Asset Management Approach for the Building Owner's Information Requirements

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Abstract
The capabilities of collecting larger sets of data for facilities management (FM) use has provided a benefit for owners, especially with regards to BIM and the information collection process. The amount of data has also created new issues in terms of an effective and systematic process to manage and then distribute the information to those in the organization that utilize it. The problem with large sets of data is first, the need to define a meaningful list of what information is needed to operate a facility, and secondly, the need to develop the taxonomy to manage that data. The BIM ontology ultimately ties to effective Asset Management (AM) which can reduce operating expenses for an owner, but only after the organization has surpassed the difficulties of both the storage and retrieval of information. This research evaluates the owner's information needs, but from a different viewpoint - an asset management perspective.

Keywords: Building Information Modeling; Facilities Management; Asset Management.

1 Introduction
In recent years, there has been a focus on facilities management and the connection to effective documentation through Building Information Modeling (BIM). BIM has also served as a catalyst for changing the way project teams think about the entire project life cycle, especially from a building data perspective. But to date, the adoption rate by facility managers (building owners), for use in post-construction applications such as building maintenance has been difficult, even when it has shown promise in the areas of collecting required information for the operations and maintenance (O&M) needs after completion of the construction project. Researchers (Love et al., 2014, Mayo and Issa, 2015) identified that the slow adoption by owners has been partly due to the complex nature of the facilities information. The problem with the large amount of data available at the end of a project is first, the need to define a meaningful list of what information is needed to operate a facility, and secondly, the need to develop the taxonomy to manage that information. These issues were also addressed as topics of interest in a recent meeting of the Facility Maintenance and Operations Committee (FMOC) – operating as part of the National Institute of Building Sciences. The minutes list "other suggested topics" to be addressed by the committee, two of which were directly related to the industry problems stated above:

a) Why are Owners not making significant progress relative to optimizing management of the built environment?
b) Importance and "Role" of a BIM Ontology.

While the BIM ontology refers to the overall use of the model, there is also a need to review the taxonomy of information for facilities. Pittet et al. (2014) defines BIM ontology (for FM) as the "representation of knowledge of a building and the associated FM project features…. Intended to support the domain knowledge requirements of multiple disparate users." Malafsky and Newman

(2009) describes the challenge of managing knowledge through ontologies and taxonomies as overcoming the issue of "large amounts of related but disjointed information into a useful, accurate, and trustworthy set of knowledge." To explore the application of establishing a taxonomy, this research utilized a case study with the UNC Charlotte's Facilities Operations (FO) Department. Previous research exploring a process for deliverables (Mayo and Issa, 2015) was first applied, and the research team was faced with questions regarding input into the computerized maintenance management system (CMMS). The team then approached the same problem from an asset management perspective by looking at their existing assets and how each asset was documented and organized and how the information was used.

2 Literature Review

Existing literature (Yu et al. 2000) indicates that there is an excess of information that owners must receive and utilize in day-to-day operations, and therefore, a taxonomy is needed to effectively organize and store information. Despite of what many owners may assume, (which is that all information is relevant), this belief is not realistic and furthermore it is a contributor to the ongoing problem of the capabilities to collect usable information which provides value to the operational maintenance efficiency. But the issue is not simply an abundance of information, but instead centers on the decisions regarding what is relevant and what will provide value for the organization. To effectively maintain facilities, a systematic process for asset management should exist. Love et al. (2013) described the need for flexibility due to the owner's changing needs, such as those pertaining to performance measurements. Love et al. (2013) noted that asset planning should occur through their performance measurement systems (KPIs, or Balanced Score Card) to "measure the overall business results that emanate from a building information model that is used to manage and maintain the asset." Although owners might recognize this need, Lui & Issa (2013) reported that there is the perception that even when FM personnel were involved in the earlier project planning phases, their existing business process and practices did not provide a means of delivering the required information to those that need it during the Operations and Maintenance (O&M) phase.

