BIM BASICS
Past, Present, Future

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What is BIM?

National BIM Standard Definition of BIM

- A Building Information Model (BIM) is a digital representation of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle from inception onward.

- A basic premise of BIM is collaboration by different stakeholders at different phases of the life cycle of a facility to insert, extract, update or modify information in the BIM process to support and reflect the roles of that stakeholder. The BIM is a shared digital representation founded on open standards for interoperability.
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What is BIM?

– BIM very simply is “A digital representation of the physical and functional characteristics of a building that is shared/used by all stakeholders to eliminate waste and increase efficiency.”

– BIM is not about the B and the M it is about the I = Information is the key
What are Owners Saying about BIM?

“With BIM we have successfully increased labor productivity, thereby lowering its net cost, changed or reduced the amount of materials used and wasted on a job site to lower their net cost, and modeled construction costs are more accurate to the point that some of the more expensive site options available became financially viable.”

“Our team is so committed to the use of this tool that long time suppliers who were not or could not get onboard and demonstrate their readiness to use BIM were replaced in favor of new allies.”

John Moebes, AIA
Director of Construction
Crate and Barrel

Source: Used with Permission. FMI Corporation, Raleigh, NC. (919) 785-9351, MBridgers@fminet.com
"FMI/CMAA Eighth Annual Survey of Owners: The Perfect Storm – Construction Style."
What are Owners Saying about BIM?

“We pursued BIM because of efficiency. BIM has the potential to provide us with a far more efficient operation, not only as part of design and construction but also in operations and maintenance. Accuracy is another main reason. BIM appears to offer greater accuracy than what our current practices produce.”

Charles Hardy, AIA, CCM
Deputy Director
U.S. General Services Administration (GSA)
Office of Property Development

Source: FMI Corporation, Raleigh, NC. (919) 785-9351, MIHbridges@fminet.com
"FMI/CMAA Eighth Annual Survey of Owners: The Perfect Storm – Construction Style."
What are Owners Saying about BIM?

“Constructors develop models to enhance their coordination practices and product documentation, which are incorporated into a building database and ultimately used and cherished by the building manager in helping to maintain the facility at the lowest possible cost to the end owner. In the end, we should see better quality, plus increases in productivity and profitability.”

Large Public Owner
Summary of Significant Results

Biggest BIM Adoption Hurdles
- Lack of BIM Expertise
- Lack of Industry Standards

Greatest BIM Benefits
- Improved Communication
- Improved Collaboration
- Higher Quality Project Decision Making
- More comprehensive Planning and Scheduling
Why BIM?

The Problems:

- Construction is a $4.8T Industry Worldwide
- 1.25M Construction Companies in the U.S.
- “Mom and Pop” factor: 92% of those Cos. have less than 20 Employees
- 100’s of IT Tools (Est, Sched, CAD, PM, Acctg, Document Imaging)
- Buildings have the longest Lifecycle of any Tangible Asset
- 90%+++ of our customers can’t read or understand 2D drawings
- Construction industry is stagnant – We have been building the same way since the early 1900’s
- Construction Productivity has decreased since 1964
Construction & Non-Farm Labor Productivity Index (1964-2003)

Constant $ of contracts / workhours of hourly workers

Sources: US Dept. of Commerce, Bureau of Labor Statistics

[Graph showing the productivity index from 1964 to 2003 for construction and non-farm labor, with the construction productivity index in red and the non-farm productivity index in blue.]
Why BIM?

