative approach, the BIM platform serves as a single source of information for construction workers and acts as a CDE.

A major difference from traditional projects is the active use of BIM data rather than documents during the construction phase. This approach, combined with new user-friendly software specifically designed for construction workers and integrated communication tools, enables the creation of structured information. As more Total BIM projects begin to emerge, there is now an opportunity to study how these communication tools are being utilized.

3 Method

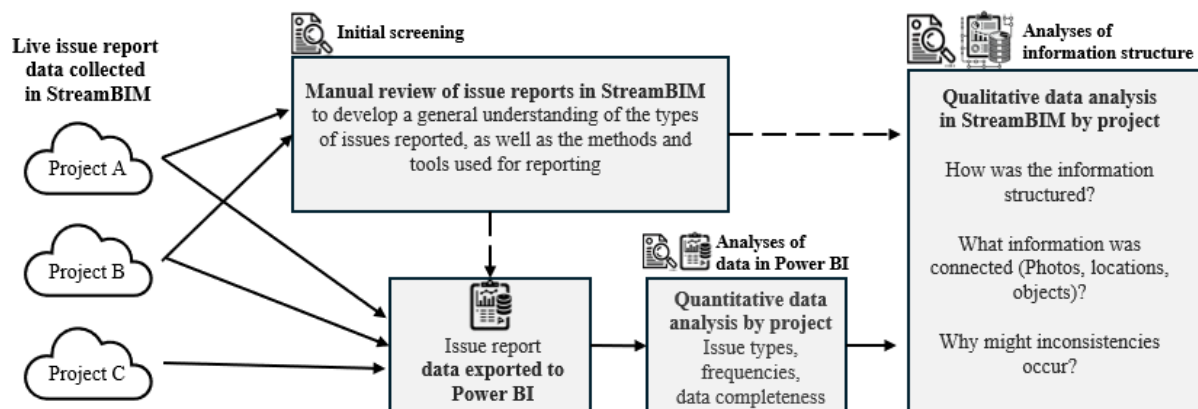
This study analyzed issue report data from three ongoing construction projects to explore the current use of digital communication tools for issue reporting. All three projects were in their final stages at the time of data collection. Projects A and B were Total BIM office renovations managed by a small Swedish construction management (CM) company, whereas Project C was the development of a new residential apartment building by a large Swedish contractor. In Project C, the aim was to take the first steps towards Total BIM, but due to legal requirements, traditional drawings were also produced. Subsequently work on the construction site more closely resembled traditional practices using drawings. Therefore, Project C offers a comparison between projects using traditional documents in combination with digital issue reporting, and projects where BIM is actively used by construction workers in Total BIM projects.

The three projects were selected due to the limited availability of Total BIM projects and the unique opportunity to access live production as it is created. All projects used the StreamBIM [15] software, which is currently a leading platform in Scandinavia for implementing Total BIM due to its user-friendly interface and features that support model-based construction processes [14]. An overview of the projects is presented in Table 1.

Table 1. Overview of the projects.

	Project A	Project B	Project C
Location	Uppsala, Sweden	Stockholm, Sweden	Gothenburg, Sweden
Date of construction	2022-2024	2021-2024	2023-2024
Project type	Mixed-use renovation (Offices, shops, other)	Mixed-use renovation (Offices, shops, other)	New residential housing
Project area	21,000 m ²	8,200 m ²	5,170 m ²
No. of issues created (June 2024)	6,884	17,881	2,786
Construction approach	Total BIM	Total BIM	Traditional drawing-based
Site BIM platform	StreamBIM	StreamBIM	StreamBIM

This research is part of an ongoing PhD project exploring the implementation of Total BIM. In September 2022, access to the BIM platform used in projects A and B was granted by the CM company. The initial phase of this research involved developing a general understanding of the types of issues reported, as well as the methods and tools used for reporting them. This was accomplished through a manual review of randomly selected digital issue reports and leveraging the visualization features within the BIM software. However, due to the limitations of these in-built features, the issue report data was exported to Power BI to conduct a more extensive quantitative analysis. The data collection and analysis process is shown in Fig. 1.

