

Project Information Management Practices for Digital Asset Delivery

Amelia Celozza, PhD¹

Extended Abstract

Research Problem Statement

Information management is critical for architecture, engineering, and construction (AEC) projects as it can support information-based decision-making throughout a project's lifecycle. There are numerous technologies, such as building information modeling (BIM), that are being developed and adopted that can support information management. This transition to digital information management is part of a larger digital transformation of the AEC industry. This transformation has yielded improvements in metrics such as cost and efficiency; for example, using BIM as a centralized and connected source of information for multiple project participants (Criado-Perez et al., 2022). As the AEC industry undergoes this digital transformation, the products that are developed during project delivery have changed as well. One product that supports decision-making is the digital asset, a digital representation of the physical asset that is delivered to client organizations. Client organizations typically use these digital assets to support the operations and maintenance (O&M) phase of a physical asset's lifecycle. Digital assets in the O&M phase can consist of as-built digital documents, such as BIM, paired with "actual performance data" as posed by Gurevich et al. (2017), and the data it contains are needed to support facilities management functions (e.g., repair and maintenance activities) (Becerik-Gerber et al., 2012). To create and deliver these digital assets, specific requirements must be defined and fulfilled. For example, it is recommended that data from three categories (equipment and systems, data, and documents) be included in the digital asset (Becerik-Gerber et al., 2012). Other recommendations focus on developing an asset information model (AIM) to fulfill organizational information requirements and project information requirements (ISO, 2018). These digital assets are created by the project delivery teams, consisting of designers and constructors, and are often

¹Assistant Professor, Dept. of Civil, Environmental, and Architectural Engineering, Univ. of Colorado Boulder, 1111 Engineering Dr., UCB 428, Boulder, CO 80309-0428. ORCID: <https://orcid.org/0000-0001-9099-1538>. E-mail: amelia.celozza@colorado.edu

derived from digital products used throughout the design and construction phases of a project. If requirements are not well-defined, the client or owner may experience challenges when trying to use the digital asset in the O&M phase due to the lack of appropriate information or incompatible information formats, among other barriers.

Much of the existing literature focuses on what should be required in digital assets, rather than how organizations and project teams should define information requirements and associated processes to deliver digital assets. The digital transformation of the AEC industry demands that traditional, paper-based business practices of project organizations evolve to a more digital project delivery process. These strategies to digitally deliver a project must include processes that incorporate the needs of each organization delivering the project, as well as being sensitive to their respective digital maturity. Thus, the objective of this research was to identify current challenges and future research directions to understand how processes between project organizations must be adapted to support digital project delivery.

Brief Research Methodology and Approach

First, a literature review was conducted to identify and assess potential strategies to improve collaboration between primary project participants (owner, designer, and constructor) to support defining requirements for digital assets. This focuses on processes that support the creation of this digital asset as well as intraorganizational and interorganizational strategies required to ensure that all parties receive value from the creation of digital assets. Then, preliminary semi-structured interviews were performed to identify current opportunities and challenges related to this early phase collaboration between primary project participants related to information management requirements definition. These semi-structured interviews add context to many of the findings from the literature review, as there may be a gap between current academic recommendations and industry practice.

Key Findings

The literature review identified a number of concepts focused on organizational processes to support digital asset creation. An emergent concept focused on development of an employer's information requirements (EIR) or operational information requirements, which can capture the needs of both the client

