BIM BASICS

Past, Present, Future

Prepared for:
March 18, 2010

DRIVING CHANGE
CREATING OPPORTUNITIES
2010 PARTNERS IN PROGRESS CONFERENCE

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Matt Cramer
Steve Hunt

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***

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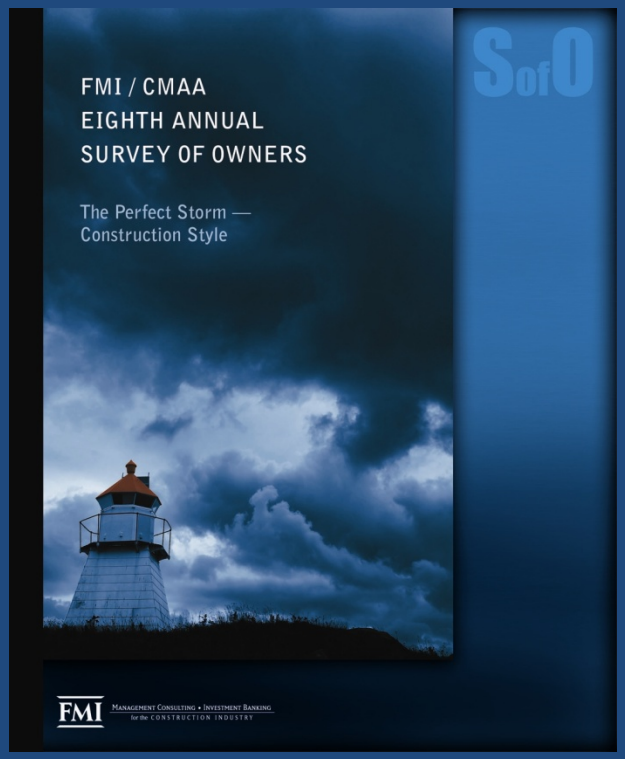
What are Owners Saying about BIM?



"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

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"FMI/CMAA Eighth Annual Survey of Owners: The Perfect Storm – Construction Style."

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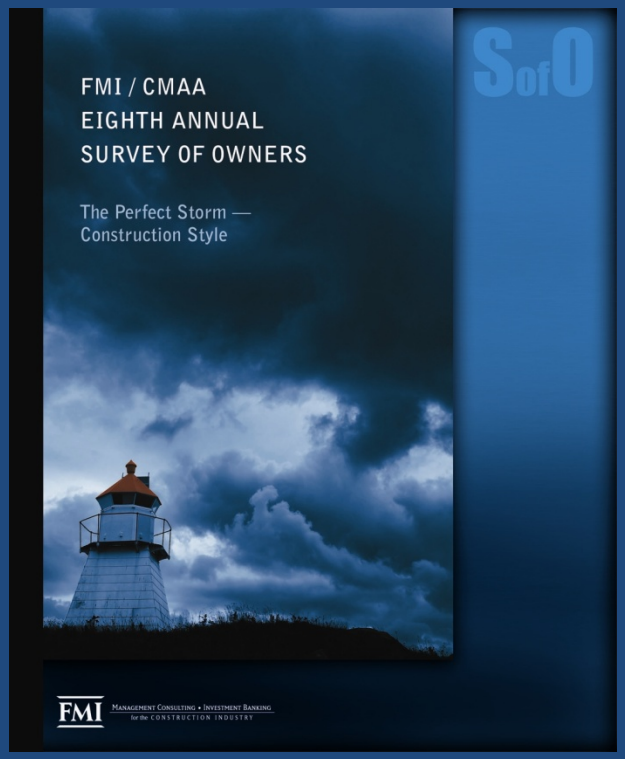

"We pursued BIM because of efficiency. BIM has the potential to provide us with a far more efficient operation, not only as part of design and construction but also in operations and maintenance. Accuracy is another main reason. BIM appears to offer greater accuracy than what our current practices produce."

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

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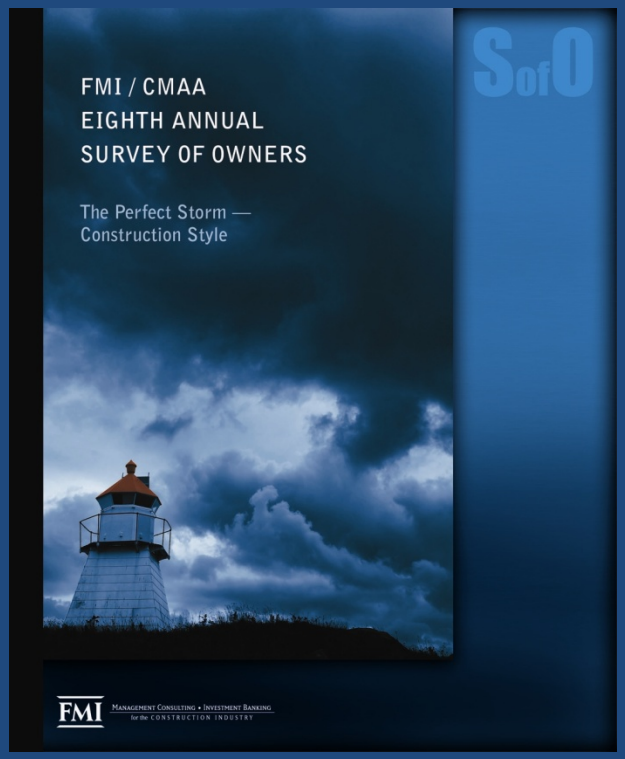

"Constructors develop models to enhance their coordination practices and product documentation, which are incorporated into a building database and ultimately used and cherished by the building manager in helping to maintain the facility at the lowest possible cost to the end owner. In the end, we should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

Large Public Owner

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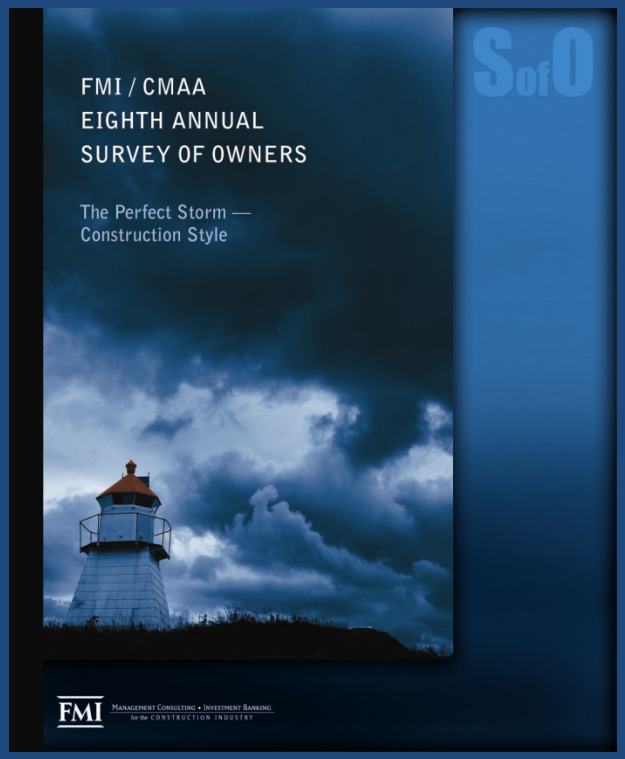
Summary of Significant Results



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

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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

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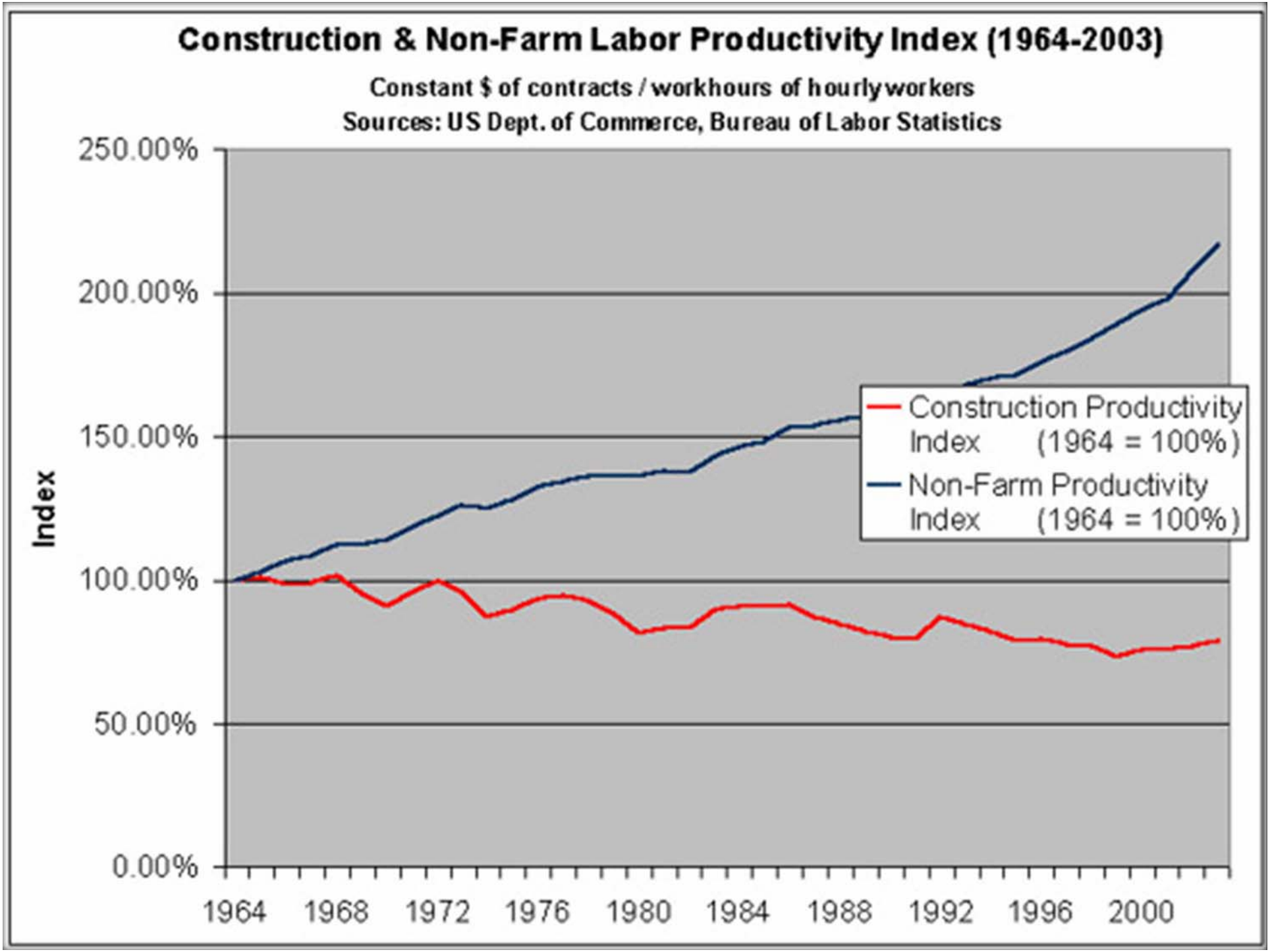
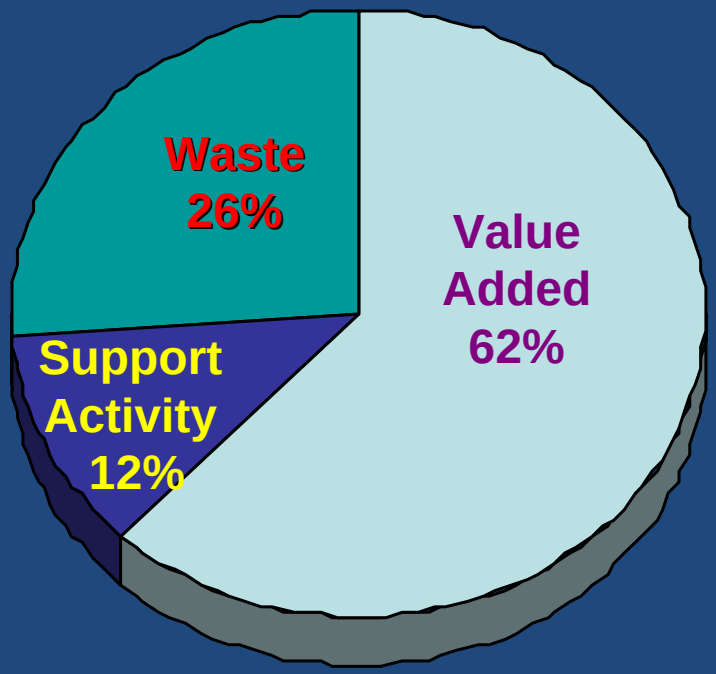

Construction & Non-Farm Labor Productivity Index (1964-2003)
Constant $ of contracts / workhours of hourly workers
Sources: US Dept. of Commerce, Bureau of Labor Statistics
250.00%
200.00%
150.00%
100.00%
50.00%
0.00%
Index
1964
1968
1972
1976
1980
1984
1988
1992
1996
2000
Construction Productivity Index (1964 = 100%)
Non-Farm Productivity Index (1964 = 100%)

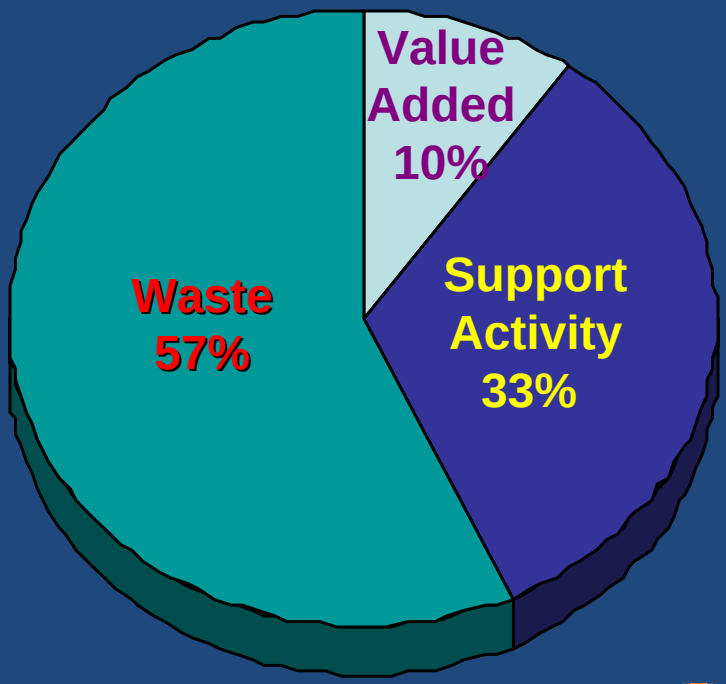
Why BIM?

