Getting to Lean Project Delivery in Public Higher Education Institutions

Presented to IFMA – AFC Spring Conference
San Diego, CA – June 13, 2013
Lean Construction
A World View – Extreme Lean!

改写历史
History Rewritten
31. 12. 2011
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Construction Productivity in the U.S.

Figure 1: Construction and Non-farm Labour Productivity Index (1964–2003)

Constant US$ of contracts/work-hours of hourly workers

- Construction productivity index (1964 = 100%)
- Non-farm productivity index (1964 = 100%)

Year:

Index (%):
0   50   100   150   200   250

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Construction Waste in the U.S.

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

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

Source: Construction Industry Institute
Typical Types of Construction Waste:

- Rework
- Requests for Information
- Change orders
- Inadequate Resources
- Inefficient work flow
- Work arounds
- Multiple handling of material
- Excess material
- Waiting on supplies
- Waiting on another trade
- Safety losses
- Improper sequencing of work
Lean Construction

What is Lean Construction?

Shared principles:

1. Whole System Optimization through collaboration and systematic learning
2. Continual improvement/pursuit of perfection involving everyone in the system
3. A focus on delivering the value desired by the owner/client/end-user
4. Allowing value to flow by systematically eliminating obstacles to value creation and those parts of the process that create no value
5. Creating pull production

The priority for all construction work is to:

1. Keep work flowing so that the crews are always productive installing product
2. Reduce inventory of material and tools, and
3. Reduce costs

(From Wikipedia)
Lean Construction

Who is Going Lean?

- UHS
- Sutter Health
- UCSF
- Seal of the City and County of San Francisco
- AMGEN
- Walt Disney Imagineering
Why Go Lean?
Why Go Lean?
(From UHS Lean Project Delivery Guide)

Fundamentals of Lean:
• To understand value from the customer’s perspective and to only take actions which deliver that value (thus eliminating waste).
• Waste is disrespectful
  1. to humanity – squanders scarce resources
  2. to individuals – adds work
  3. to clients – adds cost/time/aggravation
• Become a leaning organization through relentless reflection and continuous improvement as a team. Status quo is never acceptable.
• Lean is about inspiration and empowerment. People are empowered to affect decisions and the work itself which not only delivers better projects, but leads to heightened satisfaction for all.
• Lean is about developing principles that are right for your organization & diligently practicing them to achieve high performance. It is not about imitating the tools used by Toyota in a particular manufacturing process.
Lean Philosophies

- Define customer value
- Identify and remove waste
- Innovate and perfect

Value

- Value is defined by the owner
- Value is not cost

Reductions in:
- Defects
- Lead time
- Cost
- Inventory
- Space
- Waste

Improvements in:
- Productivity
- Customer Satisfaction
- Capacity
- Responsiveness
- Quality
- Profit

1. Identify Value
2. Map the Value Stream
3. Create Flow
4. Establish Pull
5. Seek Perfection
The Eight Wastes as Defined by Toyota (and Liker)

1. Overproduction
2. Waiting
3. Unnecessary transport
4. Overprocessing
5. Excess inventory
6. Unnecessary movement
7. Defects
8. Unused employee creativity
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Why Did We Go Lean?

- Reduced operating budgets of $46 million in past four years (-16%)
- Increased build environment footprint of 1.3 million square feet (+65%)
- Capital funding from locally approved and funded general obligation bonds
- Reduce waste, create greater value
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Practicing the Toyota Way Business Principles
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The Toyota Way Business Tools

• The Machine that Changed the World – James Womack
• The Toyota Way – Jeffrey Liker
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Early (and continued) Attitudes Toward Lean

- We’ve tried that.
- We already do that.
- We don’t need it.
- It won’t work here.
- We don’t build cars.
- We’re different.
- The other guy needs it, not me.
- We’re doing well, so why change?

Credit: Lean Construction Institute
## San Diego Community College District
### Rainbow Report

| # | Prop. | Campus | Project Description | Contract Manager Project Budget as of 2011_08_12 | Contract Manager Commitments to 2011_09_02 | SOI Cost | Hard Cost | FTE AV/IT | IT | Expenditures as of 2011_06_30 | DSA Submit | DSA Approved | Board Approval | Construction Complete | Change Order Rate | Status |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | S | CE | ECC - Land Acquisition & Relocation Skills Center (Land $17.4M) | $31,665,000 | $31,681,400 | $11,207,890 | $10,732,867 | $1,560,878 | $614,124 | $31,737,281 | Jan-06 | Oct-06 | Nov-07 | Aug-09 | 8.0 | 102% |
| 2 | S | CE | West City Campus | $17,039,369 | $17,039,369 | $2,464,567 | $13,439,204 | $1,573,111 | $369,546 | $17,039,365 | Oct-05 | Nov-06 | Jun-07 | May-09 | 10.0 | 102% |

| Miramar | Cafeteria/Bookstore & Student/Campus Center | $34,519,245 | $31,515,776 |
| Miramar | Aviation Maintenance Technology Center | $10,251,857 | $8,475,485 |
| Miramar | Parking Structure #1 & Police/Emergency Center | $17,848,765 | $16,008,677 |
| City | Infrastructure - Central Plant/Sewer & Storm Drain/Data & IT projects | $19,441,050 | $17,017,141 |
| Mesa | Infrastructure - Fire Lane/Central Plant/IT/Stadium Restrooms | $8,127,787 | $9,637,103 |
| Miramar | Infrastructure Phase II | $41,584,305 | $17,108,101 |
| District | Proposition N Program Management | $41,992,026 | $17,874,745 |
| CE | Fire Science / EMT Training Facility | $13,000,000 | $1,774,354 |
| City | Science Building | $54,014,278 | $14,369,196 |

