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WHITE PAPER / **SCALABLE AND REPEATABLE BUILDING INFORMATION MODELING**

TRANSITIONING AVIATION ASSETS FROM DESIGN TO OPERATIONS

BY Vicky Borchers

Effective, long-term facilities management (FM) requires data from all stages of design and construction, but building information modeling (BIM) rarely addresses FM until commissioning. By considering FM throughout the life cycle of the facility, operations managers can create scalable BIM models that provide accurate, actionable data.

Operations managers want to run their aviation facilities efficiently; software solutions for facility management (FM) rely on data structured to meet each system's unique configuration. There is no industry standard for how data should be assembled and delivered to an end user. Operations managers may not know how to ask for the information they need, and few architecture, engineering and construction (AEC) companies have a clear vision or process for delivering critical facilities data. Consequently, airport managers rarely have easy access to the comprehensive data they need to support streamlined operations over the long-term.

Effective FM requires data from every stage of design and construction. Yet, architects, engineers, construction teams and facilities managers tend to talk about one phase of the project at a time. A new building information modeling (BIM) process is required, in which all stakeholders think about FM in the context of the entire lifecycle of an aviation facility. Data collection should begin during the design phase, continue through construction and commissioning, and be updated regularly thereafter.

This paper will explore some of the limitations of existing approaches to data management and explain how to build a sustainable, scalable and repeatable BIM model that will support successful FM over the life of your facility.

DATA IN DEMAND

Many U.S. airports were built in the 1950s and 1960s. For decades, they haven't kept pace with technological and security advancements, or the increasing volume of air travel. Now they're playing catch-up, and airport construction is booming nationwide.

At the same time, facility owners are looking for ways to better manage life cycle costs. Viewed over a 30-year period, initial building costs account for approximately 2 percent of total costs, while operations and maintenance costs equal 6 percent and personnel costs equal 92% (Figure 1).

Airport facility managers want to cut costs, while continuing to deliver value to their customers. Effective facility management is one of the best ways to accomplish this — and comprehensive facility data combined with advanced software tools supports effective facility management.

There is no "one size fits all" data solution to this challenge. To optimize facility management, airport managers need customized data that accounts for the specific size, location and requirements of their facility. A number of potential solutions currently exist, though their usefulness depends on the available data.

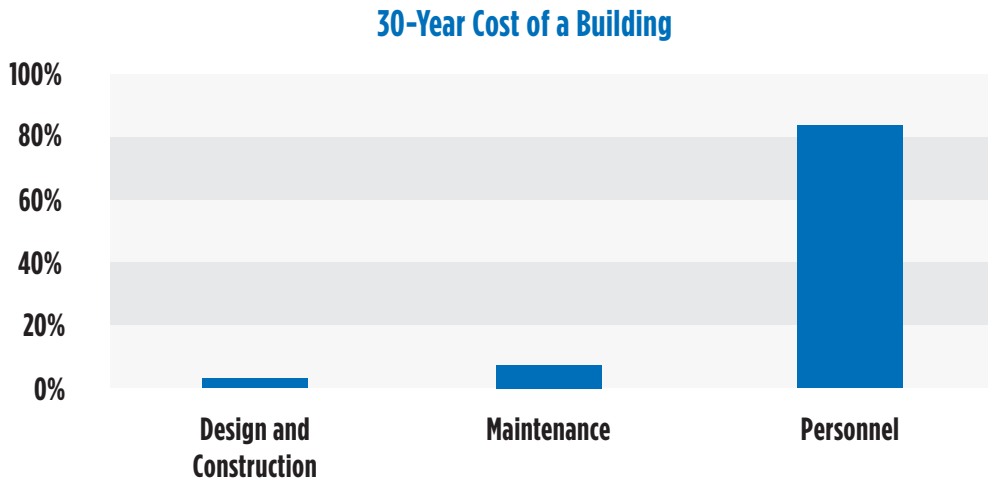

FIGURE 1: *Whole Building Design Guide*

THE FM DATA GAP

The BIM models delivered at the completion of a project can be used effectively to manage aviation facilities and maintain existing as-built models, if they are built with this goal in mind. Unfortunately, the potential of BIM models in facilities management is not yet widely understood.

Most BIM models contain data useful for the construction of the building for which the model was created and are less likely to include clear, organized data that would be beneficial in the management of the facility. Accordingly, many operations managers who receive BIM models as a deliverable still expect to receive two-dimensional DWG files as a fulfillment of the as-built portion of a contract.

Typically, drawings are "archived" as 2D representations of the completed facility. In many cases, clients leave in-house personnel who receive the information to devise their own methodology for archiving. The result is a lack of standardization on where information resides or even who "owns" the documentation. Drawings quickly become outdated, BIM models languish on CDs and models become obsolete within months of turnover.

