

BIM and Facilities Management

Building information modeling (BIM) is changing the way buildings are designed and constructed—but is it changing how they're operated and maintained? Do the benefits of BIM extend to facilities management? This whitepaper focuses on ways that facility managers and FM applications can take advantage of the consistent, coordinated building information that comes from a BIM design process.

Interoperability, Facilities Management, and BIM

There are a series of discontinuities in the transmission of building data that occur throughout the typical building process. Transitions from design to construction to operation result in loss of data, added cost to reconstitute the data, and overall reduction in data integrity—the impact growing at each handover, culminating with the handover to the facility operator. In a 2004 NIST study¹ undertaken to estimate the efficiency losses in the U.S. capital facilities industry, it was reported that the annual cost (in 2002) associated with inadequate interoperability among computer-aided design, engineering, and software systems was \$15.8B.

The study went on to report that owners and operators shouldered almost two thirds of that cost as a result of their ongoing facility operation and maintenance. These statistics are borne out in the day-to-day activities of facility managers: manually updating occupancy reports via whiteout; calculating area for space charge-backs by counting ceiling tiles; digging through stacks of building documentation to find the maintenance manual for a water heater; or searching in vain for an as-built floor plan, only to find they never received it in the first place.

But the lack of interoperability highlighted in the NIST study is only part of the problem. Is the data trapped in those computer systems studied worth sharing? We tend to overlook the issue of data quality, glossing over the unfortunate truth that often the data produced by conventional design software is unreliable and thus not worth the effort required to share it. Whereas the hallmark of BIM is coordinated, consistent, computable information about a building project—information that's worth sharing and reusing.

Therefore, owners and operators can mitigate their portion of the cost associated with the lack of interoperability cited above by using the high-quality building information coming from a BIM design process during the longer, more expensive maintenance and operation phase of the building's lifecycle. To that end Autodesk uses DWF technology to link Revit[®], Autodesk's purpose-built BIM solution, and Autodesk[®] FMDesktop, Autodesk's suite of applications for organizing and reporting facility-related information.

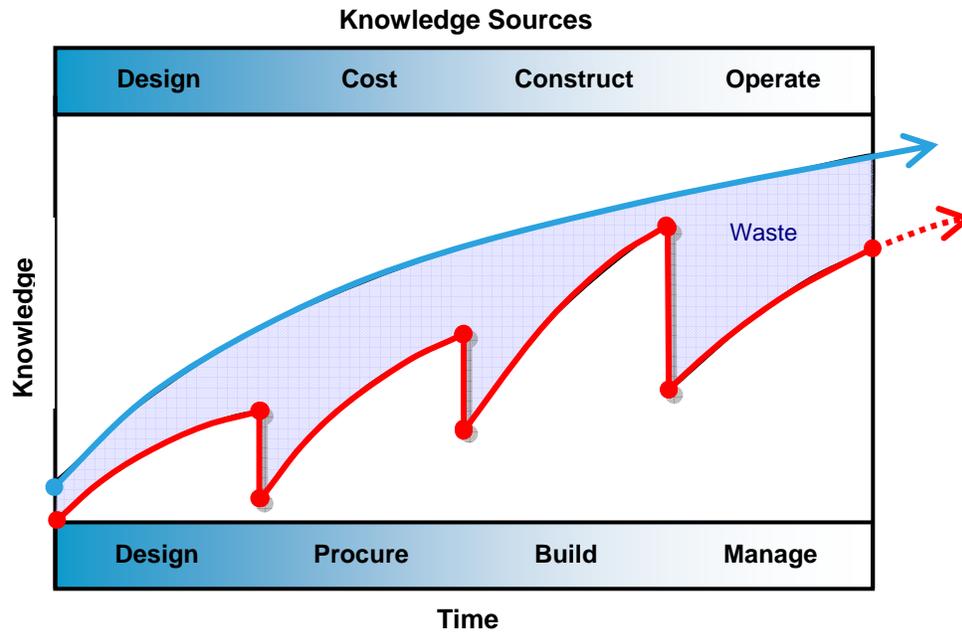


Figure 1:

Transitions from design to construction to operation result in loss of data and the impact grows at each handover, culminating with the handover to the facility operator.

Introduction to Autodesk FMDesktop

Autodesk FMDesktop is a full suite of purpose-built, scalable facilities management products that can help building owners and operators integrate building data derived from BIM processes and use it to manage their facility drawings, data, assets, occupants and work requests.

Autodesk FMDesktop is a graphics-capable facilities management application, with both a database component and a graphics component—giving facility managers a toolset to access and work with facility data integrated with existing facility drawings. This graphic component provides non-CAD users with simple, intuitive tools for viewing and managing graphical spatial information. From a functionality viewpoint, Autodesk FMDesktop combines the features of CAFM (computer-aided facilities management) and CMMS (computerized maintenance management system)—with a variety of space, asset and maintenance management features.

The Autodesk FMDesktop product suite includes these major components:

Facility Manager: The primary module of Autodesk FMDesktop, Facility Manager enables organizations to track and maintain assets and spaces, manage repair or renovation projects, and implement maintenance procedures and schedules. With Facility Manager, organizations can manage all facility drawings and data in a single environment—enabling users to query, pan, zoom, print, and share facility drawings and data.

