AUTODESK **UNIVERSITY** 2013

Seeking Breakthrough Outcomes in Projects and Building Whole Life Management

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FM 2921

The class describes DPR's implementation of integrated project delivery (IPD) to deliver breakthrough project outcomes and to make the digital assets developed for design and construction flow into the owner's systems to support whole-life facility management. Our clients seek reliable and predictable project outcomes. After handover, their O&M teams seek to reduce the total cost of ownership through building performance and by extending the service life of systems. These goals require us to rethink roles and relationships in terms of measurement and validation, knowledge transfer, and managing facility changes. Integrating design, commission, and test information with integrated workplace and building automation systems helps clients to manage buildings at a lower cost. We will share our experiences in working with clients who understand the business value of IPD based on shared models to achieve breakthrough project and building whole-life management outcomes.

Learning Objectives

At the end of this class, you will be able to:

- Describe the total-cost-of-ownership value proposition
- Communicate how IPD methods can deliver whole-life value
- Design whole-life value requirements into your project design and buyout plan
- Develop assessment processes and design an incremental whole-life value plan

About the Speaker

As director of DPR Consulting, Andrew Arnold applies more than 25 years of experience in product design and management, product, and process modeling for AEC applications and consulting to help DPR clients establish appropriate lean construction, building information modeling (BIM) and integrated project delivery (IPD) strategies and practices for their projects and facility operations. Most recently, Andrew assisted in a BIM for facilities management implementation on a large-scale healthcare project in San Francisco, CA.

Andrew received his PhD in construction engineering and management from Stanford University's Center for Integrated Facilities Engineering (CIFE). Beforehand, he worked in architecture, participating in hospitality, health science, and education projects. He also consulted for large enterprises in selection and deployment of computerized aided facilities management (CAFM) systems. After his graduate work, he worked in technology startups, designing and managing products and services that focused on modeling and indexing product performance information with BIM, BIM content management, and BIM analysis applications, including quantity take-off and cost estimating, LEED contribution and documentation, and immersive BIM visualization using game engine technologies.

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The Total Cost of Ownership Value Proposition

Our industries, and most owner representatives, are heavily incentivized to focus on the price tag of design and construction, but that is a small percentage of the building's cost throughout its whole lifecycle (Figure 1). Many DPR clients see an opportunity to lower the total cost of building ownership (TCO) through a better understanding of major systems, including regular servicing and preventive maintenance, ongoing repairs, consumables, and energy consumption.

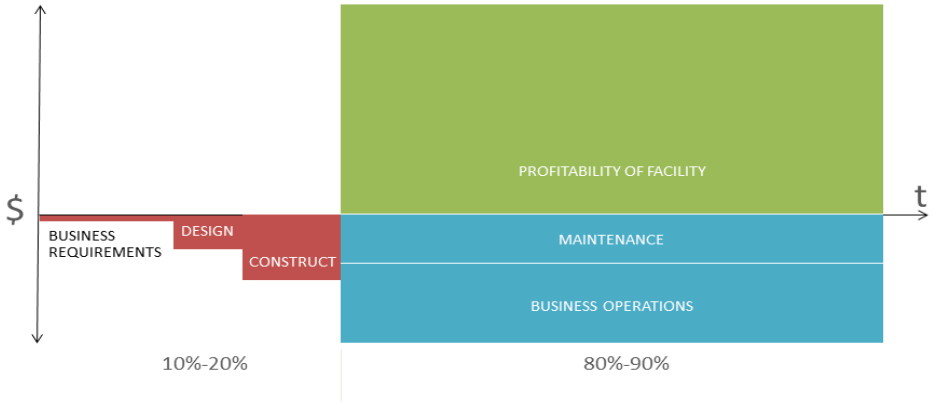


Figure 1 Design and construction are a fraction of the total costs over a building's lifecycle

The ability to manage building systems effectively depends on the information the owner has about them. Historically, collecting and organizing such information for input into asset management systems has been costly, and out of reach for many of our clients; however, relevant technologies have advanced and costs are dropping. Our clients are beginning to understand that digital design and construction information (BIM) offers increased value for facilities management, but also increased complexity.