To add to the confusion, companies often organize files relative to the project construction path. As each phase of construction is completed, files may be grouped into folders based on contracts, subcontractors or phase completed.

This organizational method loses merit immediately when it comes to managing the building. A few years down the road, when you want to find the drawings for, say, the east wing, it's unlikely you'll remember whether it was completed before or after the north wing. Once the data is buried by each phase, it makes it unnecessarily difficult to locate.

With the upsurge of BIM modeling tools, computerized maintenance management systems (CMMS) and cloud computing environments, and an AEC industry widely standardized on the production of graphical databases (such as BIM), the next step is developing the workflows that streamline the integration of these two tool sets. Understanding the strengths and limitations of existing software and data solutions is a good place to start.

EXISTING SOFTWARE AND DATA SOLUTIONS

In aviation, many operations and project managers manage their assets using computerized maintenance management system (CMMS) or computer-aided facility management (CAFM) software. These systems may be customized to fit specific airport configurations and facility types, such as terminals, airfields, hangars and business operations.

COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEMS

A CMMS software package maintains a computer database of information about an organization's maintenance operations, an inventory of critical infrastructure equipment and work plans for preventative maintenance that allow personnel to efficiently execute reactive maintenance. Other components of a robust CMMS system may include safety plans, fleet management tools, predictive analytics, and financial information tied to operations.

This information is intended to help maintenance workers do their jobs more effectively by, for example, determining which machines require maintenance and which storerooms contain the spare parts they need. CMMS data can help management make informed decisions regarding the allocation of resources by, for instance, calculating the cost of an unexpected repair versus preventive maintenance for each type of equipment. It also may be used to verify regulatory compliance.

CMMS packages may be used by any organization that must perform maintenance on equipment, assets and property. Some CMMS products focus on particular industry sectors, like the maintenance of vehicle fleets or healthcare facilities. Other products aim to be more general.

CMMS packages can produce status reports and documents giving details or summaries of maintenance activities. The more sophisticated the package, the more analytics functions are available.

COMPUTER-AIDED FACILITY MANAGEMENT SOFTWARE

CAFM software may be a component of a CMMS system. CAFM software and CMMS systems enable facility managers to increase the utilization of space and facilities, reduce office moves and reallocations, standardize services and streamline processes. Ultimately, information from CAFM software allows managers to improve long-term planning of real estate, space, facilities, maintenance and service requirements against budgets to align with core business needs.

DATA AUTHORING TOOLS

Authoring tools used to represent facilities graphically and from a data perspective are limited. Most facilities managers use a variety of CAD tools to construct graphical representations of their facilities. Some of these tools are built on top of proprietary database formats. More advanced CMMS systems on the market are typically based on an SQL or Oracle database, with some using GIS integration such as Esri. Other facility managers may still use basic tools like Excel or Access.

For this reason, linking the graphical model to the data in a CMMS presents unique challenges. For example, how and what format will you use to link data? How will change management be supported within the workflows? These questions and more are posed within the framework of your organizational structure to provide maintainability of the data within the system.

The tools you use generally are determined by the scale of your organization, technical knowledge and experience within your organization, stakeholder requirements within your organization, and budget. Regardless of which tools your organization chooses, virtually none of them will "talk" to each other without significant customization. They do not share a common data structure, and in some cases, the data structures are proprietary.

BUILDING INFORMATION MODELS

Building information modeling provides a better alternative for creating a graphical representation of data that can be leveraged by a CAFM/CMMS solution. Understanding how the CAFM system/CMMS wants to "receive" the data, whether through a data import or graphically, is essential to properly constructing a BIM model that can interact with that system.

However, AEC firms historically have developed BIM models with construction, rather than facility management, in mind. After construction, some of the design data within the BIM model might be "surfaced" to facilitate the management of the new facility. More often, the data within the design model must be augmented and transformed if the model is to have a life after design and move into the CAFM/CMMS environment.

Integrating data that supports a CAFM/CMMS solution at the very earliest stages of design can minimize the rework involved in transforming the data. This means engaging with the final facilities stakeholders to understand their requirements and see that the data is built into the model. If you have a facility that undergoes frequent change, this, too, must be factored into how the model is structured at the very earliest stages of the design process.

PROJECT EXECUTION PLANS

A project execution plan (PxP) is sometimes seen as the solution to the FM data gap. But in fact, most PxPs are not geared toward how the BIM model will be used by the facility manager upon turnover. Instead, they tend to focus on how to build the model to see that it delivers 2D documentation in formats prescribed by outdated CAD standards. In other words, PxPs are written to ensure that BIM modelers are kept in check by stringent guidelines for content development.

None of these objectives speak to the merits of capturing data that would be beneficial in the management of the facility after construction is complete. As a result, facility managers are receiving BIM models that cease to provide value once the keys to the structure are turned over.

