BIM for Design, Preconstruction, & Construction  
Brian Krause, Dan Gramer, Turner Construction Company

Why BIM?  Excessive Re-Work and Waste

Construction Industry

Why BIM?  Try to visualize this section

Pike Place Market – Seattle, Washington

Why BIM?  Does this make more sense?

Pike Place Market – Seattle, Washington

BIM for Design, Preconstruction, & Construction

Define  
Create  
Plan  
Build  
Measure  
Educate

Support Activity

Value Added

Construction Industry

Manufacturing Industry

Why BIM?  Construction Productivity is Declining

Construction & Non-Farm Labor Productivity Index (1964 = 100)
Stanford University CIFE 2004

Construction & Non-Farm Productivity Index (1964 = 100)

Support Activity

Value Added

Construction Industry

Manufacturing Industry

Why BIM?  Construction Productivity is Declining

Construction & Non-Farm Labor Productivity Index (1964 = 100)
Stanford University CIFE 2004

Construction & Non-Farm Productivity Index (1964 = 100)

Support Activity

Value Added

Construction Industry

Manufacturing Industry
BIM is...

- Building Information Modeling (Yapi Bilgi Modellemesini)
- Intelligent 3D model
- Central platform for information exchange
- Collaborative work environment
- Better communication

Level of Detail

<table>
<thead>
<tr>
<th>LOD</th>
<th>100</th>
<th>200</th>
<th>300</th>
<th>400</th>
<th>500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Line work, areas, volumes, and text</td>
<td>Generic 3D elements, maximum size, purpose</td>
<td>Specific 3D elements with actual dimensions, capacities, and connections</td>
<td>Shop/Fabrication 3D model, actual dimensions with manufacture details</td>
<td>As-Built 3D model, actual</td>
</tr>
<tr>
<td>Purpose</td>
<td>Drawing (CAD) Coordination</td>
<td>General Reference for Fabrication</td>
<td>Detailed Plan for Fabrication and Installation</td>
<td>Defined by Owner</td>
<td></td>
</tr>
</tbody>
</table>

Documentation Advantages – Rapid Visualization

- Integrated visualization and documentation process
- Changes to model automatically updates project documentation

Documentation Advantages – Integrated Information

- Inherent information in model objects create quick automatic schedules

What we are trying to avoid...

BIM for Design, Preconstruction, & Construction

Define
Create
Plan
Build
Measure
Educate

Copyright © Turner Construction Company 2012 All Rights Reserved. No part of this document may be reproduced without written consent from the author.
Model Based Code Checking
Space 1.6: STAFF TOILET(2039) has insufficient room for wheelchair turning space...

Program Design Validation
Too small OFFICE spaces. Area of the spaces is 96.48 sq ft, when the required minimum area is 125.00 sq ft.

Visualization of Scope

Visualization of Scope

Visualization of Scope

Visualization of Scope

BIM for Design, Preconstruction, & Construction
Define
Create
Plan
Build
Measure
Educate
**BIM Project Execution Plan**

**BIM Project Execution Planning Procedure**

1. Identify BIM Goals and Objectives
2. Design BIM Project Selection Process
3. Develop Information Exchanges
4. Define Required Infrastructure for BIM Implementation

---

**Model Based Estimation – 5D**

- **Model Based Estimation – 5D**

---

**Voxel iStudio Quantify – Model Based Estimation**

- **Voxel iStudio Quantify** – Takeoff, quantify, model, and report using traditional 2D takeoff methods, but in a 3D environment.

---

**Voxel iStudio Attribute – Content Management**

- **Voxel iStudio Attribute** – Intelligent building information content management in a model-based environment.
Total Cost of Ownership

- Land, Planning & Design: 7%
- Construction Costs: 31%
- Operations & Staff: 9%
- Energy: 9%
- Maintenance & Repair: 16%
- Business Impact: 12%
- Medical Equip./FF&E: 12%
- Construction Management: 3%
- Financing: 2%
- Total: 100%

Lifecycle Studies – Daylight Simulations – Energy Analysis

Visualization of Scope
- Bid Package Scope
- Scope by Discipline

Detailed Concrete Formwork Planning

Schedule Simulation – 4D

Sacramento Airport – Sacramento, CA

Permit Submission & Review

NYU Dentistry – Department of Buildings Submission in .dwfx for site safety

Copyright © Turner Construction Company 2012 All Rights Reserved.
No part of this document may be reproduced without written consent from the author.
BIM for Design, Preconstruction, & Construction

Define
Create
Plan
Build
Measure
Educate

Approach

Transparent, collaborative environment

Best results if owner, designers, and subcontractors are involved

Guide, support, and enable project participants to work in 3D

3D Trade Coordination

Architectural & Structural Models

Ductwork & Piping Models
3D Trade Coordination

Plumbing & Other Piping Models

3D Trade Coordination

Electrical Power & Lighting Models

3D Trade Coordination

Fire Protection Models

Capture Existing Conditions

Capture Existing Conditions
Capture Existing Conditions

Madison Square Garden - New York, NY

2D versus 3D Coordination

The Old Way... 2D  The New Way... 3D

iRoom Coordination Environment

- iRoom – Use of two SMART Boards driven by a single computer for coordination
  - Fire Sprinkler Coordinator
  - Mech Pipe Coordinator
  - Plumbing Coordinator
  - Turner MEP Manager
  - Turner Model Coordinator

Virtual Coordination Environment

- Teleconference
- Webinar
- Collaborative Digital Whiteboard
- Remote Desktop

- iPad
- Desktop/Laptop
- Smartboards
- Remote User

iRoom Coordination Environment

Seattle, WA  Sacramento, CA  New York, NY

Butler, PA  Salem, OR  Gaithersburg, MD
Model Based Layout

- Combined model reviewed with structural engineer, layout team, and detailers.
- Points exported from model to total station for layout.
- As-built information overlaid for verification prior to concrete pour.

