CMAA San Diego Regional Lean Construction Seminar

May 9, 2019

By David Umstot, PE
Join us on June 21st, 2019
for the
CMAA of San Diego
13th Annual Golf Tournament

Twin Oaks Golf Course
in San Marcos
LEARNING OBJECTIVES

AFTER THIS WORKSHOP, PARTICIPANTS WILL BE ABLE TO:

1. Define Lean
2. Identify principles and tools relevant to Lean design and construction processes
3. Recognize various types of waste and potential tools to reduce and/or eliminate waste
4. Increase collaboration and communication on projects through structured planning systems and processes
WHY?
Suddenly, a heated exchange took place between the king and the moat contractor.
Traditional Project Design and Delivery Approaches are Failing at Alarming Rates!
FEBRUARY 2015 Study

- Examined over 3,700 projects
- Strong correlation between failure rate and size. **37% of projects under $750M fail.**
- **2/3 of megaprojects** costing greater than $750M fail
- Failure defined as meeting at least one of these four criteria
  1. Costs grew by 25% or more
  2. the schedule slipped at least 25% (one year, on average, for mega-projects)
  3. the project overspent compared to the industry average; or
  4. there were severe and continuing operational problems lasting more than two years after startup.
- Errors in basic data, including engineering design and constructability, lead to the failure of about 30% of megaprojects
Schedules suffer more in normal size projects.

Source: ENR March 2/9, 2015

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Closing the US Infrastructure Gap

- $3.6 Trillion Infrastructure Needs
- $1.6 Trillion Gap
- $2.0 Trillion Available Funding
- Policy Actions
- New Funding Sources

TIME

$
Construction matters for the world economy
... but has a long record of poor productivity

Construction-related spending accounts for
13% of the world’s GDP

...but the sector’s annual productivity growth has only increased
1% over the past 20 years

$1.6 trillion of additional value added could be created through higher productivity,
meeting half the world’s infrastructure need

In the United States, labor productivity in construction has declined since 1968, in contrast to rising productivity in other sectors.

Construction labor productivity has not kept pace with overall economic productivity.

Labor productivity, gross value added per hour worked, constant prices,\textsuperscript{1} index: 100 = 1995

\textsuperscript{1}Based on 2010 prices.

\textsuperscript{1}Source: Organisation for Economic Co-operation and Development
937
1 every 2 hours
National Death Toll Due To Construction Accidents

2015

- 7.2% Caught In/Between
  - 67 deaths
  - Getting caught by objects or in between two objects is extremely dangerous, and accounted for 7.2% of construction accidents in 2015.

- 8.6% Electrocuted
  - 81 deaths
  - In 2015 8.6% of construction deaths were caused by electrocution. Most of those were the result of contact with overhead power lines.

- 9.6% Struck By Objects
  - 90 deaths
  - Protection from falling objects is extremely critical. 9.6% of the deaths on construction sites could have been avoided if safety protections had been in place.

- 38% Falling On Site
  - 364 deaths
  - Falls are the number one cause of fatal injuries on construction sites. Although fatalities in the industry have declined, falls still account for 38% of all construction fatalities each year.
US Bureau of Labor Statistics
As of January 18, 2019

42.5 years
Median age of US construction industry workers

<1/3 of workforce is under 34
Out of 100 million people in America who hold full-time jobs:

- 30% are engaged
- 20% are actively disengaged
- 50% are not engaged and just there

Source: Vocoli (2014)
Construction Waste in the U.S.

Current Manufacturing

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

Current Construction

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

### How Owners Define Value

**Ranking Relative Importance of Performance Metrics**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Schedule</td>
<td>75%</td>
</tr>
<tr>
<td>Cost/Budget Control</td>
<td>68%</td>
</tr>
<tr>
<td>Quality</td>
<td>61%</td>
</tr>
<tr>
<td>Safety</td>
<td>54%</td>
</tr>
<tr>
<td>Project Design/Service Provided</td>
<td>25%</td>
</tr>
<tr>
<td>End User Experience</td>
<td>4%</td>
</tr>
</tbody>
</table>

Frequency with Which Projects Meet Expectations

Most who never heard of Lean think the industry is **Efficient**

Source: McGraw-Hill 2013
Owner Satisfaction & Project Performance Research Overview (2016)

Objectives:
1. Benchmark owner satisfaction & project performance
2. What is the impact of Lean?