Figures from CII – Construction Industry Institute

Current Manufacturing



Current Construction



**** Difference in waste is 31%

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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

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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**

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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

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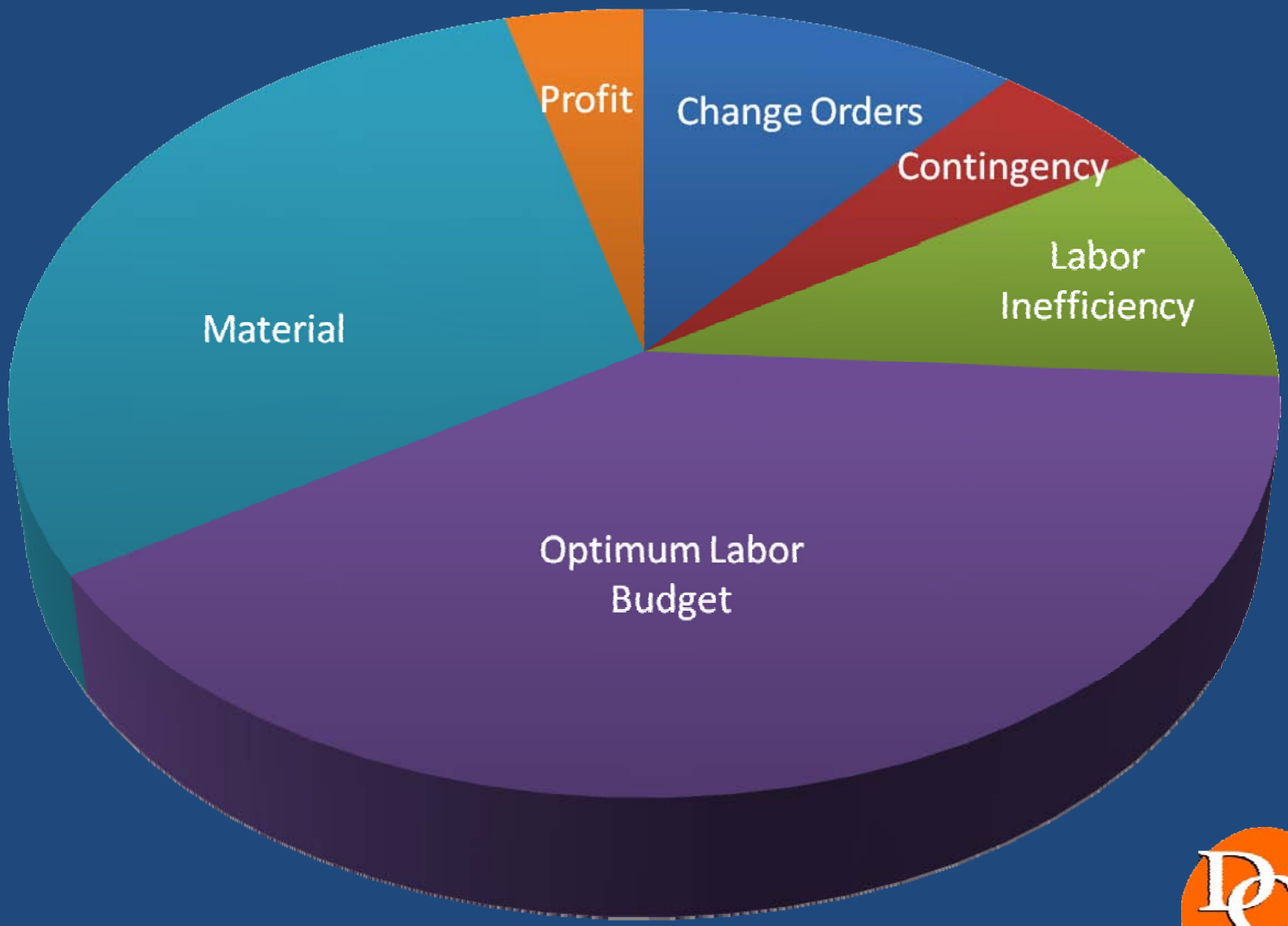
Change Order
YAMAHA

Typical Subcontractor Bid



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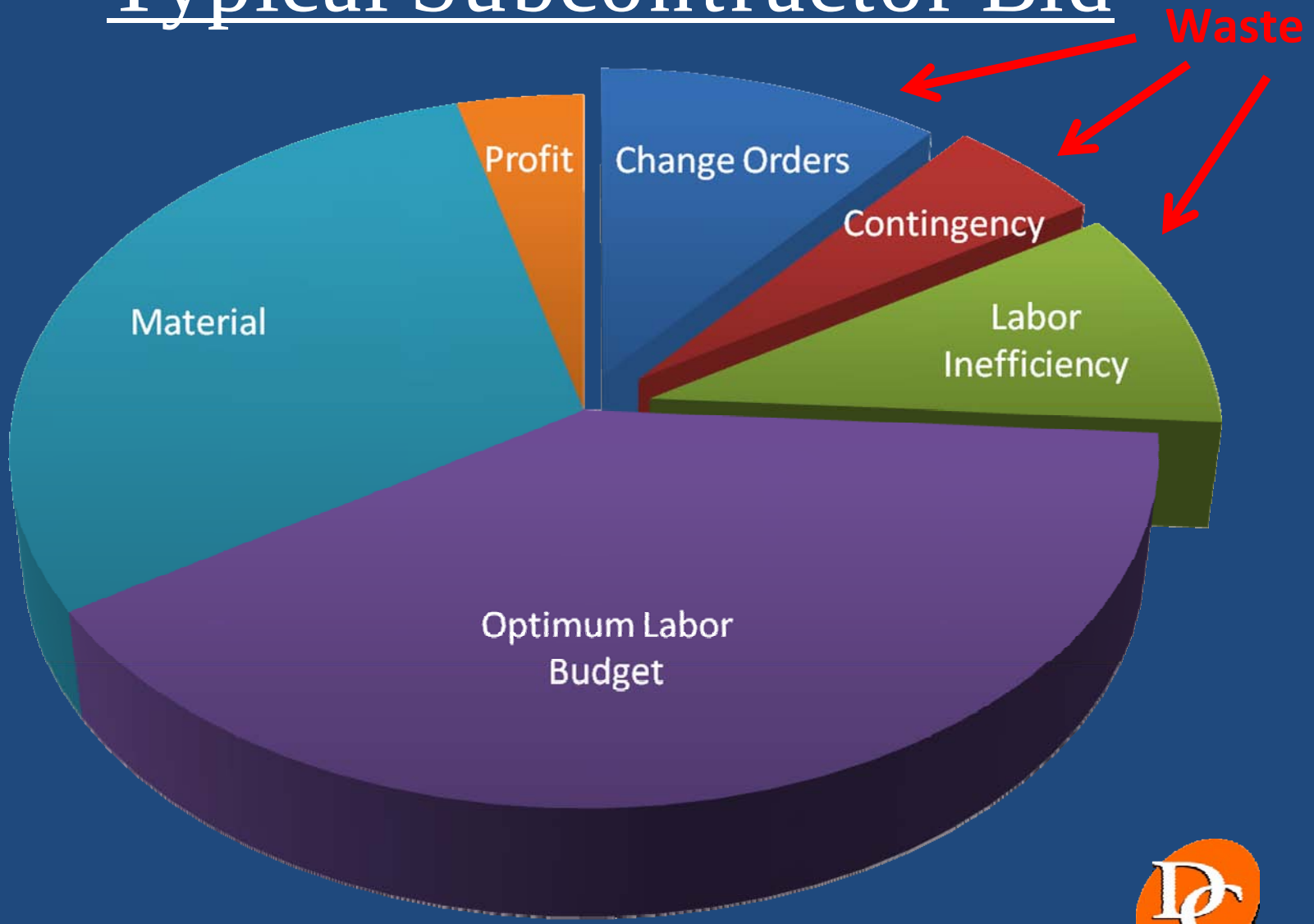
Typical Subcontractor Bid



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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

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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

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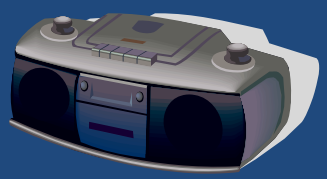
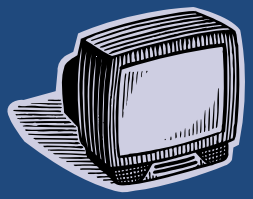
What are the barriers?

* 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

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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

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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

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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.

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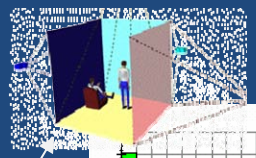
Large Scale BIM (Lifecycle Information View)

Laws and regulations
-Building regulations
-Building specifications

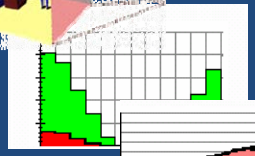
CAD software
-Drawings, calculations
-Architect, engineer,…

Knowledge databases
-Best practise knowledge
-Own practice

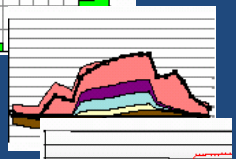


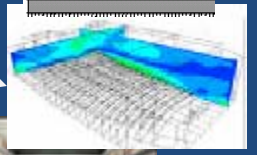
VRML
-Visualisation, 3D models

Briefing
-Functional req.
-Estimates
-Conditions
-Requirements



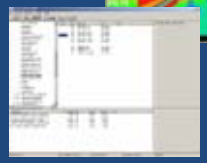
Simulations
-Comfort
-Ventilation, heating
-Life cycle cost
-Light, sound
-Insulation
-Fire, usage
-Environment
-Life time predictions





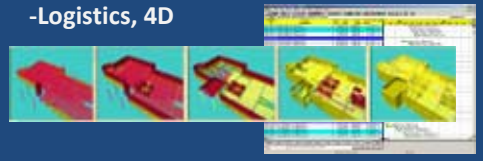
Demolition, refurbishment
-Rebuild
-Demolition
-Restoration

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



Specifications
-Specification sheets
-Classification standards
-Estimates, accounting

Construction management
-Scheduling
-Logistics, 4D



Procurement
-Product databases
-Price databases

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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**

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Basics of BIM

Mode of Operation – "MO"

MO-#1 Field Measure/No CAD Department

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

Inaccurate
Time Consuming
Error Prone
Duplicated Effort

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

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Basics of BIM

Mode of Operation – "MO"

MO-#4
Download
to Fab

MO-#5
Upload to
Estimating

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

"Now your ready to BIM"

6D Facility Management

3D CAD

4D Scheduling

Revit

NavisWorks

5D Cost

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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