Figures from CII – Construction Industry Institute

Current Manufacturing

- Value Added: 62%
- Support Activity: 12%
- Waste: 26%

Current Construction

- Value Added: 10%
- Support Activity: 33%
- Waste: 57%

**** Difference in waste is 31%
Construction Waste Identified
(Owner’s Perspective from CURT)

- Correction / Re-Work
- Performing Work out of Sequence
- Waiting for Design Review Comments
- Inefficient Construction Methods
- Moving Materials on site
- Redundant Design/Construction Processes
- Lack of JIT Construction Practices
- Lack of Teamwork/Communication
- Slowdown/Stoppages of Work Processes
The Math

- Worldwide Construction Industry 2008 = $4.8T  
  (Source ENR - Estimate)
- U.S. Construction Industry 2008 = $1.288T  
  (Source ENR - Estimate)
- 57% Waste (Construction) - 26% Waste (Manufacturing) = 31%
- 31% of $1.288 T = $399B More Construction Waste Annually
- If we eliminate 10% of waste = $40 Billion Savings to Owners
Why BIM?

Examine dynamics of most construction projects

- Owner has “clouded” vision of final deliverable
- Inaccurate/Incomplete Plans/Specs
- Trades are picked by Lowest Price (in most cases no “value added” assigned to competence)
- Nobody will share info because of Liability
- Everyone wants to shove Risk to someone else
- Every man for himself
- Schedule is irrelevant – Often times ignored
- Because the job is awarded on low price, subs need to make up money on change orders
Typical Subcontractor Bid

- Optimum Labor Budget
- Material
- Profit
- Change Orders
- Contingency
- Labor Inefficiency
Typical Subcontractor Bid

- Material
- Profit
- Change Orders
- Contingency
- Labor Inefficiency
- Waste

Optimum Labor Budget
Key Concepts of BIM

• It is a Database – Not just 3D Drawings
• It is all about sharing info through a Model with all disciplines
• Refers to a “Model” but it is a “Process” not a Product
• Ultimate Communication Tool because it’s visual
• Connects formerly disconnected silos of info
• Collaboration to the Nth degree
• Process + Tools = Power of BIM
• Enabler for Lean Construction – can rely on Model to help facilitate prefabrication
• VDC + Analysis + Facility Information = BIM
What are the barriers?

My costs will skyrocket if I get into BIM - FALSE

- There is a learning curve
- Payback is less than 6 months

Technology changes so fast it intimidates us - TRUE

* 1992 First Commercial text message sent

- Today the total number of text messages sent and received every day exceeds the population of the planet
What are the barriers?

* In 2006 2.7 Billion Google Searches every month
  - Today there are 31 Billion every month
  - What did we do B.G.?

* Number of years it took to reach 50 Million Homes

- Radio: 38 years
- TV: 13 years
- Internet: 4 years
- IPOD: 3 years
- Facebook: 2 years
What are the barriers?

“If you don’t like change, you’re going to like irrelevance even less.”

Eric Shinseki – 4 Star General
Former Army Chief of Staff
Currently US Secretary of Veteran Affairs
What are the barriers?

“The problem is never how to get new innovative thoughts into your mind, but how to get the old ones out.”

Dee Hock
Founder VISA
Face Reality

“Companies not reacting quick enough to the changing demands of both technology and our economy will fail.”

Tom Schleifer, Ph.D.
Author - Construction Contractor’s Survival Guide

Do you want to invest in?

- Pay Phone Business
- Fax Machine Business
- Typewriter Business
- U.S. Postal Service

Our customers are demanding we implement BIM.
Large Scale BIM (Lifecycle Information View)

Knowledge databases
- Best practice knowledge
- Own practice

Briefing
- Functional req.
- Estimates
- Conditions
- Requirements

Demolition, refurbishment
- Rebuild
- Demolition
- Restoration

Facility management
- Letting, sale, operations
- Maintenance
- Guaranties

Construction management
- Scheduling
- Logistics, 4D

CAD software
- Drawings, calculations
- Architect, engineer, ...

VRML
- Visualisation, 3D models

Simulations
- Comfort
- Ventilation, heating
- Life cycle cost
- Light, sound
- Insulation
- Fire, usage
- Environment
- Life time predictions

Specifications
- Specification sheets
- Classification standards
- Estimates, accounting

Procurement
- Product databases
- Price databases

Laws and regulations
- Building regulations
- Building specifications

Dee Cramer
BIM Test – Is it BIM?

