BIM Implementation Strategies

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Gehry Technologies
Who we are

- Dennis R. Shelden, Ph.D.,
  *Chief Technology Officer*
  *Gehry Technologies*
  - BIM Procedures
  - BIM Technologies

- Howard Ashcraft
  *Senior Partner*
  *Hanson Bridgett*
  - Contractual implications
  - Integrated Project Delivery

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Who are you?

Target audiences

- Firms just starting out
- Firms getting their feet wet
- Firms who want to compare their view with others
- People interested in contractual and legal issues
What will be covered

- **Technical issues**
  - What software is used? Who uses what?
  - What are the technical and infrastructural requirements for using BIM software
  - How do you start? How do you manage it?

- **Procedural**
  - “Who owns the model”
  - How does each parties’ BIM play together
  - What are the hand-offs

- **Contractual**
  - What are the responsibilities of each party? How do they co-exist?
  - What is the “risk vs. reward” equation
  - How are the agreements structured?
Scope of consideration: Within the office

Architect
Scope of consideration: Within the team

- Owner
- Architect
- Specialist Consultants
- Engineers (A+E)
Scope of consideration: Across the project

- Owner
  - Architect
    - Specialist Consultants
    - Engineers (A+E)
  - Contractor
    - Engineers (Contractor)
    - Sub-contractors
      - Product Suppliers
      - Material Suppliers
      - Installers
      - Sub-subs
      - Labor (Unions)

- Design Review Agencies
- Q.C, Testing & Inspection
What is BIM?

- It’s “just a tool”?
- It’s a methodology – a way of working
- It’s both…
Building Information Modeling

Technologies and processes
integrating building information
through attributed 3D geometry
Building Information Modeling

Technologies and processes
integrating building information
through attributed 3D geometry

Data
Technologies
Work methods
Scope
Deliverables
Contractual procedures
...
Building Information Modeling

**Technologies and processes**

*integrating building information through attributed 3D geometry*

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Building Information Modeling

Technologies and processes integrating building information through attributed 3D geometry

Solids
Wireframe & surface
2D Drawings
Specifications
RFIs
Site scanned data
...
Building Information Modeling

Technologies and processes
integrating building information
through attributed 3D geometry

Some of this happens “automatically”
Some through the diligence of intelligent professionals
Building Information Modeling

Technologies and processes
integrating building information
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Some of this happens “automatically”
Some through the diligence of intelligent professionals

There’s no agreed on standard process yet
There’s a lot of different flavors
Firms and projects can define their own versions
CAD and BIM
CAD and BIM

CAD is “BIM 1.0”
There are “intelligent objects” (blocks)
• We can track some information in these objects and
• There is the ability to repurpose information in different contexts
• (Backgrounds)
• There is an ability to integrate information in shared repositories
• There is 3D (but used mostly for client presentations and visualization)

• There were perceived risks of liability leak
• There were questions of ownership and copyright
• There were data translation, storage and corruption issues
How is BIM different? Technical:

- There are identifiable objects that persist in different contexts. The 3D object is the central representation.
- 3D allows extraction of useful information (schedules, quantities, drawings, etc.).
- Alternative representations are linked. (drawings, schedules, budgets)
- Information aggregates – Integration of ALL spatial information Integration of geometry with reports 2D and Schedules
- Information is repurposeable and inter-related. Data is used for construction. Data can be used for owner asset tracking and management.
How is BIM different? Procedural:

- We work in 3D
- 2D and other documents are reports from the 3D model
- We spend less time “red lining”
- We spend more time “getting the model right”
- More localized implications are resolved, less is left to “intent”
- There is a change in where we put our hours
  - Less is spent in “production”
  - More is spent in “design”
How is BIM different? Contractual:

- BIM data is operative beyond the context in which it was created.
- BIM supports – perhaps requires – a more collaborative way of working.
- …. (from your paper?)
Some applications

**Design and Engineering**
- Project Definition
- Design (Conceptual, Architectural, Engineering)
- Document production
- Document Quality Control

**Project Management Construction Planning**
- 4D Modeling (Scheduling)
- Value engineering

**Collaboration**
- Information integration
- Information distribution
- Document management

**Bidding & Construction Management**
- Quantity surveying
- Scope definition

**Construction Planning**
- Shop drawing and Fabrication
- Surveying / Scanning
- Field positioning
- RFI Management

**Risk Assessment**
- Metrics & Impact
- Scheduling
- Conflict Identification / Problem Identification
- Resource Assessment
- Visualization
- Scenario Analysis
- Feasability & ROI