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

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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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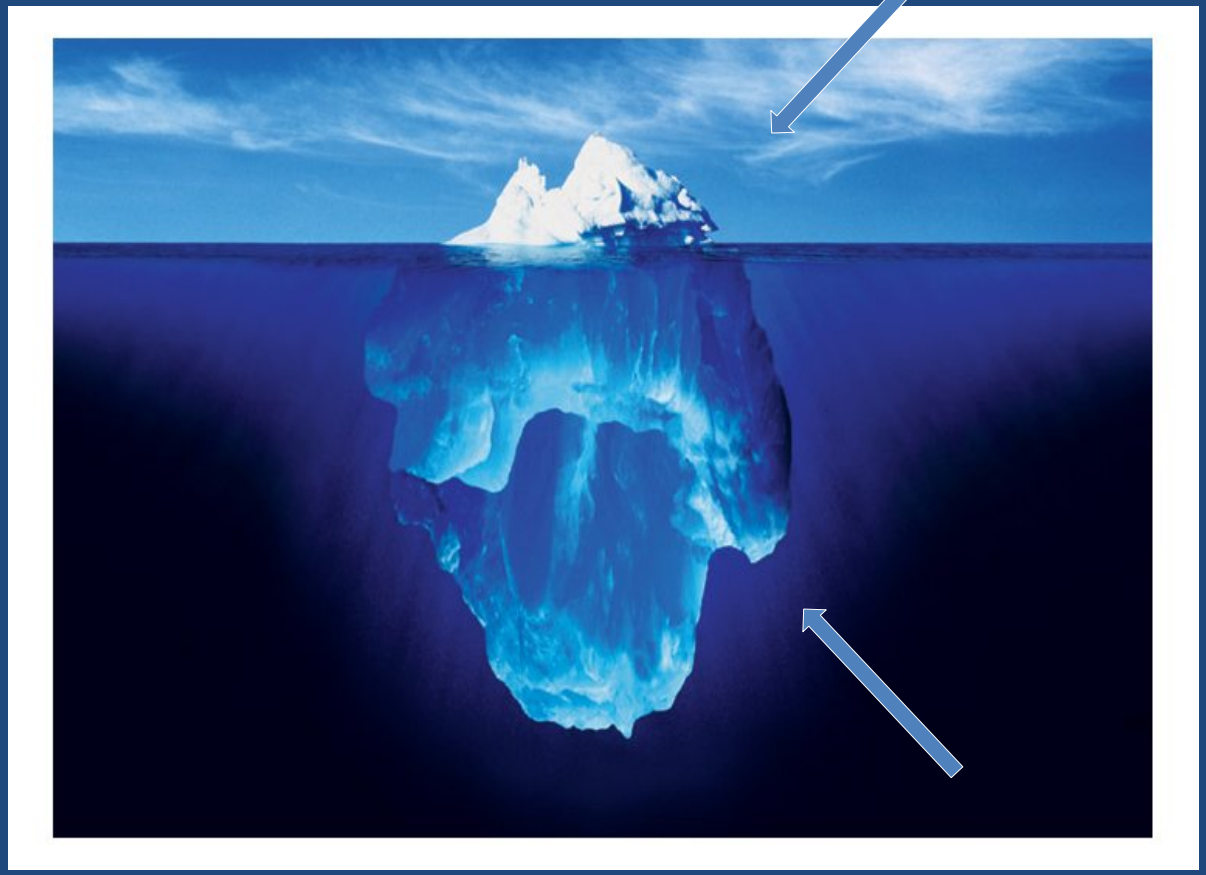
Small Scale BIM



Large Scale BIM

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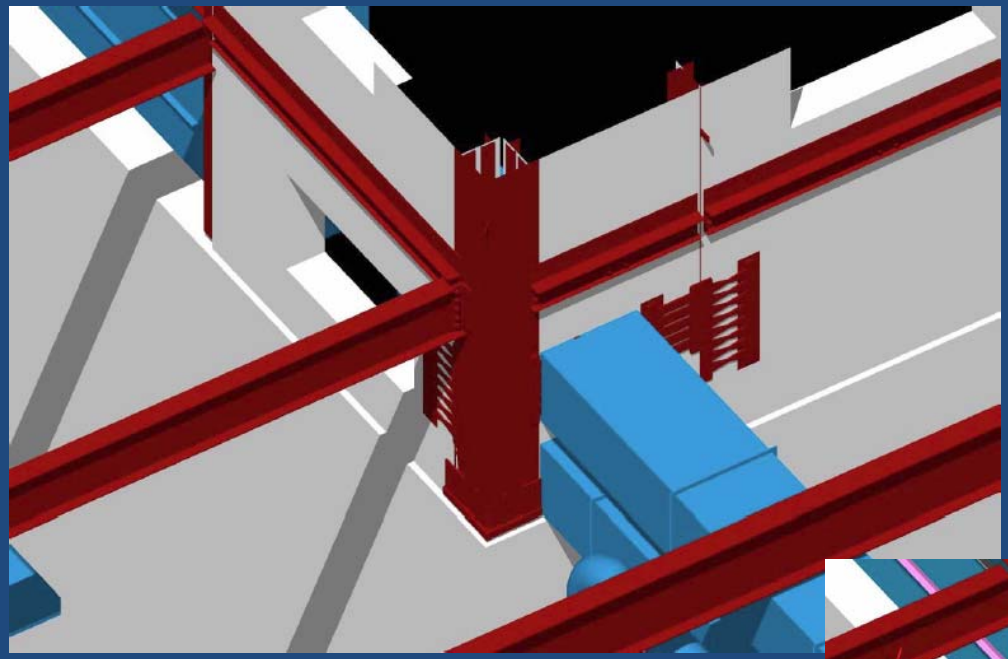
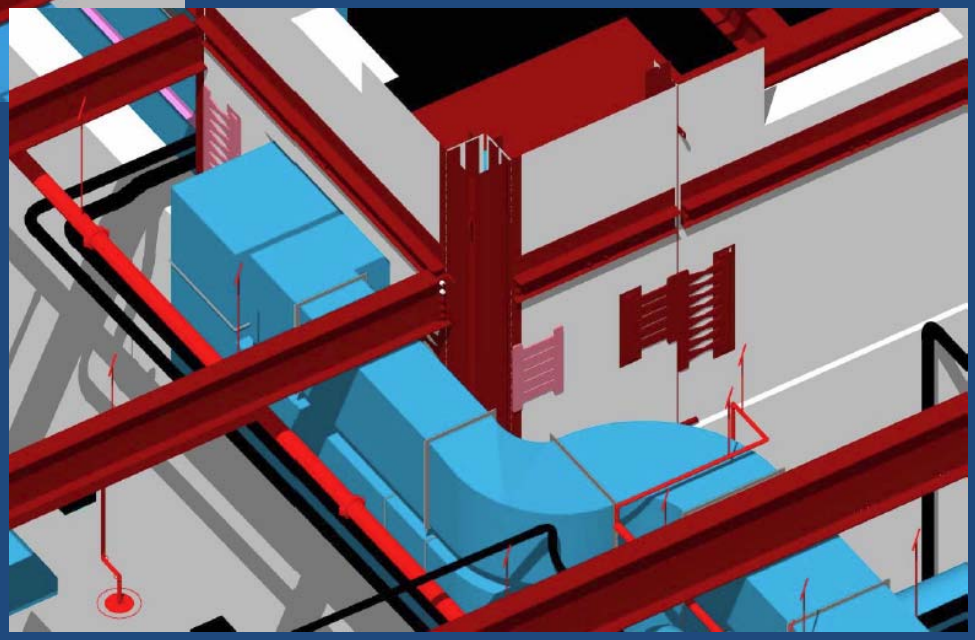
Small Scale BIM = Eliminate Conflicts





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“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

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“Old School” MEP Coordination

Uses for Light Tables:

- Print Storage
- Storing Water Bottles
- General “Collect All”

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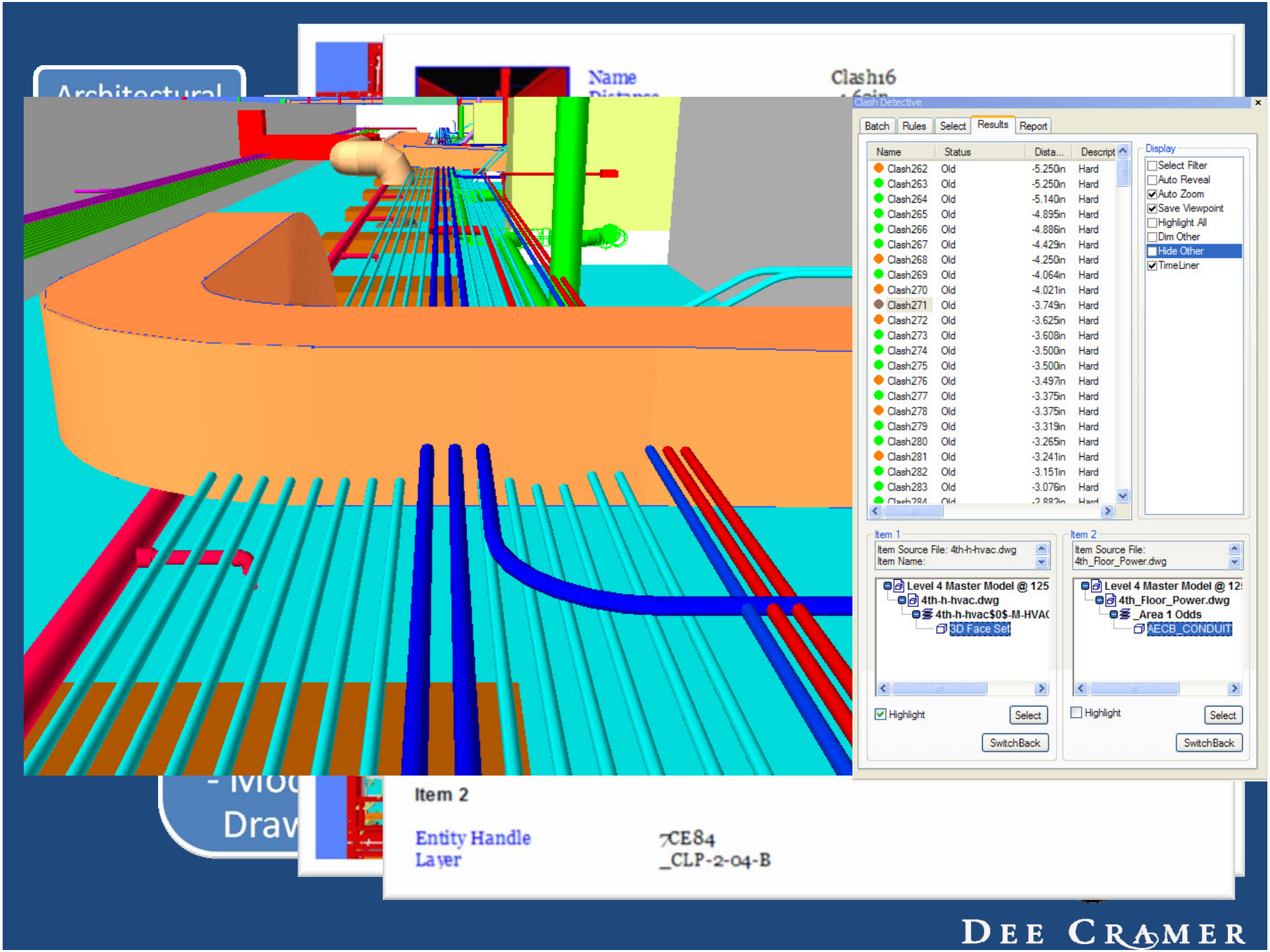
Architectural
Name
Clash16
Clash Detective
Batch
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Descript
Clash262 Old -5.250in Hard
Clash263 Old -5.250in Hard
Clash264 Old -5.140in Hard
Clash265 Old -4.895in Hard
Clash266 Old -4.886in Hard
Clash267 Old -4.429in Hard
Clash268 Old -4.250in Hard
Clash269 Old -4.064in Hard
Clash270 Old -4.021in Hard
Clash271 Old -3.749in Hard
Clash272 Old -3.625in Hard
Clash273 Old -3.608in Hard
Clash274 Old -3.500in Hard
Clash275 Old -3.500in Hard
Clash276 Old -3.497in Hard
Clash277 Old -3.375in Hard
Clash278 Old -3.375in Hard
Clash279 Old -3.319in Hard
Clash280 Old -3.265in Hard
Clash281 Old -3.241in Hard
Clash282 Old -3.151in Hard
Clash283 Old -3.076in Hard
Display
Select Filter
Auto Reveal
Auto Zoom
Save Viewpoint
Highlight All
Dim Other
Hide Other
TimeLiner
Item 1
Item Source File: 4th-h-hvac.dwg
Item Name:
Level 4 Master Model @ 125
4th-h-hvac.dwg
4th-h-hvac0-M-HVAC
3D Face Set
Item 2
Item Source File:
4th_Floor_Power.dwg
Level 4 Master Model @ 12
4th_Floor_Power.dwg
_Area 1 Odds
AECB_CONDUIT
Highlight
Select
SwitchBack
Highlight
Select
SwitchBack
Item 2
Entity Handle
Layer
7CE84
_CLP-2-04-B
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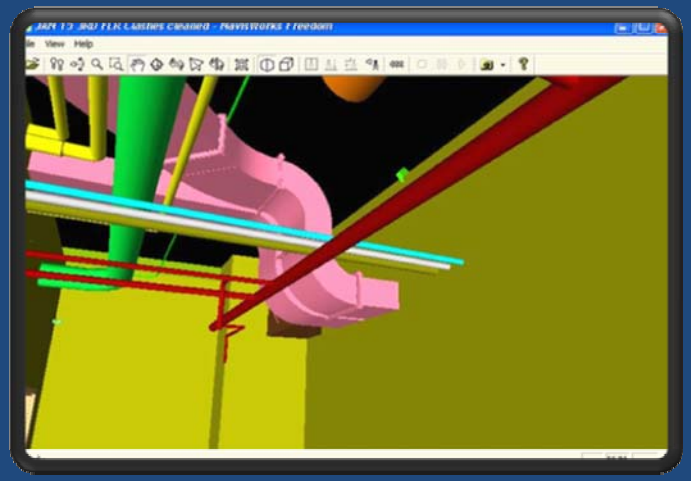
Small Scale BIM Advantages