Survey: 81 Owners/162 projects
Performance from Approval of Capital Project (% of Best/ Typical Projects)

SCHEDULE
- Completed Ahead of Schedule
  - Best Project: 24%
  - Typical Project: 61%
  - Total: 21%
- Completed Behind Schedule
  - Best Project: -21%
  - Typical Project: -61%
  - Total: -49%

BUDGET
- Completed Under Budget
  - Best Project: 46%
  - Typical Project: 10%
  - Total: 49%
- Completed Over Budget
  - Best Project: -17%
  - Typical Project: -49%
  - Total: -61%

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Schedule Performance
Variance of Final Schedule vs. Allocated Capital Schedule

 Ahead of Schedule

<table>
<thead>
<tr>
<th>Variance</th>
<th>Typical</th>
<th>Best</th>
</tr>
</thead>
<tbody>
<tr>
<td>26% to 35% of schedule</td>
<td>1%</td>
<td>6%</td>
</tr>
<tr>
<td>11% to 25% of schedule</td>
<td>22%</td>
<td>33%</td>
</tr>
<tr>
<td>1% to 10% of schedule</td>
<td>56%</td>
<td></td>
</tr>
</tbody>
</table>

 Behind Schedule

<table>
<thead>
<tr>
<th>Variance</th>
<th>Typical</th>
<th>Best</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Variance</td>
<td>1% to 10% of schedule</td>
<td>14%</td>
</tr>
<tr>
<td>11% to 25% of schedule</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>26% to 35% of schedule</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>More Than 35% of schedule</td>
<td>4%</td>
<td></td>
</tr>
</tbody>
</table>
Typical Projects:

- 42% don't engage key stakeholders until design development or later

Best Projects:

- 76% engage key stakeholders before or during conceptualization

Timing of Key Stakeholder Engagement

<table>
<thead>
<tr>
<th>Stages</th>
<th>Typical</th>
<th>Best Performing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-business case</td>
<td>9%</td>
<td>3%</td>
</tr>
<tr>
<td>Business case validation</td>
<td>9%</td>
<td>9%</td>
</tr>
<tr>
<td>(pre-design)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>During conceptualization</td>
<td>7%</td>
<td>25%</td>
</tr>
<tr>
<td>(0-15% design)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>During schematic design</td>
<td>11%</td>
<td>22%</td>
</tr>
<tr>
<td>(15-30%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>During design development</td>
<td>17%</td>
<td>42%</td>
</tr>
<tr>
<td>(30-60%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>During construction documents</td>
<td>16%</td>
<td>9%</td>
</tr>
<tr>
<td>(60-90%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End of construction documents</td>
<td>3%</td>
<td>4%</td>
</tr>
<tr>
<td>or later (100% CD)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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### LEAN TOOLS USE IN BEST VS. TYPICAL PROJECTS

<table>
<thead>
<tr>
<th>Tool</th>
<th>Typical</th>
<th>Best</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-location Big Room</td>
<td>6%</td>
<td>44%</td>
</tr>
<tr>
<td>Target Value Design</td>
<td>6%</td>
<td>40%</td>
</tr>
<tr>
<td>Prefab/Modularization</td>
<td>17%</td>
<td>49%</td>
</tr>
<tr>
<td>Conceptual/Continuous Estimating</td>
<td>22%</td>
<td>48%</td>
</tr>
<tr>
<td>Full-team On-boarding</td>
<td>17%</td>
<td>41%</td>
</tr>
<tr>
<td>BIM Design authoring</td>
<td>17%</td>
<td>41%</td>
</tr>
<tr>
<td>A3 Thinking</td>
<td>5%</td>
<td>27%</td>
</tr>
<tr>
<td>Last Planner System®</td>
<td>19%</td>
<td>40%</td>
</tr>
</tbody>
</table>

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- **Part-time co-lo more common than full time**
- **LPS more common in construction than in design**
It’s Time to Expect More!
The Business Case for Lean, Projects are…

3: As likely to finish on or ahead of schedule!!!