**Integrated Project Delivery**
- Decision / Knowledge / Data aggregation
- Accelerated decision making
- Impact exposure
- Accountability & auditability

**Capital Allocation Planning**
- Calibrating funding with execution

**Project Assurance**
- Quality Control
- Predictability
- Delivery Optimization
- Visibility
- Cost & Risk avoidance
- Information control

**Project, Contract & Financial Controls**
- Claims analysis
A Note on Technologies

There are many BIM applications...

Design / Engineering
- Bentley Triforma
- Graphisoft ArchiCAD
- AutoDesk Revit
- AutoDesk Architectural Desktop
- Digital Project
- Nemetchek All Plan
- Rhinocerous

Engineering
- Tekla Engineer
- FEA (SAP, Staad, ...)

Integration
- Navisworks
- Innovaya
- Digital Project
- Rhinocerous

4D Modeling / Construction Management
- Vicon Constructor
- Navisworks

Facilities Management
- Onuma Systems

Shop Drawing
- Tekla Structures
- SDS-2

Many will co-exist on a given project, even within one office!
Barriers

- **Legal**
  - Fluid Collaboration v. Precisely Defined responsibilities
  - Distinction between Professional and IT Risks

- **Technical**
  - Interoperability
  - Standards

- **Commercial**
  - Inertia
  - Investment
  - Assymetric Risks & Rewards
  - No Standard Business Models
  - No Standard Contract Models
BIM Implementation

1. Within an office
2. Across the design team
3. Across the project delivery team
1. BIM Implementation – Within an Office

1. Selecting software
2. Addressing IT issues
3. Training up & rolling out
Selecting Software

Standard BIM packages
- Bentley Triforma
- Graphisoft ArchiCAD
- AutoDesk Revit
- AutoDesk Architectural Desktop
- Nemetchek All Plan

Specialized BIM packages
- Digital Project
- Rhinoceros
- Sketchup

All are conceptually similar
- 3D modeling environment
- “Domain” toolkits
- Cutting drawings
- Import and export

There are some differences
- Some are easier to use
- Some are more geared toward “traditional practice in 3D”
- Some handle more complex geometries
- Some handle larger scale
How do you decide?

Call the vendors

Talk to a consultant
   AEC Infosystems
   Gehry Technologies
   Jordani Consulting
   Christine Fallon Associates
   ...

Try a couple
   It is likely you will wind up using a couple before your office standardizes

   Your firm may standardize on 1, but have others in mix

Engineering firms often follow architects
Hardware - Client

Most current workstations and high end laptops will run BIM software

- Get some extra RAM (2 Gig suggested)
- Get a better graphics card
- 50+ Gig hard drive
- Multiple cores will have limited impact, but it’s good to have a dual core
- Cost: about $3-4K buys you a great system

Vista issues
- 64 Bit OS issues

Workstation power will impact size of model that can be run

- You may want 1 supped up station in the office
- Presentations, heavy duty operations

- 8-32 gig ram
- quad core
- Best available graphics card
- Cost: about $10K
Hardware - Network

**BIM Files are Large!**

- 100 mByte or larger per version
- May need ½ + terrabyte server!
- Backup can be an issue.
  - Tape
  - Mirror off site

- Fast network
- License server

**Shared access can be an issue**

- VPN issues
- FTP sites
- External hosting services
- Project web sites
- More to come on this...

Control Group in New York

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Getting started

Just start!

Limited deployment
- Start in SD
- Use for drawing generation

Critical: Project Leadership must get in the model!
2. BIM Implementation – Across the design team

1. Selecting software
2. Addressing IT issues
3. Legal and contractual
Selecting Software

1. **Using a common platform**
   
   *Many BIM tools support most AE Disciplines*
   
   *Different parties may have investments in particular tools*
   
   *Sometimes Engineers will “go with the Architect”*

   - Bentley Triforma
   - Graphisoft ArchiCAD
   - AutoDesk Revit
   - AutoDesk Architectural Desktop
   - Digital Project
   - Nemetchek All Plan

1. **Using preferred tools**

   *Each party uses their preferred tools*
   
   *Translation standards are adopted for the team*
   
   *A common integration environment is selected*

   - Navisworks
   - Innovaya
   - Digital Project
Wide Area Network issues

Where are the models stored?

