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# ASSESSING BIM MATURITY OF CONSTRUCTION PROJECT TEAMS IN ALIGNMENT WITH PROJECT NEEDS

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## Abstract

The implementation of BIM in the AEC industry faces challenges due to misalignment between project needs and team capabilities. Current BIM maturity assessments focus on organizational qualifications rather than project-specific needs. This research addresses this gap through an ethnographic case study of two projects, emphasizing strategies for aligning project needs with BIM uses, assigning responsibilities, and assessing maturity. The first case demonstrates how collaborative models like IPD foster team support in implementing BIM. The second case illustrates how teams with lower organizational BIM maturity can still efficiently contribute by leveraging capabilities aligned with project-specific requirements.

## Introduction

The adoption of Building Information Modeling (BIM) has been increasing dramatically in the Architecture, Engineering, and Construction (AEC) industry; however, the misalignment between the actual needs of construction projects and BIM capabilities of project teams remains a significant challenge. This issue has prompted some research efforts aimed at developing methods to evaluate the BIM maturity (also referred to as capability or readiness) of construction organizations (Succar, 2010; Kassem and Succar, 2017; Mahamadu et al., 2019; Bismyhas et al., 2023; Adekunle et al., 2022). These evaluation methods are usually designed to assess the competence of an organization by identifying the capabilities required to attain their effectiveness in implementing BIM (Herndon et al., 2003; Succar, 2010; Proença et al., 2016; Adekunle et al., 2022). However, the majority of these BIM maturity assessment methods are typically conducted at the organizational level, focusing primarily on generic criteria related to an organization's overall qualifications for implementing BIM (Herndon et al., 2003; Proença et al., 2016; Mahamadu et al., 2019; Adekunle et al., 2022; Alankarage et al., 2023).

While organizational BIM maturity models provide a broad framework for evaluation, their limited focus on project-level dynamics highlights a critical gap in assessing team-specific readiness for implementing BIM within unique project contexts. Project-specific circumstances and needs, and consequently the type of BIM capabilities required to address them, can vary significantly from one project to another. Therefore, it is essential to perform BIM maturity assessments at the project level to ensure alignment between project needs and team capabilities.

Despite this need, limited research has addressed project-level BIM maturity. For instance, the authors in (Kam et al., 2013) introduce an assessment method for projects and use criteria, such as being holistic, quantifiable, practical, and adaptive, for generalizability reasons but lack project-specific granularity.

Furthermore, many of existing BIM maturity models are based on academic literature, lacking practical examples. Although these studies break down BIM maturity into subcategories such as IT infrastructure, people, organizational strategy, and processes, they remain limited to the organizational level and fail to address the interorganizational impact at the project level (Alankarage et al., 2023; Siebelink et al., 2021). As a result, project-specific needs are not considered in most of these models. An additional limitation, according to (Siebelink et al., 2021), is that many BIM maturity models are developed based on the perspectives of individuals responsible for BIM implementation within each organization. However, there is no guarantee that an organization's representation in a project reflects its internal BIM maturity, highlighting the need for a project-specific BIM maturity assessment.

BIM implementation in many projects is highly influenced by the contract model (Celoza et al., 2023) and is often tailored to the preferences of the contract lead (Aladağ et al., 2023), for example, to facilitate their internal coordination and efficiency. In some cases, BIM procedures are even shaped by the personal preferences of individuals (Khalil and Stravoravdis, 2022).

BIM Execution Plans (BEPs) provide a vehicle for considering project needs in a construction project. For instance, (Messner et al., 2019; National Institute of Building Sciences, 2024) particularly emphasize that the identification of appropriate BIM Uses during the development of BEPs should be guided by specific project goals and team objectives. However, as demonstrated in (Siebelink et al., 2021), the successful implementation of BIM remains contingent on the maturity of the project team, as one of the key factors, to effectively execute the BEP.

The primary objective of this paper is to present a systematic approach for assessing the maturity of project teams in implementing BIM uses that are driven by project needs. This systematic approach will be illustrated using practical examples from two distinct construction projects with varying contexts and needs. The study discusses best practices in BIM maturity assessment, and describes strategies employed by the project teams to address any potential maturity gaps. Furthermore, this research aims to explore the potential of successfully engaging organizations with relatively low BIM maturity at the organizational level in projects where the project team scores a high level of BIM maturity.

