Target Value Design (Delivery)  
An Overview

By David Umstot, PE, CEM  
Umstot Project & Facilities Solutions, LLC
Why Target Value Design?

Traditional Project Design and Delivery Approaches are Failing at Alarming Rates!
Figure 2
Capital projects’ budget performance

% of projects

63%

Projects over budget
(%, by project type)

49%
14%
>20%

New construction: 69%
Facility upgrade: 64%
Facility maintenance: 50%

Level over budget

Figure 3

Capital projects’ schedule performance

% of projects

75%

Level behind schedule

<table>
<thead>
<tr>
<th>Level behind schedule</th>
<th>% of Projects</th>
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<tbody>
<tr>
<td>0-10%</td>
<td>44%</td>
</tr>
<tr>
<td>11-20%</td>
<td>19%</td>
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<tr>
<td>&gt;20%</td>
<td>12%</td>
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Projects behind schedule (% by project type)

<table>
<thead>
<tr>
<th>Project Type</th>
<th>% Behind Schedule</th>
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<tbody>
<tr>
<td>New construction</td>
<td>57%</td>
</tr>
<tr>
<td>Facility upgrade</td>
<td>54%</td>
</tr>
<tr>
<td>Facility maintenance</td>
<td>39%</td>
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VA Says Aurora Hospital Costs Have Soared to $1.73B

"Costs for the Dept. of Veterans Affairs replacement hospital in Aurora, Colo., have ballooned to $1.73 billion, more than five times the project’s original cost and twice the spending cap set for it by Congress. VA Deputy Secretary Sloan Gibson delivered the bad news about revised cost estimates to congressional leaders in March 17 phone call.

The new price tag, up sharply up from the $800 million claimed by the VA in early March, comes from the U.S. Army Corps of Engineers, which is advising VA on the project. USACE will assume full management of the project this summer. The project was originally estimated at $328 million."
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
Source: ENR March 2/9, 2015
Why do projects perform so poorly?

- poor specifications and planning
- frequent design changes
- unrealistic price estimates
- unrealistic schedule performance expectations
- aggressive fee bidding
- optimistic revenue projections
- contractual complexity
- inappropriate procurement, and
- an adversarial business culture
Target Value Design – What is it?

“A management practice that drives design to deliver customer values and develops design within project constraints.”

– Glenn Ballard
Target Value Design

Definition of value
Conceptual estimating
Keys to collaboration
Concurrent Estimating
Set-based design
Target costing
Systems integration
Who’s Using Target Value Design?
What is of Value?

• Total Cost of Ownership?
• Energy Efficiency?
• Speed to Market?
• No disruption to ongoing business operations?
• Iconic design?
• Improved productivity and occupant satisfaction?
• Sustainable buildings?
How the customer explained it
How the Project Leader understood it
How the Analyst designed it
How the Programmer wrote it
How the Business Consultant described it

How the project was documented
What operations installed
How the customer was billed
How it was supported
What the customer really needed
Total Cost of Ownership

- 50-year design life
- 100,000 square foot classroom building
- Design and construction cost - $30 million
- Capital Renewal: 2% of current replacement value benchmark
- O&M Budget $5.69/square foot
- Inflation: 3%
Total Cost of Ownership

<table>
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<tr>
<th>Costs</th>
<th>Savings</th>
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<tr>
<td>D&amp;C: $30M</td>
<td>Total</td>
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<tr>
<td>Cap. R.: $101M</td>
<td>$5M</td>
</tr>
<tr>
<td>O&amp;M: $149M</td>
<td>$15M</td>
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<tr>
<td>Total: $280M</td>
<td>$20M</td>
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Understanding the Work Flow

Example of support “spread”
Frequency of use studies demonstrate support space that contribute to wasted steps.

Example of clustering support
Optimize floor plans to reduce travel distance and cluster based on frequency of use analysis.

Diagram courtesy of Health Strategies & Solutions, Inc.

