Building Information Modeling: A Platform For Global AEC Change

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tiny.cc/businessofbim
To improve the quality of the built environment and the collaborative process by which it is created.
Mega-Trends

Macro-Economic Change
- Protracted Financial Uncertainty
- Increased Volatility in Materials
- Changing Economic Hegemony

Shifting Demographics
- Aging Developed Economies / Youthful BRICs
- Rise in Urbanization & Middle-Class Wealth
- Maturation of the “New Millennial” Generation

New Assets, New Models
- Infrastructure: Expansion (1.0), Renewal (2.0)
- Pervasion of “Harmony with Nature”
- Market Liberalization

Data Explosion
- Data Fusion
- Ubiquitous Communication
- Rise of Smart Systems
Owners

Owner Model for Operations and Maintenance

Design Model

Construction Model

Electronic Document Management

Facility Management (CAFM)

Maintenance Management (CMMS)

Energy Management (EMS)
Crossing the Chasm (Geoffrey Moore)

- **Visionaries**: We can drive huge competitive advantage
- **Techies**: I have to try it!
- **Pragmatists**: Have my peers implemented?
- **Conservatives**: Is it a standard yet?
- **Skeptics**: Is there no way to avoid it?
3 Phases of BIM Engagement

What is BIM?

Why should I invest?

Help me implement BIM.

What is BIM?
BIM Adoption | worldwide

- UK – 2010 – major acceleration - National BIM Survey¹
  - 31% of construction professionals are using BIM (vs 13% in 2010)
  - 78% say BIM is “Future of Project Innovation”

- BuildingSMART ME – 2010²
  - BIM penetration 25%
  - Recognition of BIM value connected to error reduction, improved quality control, improved productivity
  - Need to develop competency relative to Western Europe, US

- Architosh BIM survey – 2010³
  - Over 60% report BIM adoption

- World Market Intelligence⁴
  - 40% contractors and project developers anticipate increased profitability due to BIM

² http://www.ameinfo.com/251742.htm
China

- Strong BIM awareness
- Growing adoption across major customers
- Gov’t researching BIM & IPD
- China BIM Standards (CBIMS) phase 1 published
- BIM Services businesses by leading partners & DIs
- Lack of BIM-experienced workforce

Image courtesy of: Shanghai Tower Construction and Development Co., Ltd. Rendering by Gensler.
Japan

- BIM reached broader acceptance in 2009
- 80% are aware of BIM; 50% know what it is
- Architects leading demand for BIM
- Much slower adoption than any major market
South & Central Europe

- 60% of market not using BIM
- 14% creating and analyzing models
- In 2 years, BIM will be used on most projects
- Lack of time to evaluate is largest obstacle
2010 Europe vs. North America

**BIM Adoption North America vs. Europe**

- 2007: North America = 28%, Europe = 49%
- 2009: North America = 49%, Europe = 36%

**Years Using BIM**

- 1 year: North America = 22%, Europe = 18%
- 2 years: North America = 14%, Europe = 26%
- 3 years: North America = 18%, Europe = 14%
- 4 years: North America = 10%, Europe = 10%
- 5 years: North America = 6%, Europe = 10%
- 5+ years: North America = 18%

2010 Western Europe Adoption

BIM Adoption Rate

- Western Europe: 36%
- United Kingdom: 35%
- France: 38%

BIM Benefits Contributing the Most Value

- Improved collective understanding of design intent: 69%
- Improved overall project quality: 62%
- Reduced conflicts during construction: 59%
- Reduced changes during construction: 56%
- Fast Client Approval Cycles: 44%
- Better cost control/predictability: 43%
- Reduced number of RFIs (Requests for Information): 43%
2010 Europe Adoption

BIM Usage on Projects

**CURRENT**
- <15%: 44%
- 15-30%: 16%
- 30-60%: 15%
- 60%+: 25%

**IN 2 YEARS**
- <15%: 58%
- 15-30%: 17%
- 30-60%: 18%
- 60%+: 7%
Innovation Adoption in the U.S.
Use of BIM for U.S. AEC Firms, 2008-2011

2011
- More than 60%: 6
- 30-60%: 25
- 15-30%: 17
- Less than 15%: 6

2009
- More than 60%: 34
- 30-60%: 21
- 15-30%: 18
- Less than 15%: 6

2008
- More than 60%: 38
- 30-60%: 17
- 15-30%: 10
- Less than 15%: 6

U.S. BIM Adoption Timeline – Key Events

Cumulative Seat Adoption Curve


Industry Events

- 3/03 GSA BIM Standard
- 7/04 WSJ Freedom Tower article
- 8/04 CURT Paper
- 5/05 AIA Conv
- 12/07 National BIM Standard
- 10/08 AIA BIM Protocol
- 09/07 AIA IPD Guide