Facility Web: This module publishes the facility data and drawings managed with Facility Manager into web formats, providing read-only access to data, drawings and reports to others in an organization.

Facility Request: An interactive web-based module, Facility Request automates the work request process by allowing facility occupants to enter their own service requests such as corrective maintenance or moves.

Facility Link: For organizations with AutoCAD-based facility drawings, this module is used to connect objects in those AutoCAD drawings to records in the Autodesk FMDesktop database.

Importing Facility Information

Autodesk FMDesktop connects graphical elements contained in design drawings and BIM models to backend database engines including Microsoft Access, Microsoft SQL, or Oracle. The data import features of Autodesk FMDesktop means that virtually any existing digital facility data can be easily imported into the Autodesk FMDesktop database.

Autodesk FMDesktop also has simple processes by which graphical¹ spatial information—particularly room areas and attributes—can be connected to the database. The DWF file format can be used to import and manage drawing information outside the native CAD or BIM environment. This method is the primary means of connecting BIM-based design information to downstream facilities management and operations.

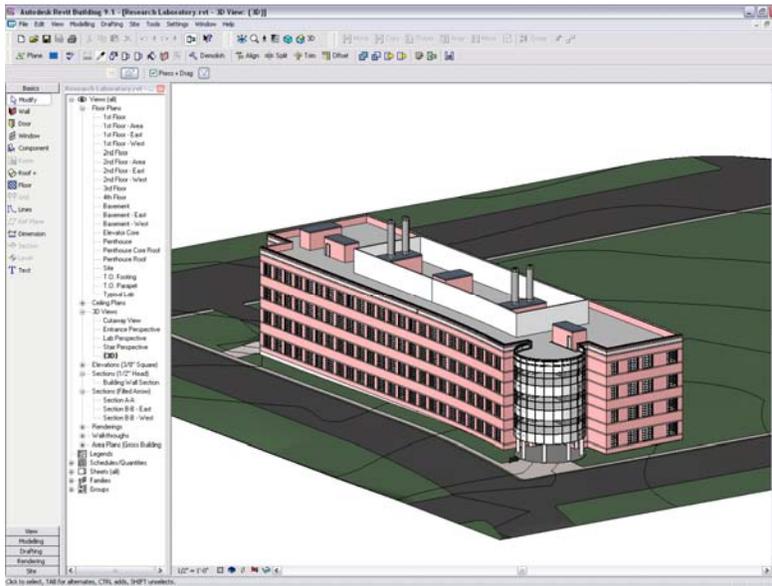
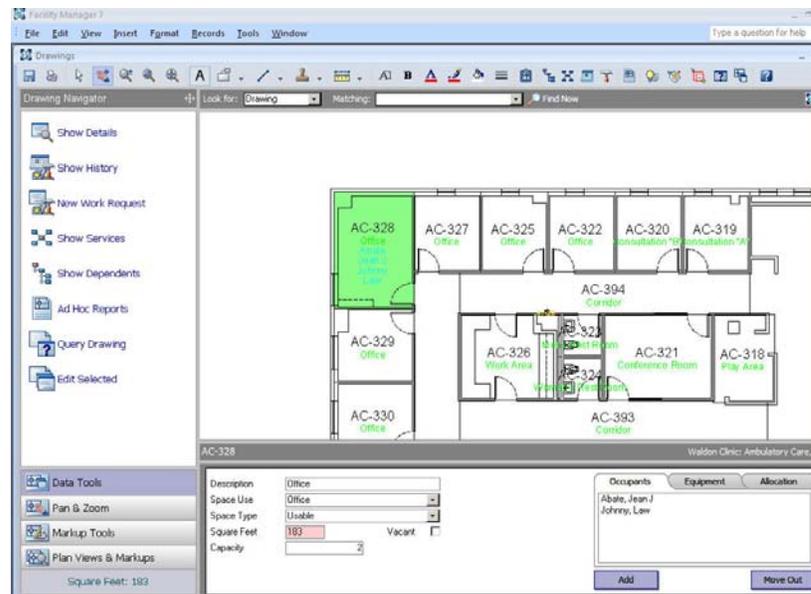


Figure 2:

DWF technology is used to connect BIM-based building information from Revit to Autodesk FMDesktop for facilities management and operations.



¹ For organizations that don't have supporting CAD drawings, spatial information can also be entered directly into the database. If and when facility drawings become available, the user has the choice of using the entered area or the area derived from the drawing.

DWF-based Space Management

DWF is a technology platform developed by Autodesk to distribute and communicate design information, without losing critical data and without the recipient needing to know or even have the native design software. In that framework, Autodesk FMDesktop reads DWFs published from BIM solutions such as Revit² and automatically interprets space and room data. Note: The Facility Link module described earlier also allows organization to "batch-connect" spaces drawn in AutoCAD-based facility drawings to the facility database, enabling Autodesk FMDesktop to consume building data that isn't derived from a BIM process.