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### Top Triggers Driving Future Green Building Activity in the United States

**Dodge Data & Analytics, 2016**

<table>
<thead>
<tr>
<th>Trigger</th>
<th>US</th>
<th>Global Respondents</th>
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</thead>
<tbody>
<tr>
<td><strong>Client Demands</strong></td>
<td>52%</td>
<td></td>
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<tr>
<td><strong>Right Thing to Do</strong></td>
<td>40%</td>
<td></td>
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<tr>
<td><strong>Environmental Regulations</strong></td>
<td>31%</td>
<td></td>
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<tr>
<td><strong>Market Demands</strong></td>
<td>25%</td>
<td></td>
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<tr>
<td><strong>Lower Operating Costs</strong></td>
<td>30%</td>
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Value-Waste Nexus

- How to create value within fixed monetary constraints?
- Eliminate waste
- Enhance value with the savings from waste reduction
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*
The Eight Wastes as Defined by Toyota (and Liker)

1. Overproduction
2. Waiting
3. Unnecessary transport
4. Over-processing
5. Excess inventory
6. Unnecessary movement
7. Defects
8. Unused employee creativity
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
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
Fish-Bone Diagram – Root Causes of Rework

Source: Robin McDonald, 2013
Pistanthrophobia – fear of trusting people due to past experiences with relationships gone bad
Collaborative Team Is Key
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
Manage Risk Collaboratively

Understanding the Work: Traditional Processes

- Owner
- Architect Hired
- Engineers Hired
- CM/GC Hired
- Major Trades Hired

© Dick Bayer
Manage Risk Collaboratively

Understanding the Work: LEAN IPD Project

- Owner
- Architect Hired
- CM/GC Hired
- Engineers Hired
- Major Trades Hired

Time

Pre-Construction Services

Construction

Valid. Concept Design Implementation

100%
Manage Risk Collaboratively

<table>
<thead>
<tr>
<th>Known</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>What we assume/what we predict</td>
</tr>
</tbody>
</table>
Manage Risk Collaboratively

Known

Risk

Core Group

Risk Management

Insurance
Manage Risk Collaboratively

Superintendent Confidence: Beginning of job

We understand WHAT we’re building

We understand HOW to build it

© Dick Bayer
Manage Risk Collaboratively

Superintendent Confidence:
- Beginning of job
- Three months into the job

We understand WHAT we're building

We understand HOW to build it

© Dick Bayer
Use of Lean Tools in Target Value Design

1. Target Costing
2. A3 Problem Solving and Reporting
3. Set-Based Design/Concurrent Engineering
4. Choosing by Advantages
5. The Last Planner® System
6. Building Information Modeling (BIM)
Target Value Design

THE BASICS
Target Value Design...

• ...strives to reduce the waste and rework in the Design/Estimate/Redesign cycle.
• ...requires a fundamental shift in thinking from “expected costs” to “target costs”.
• ...necessarily involves cross functional teams. No one person has all the knowledge.
• ...cries out for an integrated product/process/cost model.

Source: Ballard
TVD Flow

• Developing the value proposition
• From values to program
• From program to interactive design
• From interactive design to selecting design options
• From design options to TVD clusters
• From clusters to systems and pricing
• To fully developed package

©Dick Bayer
Target Costing

Market Conditions → Target Selling Price → Target Profit Margin → Allowable Cost

Source: Cooper & Slagmulder (1997)
Market-Driven Costing

- Market Conditions
- Target Selling Price
- Target Profit Margin

Project Level Target Costing

- Allowable Cost

Strategic Cost-Reduction Challenge

- Project-Level Target Cost
- Target Cost Reduction Objective
- Current Cost

Assembly/Trade Target Costing

- System Level Target Cost
- Assembly Level Target Cost
- Specialty Trades

After Cooper & Slagmulder (1997)
Market Benchmarking Prices

Owner’s Budget

Establish Target Price (typically lower than Benchmarking)

Minus profits

Target Cost

Establish Target Value (target cost plus project objectives)

Project objectives (e.g. sustainability, quality, time, life cycle costs, time to market)

Evaluate Project Performance in Achieving Project Objectives

Design to Target Value

Evaluate Project Cost

Source: Pishdad-Bozorgi, Moghaddam, and Karasulu (2013)
Steps During Design

• Set the target cost—typically lower than the budget that assumed current best practice
• Form Target Value Design teams by building system and allocate the target cost to each team
• Use a set-based approach, evaluating sets against target values
• Provide cost and constructability guidelines for design

Source: Ballard
Steps During Design (cont.)

