McGraw-Hill Construction
Research on BIM Users

Steve Jones
McGraw-Hill Construction

Images: Dunham Engineering, University Mechanical
Speaker

Steve Jones

- BA from Johns Hopkins, MBA from Wharton
- 19 years in Design
  - Principal, Burt Hill (1,400-person global A/E firm)
- 3 years in Technology
  - Vice President, Primavera Systems
- 6 years McGraw-Hill Construction
  - Business Development for content and technology
  - Thought Leadership re: BIM, Virtual Design & Construction, Integrated Project Delivery
SmartMarket Report on Interoperability (Nov 2007)

- 3% of project cost related to lack of interoperability

Sponsored by 9 Industry Associations
SmartMarket Report on Interoperability (Nov 2007)

- 3% of project cost related to lack of interoperability
- BIM “tipping point” in AEC/O in 2008
Not “IF”, but “WHEN”

2008 research focused on BIM users

- Impact of Adoption and Implementation
  - Internal, External
- Determining Value of BIM
  - Qualitative and Quantitative
- BIM Infrastructure
  - Content
  - Hardware, Software, Model management, Interoperability
  - Training, Certification
  - Contracts
McGraw-Hill Construction SmartMarket Report on BIM

Released December 4, 2008

23 Sponsors:

– Corporate (7):
  • Autodesk (Premier Corporate Partner)
  • CMiC (Corporate Partner)
  • Barton Malow
  • HOK
  • Mortenson Construction
  • Skanska
  • Walbridge

– Associations (15):
  • AGC, ACEC, AIA, AISC, ASCE, ASPE, CURT, COAA, CSI, DBIA, ICC, MCAA, SMPS, buildingSMART Alliance, and Charles Pankow Foundation

– Government:
  • U.S. Army Corps of Engineers
McGraw-Hill Construction SmartMarket Report on BIM

- Study only BIM users
- Track 5 major aspects:
  - Adoption
  - Implementation
  - ROI
  - Impact (internal, external)
  - Infrastructure (Standards, Content, Software, Training, Certification, Outsourcing)
- Baseline for future progress
  - Aspects that will change over time
  - Future Follow-Up Studies
Research Process

40 minute phone interviews
- 35 page survey questionnaire
- Vetted by sponsors

302 BIM users*
- 39 Owners
- 80 Contractors
  - CM, GC and Trade
- 101 Engineers
  - Civil, MEP, Structural
- 82 Architects

(*statistically significant)
Screening by Company Size

4 tiers of company sizes (S, S-M, M-L, L)

<table>
<thead>
<tr>
<th>Architected/Engineers</th>
<th>Construction Manager/Contractors &amp; Owners</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10Mil+</td>
<td>33%</td>
</tr>
<tr>
<td>$5Mil to &lt;$10Mil</td>
<td>15%</td>
</tr>
<tr>
<td>$500K to &lt;$5Mil</td>
<td>38%</td>
</tr>
<tr>
<td>&lt;$500K</td>
<td>15%</td>
</tr>
<tr>
<td>$500Mil+</td>
<td>13%</td>
</tr>
<tr>
<td>$100Mil to &lt;$500Mil</td>
<td>18%</td>
</tr>
<tr>
<td>$25Mil to &lt;$100Mil</td>
<td>24%</td>
</tr>
<tr>
<td>&lt;$25Mil</td>
<td>24%</td>
</tr>
</tbody>
</table>

Total %s
- Large: 38%
- Medium to Large: 14%
- Small to Medium: 29%
- Small: 19%
Screening by BIM Sophistication

- 19% Expert
- 22% Advanced
- 33% Intermediate
- 25% Beginner
- 2% Outsourced
Screening by Current & Future BIM Projects

- BIM project involvement (2009 forecast)
  - 45% Very High (>60%)
  - 17% High [30-60%]
  - 21% Medium [15-30%]
  - 18% Low [<15%]
Screening by Project Types

- Transportation
- Land development
- Environmental
- Infrastructure/Utilities
- Residential
- Hospitality
- Retail/mercantile
- Healthcare/institutional
- Office/business
- Education
- Assembly

0% 10% 20% 30% 40% 50% 60%
Major Findings

- 63% of BIM users will use it on more than 30% of their projects in 2009
- 72% of BIM users say that BIM has had an impact on their internal project processes
- 82% of Expert BIM users believe that BIM has a very positive impact on their company’s productivity
- Contractors expect to see the greatest % growth of BIM use in 2009
- Users who measure it report higher ROI than the perceived ROI of those going on “gut feel”
McGraw-Hill Construction SmartMarket Report on BIM

Released December 4, 2008

- Special Section: 4pp center
  - “Introduction to BIM” as a tutorial
  - Please distribute as much as you need to help people get on board
**BIM Case Studies**

**INFRASTRUCTURE**

- **PCL Construction**

  - “Lonely BIM”

---

**Case Study: PCL Construction**

In recent years, the construction industry has seen a shift towards the adoption of Building Information Modeling (BIM) technology. PCL Construction, a leading construction company, has been at the forefront of this digital transformation. This case study delves into the experiences of PCL Construction in implementing BIM projects and the challenges and benefits they encountered.

**PCL Construction - “Lonely BIM”**

PCL Construction is a prominent player in the construction industry, known for its innovative approach to project delivery. In recent years, the company has witnessed a significant shift towards the adoption of BIM technology. This transition has been driven by the need for improved collaboration, enhanced project visibility, and reduced construction risks. Despite the evident benefits of BIM, PCL Construction faced challenges in implementing this technology, particularly due to the lack of standardization and interoperability across different project stakeholders.

**Challenges**

- **Data Inconsistency**: One of the major challenges faced by PCL Construction was the inconsistency in data formats and models across different BIM projects. This led to difficulties in integrating data from various sources and maintaining a cohesive project database.
- **Resource Allocation**: The adoption of BIM required a significant investment in resources, including skilled professionals and technology. Allocating the necessary resources efficiently was a challenge for the company.
- **Communication**: Effective communication among project stakeholders was crucial for the successful implementation of BIM. However, this proved challenging due to the diverse skillsets and backgrounds of the team members.