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**Legend:**
- Project Completed
- Construction Phase
- Design/Bid Phase
- Ongoing
- Future Projects
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Schedule Performance

### Traditional Design-Bid-Build

- **Change Order Rate**
  - Average = 10.8%
- **Project Delay**
  - Average = 43.5 Days

### CM Multi-Prime

- **Change Order Rate**
  - Average = 7.1%
- **Project Delay**
  - Average = 19.5 Days
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Integrated Project Delivery (IPD)

Integrated Project Delivery: A Guide

Integrated Project Delivery (IPD) leverages early contributions of knowledge and expertise from all team members, allowing all team members to better realize their high value, expanding the value they provide throughout the project lifecycle.

http://www.aia.org/ipdg
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IPD – What Is It?

- Project delivery approach that integrates people, systems, business structures, and practices to optimize project results, increase value to the owner, reduce waste and maximize efficiency of project delivery.

- Distinguished by highly effective collaboration among the owner, prime designer and prime constructor commencing at early design through project completion.
An integrated design process allows decisions to be made early when the opportunity for change is maximized and the cost of changes are minimized.

MacLeamy Curve
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Integrated Project Delivery Charter

Integrated Project Delivery Charter
SDCCD North City Campus Parking Structure

We, the Design Build Team for the SDCCD North City Campus Parking Structure, will be utilizing the Integrated Project Delivery (IPD) model for the design and construction of this project to integrate the 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.

We, the undersigned, agree to achieve this mission by implementing the following objectives:

- **Mutual Respect and Trust** – we agree to foster an environment that promotes collaboration, and we are committed to working as a team in the best interests of the project.

- **Mutual Benefit and Reward** – we agree to a shared contingency and a shared savings to breakdown the silo mentality and reward a “what’s best for the project” behavior.

- **Collaborative Innovation and Decision Making** – we agree to a team decision making structure where major decisions are made objectively and unanimously.

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Legacy Building Services
NTD Architecture
IPD Programs in the United States
As of January 1, 2008, Community Colleges can use design build under SB614.
  - Must be at least $2.5M in value
  - Requires project-specific Board resolution

Need to evaluate the project based on five minimum criteria.
  - Price (10%)
  - Technical Experience (10%)
  - Life cycle cost over 15 years (10%)
  - Skilled Labor Force (10%)
  - Safety Record (10%)
## Design-Build Scoring Criteria and Weight

**Mesa College Fitness Center Project**

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<th>Point Value</th>
<th>1 (TECHNICAL EXPERTISE / 20%)</th>
<th>2 (DESIGN EXCELLENCE / 20%)</th>
<th>3 (LIFE CYCLE COST / 10%)</th>
<th>4 (SKILLED LABOR FORCE AVAILABILITY / 10%)</th>
<th>5 (PRICE / 20%)</th>
<th>6 (COMMITMENT TO DIVERSITY / 10%)</th>
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Schedule Performance

Is Critical Path Scheduling Obsolete?
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Schedule Performance

- SDCCCD Experience:
  30 Major Projects with CPM Scheduling
  3 (10%) finished on time

- Research by Glenn Ballard and Greg Howell indicated only 54% of planned weekly activities get completed.

- LastPlanner pull system – a better way (typically 80-90% percent promises kept)
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Pull Planning
San Diego Community College District

Pull Planning
San Diego Community College District
Target Costing – Project Budget Development

- Space Programming
- Efficiency
- Targeted Cost Per Sq. Ft.
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BIM Clash Detection

- **Building Construction**
  *Mechanical piping hits cable tray and fire protection piping in ceiling space*

- **Survey Average Results**
  - Man-hour Savings = 61
  - Delay Savings = 3 Days
  - Cost Savings = $30,349.00

- **Number of Clashes Shown in Example = 9**
- **Savings per Clash Resolved = $3,372.00**
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Change Order Metrics – BIM vs. No BIM

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<tr>
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Schedule Impacts – BIM vs. No BIM

Average Days of Delay
BIM: 24.5
No BIM: 79.6
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BIM Integration: Mesa College Social & Behavioral Sciences Building
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MacLeamy – Buildings Are Assembled Not Built

Buildings are Assembled
Not Built
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Off-site Fabrication Trends

Exterior skin – Mesa College Math & Science Building

Columns and Double Ts – City College Arts & Humanities Building
San Diego Community College District
Off-site Pre-Fabrication Trends

Mechanical systems off-site racking – Mesa College Math & Science Building
San Diego Community College District
Off-site Pre-Fabrication Trends

Pre-fabrication warehouse – University Mechanical & Engineering
San Diego Community College District

Off-site Pre-Fabrication Trends
Questions?
David Umstot, PE
Vice Chancellor, Facilities Management
San Diego Community College District
dumstot@sdccd.edu
(619) 388-6546