- Promote collaboration: have designers get cost input before developing design options
- Do rapid estimating; hold frequent budget alignment sessions
- Use value engineering proactively
- Hold design reviews with permitting agencies

Source: Ballard
Value Engineering - Questions to Ask
(from L.D. Miles)

• What is it?
• What does it do?
• What does it cost?
• What else will do the job?
• What does that cost?
Understanding the Value Proposition

Additional Questions to Ask

• What is space used for?
• How do the occupants actually use the space?
• What is the energy intensity usage goal for space?
• How to use nature to your benefit?
• How will the systems be accessed for maintenance?
• Ease of cleaning or maintenance? How will these impact ongoing operations?
The Cardinal Rule

The Target Cost Must Never Be Exceeded!!!
Applying the Cardinal Rule

• Whenever improvements in the design result in increased costs, alternative, offsetting savings have to be found elsewhere without compromising value.

• Launching projects whose costs exceed their target is not allowed.

• Refusing to add scope to the project that will exceed target cost.

• The transition from design to construction is managed carefully to ensure that the target cost is indeed achieved.
Current Cost to Target Cost

After Cooper & Slagmulder (1997)

- System 1: Keep Functionality Constant; Decrease Cost
- System 2: Increase Functionality; Increase Cost

Current Cost  |  Target Cost
How Multiple Systems Interact to Target Cost
When to Set the Target Cost?

• Early in the project process.
• Don’t wait until you start construction!!!
How to Set the Target Cost?

• Clearly understand the value proposition and prioritization.
• Don’t pick numbers out of the air without a firm business case understanding.
• Estimates based on past performance are embedded with waste. Set a target that strives to eliminate some of the embedded waste. 20% is not uncommon.
• Have the core team members buy in to setting the target cost.
• Eliminate individual buffers (waste) in historic estimating models.
• Have the right players on the core team that are empowered to make financial commitments on behalf of their organization.
Target Value Design

EXAMPLES
Courtesy: Tipping Mar
San Diego Community College District

Target Costing – Project Budget Development

- Space Programming
- Efficiency
- Targeted Cost Per Sq. Ft.
### TARGET COST MODEL COMPARISON #1