The strategic alignment between the proposed investment in BIM and the asset owner's business strategy should be connected. The most common theme throughout good facilities management is the understanding that in order to work toward continuous improvement, facilities personnel must document their assets. Historically, assets were managed by a prescribed maintenance management regimen. But Campbell et al. (2011) describes the need for a life cycle management approach which incorporates a more strategic approach to align, and support the strategic organizational objectives. Wikoff (2015) defines a Strategic Asset Management Plan (SAMP), as "nothing more than evidence of 'documented information' requirements and specifies that asset management objectives should align, support, and convert to strategic organizational objectives." Because many owners have operated on a less-formal basis and have not yet reached this level of internal planning, it becomes more apparent why they are not yet at the point of articulating the needs for contract language. Ultimately, the owner has two concerns as it pertains to information for Operations and Maintenance (O&M). The first is a need to not only specify the information needs, but secondly, to also manage it once it is received. Therefore, in addition to developing an asset management plan, owners are also working through the exploration of a basic taxonomy for organizing their information to support that plan.

Several recent publications (Cavka et al., 2015; Shepard, 2015; Khodier & Soliman, 2016) have addressed the connection the BIM deliverables to an organization's goals and ultimate use needs. Lucas et al. (2013) conducted a case analysis for hospital facilities data, and developed a framework which was used to combine the healthcare information needs and a classification system for healthcare hazards. But for many owners, there is a lack of internal processes to articulate and connect organizational needs to the BIM delivery efforts, and additionally, an issue with the distribution of information once it is received. A majority of the research has previously been focused on a top-down delivery through the design and construction process, but the success of the top-down approach has been dependent on the owner's designated information requirements, leaving the design and construction team to make assumptions. Some recent studies have begun to review the importance of a more detailed look at data organization. Ashworth et al. (2016) reported after a workshop (and subsequent survey) titled "FM and BIM" that Data Management was the number one concern regarding the use and adoption of BIM. Another case study at an educational institution by

Thabet et al. (2016) concluded that the typical issues faced were that asset data is scattered and not organized and that data for components (parent/child related) are not referenced or connected.

Contract language and standards have provided a great resource to assist owners but are generally segregated to express specific goals for particular parts of the project. For example, many owners require designers to follow a standardized design guide, which only focuses on the design intent. An additional document, the Owner's Project Requirements (OPR), is centered on the design efforts as well but provide a performance specification. The NIBS Guideline 3-2012 (NIBS, 2012) addresses the use of the OPR and states, "Direction for the commissioning team is provided by the OPR at the inception of a project and the proper transfer of this information from one party to the next throughout the life of the building." BIM related duties are outlined in a BIM Execution Plan (BEP) which is often a supplemental document and an addition to the contract requirements. Recent research by Ashworth et al. (2016), also referenced the UK's version, an Employer's Information Requirements (EIR) form. ISO55000 provides management structure for managing assets and more specifically, ISO 14224 provides a taxonomy reference for the Petroleum/Gas industries for exchange of maintenance data. Ruiz (2016), a BIM consultant, has noticed that there are occasions when these singular purpose contract documents conflict, or at a minimum, overly complicate the instructions for the design and project teams.

The struggles within an owner organization include the amount of information, prioritizing information, formats to use the information for their mission, and attempting to articulate those needs after internal decisions are made. At the most fundamental level, the owners must establish a taxonomy to organize the information to enable its use in maintaining a facility. The owner's data taxonomy may be established using a standard, such as *Uniformat* (CSI, 2016b), *Masterformat* (CSI, 2016a) or *OmniClass* (OmniClass, 2016). Table 23 *OmniClass* (OmniClass, 2016) works well where individual items must be tracked and is especially useful for developing a database structure because it is detailed and can meet the needs at a component level (Brodt, 2001). Additionally, Keady (2013) noted that "*OmniClass* can be used for many applications, such as organizing library materials, product literature, and project information" and the benefit in using the standards is that vendors are moving to a system that will provide OmniClass numbers as part of their documentation (Brodt, 2011). Additional tables can assist with organizing warranties (Table 49) and Table 14 for space which also must be coordinated with mandated space reporting guidelines. Although many of standards and resources exist, it is the internal structuring and owner decisions that have been an issue.