2: As likely to finish on or below original budget
Lean Tenets

- Optimizing the Whole
- Respect for People
- Removal of Waste
- Continuous Improvement
- Focus on Process & Flow
- Generation of Value
Why Lean Project Delivery?

1. We want to transform the design and construction industry!
2. We want to improve productivity in design, and construction through less rework and better work practices.
3. We want to better leverage the collective creative problem solving of the entire team through collaborative processes to enhance the value the team delivers.
SHOCKWAVE TRAFFIC JAMS RECREATED FOR FIRST TIME

Footage courtesy of University of Nagoya, Nagoya, Japan
“Lean Construction is a production management-based approach to project delivery to maximize value and minimize waste.”
Lean Philosophies

• Value is defined by the customer
• Identify and remove waste
• Innovate and perfect

Courtesy: Southland Industries
What is Lean Project Delivery?

Shared principles:

1. Optimize the Whole
2. Collaborate, Really Collaborate!
3. Continual improvement/pursuit of perfection
4. A focus on delivering value
5. Allowing value to flow
6. Creating pull production

The priority for all construction work is to:

1. Keep work flowing
2. Reduce inventory of material and tools, and
3. Reduce costs

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PLAN, DO, CHECK, ACT
"We have learned to live in a world of mistakes and defective products as if they were necessary to life. It is time to adopt a new philosophy in America."
DEMING’S FINDINGS

“When people and organizations focus primarily on quality, quality tends to increase and costs fall over time.

However, when people and organizations focus primarily on costs, costs tend to rise and quality declines over time.”
UK Construction 2025 Goals

UK Construction 2025 Goals

**Lower costs**
33%

reduction in the initial cost of construction and the whole life cost of built assets

**Faster delivery**
50%

reduction in the overall time, from inception to completion, for newbuild and refurbished assets

**Lower emissions**
50%

reduction in greenhouse gas emissions in the built environment

**Improvement in exports**
50%

reduction in the trade gap between total exports and total imports for construction products and materials

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Lean is all about Flow

1. Optimize flow efficiency!
2. Move away from optimizing the piece, and optimize the whole.
SINGLE PIECE FLOW
Sure glad the hole isn’t at our end.
What is the Number One Builder and Owner Complaint?

The Design Management Process!!!
Commitments

Projects are networks of commitments
Awareness Test
Ohno Circle (Open Your Eyes)
Eight Types of Waste

- Overproduction
- Waiting
- Transportation
- Over Processing
- Inventory
- Motion
- Defects
- Underutilizing the creativity of project team members
What is value or waste?
Typical Types of Design Waste:

- Iterative Design
- Rework
- Lack of Coordination Between Disciplines
- Inefficient work flow
- Over design of systems (diversity and factors of safety)
- Poor design that generates waste during construction
- Designing over allowable budget
- RFIs
Typical Types of Construction Waste:

• Rework
• Requests for Information
• Change orders
• Inadequate Resources
• Inefficient work flow
• Workarounds
• Multiple handling of material
• Excess material
• Waiting on supplies
• Waiting on another trade
• Safety losses
• Improper sequencing of work
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?
The Death Knell of an Organization

We have always done it this way.
Is Critical Path Method Scheduling Obsolete?
## The Project Management Methods Developers Use

A study shows most developers use Scrum, but a large percentage also choose to use nothing at all.

<table>
<thead>
<tr>
<th>Method</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrum</td>
<td>37</td>
</tr>
<tr>
<td>Agile-Waterfall Hybrid</td>
<td>21</td>
</tr>
<tr>
<td>Kanban</td>
<td>20</td>
</tr>
<tr>
<td>Waterfall</td>
<td>15</td>
</tr>
<tr>
<td>FDD</td>
<td>10</td>
</tr>
<tr>
<td>Lean</td>
<td>9</td>
</tr>
<tr>
<td>XP</td>
<td>9</td>
</tr>
<tr>
<td>ASD</td>
<td>6</td>
</tr>
<tr>
<td>Scrumban</td>
<td>6</td>
</tr>
<tr>
<td>DSDM</td>
<td>3</td>
</tr>
<tr>
<td>Nothing Specific</td>
<td>19</td>
</tr>
<tr>
<td>Nothing at all</td>
<td>23</td>
</tr>
</tbody>
</table>