Contrast this approach with the typical CAFM (computer-aided facilities management) process. The facility manager scans paper floor plans (or sometimes imports electronic CAD files) for use within the CAFM application. The electronic floor plans are then used as backdrops to create "polylines" (closed loops composed of line and arc segments) to define an area and identify room numbers to name that area. The time it takes to manually "polyline" a typical commercial building can stretch from days to weeks (a 75,000 sq. ft., 3-story office building might take 4 or 5 days to "polyline") and has spawned an entire cottage-industry for "polylining" services. By using DWFs to move building data from Revit to Autodesk FMDesktop, Autodesk has made this reliance on the labor-intensive, manual creation of polylines obsolete.

Traditionally architects have had difficult choices to make when their clients asked for help getting design data into their CAFM systems: say "no"; use high-rates to dissuade the client; or agree to do tedious manual entry or complicated database transfers at low margin for the sake of a client relationship. But now, architects using Revit Architecture can simply publish their Revit building model to DWF and email the file to the owner having Autodesk FMDesktop. The owner imports the DWF file into Autodesk FMDesktop, which reads the room boundaries, room areas, room numbers and descriptions from the DWF, and (if applicable) compares it to the existing database to find new and removed rooms, and then updates the Autodesk FMDesktop model. No polyline services or database transfers.

In addition, DWF files can be generated from other Autodesk design products such as AutoCAD, there may be some manual data cleansing required by the facility manager (based on the quality of the data coming from the design tool and the fidelity of its data transfer to DWF). But the end result is that owners/operators using Autodesk FMDesktop can consolidate data from multiple sources—taking advantage of data coming from their different architects and contractors who've worked on different properties or renovated spaces using different authoring tools.

Facility managers can then use the simple tools in Autodesk FMDesktop to generate their own color-diagram room reports and their own floor plans with room numbers, areas, occupant names, and so on—without having to call the architect or their in-house CAD specialist...unless it's time to move a wall. And if that time comes, DWF also facilitates the return of updated information back to the architect's Revit building model. For example, the facility manager can redline the DWF to highlight modified room numbers or room types, and email the DWF back to the architect.

² Autodesk FMDesktop can also read DWFs published from AutoCAD Architecture and interpret those space objects.

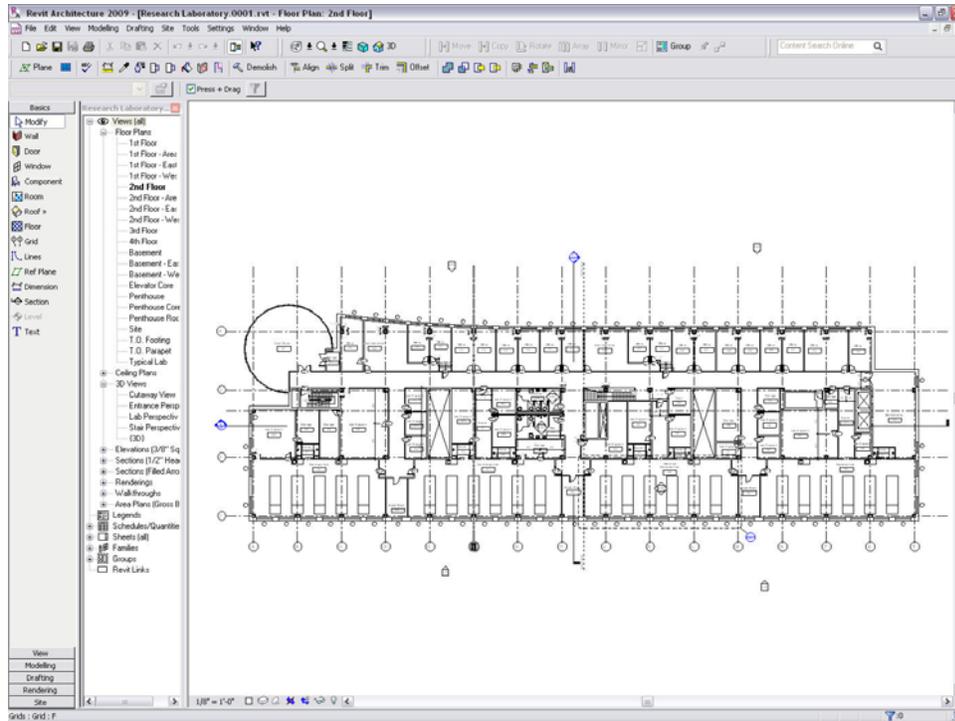


Figure 3:

Facility managers using Autodesk FMDesktop can take advantage of the consistent, coordinated building information coming from a Revit BIM process—such as the research laboratory facility shown here.