## Methodology

This study employed an ethnographic case study approach, a recognized methodology for conducting qualitative research, applied to two construction projects. The ethnographic approach allowed the researchers to be fully immersed in the projects, providing extensive access to project documents, meetings, and interactions with the project team. This firsthand experience was instrumental in obtaining a more objective perspective on BIM implementation within the studied projects. A mixed-method data collection strategy was used in both projects, including multiple surveys, semi-structured interviews, project document analysis, and direct observations during meetings (see the following section). The collected data was subsequently analyzed to formalize the strategies each project team employed for assessing their BIM maturity. This analysis focused on identifying the following key aspects:

1. The alignment between project needs and BIM uses in each project. In the absence of BIM requirements at the outset of both projects, the research team relied primarily on semi-structured interviews with key stakeholders, particularly the owners, to understand which project needs could potentially be addressed through BIM. As the projects progressed and project teams began utilizing BIM, the research team conducted another series of interviews, this time with BIM professionals, to determine the specific BIM uses in practice. Although one of the case study projects had developed a BIM Execution Plan, this step was still necessary to verify which BIM uses were actually implemented and how each corresponded to a previously identified project need.
2. The responsible parties for each required BIM use. For this step, the research team reviewed the contractual documents of both projects to better understand the relationships and scope of work of each project participant. This analysis was further supported by data collected from the interviews.
3. The maturity of each responsible project partner for each required BIM use. This step was conducted differently in each project. In one project, the team developed a BEP and, in the process, conducted a maturity assessment for each required BIM use. The research team, as objective observers, was not involved in this process. In the second case study, as described in the next section, the lack of BIM maturity across the board was evident to the project team, leading to the onboarding of an external VDC service provider. However, the research team integrated BIM maturity-related questions into their interviews with practitioners to gain a clearer picture of their capabilities.

It is important to note that this paper intentionally uses the term "project needs" instead of "project requirements" to avoid implying that these needs must be explicitly documented for the project team.

Finally, the observed strategies for assessing the BIM maturity of each project team were verified through semi-structured interviews with project participants to ensure the integrity and reliability of the findings.

## Overview of Case Studies

### Case Study 1: $1^{st}$ and Clark Project

This project is a mixed-use development combining healthcare and residential facilities, located at East $1^{st}$ Avenue and Clark Drive in Vancouver, Canada. Currently ongoing, the project is a collaborative initiative among three government partners. It includes 97 affordable rental housing units, a state-of-the-art withdrawal management center, an academic research hub, trauma-informed culturally appropriate services, and a social enterprise program space focused on Indigenous healing and wellness.

Given the high complexity of the project, an early decision was made to adopt the Integrated Project Delivery (IPD) model and implement BIM as a tool to facilitate collaboration among multiple stakeholders. IPD can be understood as a legal framework for creating a virtual, temporary, vertical team that fosters the highest level of collaboration among different disciplines to achieve overall project anticipated goals (Cheng and Johnson, 2016; Allison et al., 2018; Bhonde et al., 2020).

The IPD model is especially favorable in complex projects (Chen et al., 2020). The complexity in the $1^{st}$ and Clark project stemmed primarily from specialized healthcare-related requirements, the involvement of three distinct owners with varying objectives, and the high sensitivity of the project within the local community.

The ethnographic research approach used in this project enabled the researchers, over the course of a two-year engagement, to conduct over 40 hours of interviews with project stakeholders, perform 15 rounds of short surveys, and participate in more than 200 project meetings. Moreover, the research team was granted access to all project documents including models, BIM Execution Plan, and project 2D plans.

### Case Study 2: UBC's Bioenergy Research Demonstration Facility

The Bioenergy Research Demonstration Facility (BRDF) is a renovation and expansion project located on the University of British Columbia's main campus in Vancouver, British Columbia, Canada. The original BRDF facility utilizes renewable biomass from wood waste to generate thermal energy for 25% of the campus's heating and hot water, as well as over 5% of its electricity demands.

The expansion project, initiated in 2018 and completed in 2022 through a Design-Build (DB) delivery model, aimed to substantially reduce campus greenhouse gas emissions by 67% below 2007 levels while providing nearly all the needed heating and hot water for most of the year.

