Building Information Modeling, Integrated Project Delivery

2009 SMACNA Annual Convention
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BIM & IPD Product leader
Navigant Consulting

Construction Group Offerings

- Real Estate
- PRM (Project)
- D&I (Project)
- Building Information Modeling
Discussion Outline

» Introduction to IPD and BIM
  › Why IPD / BIM
  › IPD / BIM Overview
» Benefits of IPD / BIM
» IPD / BIM Implementation

Survey

» Contractors
  › 60% Stated designer technical document quality is poor
  › 51% Response to questions (RFT's) is slow

» Owners
  › 71% Document quality is declining
  › 60% Viewed declining document quality as an inhibitor to contractor productivity

FMI, CMAA 2004 Owners Survey
FMI 2005 Contractors Survey
Results of These Challenges

» RFI’s and Change Orders
» Rework
» Mob and Demob
» Time spent waiting .................

» Significant Loss in Productivity

Profit Equation

Increase Profits by Price Increase

Price to Sell

Cost to Produce

Some Profit

Bigger Profit

But, may lose customers!

The old way: Price = Cost + Profit
Profit Equation

Increase Profits by Cost Reduction

The new way: Price - Cost = Profit

The Market Now Sets the Price!

Example Construction Company Income Statement

<table>
<thead>
<tr>
<th></th>
<th>Amount</th>
<th>% of Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>SALES</td>
<td>$30,000,000</td>
<td>100.00%</td>
</tr>
<tr>
<td>DIRECT COSTS:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor</td>
<td>12,000,000</td>
<td>40.00%</td>
</tr>
<tr>
<td>Materials</td>
<td>12,000,000</td>
<td>40.00%</td>
</tr>
<tr>
<td>Equipment</td>
<td>1,050,000</td>
<td>3.50%</td>
</tr>
<tr>
<td>Subcontractors</td>
<td>750,000</td>
<td>2.50%</td>
</tr>
<tr>
<td>Total Direct Costs</td>
<td>$25,800,000</td>
<td>86.00%</td>
</tr>
<tr>
<td>GROSS PROFIT</td>
<td>$4,200,000</td>
<td>14.00%</td>
</tr>
<tr>
<td>Overhead</td>
<td>$3,000,000</td>
<td>10.00%</td>
</tr>
<tr>
<td>NET PROFIT (BEFORE TAXES)</td>
<td>$1,200,000</td>
<td>4.00%</td>
</tr>
</tbody>
</table>
The Opportunity

<table>
<thead>
<tr>
<th>Percent Improvement</th>
<th>8 Hour Day</th>
<th>Percent Increase in Profitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>2%</td>
<td>9.6 minutes</td>
<td>20%</td>
</tr>
<tr>
<td>5%</td>
<td>24 minutes</td>
<td>50%</td>
</tr>
<tr>
<td>10%</td>
<td>48 minutes</td>
<td>100%</td>
</tr>
</tbody>
</table>

Where Would You Look to Save Time?

8-Hour Work Day

- Unnecessary breaks, 12%
- Personal breaks, 7%
- Late starts & early quits, 4%
- Redo work, 6%
- Poor communications, 5%
- Waiting, 24%
- Direct work, 42%
Industry Net Profit Before Taxes

Summary

» Productivity improvement through BIM implementation is a low-risk/high-return strategy

» A pure volume-driven strategy is high-risk/low-return

» Cutting overhead is typically not the answer

» Small changes in productivity equate to large changes in profitability
Productivity Trends in Construction

Productivity Changes in the Construction Industry

Sources: Bureau of Economic Analysis; author's calculations.

Notes: All estimates represent average annual growth rates of real gross output per full-time-equivalent worker. The diagonal line indicates no change in productivity growth. Sectors above the line show productivity growth acceleration; those below show productivity growth deceleration. Sectors are weighted by their 1995 share of private employment.

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![Graph showing productivity comparison between Design/Construction and Manufacturing industries from 1964 to 2004. Legend includes Construction Productivity Index (1964 = 100%) and Cumulative Non-Farm Productivity Index (1964 = 100%).]

