Getting to a Facility Management BIM

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Lake Constance 5D-Conference 2013

Constance, 28th-29th of October
Introduction

The evolution of building information modeling (BIM) has been very impressive in recent years. BIM has clearly demonstrated value-add to the design and construction world and is starting to evolve rapidly into the facilities management (FM) world. It is well understood that the cost to design and construct a project is only a small fraction of the total lifecycle cost to occupy and maintain the facility. For this reason, many owners are getting increasingly savvy about leveraging BIM to operate their buildings more efficiently. 3D models are being populated with detailed metadata and have become a powerful tool in the building management lifecycle.

This paper will serve as a guideline for developing at a useful FM model through clear and efficient methods executed during the construction process. It is not the intent of this document to elaborate on the benefits of a facilities model but instead to focus on the process of creating one. A recent implementation of this methodology was performed at the MathWorks Natick, Massachusetts campus in the United States. The cited MathWorks project consisted of a four-story, 176,000 SF building that began construction in 2011 and finished in 2012. The approach presented in this paper was successfully applied by Vico/Trimble to provide the owner with a facilities model during construction on the MathWorks project.

Proper planning and organization are required from the outset if a BIM model is to be used for FM on a project. This paper will discuss the planning steps, including the establishment of project goals, identifying key participants, technology to be applied, and the need for clearly defined requirements. An implementation strategy will be outlined and a summary of the handover process and lessons learned will be provided. While every project and project team is unique, this document should serve as a practical reference for guide for most building projects.

Project Objectives

Clearly defined goals and objectives are a fundamental first step when seeking to produce an FM model through the construction process. BIM models have become increasingly detailed in their ability to communicate project information through the inclusion of the metadata. There is, seemingly, no limit to how much information could be populated in these models. Further, the evolution of hardware and software tools makes it increasingly tempting for an owner to want “everything” in the final model. While including everything in the delivery model may seem wise, the truth is that it may not really be necessary and, in fact, will needlessly increase the cost to produce an FM model. Owners must carefully look at their operational needs when before defining the requirements for an FM BIM. In doing so, the owner avoids the possible risk of creating a spec requirement that is overly costly and exceeds their ability to leverage the data.

Project Team

Sophisticated owners, such as the MathWorks, will first choose to look at the team that they have in place to operate the building. Understanding the competency of the on-site operations staff to leverage
digital deliverables is vital when creating project requirements. Owners should consider how the on-site team may grow and/or evolve over time. That is to say that not all projects will have sophisticated technologists who know how to leverage BIM managing their facility at hand-over but these existing facility staff may still be the most competent to physically maintain the space. In cases such as these, an owner should seek to pair up their existing hands-on facilities staff with new team members that have been trained in the use of new FM software. Pairing up new technologists with seasoned facility practitioners provides the benefit of knowledge from one generation of operators to the next.

On-site operations teams should begin to work with the design team immediately once the project design is underway. Relationships between the operators and designers provide immense value for both parties. Operators will have a vested interest in the new design and designers will have the satisfaction of knowing they’ve met the client needs. Designers will also gain practical insight from building operators that can be applied to future design projects. Owners and designers should not fear the complexity of the relationship that exists when the blue and white collar project team members work together to achieve the common goal of efficient lifecycle management of a building.

Once the operations and design staff are put into place the owner is likely to move onto the selection of a general contractor (GC). Selection of a qualified GC to deliver an FM BIM is a critical step because they will in turn evaluate the subcontractor qualifications. GCs that are chosen for their technical competency should be well-vetted to ensure that they fully grasp the owner’s desired outcome and are capable of delivering upon it. Further, the need to vet and qualify the subcontractors should be well communicated to the GC so that they can apply it to the sub selection process. Contractors should not only be taken on their word when it comes to BIM competency. Detailed investigation of BIM performance on previous projects should be completed and validated through other industry contacts.

It may be the case the most qualified GC from a construction perspective does not have the desired level of BIM proficiency but this can be easily overcome by pairing up the GC with a BIM consultant.

**Technology**

The evolving BIM spectrum is resulting in a wide array of technologies and mediums available to teams wanting an FM BIM. Careful analysis of what technologies exist should be applied before the BIM process begins. First consider the BIM authoring platform that will be used to create the 3D content. BIM platforms are far different from traditional CAD software in that they host much more metadata and a selection should be made to suite the initially defined goals. After selecting the project platform the owner should invest in training to facilitate the as-managed model after project handover. Revit 2012 was chosen for the MathWorks, with some detailed steel scopes being modeled in Tekla.

