

Meridian Systems White Paper



BIM and Project Management

Advancing Integrated Project Delivery on Capital Building Programs

A white paper from Meridian Systems that describes how Integrated Project Delivery is being advanced through the integration of Building Information Modeling with construction project management and Infrastructure Lifecycle Management solutions.

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Meridian Systems

Definition of Building Information Modeling

Designing buildings and facilities using data rich Building Information Modeling (BIM) is taking hold in the marketplace. BIM can be described as a design methodology that results in a digital 3-dimensional model. This model represents three key facets: 1) a facility's geometrical and spatial relationships; 2) building systems and components, as well as 3) properties of specified equipment and materials. To visualize BIM as part of a technology solution, imagine a 3-dimensional visual interface that sits on top of a database of information that describes all elements within a building.

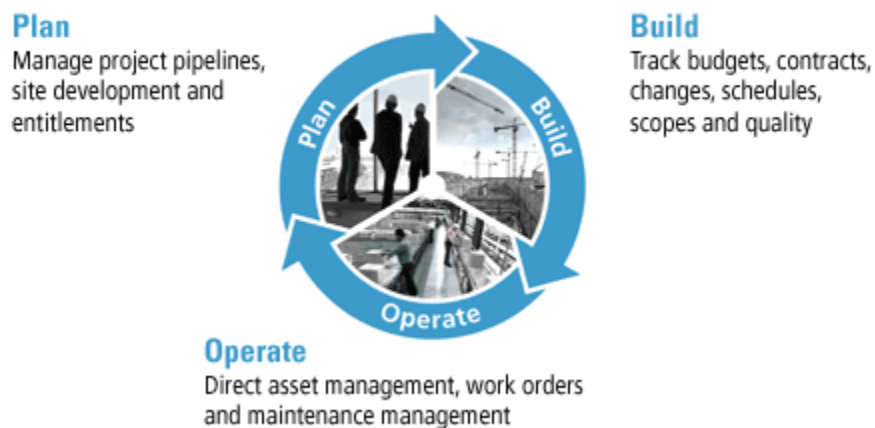
Understanding the value of BIM begins with a short review of how buildings have traditionally been designed by architects; in a 2-dimensional, document-driven world that includes elevations, plan views, and sections. Various engineers have to overlay and coordinate the geometry to make everything work together. The result is hundreds of 2-dimensional drawings and a specifications book consisting of thousands of pages that describe the building's geometry, systems, materials and equipment.

Rather than using this static 2-D approach, BIM requires architects and engineers to initially design in a 3-dimensional way. BIM models typically align by discipline. For example, a building can have an Architectural BIM model, a Structural BIM model, and a MEP (Mechanical, Electrical, and Plumbing) BIM model, and so on. Ideally, these multi-discipline models seamlessly come together to form one unified and complete building model.

BIM is primarily a methodology; however it requires suitable technology to be implemented effectively. There are multiple software applications that support the creation of BIM models; these applications typically utilize a "3-D model" user interface which is linked to an underlying database.

Infrastructure Lifecycle Management: An Expanded Successor to Construction Project Management

Over the years, the discipline of construction project management has evolved from AEC-centric applications to broader use across the capital projects industry. This evolution led to the introduction of Infrastructure Lifecycle Management (ILM) software solutions. ILM is an expanded successor to Project Management because it is designed for those companies that manage the plan, build and operate lifecycle for both new and existing buildings and facilities.



ILM manages business data between the various parties that come together including budgets, contracts, changes, designs, schedules, resources, correspondence, quality, assets and maintenance. ILM processes start with the planning and design phase of potential projects, progress through procurement and construction, and continue ultimately into the management of assets and maintenance for facilities.

ILM is an organizational commitment, and thus requires technology suitable for large-scale enterprises that are continuously involved in managing several programs, projects, and existing facilities. These organizations require individual project focus, but perhaps more importantly, also need consistent processes and performance visibility across their entire facility portfolios.