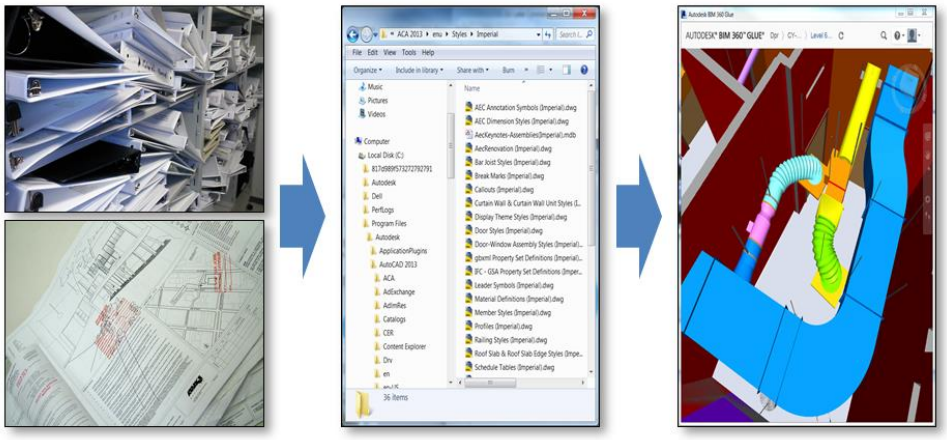


Figure 2. O&M organization's information management challenge

They face a transition from managing as-built paper drawings; to managing electronic as-built drawings; to managing the extraction of information from BIM elements that represent systems and products installed in their facilities for input to asset management databases (Figure 2). They will realize a cost savings if the information can flow seamlessly. Paul Teicholz, the editor of *BIM for Facility Managers* (IFMA, IFMA Foundation, 2013) proposes the following benefits:

1. Reduced costs of data input into the Space Planning and Work Order Management modules of their asset management systems;

2. BIM data integrated with asset management and building automation systems provides a rich information set for better understanding of building systems in operation;

3. Rich, accurate, and fast access to building data leads to faster analysis and correction of problems, and fewer breakdowns, which supports happier and more productive building users, and ultimately improved building performance.

He calculates a potential annual O&M savings of $0.10/SQ FT, with a ROI of less than two years based on conservative assumptions about costs and benefits of making design and construction data flow into the owner's asset management systems[i].

He also worked with Igor Starkov, CEO of ecoDomus, on the ecoDomus ROI calculator that you can use to make the business case of BIM for FM to building owners, see '*EcoDomus FM ROI Calculator_rev3_PT.xlsx*' on the class handout portal, courtesy of ecoDomus. In addition, Fallon and East developed a study and spreadsheet to calculate the savings during design and construction related to the use of COBie to exchange information as opposed to sharing paper documents, http://www.nibs.org/default.asp?page=bsa_cobiecalc.

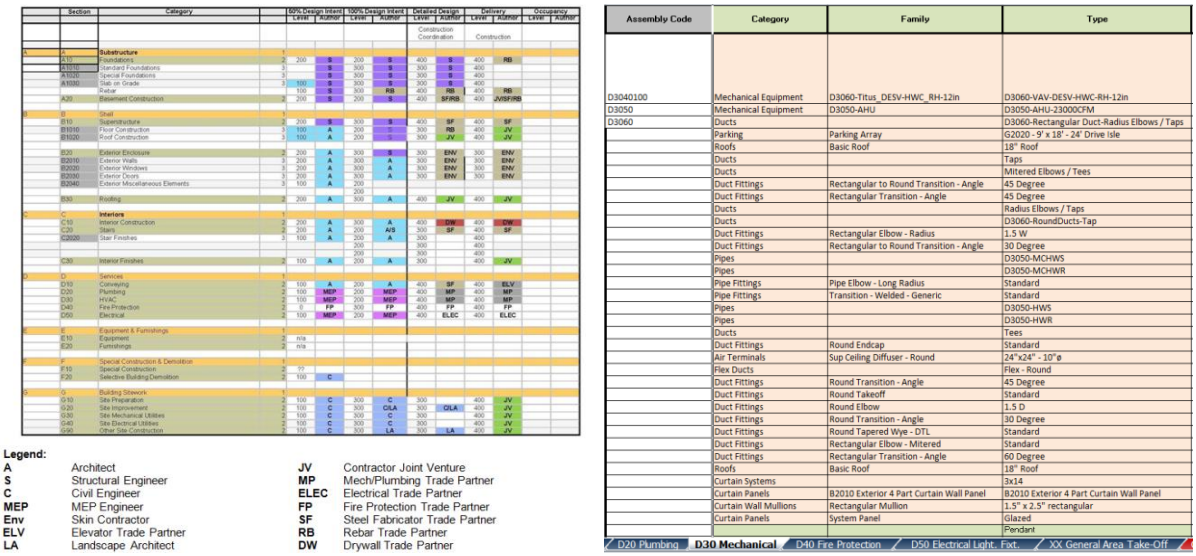
In coming years project-metrics will emerge to validate the Teicholz analysis. The industry needs projects that implement BIM for FM to measure actual costs and benefits.