*Good ol’ FTP: who will host what pieces?*
- Architect?
- Owner?

*Project web sites*

*Mirrored drives*

*Shared network with VPN*
Implementation Questions

- **Scope**
- **Ownership**
- **Status**
- **Specification**
- **Implementation**
Scope

- Design Only
- Coordination
- Estimating
- Scheduling
- Submittal Review
- Shop Drawings/Fabrication
- Agency Review
- Facility Management
Who owns the model??

Who authors the model(s)?
Who uses the model(s)?
Who is responsible for the information in the model(s)?
Who stores the model(s)?
Who has copyright on the model(s)?
Who owns the model??

Simple answer:

• “The model” is actually a collection of sub-models
• Each party owns, maintains, and is responsible for their part of the model
• Models are read-write by the authoring party
• Models are read only by receiving parties
• Models are shared more or less along standard contractual bounds
• Models may be distributed as part of conventional document packages

More interesting answers are possible…
Who owns the model??

Federated Model
- Architect
- Structural
- MEP
- CM
- Owner

Linked Database Model
- Structural
- MEP
- Architect
- CM

Object Database Model
- Owner
- Architect
- MEP
- CM
- Structural

Some shared Viewing environment
Native or 3rd party

Object Database Model
Doesn't exist yet

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Ownership

- Owner
  - Embedded Copyrights
  - Protection of Confidential Data
  - Gatekeeping
  - DP as Licensee
    - Publicity
    - Attribution
    - Liability for Reuse

- Design Professional
  - Instrument of Service
  - Copyright
    - Embedded Copyrights
    - Derivative Works
  - Owner as Licensee
    - Completion
    - Maintenance
    - Renovation/Expansion
    - Reuse
Status

- **Legal Status**
  - Contract Document
    - Precedence
    - Allowable Reliance
    - Relationship to:
      - 2D Drawings
      - Specifications
    - Conflict Resolution
  - Interpretive Document
    - Conflict Resolution
  - Informal Document

- **Submittals**
  - RFIs/Clarifications

- **Record Drawing**
  - Who
  - When
  - How
  - Format
Specification

- **Detailed Spec**
  - Software Choices
    - Compatible
    - Interoperable
    - IFC Classes
  - Detail Level
    - Design
    - Submittal
  - Tolerances
  - Information Management
    - Administration
    - Infrastructure
    - Digital Rights
    - Gatekeeping
Implementation

Model Administration
- Who
  - Owner/Owner Consultant
  - Contractor
  - Construction Manager
  - Prime Design Professional
- What
  - Technical
  - Administrative
  - Substantive

Model Management Process
- Version Control
- Design Coordination
- Construction Coordination
- As-Built Information

Job Site Use/Availability

Site Survey/Existing Conditions

Agency Review

Archiving

Insurance
Emerging Standards

- **NBIMS**
- **AIA**
  - IPD Use Guide
  - IPD Contract
  - C106 Digital Data Licensing
  - E201 Digital Data Protocol
- **AISC “Appendix A”**
  - Model Administrator
  - Logical Project Model
    - Design Model
    - Analysis Model
    - Manufacturing Model
  - Interoperable through CIS/2
  - Model Takes Precedence
  - Conditional Acceptance by Fabricator
  - Submittals Through Model
  - No Discussion of Legal Issues Involved
- **AGC**
  - Contractor’s Guide to BIM
  - Consensus Docs
    - 200.2 Electronic Communications Protocol Addendum
    - Series 300 IPD
- **GSA**
  - Spatial BIM Required
  - BIM Design Center
- **USACE**
  - BIM is Superset of CAD
  - A/E to Provide Plan for BIM Use
  - BIM Will Be Sufficient for Costing
  - Model Elements That Are Shown on $\frac{\text{1}}{4}:1$
  - Structural Model “As it Would Be Built”
  - No Unresolved Interferences from 20%!
- **CURT**
- **CIFEI**
Legal Issues

- Inherent in the Use of BIM
- Arising from BIM as a Collaborative Framework
Issues Inherent in BIM