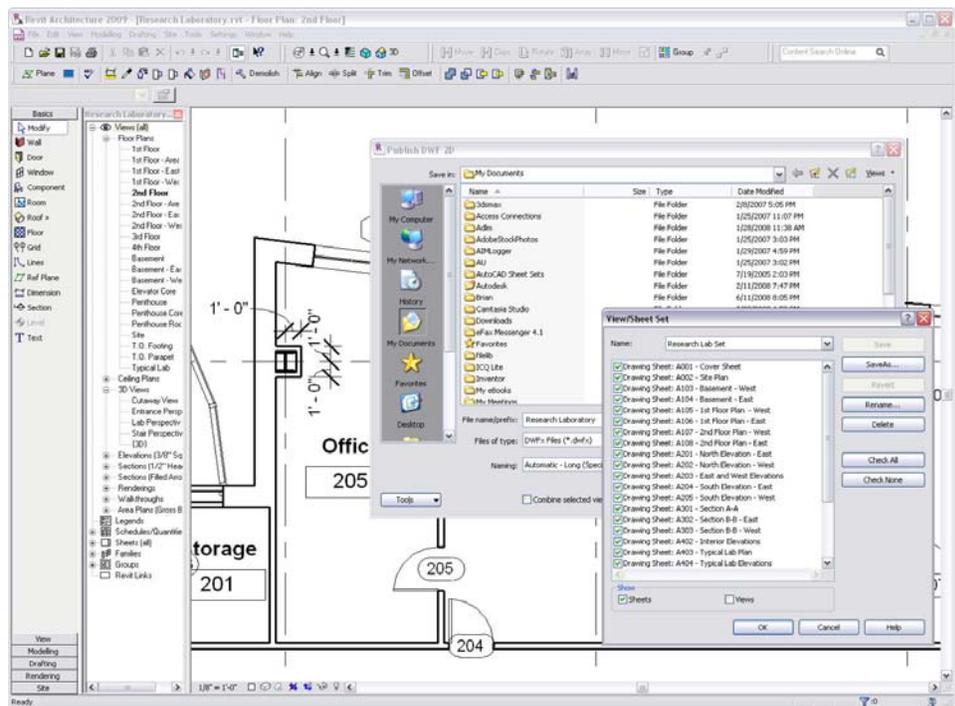


Figure 4:

To use the Revit building information in Autodesk FMDesktop, the Revit model (and pertinent drawing sheets) are published to DWF.

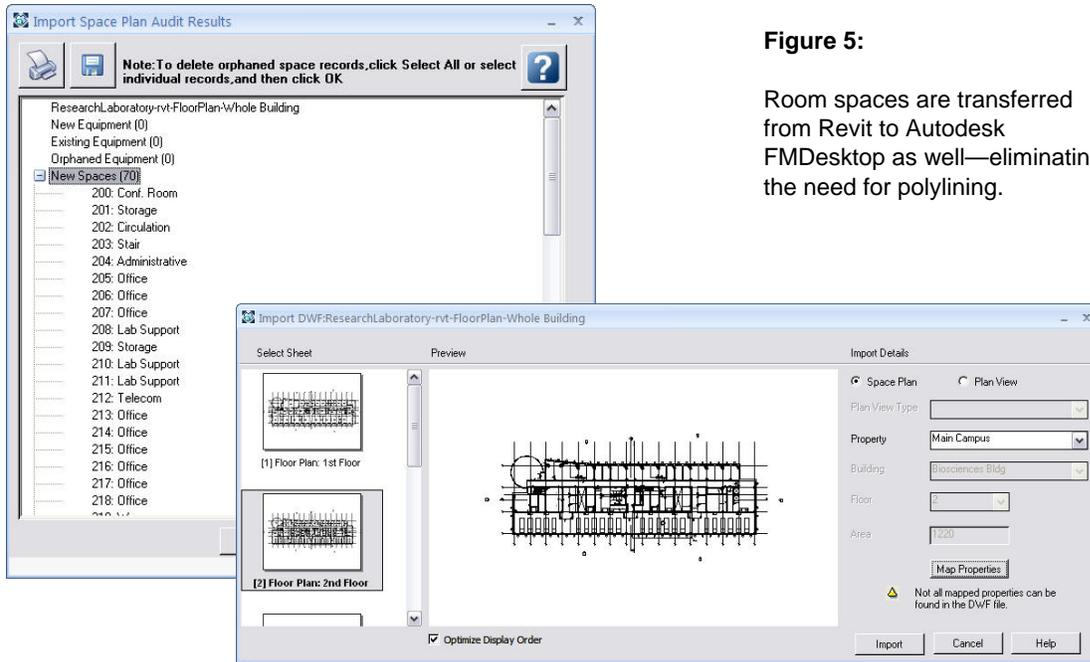


Figure 5:

Room spaces are transferred from Revit to Autodesk FMDesktop as well—eliminating the need for polylining.

