Target Value Design
How Can It Benefit You?

By David Umstot, PE, CEM

Umstot Project & Facilities Solutions, LLC

September 4, 2014

THE WALL STREET JOURNAL.

Towering Costs for Trade Center Hub

Peter Foley for The Wall Street Journal

RUNAWAY TRAIN: The most expensive train station in the U.S. is shape beneath Ground Zero, including billions in cost overruns. A

Disputes Send Rail Hub's Cost Soaring

By Eliot Brown

NEW YORK—The most expensive train station in the U.S. is taking shape at the site of the former World Trade Center, a majestic marble-and-steel commuter hub that was seen by project boosters as a landmark to American hope and resilience.

Instead, the terminal connecting New Jersey with downtown Manhattan has turned into a public-works embarrassment. Overtaking the project's emotional resonance is a practical question: How could such a high-profile project fall eight years behind schedule and at least $2 billion over budget?

An analysis of federal oversight reports viewed by The Wall Street Journal and interviews with current and former officials show a project sunk in a morass of politics and government. Those redesigning the World Trade Center—destroyed by terrorists in 2001—were besieged by demands from various agencies and officials, and "the answer was never, 'No,'" said Christopher Ward, executive director from 2008 to 2011 of the Port Authority of New York and New Jersey, the project's builder.

Why that happened is more difficult to untangle. The Port Authority, run jointly by the two

Associated Press

Work continues on a new station at the redeveloped World Trade Center site in New York City. The project is at least $2 billion over budget.

$2B OVERRUN

Target Value Design – What is it?

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

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

The Cardinal Rule

The Target Cost Must Never Be Exceeded!!!

Target Value Design Works Using:

- Design-Build
- EPC
- Design-Assist
- CM at Risk
- Integrated Project Delivery

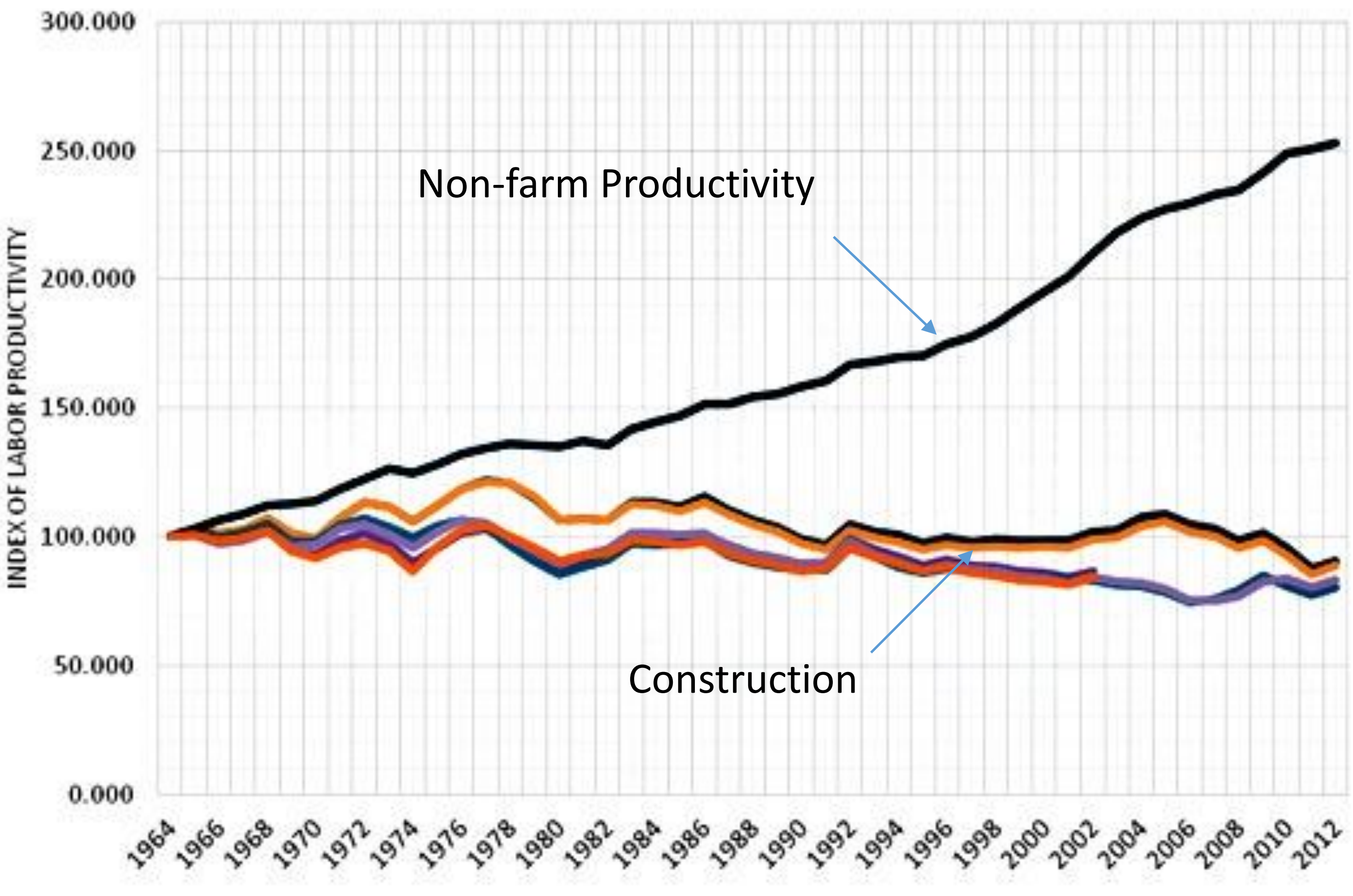
What is of Value To You?