Data mediums for the input information should also be carefully evaluated at the project outset. Most often project submittal and O&M information come in printed or PDF format, which can present a special challenge if document fidelity is poor, as is often the case with submittal data. Owners should give consideration to this and write requirements that PDF documents meet OCR text recognition
requirements to ensure data fidelity. Requiring native file formats for vendor submission is the safest way for owners to ensure that source information can be efficiently input into their FM tool of choice.

Last but not least, the owner will have to carefully choose the FM tool that best meets their need to manage the project. Many tools exist on the market today and can provide different functionality, including energy analysis, occupancy costing, space and move management, asset inventory and tracking, and work order management. Again, understanding the on-site staff and technology is of fundamental importance for an owner when making their final decisions about which tool they will use. Consideration about scalability and hosting environments should also be given.

**Project Requirements**

Understanding the project team and available technology will help the owner to define the FM requirements on a project. Requirements should be clearly defined in the owners RFP and written into the resulting contracts for construction. It is best to write detailed requirements about each asset and to avoid the “we want everything” syndrome. Requirements should result in a BIM execution plan with a clearly defined FM deliverable stated. Many sources of information can be referenced by an owner when drafting their requirements, including execution plans created by several competent university programs. General contractors may also have their own BIM execution template but the owner should feel comfortable reviewing and modifying the template to make it best suit their needs.

Another important aspect of planning will be to select the reporting format for the final FM deliverables on the project. Several interpretations of these requirements exist, with the most popular being the ‘Construction Operation Building Information Exchange’ (COBie) format. COBie is a practiced standard that has been implemented on projects around the world. In general, COBie provides a framework for organizing and reporting FM data using an Excel-based format but owners should be realistic when deciding if an excel spreadsheet will really enable them to be proactive building managers. It is this author’s experience that COBie should be referenced for its superior effort to organize and categorize FM data but that the final project deliverables may be much more elaborate than a COBie-compliant spreadsheet. In the case of the MathWorks project, COBie was referenced but the final deliverable were guided by the actual on-site operational needs. The figure below shows how FM information was populated into Revit using general COBie guidelines:

*Figure 1: Revit interactive schedule, with FM data populated*
Process

A detailed process specification or diagram should be established to clarify the relationship between the project participants and data flow when producing an FM BIM. Swim lane diagrams are well suited for this type of document, as they visually depict the participants and interactions with data along with the gates for approval.

In the case of the MathWorks project, Vico/Trimble was brought on as a consultant to facilitate the design coordination and FM deliverable simultaneously. Vico/Trimble was chosen for this role because design coordination and data management is a core competency of their VDC Services team. Having a consultant such as Vico/Trimble manage the coordination and data population is a wise decision because their coordination process was guided by a detailed System Priority Structure (SPS) that makes pragmatic coordination choices that are best for each mechanical system. Vico/Trimble was able to recognize this consistency by using Revit as a central platform pre-coordination and then handing the pre-coordinated deliverables off to the individual subs for fabrication. Any changes needed for fabrication were then communicated back to Vico/Trimble and incorporated into the final FM model. See diagram below for the organizational structure that was used for this pre-coordination and FM population under this delivery method.

Figure 2: Swim lane diagram for FM data flow
FM data implementation should commence concurrent with the building construction. Data should be populated in an incremental and pragmatic way so as to keep the process manageable and valuable to all. Inputting data incrementally ensures a quality delivery because waiting until the end may result in a large "data dump" after the interest in the project has faded and contractors are moving on to their next job. Establishing a framework for information required, such as equipment type, location, system, etc. is one part of the process that can be started even before submittals are approved. Other more detailed information such as make, model, design size, etc. can be input into the models as the submittals get approved. Finally, commissioning specific information such as serial number, date installed, approved performance date, and asset acceptance date can be input closer to final inspections. Typical projects will see the first two rounds of information entered in a desktop environment, while the final round of information is likely to be entered on-site via a tablet or a mobile device.