**ARCHITECT:** WRNS Studio  
**LOCATION:** San Francisco, CA  
**DATE:** 30-Apr-12  
**BLDG. AREA:** 266,000

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>CURRENT COST</th>
<th>CURRENT COST/SF</th>
<th>TARGET COST</th>
<th>TARGET COST/SF</th>
<th>TARGET REDUCTION</th>
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<tr>
<td>Foundations</td>
<td>$3,099,495</td>
<td>$11.65</td>
<td>$3,000,000</td>
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<td>Substructure</td>
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<td>Superstructure</td>
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<td>Exterior Envelope</td>
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<td>$32.59</td>
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<td>Roofing</td>
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<td>$2.27</td>
<td>$1,770,000</td>
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<td>Interior Construction</td>
<td>$10,061,826</td>
<td>$37.83</td>
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<td>Office Furniture Systems</td>
<td>$6,000,000</td>
<td>$22.56</td>
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<td>Elevators</td>
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<td>$6.11</td>
<td>$1,600,000</td>
<td>$6.02</td>
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<td>Special Building Equipment</td>
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<td>$6.79</td>
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<td>$7.00</td>
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<td>Fire Sprinkler Systems</td>
<td>$3,276,000</td>
<td>$5.17</td>
<td>$1,200,000</td>
<td>$4.35</td>
<td>$1,076,000</td>
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<td>Plumbing Systems</td>
<td>$3,820,000</td>
<td>$6.84</td>
<td>$1,800,000</td>
<td>$6.77</td>
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<td>HVAC, Controls &amp; Balancing</td>
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<td>Electrical Systems</td>
<td>$12,307,900</td>
<td>$46.27</td>
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<td>Low Voltage Systems</td>
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<td>$22.68</td>
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<td>Site Work Construction</td>
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<td>$7.52</td>
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<td>Job Site Requirements</td>
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<td>$17.50</td>
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<td>$0</td>
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<td>Big Room Costs</td>
<td>$311,000</td>
<td>$1.17</td>
<td>$300,000</td>
<td>$1.00</td>
<td>$11,000</td>
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<td>Permit Fees</td>
<td>$285,000</td>
<td>$1.57</td>
<td>$285,000</td>
<td>$1.57</td>
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<td><strong>SUBTOTAL</strong></td>
<td>$86,727,161</td>
<td>$326.04</td>
<td>$76,850,000</td>
<td>$288.92</td>
<td>$9,877,161</td>
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<td><strong>DESIGN FEES &amp; CA COSTS</strong></td>
<td>$7,881,000</td>
<td>$28.50</td>
<td>$6,000,000</td>
<td>$22.56</td>
<td>$1,881,000</td>
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<td><strong>SUBTOTAL</strong></td>
<td>$94,608,161</td>
<td>$354.54</td>
<td>$82,850,000</td>
<td>$311.47</td>
<td>$11,808,161</td>
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<td><strong>DESIGN CONTINGENCY AT 5%</strong></td>
<td>$4,715,498</td>
<td>$17.73</td>
<td>$4,142,000</td>
<td>$15.73</td>
<td>$573,498</td>
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<td><strong>CONSTRUCTION CONTINGENCY AT 3%</strong></td>
<td>$2,970,707</td>
<td>$11.17</td>
<td>$2,609,838</td>
<td>$9.81</td>
<td>$360,869</td>
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<td><strong>SUBTOTAL</strong></td>
<td>$101,994,276</td>
<td>$383.44</td>
<td>$89,604,138</td>
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<td>R &amp; F Fee, Bond, Insur., PRECON</td>
<td>$4,781,765</td>
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<td>$4,273,782</td>
<td>$16.97</td>
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<td><strong>TOTAL COST</strong></td>
<td>$106,776,041</td>
<td>$401.41</td>
<td>$93,878,220</td>
<td>$352.93</td>
<td>$12,897,821</td>
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**MAXIMUM ACCEPTANCE COST:** $93,880,000

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Courtesy: Rudolph & Sletten and WRNS Studio
UCSF Mission Hall

Courtesy: Rudolph & Sletten and WRNS Studio
GMP vs. IPD Risk Allocation

Source: Pishdad-Bozorgi, Moghaddam, and Karasulu (2013)
UHS Temecula Hospital Labor Curves

UHS TEMECULA PLUMBING MANPOWER CURVE

- Actual Total Manpower
- Planned Foreman Manpower (100k Savings)
- Goal Manpower
- Estimated Manpower

MEN

WEEKS

5/29, 6/26, 7/24, 8/21, 8/18, 10/16, 11/13, 12/11, 1/8, 2/5, 3/5, 4/2, 4/30, 5/28, 6/25, 7/23, 8/20, 9/17, 10/15
Set-Based Design

THE BASICS
Set-Based Design

- Design Option
  - Evaluation Gate 1
  - Evaluation Gate 2
  - Concept Selected

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Rebar Alternatives
Set-Based Design – Connection Example

Design To Suit

Conventional

Courtesy: Tipping Mar
Set-Based Design – Connection Example

Design To Suit

![Diagram A - $4.37 / kip](image)

- 4'-0" spacing of embed plates
- deck studs at 6" O.C.

![Diagram B - $11.49-$18.75 / kip](image)

- 4'-0" spacing of embed plates
- deck studs at 6" O.C.

![Diagram C - $4.88 / kip](image)

- 4'-0" spacing of embed plates
- deck studs at 12" O.C.

![Diagram D - $5.30 / kip](image)

- 4'-0" spacing of embed plates
- deck studs at 12" O.C.