- Total Cost of Ownership?
- Energy Efficiency?
- Speed to Market?
- No disruption to ongoing business operations?
- Iconic design?
- Improved productivity and occupant satisfaction?
- Sustainable buildings?

Value-Waste Nexus

- How to create value within fixed monetary constraints?
- Eliminate waste
- Enhance value with the savings from waste reduction

Index of Construction Labor Productivity 1964-2012



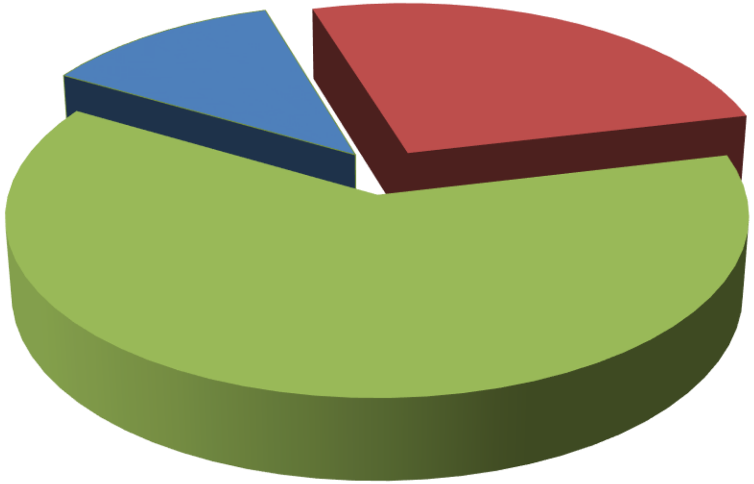
From: Teicholz (2013)

Construction Waste in the U.S.