The BRDF expansion posed significant challenges due to the need to replace and integrate new sensitive components within an already dense space, all while maintaining partial operational functionality. Key additions included a fuel delivery infrastructure, a 12 MW hot water boiler, an expanded fuel storage bunker, a small research center, and a new lab facility.

Similar to the previous case study, an ethnographic research approach was conducted on this project over the course of one and a half years This method allowed the researchers to directly observe project meetings, analyze communications, reports, models, and 2D plans. Please note that this project did not include a BIM Execution Plan. Data collection also involved two rounds of surveys and one round of semi-structured interviews during execution, followed by a post-delivery round of survey and interviews.

## Observed Strategies for assessing BIM Maturity of Construction Project Teams

In this section, the three steps of BIM maturity assessment strategies observed in the selected case studies are discussed in detail. These steps were taken in each case study to establish maturity assessment based on the BIM uses identified in alignment with project-specific needs. In this way, BIM maturity assessment can be conducted at a project level. As a result, even organizations that might not score highly in overall BIM maturity at the organizational level can still participate efficiently and actively in the projects due to their specific capabilities in BIM execution that align with project-specific requirements.

### Step 1: Alignment Between Project Needs and BIM Uses in Each Case Study

At this step, the research team observed numerous initial conversations among project stakeholders in both case studies, particularly with the owner's engagement, to identify the project needs.

#### *$1^{st}$ and Clark Project's Needs and BIM Uses*

For the $1^{st}$ and Clark project, the IPD delivery model enabled the project team to discuss BIM implementation with all the major stakeholders from the very beginning. This allowed the team to conduct alignment sessions during the Validation phase and start working on a BIM Execution Plan, even before the design phase where the actual use of BIM began. It should be noted that in the project documentation, the project needs were referred to as BIM objectives and goals. The identified BIM uses and project needs for this project are presented in the following subsections. Please note that some project needs drove multiple BIM uses. Additionally, BIM for design authoring is not identified as a separate use, as it is the precursor to all the uses mentioned.

#### BIM for Design and Construction Coordination

As mentioned earlier, this project has three governmental owners, two of whom have their own extensive internal standards and guidelines that must be considered in the design and construction of the project, in addition to the general codes and bylaws applicable to construction projects. This required the project team to achieve high efficiency and increased transparency in collaboration among the project team, high-quality submittals, and seamless communication of the design to the owner, construction team, and end users, as well as obtaining their feedback.

Given the project's tight schedule constraints, it was essential to establish shorter and more efficient design and design review processes, along with highly coordinated construction sequences. Furthermore, to enhance project efficiency, the team began exploring prefabrication options for some MEP systems, which required precise coordination among different parties, including the manufacturer.

All these project needs formed the basis for the project team's decision to use BIM for design and construction coordination. This was implemented through a cloud-based BIM platform with the highest level of integration, accessible to all project partners (Figure 1).

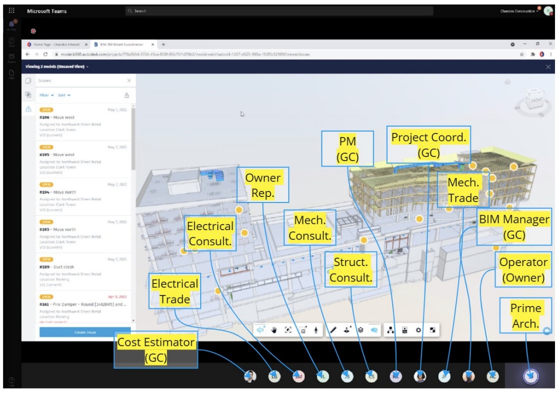


*Figure 1: Project partners participating at BIM coordination meetings in the $1^{st}$ and Clark project Using Autodesk BIM 360 and MS Teams Platforms ©Chandos Construction*

#### BIM for Producing Drawings for Submittals

Like most construction projects, the $1^{st}$ and Clark project required the preparation of various packages for permitting applications and communication with the AHJs. As is common with many AHJs, the local authorities would only accept and review 2D drawings as part of the required submittals. Similarly, this was the case for communication with some parties outside the project team and certain onsite crews who lacked the capability to use BIM. Additionally, at the time this project was in the design phase, there was no legally accepted method for practitioners to issue and sign off on directly 3D models that contain Issued for Tender (IFT) and Issued for Construction (IFC) documents. Therefore, generating and issuing 2D drawings was a necessity for the project team. Fortunately, such drawings, with some extra customization, can be produced as a byproduct of BIM. Consequently, the project team decided to utilize BIM for this purpose.