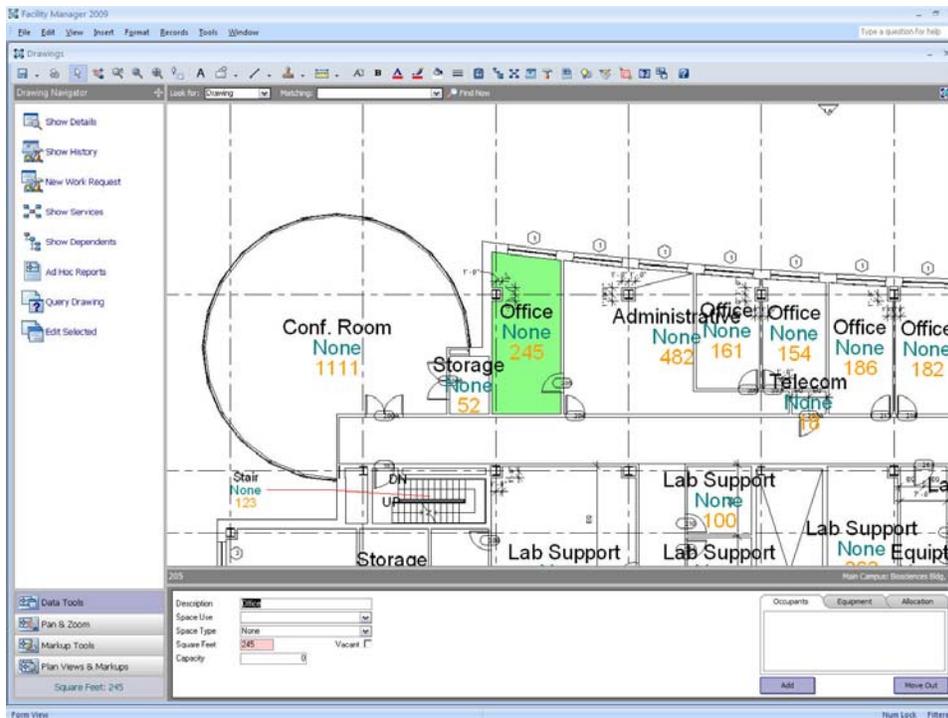


Figure 6:

Autodesk FMDesktop reads the DWFs published from Revit and automatically interprets the space and room data.

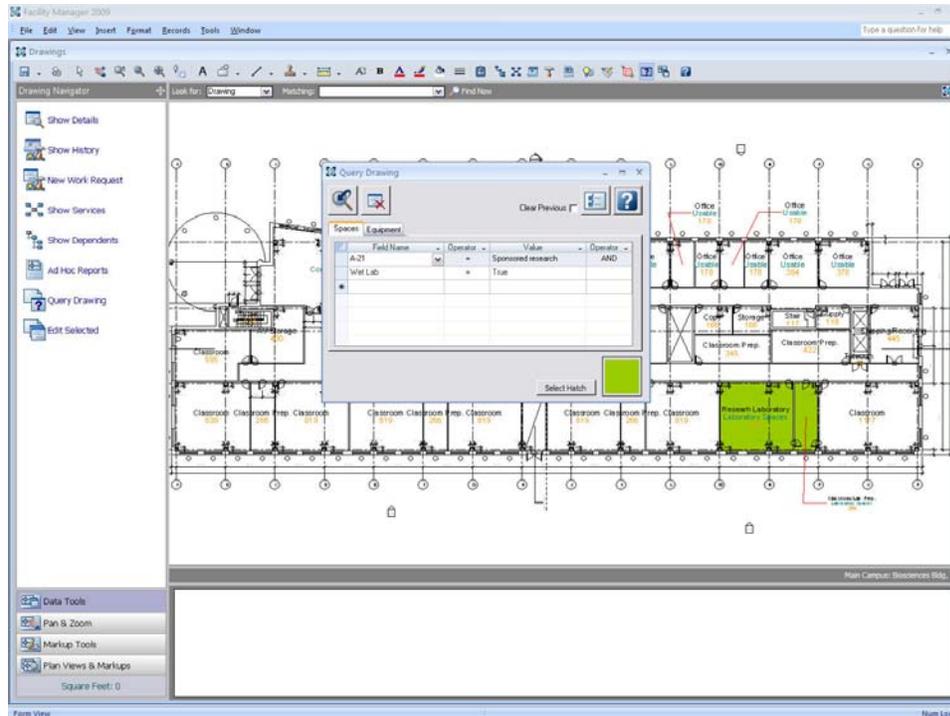


Figure 7:

The building data derived from Revit BIM processes can then be used for a variety of space management activities, such as the query shown here and the resulting color-coded floorplan.

DWF-based Asset Management

In addition to linking spatial data, DWF can also be used to migrate asset information from a Revit design model to Autodesk FMDesktop. As a building design progresses, important asset information is gradually added to a building model. For example, during early design, generic forms of equipment or building components are depicted in the building model—a 2'x2' acoustical ceiling panel or a horizontal air handling unit for example.

As the design progresses and procurement occurs, these generic representations are fleshed out and updated with manufacturer-specific components—a 2'x2' USG Glacier Panel or a Trane T-Series Air Handler for example. After procurement and/or installation, part-specific data such as serial numbers may be added for important equipment, especially equipment under warranty such as the air handling unit used in the example above.

Using DWFs to transmit the data, all of that asset information can be easily moved from the Revit design model³ into Autodesk FMDesktop. In addition, supporting documentation like warranties, installation manuals—data typically included in the submittals provided by the builder to the facility owner during handover—can be linked to the components in the building model and uploaded into the documents area of Autodesk FMDesktop and attached to the imported assets

³ Models from any solution within the Revit platform: Revit Architecture, Revit MEP or Revit Structure.