Current Manufacturing

Support Activity 12%

Waste 26%

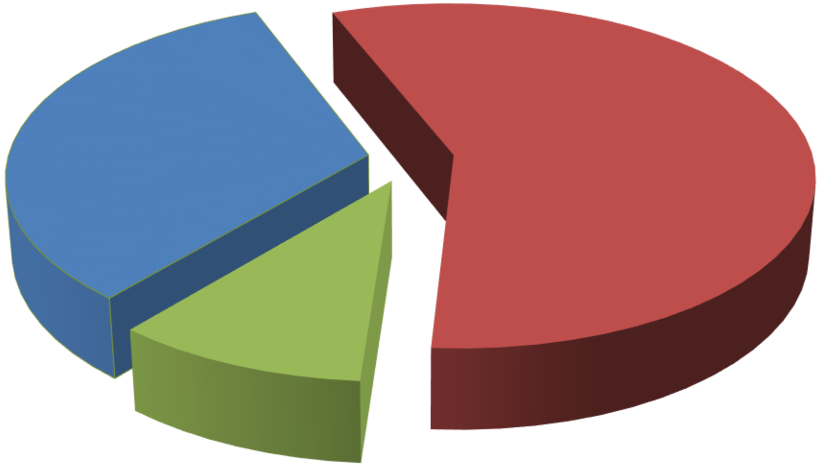


Value Added 62%

Current Construction

Support Activity 33%

Waste 57%

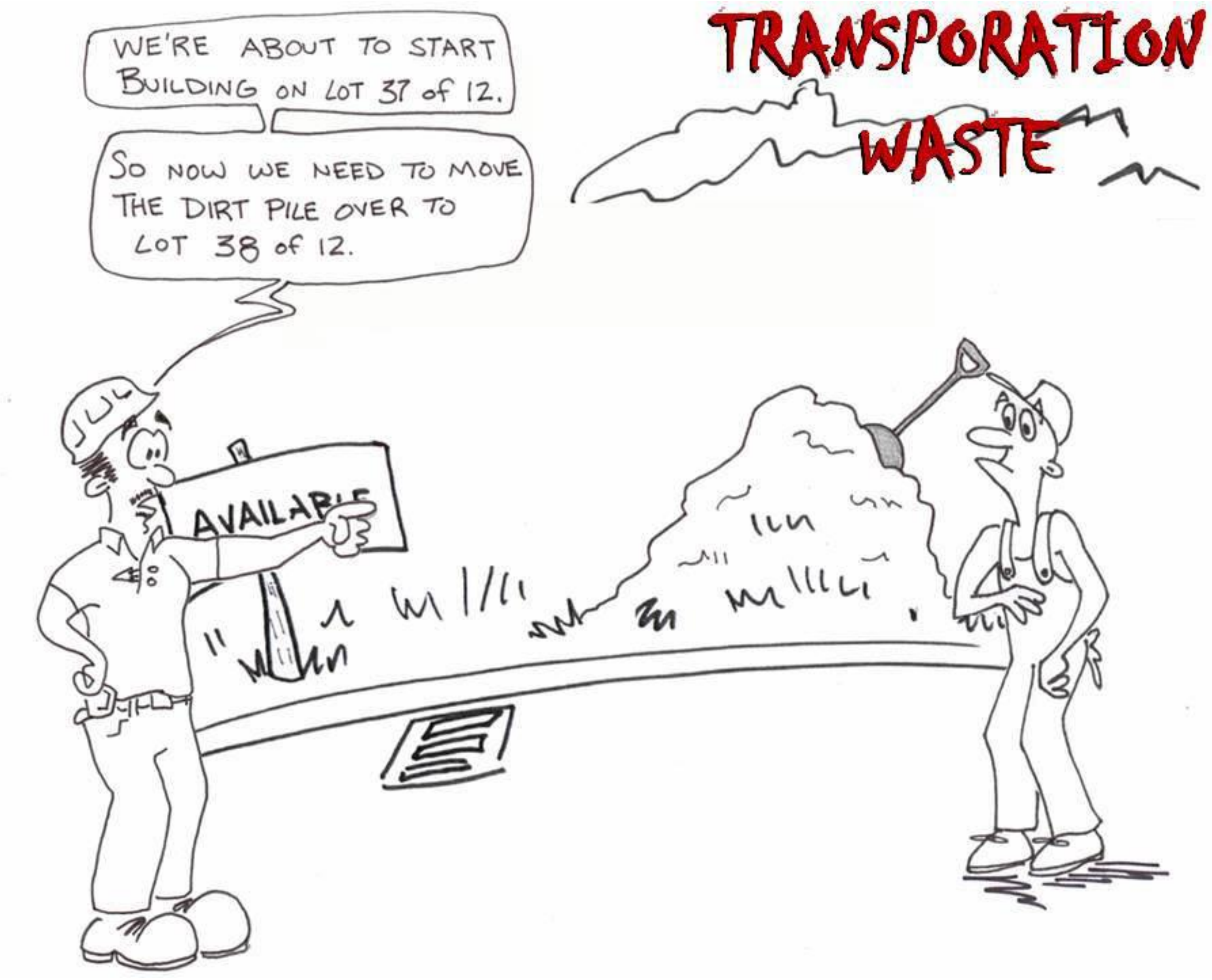


Value Added 10%

Source: Construction Industry Institute

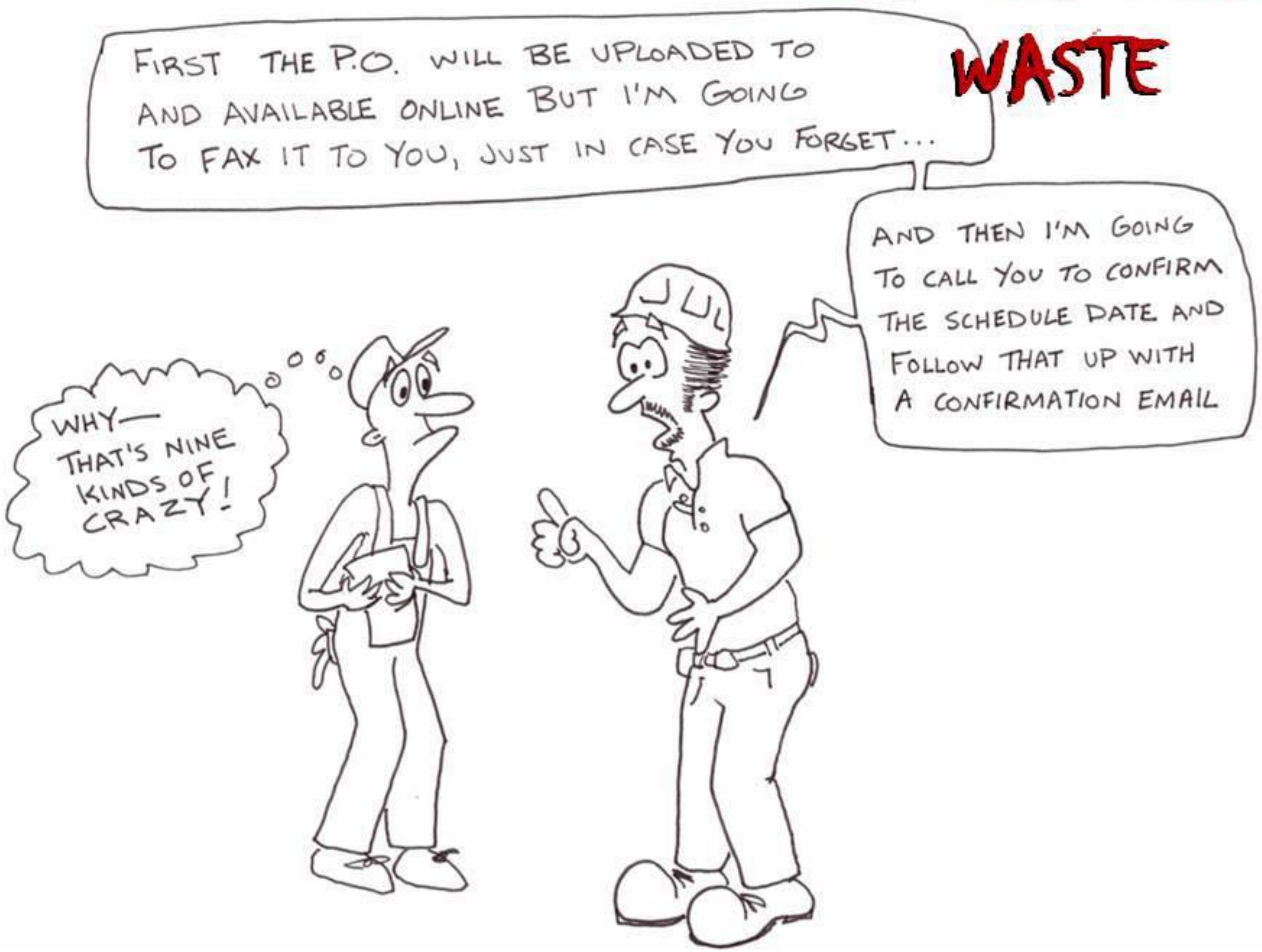