- Is Drawing in 3D BIM? - No
- Is Downloading CAD Drawings to Fabrication Equipment BIM? - No
- Is linking Schedule (Time) to a Model BIM? - Yes
- Is having product information in Model BIM? - Yes
Basics of BIM
Mode of Operation – “MO”

MO-#1 Field Measure/No CAD Department
- Inaccurate
- Time Consuming
- Error Prone
- Duplicated Effort

MO-#2 Have CAD, but Only draw in 2D
- AutoCAD
- AutoCAD LT
- Turbo CAD

MO-#3 Start Drawing in 3D
- AutoCAD MEP (East Cost CAD)
- Bentley
- CAD Duct (TSI)
- InteliCAD
- PractiCAD
- Quickpen
- Revit MEP
- QuickDuct CAD
**Basics of BIM**

Mode of Operation – “MO”

MO-#4
Download to Fab

MO-#5
Upload to Estimating

“Now your ready to BIM”

6D Facility Management

3D CAD
  - Revit

4D Scheduling
  - NavisWorks

5D Cost

CAM Duct (TSI CAD Duct)
EC CAD Duct Maker (AutoCAD MEP)
PractiCAM (PractiCAD)
QuickDuct CAM
Vicon (InteliCAD)
Vulcan (Quickpen)

CAD EST (TSI)
Fast Duct
PractiCAM
Quickpen Autobid
Quote Express
Basics of BIM - Hardware

**Minimum Acceptable**

**Processor:**
Intel® Core™ 2 Duo P8400 (2.26GHz, 3M L2 Cache, 1066MHz FSB)

**Operating System:**
Windows 7 with Business Downgrade to XP Professional

**LCDs:**
15.4" Wide WXGA (1280x800) Display

**Graphics:**
NVIDIA Quadro FX 770M, 512MB

**Memory:**
2.0GB (3.0GB Recommended), DDR2-800 SDRAM, 2 DIMMS

**Approximate Cost:**
Desktop: $1,200 - $1,500
Laptop: $1,500 - $2,000

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**High End**

**Processor:**
Intel® Core™ 2 Quad QX9300 (2.53GHz, 12M L2 Cache, 1066MHz FSB)

**Operating System:**
Windows 7 – 64-BIT SP1, With Media

**LCDs:**
17” UltraSharp™ Wide Screen WUXGA (1920x1200) RGB LED LCD Display

**Graphics:**
NVIDIA Quadro FX 3700M, 1.0GB

**Memory:**
16.0GB, DDR3-1066MHz SDRAM, 4 DIMMS

**Approximate Cost:**
Desktop: $1,500 - $2,500
Laptop: $2,000 - $3,000
Basics of BIM - Software

What to Look For in A Software Solution

- Simplicity
- Functionality
- Interoperability
- Collaborativeness
- Vendor Longevity
- Support / Training
- Environment

$4,000 - $7,000 (Single License)

Base AutoCAD Packages:
- AutoCAD MEP
- Revit MEP Suite

$10,000 - $12,000 (Single License)

3RD Party Autodesk Add On Software Packages:
- Bentley
- CAD Duct
- InteliCAD
- PractiCAD
- Quickpen
- Shop Data

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Small Scale BIM = Eliminate Conflicts
“Old School” MEP Coordination

- Old School Coordination
- Isolated Drawing Process
- Weekly Coord. Meetings
- Overlay MEP Drawings
- Drawing Scale Conflicts
- Lengthy Non-Productive Coord. Meetings
- No on-time solutions
- Accuracy Suffers
“Old School” MEP Coordination

Uses for Light Tables:

- Print Storage
- Storing Water Bottles
- General “Collect All”
Small Scale BIM Advantages

**Download Duct Direct to Fabrication Equipment**

- Automated download – No “punch in”
- Eliminates human error in “punch in”

**BIM allows us to utilize JIT – Just In Time Practices**

- Less Duct Storage on Site – Less Clutter, Safer Site
- Eliminates Waste of Material Handling
- Eliminates Lost Pieces which require rework
Small Scale BIM Advantages