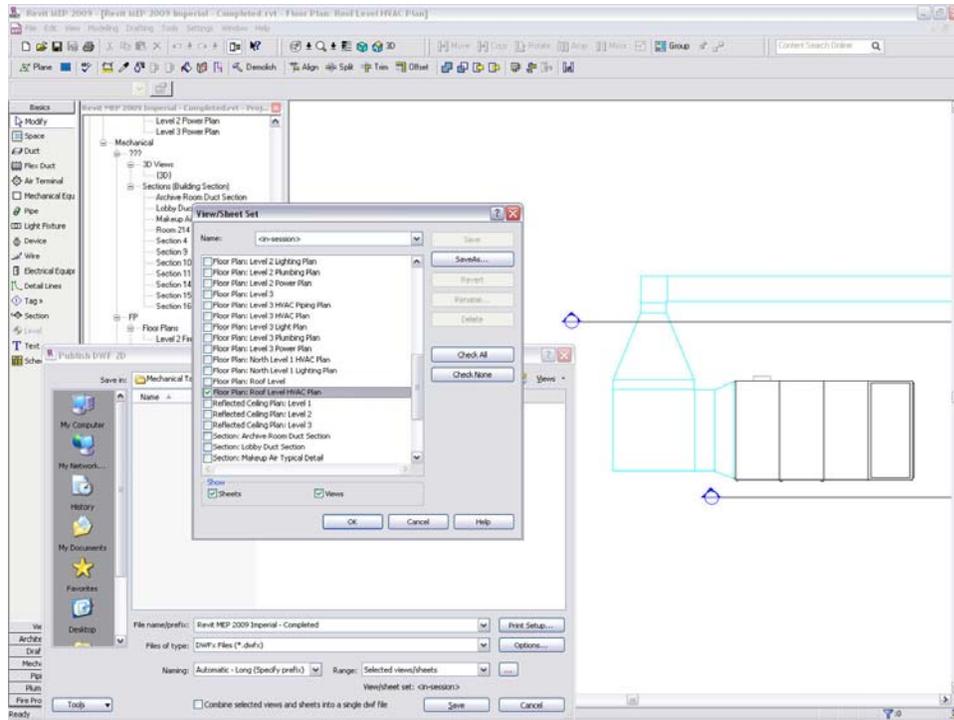


Figure 8:

DWF technology is also used to connect BIM-based asset information (HVAC equipment from a Revit MEP model for example) to Autodesk FMDesktop for asset management.

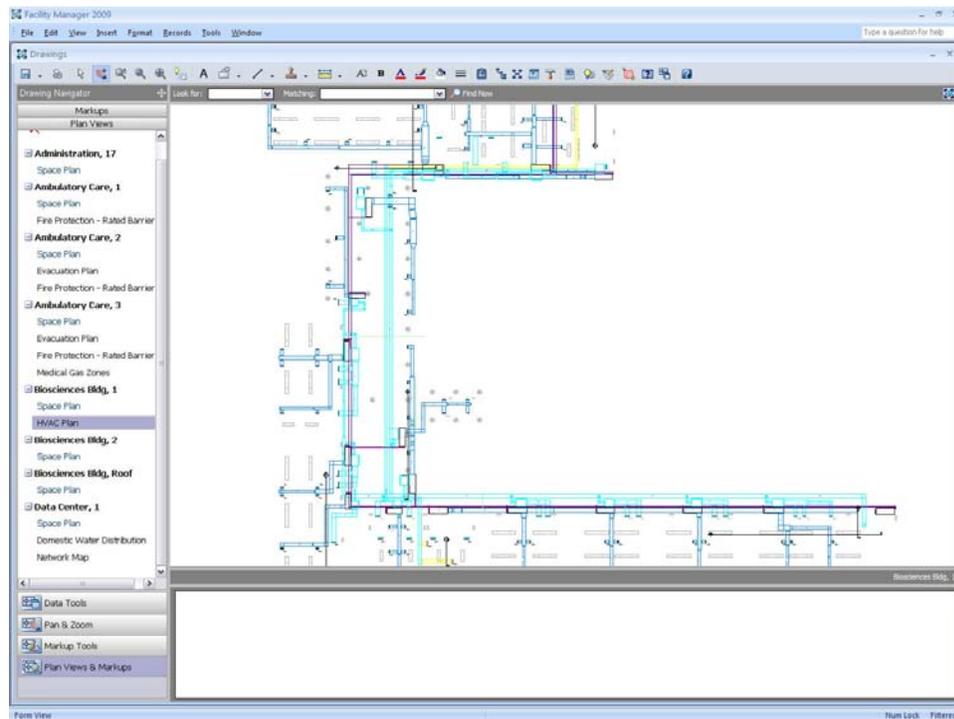


Figure 9:

The Revit MEP drawing sheets are also imported and accessible from the Autodesk FMDesktop environment.