3 Methodology

Previous research conducted by Mayo and Issa (2015) utilized the Delphi method to establish a ranked list of recommended OmniClass Table 23 perceived needs for product information deliverables. This research used the previous (2015) results and compared the final list with similar lists from organizations/owners who had already conducted their own internal process to determine their information needs. The comparison also included the preferred levels identified by the owners in each category. Table 1 provides an example of the levels for a product in OmniClass' Openings, Passages, and Protection Products. Although owners may designate their information needs, understanding the levels of detail for this information adds another layer of decisions.

Table 1. OmniClass Levels for Door Information

Table 23 OmniClass	Level 1	Level 2	Level 3	Level 4	Level 5
23-17-00-00	Openings, Passages, and Protection Products				
23-17-11-00		Doors			
23-17-11-11			Door Components		
23-17-11-11-11				Door Frames	
23-17 11 11 25 23					Door Lights

The 2014 study resulted in a perceived list of product needs based on what was believed to provide value for operations. However, once the list was used in the application of this pilot study, it was apparent that to effectively determine what the owner needed, the approach should also include the asset management perspective. This research also highlighted the need to explore information taxonomies for the owner's database, because similar to the example for doors (Table 1), the Facilities' Central Operations Director was attempting to organize what the team termed "attribute data" which included key information such as locks and fire rating.

The previous survey requested that the expert panel members identify their most important perceived needs from the OmniClass Table 23 product categories. Due to the limitations of the study, the panel was provided a pre-selected Level II category list. The resulting contribution was a reduced list of owner deliverables, which created a starting point for owners who were initially determining their desired product information deliverables. The limitation of the survey was that although they may have selected the need for door information, Level II still will not provide enough detail to connect to a SAMP and additionally, not enough to outline contract language for the required deliverables. However, the advantage was that the research provided a shortened list and determined that a focus on three areas might be beneficial as a starting point for owners just beginning the same process: a) General Facility Services Products, b) Facility and Occupant Protection Products, c) HVAC Specific Products and Equipment. For comparison, the researchers obtained information from a consultant who had worked with five different owners in 2015, to determine a similar list of needs. The five owners included a food retailer, a judicial center, a medical office building, and two universities. Additionally, another university also provided the results of their efforts, resulting in a total of six owner data requirement files. Table 2 shows the number of product items used for the study (a few uncommon items were not included) and shows the resulting percentage of items from each OmniClass category. The percentages reflect the combined number of items from the previous Mayo and Issa (2015) study and the additional six owners. The levels that were requested are summarized in Table 2 and indicated that Level II is the primary Level used for the owner's requested information needs. Surprisingly, there was a greater percentage (25.4%) of plumbing items identified than HVAC, which was consistent with the results of the previous Delphi study (Mayo and Issa, 2015). Obviously, in the case of a hospital owner or a lab building, the percentage would be higher for Medical and Laboratory Equipment.

The previous research, as described, was shared with the Facilities Operations (FO) department at a time when an instrumental effort was underway to collect inventory data throughout campus. After several initial meetings, it became apparent that for this organization, as opposed to the typical progression of deciding deliverables needed from the capital project (from BIM and COBie), collecting asset inventory data became the driving force in making some critical internal decisions. The actual inventory collection process also contributed to realizing the importance (or non-importance) of information for products, but it also helped to contribute to the understanding that the organization of the information from a perspective of the CMMS was critical. The first internal decision centered on the establishment of a taxonomy of the asset inventory. The use of data in FM, even after it was collected, was dependent upon the entire organization understanding the hierarchy of inventory. An additional reason for first looking at the existing data was due to an observation that standardization was needed for naming conventions as well as existing procedures. Acronyms for example were entered in different ways depending on the responsible CMMS personnel and additionally, for the same discipline there were examples of acronyms entered for a water fountain which included variations such as WFN, WTFN as well as a combination of upper and lower case letters. The data input was not only an issue from internal data collection methods, but also from the project handover perspective and the use of BIM 360 (Autodesk, 2016) during capital project information handover.