MAYBE WE SHOULD DO A LUMBER TAKE-OFF.
OVER - PRODUCTION WASTE
©JCGATLIN JUNE 2010

Cartoon By: JC Gatlin

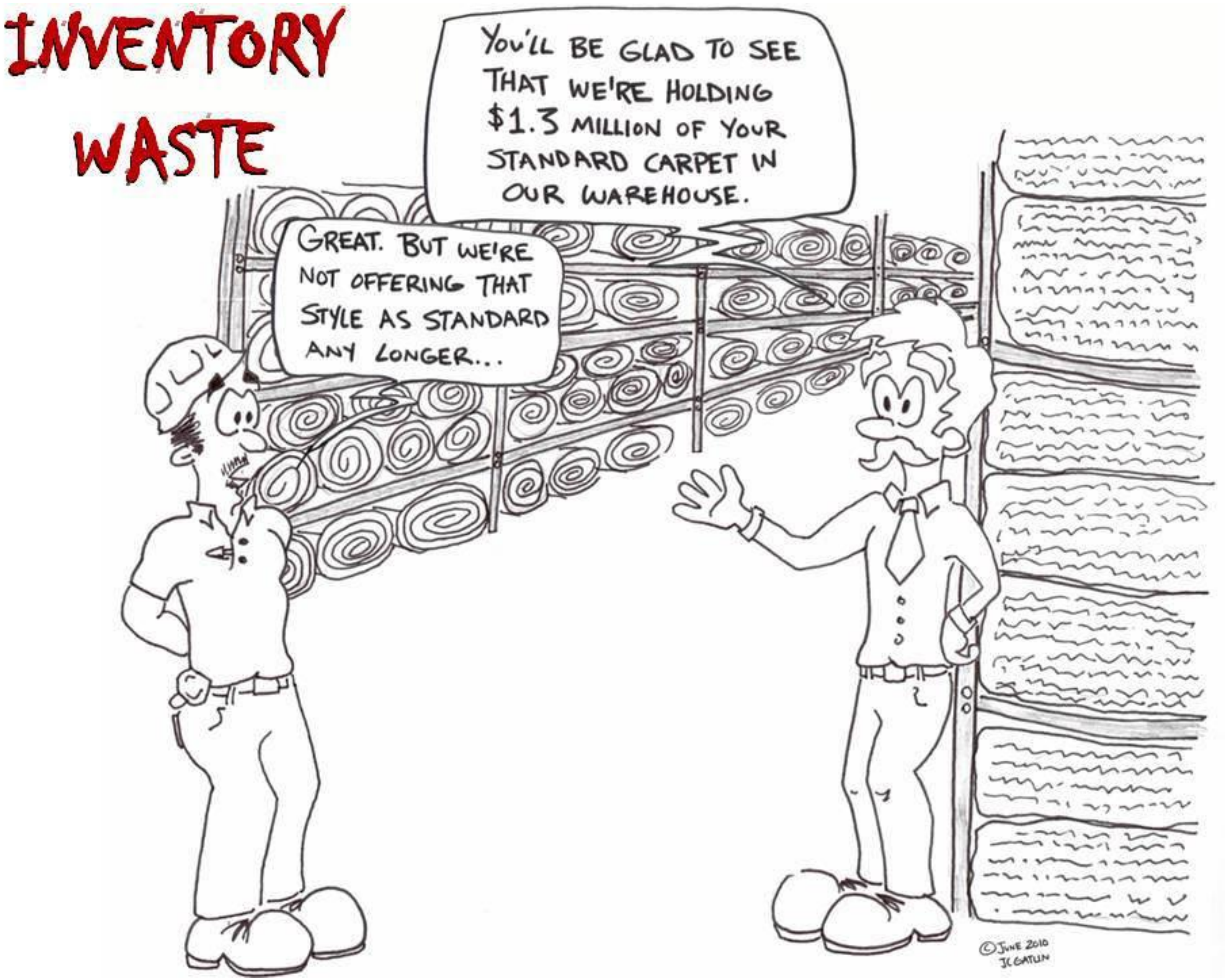


Cartoon By: JC Gatlin

OVER - PROCESSING WASTE



Cartoon By: JC Gatlin



Cartoon By: JC Gatlin

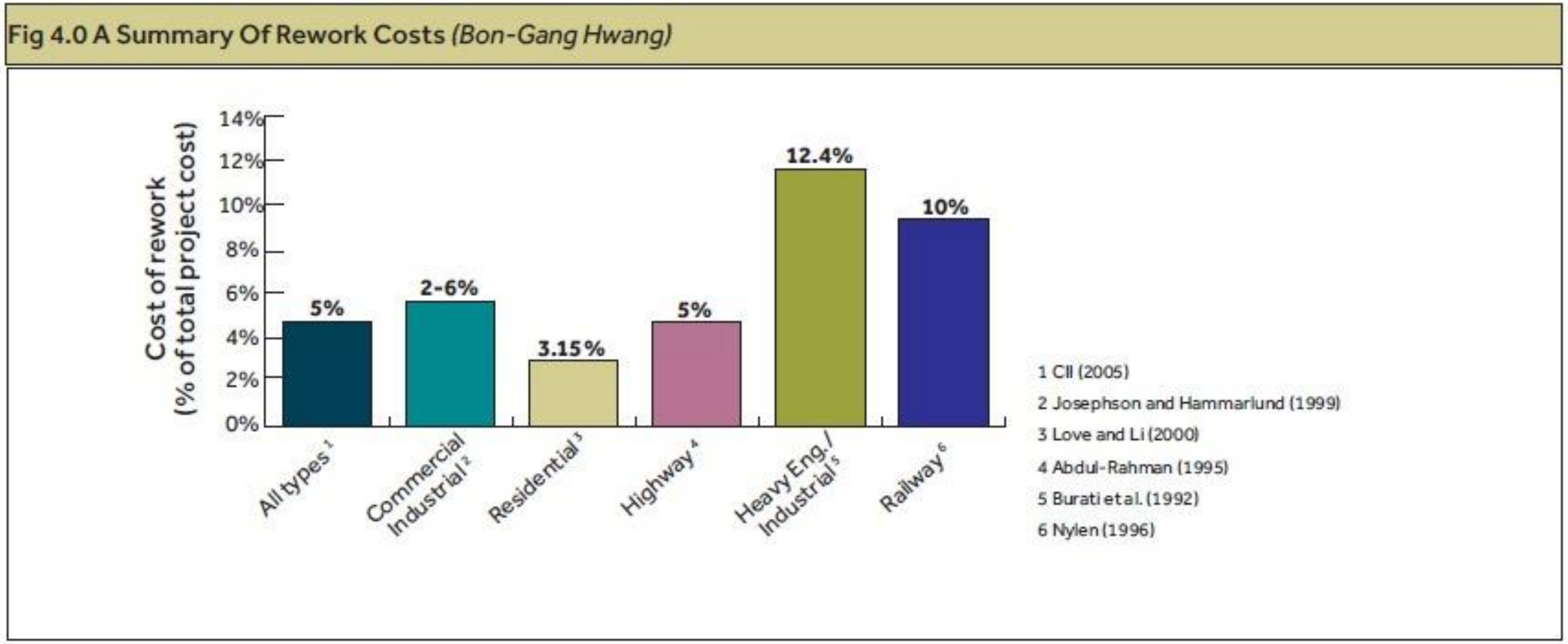
Cartoon By: JC Gatlin

CORRECTION WASTE