Courtesy: Tipping Mar
Knowledge Map

All Possible Structural Systems

Initial Analysis
S5.1

Cast In Place Concrete - Post & Beam - S1.1
Cast In Place Concrete - Structural Walls - S1.2
Light Gauge Steel - Structural Wall - S1.3
Light Wood Frame - Structural Wall - S1.4
Masonry - Structural Wall - S1.5
Precast Concrete - Post & Beam - S1.6
Precast Concrete - Hybrid Frame - S1.7
Tilt Up Concrete Structural Panel - S1.8
Prefab Metal Building - S1.9
ConXtech Buildings - S1.10
Structural Steel Post & Beam - S1.11

Courtesy: Buehler & Buehler
A3 Example

Proposition for use of Precast Concrete Post/Beam Structural System

DPR - Larry Summernfield

Structural System

Discipline: Structural
Element: All
Date Opened: 8/27/08
Revision No./Date: R1 - 11/10/08

A3 Team

Element Leads: All

A3 Status

Idea Development: Sponsor Identified
Customer has Accepted: A3 Development
Integration: Path Forward
Closed

Schedule

First Cost
Lifecycle Cost
Patient Safety
Staff Safety
Efficiency
Sustainability
Creativity/Innovation
Patient First
Future
Community Relation
Team Attitude

Section 1 - Background

In order to evaluate various structural systems, a common understanding of the various systems is needed. This A3 is intended to describe one such system for analysis and comparison in subsequent A3s.

Section 2 - Current Condition

High level of repetition gives economy of scale
Difficult to adapt to sloping sites

No current condition exists

Adaptable to any number of beds
Heavy structure/ heavy foundations

Section 3 - Proposal

Description
Prefabrication off-site shortens construction schedule
Coordination more critical

Durable and secure
Limited adaptability to future

Highly secure
Customer needs

Limited windows makes efficient, distributed seismic system
Wall panel widths limited for shipping (12'-14')

8" thick hollowcore PC planks for floor and roof
Elements could be manufactured off-site to reduce shipping costs & schedule

8" thick PC panel for exterior walls
Sustainable materials (fly ash for LEED credit MR 4)

High degree of thermal insulation
Hosting required for erection

4" NW concrete topping on floor and roof with WRF
Potential for off-site storage would relieve laydown requirements
High shipping costs

Rectangular PC girders support planks
Efficient, distributed seismic system

Minimal acoustic transmission through walls
Design changes could hold up production

PC concrete columns with corbels at floors support girders

5" thick concrete slab on grade with rebar

Spread footing foundation

Module from shipping width of walls (10'-0"/12'-0")

Bay spacing is limited by dock or plank span. Effective range 30 to 40 feet
Bay spacing is limited by depth of girder.

Effective bay span 30 ft to 60 ft

Section 5 - Unresolved Issues

Section 6 - Path Forward/Recommendations

Section 7 - Follow-up

Relative Cost

Courtesy: Buehler & Buehler
Knowledge Map

All Possible Structural Systems

- Cast In Place Concrete - Post & Beam S1.1
- Cast In Place Concrete - Structural Walls - S1.2
- Light Gauge Steel - Structural Wall - S1.3
- Light Wood Frame - Structural Wall - S1.4
- Masonry - Structural Wall - S1.5
- Precast Concrete - Post & Beam S1.6
- Precast Concrete - Hybrid Frame - S1.7
- Tilt Up Concrete Structural Panel - S1.8
- Prefab Metal Building - S1.9

Initial Analysis S5.1

Courtesy: Buehler & Buehler
## Section 1 - Background - Relevance of the topic to CPR Objectives & Values

The process of designing the facilities that will fulfill the CPR objectives requires careful selection of structural building systems that will, to the greatest extent possible, embody the key values of the Receiver as outlined in the RFPQ and subsequent documents. This selection process is being conducted rigorously, through the collaborative preparation of A3s which first serve to unify the definition of the various structural systems and then evaluate each against the Receivers Key Values, as stated, and as expanded by the IPD teams.