- Data Translation
- Data Misues
- Intellectual Property
- Valuable Papers/IT Risk
- Status of Model
- Standard of Care
- Design Delegation

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Data Translation

- **Errors**
  - Professional Liability
  - Limited Software Warranties
- **Inconsistent Features**
- **Interoperability**
Data Misuse

- Currency
- Adequacy
- Tolerances
Intellectual Property

- Ownership
  - Collaborative Work
    - Copyright
  - Instrument of Service
- Confidential Information
- Embedded Information
- What is the Design
- Gatekeeping

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Valuable Papers/IT Risk

- Data Loss
- Insurance
Status of Model

- Contract Document
- Visualizes Intent
- Unofficial
Standard of Care

- Conflict Resolution
  - Depth of Modeling
- Optimization
Design Delegation

- Licensing
  - Frankfort Digital Services v. Kistler
- Responsible Charge
3. BIM Implementation – Across the project team

1. Procedural Scope
2. Legal and contractual
Procedural Scope

1. Who benefits
   - Internal benefits
   - Team benefits
   - Owner benefits

2. Who Pays?
Suggested Scope

1. Project Site model
2. BIM as – or not as – a contract document
3. Subcontractor interface
   1. BIM provided for subcontractor work
   2. BIM as context for shop drawing review
4. Direct site integration
5. As built
BIM Coordination Workshop

- Software Choices
  - Compatible
  - Interoperable
  - IFC Classes
- Detail Level
  - Design
  - Submittal
- Tolerances
- Coordinate system

- Information Management
  - Administration
  - Infrastructure
  - Digital Rights
  - Gatekeeping

- Coordination Process
  - Organization
  - Leadership
Issues Arising from How Building Information Modeling is Used

BIM as a Collaborative Framework
Issues Arising From How BIM Is Used

- *Boundaries*
- *Vagueness*
- *3rd Party Reliance*
- *Contracts*
- *Intellectual Property*
- *Design Delegation*
- *Implied Warranties*
- *Insurance*
The Boundary Dilemma
Authority → Responsibility → Liability
Constant $ of Contracts/Workhours of Hourly Workers
Sources: U.S. Dept. of Commerce, Bureau of Labor Statistics

Reference: Paul Teicholz, Ph.D., Professor (Research) Emeritus, Dept. of Civil and Environmental Engineering, Stanford University
**Integrated Project Structures:** The building process cannot be optimized without full collaboration among all members of the design/build/own project.

**Open Information Sharing:** Project collaboration must be characterized by open, timely and reliable information sharing.

**Virtual Building Models:** Effectively designed and deployed technology will support full collaboration and information sharing and will lead to a more effective design/build manage process.
From Hierarchy to Collaboration
OH WOW!
PARADIGM SHIFT!

HANSON
BRIDGOTT

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AI A/AI ACC
Integrated Project Delivery

- AI ACC IPD: A Working Definition
  - www.ipd-ca.net
- AIA/AI ACC IPD Use Guide
  - www.aia.org/ipdg
- Essential Principles
- Business Models
- Building the Integrated Team
- Integrated Project Workflow
- Legal Considerations

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1. Ability to impact cost and functional capabilities
2. Cost of design changes
3. Traditional design process
4. IPD design process

Design Effort/Effect

Conceptualization
- Predesign
- Schematic Design
- Design Development

Implementation Documents
- Construction Documents
- Agency Permit / Bidding

Construction
- Construction
- Final Buyout

Graphic originated by Patrick MacLeamy, FAIA
Collaborative Contracts

- Be Collaborative
- Engineering & Construction Contract (NEC3)
  - [www.necontract.co.uk/](www.necontract.co.uk/)
- “Lean Construction”
  - [www.leanconstruction.org](www.leanconstruction.org)
- Consensus Docs – 300 Series
  - [http://www.consensusdocs.org](http://www.consensusdocs.org)
- NBBJ Agreement
- AIA
  - IPD: A Guide
  - IPD Agreement(s) Spring 2008
Additional Resources and Developments

- NBI MS  www.nibs.org
- GSA  www.gsa.gov.bim
- USACE  cadbim.usace.army.mil/BIM
- AIA  www.aia.org
- AI ACC  www.ipd.ca.net
- AGC  www.consensusdocs.org
- CURT  www.curt.org
- CI FE  www.cife.stanford.edu
- Lean Construction  www.leanconstruction.org