IPD methods can (also) deliver Whole Life Value benefits

At DPR, we characterize Integrated Project Delivery in terms of designing and building the right product (the facility), developing collaborative and concurrent processes, and establishing organizational alignment for integrated multi-disciplinary teams through shared risk and reward agreements i.e., the Product, Process, Organization framework (Fischer & Kunz, June 1996). Our IPD projects:

- Establish Clear and measurable client goals;

- Implement Multi-disciplinary coordination: project participants form cross disciplinary clusters for major building systems/components and collaborative processes for rapid model review, clash detection, constraint identification and removal, and continuous cost modeling;
- Map design and engineering processes, and use pull planning to understand information give and get relationships between team members;
- Define and formalize modeling and other information development responsibilities between team members in a BIM Execution Plan that includes a Model Development Specification and Content Plan;
- They mapped design and engineering processes to understand information give/get relationships, which they documented in a Model Development Specification (MDS) and BIM Content Plan (BCP), see Figure 3.



Legend:

A	Architect	JV	Contractor Joint Venture
S	Structural Engineer	MP	Mech/Plumbing Trade Partner
C	Civil Engineer	ELEC	Electrical Trade Partner
MEP	MEP Engineer	FP	Fire Protection Trade Partner
Env	Skin Contractor	SF	Steel Fabricator Trade Partner
ELV	Elevator Trade Partner	RB	Rebar Trade Partner
LA	Landscape Architect	DW	Drywall Trade Partner

Assembly Code	Category	Family	Type
D3040100	Mechanical Equipment	D3060-Titus_DESV-HWC_RH-12in	D3060-VAV-DESV-HWC-RH-12in
D3050	Mechanical Equipment	D3050-AHU	D3050-AHU-23000CFM
D3060	Ducts		D3060-Rectangular Duct-Radius Elbows / Taps
	Parking	Parking Array	G2020 - 9' x 18' - 24' Drive Isle
	Roofs	Basic Roof	18" Roof
	Ducts		Taps
	Ducts		Mitered Elbows / Tees
	Duct Fittings	Rectangular to Round Transition - Angle	45 Degree
	Duct Fittings	Rectangular Transition - Angle	45 Degree
	Ducts		Radius Elbows / Taps
	Ducts		D3060-RoundDucts-Tap
	Duct Fittings	Rectangular Elbow - Radius	1.5 W
	Duct Fittings	Rectangular to Round Transition - Angle	30 Degree
	Pipes		D3050-MCHWS
	Pipes		D3050-MCHWR
	Pipe Fittings	Pipe Elbow - Long Radius	Standard
	Pipe Fittings	Transition - Welded - Generic	Standard
	Pipes		D3050-HWS
	Pipes		D3050-HWR
	Ducts		Tees
	Duct Fittings	Round Endcap	Standard
	Air Terminals	Sup Ceiling Diffuser - Round	24"x24" - 10"ø
	Flex Ducts		Flex - Round
	Duct Fittings	Round Transition - Angle	45 Degree
	Duct Fittings	Round Takeoff	Standard
	Duct Fittings	Round Elbow	1.5 D
	Duct Fittings	Round Transition - Angle	30 Degree
	Duct Fittings	Round Tapered Wye - DTL	Standard
	Duct Fittings	Rectangular Elbow - Mitered	Standard
	Duct Fittings	Rectangular Transition - Angle	60 Degree
	Roofs	Basic Roof	18" Roof
	Curtain Systems		3x14
	Curtain Panels	B2010 Exterior 4 Part Curtain Wall Panel	B2010 Exterior 4 Part Curtain Wall Panel
	Curtain Wall Mullions	Rectangular Mullion	1.5" x 2.5" rectangular
	Curtain Panels	System Panel	Glazed
			Pendant

D20 Plumbing | D30 Mechanical | D40 Fire Protection | D50 Electrical Light Fixt. | XX General Area Take-Off

Figure 3: Model Development Specification and BIM Content Plan

- They also track key measures, including target and expended costs for each cluster, performance percentage complete (PPC) using the Last Planner© system, the number of clashes, and RFI count and response rates.

Incorporating Whole Life Value Requirements into project design and buyout

Incorporating the client's Facilities and Support Service groups in the IPD process will assure that their requirements are pulled into the project and incorporated into the project buyout. Often, an Assessment engagement will help the client's Facilities and Support Services teams articulate their BIM for FM requirements.

Assessment

A BIM for FM assessment helps the client understand its capability and capacity to manage BIM data. The assessment defines information that should be "pulled" from the construction project to serve the client's facilities management needs; i.e., to pull project information, we need to understand the client's FM requirements; to understand FM information requirements, we need to define am FM data schema; to define an FM data schema, we need to understand the tools the client uses to manage its facilities; to understand the client's tools, we need to understand the client's use cases, goals, and organizational maturity model. Figure 4 summarizes the assessment process as a pull plan.

