BIM - From Pre-Design Through Lifecycle Management
What is the cost to Facility Operators?

Mismanagement of facility data results in $15.8 B in lost productivity.

Source: NIST

As much as 75% of the total lost opportunity is in operations!

Vision
- Low data loss
- Maximized value

Operation

As-Is
- Continuous data loss
- Value reduced

Information Value

Time

Planning
Design
Construction
Greater Certainty, Lower Cost

1. Improved communication of scope and design intent.
2. Greater schedule control
3. Reduced hidden costs
Building Information Modeling (BIM)

- **Building** – Describes the objects you need modeled (site, building elements, furniture, fixtures, equipment, infrastructure, etc…)

- **Information** – Any piece of information tied to the model elements in the BIM (dimensional, location, cost, schedule, lifecycle, energy, responsibility, etc…)

- **Model** – A computer representation used for prediction or analysis based on the provided information (visualization, documentation, cost, schedule, sustainability, lifecycle, operation, etc…)

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*Element Properties*

- **Family**: Interior Single Door
- **Type**: Interior Single Door

<table>
<thead>
<tr>
<th>Instance Parameters - Control selected or to-be-created instance</th>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constraints</td>
<td>Level</td>
<td>GROUND LEVEL</td>
</tr>
<tr>
<td></td>
<td>LSF Height</td>
<td>0.10</td>
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<td>Construction</td>
<td>Panel Type</td>
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<td></td>
<td>Frame Type</td>
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<td></td>
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<td>50</td>
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<tr>
<td></td>
<td>Frame Fill</td>
<td>50</td>
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</tbody>
</table>
Virtual Building Toolkit

- DProfiler: Conceptual Cost Estimating
- Revit: BIM Creation, 2D & 3D Visualizations
- Navisworks: 3D Coordination & Visualizations
- Synchro: 4D Simulations
- Innovaya: Visual Estimating
- Timberline: Cost Database
Stages of Virtual Building

• Planning
  – conceptual design and cost estimating

• Design
  – development of design visualizations in both 2D and 3D

• Design Evaluation & Constructability
  – analyze the design BIM for constructability, pricing, logistics, and scheduling

• Detailed Coordination
  – coordination of design using detailed construction models

• Fabrication
  – production of materials for install from coordinated detailed construction models

• Advanced Field Technology
  – enhance schedule and visualizations for material install

• Facility Management
  – integration of models for facility management
# Conceptual Estimating

**Conceptual Cost Estimating**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>$/SF</th>
<th>COST</th>
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</thead>
<tbody>
<tr>
<td>A - Substructure</td>
<td>$2.28</td>
<td>$320,628</td>
</tr>
<tr>
<td>B - Shell</td>
<td>$49.73</td>
<td>$6,981,274</td>
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<tr>
<td>C - Interiors</td>
<td>$12.19</td>
<td>$1,711,453</td>
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<tr>
<td>D - Services</td>
<td>$39.41</td>
<td>$5,531,915</td>
</tr>
<tr>
<td>G - Site Work</td>
<td>$8.62</td>
<td>$1,210,448</td>
</tr>
</tbody>
</table>

**COST SUMMARY**

I. **SUBTOTAL**  
   General Conditions  $1,260,457
   General Liability  $157,557
   Builder's Risk  $157,557
   Fee  $551,450

II. **TOTAL COST**  
   $127.39  $17,882,739
BIM for Lifecycle Services

BIM for Design

- Allows the Architect to:
  - Focus on finding creative solutions for the project
  - Solve the issues that matter most to the client
  - Concentrate on designing the project, not documenting it
BIM for Communication

- Facilitates interaction with the owners and end users
- Encourages cooperation between all project team members
- Assists coordination with consultants, contractors, and subcontractor
- Helps preserve the design intent
- Data rich models allow for downstream use in construction and operation
Design Evaluation
Design Evaluation
Design Evaluation
Design Evaluation
Design Evaluation
Design Evaluation
Design Evaluation
BIM for Lifecycle Services
BIM for Lifecycle Services
Detailed Model Creation
BIM for Documentation

3D views add clarity to details
Cost Evaluation - Preconstruction
Constructability Evaluation – 4D Sequencing
analyze the design BIM for constructability, pricing, logistics, and scheduling
Detailed Coordination
Constructability Evaluation – Laser Scanning
Digital Pre-Fabrication

- Shop fabrication – enhanced quality, productivity, and safety
Fabrication Model – Rebar and PT

Blue = Electrical Conduits
Yellow = Mild Steel
Red = PT
Green = Column Steel

Major collisions between 3/8" conduits and reinforcing. Sufficient concrete coverage cannot be reached.
Fabrication Model - Light Gauge Framing
Design to Fabrication Workflow
Design to Fabrication Workflow
Design to Fabrication Workflow
Design to Fabrication Workflow
Facility Management
integration of models for facility management
The Opportunity for Advanced FM

Table ES-2. Costs of Inadequate Interoperability by Stakeholder Group, by Life-Cycle Phase (in $ Millions)

<table>
<thead>
<tr>
<th>Stakeholder Group</th>
<th>Planning, Design, and Engineering, Phase</th>
<th>Construction Phase</th>
<th>Operations and Maintenance Phase</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architects and Engineers</td>
<td>1,007.2</td>
<td>147.0</td>
<td>15.7</td>
<td>1,169.8</td>
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<tr>
<td>General Contractors</td>
<td>485.9</td>
<td>1,265.3</td>
<td>50.4</td>
<td>1,801.6</td>
</tr>
<tr>
<td>Specialty Fabricators and Suppliers</td>
<td>442.4</td>
<td>1,762.2</td>
<td>—</td>
<td>2,204.6</td>
</tr>
<tr>
<td>Owners and Operators</td>
<td>722.8</td>
<td>898.0</td>
<td>9,027.2</td>
<td>10,648.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,658.3</strong></td>
<td><strong>4,072.4</strong></td>
<td><strong>9,093.3</strong></td>
<td><strong>15,824.0</strong></td>
</tr>
</tbody>
</table>

Source: RTI estimates. Sums may not add to totals due to independent rounding.

NIST GCR 04-867, Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry

Easy formula: $0.20 per square foot for the O&M phase lost due to interoperability problems
Begin with the End in Mind