## Section 2 - Current Condition - Frame the problem in a useful manner for communication

Separate A3s have been created which describe each of the structural systems outlined below and list advantages and disadvantages of each as related to the project metrics. The Project metrics are based on the Receivers Key Values and expanded by the IPD teams to embody the spirit of the Key Values more completely.

## Section 3 - Proposal - How the proposed changes will function upon implementation

This A3 analyzes the individual systems against the metrics and against each other, combining the input of the project structural engineers with that of the project contractors and architects to refine the analysis and present a useful tool for the selection of structural systems for the four project elements.

### Section 4 - Analysis

Each proposed structural system is evaluated against the metrics using a three point value system.

- 1 meaning the systems detracts from the projects overall achievement of that metric
- 0 meaning the system neither adds nor detracts from the projects overall achievement of that metric
- 1 meaning the system adds to the projects overall achievement of that metric

Note that no weighting of the metrics has been attempted. This is intentional as it is recognized that the value of each metric varies depending on the Element in which the system resides. It is expected that the weighting and final system selection will take place at the IPD team level and the Element level.

The following represents key points raised during the evaluation of the systems that will help clarify the ratings assigned.

### CIP Concrete Post/Beam - Labor intensive formwork increases schedule, first cost and reduces constructability.

### CIP Concretes with Walls - Same as CIP Post/Beam but interior walls block lines of sight (LIS) and restrict travel which detracts from safety and staff efficiency.

### Light Gauge Steel - Less durable exterior finishes add Lifecycle costs. Interior walls block LIS which detracts from Safety and Efficiency. Recycled materials are sustainable. Residential environment is therapeutic.

### Light Wood Frame - Same as Light Gauge Steel but reduced quality control detracts from Constructability.

### CMU Structural Wall - Site labor intensive erection process detracts from Schedule. Interior walls detracts from Safety and Efficiency as with concrete walls above. No formwork improves Constructability and lowers First Cost.

### Precast Concrete Post/Beam - Offsite prefabrication promotes schedule. First costs somewhat high. Low maintenance reduces Lifecycle costs. Thermal mass of sides and roof support sustainability. Good quality control.

### Precast Concrete Hybrid Moment Frame - Similar to CIP Post/Beam except with more open exterior promotes sustainability. Innovative seismic solution.

### Tilting Concrete Walls - Wood or steel roof assumed. Onsite fabrication and casting beds increase schedule. Low cost, durable, open plans promote safety and efficiency. Less QC than precast. Roof is less sustainable than process.

### Prefab Metal Bldg. - Quick, inexpensive. Less durable/secure exterior detracts from safety and lifecycle costs. Open, warehouse construction is not therapeutic.

### CornTech - Quick to erect and enclosing. Complete package includes proprietary exterior skin wall does not include concrete option increases Lifecycle costs. Regular column spacing reduces efficiency.

### Structural Steel Post/Beam - Leads times affect schedule. Recent cost reductions and precast concrete exterior keep costs low. Open, flexible floor plans promote safety and efficiency.

## Section 5 - Unresolved Issues - Identify any problems or constraints that still exist

### A3 number Description

<table>
<thead>
<tr>
<th>A3 Number</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>S1.1</td>
<td>Proposal for use of Cast in Place Concrete Post and Beam</td>
</tr>
<tr>
<td>S1.2</td>
<td>Proposal for use of Cast in Place Concrete - Structural Wall</td>
</tr>
<tr>
<td>S1.3</td>
<td>Proposal for use of Light Gauge Steel Structural System</td>
</tr>
<tr>
<td>S1.4</td>
<td>Proposal for use of Light Wood Frame Structural System</td>
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<tr>
<td>S1.5</td>
<td>Proposal for Masonry - CMU Structural Wall</td>
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<tr>
<td>S1.6</td>
<td>Proposal for use of Precast Concrete Post/Beam Structural System</td>
</tr>
<tr>
<td>S1.7</td>
<td>Proposal for use of Precast Concrete Hybrid Moment Frame</td>
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<tr>
<td>S1.8</td>
<td>Proposal for use of tilt-up Concrete Wall Structural System</td>
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<tr>
<td>S1.9</td>
<td>Proposal for use of PreFabMetal Structural Steel System</td>
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<tr>
<td>S1.10</td>
<td>ConTech building frame system</td>
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<td>S1.11</td>
<td>Proposal for use of Structural Steel Post/Beam</td>
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<td>MO2.2</td>
<td>Precast Concrete Modular Construction</td>
</tr>
<tr>
<td>MO2.3</td>
<td>Steel Modular Construction</td>
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## Section 6 - Path Forward/Recommendations