**Fig. 1.** Data collection and analysis process

The quantitative analysis in Power BI aimed to identify the number of issues reported per project and assess how these issues were categorized. Since Project A and B were managed by the same company, they shared a similar structure, while Project C's structure differed notably. However, the categorization for Project C was simpler due to the limited scope of StreamBIM usage outside of quality issues. Subsequently, the data was assessed for completeness. This involved examining the number of issues with missing titles and descriptions, followed by identifying how many issues were linked to BIM objects.

Following the quantitative analysis, a qualitative analysis was conducted directly in StreamBIM to identify how the platform was used for issue reporting on the three construction sites. This analysis focused on approximately 100 randomly selected issue reports per project to determine the data contained within them and specifically to examine whether photos, BIM views, 2D locations, or a combination thereof was used. Additionally, the analysis focused on how effectively the issue reports were linked to BIM objects across the three projects. All research findings were anonymized and translated from Swedish to English.

4 Findings

The findings presented below illustrate how digital issue reporting was conducted in the three projects. Selected examples are provided to demonstrate the types of issues reported and how they were reported within the projects.

The types and frequencies of issues reported for each of the three projects are presented in Table 2. Projects A and B were both managed by the same company, using StreamBIM as a comprehensive platform for project communication. Consequently, the platform was utilized for a wide variety of issue reporting. The most common types of issues reported in both Project A and B, each accounting for over 20% of the total, were work environment issues. The CM company primarily created new topics to inform subcontractors about cleaning and safety issues. These topics were labelled with varying degrees of priority: critical issues needed to be addressed within 4 hours, high priority issues within 8 hours, and medium priority issues within 16 hours.

In Projects A and B, subcontractors actively used issue reports to ask questions to site management, accounting for 15,5% of all issues in Project A and 5,2% in Project B. Furthermore, issue reports were frequently related to on-site decisions made by subcontractors, with 11,2% and 10% reported respectively. Issue reports in Projects A and B were also used to communicate directly with design teams as well as internally by design teams. In contrast, in Project C, subcontractors utilized the BIM platform much less, as 173 out of 182 questions for site management were created by the contractor.

All projects used the BIM platform to report issues arising during quality inspections. Notably, 84,4% of the issues in project C were related to quality inspections, with most of these being pre-inspections created by the contractor. This indicates that the BIM platform in Project C was primarily used to document and assign quality-related issues rather than as a project communication tool. In contrast, Projects A and B reported a wider range of issues. Particularly in Project B, the data indicates that the platform was extensively used by subcontractors to plan and document their work.

Table 2. Issue types and frequencies for each of the projects using the BIM platform.

	Project A		Project B		Project C	
	Issues	%	Issues	%	Issues	%
Work environment management	1,962	28,5	3,737	20,6		
Questions for site management	1,064	15,5	940	5,2	182	6,3
Quality inspections	852	12,4	1,518	8,4	2,439	84,4
Site decisions	774	11,2	1,810	10,0		
Construction notes and comments	460	6,7	1,681	9,3		
Self-controls / reports	25	0,4	3,182	17,6		
Design questions and coordination	851	12,4	1,299	7,2		
Tenant related	464	6,7	178	1,0		
Other (Reports, work prep, notes etc.)	432	6,3	3,775	20,8	269	9,3
Total	6,883	100	18,120	100	2,890	100

During project setup in StreamBIM, an administrator creates a structure for the digital issues and determines how they will be categorized. Fig. 2 highlights a clear difference between the CM company's projects and the large contractor's project. It shows how issues in Project B were connected to BIM objects (63% of the time when a subcontractor was asking a question to site management), where a BIM view was frequently added to the message in addition to a 2D location and photo(s) taken by the user on the construction site. In contrast, this did not occur to the same extent in Project C. Instead, issues reports were most often created by placing a pin on a 2D digital drawing to indicate the rough location of the issue. For Project A 52,6% of issues were connected to BIM objects, 37,8% in Project B, and 22,5% in Project C (see Table 3).

By selecting a BIM object in the issue report, the report becomes attached to the object, creating connected data between the selected issue and the BIM object. However, it was observed that in all projects, objects were frequently mistakenly selected when creating issues, leading to irrelevant data erroneously being attached to objects. It was clear that these were mistakes because the titles, descriptions, and the location of the issue did not match the selected object. Fig. 3 illustrates the problem by showing how the object selected in Fig. 2 was connected to six issue reports, but only one was relevant to that specific object. The other five concerned issues such as a door not closing properly, missing sealant between wooden framing and the floor, and a missing, as well as unpainted hatch in a kitchen. In other cases, issue reports were created without being attached to any object. For example, cleaning issues involving items left on the floor were not always attached to BIM objects because the issue pertained to a space rather than a specific object.