To further refine the need to identify owner's desired information needs, this study utilized an approach borrowed from methodologies utilized for long-term business strategies. Backcasting was introduced as a method to analyze future options and more specifically, a "desirable future end-point." In an attempt to resolve issues pertaining to BIM for FM, many research methods to date have included surveys, Delphi studies, and case studies. The disadvantages in many of the current methodologies is the inability for inclusion of the alignment to organizational strategies and best practices for asset management. Jones et al. (2015) utilized both the forecasting and backcasting methodology in efforts with an established design team to align current project goals. The goal was to establish the expected impacts, primarily on thermal performance, from the effects of climate change. Although it was not the intent of the authors to test the backcasting approach, its use for facilities and asset management provided a practical strategy for a new perspective since it includes future planning perspectives.

Table 2. Comparison of Desired Owner Information and the Standard Levels.

OmniClass Table 23 (Level 2)	Products	Total # of items	% Requested (of Total OmniClass Category)	Level 1	Level 2	Level 3	Level 4	Level 5
23-11	Site Products	241	6.2%	0	0	0	15	0
23-13	Structural and Exterior Enclosure Products	761	2.9%	0	9	5	8	0
23-15	Interior and Finish Products	341	5.7%	0	9	6	3	1
23-17	Openings, Passages, and Protection Products	465	3.0%	0	8	3	3	0
23-19	Specialty Products	208	1.0%	0	1	1	0	0
23-21	Furnishings, Fixtures and Equipment Products	816	3.0%	1	6	14	3	0
23-23	Conveying Systems and Material Handling Products	188	4.4%	0	5	3	0	0
23-25	Medical and Laboratory Equipment	1473	0.07%	0	0	0	1	0
23-27	General Facility Services Products	497	8.8%	0	33	9	0	0
23-29	Facility and Occupant Protection Products	239	14.0%	0	16	12	4	0
23-31	Plumbing Specific Products and Equipment	136	25.4%	0	21	11	5	0
23-33	HVAC Specific Products and Equipment	384	18.9%	0	40	20	6	1
23-35	Electrical and Lighting Specific Products and Equipment	449	8.9%	0	22	13	1	1
23-37	Information and Communication Specific Products & Equip	211	3.1%	0	6	0	0	0
	Totals			1	176	97	49	3

4 Results

The research team began by looking at the desired end result for using FM data. The primary issue was the difficulty in using the CMMS system data for FM work due to inconsistencies in entering not only the new data from completed capital projects, but also from a new effort to begin capturing asset data which was not previously entered into the system. Gaps between the data entry process were identified. "Issues inherent in the integrated database are data custodianship, shared data, and data entry." The initial meetings resulted in a primary goal and first step, which was to identify a data hierarchy for the CMMS system (Archibus) information and a standard nomenclature to be used for the asset tags in the field. A data download from Archibus was used in subsequent meetings to compare to existing industry standards. The most notable effort was beginning with the determination of a primary list of categories for assets. The descriptions in Uniformat, MasterFormat, and OmniClass were presented to identify the overarching categories of assets. Additionally, the CAD (NIBS, 2014) standard was added as a column as an option for the acronym list.

The next goal was to determine the application of the taxonomy and standards to the asset labeling process. Since the FO Department had already began their inventory and data collection process, they had an immediate need to be establish nomenclature for the field tags (RFID). The desire was to ensure that any tag (called the equipment code) would also give a short "address" to the equipment, with further attribute data available through the RFID. The naming convention, will identify the equipment in the following combination:

Tag Nomenclature:	Building – Category – Acronym - Sequence
Description Analogy:	City – County – Street – House Number
Example:	012-PLBG-BFLW-003

The building identification in the nomenclature followed the existing campus space standards but the "category" needed to be determined from one of the standards. The goal was that this would help to put each asset into an identifiable and searchable category. Using a taxonomy to organize the assets in Archibus, the results lead to the development of what the team nicknamed "The Super 10" Category list: Architecture, Electrical, Emergency, Equipment, HVAC, Plumbing, Site, Utility, Transportation, and Telecommunications. Thabet (2016) similarly determined that a total of 49 asset groups would be tracked, but that their main focus would concentrate on 5 asset groups: Air Handling Units, Coilers, Emergency Transfer Switches, Emergency Generators, and Fans. Table 3 provides a summary of the team perceptions with regards to the advantages and disadvantages that were determined for the nomenclature development.