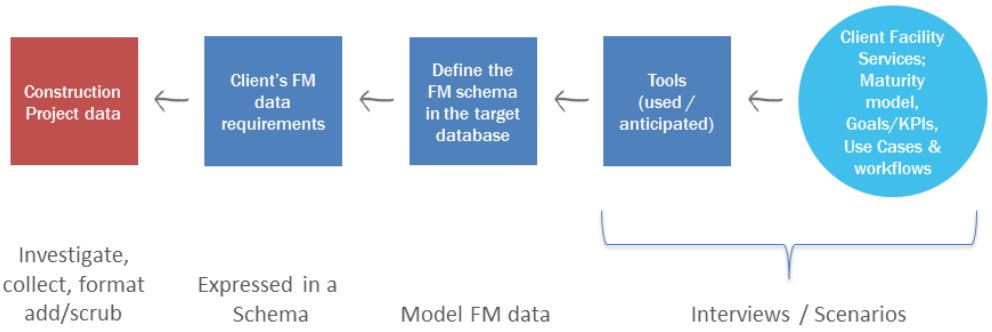
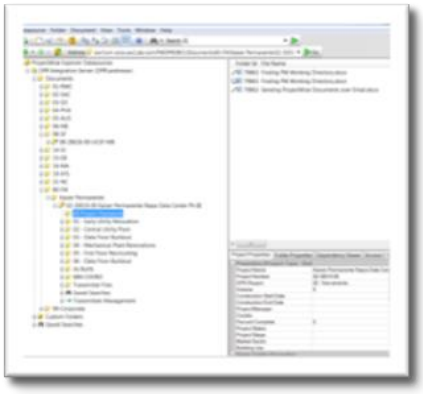


Figure 4. Assessment Summary

The assessment deliverables include a strategy and implementation plan, and BIM modeling Guidelines. It is critical to include the Facility Services and Operations groups in the assessment effort to assure that their requirements are incorporated into the project from the beginning. The assessment should also layout requirements for:

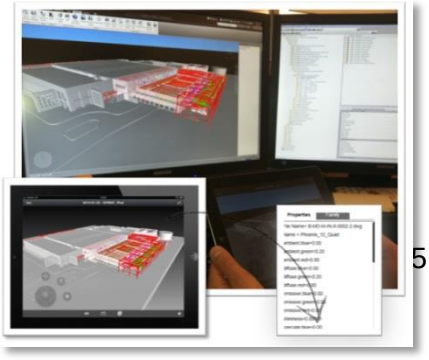
Document Control

Setting up and placing project files in a content management system, which controls file sharing and versioning, is the first step in managing project information. Such a system permits the information owner to control access and manage changes, assuring a 'source of truth' for updated and reliable information. The client should select and deploy a system or procure it as a Managed Service.



2D and 3D Visualization

2D and 3D visualization tools provide an intuitive way to find building information by the location of systems and products in the facility. It is necessary to simplify and organize design and construction models for FM use, associate project documents e.g., specs, approved submittals, warranties,



commission and test reports, etc., to model elements, and integrate all the data in tools that support 2D and 3D viewing, data, and document finding.

Catalog spaces

Functional spaces, rooms, and square footage data modeled in the architectural drawings should flow into the client's Space Planning system.

Catalog Systems and products

BIMs that accurately catalog the assets in the project represent a critical step forward in achieving a TCO approach to facility management. A catalog of assets, including system and product operational attributes, should flow from the BIM into the client's Work Order System. This allows the client to track historical performance and improve planning for asset repair or replacement. By incorporating key modeling activities during design and construction we can leverage the model post construction to eliminate redundant data entry into work order management systems.

Project buyout scopes for trade partners should specify the right information for FM, formatted the right way. Additionally, the project should think through how it will validate as-built BIMs and data for correctness. Laser Scanning can compare the as-built BIM with installed systems and through tools that check that FM data conforms to the client's data requirements.

System Integration

Bridging design and construction data with the client's asset management systems includes system integration effort to support system interface setup for sharing BIM data with space planning, work order management, and Building Automation Systems (BAS) and for implementing direct program interaction between Asset Management Systems and BIM visualization tools.

Other Services

In addition to document control, the client should think through how it will manage ongoing updates to keep the client's as-built BIMs and CAD drawings and data current.

Further, clients can drive conformance to BIM standards and guidelines by creating and distributing BIM content (models of building assemblies and products) that is indexed to corporate facilities guidelines and represents the real-world building products that the client procures.

[i] Teicholz analyzed facility management cost data that IFMA (International Foundation of Facility Managers) collected from its membership. He calculated NPV and ROI based on a typical 400,000 SQ FT office building. The potential ROI is higher for more complicated building types.