**Benefits**

- **Improved Collaboration**: BIM enabled improved collaboration among project stakeholders, leading to more informed decision-making and a smoother workflow.
- **Enhanced Project Visibility**: The use of BIM allowed for better visualization of the project, facilitating better understanding and management of the construction process.
- **Reduced Risks**: By identifying potential issues in the early stages of the project, BIM helped in minimizing risks and costs associated with变更 and rework.

**Conclusion**

PCL Construction’s experience in implementing BIM illustrates the importance of overcoming challenges through strategic planning and investment in resources. By embracing BIM, the company not only addressed these challenges but also reaped significant benefits, including improved project outcomes and stakeholder satisfaction. This journey serves as a valuable lesson for other construction firms looking to adopt BIM technology.
BIM Case Studies

INFRASTRUCTURE

- PCL Construction
  - “Lonely BIM”

- Burt Hill – Springfield Literacy Ctr
  - Green BIM/Educational facility
**BIM Case Studies**

**INFRASTRUCTURE**

- **PCL Construction**  
  - “Lonely BIM”

- **Burt Hill – Springfield Literacy Ctr**  
  - Green BIM/educational facility

- **Crate & Barrel**  
  - Owner national program
BIM Case Studies

INFRASTRUCTURE

- **PCL Construction**
  - “Lonely BIM”

- **Burt Hill – Springfield Literacy Ctr**
  - Green BIM/Educational facility

- **Crate & Barrel**
  - Owner national program

- **UCSF**
  - “Social BIM” integrated project delivery/ health care
1. Adoption of BIM
Adoption of BIM – Key Survey Focus Areas

- Level of BIM Sophistication
- Percent of Current & Future Projects Involving BIM
- Frequency of 2D-to-BIM Use Among Contractors
- Impact of BIM Implementation
- Perceived Net Effect of BIM on Future Use
- Challenges to BIM Adoption
Level of BIM Sophistication By Profession

BIM sophistication (Company)

- Owner: 18% Expert, 22% Advanced, 38% Intermediate, 22% Beginner, 13% Outsource BIM
- Contractor: 21% Expert, 23% Advanced, 34% Intermediate, 25% Beginner, 23% Outsource BIM
- Engineer: 21% Expert, 31% Advanced, 31% Intermediate, 23% Beginner, 23% Outsource BIM
- Architect: 10% Expert, 23% Advanced, 19% Intermediate, 22% Beginner, 31% Outsource BIM
Level of BIM Sophistication By Profession

BIM sophistication (Company)

- Architect: 18% Expert, 22% Advanced, 38% Intermediate, 22% Outsource BIM
- Engineer: 21% Expert, 19% Advanced, 34% Intermediate, 27% Outsource BIM
- Contractor: 21% Expert, 25% Advanced, 31% Intermediate, 23% Outsource BIM
- Owner: 10% Expert, 23% Advanced, 31% Intermediate, 13% Outsource BIM

46% Top-two
Current & Future BIM Projects

BIM project involvement (Company Type)

- Architects
  - V.High 60%+: 43%
  - High 31-59%: 11%
  - Med 16-30%: 14%
  - Low 1-15%: 32%
  - Current

- Engineers
  - V.High 60%+: 35%
  - High 31-59%: 8%
  - Med 16-30%: 21%
  - Low 1-15%: 36%
  - Current

- Contractors
  - V.High 60%+: 23%
  - High 31-59%: 13%
  - Med 16-30%: 20%
  - Low 1-15%: 45%
  - Current

- Owners
  - V.High 60%+: 41%
  - High 31-59%: 8%
  - Med 16-30%: 10%
  - Low 1-15%: 41%
  - Current
Current & Future BIM Projects

BIM project involvement (Company Type)

- Architects
  - V. High: 60%+
  - Current: 43%, 2009: 54%
  - High: 31-59%
    - Current: 11%, 2009: 25%
  - Med: 16-30%
    - Current: 14%, 2009: 22%
  - Low: 1-15%
    - Current: 32%, 2009: 12%

- Engineers
  - V. High: 60%+
  - Current: 35%, 2009: 43%
  - High: 31-59%
    - Current: 8%, 2009: 25%
  - Med: 16-30%
    - Current: 21%, 2009: 16%
  - Low: 1-15%
    - Current: 36%, 2009: 21%

- Contractors
  - V. High: 60%+
  - Current: 23%, 2009: 35%
  - High: 31-59%
    - Current: 13%, 2009: 20%
  - Med: 16-30%
    - Current: 43%, 2009: 20%
  - Low: 1-15%
    - Current: 45%, 2009: 21%

- Owners
  - V. High: 60%+
  - Current: 41%, 2009: 46%
  - High: 31-59%
    - Current: 10%, 2009: 15%
  - Med: 16-30%
    - Current: 8%, 2009: 10%
  - Low: 1-15%
    - Current: 41%, 2009: 33%
Current & Future BIM Projects

BIM project involvement (Company Type)

- **Architects**
  - V.High 60%+: 43% Current, 54% 2009
  - High 31-59%: 11% Current, 12% 2009
  - Med 16-30%: 14% Current, 22% 2009
  - Low 1-15%: 32% Current, 12% 2009

- **Engineers**
  - V.High 60%+: 35% Current, 8% 2009
  - High 31-59%: 8% Current, 21% 2009
  - Med 16-30%: 21% Current, 16% 2009
  - Low 1-15%: 36% Current, 20% 2009

- **Contractors**
  - V.High 60%+: 23% Current, 13% 2009
  - High 31-59%: 43% Current, 20% 2009
  - Med 16-30%: 35% Current, 15% 2009
  - Low 1-15%: 45% Current, 35% 2009