Typical Types of Design Waste:

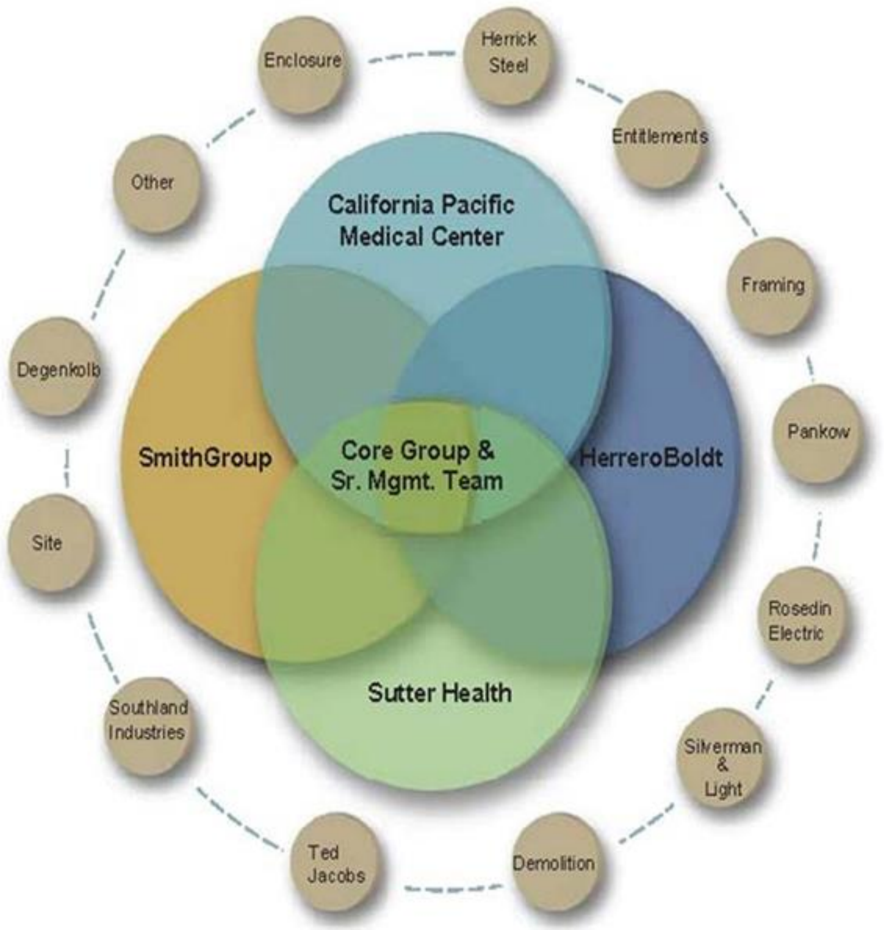
- Iterative Design
- Rework
- Lack of Coordination Between Disciplines
- Inefficient work flow
- Over design of systems (diversity and factors of safety)
- Poor design that generates waste during construction
- Designing over allowable budget