Connecting ILM and BIM along the Plan, Build and Operate Lifecycle

Diving deeper into the plan, build, operate project lifecycle, one can see many synergistic opportunities for ILM technology and BIM models to come together. For example, during the plan phase the building owner determines the financial feasibility of a project and hires architects and engineers to design the project. During the build phase, a general contractor is selected to construct the facility, while the owner and design teams provide oversight. And finally, during the operate phase, the owner takes over the newly completed facility and manages this new asset through preventative, predictive, and corrective maintenance.

Currently, BIM is most prevalent in the plan phase as architects and engineers can digitally design BIM models that create huge efficiencies in the iterative design process. But once rich BIM models have been designed, downstream value is created for both the contractor and owner through cost reductions, and by providing a more accurate model of the final finished building.

	Plan	Build	Operate
Infrastructure Lifecycle Management (ILM) Operational Business Processes and Data	<ul style="list-style-type: none"> • Project Pipelines • Budget Development • Scope Development • Budget Approvals • Funding Approvals 	<ul style="list-style-type: none"> • Contracts & Changes • Scheduling • Bidding and Buyout • Design Distribution • RFIs & Submittals 	<ul style="list-style-type: none"> • Asset Management • Equipment Assets • Location Assets • Maintenance Mgmt • Work Orders
Building Information Modeling (BIM) Digital Design Model	<ul style="list-style-type: none"> • Conceptual Design • Iterative Designs • Architectural BIM • Structural BIM • MEP BIM 	<ul style="list-style-type: none"> • Construction Sequencing • 4 D Modeling • Clash Detection • Fabrication BIM • Spatial BIM Installation 	<ul style="list-style-type: none"> • As Built Model • As Built Equipment • Complete Virtual Bldg

There are several opportunities to synchronize ILM with BIM methodology across the plan, build, operate lifecycle

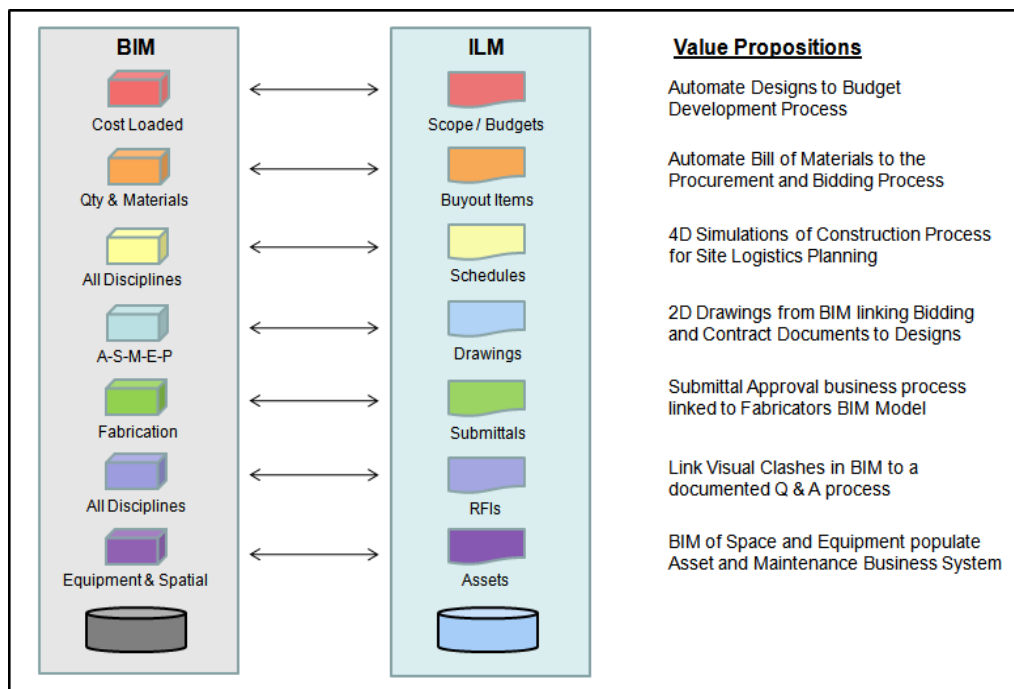
Similarly, an organization goes through various business processes during the same three phases. Companies must make go/no-go decisions on a pipeline of projects, and they must iteratively develop a

budget and funding strategy sufficient to execute on each project. The business process continues during the build phase where managing costs, schedules, scopes, and quality become paramount. Once construction is complete, the business process of managing all the assets within a building, and the maintenance of those assets, is key to maintaining a high-performing facility.