- **Owners**
  - V.High 60%+: 41% Current, 41% 2009
  - High 31-59%: 10% Current, 10% 2009
  - Med 16-30%: 10% Current, 10% 2009
  - Low 1-15%: 33% Current, 33% 2009

2009: Year of the Contractor
Current & Future BIM Projects

BIM project involvement (Company Size)

- **Small**
  - V.High: 60%+
  - High: 31-59%
  - Med: 16-30%
  - Low: 1-15%

- **Small-Medium**
  - V.High: 43%
  - High: 11%
  - Med: 15%
  - Low: 30%

- **Medium-Large**
  - V.High: 29%
  - High: 12%
  - Med: 15%
  - Low: 50%

- **Large**
  - V.High: 30%
  - High: 9%
  - Med: 20%
  - Low: 41%

Larger Users Slower to Expand Usage
2D-to-BIM Use Among Contractors

- 60% Contractors frequently 2D-BIM
  - “Lonely BIM”
Q2. When you work on a project that has been designed in conventional 2D how often do you model it in BIM yourself? Please use a scale from 1 to 10, where one is Never and 10 is Always.

Asked only among Construction Managers/Contractors/Subcontractors = 80

BIM sophistication more than company size

“Lonely BIM”
Positive Impact of BIM Implementation

- Only 7% negative impact

![Pie chart showing the distribution of positive, neutral, and negative impacts among all respondents. 49% positive (8-10), 7% neutral, and 44% negative (1-4).]
Impact by BIM Experience Level

Expertise directly impacts positive experience

- Expert
  - Most Negative (1-4): 4%
  - Neutral: 14%
  - Most Positive (8-10): 82%
- Advanced
  - Most Negative (1-4): 4%
  - Neutral: 30%
  - Most Positive (8-10): 66%
- Intermediate
  - Most Negative (1-4): 5%
  - Neutral: 53%
  - Most Positive (8-10): 42%
- Beginner
  - Most Negative (1-4): 15%
  - Neutral: 65%
  - Most Positive (8-10): 26%

Supports Tipping Point Analysis
**Positive Impact of BIM Implementation**

- **Contractors most positive impact of BIM**

  - Architects: 5% 38%
  - Engineers: 37% 9%

  "Year of the Contractor" 61%
Challenges to BIM Adoption

- Training, software/hardware costs, sr mgt buy-in
  - Jr staff and IP issues least troublesome

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Users Reporting Least Challenging (1-4)</th>
<th>Mean scale (1-10)</th>
<th>Users Reporting Most Challenging (8-10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate training</td>
<td>35%</td>
<td>5.25</td>
<td>19%</td>
</tr>
<tr>
<td>Cost of software</td>
<td>44%</td>
<td>4.70</td>
<td>15%</td>
</tr>
<tr>
<td>Cost of required hardware upgrades</td>
<td>50%</td>
<td>4.46</td>
<td>13%</td>
</tr>
<tr>
<td>Senior Management / senior staff buy-in</td>
<td>52%</td>
<td>4.37</td>
<td>17%</td>
</tr>
<tr>
<td>Middle management / middle staff buy-in</td>
<td>51%</td>
<td>4.27</td>
<td>11%</td>
</tr>
<tr>
<td>No external incentives or directives moving us to use BIM</td>
<td>61%</td>
<td>3.76</td>
<td>13%</td>
</tr>
<tr>
<td>Risk of losing intellectual property and liability issues</td>
<td>60%</td>
<td>3.72</td>
<td>9%</td>
</tr>
<tr>
<td>Junior Management / junior staff buy-in</td>
<td>55%</td>
<td>3.61</td>
<td>12%</td>
</tr>
</tbody>
</table>
Adoption of BIM

**Take-aways:**

- Architects still lead in extent of adoption
  - Majority will be “Very Heavy” Users in 2009
- Contractors catching up fast
  - Not waiting for design professionals (Lonely BIM)
- Smaller firms dive deeper faster than large
- More expertise = more satisfaction/benefit
  - Will drive deeper adoption
- Top challenges
  - Software costs
  - Hardware costs
  - Senior Management
2. Implementation & Usage of BIM
Implementation and Usage of BIM - Key Survey Focus Areas

- Primary Driver of BIM Project Team
- Extra Payments to Designers/Contractors by Owners
- Frequency of Modelling Specific Elements in BIM
  - Architectural, Mechanical, Electrical, Plumbing/FP, Civil, Structural
- Integration of Scheduling Data with BIM
- Integration of Cost Data with BIM
- Outsourcing of BIM
- Level of Involvement in Green Projects
- BIM Impact on Green Projects
- BIM Features to Improve Impact on Green Projects
Primary Driver of BIM Project Team

- Architects, CM/GC, combination
Owners Willingness to Pay Extra for BIM

- Software, extra time

<table>
<thead>
<tr>
<th>Activity</th>
<th>Least Willing (1-4)</th>
<th>Moderately</th>
<th>Most Willing (8-10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchasing BIM Software</td>
<td>62%</td>
<td>8%</td>
<td>30%</td>
</tr>
<tr>
<td>Time &amp; Effort on Detailing BIM Modeling</td>
<td>49%</td>
<td>32%</td>
<td>19%</td>
</tr>
<tr>
<td>Outsourcing to 3rd Parties</td>
<td>57%</td>
<td>24%</td>
<td>19%</td>
</tr>
<tr>
<td>Training</td>
<td>60%</td>
<td>24%</td>
<td>16%</td>
</tr>
<tr>
<td>Purchasing Hardware to Run BIM</td>
<td>73%</td>
<td>11%</td>
<td>16%</td>
</tr>
</tbody>
</table>
## Frequency of Modeling Elements with BIM