Rework Costs (as % of total project costs)

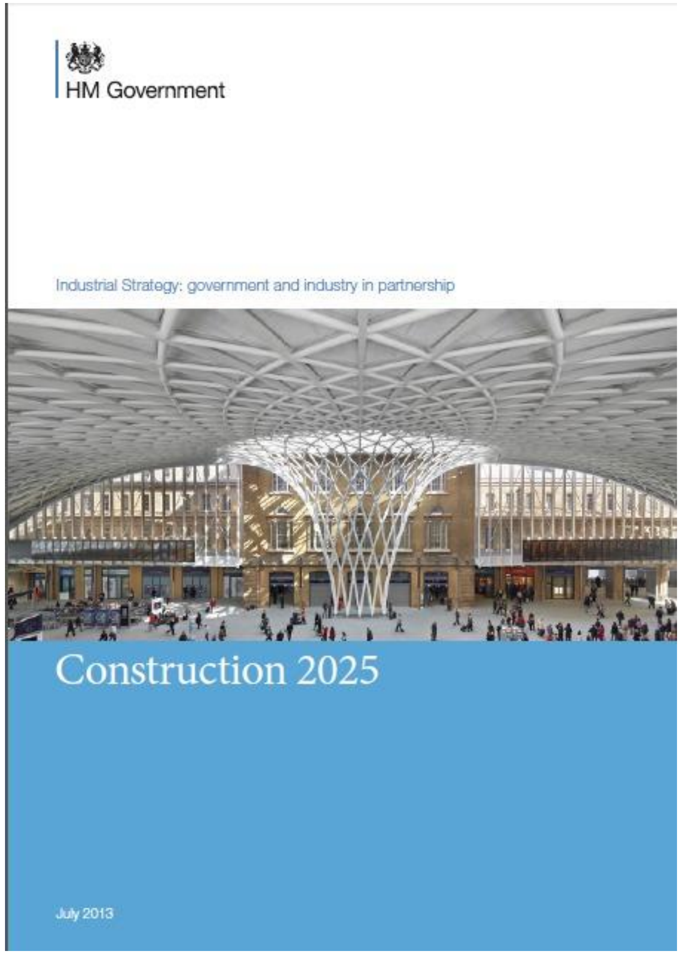


Source: Robin McDonald, 2013

Collaborative Team Is Key



UK Construction 2025 Goals



https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/210099/bis-13-955-construction-2025-industrial-strategy.pdf