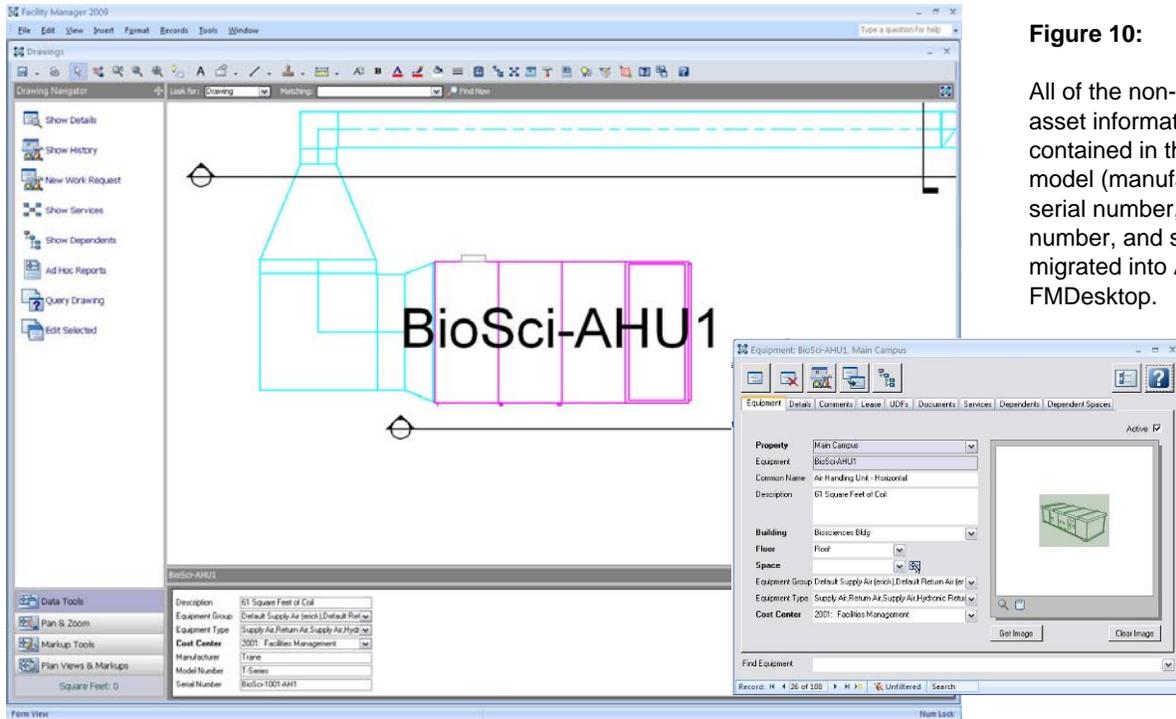


Figure 10:

All of the non-graphic asset information contained in the Revit model (manufacturer, serial number, model number, and so on) is migrated into Autodesk FMDesktop.

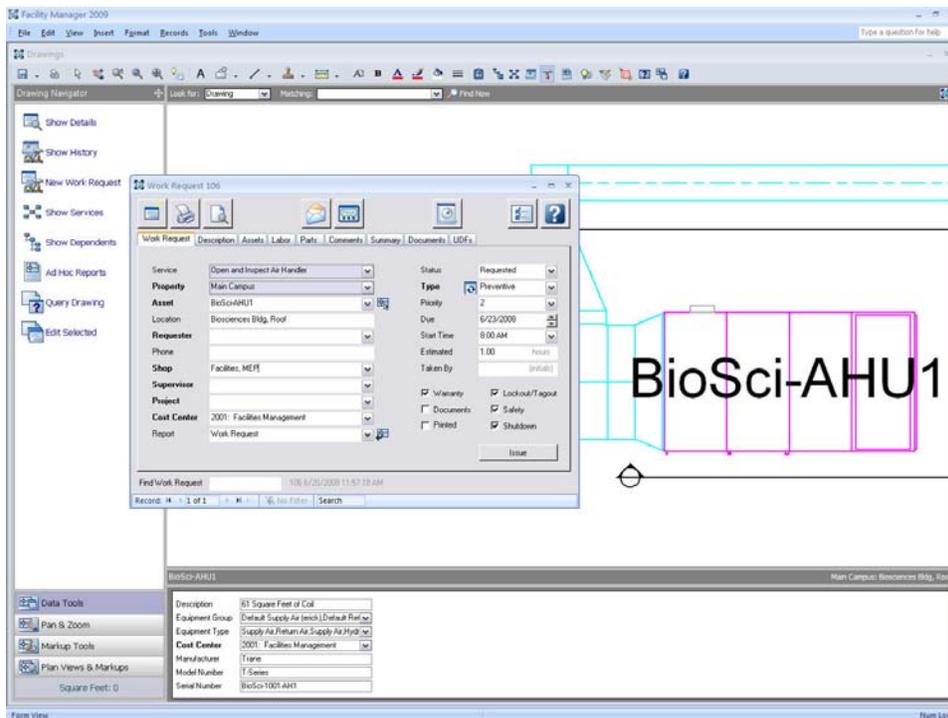


Figure 11:

This asset information is critical for maintenance management and related activities, such as the preventative maintenance work request shown here.

BIM and Facilities Management: High Expectations

The prospect of using BIM in building operation and maintenance increases as the adoption of BIM solutions within design and construction firms grows. As architects move more rapidly to BIM—and the building industry towards integrated project delivery (IPD)—the opportunities to leverage digital design data for downstream facilities management become more prevalent.