- **Architecture, Structure, Mechanical, Plumbing**

<table>
<thead>
<tr>
<th>Element</th>
<th>Users Reporting Least Frequent (1-4)</th>
<th>Mean Scale (1-10)</th>
<th>Users Reporting Most Frequent (8-10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture</td>
<td>23%</td>
<td>7.06</td>
<td>58%</td>
</tr>
<tr>
<td>Structural system</td>
<td>33%</td>
<td>6.33</td>
<td>49%</td>
</tr>
<tr>
<td>Mechanical system</td>
<td>41%</td>
<td>5.41</td>
<td>38%</td>
</tr>
<tr>
<td>Plumbing system</td>
<td>50%</td>
<td>4.88</td>
<td>30%</td>
</tr>
<tr>
<td>Accessibility</td>
<td>49%</td>
<td>4.64</td>
<td>25%</td>
</tr>
<tr>
<td>Construction sequencing &amp; site planning</td>
<td>55%</td>
<td>4.42</td>
<td>23%</td>
</tr>
<tr>
<td>Electrical system</td>
<td>56%</td>
<td>4.38</td>
<td>24%</td>
</tr>
<tr>
<td>Fire/life safety systems</td>
<td>57%</td>
<td>4.28</td>
<td>23%</td>
</tr>
<tr>
<td>Storm-water system</td>
<td>60%</td>
<td>3.96</td>
<td>21%</td>
</tr>
<tr>
<td>In-ground utilities</td>
<td>60%</td>
<td>3.84</td>
<td>18%</td>
</tr>
<tr>
<td>Energy management systems</td>
<td>65%</td>
<td>3.51</td>
<td>13%</td>
</tr>
<tr>
<td>Transportation system</td>
<td>78%</td>
<td>2.77</td>
<td>10%</td>
</tr>
</tbody>
</table>

## Modeling Architectural Elements in BIM

### Exterior envelope and openings, partitions

<table>
<thead>
<tr>
<th>Element</th>
<th>Least Frequent (1-4)</th>
<th>Moderately</th>
<th>Most Frequent (8-10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Skin</td>
<td>9%</td>
<td>8%</td>
<td>83%</td>
</tr>
<tr>
<td>Exterior Openings</td>
<td>6%</td>
<td>11%</td>
<td>83%</td>
</tr>
<tr>
<td>Exterior Wall &amp; Skin</td>
<td>9%</td>
<td>9%</td>
<td>82%</td>
</tr>
<tr>
<td>Interior Partitions</td>
<td>8%</td>
<td>10%</td>
<td>82%</td>
</tr>
<tr>
<td>Roof/Roof Assemblies</td>
<td>11%</td>
<td>13%</td>
<td>76%</td>
</tr>
<tr>
<td>Stairs</td>
<td>10%</td>
<td>15%</td>
<td>75%</td>
</tr>
<tr>
<td>Interior Doors</td>
<td>10%</td>
<td>16%</td>
<td>74%</td>
</tr>
<tr>
<td>Toilet Rooms</td>
<td>12%</td>
<td>15%</td>
<td>73%</td>
</tr>
<tr>
<td>Floor Assemblies</td>
<td>12%</td>
<td>22%</td>
<td>66%</td>
</tr>
</tbody>
</table>

Legend:
- Least Frequent (1-4)
- Moderately
- Most Frequent (8-10)
Modeling Mechanical Engineering Elements in BIM

Ducts, Air Handlers, Grilles/Diffusers

- Duct Systems
  - 8% Least Frequent (1-4)
  - 12% Moderately
  - 80% Most Frequent (8-10)

- Major Equipment
  - 12% Least Frequent (1-4)
  - 12% Moderately
  - 76% Most Frequent (8-10)

- Air Handlers
  - 12% Least Frequent (1-4)
  - 12% Moderately
  - 76% Most Frequent (8-10)

- Grilles & Diffusers
  - 16% Least Frequent (1-4)
  - 20% Moderately
  - 64% Most Frequent (8-10)

- Energy Management Systems
  - 60% Least Frequent (1-4)
  - 20% Moderately
  - 20% Most Frequent (8-10)

- Controls
  - 64% Least Frequent (1-4)
  - 16% Moderately
  - 20% Most Frequent (8-10)
Modeling Electrical Design Elements in BIM

- Light fixtures, panels, switches/outlets

<table>
<thead>
<tr>
<th>Component</th>
<th>Least Frequent (1-4)</th>
<th>Moderately</th>
<th>Most Frequent (8-10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Fixtures</td>
<td>58%</td>
<td>16%</td>
<td>26%</td>
</tr>
<tr>
<td>Panels</td>
<td>70%</td>
<td>11%</td>
<td>19%</td>
</tr>
<tr>
<td>Switches/Outlets</td>
<td>64%</td>
<td>20%</td>
<td>16%</td>
</tr>
<tr>
<td>Junction Boxes</td>
<td>72%</td>
<td>15%</td>
<td>13%</td>
</tr>
<tr>
<td>Conduit</td>
<td>73%</td>
<td>17%</td>
<td>10%</td>
</tr>
<tr>
<td>Energy Management Systems</td>
<td>77%</td>
<td>15%</td>
<td>8%</td>
</tr>
</tbody>
</table>
Modeling Civil Engineering Design Elements in BIM

- Site grading, stormwater drainage

<table>
<thead>
<tr>
<th>Element</th>
<th>Least Frequent (1-4)</th>
<th>Moderately</th>
<th>Most Frequent (8-10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Grading</td>
<td>7%</td>
<td>25%</td>
<td>68%</td>
</tr>
<tr>
<td>Stormwater Drainage</td>
<td>14%</td>
<td>25%</td>
<td>61%</td>
</tr>
<tr>
<td>Streets/ Highways</td>
<td>36%</td>
<td>11%</td>
<td>53%</td>
</tr>
<tr>
<td>Sanitary/ Sewer System</td>
<td>25%</td>
<td>25%</td>
<td>50%</td>
</tr>
<tr>
<td>Water Distribution System</td>
<td>21%</td>
<td>36%</td>
<td>43%</td>
</tr>
<tr>
<td>Building Pads</td>
<td>36%</td>
<td>25%</td>
<td>39%</td>
</tr>
<tr>
<td>Bridges</td>
<td>68%</td>
<td>18%</td>
<td>14%</td>
</tr>
</tbody>
</table>