*Source: SlashData, May 2019*
Pull vs. Push
Pull vs. Push
Pull vs. Push
Schedule Performance

• Research by Glenn Ballard and Greg Howell indicated only 54% of planned weekly activities get completed on average.
• Last Planner® pull system – a better way (typically 80-90% percent promises kept)
Last Planner® System

Who are the Last Planners?
The foremen and superintendents/site managers

5 Major Elements of System

1. **Master Scheduling** – setting milestones
2. **Phase (Pull) Planning** – specifying handoffs
3. **Make Work Ready Planning** – 6 week look-ahead
4. **Weekly Work Planning**
5. **Learning** - Measure Percent Promises Complete, conduct root cause analysis and act on reasons for failure to keep promises

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Last Planner® System Principles

1. All plans are forecasts and all forecasts are wrong. The longer the forecast the more wrong it is. The more detailed the forecast, the more wrong it is.
2. Plan in greater detail as you get closer to doing the work.
3. Produce plans collaboratively with those who will do the work.
4. Reveal and remove constraints on planned tasks as a team.
5. Make reliable promises.
6. Learn from breakdowns.

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Last Planner® System

5 Connected Conversations

- SHOULD
  - Milestone Planning
    - Set milestones

- CAN
  - Phase “Pull” Planning
    - Specify handoffs
    - Make work ready

- WILL
  - Look Ahead Planning
    - Make promises

- DID
  - Weekly Work Planning
  - Learning/Improving
    - PPC/Variance
Patrick MacLeamy, FAIA, Chairman and CEO, HOK
-- “Buildings are Assembled Not Built”
Structure and Skin Pre-Fabrication Trends

Exterior skin – Mesa College Math & Science Building

Columns and Double Ts – City College Arts & Humanities Building
Off-site Pre-Fabrication Trends
Pre-Fabrication In Controlled Setting
The Challenges
Action Bias
If you fail to plan, you plan to fail.
Complex vs. Complicated
I've missed more than 9000 shots in my career.
I've lost almost 300 games.
26 times, I've been trusted to take the game winning shot and missed.
I've failed over and over and over again in my life.
And that is why I succeed.

~ Michael Jordan
Different skill sets
Servant Leadership

“What do you need from me to do your job?”
DIFFUSION OF INNOVATION

THE CHASM

EARLY ADOPTERS

INNOVATORS

EARLY MAJORITY

34

34

LATe MAJORITY

LAGGARDS

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Getting Better Every Day

Free Download at https://paulakers.net/books/2-second-lean
How Are Public Owners Asking for Lean?
“A collaborative, team-managed design process that is used throughout all stages of design and construction to ensure that projects are delivered within the allowable budget, that projects meet the operational needs and values of the users and that projects promote innovation to increase value and eliminate waste”.
### TARGET VALUE DESIGN VS. TRADITIONAL ESTIMATING APPROACH

<table>
<thead>
<tr>
<th>Target Value Design</th>
<th>Traditional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost as an input to design</td>
<td>Cost as an output of design</td>
</tr>
<tr>
<td>Share information early and often</td>
<td><em>Wait till I’m finished; don’t bother me</em> mentality</td>
</tr>
<tr>
<td>Rapid model based estimating</td>
<td>Time consuming manual quantity take-off</td>
</tr>
<tr>
<td>Carry multiple solutions sets forward as long as possible</td>
<td>Early commitment to design solutions</td>
</tr>
<tr>
<td>Provide cost feedback to concepts rather than drawings</td>
<td>Design, then calculate cost of design</td>
</tr>
<tr>
<td>Graphical display posted for all to see</td>
<td>Tabular cost estimates and reports for owners</td>
</tr>
</tbody>
</table>

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Would you buy a car this way?
Integrated Design-Build Contract Between Owner and Design.Builder Cost Plus Fee with a Final Target Cost

2.5 Incentive Compensation. The Incentive Compensation and the Incentive Compensation Percentages of the Risk/Reward Team Members will be set forth in the Incentive Distribution Spreadsheet. The Incentive Compensation can be adjusted by Modification. Incentive Compensation may be provisionally earned during the Project but will not be earned or paid before Final Completion.
1.10.6 Lean Principles. The Design-Builder will utilize Lean™ principles and techniques (the “Lean Principles”) as developed or defined by the Lean Construction Institute™ and as generally identified below.