Figure 2 displays two side-by-side screenshots of issue reporting interfaces for Project B (left) and Project C (right). Red arrows highlight differences in how issues are connected to BIM objects.

Project B (Left):

- Workflow:** Production/Question for production management
- Location:** Project B, Floor 9, Historical Room 18P
- Object:** Motion detector: Inset Dali Dynalite DUS360CR-D
- Selected Objects:** Motion detector: Inset Dali Dynalite DUS360CR-D
- Title:** Too small hole for D1
- Status:** Open
- Priority:** Medium
- Categories:** —
- Labels:** —
- Assigned to:** @Productionmanagement
- Attachments:** A photo of a construction site and a 2D digital drawing showing a hole in a floor. A red box labeled "Photo from the construction site" points to the photo. A red box labeled "2D location generated from BIM object selection" points to the 2D drawing. A red box labeled "View of selected object in BIM" points to a 3D BIM view of the motion detector.
- Issue Description:** Hole for D1 sensor is too small

Project C (Right):

- Workflow:** Inspections/Construction/5A/Floor 15/5A-1001
- Location:** Project C, Floor 15, 5B-1501, +2 more
- Title:** Painting defect
- Status:** Open
- Priority:** Medium
- Labels:** <Pre-inspection>
- Assigned to:** @Painter
- Cost:** —
- Attachments:** A photo of a construction site and a 2D digital drawing showing a painting defect. A red box labeled "Photo from the construction site" points to the photo. A red box labeled "Pinned location on 2D digital drawing" points to the 2D drawing.

Fig. 2. Examples of how issues were reported in Project B (left) and Project C (right), with differences highlighted in connecting issues to BIM objects.

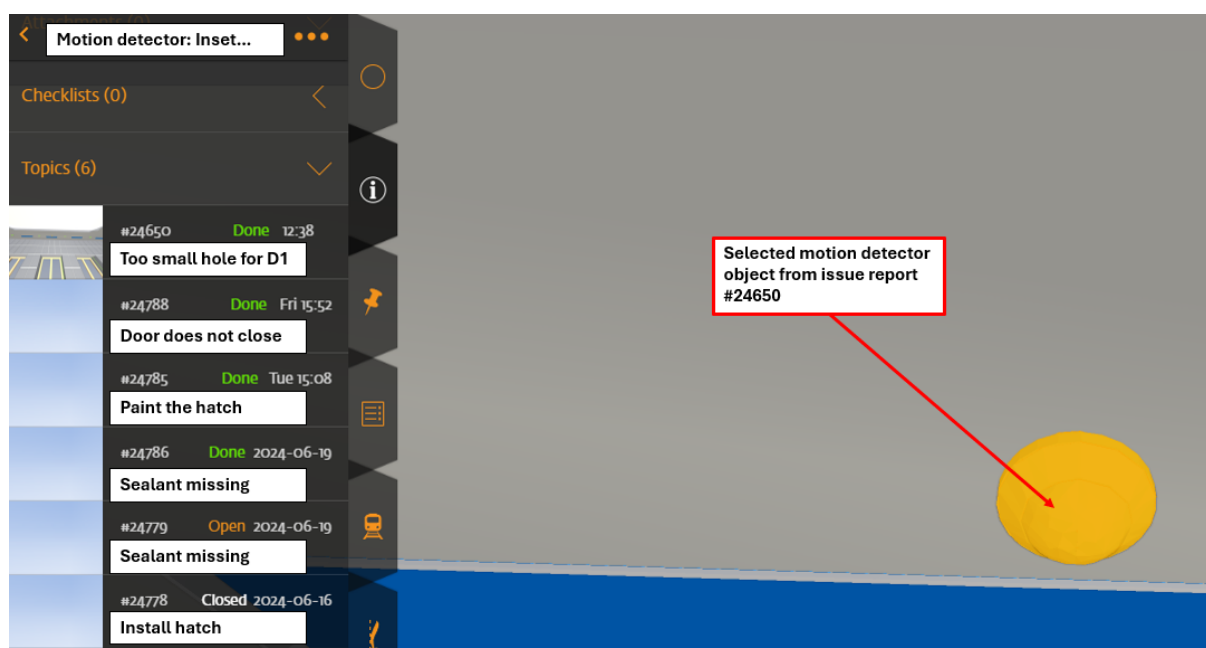


Fig. 3. Issue reports from Project B attached to a motion detector BIM object, where five out of six of the reports are irrelevant to that specific object.