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

Target Value Design

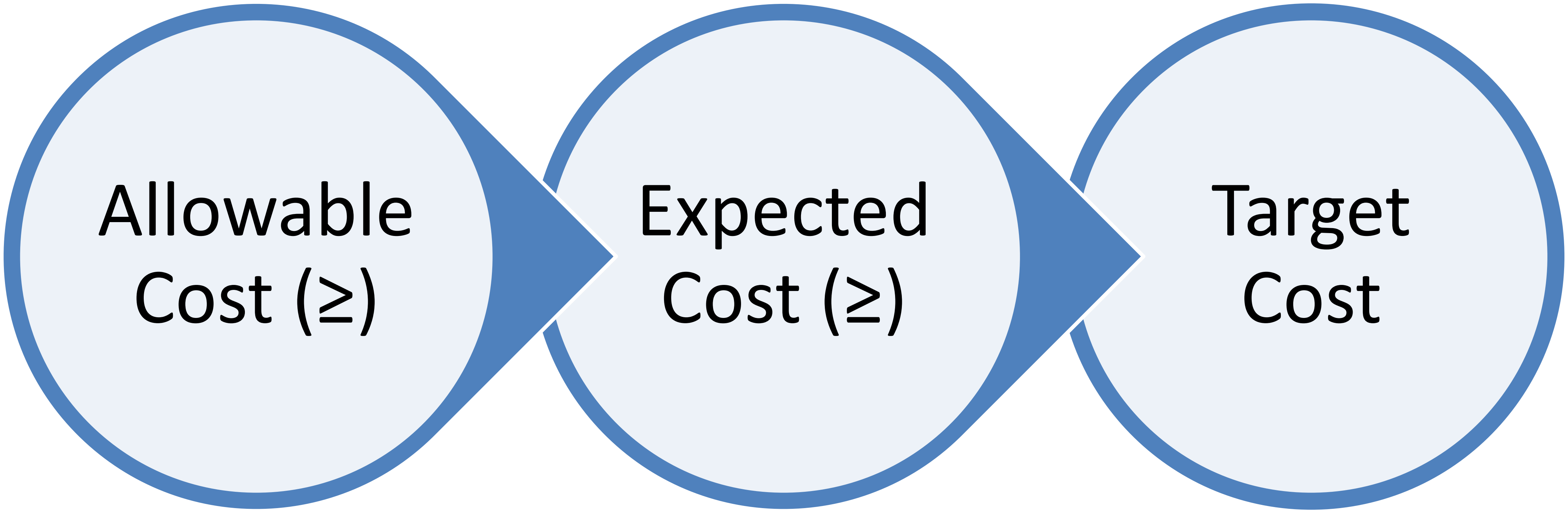
THE BASICS

Business Case Evaluation (from Ballard)

1. Assess the business case (demand, revenues), taking into account the cost to own and use the facility (business operations, facility operations, facility maintenance, adaptability, durability) as well as the cost to acquire it.
2. Determine minimum acceptable ROI or maximum available funds -- set the allowable cost for the facility.

Business Case Evaluation (from Ballard)

3. Answer: “If we had a facility with which we could achieve our specific purposes, and if we could have that facility within our constraints of cost, location and time, would we do it?”
4. If the answer is yes, and if project delivery is not considered risky, fund the project. If the answer is positive and project delivery is considered risky, fund a feasibility study to answer the question: Can we have the facility we have in mind, will it enable us to achieve our purposes, and can we acquire it within our constraints?


Allowable Cost (≥)
Expected Cost (≥)
Target Cost

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

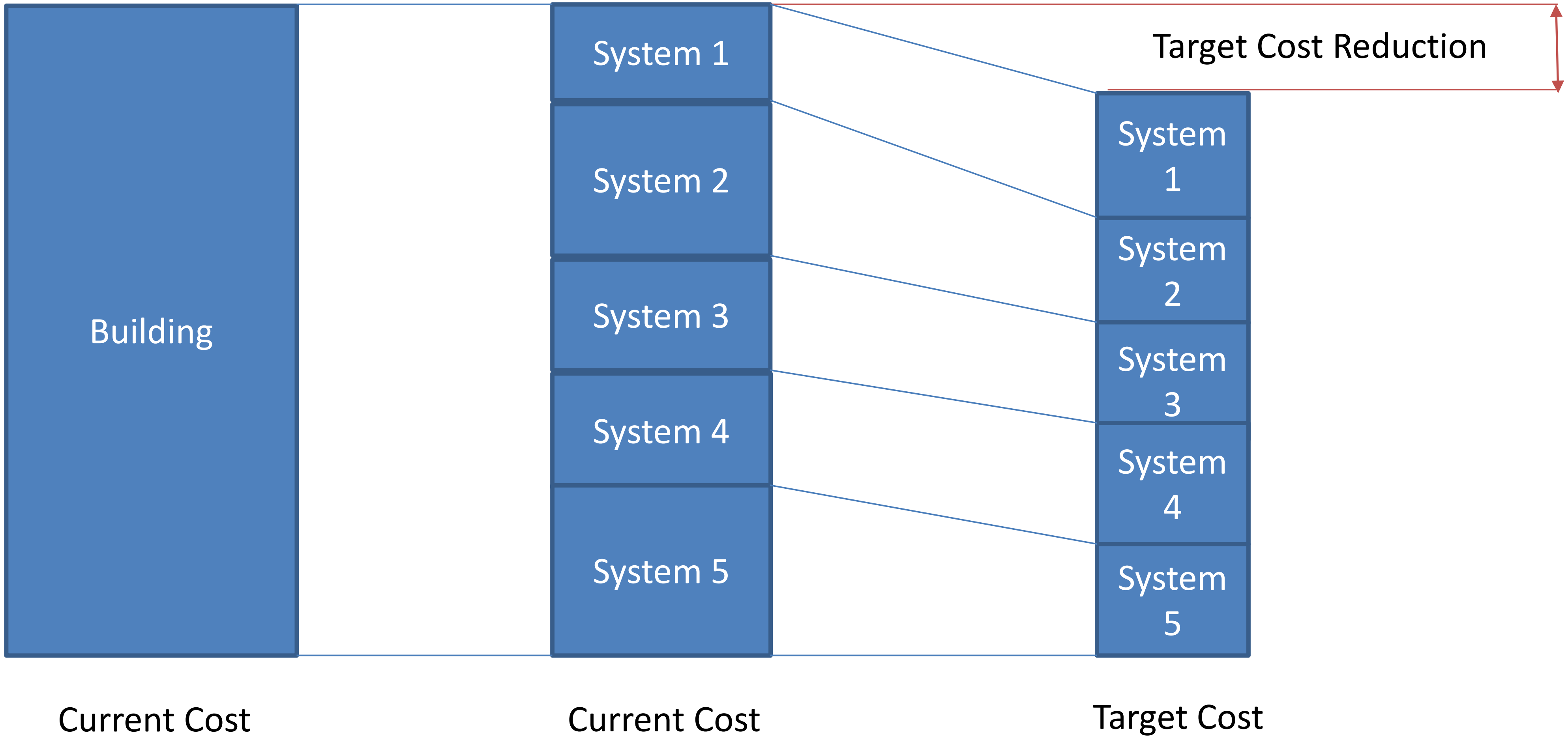
The Cardinal Rule

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.