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

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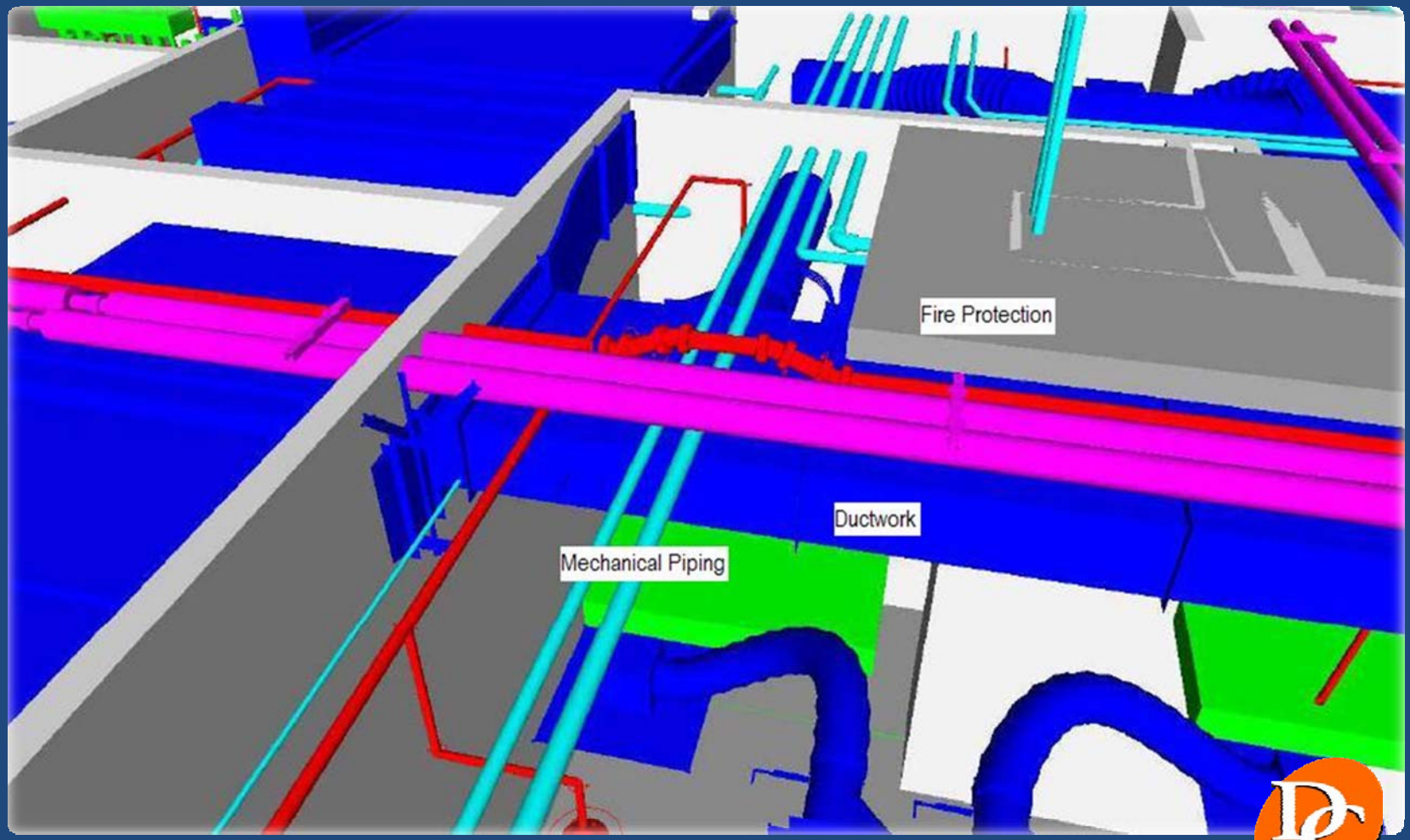
Small Scale BIM Advantages

Enabler for Lean Construction



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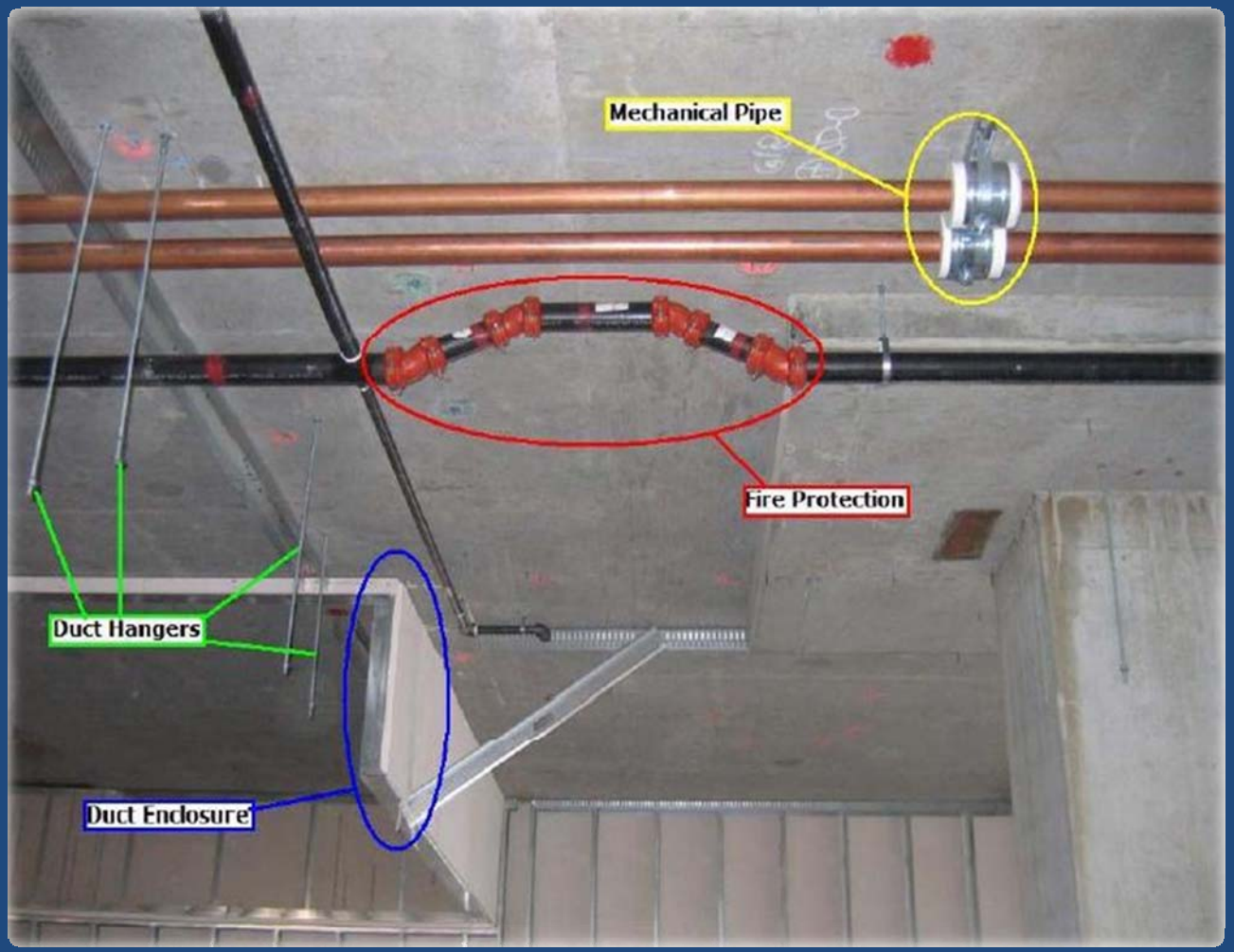
Small Scale BIM Advantages

Enabler for Lean Construction



What in the world is the Fire Protection Contractor doing?

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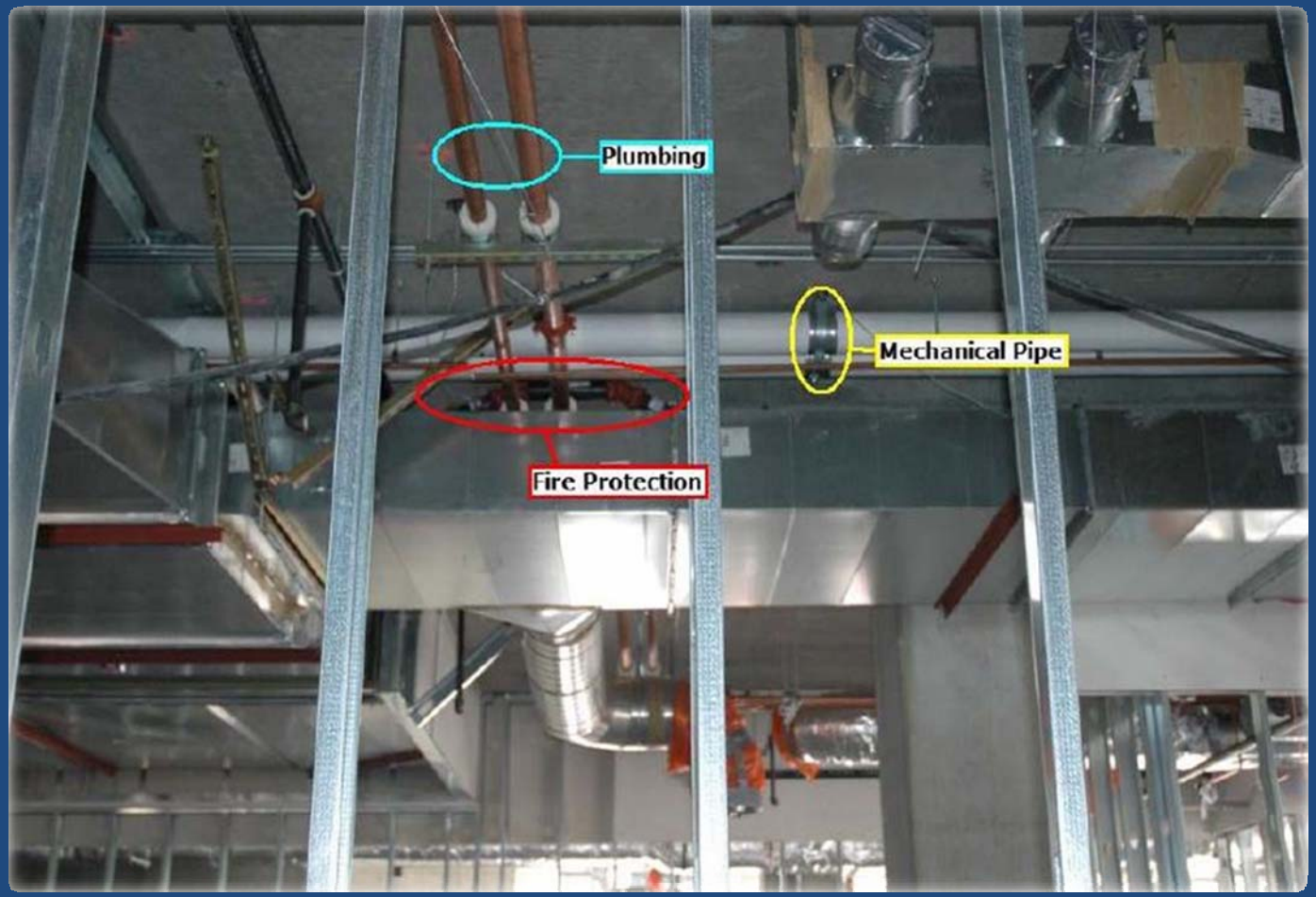
Small Scale BIM Advantages