1.10.6.1 Open Communication. Communication is open, clear, and direct. It is important that the Owner and all Design-Build Team Members be apprised of information that affects their performance or which they can impact. Communication will be directly between the immediate participants through the most expeditious manner, with information or decisions documented, and made available to the Owner and Design-Build Team Members. The goal of communication in Lean™ is to ensure that the Owner and all Design-Build Team Members have a high level of common understanding.

1.10.6.2 Collaboration. The Design-Build Team Members will freely share concepts and ideas with each other to improve the overall Project outcome. Within the limits of licensing or professional registration, the Design-Build Team Members will review each other’s portions of the Work and recommend improvements and will openly consider suggestions from the Owner and all Design-Build Team Members. Nothing in this Section changes a Design-Build Team Member’s responsibility for its portion of the Work or requires another Design-Build Team Member to assume responsibility for, or to engage in portions of the Work that require licensure beyond that necessary to perform its respective Work.

1.10.6.3 Reliable Promising. Effective Project planning requires that each Design-Build Team Member clearly communicate its needs and provide reliable promises to other Design-Build Team Members with regard to its own performance. If a Design-Build
Team Member discovers that it will not achieve a promise, it must immediately inform the PMT identifying when it can perform, and any impediments to its performance.

1.10.6.4 **Commitment-Based (Pull) Scheduling.** The Milestones will be collaboratively developed by the Owner and Design-Build Team Members based on the Owner’s schedule requirements and realistic durations agreed by those who are primarily responsible for delivering the information, services, or materials for various components of the Project. In making detailed work plans for accomplishing the various Milestones, Design-Build Team Members will use a planning system based on requests and commitments by Design-Build Team Members to each other for information, materials, or resources that the requester needs to accomplish its task by a certain time in order to optimize the flow of Work through the Project by increasing schedule reliability and reducing bottlenecks and activities that do not facilitate achievement of the Milestones.

1.10.6.5 **Elimination of Waste.** Design or construction effort that does not add value is waste and will be reduced or eliminated. Design effort that is not necessary for construction or for regulatory purposes will be avoided. Similarly, construction resources and materials that are not incorporated into the completed Project will be reduced or eliminated. The Design-Build Team Members will maximize the use of just-in-time delivery of materials and information to reduce waste associated with maintaining inventories.

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1.10.6.6 **Quality and Reduction in Rework.** Quality is created through careful execution of Work, not by inspection and rejection. The Design-Builder will develop a Quality Assurance/Quality Control work plan (QA/QC Work Plan) for the Project, which will be submitted to the Owner for approval. The Design-Build Team Members will consider innovative ways to design Work that reduces the risk of installation errors. Each Design-Build Team Member must strive to accurately complete its Work and identify any Work that does not meet the Project requirements so that necessary corrections can be identified and executed before, or at the time, the Work is being performed. The Design-Build Team Members will strive to eliminate rework. The Design-Builder will collaborate with the Design-Build Team Members to develop clear and effective procedures for a Design-Build Team Member to handoff its Work to a follow-on Design-Build Team Member so that any quality deviations are caught early.

1.10.6.7 **Best Performer.** Work is performed, to the greatest extent possible, by the organization or individual best capable of performing that Work.

1.10.6.8 **Value of Ideas, Not Status of Author.** Open communication and collaboration leads to the development of new ideas and concepts. Good ideas can come from any Design-Build Team Member, and it is the value of the ideas, not the role or status of the author, that determines whether an idea or concept will be used.

1.10.6.9 **Optimize the Whole Project, Not Its Components.** Under the leadership of the PMT, each Design-Build Team Member will focus efforts on creating value for the Project as a whole within the Project Charter. Efforts to optimize any individual Design-Build Team Member’s portion of the Work must benefit the entire Project to be justifiable.