What Strategies Does Your Company Currently Have to Improve or Address Productivity?

- **Strategy 1:** Increase the crew size
- **Strategy 2:** Work harder or more hours
- **Strategy 3:** Whine and complain about the workforce
- **Strategy 4:** Do a training session with no follow-up or implementation
- **Strategy 5:** Invest time, effort, energy and money in things that support the field:
  - Planning
  - Communication
  - Technology
  - Tools
  - Equipment
  - Measurement and feedback
  - Training
  - Leadership
  - Prefabricate

Source: [Data Source], 2009
The Challenge Ahead

The Challenge

New Way of Thinking

New Working Methodology

The Key

Open-Minded Attitude

Willingness to Change

"We cannot become what we need to be by remaining what we are."

Max Du Pree

Understand the transition to Virtual Building Process and become a part of a leading team.

Driving Forces

- Private Owners
- GSA
- Army Corps of Engineers
- US Coast Guard
- State Requirements
- GC required
- Benefits
- Integrated Project Delivery
BIM Defined

National BIM Standard Definition of BIM – buildingSMART

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.
BIM Overview

BIM Defined

AGC BIMForum definition
What is BIM?
A building information model (BIM) is an object-oriented building development tool that utilizes 5-D modeling concepts, information technology and software interoperability to design, construct and operate a building project, as well as communicate its details.

BIM = Building Information Modeling

Also known as “Virtual Building”, “Building Simulation”, “Virtual Design for Construction” etc.

BIM is more than software!
BIM Utilization Through the Building Life-Cycle

Pre-Construction Services
- Presentation Models
- Site Utilization
- Installation Sequencing
- Model-Based Estimates
- Model-Based Schedules
- Constructability Reviews
- Contract and Risk Management Structure
- Model-Based Collaboration
- Design Change Management

Project Management and Controls
- Virtual Mock-Ups
- Coordination Drawings
- Model-Based Schedule Updates
- Productivity Tracking and Forecasting
- Space Coordination Accountability
- Material Tracking and Management
- Project Status and Cost Projections

Facilities Management
- As-Built Model
- Model Informed Operations and Maintenance Programs
- Digital Asset Management

Federated or Composite Model

- Architectural
- Structural
- Mechanical
- Electrical
- Plumbing
- Fire Pro.
- Curtain Wall
- Other

Federated
Federated or Composite Model

» Multiple models and information combined
  » Navisworks
  » IFC
  » Other

BIM Overview

3D Modeling
- Presentation Models
- Visualization and Communication
- Marketing Renders and Fly Thru
- Site Work and Installation Sequencing
- Virtual Mock Ups
- 3D Constructability Analysis
- 3D Coordination and Accountability Management
- Coordination Drawings
- As-Built Models
- Operation & Maintenance Informed Models

4D Scheduling
- Model/Quantity Based Schedules
- Construction Sequence Simulations
- Location Based Schedule Analysis
- Line of Balance Schedule Optimization
- Productivity Tracking and Forecasting
- Model Based Schedule Updates
- As Planned vs. As Performed Sequences

5D Estimates
- Model Based Quantity Take Off
- Model Based Estimates
- Cost Planning and Comparison
- Price Variance Management
- Material Tracking and Management
Benefits of BIM

» Presentation models
  › Site Utilization
  › Installation Sequencing
  › Value engineering alternates
» Model based estimates
» Constructability Reviews
» Design Change Management
» Coordination and Detailing
» Pre-fabrication
» Virtual Mock-ups

» Production Drawings for Self Performed Work
» Model Based Schedule
» Space Coordination Accountability
» Material Tracking and Management
» Project Status and Cost Projections
» Operations & Maintenance Models

Integrated Project Delivery (IPD)

IPD Definition

Integrated Project Delivery (IPD) is a project delivery approach that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction.
Integrated Project Delivery (IPD)

» Shared Risk and Reward Structure
» Project-centric Thinking

» Consensus Docs
» AIA IPD Documents
» Other

Traditional Project delivery vs. IPD Teams

Traditional
» Fragmented
» Many excluded from decisions (only those “necessary” are involved)
» Strongly hierarchical
» Controlled
» Adversarial