BIM for Visualizations

Due to its anticipated use, the 1$^{st}$ and Clark project carries high sensitivity within the local community, making it particularly important for stakeholders to engage with the public, especially the immediate neighborhood, as well as the Authorities Having Jurisdiction (AHJ). In this context, ease of communication and obtaining feedback became a primary requirement for the project team, which could be facilitated through accurate and engaging visuals. Additionally, the stakeholders expressed a need for both still and animated visuals for marketing purposes and publicity campaigns. As a result, the project team decided to use BIM for visualization purposes.

BIM for 4D Simulations

The tight project schedule necessitated the optimization of site utilization, logistics, and construction sequences. This involves coordinating many crews and construction trades working simultaneously in close proximity to maximize efficiency. Additionally, as previously mentioned, there was a need for high-quality marketing materials and effective communication and engagement with the public and AHJs. To address these requirements, the project team decided to use BIM for creating 4D simulations. These simulations link construction activities from the project schedule with 3D objects in the building model, generating animated chronological sequences of the construction process and so can meet the outlined needs above effectively.

BIM for Information Takeoff and Cost Estimation

As part of the IPD methodology, the project team implemented a Target Value Delivery (TVD) approach, which involves continuous cost control efforts. This approach necessitates the constant extraction of the bill of materials and other required quantities based on the latest design updates. Such an approach can only be effectively executed when a fully integrated and coordinated design process is in place. Beyond maintaining project costs below the target cost, TVD enables the project team to explore various design options and concepts while staying within the owner's budget. To support these efforts, the team decided to utilize BIM for taking off the necessary information and conducting cost estimations.

BIM for Facility Management

Due to the complexity of the 1$^{st}$ and Clark project, the owners and future operators expressed a need for a highly accurate set of as-built documents at the project handover stage. The primary reasons for this request were to facilitate the commissioning process and to support the Computerized Maintenance Management System (CMMS) system considered for managing the operations and maintenance processes of the facility during its occupancy phase. In response, the project team collaborated with the owners team to plan for a digital handover upon project completion. They concluded that utilizing BIM would enable the delivery of the necessary information for both the commissioning process and the CMMS system. However, it was acknowledged that achieving this goal required the project team—including owners and operators—to develop a comprehensive set of facility data requirements to ensure the necessary data would be produced and delivered effectively at the handover stage.

*BRDF Project's Needs and BIM Uses*

In the BRDF project, the initial design had been largely developed using 2D drawings, and the project was put on hold for some time until a new design-builder was engaged to lead the project. It is important to note that BIM capability was not a critical factor during any of the related procurement processes and no BIM Execution Plan developed in this project. The necessity for BIM utilization became evident as execution challenges grew increasingly apparent after this transition phase. In contrast to the 1$^{st}$ and Clark project, where complexity stemmed primarily from the facility's sensitive intended use and the variety of guidelines and standards that had to be followed, the complexity in the BRDF project arose mainly from operational and execution challenges. These challenges involved incorporating highly sensitive and large components into a dense mechanical environment while keeping the facility partially operational, which led to the conclusion to utilize BIM in this project. Please note that, although the majority of the original design was conducted in 2D, the boiler system, conveyors, as well as the new steel structure and pipe routing were subsequently designed directly in BIM. The identified BIM uses and corresponding project needs for the BRDF project are presented below.

BIM for As-built and Reality Capture

In this project, accurate and precise geometric information of the existing built environment was necessary to sufficiently plan and execute the work. This was especially critical when examining whether the new boiler and electrostatic precipitator would fit within the existing structure and equipment in the facility and whether they could be moved and rotated within the building without any conflicts. Therefore, the team conducted multiple laser scans to capture the existing conditions and developed a point cloud data set. To make these conditions accessible to the rest of the team, the point cloud data was later integrated into the BIM environment (Figure 2). This step was fundamental to all other BIM uses, as the as-built conditions were a significant constraint for all of them.