1.10.6.10 **Continuous Improvement.** Lessons learned are generated continuously and used to guide and improve processes while the Project is underway rather than only at its conclusion.
Set-Based Approach to Design
LAX TERMINAL CORES PROJECT TO PREPARE FOR THE PLANNED AUTOMATED PEOPLE MOVER
Proposers shall submit a two-page narrative, not including any supporting tables, diagrams or illustrations outlining the Proposers’ methods in integrating innovative design concepts and existing conditions of the work site and how that integration will be planned, executed and documented. Proposers should focus on how quality will be instituted as an overarching influence on all stages and aspects of the Project.

6. Risk Management Plan

Provide a Risk Management Plan that identifies the Proposers’ strategy in identifying, assessing, and managing risk throughout the Project. Identify those resources that should be included in the Risk Management process and describe the roles they would play.

The Risk Management process should be applied to all stages of the Project and be included in Project Plans and operational documents. In this way, it becomes an integral part of every aspect of managing the Project, in every phase and in every process group.

Provide a preliminary risk register and Risk Breakdown Structure that identifies and assesses preliminary Project risks, both threats and opportunities, and includes an assessment of each along with a preliminary response strategy. The response strategy shall be of sufficient detail to adequately communicate its meaning.

7. Lean Construction

Proposers are required to submit a plan to incorporate BIM and Lean Construction methodologies in its execution of the Project. The plan should include recommended uses of Lean Construction techniques as they apply to each stage of the Project – Design, Preconstruction and Construction. Additionally, provide a narrative that illustrates the clear benefits to the Project and LAWA. Include Lean Construction tools that may be applicable to the Project and its goals. Examples include Reliable Promises, Last Planner® System, Standard Work Process, Value Stream/Process Mapping, etc.

All trade contractors and significant vendors are expected to fully participate in the appropriate selected Lean Construction tools as facilitated by the Contractor. Include in the Plan how the Proposer will prequalify or train those partners to ensure their participation.

In addition, the Plan will require the designation of an internal or outside consultant facilitator. The facilitator shall be trained and competent in establishing work practices for the Lean Construction tools being implemented. Additionally, the facilitator will be required to have the facilitation skills which permit them to remain a neutral party in planning sessions.

8. Safety Plan
Proposers should consider the use of Early Work Packages in the
determination of its strategy for accomplishing the Work. Identify enabling
projects, including approximate scope, sequencing and phasing.

The overall design submittal requirements for the RFP will include the
following:
an. Target Value Design Plan
b. Drawings – Type and scale described
c. Listing of anticipated specifications
d. Design narrative
e. Proposed finish materials boards

Target Value Design Plan

Target Value Design is a collaborative design process involving the
Design/Builder, their suppliers, estimators, schedulers and LAWA co-located
in one Project Management Office to collaboratively produce a design that
provides the best value for LAWA where budget is a design criterion.
Proposers shall submit a narrative that discusses the Proposers’ successes
and failures in performing Target Value Design and a Project plan that details
the Proposers’ approach to and plan for Target Value Design.

The plan shall include:

- Expected engagement efforts and interface with stakeholders
- Leadership approach during the design process that takes into account
  unexpected information.
- Approach to estimate development, level of detail and establishment of
  the target value(s)
- Project planning methods and studies that will be used to develop the
  Basis of Design.
- Identification of the methodology for developing details in small
  batches in collaboration with Stakeholders.
- Description of the proposed methodology for prioritization of design
  details based on Stakeholder prioritization.
- The organization of resources in groups or disciplines or other means
  and the advantage that organization brings to the design effort.
- A plan that best exploits the advantages of co-location and the
  expected outcomes.
- Description of design cycles and the methodology that will be used to
  incorporate lessons learned from previous design cycles.
Set-Based Approach to Design
Pull Planning and Scrum in Design
Big Room Daily Scrum Stand Up
Fullerton College Instructional Building Progressive Design-Build Project
C. Non-Price Factors

1. Technical Expertise: The Design-Builder’s qualifications including but not limited to the following:

   General Information
   a. Name of Firm
   b. Contact information, including primary contact individual(s)
   c. Number of years the firm has been in continuous practice
   d. Total number of employees (if the firm has more than one office, list the number of employees in each office and designate the office where the majority of the work effort will take place)
   e. Number of employees by discipline or expertise. Include numbers of registered professionals

   Include the information as listed above for each Firm listed in the proposal.