Enabler for Lean Construction
Small Scale BIM Advantages

Enabler for Lean Construction

What in the world is the Fire Protection Contractor doing?
Small Scale BIM Advantages

Enabler for Lean Construction
Small Scale BIM Advantages

Enabler for Lean Construction
Small Scale BIM Advantages
Enabler for Lean Construction
Lean Principles – Design for Manufacturing

*HVAC Sheet Metal – JIT Delivery*

- Fully coordinated HVAC model with steel and other MEP systems
- Direct interface from fully coordinated 3D model to cutting table
- Installation drawings from 3D Model.
- JIT delivery & installation without field changes
- Offsite fabrication in shop

Potential to reduce raw material by up to 20%
Small Scale BIM Advantages

The Job Fits – The First Time

* Eliminates the need to field measure certain pieces due to collisions

* No Interferences = No Interruptions

* No Interruptions to work flow means higher productivity in the field

* Conflicts are resolved with less wasted time – check the model – little or no GC involvement
Eliminates Guesswork on Actual Productivity

* Subs Risk is in Field Labor

* If you eliminate uncertainties which negatively impact our productivity – there is less risk

* Less Risk = Lower Cost

* Hospital in Lansing – Increased productivity 18% in our bid due to BIM
Small Scale BIM Advantages

BIM makes Scheduling and Coordination Easier

* Phase the 3D Modeling with the GC’s schedule for Construction

* Completed Model is like a puzzle – it’s clear what needs to be installed first

* Smoother Jobs = Faster Schedule

* Eliminates unnecessary Change Orders due to interferences

* Eliminates the need to “redo” as builds based on actual installation
Small Scale BIM Advantages

BIM Allows for:

* Less wasted materials and rework

* Less Interferences/interruptions to work flow which allows everyone to be more productive

* Less Risk = Lower Cost

* Fewer/No Change Orders

* Better Trade Coordination and Sequencing – Less Congestion of Trades

* Safer Job – Less clutter, fewer lifts, less congestion
BIM Case Study

Project Overview – GM Global V6 Engine Plant

- 442,000 sq. ft addition
- 85 Week Design and Construction Schedule
  - 24 Weeks less than typical
- 36 Week Construction Schedule
  - Delivered in 31 weeks - complete
- Zero Change Orders from Building Component interferences
3D Enabled Interference Detection

Engine Facility

3000 - 4000 Initial interferences Jan. 11, 2005
Project Management Approach: Weekly Coordination Sessions

March 11, 2005

0 Interferences
BIM Case Study

Project Overview

- 10 Story Hospital
- New Construction
- Phased at 2 Story Intervals
- Design - Bid - Build Delivery
- Each Phase 100% Complete prior to next phase bid date
- Phases almost Identical
- Low Bid Wins
BIM Case Study

Productivity Achievements Summarized

Phase I → Phase II
5% higher

Phase II → Phase III
13% higher

Phase I → Phase III
*18% more productive due to BIM
BIM – What is next?

4D Schedule
5D Estimating
6D Facility Management
Total Station – Hanger & Pipe Sleeve
Layout
3D Scan to BIM
IPD
BIM – What is next?

Add 3D + Time = 4D

- Better Communication for Construction Sequencing
- Better Site Planning & Logistics
- Better Analysis for Project Management
- Uncovers flawed logic in the Schedule because it’s visual
BIM – What is next?

Add  $4D + \text{Quantity} + \text{Cost} = 5D$

- QTO – Quantity Take Off
- Takeoff in Minutes
- Spot the Difference – track changing variables
- Quantify More quickly w/ auto search
- Maintain a Dynamic Document of Record
BIM – What is next?

Add 5D + Facility Information = 6D

- As built models are delivered as a Model
- O&M data - Technical product Info – Warranty Info – Maintenance Schedule/History – All exist in the Model
- Space Utilization Tool – Simplify remodels – lease and rental analysis tools

5D + Facility Information = 6D
BIM – What is next?