HOW TO BUILD A BETTER BIM

By passing the model from the design team (including architects, surveyors, consulting engineers and others) to the contractor and subcontractors and then to the owner, the BIM model can serve as the container for tying data in the virtual model to the actual physical conditions.

Along the way, each group can add its own discipline-specific knowledge and track all changes to the single model.

This approach presents fewer opportunities to introduce errors or lose information in transfer. Automated conflict detection reduces errors further still. For example, the model will inform the team if parts of the building clash with other building elements. It also offers detailed computer visualization of each part in relation to the total building.

Building an effective BIM model can be challenging, but working with an experienced BIM manager greatly simplifies the process. When you engage a BIM manager who understands the entire trajectory of a project — from design to construction to commissioning and management — the manager will ask the precise questions needed to obtain all necessary data and deliver it in a useable format. A BIM management team that is focused on the data stream contained within the BIM model and the integration of that data into downstream systems — such as your CMMS — keeps the end goal in mind as the BIM model evolves.

The steps to producing an efficient PxP should be similar to those for approaching a new design project. And, like a design project, the PxP is a living document that should be reviewed and updated throughout the design, construction, commissioning and management of your facility.

DEFINE THE SCOPE

The first step in this process is defining the scope of your project. Knowing that you need data is good, but that alone won't create a useable BIM model. For your model to be truly valuable, its exact size and scope must be guided by your facility and your operational needs. Your BIM team will work with you to pinpoint detailed information about your facilities, customers and processes, as well as the available budget.

ASSIGN ROLES AND RESPONSIBILITIES

Using BIM becomes more than a change in software. It is a change, going from a traditional linear process and methodology to a true collaborative environment.

As such, it requires a manager (or management team) to facilitate and coordinate all BIM activities, from design to construction to operations and maintenance. This role should be fulfilled by the A/E firm, and it can be referred to as the BIM Manager Overall (A/E-BMO).

YOUR DATA 'CONDUCTOR'

Your BIM team plays the role of an orchestra conductor. The conductor may not know how to play all the instruments, but she knows how they function technically in the context of a symphony or concerto. Plus, she understands how they work best together, and she can use that knowledge to lead the orchestra in producing a cohesive performance.

Similarly, your BIM team understands the technical details of all stages of your project, as well as how they fit together to create a working facility. Your team will step into your workflow, gather the necessary data from each discipline and respond to changes dynamically. Ultimately, you will receive a sustainable and scalable BIM model that will serve your needs for years to come.

GET STARTED

Often, it is useful to begin with a pilot project that can be completed in a few months. This will allow you to quickly understand the arc of a BIM project and evaluate its costs and benefits. For example, if you're currently completing a central utility plant in preparation for building a new terminal, you could try out the BIM process on the utility plant first.

BUILD A 'SAFETY NET'

Over time, your BIM team will become a "safety net" you can call on as needed. Whether you require support for frequent small changes, such as retail turnover or a major renovation, you'll have a knowledgeable resource readily available.

Your team can provide analysis, make operational recommendations and facilitate smooth transitions from construction to facility management.

CONCLUSION

In aviation, optimizing facility management requires the seamless transfer of assets from design through operations. BIM has the potential to transform this process by providing a virtual information model that includes all relevant data generated from inception through commissioning.

Creating BIM models requires thinking about facilities management from the earliest days of a project and collecting data with an eye toward long-term FM objectives. Though this can be a daunting prospect, an experienced BIM team will help see that you receive a sustainable and scalable BIM model in a cost-effective and timely manner.

THE FUTURE OF FACILITIES MANAGEMENT

As aviation companies upload more operational data to the cloud, countless opportunities will emerge for streamlining facilities management. It's already possible to monitor facilities remotely, analyze ongoing operations data and plan ahead for future upgrades. For example, a remote team could use current traffic data inside an airport to determine whether the carpet will need to be replaced in 10, or more like 15, years. Eventually, this model will be extended to create a living virtual environment that reflects ongoing changes to all aspects of your facility.

Because FM technologies continue to evolve, it is essential to anticipate changes and assemble innovative solutions that can easily be updated.

BIOGRAPHY

VICKY BORCHERS is a senior architect and the architectural production manager in the Aviation Group at Burns & McDonnell. She is experienced in BIM modeling, facilities management, business systems analysis, data analysis and modeling, spatial programming, computerized maintenance and management systems, and building design. Currently, she is tasked with analyzing and improving production methods in the architectural department. Vicky holds a Bachelor of Interior Architecture degree from Kansas State University and a Master of Architecture degree from Texas A&M University. She is a registered architect (RA) in Missouri, is a LEED Accredited Professional (AP), and holds National Council of Architectural Registration Boards (NCARB) certification.

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