and facilities management (FM) (Ashworth et al., 2019; Munir et al., 2019). One study identified EIRs as a focal point for project teams to have a common understanding of BIM processes, while noting that a key issue in these processes was engaging teams early (Ashworth et al., 2019). Another study identified a high-level process to identify information required for FM, which begins with the owner and FM teams collaborating to identify and verify information requirements and these requirements are submitted to the design and construction teams to be fulfilled throughout project delivery (Matarneh et al., 2019). Another concept identified was value co-creation among project organizations. Numerous studies have evaluated value creation between project participants and have identified numerous elements required to be successful in this value creation (Chi et al., 2022; Lavikka et al., 2017; Lehtinen et al., 2019; Liu et al., 2014). Traditionally, organizations have specific roles in the value process; for example, owners are value receivers or value consumers, while contractors serve as value creators or value producers (Liu et al., 2014). Value co-creation has changed this dynamic, and project participants act as both value consumers and producers throughout the project's lifecycle. Lavikka et al. (2017) specifically evaluated co-creation of digital deliverables to support facilities management (FM) and they identified three elements required for a successful co-creation process: discussion between project participants, a shared context between project participants, and a shared understanding of the needs of the FM team and how this value could be created by other project participants. Other key elements to improve value co-creation include early involvement of contractors to provide experience (Liu et al., 2014) and a shared vision between contractors and owners (Chi et al., 2022).

Preliminary analysis of semi-structured interviews has identified a range of practices present in the industry today with respect to defining digital asset requirements. Two contrasting projects are subsequently shared: one from a design-builder and another from a general contractor working on a design/bid/build project. Design-builder X described a design-build project in which the client contractually required a BIM suitable for use during facilities management. Design-builder X identified this need and found that the client-provided BIM for FM requirements needed more detail. They subsequently implemented a process in concert with the client organization (including their FM team) to regularly meet and standardize the data

required for the BIM. This process happened “before we even were able to say this is what the actual deliverable is going to” look like, and it took about a year of workshopping between Design-Builder X and the client organization to come to this understanding of the content of the BIM. The result of this project was positive for both the design-builder and the client organization.

In contrast, General Contractor Y discussed a design/bid/build library project, in which the client required a level of development (LOD) 500 BIM as one of the digital deliverables upon project completion. LOD 500 BIM objects are field-verified (as-is representation) and may contain information in addition to the geometric information (e.g. warranties, manuals, etc.) (Leite, 2020). When this requirement was presented to the General Contractor Y’s project team, they wanted to understand what the client specifically needed and how this supported the owner’s existing FM processes. The interviewee posited that their client learned about BIM from a seminar or book and simply put the LOD 500 requirement in their contract without understanding the implications for the General Contractor or the client’s FM team. Upon further discussions between General Contractor Y and their client, they found out that the client’s FM team did not have the appropriate hardware or software, nor the know-how to leverage an LOD 500 model within existing FM processes. These discussions resulted in General Contractor Y proposing to provide an “intelligent PDF” that included 2D drawings with hyperlinks to relevant information, such as warranty or O&M manuals. While this case resulted in a digital deliverable that was appropriate for the client’s needs, there was a potential risk for the client organization as they seemingly did not understand the implications of requesting an LOD 500 model as their digital deliverable. This could have resulted in increased costs to develop this digital deliverable while not providing proportional value to the client due to their lack of trained personnel and technological resources to utilize an LOD 500 BIM.

The literature review and semi-structured interviews identify a need to further study intra- and interorganizational processes to improve digital asset requirements definition and creation. Value co-creation has emerged as a strategy to ensure that digital asset requirements reflect the needs of project organizations. Preliminary findings suggest that there is an opportunity to leverage the experience of certain project organizations, such as contractors, to improve digital assets’ requirements definition. For example,

how does the early involvement of contractors and O&M teams improve the definition of digital O&M deliverables and subsequent digital assets? Further, the semi-structured interviews suggest that project delivery methods may influence how project organizations are incentivized to collaborate early in the project. For example, is there a difference in how digital asset requirements are defined when comparing more collaborative delivery methods (e.g., design/build) and less collaborative delivery methods (e.g., design/bid/build)?

Implications

This research identifies future research directions focused on the digital transformation of project organizations' processes. Specifically, these research directions support the development of digital assets that create value throughout a project's lifecycle by having numerous project organizations serve as value producers and consumers. This work contributes practically by developing project recommendations that improve digital deliverables to support information-based decision-making throughout a project's lifecycle.

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