Total Station/Trimble

Lay out pipe and duct hangers directly on the deck from below using a prism or laser pointer.

Accurately lay out points on the floor and transfer up using a handheld laser pointer.

Rapidly lay out points for sleeves and inserts on the deck using a prism.
BIM – What is next?

Actual Hanger Layout for Duct
BIM – What is next?

3D Scan to BIM
BIM – What is next?
BIM – What is next?
BIM – What is next?

Field Time
4 Days (field time)
234 scan positions
10 Billion Points

Project Highlights

1. Decisive factor in winning the project contract for the contractor because of due diligence in preparing for the presentation.
2. Visualize the new ED from several different angles.
3. Completed 3D survey of the campus.
4. Completed the 3D survey without disrupting operations.
BIM – What is next?

Integrated Project Delivery - IPD

- Involve all Team Members in design meetings
- Identify key objectives up front
- Open Collaboration at all stages of a project
- BIM is utilized
- Minimize paper based processes and collaborate digitally
- Check for and manage interferences with 3D Clash detection
- Set up contract mechanisms that enable and reward achievement of key objectives
- Create a culture of trust and information sharing (win-win-win)
1. ability to impact cost and functional capabilities
2. cost of design changes
3. traditional design process
4. Integrated Project Delivery Process

Introduced in the Construction Users Roundtable’s "Collaboration, Integrated Information, and the Project Lifecycle in Building Design and Construction and Operation" (WP-1202, August, 2004), the "MacLeamy Curve" illustrates...
“Owners driving full collaboration through information sharing early in the project process are most likely to achieve desired outcomes: fast, efficient, effective, cost bound buildings”
IPD from CURT

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IPD from CURT

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– In the Traditional Construction Process if you choose fast you can’t have the other three

– “Fast” is a relative term
<table>
<thead>
<tr>
<th>Traditional Project Delivery</th>
<th>Integrated Project Delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fragmented, assembled on “just-as-needed” or “minimum-necessary” basis, strongly hierarchical</td>
<td>Integrated team entity composed key project stakeholders, assembled early in the process, open, collaborative</td>
</tr>
<tr>
<td>Linear, distinct, segregated; knowledge gathered “just-as-needed”; information hoarded; silos of knowledge and expertise</td>
<td>Concurrent and multi-level; early contributions of knowledge and expertise; information openly shared; stakeholder trust and respect</td>
</tr>
<tr>
<td>Individually managed; transferred to greatest extent possible</td>
<td>Collectively managed, appropriately shared</td>
</tr>
<tr>
<td>Individually Pursued; minimum effort for maximum return</td>
<td>Team success tied to project success; value-based</td>
</tr>
<tr>
<td>Paper-based, 2 dimensional; analog</td>
<td>Digitally based, virtual; BIM (3D, 4D, and 5D)</td>
</tr>
<tr>
<td>Encourage unilateral effort; allocate and transfer risk; no sharing</td>
<td>Encourage, foster, promote and support open sharing and collaboration</td>
</tr>
</tbody>
</table>
Questions
??????
DCI Clash Detection
10 Commandments

1) Thou shalt put your best foot forward when drawing your systems and utilize the most efficient layout the first time

2) Thou shalt not post drawings that contain clashes with yourself

3) Thou shalt always meet promised deadlines

4) Thou shalt give notice to other team members if promised deadlines can’t be met - ahead of the deadline

5) Thou shalt notify other team members if the routing of your systems materially impacts another team members work
6) Thou shalt have other team members files attached and loaded while developing and drawing your systems

7) Thou shalt not make promises you know you can’t keep - this severely impacts the team in an extremely negative way

8) Thou shalt always treat one another with respect and treat each other as you want to be treated as far as communication and collaboration are concerned

9) Thou shalt stay engaged and committed to continually update the Model (including Change Orders) throughout the life of the Project

10) Thou shalt always be committed to full collaboration and BIG BIM, not just little bim