Product Events

- 3/00 ADT V 2001
- 4/02 Revit acquisition
- 6/02 Term “BIM”
- 2/08 GBS acquisition
- 07/08 Ecotect acquisition
- 6/06 Revit Structure release
- 3/06 Revit MEP release
- 10/10 Project Vasari

4/02 Revit acquisition
5/05 AIA Conv
6/06 Revit Structure release
6/02 Term “BIM”
Percent of Current & Future Projects Involving BIM

<table>
<thead>
<tr>
<th>Relative Importance of internal benefit</th>
<th>NA</th>
<th>Low</th>
<th>Mod</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketing new business</td>
<td>2%</td>
<td>22%</td>
<td>27%</td>
<td>49%</td>
</tr>
<tr>
<td>Overall better construction project outcomes</td>
<td>2%</td>
<td>25%</td>
<td>25%</td>
<td>48%</td>
</tr>
<tr>
<td>Reduced errors and omissions in construction documents</td>
<td>4%</td>
<td>21%</td>
<td>28%</td>
<td>47%</td>
</tr>
<tr>
<td>Offering new services</td>
<td>2%</td>
<td>24%</td>
<td>27%</td>
<td>47%</td>
</tr>
<tr>
<td>Reducing rework</td>
<td>3%</td>
<td>25%</td>
<td>27%</td>
<td>45%</td>
</tr>
<tr>
<td>Maintaining repeat business with past clients</td>
<td>5%</td>
<td>31%</td>
<td>28%</td>
<td>36%</td>
</tr>
<tr>
<td>Improving knowledge about building in staff</td>
<td>6%</td>
<td>33%</td>
<td>30%</td>
<td>31%</td>
</tr>
<tr>
<td>Reducing cycle time for specific workflows</td>
<td>3%</td>
<td>34%</td>
<td>32%</td>
<td>31%</td>
</tr>
<tr>
<td>Reducing overall project duration</td>
<td>3%</td>
<td>41%</td>
<td>29%</td>
<td>27%</td>
</tr>
<tr>
<td>Reducing construction cost</td>
<td>6%</td>
<td>37%</td>
<td>32%</td>
<td>25%</td>
</tr>
<tr>
<td>Increasing profits</td>
<td>2%</td>
<td>46%</td>
<td>71%</td>
<td>21%</td>
</tr>
<tr>
<td>Recruiting, retaining staff</td>
<td>6%</td>
<td>43%</td>
<td>30%</td>
<td>21%</td>
</tr>
<tr>
<td>Fewer claims/ litigation</td>
<td>14%</td>
<td>40%</td>
<td>26%</td>
<td>20%</td>
</tr>
</tbody>
</table>

## Link between BIM Benefits and ROI

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Better multi-party communication and understanding from 3D visualization</td>
<td>5%</td>
<td>77%</td>
</tr>
<tr>
<td>Improved process outcomes, such as fewer RFIs and field coordination problems</td>
<td>6%</td>
<td>74%</td>
</tr>
<tr>
<td>Improved productivity of personnel</td>
<td>7%</td>
<td>73%</td>
</tr>
<tr>
<td>Increased prefabrication</td>
<td>9%</td>
<td>71%</td>
</tr>
<tr>
<td>Positive impact on marketing</td>
<td>9%</td>
<td>71%</td>
</tr>
<tr>
<td>Reduced cycle time for project activities and delivery</td>
<td>9%</td>
<td>66%</td>
</tr>
<tr>
<td>Lower project cost</td>
<td>12%</td>
<td>57%</td>
</tr>
<tr>
<td>Improved jobsite safety</td>
<td>20%</td>
<td>50%</td>
</tr>
<tr>
<td>Positive impact on sustainability</td>
<td>21%</td>
<td>44%</td>
</tr>
<tr>
<td>Positive impact on recruiting / retaining staff</td>
<td>22%</td>
<td>43%</td>
</tr>
<tr>
<td>Faster plan approval and permits</td>
<td>26%</td>
<td>36%</td>
</tr>
</tbody>
</table>