The issue reports in all projects contained a mix of autogenerated data (such as location), structured data (such as labels, selected objects, and assigned users), and unstructured data (such as photos, titles and descriptions). A problem with the location data was that depending on how ‘spaces’ were defined in the BIM, an issue could be contained within multiple spaces, complicating the interpretation of location data. Free text fields like titles and descriptions had varying degrees of information quality. Often, descriptions were left blank and instead contained within the title, as shown in Fig. 2 with ‘painting defect’. Table 3 illustrates the data completeness for titles and descriptions in each of the projects. In Projects A and B, descriptions were left blank approximately 45% of the time, and 92% of the time in Project C. Furthermore, in some cases, if the titles and descriptions of the issue reports were poorly chosen or missing, it became very difficult to understand what the reports related to.

Table 3. Data completeness for issue titles, descriptions and whether objects are linked for each of the projects.

	Project A		Project B		Project C	
	Issues	% of total	Issues	% of total	Issues	% of total
Blank issue title	229	3,3	1,365	7,5	19	0,7
Blank issue description	3,213	46,7	8,091	44,7	2,654	91,8
Object linked to issue	3,625	52,6	6,855	37,8	651	22,5

Project administrators had control over who could create issues within specific categories. Depending on the category and whether a user or group was tagged in an issue, notifications were automatically sent when a new issue was created or responded to. While Project C mainly used the BIM platform for quality issue reporting, Projects A and B used the platform for communication, documentation, and issue reporting. Therefore, issues created in Projects A and B often required responses from assigned individuals and when the issue was resolved its status was changed from ‘Open’ to ‘Done’ or ‘Closed’.

While resolving work environment issues was a priority, other types of reports were frequently left ‘Open’. These typically involved ongoing discussions, work preparations and personal notes. It was possible to differentiate these from issue reports requiring attention based on their categorization. In all three projects, subcontractors were provided with their own subcategories within the issue reporting feature in the BIM platform, where they could keep their personal communication and documentation separate.

Clear differences existed in how issues were reported across the three projects, likely due to a lack of standardized methods. Although project administrators created categories and templates for issue reports, end-users had considerable freedom in how they filled out the templates. Despite a high variance in the quality of individual issue reports, using a BIM platform for digital issue reporting centralized communication and documentation into a common environment. A benefit of this was that data became connected to BIM objects or spaces, enabling the creation of structured data where different issues could be linked together.

5 Discussion

While digital issue reporting from construction sites is not new [6, 16], its use alongside model-based construction processes is novel and, until now, has yet to be studied. The findings indicate that digital issue reporting has the potential to create structured, and organized information by connecting digital issue reports to BIM objects and spaces, which can help overcome challenges managing documents and information found in traditional projects.

Traditionally, issues on construction sites are communicated through unconnected channels such as reports, emails and phone calls [9]. The findings show that digital issue reports were used to facilitate communication throughout the construction phase, by reporting a wide range of issues, asking questions, and documenting decisions. The issue reports were stored in a CDE, the BIM platform. The use of a CDE for issue reporting in the studied projects differed from that in traditional projects. Instead of uploading documents directly, users created digital issue reports to which documents could be attached. By creating these digital issue reports, users produced digital data that can be used to find information and maintain traceability, addressing common challenges associated with the document-based approach

[9, 12]. Therefore, this shift towards data rather than documents can assist with information management processes during the construction phase.

The findings revealed that, although not done consistently, site managers and subcontractors have begun connecting BIM data to digital issue reports. Users navigated the BIM to locate the specific object or view they wanted to link to the issue report, which may be more familiar to workers involved in Total BIM projects, where they regularly interact with BIM for model-based construction processes. This familiarity may explain why, in Project C, which was drawing-based, fewer issue reports were connected to BIM objects. However, the findings also revealed issue reports are often mistakenly linked to incorrect objects. This resulted in the creation of inaccurate structured data and incorrect metadata, which poses a problem when attempting to analyze and reuse the data. Several factors may contribute to this, including a lack of vigilance from construction workers, insufficient guidelines from management, software usability challenges (e.g., unclear indications of whether or which object has been selected). Additionally, it should be considered how to create connected and structured data in cases where issues do not relate to objects (e.g., cleaning issues), or items that have not been modeled (e.g., sealing between gaps).