Percent of Modeling Civil Elements
Modeling Structural Engineering Design Elements in BIM

Steel columns, beams, trusses

<table>
<thead>
<tr>
<th>Structural Element</th>
<th>Least Frequent (1-4)</th>
<th>Moderately</th>
<th>Most Frequent (8-10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel Columns/Beams/Trusses</td>
<td>11% 8%</td>
<td>81%</td>
<td></td>
</tr>
<tr>
<td>Concrete</td>
<td>16% 6%</td>
<td>78%</td>
<td></td>
</tr>
<tr>
<td>Steel Details</td>
<td>53% 17%</td>
<td>30%</td>
<td></td>
</tr>
<tr>
<td>Reinforcing</td>
<td>55% 17%</td>
<td>28%</td>
<td></td>
</tr>
<tr>
<td>Formwork</td>
<td>86% 8% 6%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Integration of Scheduling Data with BIM

- 4D gaining traction with contractors
Integration of Cost Data with BIM by Respondent Type

- Minimal 5D usage yet
  - Contractors, Owners lead

Samples from McGraw-Hill Construction Research & Analytics Confidential
Outsourcing of BIM

- Owners do most, Contractors project most increase

---

**Projected Outsourcing of BIM**

- Architects: 70% Stop Entirely, 29% Decrease, 8% Stay the same, 1% Increase
- Engineers: 73% Stop Entirely, 14% Decrease, 5% Stay the same, 0% Increase
- Contractors: 46% Stop Entirely, 40% Decrease, 16% Stay the same, 3% Increase
- Owners: 61% Stop Entirely, 31% Decrease, 5% Stay the same, 8% Increase

Level of Involvement in Green Projects

- Extensive green activity
  - Contractors 61%
BIM Use in Green Projects by Respondent Type

Less green BIM
BIM Features that Would Improve Impact on Green Projects

- LEED calculator, data-rich product models

<table>
<thead>
<tr>
<th>Feature</th>
<th>Bottom 4 Box (% rated 1-4)</th>
<th>Mean</th>
<th>Top 3 Box (% rated 8-10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEED calculation software that is integrated with BIM</td>
<td>19%</td>
<td>6.77</td>
<td>50%</td>
</tr>
<tr>
<td>Building product content for BIM that has integrated data about the products sustainability characteristics</td>
<td>22%</td>
<td>6.54</td>
<td>47%</td>
</tr>
<tr>
<td>Energy analysis software that is integrated with BIM</td>
<td>25%</td>
<td>6.30</td>
<td>44%</td>
</tr>
<tr>
<td>Construction process simulation software that is integrated with BIM to evaluate the jobsite aspects of LEED</td>
<td>35%</td>
<td>5.59</td>
<td>40%</td>
</tr>
</tbody>
</table>
Implementation and Usage of BIM

**Take-aways:**

– Architects driving on teams 2:1 over Contractors
– Owners least unwilling to pay for
  - Software, Extra time
– Strong demand for wide variety of BIM building product content
– 4D gaining traction with contractors
– 5D still early
– High demand for outsourcing by contractors in 2009
  - Oppty for architects with skills
– Green BIM still maturing
  - #1 need: Integrated LEED calculator
  - #2 need: Data-rich building product content
3. Value of BIM
Value of BIM - Key Survey Focus Areas

- Involvement in Measuring ROI
- Important Aspects for Measuring ROI
- Perceived ROI
Measuring ROI on BIM by Respondent Type

- Low focus on ROI
  - Only 25% high effort
Measuring ROI on BIM by Respondent Type

- Low focus on ROI
  - Contractors lead
Importance of Aspects for Measuring ROI

- Improved outcomes, communication, productivity, marketing
Perceived ROI is greater for firms that measure ROI.
Perceived ROI

Perceived ROI is greater for firms that measure ROI
Perceived ROI is greater for firms that measure ROI

- 1/3 of trackers report ROI > 100%
Value of BIM

**Take-aways**

- Low involvement in Measuring ROI
  - Contractors lead
  - 2009 will produce more metrics as contractors adopt

- Important Aspects for Measuring ROI
  - Quantifiable project outcomes
  - Communication
  - Productivity
  - Marketing

- Perceived ROI higher with measurers than non-measurers
  - 1/3 of trackers >100%
4. Impact of BIM on Internal & External Processes
Impact of BIM Usage – Key Survey Focus Areas

- Impact of BIM on Internal Project Processes
- Impact of BIM on External Project Processes
- Frequency of Participation in BIM-Related Activities
- Type of Contract Used on BIM Projects
- Awareness of Initiatives to Develop BIM Contract Forms
- Perceived Risks Using BIM (Unprompted)
Impact of BIM on Project Processes

Stron relationship between impact and expertise

[Bar chart showing the distribution of impact levels (Low Impact 1-4, Moderate, High Impact 8-10) across different levels of expertise (Expert, Advanced, Intermediate, Beginner).]