*Note: Low / High Very High*

<table>
<thead>
<tr>
<th>Pre-design</th>
<th>Spatial, functional investigation</th>
<th>Conceptual Energy Analysis from early model proposals.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Considerations of site, context, site, zoning and codes</td>
<td></td>
</tr>
<tr>
<td>Schematic Design</td>
<td>Initial proposal resolving issues of space requirements and form</td>
<td>Use of Visualization for stakeholder engagement and approvals</td>
</tr>
<tr>
<td></td>
<td>Preliminary approach to massing and concept, materials and finishes</td>
<td></td>
</tr>
<tr>
<td>Design Development</td>
<td>Detailed design, documents for client, regulatory approvals</td>
<td>Integration of collaborator models from engineering disciplines. Enhanced understanding of design, informed decision-making. Improved coordination.</td>
</tr>
<tr>
<td></td>
<td>Focus on architectural systems (wall, floor, ceiling, envelope), structural, mechanical systems, electrical, lighting, fire protection, interior finishes, materials, site</td>
<td></td>
</tr>
<tr>
<td>Construction Documents, Detailing</td>
<td>Site preparation, grading, demolition</td>
<td>Clash identification, early resolution which reduces issues in the field. Opportunity for more accurate estimates from model data.</td>
</tr>
<tr>
<td></td>
<td>Specifications – systems, materials</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Structural – components sizing, connections</td>
<td></td>
</tr>
<tr>
<td></td>
<td>System specifications</td>
<td></td>
</tr>
<tr>
<td>Construction Administration</td>
<td>Coordination, review of details and materials</td>
<td>Model increases understanding, reduces RFIs. Construction phasing, materials order and state of completion.</td>
</tr>
<tr>
<td></td>
<td>Respond to requests for information, change orders</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Construction Sequencing</td>
<td></td>
</tr>
</tbody>
</table>
BIM Benchmark
Overview of Arch Universities and BIM

- BIM in theoretical courses along with hands-on applied design studios are optimal
**REPRESENTATION**: How is the project created, documented and transmitted?

**ANALYSIS AND SIMULATION**: How is the project optimized for greatest effectiveness?

**COLLABORATION**: How does the project team work together?

**REALIZATION**: How is design information transformed into a constructed project?
Collaborative Project Delivery (IPD)

- Involve all team members in design meetings, including contractors.
- Institute building information modeling.
- Facilitate collaboration.
- Set up contract mechanisms that enable open collaboration.
- Minimize paper-based processes, and collaborate digitally.
- Check for and manage interferences between trades, digitally.
- Create a culture of trust and sharing.
- Communicate design ideas using 3D visualization to keep everyone aligned.
Always Sustainable
Example: Early Sustainable Design Decisions

Could I power my building with photovoltaics and wind power?

How sensitive is my portfolio to changes in weather?

To achieve net zero, should I go for a multi-story tower or a larger floorplate?

How much would adding insulation help reduce energy?

Should I change out my windows?

How could I minimize embodied carbon and construction waste?

How can I optimize occupancy?

How much energy should my building use per year?

How can I utilize the surrounding land to reduce energy waste?

Which envelope material will reduce energy the most?
Sustainable Buildings Lifecycle, Technology, Maturity

Capture & Model
- Generate BIM for new or existing buildings
  - 2D Drawings
  - Photogrammetry
  - Laser measurement
  - Laser scans
  - Conceptual Design

Simulate & Optimize
- Analyze energy and water use and compare scenarios
  - Energy Analysis
  - Data Availability
  - Energy Analysis
  - Onsite Renewables
  - Sensitivity
  - Optimization for Net Zero Energy

Procure & Build
- Resolve conflicts and reduce material waste during construction
  - Conflict detection
  - Sequencing & automation
  - Digital fabrication
  - Product/Materials selection
  - Product substitution analysis

Operate & Maintain
- Avoid energy ‘drift’ and adapt to new use scenarios
  - Facilities management
  - Asset management
  - Energy monitoring
  - Demand response
  - Performance Prediction
Sustainable Building Solutions

Autodesk® Revit® Architecture
Sun path simulation and cloud-based conceptual energy analysis*

Autodesk® Revit® MEP
Integrated heating and cooling load calculations and conceptual energy analysis* as a foundation for engineering-driven calculations

Autodesk® Revit® Structure
Analyze design alternatives and optimize the structure to minimize material use and waste

Autodesk® 3ds Max® Design
Natural and artificial daylighting simulation

Autodesk® Navisworks® Products
Model aggregation and project simulation help identify wasteful conflicts and errors

Autodesk® ImageModeler™ 2009
Helps capture existing conditions for rapid energy modeling of existing buildings.

Autodesk® Green Building Studio
Cloud based whole building energy analysis

Autodesk® Project Vasari
Building performance analysis in a conceptual modeling tool

Autodesk® Ecotect® Analysis
Interactive, visual tools to study the impact of solar radiation, shading, and daylighting

Autodesk® SEEK
Search for building product materials by environmental attributes such as insulation value and recycled content

*Web-based analysis is available to Autodesk Subscription customers of Autodesk® Revit® Architecture and Autodesk® Revit® MEP software during the term of their Subscription.
Business Value of BIM

- Macro-Economic change
- Shifting demographics
- New Assets, new Models
- Data explosion

- Improved decision-making
- Conflict reduction
- Faster delivery

Building design and image courtesy of Wilson Architects, Inc.