   Firm Experience
   a. Design Build team experience – List experience that this Design Build team has working together
   b. Similar Projects - List similar experience in similar situations as Design Builder. Briefly describe the project, including size and location.
   c. Other Projects - List other projects that demonstrate the firm’s experience in complex projects. Organize the list by date. Identify those which are educational in nature.
   d. BIM Capabilities – List firm experience and capability to utilize BIM.
   e. BIM Experience – List projects that demonstrate the firm’s experience in utilizing BIM. Briefly describe the project, including size and location.
   f. Preconstruction Services – Describe how this Design-Build team will approach preconstruction services.
   g. Lean Project Delivery experience – Discuss approach, projects, results and reference contacts.

   Team Member Experience

   List the following for each team member:
   a. Accurate description of proposed project role
   b. Educational credentials
   c. Number of years of Educational design and/or construction in California
   d. Number of years of experience in Educational design and/or construction overall
   e. Number of years with present firm
   f. Specific project experience with similar projects where the team member played a significant role.
   g. Office location

Information and experience requirements in this section of the proposal are applicable to the key design build team members as well as for any specialty design or planning consultants that may be listed as part of the team. Key team members are those who will have substantive input to the project.
1. FIRM EXPERIENCE (continued)

G. LEAN PROJECT DELIVERY

On Boarding

The best way to insure a successful project is to make sure that all team members understand their individual areas of expertise and their unique role in the project. To ensure this, BNBUILDERS uses the On Boarding process for not only the management portion of the project but into the field as well. Once the Core Team has been established, one of their first tasks is to create how people will become familiar with not only the project but what will be expected of them during their involvement.

Safeguarding that behavior and the decision making process evolves around the end goal of a successful project and is essential time that must be put in during the earliest steps of the project. On Boarding should include how decisions are made and what to do when issues arise that may need intervention from the management team. It should also include how the team plans to identify and implement opportunities for continuous improvement.

While on boarding is important during the design phase, it is equally important as the project transitions into the construction phase. With a majority of the cost of a project spent in the field, common sense tells us that this investment is well justified.

Conditions of Satisfaction

Conditions of satisfaction tie closely to the on boarding process as they are what will set the tone for the duration of the project. The conditions of satisfaction should include a list of items that have been discussed with the stakeholders including the Owner and their vision of the final use of the building, not just the design and construction tasks. These should be reviewed periodically and at all reflections to insure that the team is being true to the decisions that were made early on in the process.

Cluster Groups

The massive amount of decisions that are required during the design of a project can become a daunting task regardless of the size of the team. To spread the load of this process, BNBUILDERS has used cluster groups to ensure that all parties associated are represented. Cluster groups break up that complexity into an environment of rapid prototyping of solutions and learning. This way the entire group can understand the importance of all the decisions and how they are interconnected.

The groups are traditionally staffed by a representative from each discipline that would include trade partners, designers, GC and Owner. Cost is a large function of what is discussed at this early stage, but constructability can not be ignored either. These groups tie very close to the idea of Target Value Design.

Target Value Design

One school of thought is that cost drives design, but it has been proven that cost "informs design" and as such conversations between the designers and the constructors must continue to occur through this design phase so that the greatest value is delivered to the client. To accomplish this, we revert to the cluster groups and echo the importance of multiple disciplines are represented in each group.

BNBUILDERS | RNT Architects

SET BASED DESIGN goes hand-in-hand with TVD as a tool to assist in making the best value decision for a given component in a project. A Good / Better / Best selection process is used to rank the components by criteria important to delivering the best value.

Planning

Many papers have been written regarding the Last Planner® system and how it improves the level of reliable commitments. BNBUILDERS uses a form of this on every project regardless of its size or complexity. BNBUILDERS also goes to the level of tracking Tasks Made Ready and Task Made Complete as a way to track how well we, as the general contractor, are doing removing constraints and roadblocks and allowing those reliable commitments to occur. BNBUILDERS uses BIM 360 Field to track these commitments and the PFC of the Design Teams, as well as during the construction phase. But PFC should not be the only measurement of the health of a project, a master schedule in CPM format must be maintained to insure that the milestones that are being pulled from are being maintained or beaten. "This CPM schedule must include major milestones that are established by the team along with phased planning to begin to place more detail in which to pull from.