Each Element shall take this analysis and weigh each metric as appropriate to the services contained in that Element for Elements 2 & 3, each IPD team shall prepare a separate A3 which recommends system(s) for that element. For Elements 1 & 4, which are combined across teams, each Element shall prepare an A3 which recommends system(s)
A3 Report for HVAC Set-Based Design

Section 1 - Background - Relevance of the topic to CFR Objectives & Values

Comparison of HVAC system options to determine which option has lowest life cycle cost and provides greatest benefit to the facility. Responding to the challenge to improve efficiency, increase reliability, reduce maintenance and help achieve LEED Silver. A facility of this size is typically served by a chilled water (CHW) system with central plant, underground distribution piping and 4-pipe (CHW/HW) air handling units. This analysis will compare the CHW system to systems based on package direct expansion (DX) rooftop air conditioning units and ground source heat pumps (GSHP).

- For the CHW system, heating hot water (HW) is supplied by boilers and pumps in the central plant via underground distribution piping.
- Heating for the package DX system is provided by gas furnaces within the rooftop package units.
- In the GSHP system, heating is provided by the heat pump cycle of the GSHP units. The GSHP system uses a closed loop system of plastic pipe buried in the ground (ground coupled) to allow heat transfer between the earth and fluid flowing through the pipe. This closed loop system transitions to metal pipe within the building(s) where it is connected to the condenser/evaporator heat exchangers in each GSHP unit.

Section 2 - Current Condition

Two 15,000 SF facilities located in San Diego CA. Life cycle cost analysis is for a period of 15 years using a 7% discount rate, a 2% escalation rate and a 1.2% inflation rate. Average energy rates of $0.09/kWh and $0.60/therm are used.

Section 3 - Analysis

SHOULD CRITERIA

<table>
<thead>
<tr>
<th>Mechanical System Options</th>
<th>Scorecard</th>
<th>Initial Cost</th>
<th>Unit Cost</th>
<th>Efficiency</th>
<th>Sustainability</th>
<th>Creativity/Innovation</th>
<th>Accessibility</th>
<th>Corrosivity</th>
<th>Maintainability</th>
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<tbody>
<tr>
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<td></td>
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<td>1. Chilled Water</td>
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<td>+</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
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<td>2. Package System</td>
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<td>0</td>
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<td>0</td>
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</table>

Section 4 - Unresolved Issues - Identify any problems or constraints that will exist

Need analysis of existing central plant capacities. Need further input from owner in the weighting of advantages.

Section 5 - Recommendations

Based on the current information at hand the option of chilled and hot water air handlers served by central plant is recommended.

Section 6 - Path Forward/Follow-up

1. Provide existing CUP capacities - Owner
2. Analyze existing CUP capacities - Don Harrisberger
3. Review weighting of advantages with Owner and entire team - Don Harrisberger
4. Conform CHW (or final HVAC choice) meets budget - Danny Smith
5. Proceed with implement CHW (or final HVAC choice) - Don Harrisberger
What is the Number One Builder and Owner Complaint?