## Frequency of Participation in BIM-Related Activities

**Visualization, jobsite, collaborative design reviews**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percent of Frequency</th>
<th>Users Reporting Least Frequent (1-4)</th>
<th>Mean scale (1-10)</th>
<th>Users Reporting Most Frequent (8-10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routinely using 3D visualization to communicate with all parties</td>
<td>67%</td>
<td>25%</td>
<td>6.52</td>
<td>47%</td>
</tr>
<tr>
<td>Using BIM on the jobsite to guide construction activities</td>
<td>65%</td>
<td>31%</td>
<td>5.80</td>
<td>39%</td>
</tr>
<tr>
<td>Increasing time spent on design</td>
<td>61%</td>
<td>29%</td>
<td>5.69</td>
<td>25%</td>
</tr>
<tr>
<td>BIM reviews in collaboration environments with multiple parties</td>
<td>60%</td>
<td>40%</td>
<td>5.50</td>
<td>33%</td>
</tr>
<tr>
<td>Meeting with key disciplines for clash detection analysis</td>
<td>59%</td>
<td>42%</td>
<td>5.26</td>
<td>31%</td>
</tr>
<tr>
<td>Reducing time spent on contract documentation</td>
<td>59%</td>
<td>39%</td>
<td>5.05</td>
<td>25%</td>
</tr>
<tr>
<td>Integrating schedule with BIM model</td>
<td>58%</td>
<td>45%</td>
<td>4.88</td>
<td>25%</td>
</tr>
<tr>
<td>Reviewing models or deliverables generated from models as part of the review and approval process</td>
<td>59%</td>
<td>59%</td>
<td>4.33</td>
<td>23%</td>
</tr>
<tr>
<td>Using the BIM model for site, infrastructure or facilities management and renovations</td>
<td>60%</td>
<td>60%</td>
<td>4.13</td>
<td>21%</td>
</tr>
<tr>
<td>Hiring trade contractors early to participate in design assist role</td>
<td>61%</td>
<td>61%</td>
<td>3.97</td>
<td>16%</td>
</tr>
<tr>
<td>Developing cost estimates from the BIM model</td>
<td>62%</td>
<td>62%</td>
<td>3.92</td>
<td>16%</td>
</tr>
<tr>
<td>Eliminating shop or field drawings by having disciplines work within a shared model environment</td>
<td>65%</td>
<td>65%</td>
<td>3.84</td>
<td>16%</td>
</tr>
<tr>
<td>Using BIM to facilitate regulatory approval</td>
<td>67%</td>
<td>67%</td>
<td>3.37</td>
<td>10%</td>
</tr>
</tbody>
</table>

Type of Contract Used on BIM Projects

Conventional contracts still dominate

- Use conventional contracts without any modification to accommodate use of BIM
- Modifying conventional contracts to accommodate the use of BIM
- Using a new kind of contract to accommodate the use of BIM
Awareness of Initiatives to Develop BIM Contract Forms

Only 40% awareness of BIM contract initiatives

Initiatives Mentioned (n=128)

- **AIA**: 54%
- **AGC**: 23%
- **Consensus Documents**: 13%
- **IPD**: 9%
- **Other**: 45%
- **Don’t Know**: 6%

*Due to multiple responses, may total to more than 100%*
### Perceived Risks Using BIM (Unprompted)

**Errors by other, inexperienced BIM users**

<table>
<thead>
<tr>
<th>Table Title</th>
<th>Total (n=302)</th>
<th>Architect (n=82)</th>
<th>Engineer (n=101)</th>
<th>Contractor (n=80)</th>
<th>Owner (n=39)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Errors/ Accuracy Issues</td>
<td>11%</td>
<td>9%</td>
<td>9%</td>
<td>11%</td>
<td>21%</td>
</tr>
<tr>
<td>Liability &amp; Legal Issues</td>
<td>10%</td>
<td>11%</td>
<td>10%</td>
<td>13%</td>
<td>0%</td>
</tr>
<tr>
<td>Inexperience of end-users/ Learning curve</td>
<td>11%</td>
<td>17%</td>
<td>4%</td>
<td>10%</td>
<td>18%</td>
</tr>
<tr>
<td>“Ownership” of the model after distribution/ taking responsibility for changes made by others</td>
<td>8%</td>
<td>12%</td>
<td>9%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Miscommunication/ Lack of coordination</td>
<td>4%</td>
<td>4%</td>
<td>4%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Over-reliance on Models and Computers</td>
<td>3%</td>
<td>1%</td>
<td>5%</td>
<td>3%</td>
<td>5%</td>
</tr>
<tr>
<td>Encouraging BIM buy-in from clients and other end-users</td>
<td>3%</td>
<td>4%</td>
<td>1%</td>
<td>6%</td>
<td>0%</td>
</tr>
<tr>
<td>Time considerations</td>
<td>3%</td>
<td>4%</td>
<td>5%</td>
<td>0%</td>
<td>5%</td>
</tr>
<tr>
<td>Not having appropriate amount of data (too little/ too much)</td>
<td>3%</td>
<td>4%</td>
<td>3%</td>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td>General misuse of BIM software or misuse of BIM output by end-users</td>
<td>3%</td>
<td>0%</td>
<td>7%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Don’t Know/ Can’t think of any</td>
<td>10%</td>
<td>11%</td>
<td>13%</td>
<td>4%</td>
<td>10%</td>
</tr>
<tr>
<td>Don’t see any risks</td>
<td>14%</td>
<td>12%</td>
<td>11%</td>
<td>18%</td>
<td>21%</td>
</tr>
<tr>
<td>Other*</td>
<td>17%</td>
<td>12%</td>
<td>20%</td>
<td>24%</td>
<td>8%</td>
</tr>
</tbody>
</table>

*Source: McGraw-Hill Construction, 2018*
Impact of BIM Usage

**Take-aways**

- Direct relationship between amount of impact and level of BIM expertise
- Frequency of Participation in BIM-Related Activities
  - 3D visualization for communication, clash detection, collaborative mtgs, jobsite coordination,
- Std contracts still most commonly used on BIM projects
  - New ones emerging (AIA/IPD, AGC Consensus Docs, Australian)
  - Low awareness of initiatives to develop BIM contract forms
- Low concern about risk
  - Top perceived risk related to people making poor models
5. BIM Infrastructure

Content, Standards, Technology, Training
BIM Content - Key Survey Focus Areas

- Priority of Need for BIM Content
  - 17 choices of project elements
- Preference for Generic vs Proprietary (Mfr-specific)
- Sources for BIM content
Developing BIM-Related Content

- Structural, mechanical, building envelope, stairs
Preferences for Object Modeling

Architects and Engineers favor starting their BIM design with generic objects before moving on to manufacturer-specific objects at a later stage. Contractors and Owners differ however, and prefer to begin their design with as many manufacturer objects as possible.