Enabler for Lean Construction



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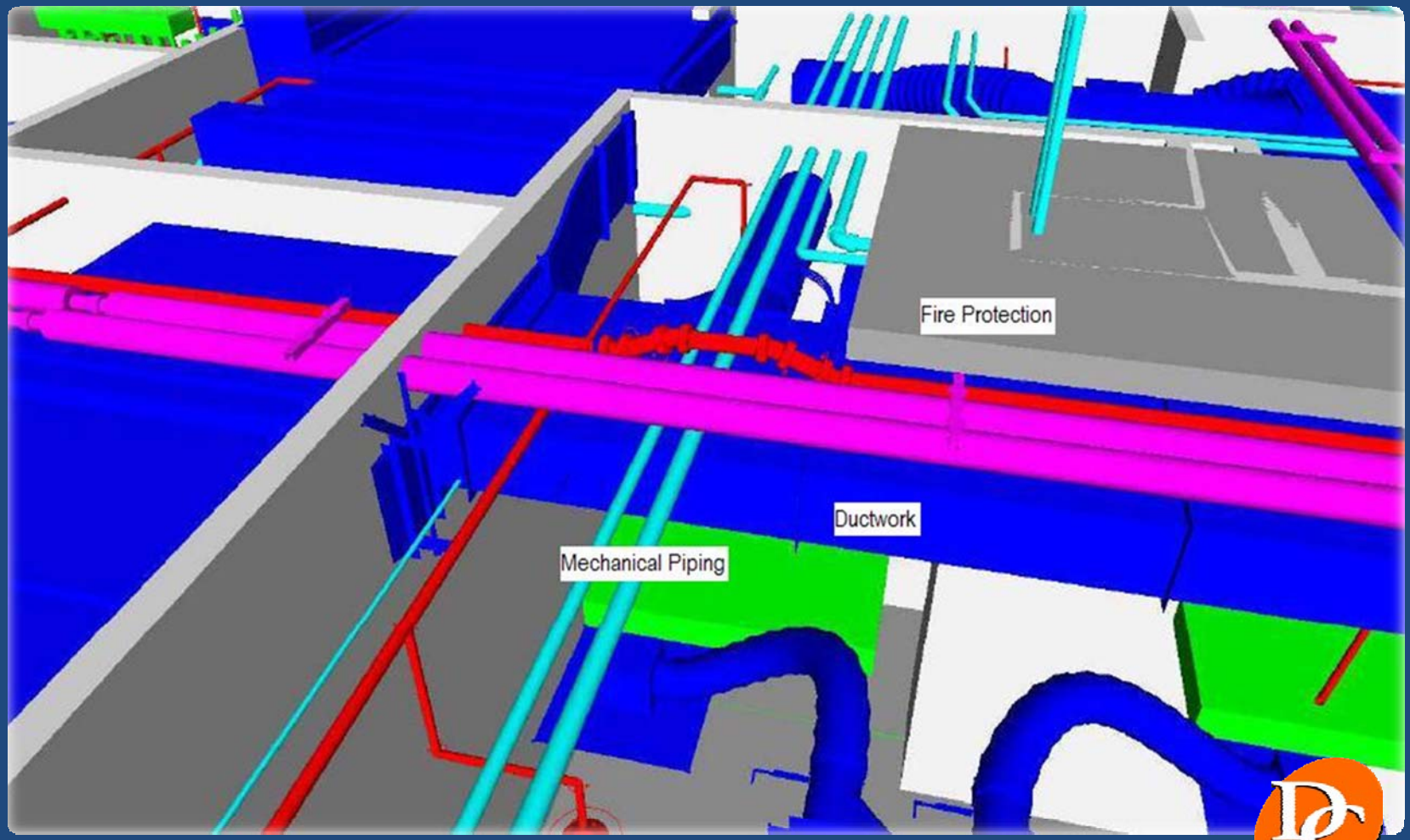
Small Scale BIM Advantages

Enabler for Lean Construction



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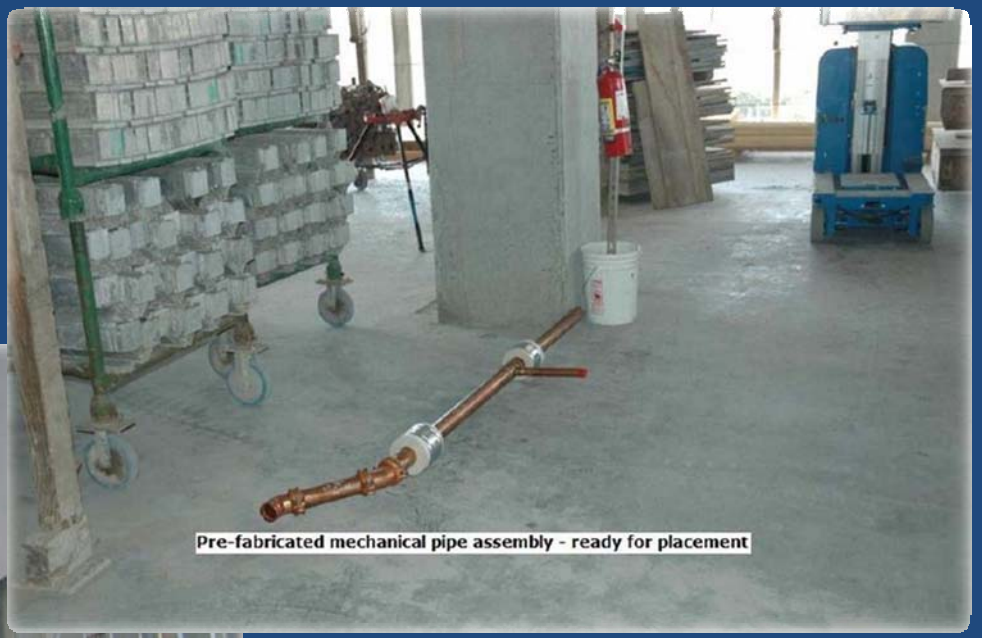
Small Scale BIM Advantages

Enabler for Lean Construction



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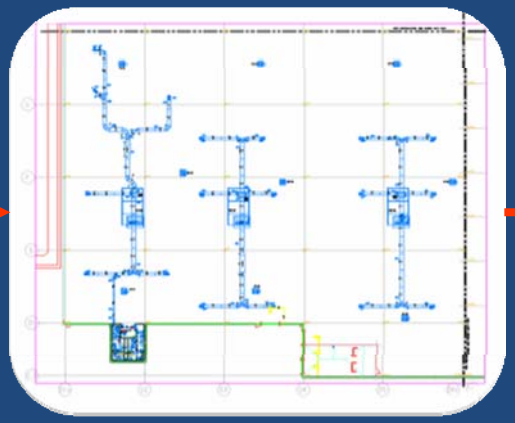
Lean Principles – Design for Manufacturing

HVAC Sheet Metal – JIT Delivery

Fully coordinated HVAC model with steel and other MEP systems



Installation drawings from 3D Model.

JIT delivery & installation without field changes

Direct interface from fully coordinated 3D model to cutting table

Potential to reduce raw material by up to 20%

Offsite fabrication in shop

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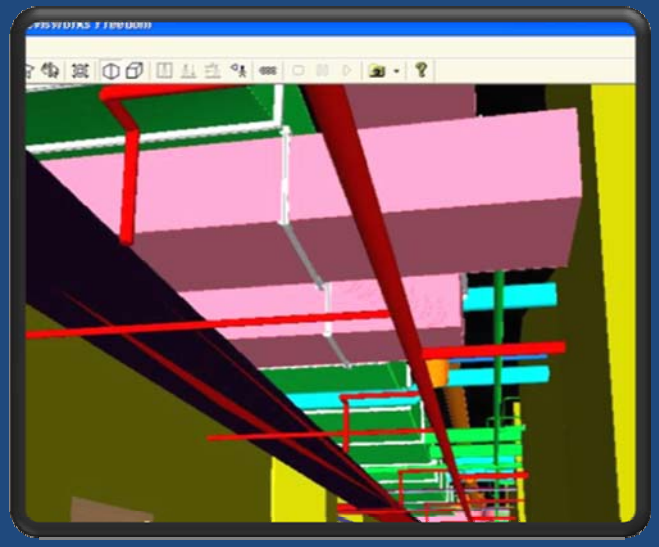
Small Scale BIM Advantages

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

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Small Scale BIM Advantages

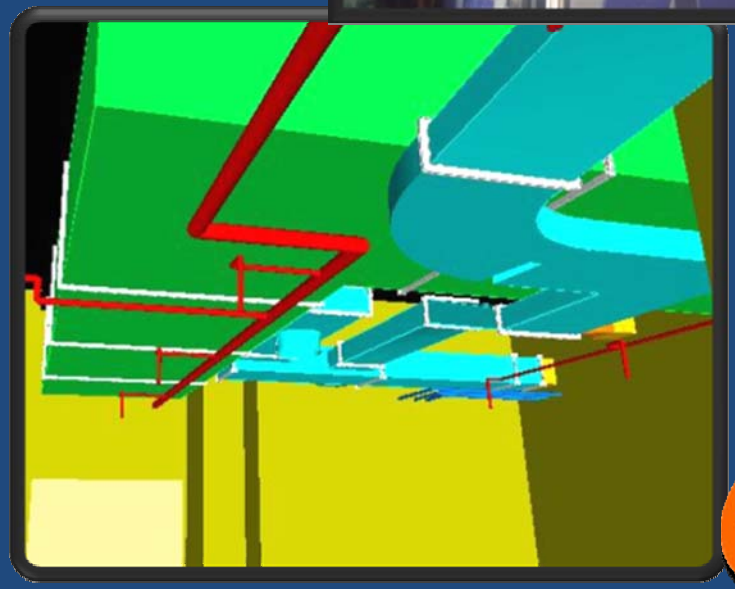
Eliminates Guesswork on Actual Productivity

* 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



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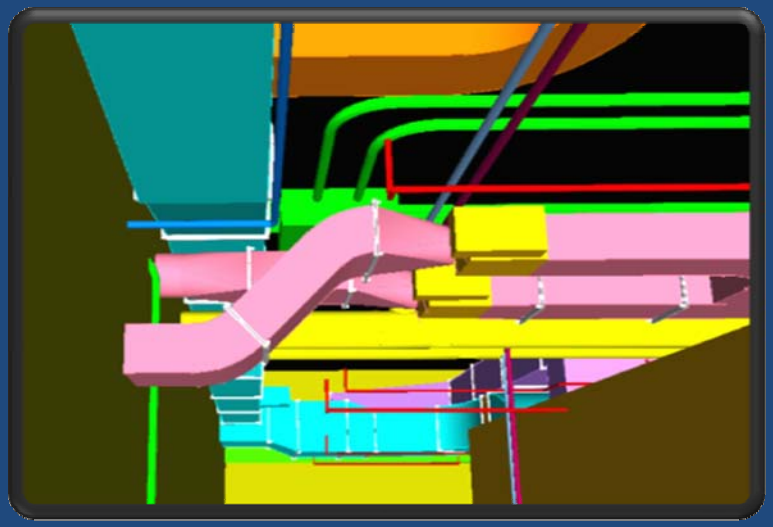
Small Scale BIM Advantages

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 builts based on actual installation

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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

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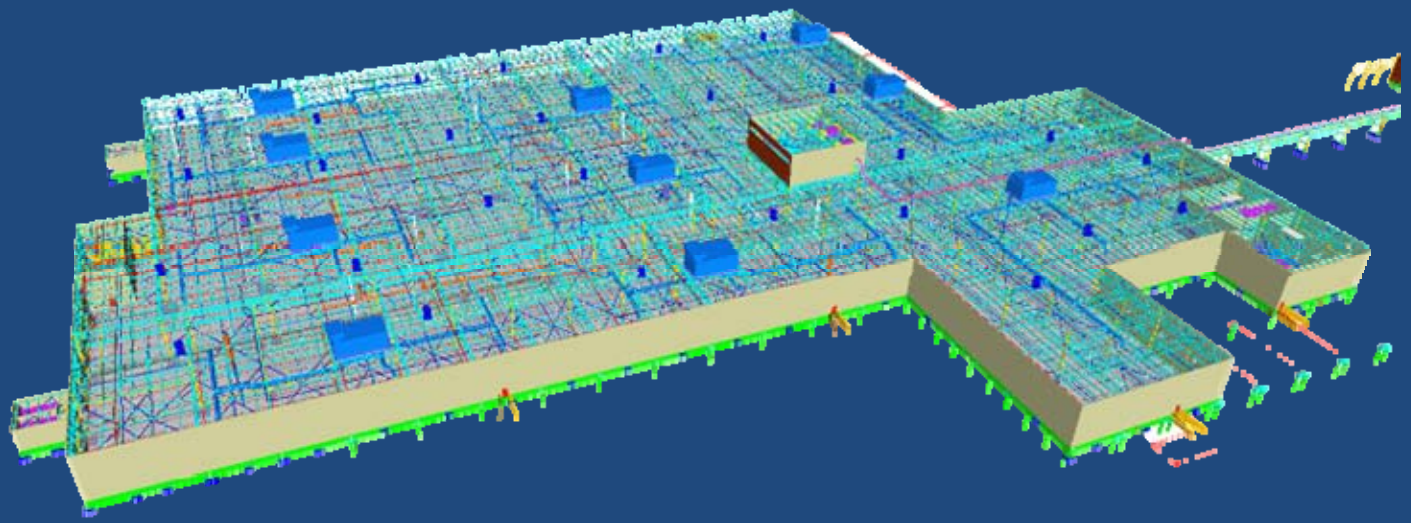
BIM Case Study