Table 3. The Use of Standards

Standard	Advantages	Disadvantage	Decision
OmniClass	Level specific	Too detailed for Super 10 category needs	Decided Table 23 would be added into database as alternate identification
MasterFormat (MF)	Trades were already comfortable with MF	Not as detailed as OmniClass Table 23	Primary Reference to Masterformat
Uniformat	An standard of disciplines already established	Typically for design, and didn't include several needed for FM	Used Uniformat for Super 10 but modified for FM
CAD Standard	A standard for acronyms	Didn't include all that was needed for FM	Using combination of CAD and internally agreed upon acronyms

There were numerous discussions to finalize some areas of question based on what was typically practiced in the field versus what the team found in the standards – for example: to determine whether items such as a backflow preventer fell under the title of Utility or Plumbing in the standards, and to decide how these items would be handled in the overall Super 10 category. The department found that by working with their customers (such as the campus technicians) to determine what information will provide value (information that will be referenced and used), the team was able to refine what information should be collected. The approach taken by the users was to devote time to individual Super 10 categories, then identify existing inventory, and lastly to determine what information should be connected to that asset (termed attribute data). The product ID exists at a general level which allowed for inventory collection without having to immediately decide on the desired MasterFormat or OmniClass Level. In some cases, this was decided after the complete inventory depending on what information was needed from the asset. Once the inventory was collected, the asset team began working to correct and add information to Archibus, but continued to struggle with the delineation of categories, products, and attributes (Figure 1). Thabet et al. (2016) established a similar hierarchy with alignment to their CMMS system (AiM) and also had "Properties" which are common fields among asset groups such as warranty and parts list.

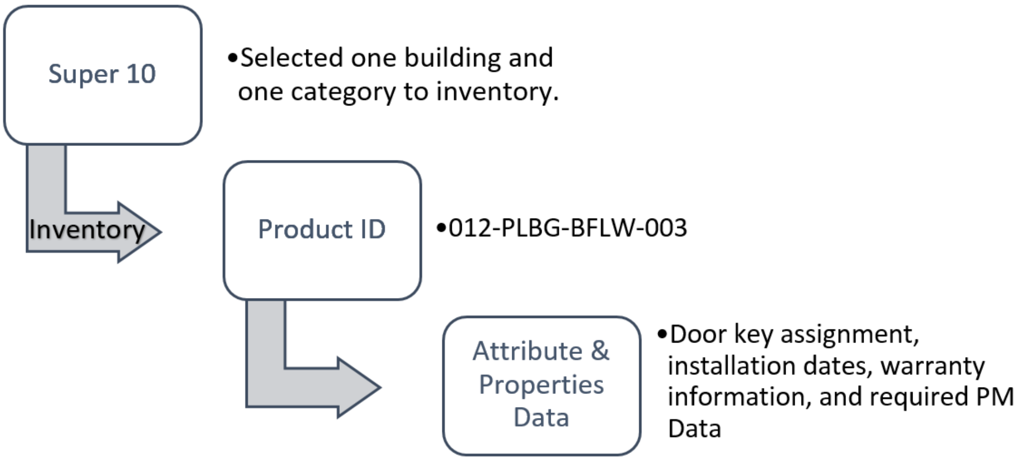

Figure 1. Asset Hierarchy for Naming/Nomenclature

Although owners have conducted similar efforts, the overall adoption of BIM and the internal use of the handover data has been not as immediate as the industry expected. One possible contribution may be due to the internal efforts required to prepare and enable the articulation of these needs in contract documents and procedures. The methodical process outlined for this institution was developed to establish a foundation in an incremental process, starting with an inventory and product ID system, which serves as a quasi "address" to the product. Overall, the asset management approach will ensure that the facilities' mission is served and supports the strategic asset management plan. The established goal was to ensure that handover data is streamlined but the research team continues to define their deliverables, which is evidence of the extensive work required before reaching the point of defining the required information.

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