Special attention should be given to the submittal tracking when managing FM information. Submittals, combined with installation information, are the primary source of information for an FM model. Often submittals will go through a lengthy submission and approval process with many project participants having touch points throughout the approval process. A detailed submittal tracking system process should be put into place by the GC from the very beginning so that complexity of the submittal process...
does not hinder or delay the FM deliverable. Meridian Prolog is a tool well-suited for submittal tracking, as it has a repository to store the actual submittal, metadata fields to detail all source and surrounding information pertaining to the submittal, and a workflow feature to track and alert project team members as documents are approved and ready for data entry into the BIM.

Room spaces are an important piece of information that needs to be added when creating an FM model. Spaces represent the physical environment of the building and can be represented in the BIM using the “room” tool. Creators should pay special attention to differences between the as-designed and as-used room layouts when adding them to the FM model. That is to say, an area may be called one thing during design (corridor, for example) but is considered differently during operation (part of human resources gross square footage). Also be aware that room names are likely to be revised from the initial design phase and into the operations phase. Space and asset management complexities are yet another reason why it is wise to have someone from the facilities side integrated into the design and coordination from the start.

Figure 4: Space representations in the BIM

Verification of element placement is a last and critical step that should occur when producing the FM BIM. Site conditions and installation accuracy can often vary between the as-planned and as-built environment and therefore a careful check between the two should occur. Facility managers could quickly get discouraged about the use of a new technology if they see or feel that the technology does not accurately reflect the true physical environment that they are responsible for. A tolerance of +/- 1” within the installed environment is recommended. The as-built verification process can be done manually on an object by object basis, or in an automated fashion using laser scanning at the completion of each work location.

Handover

Early efforts to define clear FM deliverables should make the handover process efficient and free from ambiguity. Deliverables may include data loaded onto CD/DVD or input directly into the FM application, as was the case on the MathWorks project. Handover of digital deliverables, as opposed to traditional papers-based deliverables makes for a more on-time and valuable delivery to the owner. Receiving a
well-organized file enables an owner to interact with the data in an efficient manner and also has the added benefit of reduced impact on the environment.

Initial handover of the FM deliverable takes place as the project approaches the finishes phase of work. Handover is a delicate step and should not be done hastily. Handovers of FM deliverables should happen in defined increments and prior to final project completion, thus allowing the owner an opportunity to interact with the data before the contractor demobilization from the site. Information should be provided to the owner as early as possible, even if not fully completed, so that they may use in a test environment before going live. Allowing the owner to work with small chunks of data in a test environment before going live allows them the benefit of making sure they have all the information that they need. The owner should assume that any work done in the test environment is done for their benefit and so will happen at their cost and on their time.

A system of checks should be put into place during the handover process. There needs to be a clear milestone of when the owner will assume responsibility for the data and the construction team is able consider their task complete. Having a clearly defined handover process will benefit the owner so that they can assume ownership of the as-built information and transition into the as-maintained phase of the building lifecycle.

**Lessons learned:**

An FM BIM model is still a relatively new concept in building construction and so the proposed process remains fluid. In the case of the MathWorks project many of these process steps were unknown at the outset of the project and there were many lessons to be learned. Here are just a few:

- Set clear requirements: Although hard to establish, clear requirements are the only way to inform each project participants of their role and responsibility relating to the effort. Vague requirements can result in rework and possibly increased cost.
- Vet out capable participants and tools: Not all contractors and/or technology tools perform equally. Make sure to take time and carefully vet out the performance of each using actual project history and performance. Know that it is okay to ask for third party help!
- Start early: Waiting too late in the process to incorporate FM data can cause inefficiencies and reduce a value added collaboration exercise into mundane data entry.
- Take small steps: Organizing O&M information in the traditional afterthought method is like climbing a mountain after finishing a foot race. Take small steps to make the effort tolerable and efficient.

Delivery of a facilities model that is practical and useful for managing a building throughout its lifecycle is a complex endeavor but one that proves to add significant value to the BIM process. At this time in the industry there are still many unknowns surrounding the topic. Many owners are not yet accustomed to the technological side of building management and few contractors are willing to perform BIM that does not directly benefit their daily work process without charging significant additional costs. Still, we
owe it to our projects and the environment to investigate this unknown territory. The best way to perform any investigation is with a plan. Although the plan may not be perfect to begin with, it is always best to start with a plan and have the willingness to adapt it as additional knowledge is gained. It is this author’s hope that this paper will serve as a guideline for creating an FM BIM delivery plan that serves your next project well!