A Lean Approach to BIM and Prefabrication

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Agenda

• BIM
• Lean Principles
• Prefab and Modularization
• The Real Benefits
What is BIM?

The National Building Information Modeling Standards (NBIMS) Committee defines BIM as:

“.. a digital representation of physical and functional characteristics. A BIM is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition.”
Why Use BIM?

- Are you automating a 2D wasteful process?
- How does BIM give us a better design?
- How does BIM provide a better delivered product?
- Can we eliminate model duplication?

To enable lean processes and products
Lean Principles

1. Respect people
2. Customer defines value
3. Identify and remove waste
4. Innovate and perfect
The Customer?

- Every model has a customer
- Every customer has to make a decision
- Give them what they need in their format
Who is the Customer?

- User
- Operator
- Installer
- Fabricator
- Code official
- Designer
- Owner
Waste – Potential Improvements in the Design Process

- Design basis and scope and SD is lost
- CD, SD, DD, CD, Generic Specifications, Submittals, As Built, etc
- Design constrained to stick built solutions
- Organizing designers by floor (2D vs. 3D)
- Excessive clashes – Clash detection is QC.
Product Waste

- Every SF we avoid saves 100% of cost
- Oversizing impacts operations
- View waiting areas, pipe and fittings etc. as waste
Smoke / Fire Dampers

Before - (17)

After - (4)
People Waste
Resource Waste

- Every extra step in business is repeated for ever
- Excessive energy consumption due to oversizing
Innovate and Perfect

4 New Behavioral Health Hospitals

<table>
<thead>
<tr>
<th>Springwoods Fayetteville, AK</th>
<th>Cumberland Hall Hopkinsville, KY</th>
<th>The Oaks Austin, TX</th>
<th>Holly Hill Hospital Raleigh, NC</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Lean</td>
<td>Lean Round 1</td>
<td>Lean IFOA</td>
<td>ILPD &amp; DB</td>
</tr>
<tr>
<td>80 Beds</td>
<td>100 Beds</td>
<td>80 Beds</td>
<td>80 Beds</td>
</tr>
<tr>
<td>$231K Per Bed</td>
<td>$187K Per Bed</td>
<td>$180K Per Bed</td>
<td>$175K Per Bed (Target)</td>
</tr>
<tr>
<td>12 Mo. to Build</td>
<td>10.5 Mo. to Build</td>
<td>9.5 Mo. to Build</td>
<td>8 Month (expected)</td>
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</tbody>
</table>

Learn Lean → Remove Silos → Integrated Team
What are the keys to using BIM to enable prefab and modularization?
Select a Team to Start a Project

Think about how stupid the average person is,
and then realize that half of 'em
are stupider than that.
Build the Team

• Create a big room and lean culture
• Define and capture the business purpose and intent
• Define the chain of customers. What do they need?
• Who should develop the information?
• Are they on the team?
Schematic Studies

47,000 gallons vs. 3 X 9,000 gallons

Time = 16.5245 [min]
Design Sets to Target Value
Repeatable Pipe Racks
Multi-trade Horizontal Racks
Material Impact on Crew Size
Prefab Critical Items
Modules and Connecting Pieces
MEP Horizontal Utilities
Steel MEP Combo Unit
Trade Approach

• Fabrication – materials, joint methods, elevated, aligned, bottom of insulation justified (LOD 400)
• Spooling - Break model into largest installable pieces
• Detailing – Routing, fittings, hangers, couplings (LOD 300 or 350)
• Coordination – Making things fit – clash avoidance/detection
• Design – General routing and sizing (LOD 300)
BIM Enabled Trade Sequence (1)

Plumbing
Cast Iron
- Budgeted 21 feet/md
- Actual 61 feet/md
- $300,000 savings

Copper
- Budgeted 43 feet/md
- Actual 58 feet/md
- $100,000 savings
BIM Enabled Trade Sequence (2)

1st Floor

- Budgeted
  1.3 feet/mh

- Actual
  1.7 feet/mh

- $108,000 savings
Improvements to Construction Process

- Increases ability to prefabricate, preassemble
- Allows automated layout
- 30% of rough in work transferred to shop
- EMR improves to 0.5
- Schedule savings of 25%
- Cleaner site – less waste
- Enables Lean Production
Design for Efficient Operations

All valves and terminal boxes (building automation controls) have been designed to be accessed from aisle side.
Draw Small Items Too
# Standard BIM Uses

## Conceptual Studies

### Schematic Designs
- Layout and routing studies
- Energy models
- Module/ prefab studies

### Maintenance Documents
- Control Data Displays
- Maintenance Schedules and Records

## Fabrication Models
- CNC Driven Fabrication
- Spool Drawings
- Hanger/ Support Modeling
- Material Lists
- Estimates
- Automated Layout
- Module Assembly Drawings
Safety Results

- National Average
- No Design/Limited Prefab
- No Design/Heavy Prefab
- SI Design, SI Prefab

[Bar chart showing comparisons between RIR and LWR for different design/fabrication scenarios]
A Major Benefit (5.5 Million Work Hours)

Recordable Injury Rate

- Industry Average (4 years) – 5.7
- Third Party Design, SI Fab – 3.22
- SI Design and Prefab – 1.5
- 4 Times Better Than Industry Avg.
The Real Benefit (5.5 Million Work Hours)

Lost Work Rate

- Industry Average (4 years) – 1.9
- Third Party Design, SI Fab – .78
- SI Design and Prefab – .12
- 15 Times Better Than Industry Avg.

Remember Lean Principle 1: 

Respect People
Questions