With BIM providing a complete lifecycle perspective of *design data* for a building, and ILM providing a complete lifecycle of *operational business data* for a building, the two used in conjunction together create many integration touch points that lead to even greater business value.

Integration Touch Points between BIM and ILM

There are at least seven key integration points between BIM and ILM applications. The diagram below illustrates different types of BIM models that are appropriate to integrate with different operational business processes. These seven integrations naturally occur during all three phases of the plan, build and operate lifecycle.



The value of integrating to each touch point will vary depending on a company's specific role. For example, an owner or program manager may be primarily interested in the touch points involving budget development, 4D schedule integration, and asset management integration. A general contractor may be interested in procurement integration, 2D drawing integration, fabrication integration and Request for Information (RFI) integration.

As the market continues to adopt both BIM and ILM methodologies, the value propositions will begin to shake out as more companies experiment with each touch point opportunity. The following sections describe the potential integration scenarios in detail.

Plan Phase Examples

Design to Budget Development Integration

Architects and engineers develop BIM models iteratively over time. As a natural course of having multiple disciplines, architects design the overall architectural BIM model. Structural engineers design the structural BIM model, while MEP engineers design the MEP BIM models. Farther down the process, subcontractors continue this evolution by developing their own specific BIM models for fire suppressant systems, ductwork, etc. These multiple BIM models can come together to provide rich, intelligent virtual design models.

As various elements get designed with more and more detail, they can be stored in the model. This detail can be coded in various ways such as Unifomat II. For example, Unifomat code B2010 is for all the Exterior Walls and D5010 is Electrical Service and Distribution. The Architect can code all the elements that make up the exterior walls with the appropriate code, and the electrical engineer can code all the elements that make up the electrical services. The model can automatically calculate all of the detailed quantities of the various elements, and then a unit cost can be applied based on a cost estimating database.

As these elements get designed, business executives for the owner are in the budget development process. The project budget does not get created at one time, but is developed via multiple budget scope documents. This process allows for certain aspects of the project to be known and thus management can provide partial approvals over a budget or a set of funding.

A key integration scenario would be to take a cost-loaded BIM and export the data to populate a scope document. The scope document can then be routed through a workflow process to an executive with the proper limits of authority, who then approves it and creates a baseline budget for that part of the project. The table below illustrates an example over a timeline.

Date	Description	Scope	Amount	Budget Column
6/10/2008	BIM Export 1	A10 - Foundations	4,335,000	Approved Original Budget
7/25/2008	BIM Export 2	B10 - Superstructure	10,201,000	Approved Original Budget
8/2/2008	BIM Export 3	B20 - Exterior Enclosure	6,088,000	Pending Approval
8/12/2008	BIM Export 4	C10 - Interior Construction	5,125,000	Pending Approval
		Current Approved Budget	14,536,000	
		Current Pending Budget	11,213,000	

In the example above, the BIM cost model was defined enough to export multiple scopes of work on different dates, while the rest of the mechanical, electrical, and plumbing were still being designed. Once these scopes are imported into the budget and cost management application within an ILM software solution, a senior executive can then approve multiple scope documents, creating an original approved budget.

Bill of Materials Integrated with Buyout Items

BIM models not only manage parametric objects in a given geometry, but they can save properties around specifications for materials. The systems also have the ability to calculate the quantities of material at various levels of assembly-type hierarchies. This detailed level of modeling provides the ability to produce a bill of materials for various building systems within the model.

The integration of this data is a natural fit to buyout items within a project management system. These buyout items can quickly start the procurement and bidding process of: 1) bundling multiple buyout items into a bid package, 2) determining which companies should be invited to provide quotes, and 3) ultimately analyzing quotes from multiple bidders.

This level of integration streamlines the design to procurement process and facilitates a higher degree of accuracy in the bidding process.