BIM for Design and Construction Coordination

Given the small footprint of the area where new equipment such as the boiler and electrostatic precipitator needed to

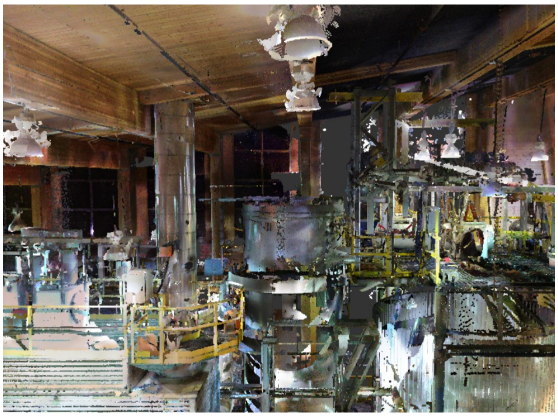

*Figure 2: Point cloud data capturing the existing condition of the BRDF ©Kinetic Construction*

be installed, it was crucial to ensure sufficient clearance between the new components and the existing structure and equipment. Therefore, BIM and the point cloud data were used to review the placement of the new equipment and determine whether they could be maneuvered within the facility.

Furthermore, in renovation projects, it is essential to ensure the constructability of the proposed changes. This requires close coordination with various trades and subcontractors to obtain their input on the feasibility of the envisioned changes and to evaluate the available working areas while considering the existing conditions. For this purpose, BIM was utilized to allow trades to walk through the virtual environment, perform 3D measurements, and review the project's constructability. This also included using BIM in Virtual Reality (VR), enabling project team members to fully immerse themselves in a 1:1-scale 3D BIM environment for a deeper understanding of the dense existing conditions.

BIM for 4D Simulations

As mentioned earlier, one of the main concerns expressed by the project team in the BRDF project was the effective delivery, rotation, and installation of large new equipment such as the boiler and electrostatic precipitator in a small facility. This made the related delivery and installation sequences critically important. More specifically, the project team needed assurance that the equipment would fit through the facility entrance and avoid any contact with existing structural elements or other equipment. Hence, conducting a highly accurate sequence analysis of the delivery and installation process for all new components became essential.

This sensitivity was one of the primary drivers behind the decision to introduce BIM in this project and to use BIM for 4D simulations to provide the necessary operational assurance (Figure 3). Notably, prior to using BIM, there was significant uncertainty among the project team regarding one of the existing structural columns that could have blocked the new components and obstructed the operations. However, with the aid of 4D simulations, they were able to safely plan the operations without requiring any modifications to the structural conditions.

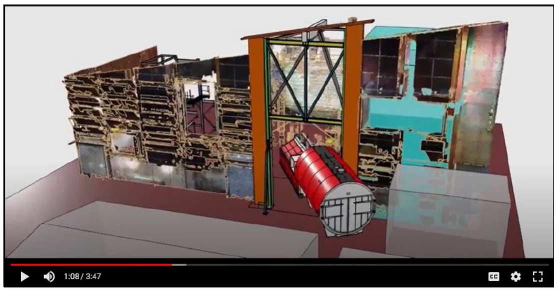

*Figure 3: 4D simulation with BIM and point cloud to coordinate the transportation logistics of mechanical equipment at the BRDF project ©Kinetic Construction*

BIM for Producing Drawings for Communication and Documentation

As outlined in later sections, there was a lack of BIM readiness among most stakeholders in the BRDF project. Therefore, in addition to the general reasons described for the 1$^{st}$ and Clark project, the BRDF project team had to use 2D drawings for internal communications, exchanging the necessary information, and documentation. Furthermore, 2D drawings were used to communicate and manage design conflicts. To address all these needs for 2D drawings while at the same time benefiting from the crucial advantages of BIM, a central BIM was utilized to produce all the necessary drawings. This was made possible through the engagement of a Virtual Design and Construction (VDC) service provider, as elaborated in later sections.

**Step 2: Responsible Parties for Each Required BIM Use**

Once the major BIM uses aligned with the project needs are identified, the responsible parties must be determined. This determination can vary from project to project and is highly dependent on the selected delivery model, as it directly impacts the responsibilities and liabilities of each project team member.