Early field verification to accelerate release to fabrication

Model Based Layout

- Trades: Mechanical, Plumbing, Electrical, Fire Protection
- Labor Savings: > 50 %  Accuracy: > 96%

Digital Document Management

AR via Turner iPad/iPhone app

VOXEL iSTUDIO

Visual Production Control

- Work in Place Tracking
- Visual RACS

Percent Plan Complete (PPC)
MEP Systems Prefabrication

Just in time delivery = Less waste

BIM for Design, Preconstruction, & Construction

Define
Create
Plan
Build
Measure
Educate

MEP Process Performance

<table>
<thead>
<tr>
<th>Meeting Date</th>
<th>Week</th>
<th>Total # of Clashes</th>
<th>Total Documented clashes</th>
<th>Percent of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>03/27/2008</td>
<td>15</td>
<td>22</td>
<td>19</td>
<td>72.7%</td>
</tr>
<tr>
<td>03/27/2008</td>
<td>15</td>
<td>12</td>
<td>12</td>
<td>99.18%</td>
</tr>
<tr>
<td>12/13/2007</td>
<td>17</td>
<td>75</td>
<td>75</td>
<td>100%</td>
</tr>
<tr>
<td>12/16/2007</td>
<td>17</td>
<td>75</td>
<td>75</td>
<td>100%</td>
</tr>
<tr>
<td>02/20/2008</td>
<td>20</td>
<td>15</td>
<td>15</td>
<td>100%</td>
</tr>
<tr>
<td>02/20/2008</td>
<td>20</td>
<td>15</td>
<td>15</td>
<td>100%</td>
</tr>
<tr>
<td>01/23/2009</td>
<td>25</td>
<td>15</td>
<td>15</td>
<td>100%</td>
</tr>
<tr>
<td>01/26/2009</td>
<td>25</td>
<td>10</td>
<td>10</td>
<td>66.67%</td>
</tr>
<tr>
<td>Avg</td>
<td></td>
<td>25</td>
<td>25</td>
<td>100%</td>
</tr>
</tbody>
</table>

Number of Clashes

Spike 1 – Structure, Sheet Metal, & Plumbing Clashes
Spike 2 – Clashes with Fire Protection
Spike 3 – Change to LEED project, MEP systems changed

Weekly Coordination Meetings

Coordination Tracking

Copyright © Turner Construction Company 2012 All Rights Reserved.
No part of this document may be reproduced without written consent from the author.
### Project Case Study

**Nintendo of America, Corporate Headquarters**
- **Location**: Redmond, WA
- **Seattle Business Unit**
- **Architect**: ZGF
- **4-story, 380k sf Office Building**
- **Volume**: $136M
- **Significant BIM & Lean Strategies**
- **LEED Gold**

#### Results
- **Accelerated schedule 3 months**
- **On-site labor 37% less than estimated**
- **Productivity 42% higher than average**
  - **Business Unit Avg.**: 33.91 ($K WIP/MM)
  - **Project Avg.**: 46.95 ($K WIP/MM)
  - **7% of total budget returned as savings**

#### Implementation at Turner
- **Senior level support & engagement**
- **National/Regional talent & support for standards, procedures, education, training, & consistency**
- **Local talent for project support**
- **Subcontractor talent for implementation**
BIM at Turner: Network of Resources

- Turner Sharepoint – VDC Internal
  - BIM Job Metrics
  - BIM Staff Metrics
  - BIM Examples
  - Recorded Webinar Wednesday Videos
  - Streaming Training Videos

Turner BIM University

- 2010 – 11 new BIM recruits
- 2011 – 25 new BIM recruits
- 8-weeks centralized VDC/BIM training
- Weekly topics – Visualization, BIM & 4D, Model Based Scheduling, Model Based Estimating, Coordination, Lean Integration & Optimization
  - Advanced BIM Training
  - BU/Project Specific Training

Next Steps – Think Big, Start Small, Move Fast

Think Big
- Identify current inefficiencies in the process
- Identify potential project issues
- Identify where technology can help ineficiencies, solve issues, or improve current processes
- Select the appropriate technology

Start Small
- Learn a 3D Model or Analysis Software
  - Free Software Available
    - Google Sketchup – Modeling
    - Autodesk Design Review – Review & Analysis
    - Autodesk Navisworks Freedom – Review & Analysis
    - Solibri Model Viewer – Review & Analysis
    - Tekla BIMSight – Review, Analysis, & Clash Detection

Turner Metrics

- Ranked #1 BIM Implementer in BD&C Magazine in 2010
- Total Number of BIM Projects - 587
- Total BIM Project Estimated Volume - $29.1 Billion
- Total MEP Clash Projects - 307
- Total Constructability Review Projects - 138
- Total Quantity Take-Off/Cost Estimating Projects - 114
- Total Scheduling/4D Modeling Projects - 128
- Total Laser Scanning Projects – 33
- Total iRoom Setups in Use – 109

Total Turner BIM Projects By Year

Questions?

Brian Krause
Manager, Integrated Building Solutions
bkrause@tcco.com

Dan Gramer
Manager, Integrated Building Solutions
dgramer@tcco.com