“"I prefer to begin a BIM design with generic objects, then substitute them with manufacturer-specific objects later.”

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Architect</th>
<th>Engineer</th>
<th>Contractor</th>
<th>Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>6.13</td>
<td>6.92</td>
<td>6.01</td>
<td>6.00</td>
<td>5.03</td>
</tr>
<tr>
<td>% Agree</td>
<td>26%</td>
<td>14%</td>
<td>29%</td>
<td>29%</td>
<td>35%</td>
</tr>
<tr>
<td>% Don't Agree</td>
<td>37%</td>
<td>38%</td>
<td>34%</td>
<td>37%</td>
<td>41%</td>
</tr>
<tr>
<td>% Agree</td>
<td>38%</td>
<td>47%</td>
<td>38%</td>
<td>34%</td>
<td>24%</td>
</tr>
</tbody>
</table>

“"I prefer to begin a design with as many manufacturer-specific objects as possible.”

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Architect</th>
<th>Engineer</th>
<th>Contractor</th>
<th>Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>5.51</td>
<td>4.47</td>
<td>5.35</td>
<td>6.75</td>
<td>5.49</td>
</tr>
<tr>
<td>% Agree</td>
<td>38%</td>
<td>51%</td>
<td>42%</td>
<td>24%</td>
<td>30%</td>
</tr>
<tr>
<td>% Don't Agree</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
<td>49%</td>
<td>32%</td>
</tr>
<tr>
<td>% Agree</td>
<td>32%</td>
<td>19%</td>
<td>28%</td>
<td>49%</td>
<td>30%</td>
</tr>
</tbody>
</table>

Q29. Using a scale from 1 to 10, where 1 is Totally Disagree and 10 is Totally Agree, how much do you agree with each of the following statements...

Total=292, Architect=78-80, Engineer=96-98, Contractor=79 and Owner=37
Frequency of Sourcing Objects for BIM

- Homemade, mfr sites, object libraries

<table>
<thead>
<tr>
<th>Method</th>
<th>Bottom 4 Box (% rated 1-4)</th>
<th>Mean</th>
<th>Top 3 Box (% rated 8-10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make them ourselves in our company</td>
<td>35%</td>
<td>5.57</td>
<td>35%</td>
</tr>
<tr>
<td>Go to manufacturer’s website</td>
<td>37%</td>
<td>5.38</td>
<td>28%</td>
</tr>
<tr>
<td>Use free object libraries or user group sites on the internet</td>
<td>44%</td>
<td>4.98</td>
<td>26%</td>
</tr>
<tr>
<td>Use a paid subscription service</td>
<td>87%</td>
<td>2.10</td>
<td>5%</td>
</tr>
</tbody>
</table>
BIM Standards - Key Survey Focus Areas

- Awareness of BIM Standard Organizations and Initiatives
- Who should Drive Development of BIM Standards
Awareness of BIM Standard Organizations

Only 48% awareness of BIM standard initiatives

Organizations Named (n=145)

- National BIM Standards (NBIMS) 16%
- Building Smart Alliance 25%
- AIA 21%
- AGC 6%
- National Institute of Building Sciences 15%
- BIM Forums 3%
- International Alliance for Interoperability 8%
- Other* 41%
- Don’t Know 7%
Development of BIM Standards

Everybody wants their industry org to do it

BIM Software - Key Survey Focus Areas

- Level of Experience of BIM Tools: Total Awareness
- Use of BIM Analysis Tools
- Improving BIM Software (Unprompted)
Level of Experience with BIM Tools: Total Awareness

- **Broad awareness**
  - Usage is more focused

<table>
<thead>
<tr>
<th>BIM Tool</th>
<th>% Aware</th>
<th>% Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autodesk Revit</td>
<td>93%</td>
<td>67%</td>
</tr>
<tr>
<td>AutoCAD Civil 3D</td>
<td>89%</td>
<td>38%</td>
</tr>
<tr>
<td>Archicad</td>
<td>86%</td>
<td>34%</td>
</tr>
<tr>
<td>Digital Project</td>
<td>41%</td>
<td>5%</td>
</tr>
<tr>
<td>Bentley</td>
<td>83%</td>
<td>36%</td>
</tr>
<tr>
<td>Bentley Architecture</td>
<td>67%</td>
<td>17%</td>
</tr>
<tr>
<td>Triformal</td>
<td>65%</td>
<td>10%</td>
</tr>
<tr>
<td>Vectorworks</td>
<td>52%</td>
<td>32%</td>
</tr>
<tr>
<td>RAM</td>
<td>38%</td>
<td>9%</td>
</tr>
<tr>
<td>CS2</td>
<td>35%</td>
<td>10%</td>
</tr>
<tr>
<td>Tekla</td>
<td>71%</td>
<td>35%</td>
</tr>
<tr>
<td>Autodesk NavisWorks</td>
<td>89%</td>
<td>64%</td>
</tr>
<tr>
<td>Vico</td>
<td>30%</td>
<td>5%</td>
</tr>
</tbody>
</table>


A = Architect; E = Engineer; C = Contractor; O = Owner
## Improving BIM Software: Unprompted Suggestions

### Interoperability #1 request for improvement

<table>
<thead>
<tr>
<th>Request</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interoperability: improve ability for different software packages to work together</td>
<td>30%</td>
</tr>
<tr>
<td>Make software more user-friendly</td>
<td>17%</td>
</tr>
<tr>
<td>Improve training</td>
<td>6%</td>
</tr>
<tr>
<td>Add more user tools and options to BIM software</td>
<td>5%</td>
</tr>
<tr>
<td>More standardization for BIM process</td>
<td>4%</td>
</tr>
<tr>
<td>Make more of an effort to listen to the software users and incorporate their feedback</td>
<td>5%</td>
</tr>
<tr>
<td>Make software less expensive</td>
<td>3%</td>
</tr>
<tr>
<td>Make software that is faster and more powerful</td>
<td>2%</td>
</tr>
<tr>
<td>Other*</td>
<td>19%</td>
</tr>
<tr>
<td>Nothing to improve/ No opinion</td>
<td>13%</td>
</tr>
</tbody>
</table>