*1$^{st}$ and Clark Project's Responsible Parties for BIM Uses*

The IPD delivery model was selected for the 1$^{st}$ and Clark project, as it establishes a shared risk and reward concept among the project team that is contractually guaranteed (Allison et al., 2018). Additionally, it allows for the engagement of all major project decision-makers at the very early stages of the project. This facilitated in-depth discussions among the 1$^{st}$ and Clark project team regarding which partners would take responsibility for the anticipated BIM uses in this project, as outlined in Table 1.

It should be noted that this responsibility assignment was made regardless of the BIM maturity of each identified responsible party, as all team members had agreed to engage external support if necessary. This fact is reflected in Table 1, where all team members expressed their readiness to be available as supporting resources.

*Table 1: Responsible Parties for BIM Uses in the $1^{st}$ and Clark Project*

| BIM Use | Responsible Leading Party | Additional Supporting Resource |
|---|---|---|
| Design & Construction Coordination | General Contractor & Prime Architect | All other IPD parties |
| Visualizations | General Contractor & Prime Architect | - |
| 4D Simulations | General Contractor | - |
| Producing Drawings for Submittals | All IPD parties | - |
| Information Takeoff & Cost Estimation | General Contractor | All other IPD parties |
| Facility Management | Owners Team | All other IPD parties |

*BRDF Project's Responsible Parties BIM Uses*

The Design-Build delivery model was selected for the BRDF project, placing primary responsibility for project success on the general contractor. Nevertheless, several essential design and coordination activities, particularly concerning the boiler system and conveyors, were undertaken by new consultants brought on after the DB contract was awarded, assigning them responsibility for their respective design portions. The responsibilities for the BIM uses and the supporting parties in the BRDF project are detailed in Table 2.

*Table 2: Responsible Parties for BIM Uses in the BRDF Project*

| BIM Use | Responsible Party | Additional Supporting Resource |
|---|---|---|
| As-built & Reality Capture | General Contractor | An external partner for Laser Scanning Solution |
| Design & Construction Coordination | General Contractor & Design Consultants | All Sub-consultants & Trades |
| 4D Simulations | General Contractor | All Trades |
| Producing Drawings for Communication & Documentation | General Contractor | All Project Parties |

**Step 3: Maturity of Each Responsible Project Partner for Each Required BIM Use**

This final step of BIM maturity assessment at the project level entails evaluating whether each identified responsible role for the major BIM uses in the project has the capability to perform the anticipated BIM use effectively.

*BIM Maturity of Responsible Parties for Each BIM Use in the $1^{st}$ and Clark Project*

In the case of the $1^{st}$ and Clark project, more than 52% of the project team had prior experience working with BIM, according to one of our surveys. It was also notable that the general contractor and the prime architect brought reasonable organizational maturity to the project, as did most of the sub-consultants. Table 3 presents the organizational maturity of each major partner, assessed at an early stage of the project and rated on a scale from 0 to 5, where 0 indicates no experience and 5 represents extensive experience.

*Table 3: BIM Maturity of Individual Major Participants in the $1^{st}$ and Clark Project*

| Project Partner | BIM Maturity |
|---|---|
| General Contractor | 4 |
| Prime Architect | 3 |
| Structural Consultant | 3 |
| Electrical Consultant | 2 |
| Mechanical Consultant | 2 |
| Electrical Trade | 2 |
| Mechanical Trade | 1 |

Assessing the BIM maturity of the team at the project level, driven by its specific needs, revealed that despite the lack of organizational BIM maturity among some team members, the team was well-prepared to execute the necessary BIM uses. Table 4 presents the maturity of each project partner responsible for the identified BIM uses. This high level of BIM maturity at the project level contributed to the successful BIM implementation, to the extent that BIM processes were fully adopted by all team members during the detailed design phase, and construction documents were issued with only a two-week delay, primarily due to external constraints. It is notable that the owners' team lacked maturity in using BIM for facility management. Nonetheless, they were able to leverage the active engagement and readiness of other IPD parties, who ensured that the required information for this project need was embedded in the models.