Build Phase Examples

4D Schedule Integration

Three dimensional models are great at providing a realistic view over how multiple elements come together in a spatial and visual way. New facilities are being built in urban areas with tight footprints, with existing structures surrounding new building sites. By applying the dimension of time against a 3D model, companies can illustrate how new buildings will look during the construction process. The contractor can append the BIM model with objects to represent cranes, man lifts, scaffolding, traffic routing and other equipment and logistics required to construct the building. This time-based view provides a much higher level of construction logistics planning.

This process can be done by linking tasks on a “critical path method” schedule to various objects within the model. The challenge is to break up the schedule into a set of tasks that can realistically demonstrate an animation over how materials get installed, and directly drive the schedule document. The value of an ILM software solution is that it can handle multiple schedules within a project. This is necessary because one project may have one schedule for BIM animation, one for a high-level cash flow projection schedule, and other schedules for different levels of task details to monitor design and construction progress.

BIM Integrates to Drawings

While BIM is forcing disruptive change across the AEC industry, the market dynamics of how this methodology and the supporting technologies get adopted is extremely varied. The industry is made up of hundreds of thousands, if not millions, of companies who play a role in the plan, build, and operate lifecycle. Many companies in the supply chain may not gain the sophistication to work directly with BIM, so there is still a large timeframe where 2-dimensional drawings need to be shared and distributed. Most BIM applications can automatically generate 2-dimensional drawings based on the typical architectural, structural, mechanical, electrical and plumbing disciplines.

Integrating these drawings within a project management system provides value from an operational business process perspective. For example, it is paramount to link these drawings to bid packages and contracts as means of creating a scope baseline for a given contract amount. Many contract disputes arise over what scope is or is not included in the contract. As a result, linking drawings to contracts and bid packages becomes an important integration point between project management and BIM applications. Because the drawings are simply an instance or '2D view' of the integrated BIM, updates to the model propagate directly to ensure that the bid drawings are current and coordinated.

Fabrication BIM with Submittals

Submittals are an operational business process where subcontractors and fabricators must submit shop drawings and material specifications for approval. This submittals process must go through various people including general contractors, architects, engineers, owners, and various consultants. The submittal process is critical in order to gain designer approvals prior to fabricating materials off site, as well as ensuring that materials are delivered in a timely manner for construction.

Many fabricators are already creating their shop drawings using BIM methodology. Structural steel and mechanical trades are designing their production models to interact with designer models. Bringing together the business submittal process with these fabricator BIM models creates another valuable integration point.

BIM Integration with Requests for Information

One of the key benefits of a virtual building model is to eliminate problems downstream in the construction phase. While this means more effort up front to create accurate, multi-discipline models, the figure below shows that problems discovered virtually are much cheaper to resolve than problems discovered once materials are fabricated and partially installed.

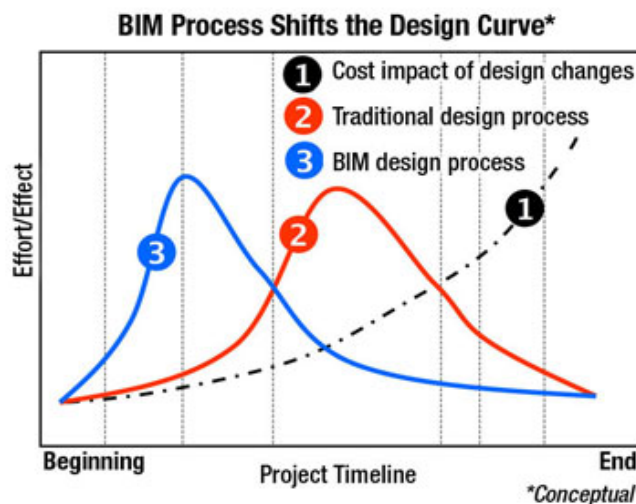


Image courtesy: Construction Users Roundtable, A/E Productivity Committee

The industry typically uses the RFI process during the build or construction phase to primarily resolve conflicts in the field. In order to virtually build a more complete model prior to the start of construction, all parties need to get involved sooner. The design team can interact with the general contractor, key subcontractors and fabricators to consolidate all of their models, invariably creating more “virtual” conflicts earlier in the building process. With more parallel virtual designs occurring, the RFI business process can also move upstream to document these virtual conflicts, and provide documented answers on how these virtual conflicts will get resolved. Providing the ability to have visual links from a business process of an RFI directly to the virtual conflict allows the entire team to understand the issues sooner and with greater clarity.