The Design Management Process!!!
Countermeasure: Last Planner® in Design
EXPERIENCE WITH TARGET VALUE DESIGN
SDCCD Completed TVD Projects

City College – Central Plant
Target Cost: $10 million
Construction Start: December 2009
Completion: December 2011

The new Central Plant distributes chilled and heating hot water to the core campus as well as electrical power to campus.
City College Math & Social Sciences

Target Cost: $80.9 million (incl. land acquisition)
Construction Start: January 2011
Completion: August 2012

Project involved land acquisition and construction of new 72,000 sq. ft. classroom and laboratory building. It will include the District’s Corporate Education Center, Military Education, a Family Health Center and a six-story parking structure with 400+ stalls.
Mesa College
Social and Behavioral Sciences Building
Target Cost: $36.9 million
Construction Start: December 2012
Completion: September 2014

The Social and Behavioral Sciences building contains 66,000 GSF of new laboratories and classrooms. Tracking LEED Gold.
SDCCD Completed TVD Projects

Miramar College - Fire Science/EMT Training Facility
Target Cost: $16.5 million
Construction Start: July 2013
Completion: July 2014

This facility consists of approximately 22,900 SF to serve as a classroom and active training center for the Fire Science and Emergency Medical Technician (EMT) programs. The facility will have labs, support space, equipment staging, classrooms, offices and an outdoor training area.
Miramar College – Science Building Expansion

Target Cost: $31.7 million
Construction Start: October 2013
Completion: November 2014

The new 50,000 SF addition includes new classrooms, faculty offices, and laboratories for chemistry, physics, astronomy, geology, microbiology, anatomy, marine biology, biology and lab preparation rooms. The roof level includes a greenhouse and observatory.
Wouldn't It Be Nice If You Could...

- Average Savings of $900,000 on each of 15 projects
- Reduce Average Schedule Delay by 56 days
- Enhance Sustainability Objectives by 44%
- Reduce Facilities Maintenance Costs by 53%
Public Owner Benefits

Reduced Waste in Project Delivery + Sustainable Buildings + Reduced Total Cost of Ownership = Enhanced Value

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Target Value Design

11 Projects

Avg. Value: US$21.8M

83% Met Target Cost; Avg. 7% Below Target Cost
Sustainability as a Core Value
LEED Gold Projects

- 20% Direct Contract with Architect
- 26% Post-Lean
- 44% Target Value Design
Value as Reduced Maintenance Costs

Over 4 Years

- $3.93/sq.ft.
- $1.91
- $1.73
- $1.46
Potential Pitfalls – Do, Ballard and Tommelein

1. Imbalance of overhead and profit among team members (all must share equally in shared risk and reward)

2. Not all core team members’ profit is at risk. Align team member’s incentives with the profit pool sharing. Too little and there is no skin in the game.

3. Not moving money across cluster group boundaries. This needs to happen to optimize the whole project budget.

4. Align expected productivity rates with actual progress.

5. Untimely distribution of profits by the owner.
Potential Pitfalls – Do, Ballard and Tommelein

6. Trades or Designers that have a major role are not included in the risk pool.

7. Trades or Designers not in the risk pool do not engage and participate collaboratively in coordination meetings.

8. Lack of transparency in development of the target cost does not allow team members to understand how the target cost was developed.

9. If owners want the benefits, they need to be engaged.

10. Owners forcing the team to cut their profits due to changing market conditions.
How to Make Shared Risk and Reward Sustainable – Ballard and others (2015)

• Owners: Don’t be greedy!
• Risk Pool: Don’t be foolish!
Personal Lessons Learned

• Clearly define value at the beginning of the project
• Understand the business case constraints
• Specialty trade contractor involvement early is essential!
• Concurrent contemporaneous estimating is crucial!
• Report target cost status first, then design progress
• Document design decision-making process through A3 Reports
• Consider life cycle costs in design analysis
• Use Last Planner® during design
This concludes The American Institute of Architects Continuing Education Systems Course

Lean Construction Institute  info@leanconstruction.org
With Lean Design and Construction rapidly becoming the standard for project planning across the U.S., the 18th Annual LCI Congress is the industry’s #1 must-attend event!

**WHY ATTEND:**

- Lean practices are used by 28% of companies in the $712b construction market —don’t get left behind!
- Role-specific education for owners, design professionals, trade partners & general contractors
- Site visits allowing you to see Lean in action
- Networking with 1,000+ Lean professionals about their Lean challenges and successes

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Questions?

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