*BIM Maturity of Responsible Parties for Each BIM Use in the BRDF Project*

In contrast to the previous case study, the majority of the BRDF team members, i.e. 60%, considered themselves as either beginners or having no prior experience with us-

*Table 4: BIM Maturity of Responsible Parties for Each BIM Use in the $1^{st}$ and Clark Project*

| BIM Use | Responsible Leading Party | BIM Maturity |
|---|---|---|
| Design & Construction Coordination | General Contractor & Prime Architect | 4 |
| Visualizations | General Contractor & Prime Architect | 5 |
| 4D Simulations | General Contractor | 5 |
| Producing Drawings for Submittals | All IPD parties | 4 |
| Information Takeoff & Cost Estimation | General Contractor | 4 |
| Facility Management | Owners Team | 1 |

*Table 5: BIM Maturity of Responsible Parties for Each BIM Use in the BRDF Project*

| BIM Use | Responsible Party | BIM Maturity | BIM Maturity with VDC Service Provider |
|---|---|---|---|
| As-built & Reality Capture | General Contractor | 5 | 5 |
| Design & Construction Coordination | General Contractor & Design Consultants | 3 | 5 |
| 4D Simulations | General Contractor | 0 | 5 |
| Drawings for Communication & Documentation | General Contractor | 2 | 5 |

ing BIM, according to a survey conducted by the research team. This lack of experience with BIM ultimately led the general contractor, who held primary responsibility for the project, to engage an external VDC service provider to address all remaining BIM-related project needs.

Table 5 shows how engaging specialized partners in VDC services can elevate teams with low maturity levels, enabling them to benefit from BIM. This approach was validated through a post-delivery survey, in which over 85% of participants expressed satisfaction with the execution of the BIM uses in the BRDF project. However, it should be noted that due to liability issues and the structure of the Design-Build contract, most project team members could not directly interact with the external VDC service provider and had to coordinate through the general contractor. Consequently, the project team had very limited direct access to and interaction with the federated model managed by the VDC service provider, a limitation that was also highlighted in the post-delivery survey.

## Conclusion

The implementation of BIM in the AEC industry faces challenges due to a misalignment between project needs and team capabilities. Current BIM maturity assessment methods primarily focus on organizational qualifications rather than project-specific needs. This research contributes to addressing this gap by presenting practical examples from two distinct complex construction projects, highlighting best practices in BIM maturity assessment at the project level and strategies for addressing potential maturity gaps.

This research utilized an ethnographic case study approach across two selected construction projects, enabling researchers to gain in-depth insights through direct immersion, extensive access to documents, meetings, and team interactions. A mixed-method data collection strategy, including surveys, interviews, document analysis, and observations, was conducted. The collected data was analyzed to formalize the strategies each project team employed for assessing their BIM maturity by identifying: 1) the alignment between project needs and BIM uses in each project, 2) the responsible parties for each required BIM use, and n3) the maturity of each responsible project partner for each required BIM use. For each construction project, a set of project needs was identified that served as the main driver for subsequently identified BIM uses. These project needs varied strongly based on the specific circumstances of each project. Findings were validated through post-delivery interviews and surveys to ensure reliability. The analysis of the first case study highlights how collaborative project delivery models, such as IPD, can enable project team members to support each other in implementing BIM uses to meet project needs. The second case study shows that even organizations with lower organizational BIM maturity can still participate efficiently in projects by leveraging specific capabilities in BIM execution that align with project-specific needs. Additionally, this research shows that early identification of project needs and their consideration when building project teams can be a key factor in leveraging BIM in highly complex projects. Furthermore, integrating BEP development at an early stage can serve as an enforcement measure for project teams to discuss project needs and conduct relevant BIM maturity assessments from the outset.

It should be noted that relying on only two construction projects presents certain limitations to this research. While this study contributes to a better understanding of the BIM maturity of project teams, further research is necessary to deepen this understanding, and the presented findings should not be generalized without complementary investigations. Furthermore, due to project circumstances, the researchers relied on a unified and simple qualitative scale to assess the maturity of project stakeholders regarding different BIM uses, which they used for self-assessment. However, a more objective approach could involve developing specific indicators for each BIM use that can be measured and independently verified by the research team. Building upon this research, the project team envisions going beyond assessing the maturity of responsible parties for each BIM use to examine methods for evaluating the quality of BIM implementation for each use. In this way, project teams can determine the extent to which BIM implementation aligns with project-specific needs during different project phases and after project completion. This approach aims to support more targeted and higher quality of BIM implementation in construction projects and enhance the accountability of project teams in meeting project-specific needs.

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