This study finds that BIM was actively used in the construction phase to structure and organize digital issue reports, thus extending BIM's active use beyond the design phase. Despite this advancement, issues were reported using a variety of approaches and varying levels of data quality, indicating that the importance of using BIM for structuring and organizing information has not yet been realized to its full potential [7] and may limit future informed, data-driven decision-making [13]. This challenge mirrors problems previously identified during the BIM design process, where critical information and requirements are sometimes overlooked [17, 18] but is now also found in the construction phase. While the issue data quality may have been sufficient for daily tasks within the projects, the varied approaches may complicate data reuse outside of the project.

The varying degrees of data quality found in the projects also reflect issues found in previous studies, such as a lack of standardization [6] and a lack of successfully implemented best practices [1]. Therefore, as Total BIM projects emerge and digital issue reporting may become more common, we suggest that to gain a more thorough understanding of the data outside of the projects, best practices need to be established, and standardization increased. One possible way to do this, as found in the projects, is through improving consistency with connecting issues reports to BIM objects, which is also not a new idea; Cusumano et al. [6] also suggested it in their study. However, the difference is that in Total BIM projects, users are already interacting with BIM on the construction site, which might make it more feasible. Furthermore, the templates created by project administrators for issue reporting should be standardized across their company's projects, balancing sufficient information quality with the time it takes to create a report.

Previous studies indicate a shift from paper-based to electronic documents in the construction phase and highlight that BIM software lacks the necessary features for accommodating construction process documentation [1, 12]. However, the findings of this study demonstrate that sufficient software now exists, and in the future, these types of software may become a single source of information for communicating and reporting issues. Furthermore, the findings show that there has been a shift towards digitalization in issue reporting, work preparations, and notes, rather than merely uploading electronic documents, which indicates that workers do, in fact, possess the required skills.

In Projects A and B, a clear structure was identified for separating issues requiring attention from those for personal or internal use within subcontracting teams. In Project C, this distinction was less obvious, as most issues were created by the contractor and directed towards subcontracting teams. For future projects, it is important for companies to consider how they organize and structure information to distinguish between issues requiring attention and those for personal use, through proper categorization and tagging of issues. This is especially crucial since information is stored in a common environment, which otherwise may make it challenging to manage information efficiently. Additionally, there is a need for a mindset shift on construction sites to recognize the value of the data being created, ensuring that document-based approaches are not replicated in digital formats. For instance, in some cases, users may have marked locations on digital drawings rather than selecting BIM objects that also contained location data because of their familiarity with drawings.

Brooks et al. [19] suggested that model-based construction has the potential to enhance data analytics in projects, enabling the prediction and elimination of mistakes. The findings in this study illustrate that

in Total BIM, model-based construction processes are being used to create a new type of dynamic data by linking issue reports to construction information. However, several challenges remain due to inconsistencies, which may currently limit the extent to which data can be used for predicting and eliminating mistakes.

6 Conclusions

Previous studies have indicated a shift towards digital reporting in construction, but current research lacks a comprehensive understanding of its impact. This research begins to address this gap by exploring how digital issue reporting is occurring in real-world projects, including two where BIM was actively used by construction workers for model-based construction. The study underscores the importance of integrating model-based construction processes with digital issue reporting, as it can improve the structuring and organization of information beyond traditional document-based approaches by linking issues to BIM objects. This practice can potentially transform issue communication during the construction phase from unconnected documents and conversations, typically found in traditional projects, to a common source of organized digital information.

Several potential benefits were identified, including, efficient categorization of issues and the creation of connected and structured data projects by attaching digital information such as photos, locations, BIM views, and BIM objects. However, several ongoing challenges remain, such as inconsistent practices, attaching incorrect objects, and varying data quality. Therefore, to fully realize the potential of digital issue reporting in model-based construction projects, this study suggests establishing standardized best practices and improving consistency through linking issue reports to BIM objects where possible. Additionally, a mindset shift is necessary on construction sites to understand the importance of data quality and the value of the data being. Failing to address current challenges may limit future opportunities for informed, data-driven decision-making, where digital issue reporting can provide useful insights beyond the project setting.