The lag between technological capability and user adoption is a well-known phenomenon and so it comes as no surprise that the uptake of BIM solutions is progressing along a path similar to the one the building project itself takes: first design, then construction, and finally facility operation. User adoption rates of BIM solutions for design are strong⁴. Builders that are implementing BIM might be categorized as “early adopters”, although the uptake of BIM in construction is progressing very quickly—catalyzed by IPD as well as the bubble of BIM-based design data currently moving through the construction pipeline. The last threshold to cross is facility operation, with an emerging use of BIM by owners and operators.

As user adoption of BIM data for facilities management evolves, Autodesk FMDesktop will be evolving as well. For example, Facility Manager already has the capacity to understand equipment dependencies (i.e. equipment that supports or are supported by other equipment such as a panel breaker that feeds electrical outlets) but currently those relationships must be established manually within Autodesk FMDesktop, although this system topology is already “built in” to Revit MEP models. The ability of Autodesk FMDesktop to read and absorb this system topology from Revit models is a logical progression for future development. Changes such as this—to more fully leverage building information coming from design and construction—will be critical to hasten the use of BIM for facilities management.

Acceptance of BIM for Facilities Management

With the increase of BIM for design, the owner/operator’s use of that building information for facilities management is becoming more commonplace and more anticipated. Consider these examples:

- To facilitate lifecycle building process integration and sharing digital datasets, the National Institute of Building Sciences (NIBS)—in conjunction with the International Alliance for Interoperability (IAI) and many other facilities-related associations and software companies—released in December of 2007 the first version of a National Building Information Model Standard (NBIMS)ⁱⁱ, which is a set of interoperable standards for exchange of facility and infrastructure data through the lifecycle of a building project.
- Government agencies such as the U.S. General Services Administration (GSA) now require the delivery of spatial program information from building models for major projects that are receiving design funding in Fiscal Year 2007 and beyondⁱⁱⁱ. This is a clear example of the growing availability of digital building models for operational purposes and will undoubtedly enable a more complete turnover of facility data.

⁴ The American Institute of Architects (AIA) reported, in its *2005-2006 AIA Firm Survey*, that on average 40% of firms surveyed who had 50 or more employees used BIM.

- Another high-profile owner-initiative that calls for improved facility data is U.S. Presidential Executive Order 13327 (EO 13327) for Federal Real Property Asset Management^{iv}. EO 13327 promotes the creation of a common infrastructure to facilitate effective information sharing/reuse, with the goal of promoting the efficient and economical use of the U.S. federal government's real property assets.

The order charged the GSA with developing and managing a centralized real property database that contains data on all federal real property assets (buildings and structures). Facility managers within the federal agencies who control these properties are required to submit data to this system (called the Federal Real Property Profile or FRPP) on an annual basis—including data such as space utilization, replacement value, etc.

Autodesk FMDesktop can be deployed at the agency, region, command or facility level to capture this local data and roll that information up to an agency level and then to the FRPP system. As program information from building models (now required by the GSA, as described earlier) are made available for facility operations, this process will become even more streamlined.

- The Construction Operations Building Information Exchange (COBIE) project^v is another example of the growing emphasis on capturing and transmitting digital building information so it can be reused during building operations. The goal of the NASA-funded project is to improve the quality of the information provided to operations and maintenance by creating standardized content and formats for the building handover as part of the U.S. National BIM Standard (NBIMS).

In keeping with the philosophy of BIM, COBIE enables facility information that is created throughout the planning, design and construction processes to be digitally captured and passed on to the next link in the building chain so to speak—and ultimately delivered to the owner—versus the standard practice of the project contractor assembling documents for electronic handover at project closeout.

- The American Institute of Architects (AIA) is considering how to modify their contract documents^{vi} to codify the transfer of a BIM-based digital design models; putting in place an agreement structure whereby the design model and the intellectual property it represents can flow naturally from the architect to the owner/operator, who can then get better data to manage a building from the most appropriate source of that data: the architect who designed the building.

Summary

The benefits of using BIM during building design have been well-publicized and are fueling its adoption rate amongst architects worldwide—transforming their drawing-based processes to model-based processes. The benefits of using information from a building model for facilities management are likewise compelling—fueling the discussion surrounding building lifecycle management and nudging facilities management towards model-based processes.

Facility managers using Autodesk FMDesktop can now take advantage of the reliable building information being created by Revit—immediately realizing several significant benefits. Using room data from the Revit design model eliminates costs associated with the manual creation of polylines. DWF technology minimizes the frustration of cobbling together disparate building data from multiple design sources. But most importantly, facility managers can rest easy—confident in their use of the coordinated, consistent, reliable data being delivered from the Revit design model.

References

- i. Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry, Gallaher, M. P.; O'Connor, A. C.; Dettbarn, J. L., Jr.; Gilday, L. T. (NIST GCR 04-867; 194 p. August 2004.)
- ii. <http://www.facilityinformationcouncil.org/bim/publications.php>
- iii. <http://www.gsa.gov/bim>
- iv. <http://www.gsa.gov/realpropertyprofile>
- v. <http://www.wbdg.org/resources/cobie.php>
- vi. http://www.aia.org/nwsltr_tap.cfm?pagename=tap_a_documents

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