BNBUILDERS | RNT Architects

"I was impressed that BNBUILDERS was truly committed to structuring a Lean approach on their work at the University of Washington. We frequently ran into organizations that are interested in Lean, but are not fully committed. Often they are looking for an easy way to 'just do Lean.' We did not get that sense from BNBUILDERS at all." - David Umstot, Lean Coach UW Denny Hall Renovation
Lean Project Delivery

- Conditions of Satisfaction – Set Vision / Goals / Values
- On Boarding – Lean Culture
- Cluster Groups – Best Value
- Target Value Design
- Planning – The Last Planner® System
Culture of Progressive Design-Build

- Mutual Respect / Benefit
- Early Goal Definition / Metrics
- Enhanced Communication
- Appropriate Technology
- High Performance Team
- Trust
Collaboration Tools

• Building Tours / Field Tours
• 3D Printed Models
• Hand Sketches
• Classroom Renderings
• Virtual Reality
## Cost Model

### SYSTEM SUMMARY

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<tr>
<th>Location</th>
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<th>Total Cost</th>
<th>Total Cost</th>
<th>Total Cost</th>
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### DIRECT CONSTRUCTION COST

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<th>$</th>
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<td>Site Management</td>
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<td>General Conditions</td>
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### INDIRECT CONSTRUCTION COSTS

| Total | 2,418,000 | 327,000 | 2,545,000 | 362,830 | $ | 2,907,830 |

### TOTAL CONSTRUCTION COST

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<td>2,907,830</td>
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Central Plant Expansion – Set-Based Design

Chiller plant life cycle analysis

– All electric chiller plant
– Hybrid gas / electric plant
– Thermal Energy Star (TES)
– Modular Chiller Plants

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Holistic Approach to Life Cycle Cost Analysis

Minimize Energy Consumption (MEP Systems)

1. Mechanical System Equipment Optimization
   • Initial cost analysis
   • Energy cost analysis
   • Maintenance cost

<table>
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<tr>
<th>Option</th>
<th>System Type</th>
<th>Annual HVAC Energy Use</th>
<th>Annual Lighting Energy Use</th>
<th>Annual Occupant Energy Use</th>
<th>Annual Total Energy Use</th>
<th>40 Year Energy Cost in present Dollars</th>
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<td>148,667</td>
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<td>Fan-coil units</td>
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<td>509,351</td>
<td>$2,800,487</td>
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</table>

Utilize Trace 700 for modeling Life Cycle Cost Analysis
Why Lean Project Delivery?

1. Enhanced value to the Owner/Customer
2. Reduced waste
3. Improved productivity
4. Reliable and predictable work flow resulting in better schedule performance
5. Improved quality
6. Safer sites
7. Satisfied employees and team partners
8. Increased profitability

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How Can Lean Project Delivery Benefit You?


Benefits Achieved From Implementing Lean Practices
(According to Lean Practitioners)


High Level of Achievement  Medium Level of Achievement

- Improved Safety: 39% 38% 77%
- Greater Customer Satisfaction: 38% 42% 80%
- Higher Quality Construction: 36% 48% 84%
- Reduced Project Schedule: 34% 40% 74%
- Greater Productivity: 33% 44% 77%
- Greater Profitability/Reduced Costs: 30% 34% 64%
- More Focus by Supervisory Staff on Managing Workers: 28% 40% 65%
- Better Risk Management: 21% 50% 71%
- Improved Sustainability/Reduced Waste: 20% 47% 67%
- Greater Reliability of Information from Other Parties: 20% 46% 66%
- Improved Lifecycle Cost/Cost of Ownership: 9% 39% 48%
Save the Date

LCI San Diego Community of Practice
Industry Day Event
Friday, August 9th
San Diego State University
Questions?

David Umstot, PE, CEM
Umstot Project and Facilities Solutions, LLC
david.umstot@umstotsolutions.com
619-201-8483 (O)

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