Given the challenges identified with digital issue reporting, future research should explore the use of Artificial Intelligence (AI) to analyze the issue report data. AI could potentially help eliminate incorrect data by comparing descriptions and spaces with linked images, thus adding a validation check before issue reports are submitted. Furthermore, future research should focus on understanding end-user perspectives to gain insights into how digital issue reports are used in practice. This approach could provide context regarding the structure and management of digital issue reports, potentially identifying shortcomings and opportunities for improvement, leading to better data visualization and metrics for project management.

References

1. Wang C, Plume J (2012) A review on document and information management in the construction industry: From paper-based documents to BIM-based approach. In: Proceedings of 2012 International Conference on Construction and Real Estate Management, pp. 369–373.
2. Agarwal R, Chandrasekaran S, Sridhar M (2016) Imagining construction's digital future. McKinsey & Company, [https://www.mckinsey.com/capabilities/operations/our-insights/imagining-constructions-digital-future#/,](https://www.mckinsey.com/capabilities/operations/our-insights/imagining-constructions-digital-future#/) last accessed 2024/08/23.
3. Björk BC (2001) Document management—a key IT technology for the construction industry. In: Information and Communications Technology in the Practice of Building and Civil Engineering-Proc. of the 2nd worldwide ECCE Symposium.
4. Disney O (2024) Total BIM: Toward transforming construction, Technical report no 2024:3. Licentiate thesis, Chalmers University of Technology.
5. Mao W, Zhu Y, Ahmad I (2007) Applying metadata models to unstructured content of construction documents: A view-based approach. *Automation in Construction*, 16(2):242–252.
6. Cusumano L, Farmakis O, Granath M, Olsson N, Jockwer R, Rempling R (2024) Current benefits and future possibilities with digital field reporting. *International Journal of Construction Management*, 1–12.
7. Sacks R, Eastman C, Lee G, Teicholz P (2018) BIM handbook: A guide to building information modeling for owners, designers, engineers, contractors, and facility managers. John Wiley & Sons.
8. Van Berlo LA, Natrop M (2015) BIM on the construction site: Providing hidden information on task specific drawings. *Journal of Information Technology in Construction (ITcon)*, 20(7):97–106.

9. Jaskula K, Kifokeris D, Papadonikolaki E, Rovas D (2024) Common data environments in construction: state-of-the-art and challenges for practical implementation. *Construction Innovation*.
10. ISO (2018) Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM)—Information management using building information modelling—Part 1: Concepts and principles (ISO 19650-1:2018).
11. Turk Ž, Sonkor MS, Klinc R (2022) Cybersecurity assessment of BIM/CDE design environment using cyber assessment framework. *Journal of Civil Engineering and Management*, 28(5):349–364.
12. Afzal M, Wong JKW, Fini AAF (2024) Towards digital approach for managing request for information (RFI) in construction projects: a literature review. *Construction Innovation*.
13. Goedert JD, Meadati P (2008) Integrating construction process documentation into building information modeling. *Journal of Construction Engineering and Management*, 134(7):509–516.
14. Disney O, Roupé M, Johansson M, Leto AD (2024) Embracing BIM in its totality: a Total BIM case study. *Smart and Sustainable Built Environment*, 13(3):512–531.
15. StreamBIM, <https://streambim.com/>, last accessed 2024/08/23.
16. Cox S, Perdomo J, Thabet W (2002) Construction field data inspection using pocket PC technology. In: International Council for Research and Innovation in Building and Construction, CIB w78 conference, pp. 243–251.
17. Ahmed S (2022) BIM implementation within infrastructure projects: A study to evaluate the work and information flow within the construction industry. Master thesis, Chalmers University of Technology.
18. Moberg L, Svensson E (2019) Effektivare BIM-projektering: En studie som belyser problematiken inom BIM projektering samt hur konstruktören kan påverka utvecklingen för en effektivare process [More efficient BIM planning: A study that highlights the problems in BIM planning and how designers can influence the development for a more efficient process]. Bachelor thesis, Halmstad University.
19. Brooks T, Zantinge R, Elghaish F (2022) Investigating the future of model-based construction in the UK. *Smart and Sustainable Built Environment*, 12(5):1174–1197.