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



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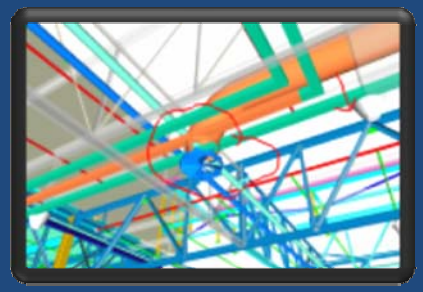
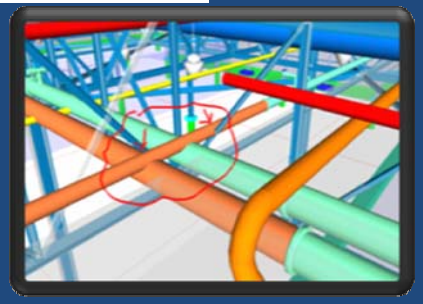
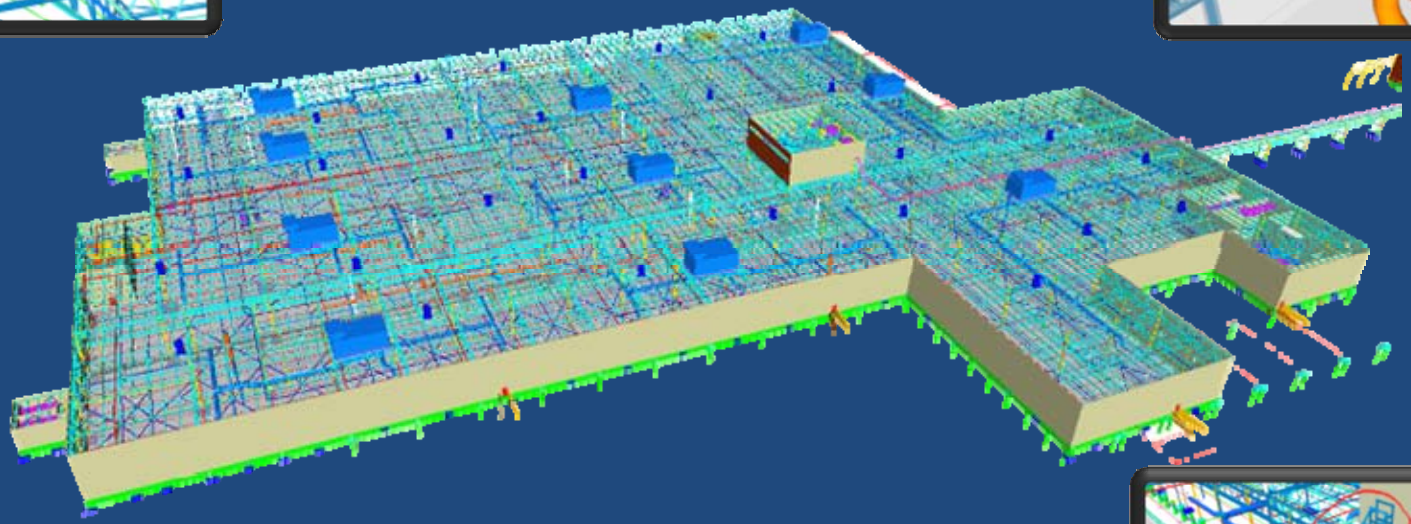
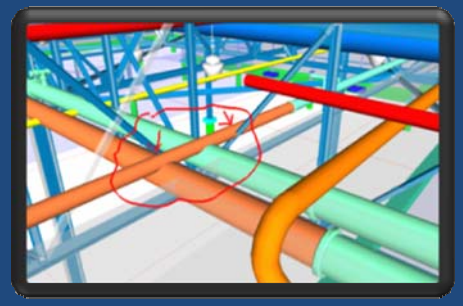
3D Enabled Interference Detection

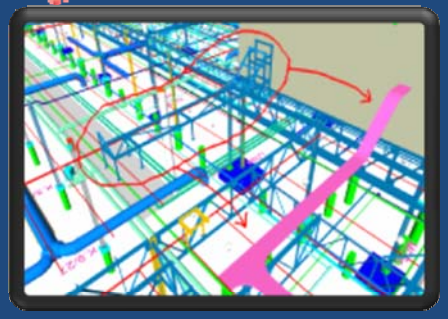




Engine Facility







3000 - 4000 Initial interferences Jan. 11, 2005

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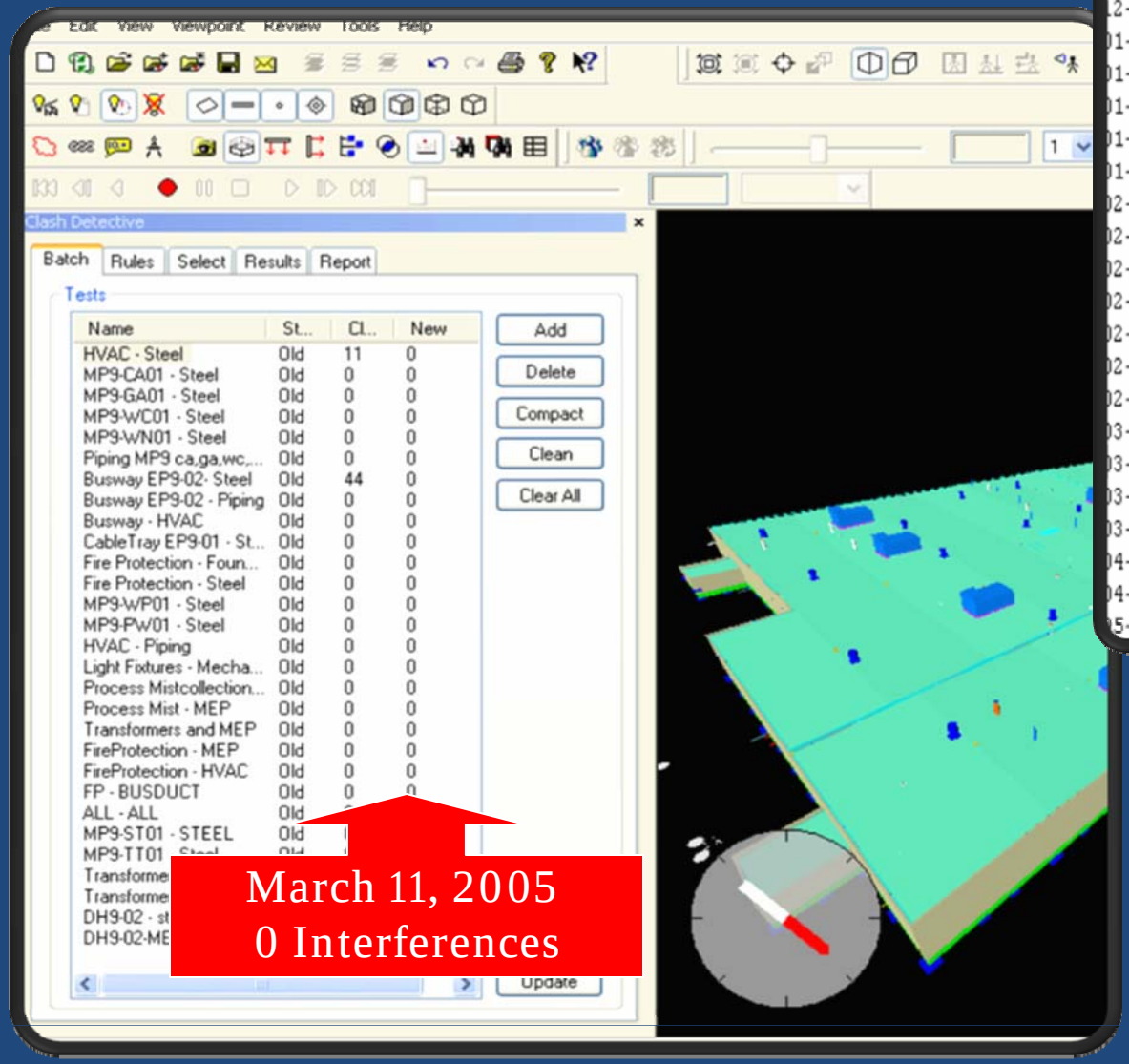
Project Management Approach: Weekly Coordination Sessions



1-29-2004 - 3D Design Review
2-06-2004 - 3D Design Intent Model Reveiw
1-06-2005 - 3D Integration Meeting
1-10-2005 - 3D Integration Meeting
1-18-2005 - 3D Integration Meeting - FAB Steel 50%
1-25-2005 - 3D Integration Meeting - FAB Steel 80%
1-31-2005 - 3D Integration Meeting
2-07-2005 - 3D Integration Meeting - FAB Steel 100%
2-14-2005 - 3D Integration Meeting
2-17-2005 - 3D Integration Meeting
2-22-2005 - 3D Integration Meeting
2-24-2005 - 3D Integration Meeting
2-25-2005 - 3D Integration Meeting
2-28-2005 - 3D Integration Meeting
3-03-2005 - 3D Integration Meeting
3-08-2005 - 3D Integration Meeting
3-10-2005 - GLOBAL V6 ENGINE FACILITY - IFC MODEL
3-21-2005 - 3D Review Proposed ISS Platform Changes
4-07-2005 - Proposed Process Changes
4-14-2005 - 3D Review - DESIGN CHANGES
5-02-2005 - GLOBAL V6 ENGINE FACILITY - IFC MODEL - R

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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

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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

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BIM – What is next?

4D Schedule

5D Estimating

6D Facility Management

Total Station – Hanger & Pipe Sleeve Layout

3D Scan to BIM

IPD

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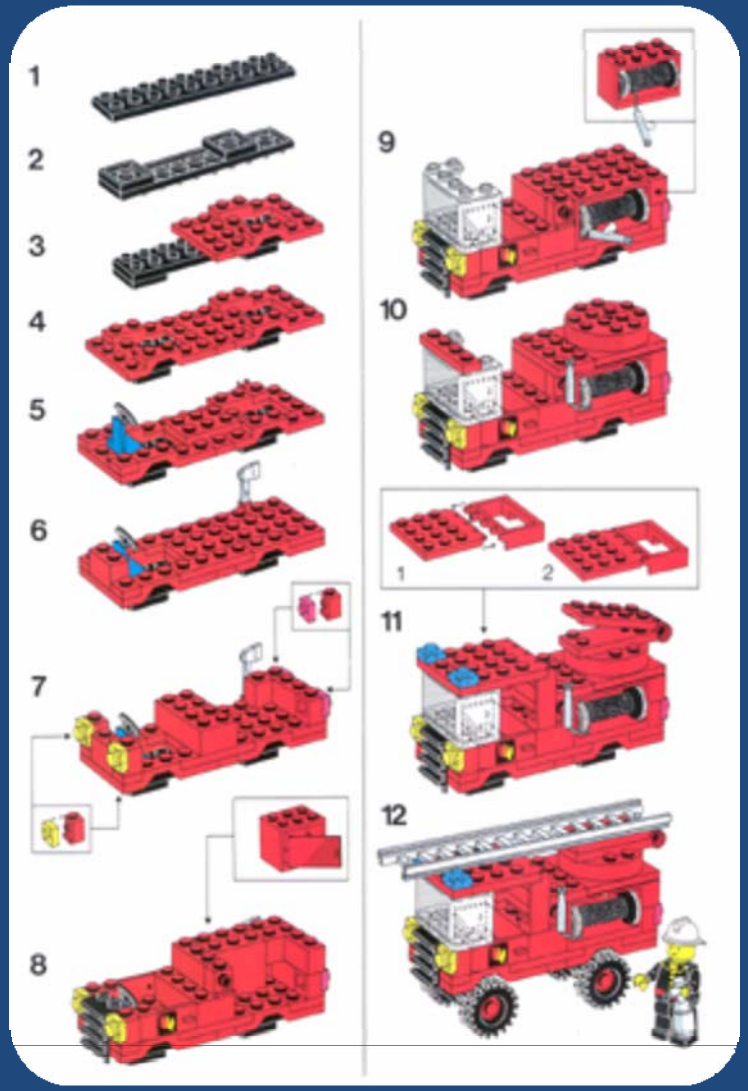
BIM – What is next?



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

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BIM – What is next?

Add 4D + Quantity + 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

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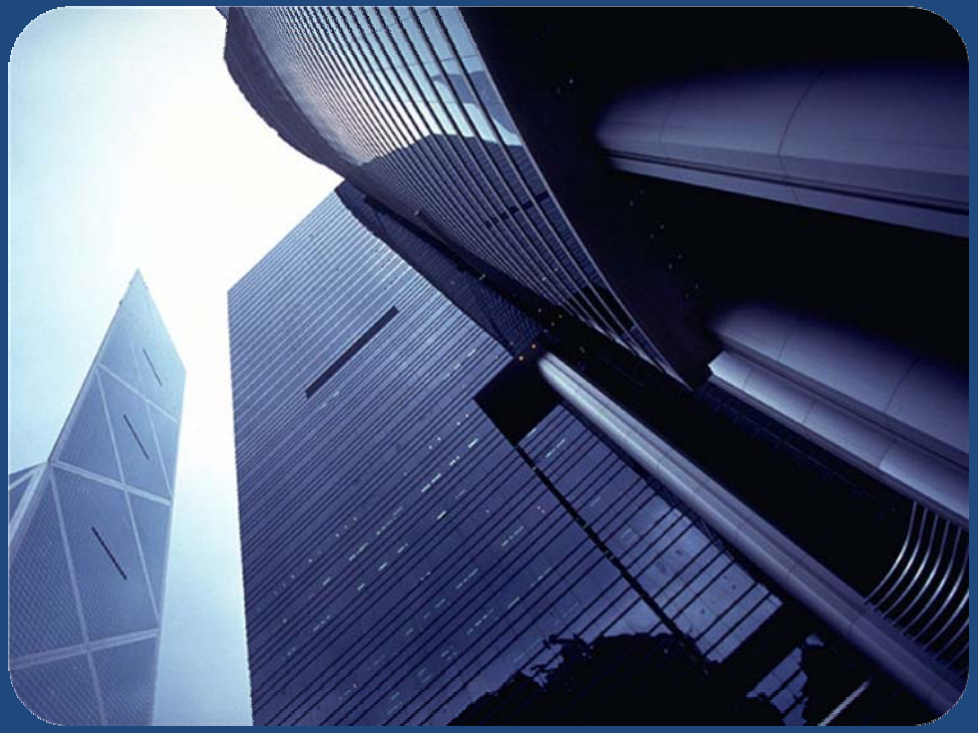
BIM – What is next?