Operate Phase Examples

Spatial and Equipment Models Integrated with Asset Management

As a BIM model progressively becomes more detailed, it can evolve into an as-built virtual model for the owner to operate a new building. For example, the BIM can store specifications data about each and every fixture, wall type, and piece of equipment within the building. These detailed specifications can be added to the model throughout the process by the designer, the general contractor, subcontractor, or fabricator.

From a business process perspective, an owner must have an asset management system to catalog all these assets in a hierarchy. This hierarchy can include “location assets” like the first floor or the roof, to specific equipment assets like VAV boxes or HVAC units. This hierarchy also must include an entire portfolio of buildings because owners need to understand what assets are installed in multiple buildings. The owner must also have a maintenance management business process that is integrated with the asset management piece to properly maintain the building and all of the components within the building.

As an example, preventative and predictive maintenance plans are applied against multiple assets of the same variety, in order to automatically create work orders to maintain such assets. An owner may have identical HVAC units from the same manufacturer on five different buildings within a campus, and as such, needs to automatically create a preventative maintenance work order at the same time for all identical units.

Therefore, integrating the building and equipment specifications within a BIM model can occur at the completion of the new building, and then pre-populate an owner’s asset hierarchy and maintenance plans. Contractors and designers can differentiate themselves to owners by providing a more fully developed turnover package through this integrated BIM and ILM approach.

The facility operations team can also benefit from integrating a BIM model and an ILM solution, as they can interact using both systems. The facility manager could select a piece of equipment visually in the BIM model, locate where that piece of equipment fits within the asset hierarchy, then view the maintenance plan against the item. Conversely, a user could view the asset hierarchy in the asset management system, and then view in 3D where that piece of equipment is located within the building. This interaction makes facility maintenance much more proactive, reducing ongoing maintenance costs.

Proliance Support for BIM Integration

Proliance® software is designed to manage operational business processes throughout the entire plan, build, and operate lifecycle of a facility. By standardizing on Proliance across the enterprise, organizations can manage entire portfolios of potential projects, funded projects under design and construction, and all existing facilities that must be maintained and operated. Through integration, Proliance can be completely aligned with BIM methodologies across all these scenarios.

As one operational business system, Proliance uniquely manages budget developments, scope and buyout items, schedules, drawings, submittals, RFIs, and assets. Each of these potential touch points within Proliance can be integrated with various BIM models.

Proliance was technically designed as a native XML and Web services platform. This approach allows a company to centrally store and manage all project and facility data in one location, yet provide access to geographically dispersed users, as well as other data from other software systems, in a secure and timely fashion.

In addition, Proliance combines a business process workflow engine with its technology platform that allows for iterative integrations initiated by users triggering a workflow event. The fact that BIM models are iteratively developed by multiple people over time, Proliance is well suited for multiple iterations of integration given its business process workflow engine. Meridian has already undertaken significant levels of research, design and development in integrating Proliance with BIM models.

Prolog Support for BIM Integration

Prolog® software is powerful at managing the “build” phase of the plan, build, and operate lifecycle. Prolog manages buyout items, budget items, drawings, submittals, and RFIs. These functional areas of Prolog are natural integration points with a BIM model.

Prolog also has a number of powerful import capabilities for all of these touch points. For example, Prolog provides the user the ability to setup an import specification, and then save the specification. This means that once the mapping has been done between BIM and Prolog once, it can be saved so future identical imports do not have to be re-mapped.

Technically integrating Prolog with a Building Information Model would primarily be done where both Prolog and the BIM data reside on the same internal network. This would allow for direct database access to both systems and provide the means to import and export from each application.

In the very near future, Meridian will announce an XML and Web services-based platform called Prolog Connect. Prolog Connect, an optional product for new and existing customers, will even further enable rich and secure integrations between Prolog and BIM over the Internet.