IPD
» Integrated team (Single Purpose Entity)
» Composed of key project stakeholders (inclusive)
» Assembled early
» Open
» Collaborative
Traditional Project delivery vs. IPD Process

**Traditional**

- Linear
- Information hoarded
- Silo’s of knowledge
- Information Drops
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Traditional Project delivery vs. IPD

**Traditional**
- Individually managed
- Transfer as much as possible

**IPD**
- Collectively managed and shared

Traditional Project delivery vs. IPD

**Traditional**
- Individually pursued and managed
- Minimum effort for maximum gain
- Self-centric

**IPD**
- Dependent upon project success
- Shared reward / shared risk
Discussion

BIM ≠ IPD
» BIM is using Modeling (Strictly defined)
» IPD is the Process
» Both are about People and Relationships
» Neither is an Easy Button
» IPD is enabled by BIM
» BIM facilitates IPD

Preparing for IPD and BIM

» Develop your BIM capacity
» Integrate within your organization
» Develop your Prefabrication capacity
Current Industry Trend

» Burden of Coordination falls upon:
  - Mechanical
  - Electrical
  - Sprinkler
  - Specialty Systems – Kitchen Equipment, Pneumatic Tube

» Liability falls upon?

» Lead in Coordination shall fall upon??????(AGC MEP BIM Coordination Requirement)

Advantages  “Taking the Lead”

» YOU set the schedule
» YOU control the drawings
» YOU can rapidly identify conflicts and request revisions PRIOR TO submittal for approval
» Great Selling Point to Owners and CMs
» Sells Design Build Capability
Anticipated Start-up Cost

» Depends on your current capacity

Anticipated Start-up Cost

» Computers
  › Laptop & CPU
  › Dual Monitors

» Software
  › AutoCAD
  › 3D Pipe/Duct Program
  › Navisworks

» Equipment
  › Color Plotter
  › High Speed Copier
  › Digital Projector
Start-up Cost (continued)

» Department Structure (Based upon Size)
  › Department Manager
  › Program Expert
  › Draftsman
  › CAD Operators
  › Project Coordinator/Administrative Assistant
» Office Space or Field Office Trailer

What to draw

» Underground Plumbing
» Deck Sleeves and block outs
» Wall Sleeves and block outs
» Above ground rough-ins/Risers
» Mechanical Equipment Pads
» Mechanical Roof top equipment
» Central Plants/Boiler Rooms/Machine Rooms
» Piping Details – coil connections/valve packages
» DETAILS – supports, anchors, etc.
» Access Door Locations
The Process

» Request Electronic Files – Verbal and Written
  › Be specific in what files are needed
  › Architectural/Structural floor plans and Reflected Ceiling Plans at a minimum

» Files
  › Available by CD
  › Import the files via email (files are large and transfer is slow)
  › Upload to an FTP site

» SIGN THE WAIVER
  › Do not pay the fee unless absolutely necessary

» Create a schedule
  › With anticipated completion dates for submission. This needs to be coordinated with Project Schedule for fabrication, delivery and installation

Depending on your Company Structure

» Drawing process is discussed in a planning meeting

» Who is responsible for drawing review and approval within your company?

» Who attends coordination meetings and who has the authority to make decisions?

» Who issues Request for Information?

» Who convinces and educates the Field Forces?
Recommendations

» Cons
  › Start up costs
  › Completing the design for A/E
  › Prolonged coordination process
  › Field Resistance

» Pros
  › Total control of the Drawing Process
  › Increase productivity and accuracy
  › Educate and modernize your company
  › Leads to Fabrication
  › Sleeve take-off program
  › Material take-off and materials weights by Program
  › Pictures are worth a thousand words
  › Growth
  › TEAM Mentality

Implementation process

» Evaluate your current process and company structure
» Develop a corporate strategy
» How does this fit with marketing
» Evaluate estimating practices
» Identify staffing changes R&R
» Define workflow changes
» Standardize processes and procedures
» Select the right technology
» Modeling support options
» Metric development
Questions

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