Add 5D +Facility Information = 6D



- As builts 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

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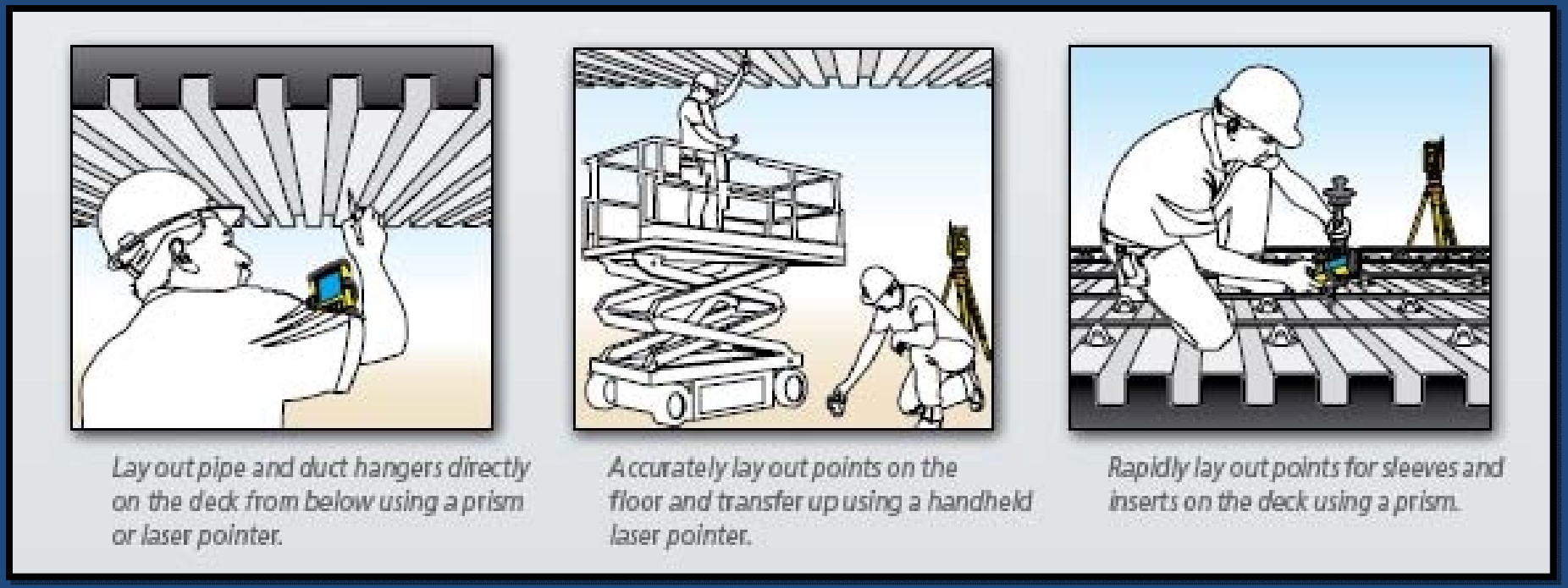
BIM – What is next?

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.

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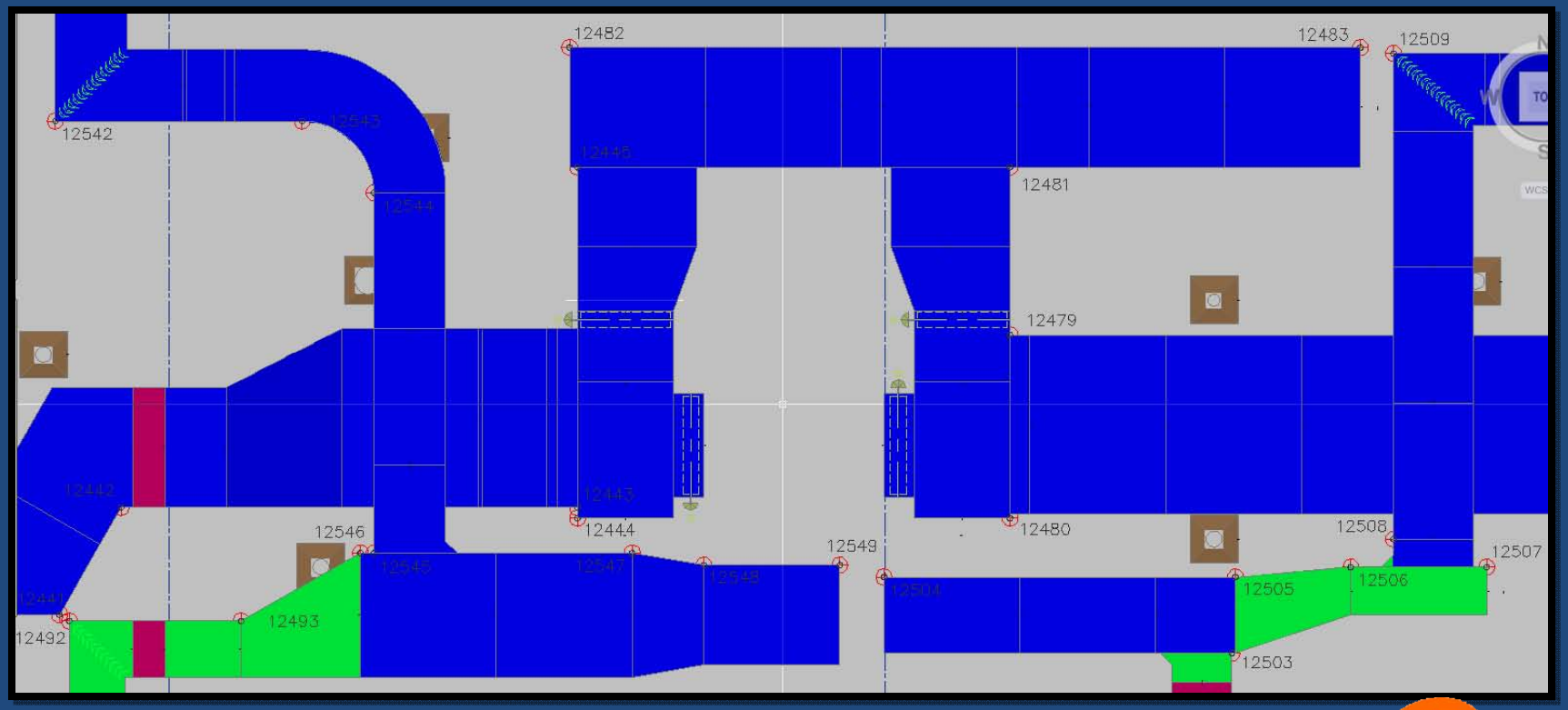
BIM – What is next?

Actual Hanger Layout for Duct



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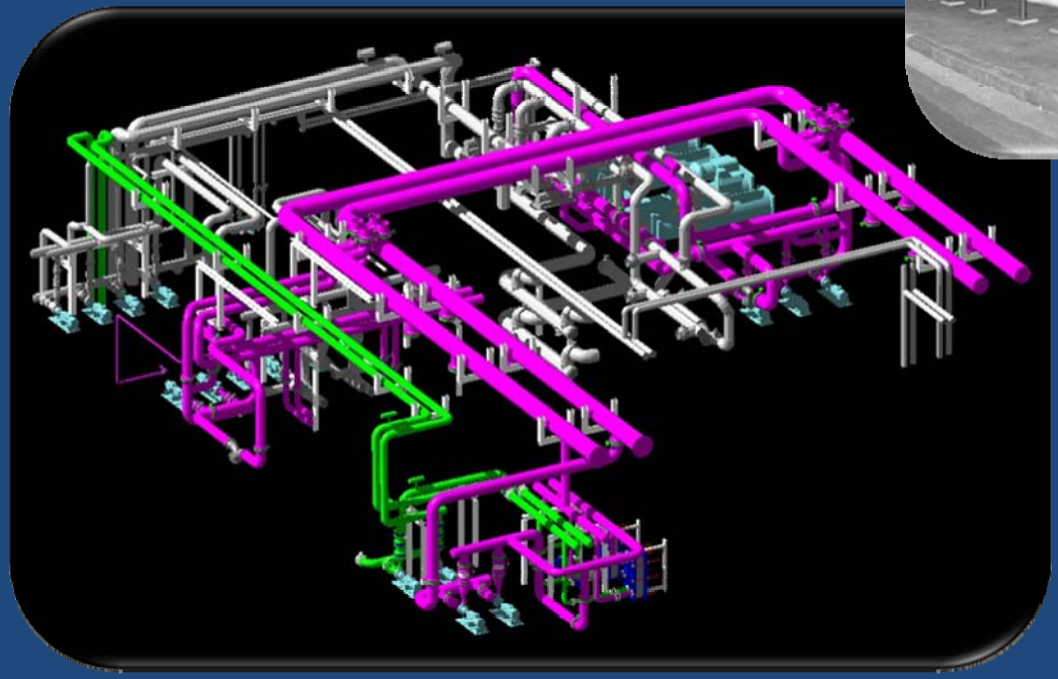
BIM – What is next?

3D Scan to BIM



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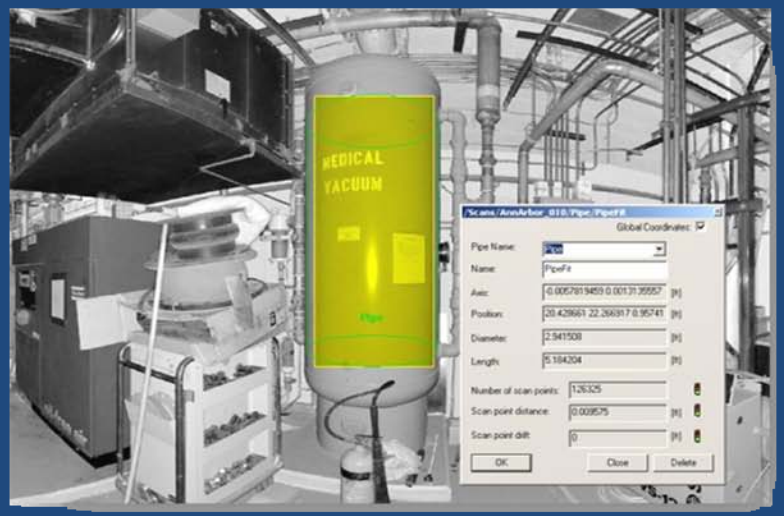
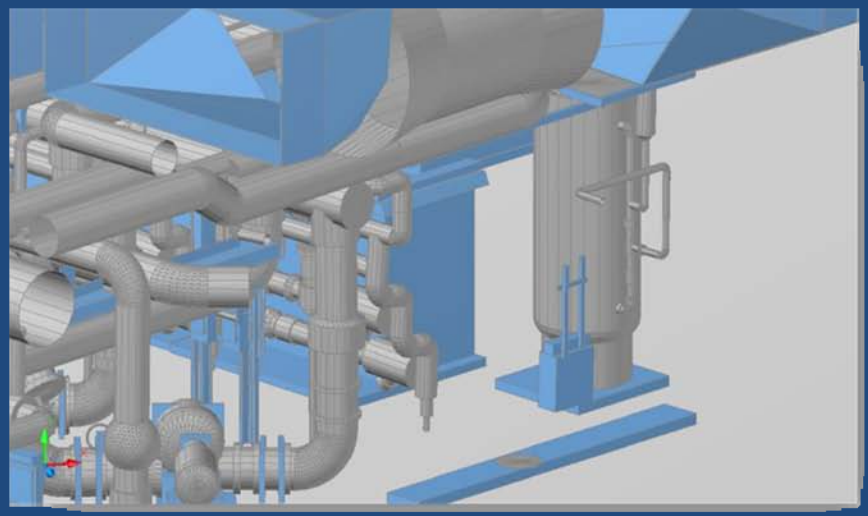
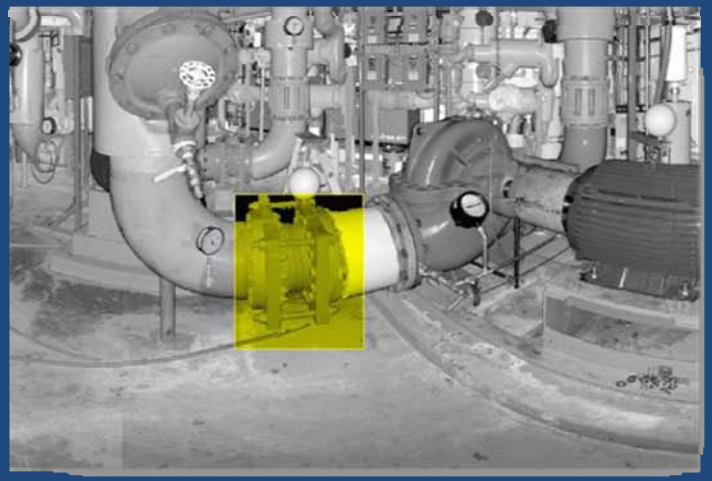
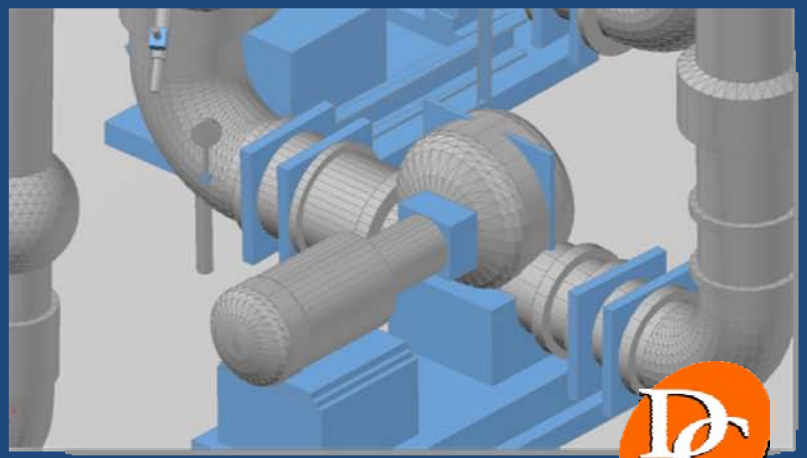
BIM – What is next?