*Source: McGraw-Hill Construction, 2008*
Education, Training & Certification - Key Survey Focus Areas

- How is BIM Training Done at Your Company
- Current Level of BIM Training at Your Company
- Adequacy of BIM Training Available
- Importance of BIM Training Needs
- Awareness of BIM Certification Organizations
- Likelihood of Working with BIM Certification Sources
Methods of BIM Training – Respondent Type

Contractors leverage internal training resources

![Bar Chart]

- Owner
  - Outsource BIM: 8%
  - Each is Self-Taught: 24%
  - Internal Trainers: 24%
  - Outside Locations: 18%
  - External Trainers: 26%
  - Visit Office: 20%

- Contractor
  - Outsource BIM: 8%
  - Each is Self-Taught: 23%
  - Internal Trainers: 40%
  - Outside Locations: 17%
  - External Trainers: 20%
  - Visit Office: 21%

- Engineer
  - Outsource BIM: 8%
  - Each is Self-Taught: 25%
  - Internal Trainers: 40%
  - Outside Locations: 24%
  - External Trainers: 21%
  - Visit Office: 20%

- Architect
  - Outsource BIM: 8%
  - Each is Self-Taught: 16%
  - Internal Trainers: 28%
  - Outside Locations: 27%
  - External Trainers: 29%
  - Visit Office: 20%

Methods of BIM Training – Experience Level

- Beginners mostly self taught or 3rd party trainers
  - Decreases directly with level of expertise
Methods of BIM Training – Experience Level

- Internal training (gray line) increases
  - Tracks directly with level of expertise

![Bar chart showing the distribution of training methods by experience level.]

Methods of BIM Training – Experience Level

- Internal training (gray line) increases
  - Tracks directly with level of expertise

![Chart showing the percentages of respondents for different training methods by experience level.]

Level of BIM Training

- Owners self-assess as least well-trained
  - Architects and Contractors better
Importance of BIM Training Needs

- Basic BIM skills most in demand
  - Collaborative skills next most important

![Diagram showing the importance of BIM training needs with categories and corresponding percentages.](chart.png)

_Sources: McGraw-Hill Construction, 2008_
Awareness of BIM Certification Organizations

Low awareness of certification initiatives

No 85%
Yes 15%

Products Named (n=46)

- Autodesk: 22%
- AGC Certification: 22%
- Revit: 9%
- CIFE @ Stamford: 13%
- Other*: 37%
- Can’t Think of Any: 13%

* Due to multiple responses, may total to more than 100%
**BIM Infrastructure**

**Take-aways**

- High demand for wide variety of BIM project elements
  - A/E want Generic and Proprietary
  - GC/Owner want Mfr-specific
- Homemade content #1, BPM/free sites (e.g. Sweets) #2
- Low awareness of stds initiatives
- Autodesk products highest awareness and usage
- Interoperability #1 demand for improved software
- Beginners self-taught, Experts/C&S leverage internal training
- Basic BIM skills #1 need
- Soft skills collaboration and technical file exchange #2
- Low awareness of certification initiatives
Outlook
Outlook on Industry Impact

- Strategic Advantage in a Challenging Economy
- Owners’ Lifecycle Focus Enhanced by BIM
- Relationship b/ Expertise and Positive Experience
- Faith-Based BIM Adoption will shift to Metrics/ROI
- 2009 Will Be the “Year of the Contractor” in BIM
- 2010 Will Be the “Year of the Owner”
- Discipline-Specific Evolution Path
- Federation of Silos of Excellence
- BIM-Driven Prefabrication on the Horizon
- Workforce Demographics
Recommendations

Beginners:

- Momentum is critical.
- Start small; know what you are trying to achieve; measure the results; and keep your expectations aligned as you move up the learning curve.
- Research shows that positive experience grows in direct relation to expertise. Don’t get discouraged — you will overcome initial challenges.
- Designate BIM champions and devote adequate training and time for them.
Recommendations

Intermediate Users:

- Focus on developing best practices and a training program to expand BIM use internally.
- Decide either to build a team of BIM experts to support multiple projects or to make BIM capability a requirement for everyone.
- Explore the growing universe of analysis tools that work with BIM (e.g. energy analysis).
- Reach out to companies you work with who are also adopting BIM to develop integrated processes for model sharing and analysis.
Recommendations

Advanced and Expert Users: (design professionals and builders)

- Leverage the competitive advantage of your BIM expertise by exploring 4D (schedule integration) and 5D (cost modeling), which provide extremely powerful process efficiencies.

- Also, consider forming alliances with other BIM-savvy companies that you work well with to approach clients as an integrated delivery team with established processes and a proven track record. You will rise above the competition as demand for BIM inevitably increases.
Recommendations

Advanced and Expert Users: (owners)

- Focus on defining specific BIM requirements for your projects so the most qualified providers will be identified.

- Also, work on migrating your completed BIMs into automated operations and maintenance, and have your teams tailor their deliverables to support that.
Recommendations

All Users:

- Leverage resources from professional industry organizations.
McGraw-Hill Construction SmartMarket Report on BIM

Free Download: Construction.ecnext.com
Next edition Fall 2009:

– The business aspects and impact of BIM/IPD

  • Benefits
    – Investment and ROI
    – Where users are finding the value
  • Impact on Business Processes
    – Agreements
    – Financial structures
    – Risk allocation

– Survey and Case Studies
McGraw-Hill Construction Research on BIM Users

Steve Jones
McGraw-Hill Construction

Images: Dunham Engineering, University Mechanical