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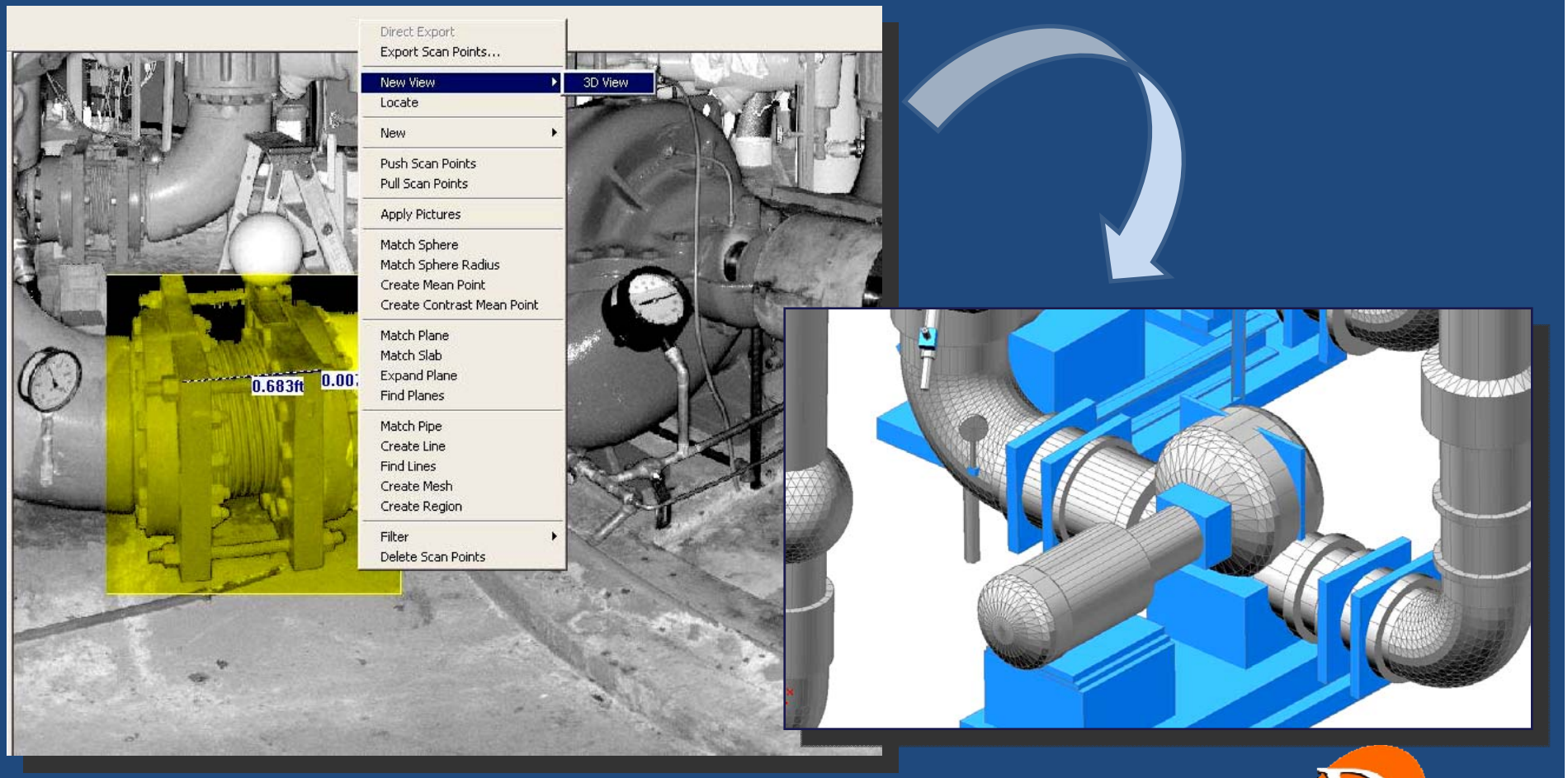
BIM – What is next?



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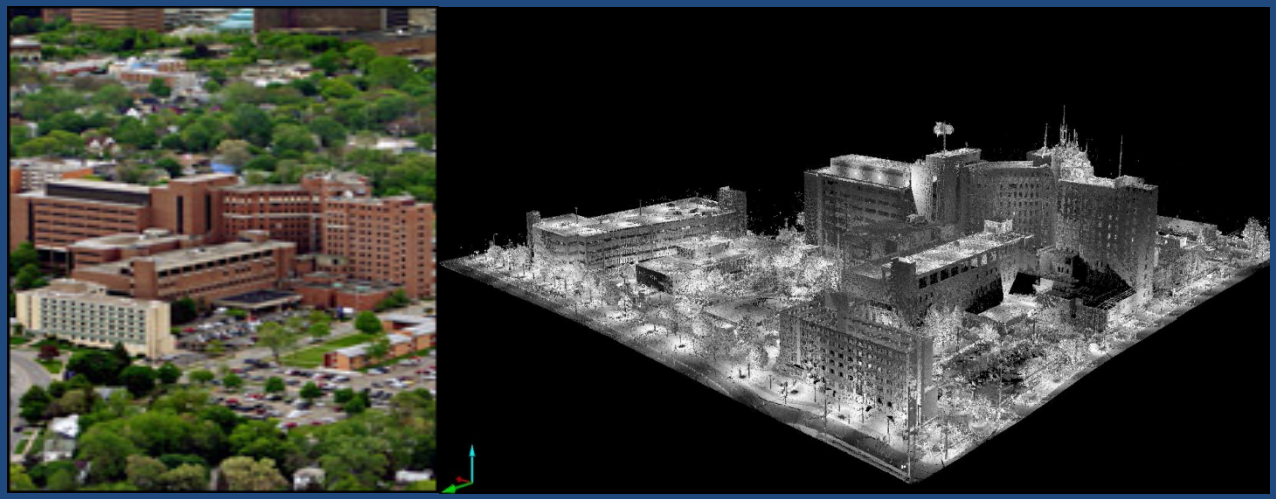
BIM – What is next?

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.*

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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)

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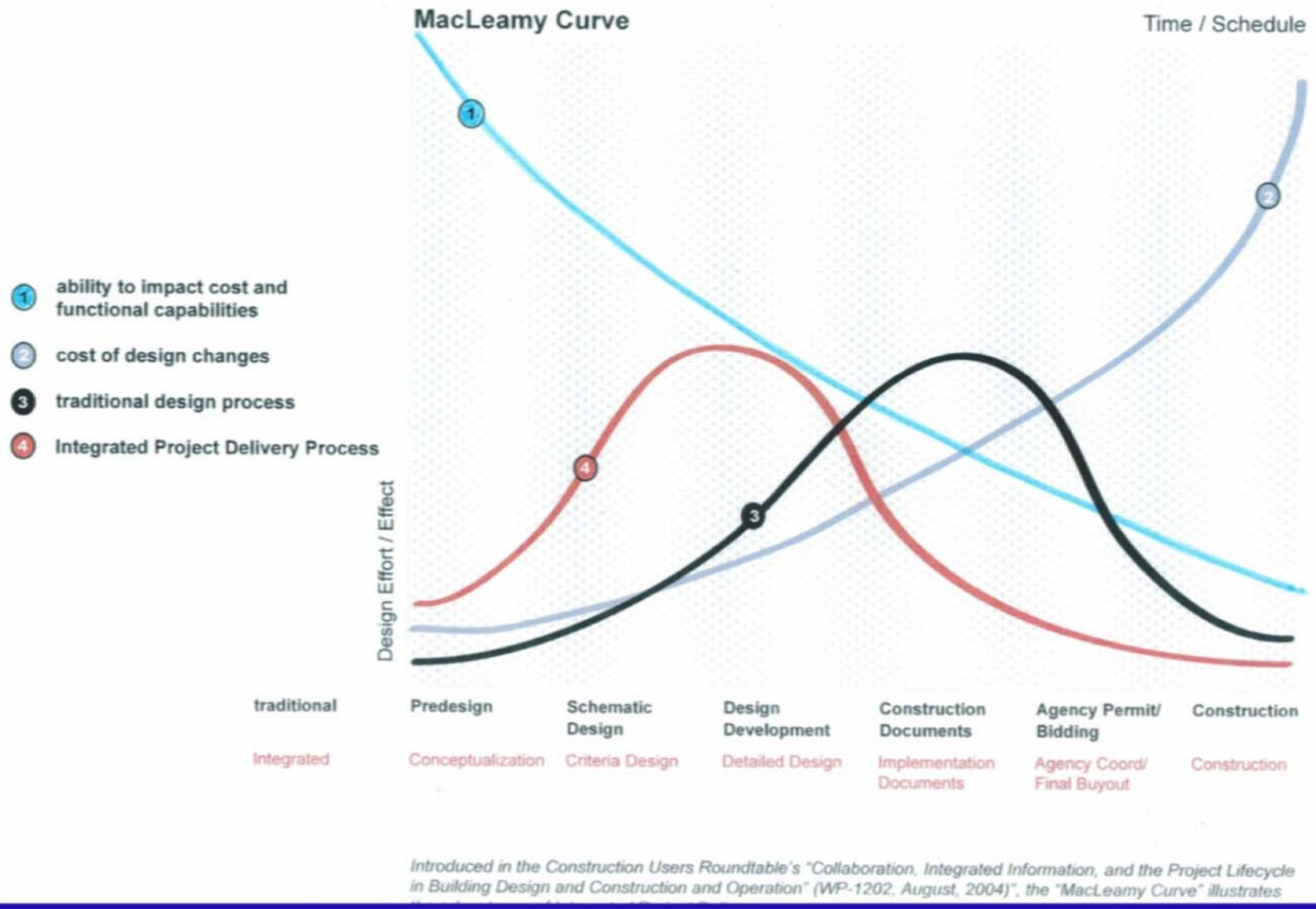
MacLeamy Curve



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

IPD from CURT

"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"

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IPD from CURT

"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"

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IPD from CURT

"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"

- In the Traditional Construction Process if you choose fast you can't have the other three
- "Fast" is a relative term

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Traditional Project Delivery vs. IPD

Traditional Project Delivery		Integrated Project Delivery
Fragmented, assembled on “just-as-needed” or “minimum-necessary” basis, strongly hierarchical	Teams	Integrated team entity composed key project stakeholders, assembled early in the process, open, collaborative
Linear, distinct, segregated; knowledge gathered “just-as-needed”; information hoarded; silos of knowledge and expertise	Process	Concurrent and multi-level; early contributions of knowledge and expertise; information openly shared; stakeholder trust and respect
Individually managed; transferred to greatest extent possible	Risk	Collectively managed, appropriately shared
Individually Pursued; minimum effort for maximum return	Compensation/Reward	Team success tied to project success; value-based
Paper-based, 2 dimensional; analog	Communications/Technology	Digitally based, virtual; BIM (3D, 4D, and 5D)
Encourage unilateral effort; allocate and transfer risk; no sharing	Agreements	Encourage, foster, promote and support open sharing and collaboration

Questions
?????

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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

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