How Multiple Systems Interact to Target Cost



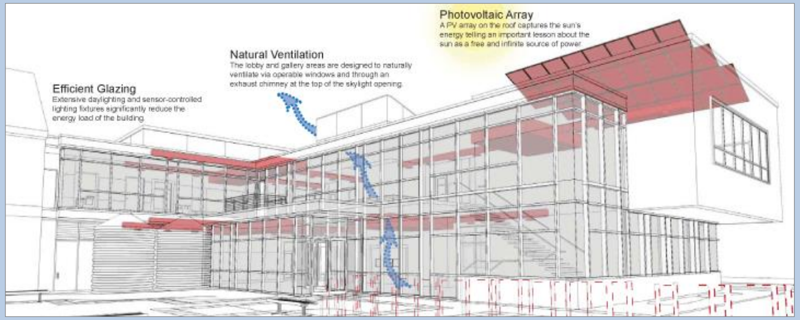
Target Value Design

EXAMPLES

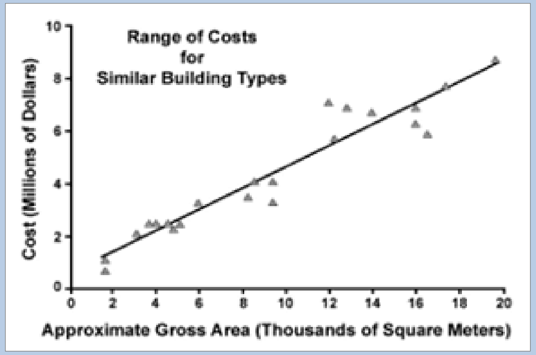
San Diego Community College District

Target Costing – Project Budget Development

- Space Programming
- Efficiency
- Targeted Cost Per Sq. Ft.



		SPACE DESCRIPTION	2024 ASF	Quantity	Extended 2024 ASF	Extended 2007 ASF	Variance	2007 Room Nos., Comments
BUILDING	Life Sciences	32-Seat Dry Lecture/Lab-Biology	1,600	x 1.0	1,600	836	764	*supplements* A202
		32-Seat Wet Lab-Biology/Botany	1,728	x 1.0	1,728	1,092	636	*supplements* A210
		32-Seat Wet Lab-Biotech/Microbiology	1,728	x 3.0	5,184	2,048	3,136	*supplement* A204, A231
		32-Seat Wet Lab-Physiology/Anatomy	1,728	x 3.0	5,184	1,834	3,350	*supplement* A226, A206
		32-Seat Lecture/Dry Lab-Life Science (computer)	1,600	x 1.0	1,600	1,053	547	*supplements* A207
		Prep/Stg/Lab Tech Rm (1 per 2 wet labs; 7 wet labs total)	800	x 4.0	3,200	1,232	1,968	*supplement* A203, A205, A226A
		Storage	1,200	x 1.0	1,200	0	1,200	*supplements* A206A, A209, A211
		Marine Biology/Oceanography Lab	500	x 1.0	500	0	500	Aquarium
		Microbiology Culture/Autoclave Room	200	x 1.0	200	0	200	
		Biology/Anatomy Dissection Room	200	x 1.0	200	0	200	
					20,596	**8,095**	**12,501**	
	Physical Sciences	32-Seat Wet Lab-Chemistry	1,728	x 4.0	6,912	3,018	3,894	M201, M202, M203
		Chemistry Lab Instrument Room (1 per 2 labs)	250	x 2.0	500	180	320	M220
		Chem. Prep/Storage/Lab Tech Rm (1 per 2 labs)	800	x 2.0	1,600	1,337	263	M216, M217, M218
		Hazardous Chemicals Storage Room	175	x 1.0	175	120	55	M219
		32-Seat Lecture/Dry Lab-Physics, Physical Science, Geography, Geology	1,600	x 4.0	6,400	2,014	4,386	M204, M205
		40-Seat Lecture/Dry Lab-Geography	2,000	x 1.0	2,000	0	2,000	
		Physics/Physical Science/Astronomy Prep/Stg/Lab Tech Rm	1,600	x 1.0	1,600	1,059	541	M214, M215, M215A
		32-Seat Computer Lab-GIS, Physics, Chemistry	1,600	x 2.0	3,200	0	3,200	
		100-Seat Planetarium	2,500	x 1.0	2,500	0	2,500	
					24,887	**7,728**	**14,659**	



Target Cost Model

Legend:	Const TOTAL per SF	D-B TOTAL per SF
Worth (Target)		
Current Estimate	89.33	94.12

Project:	Fieldhouse Expansion
Location:	St. Olaf College Northfield MN
Phase of Design:	Schematic Target
Date:	June 21, 2001

Construction	+	Owner Reserves	+	Escalation	=	Construction TOTAL	Design-Build TOTAL
9,840,302		343,115				10,183,417	10,729,883

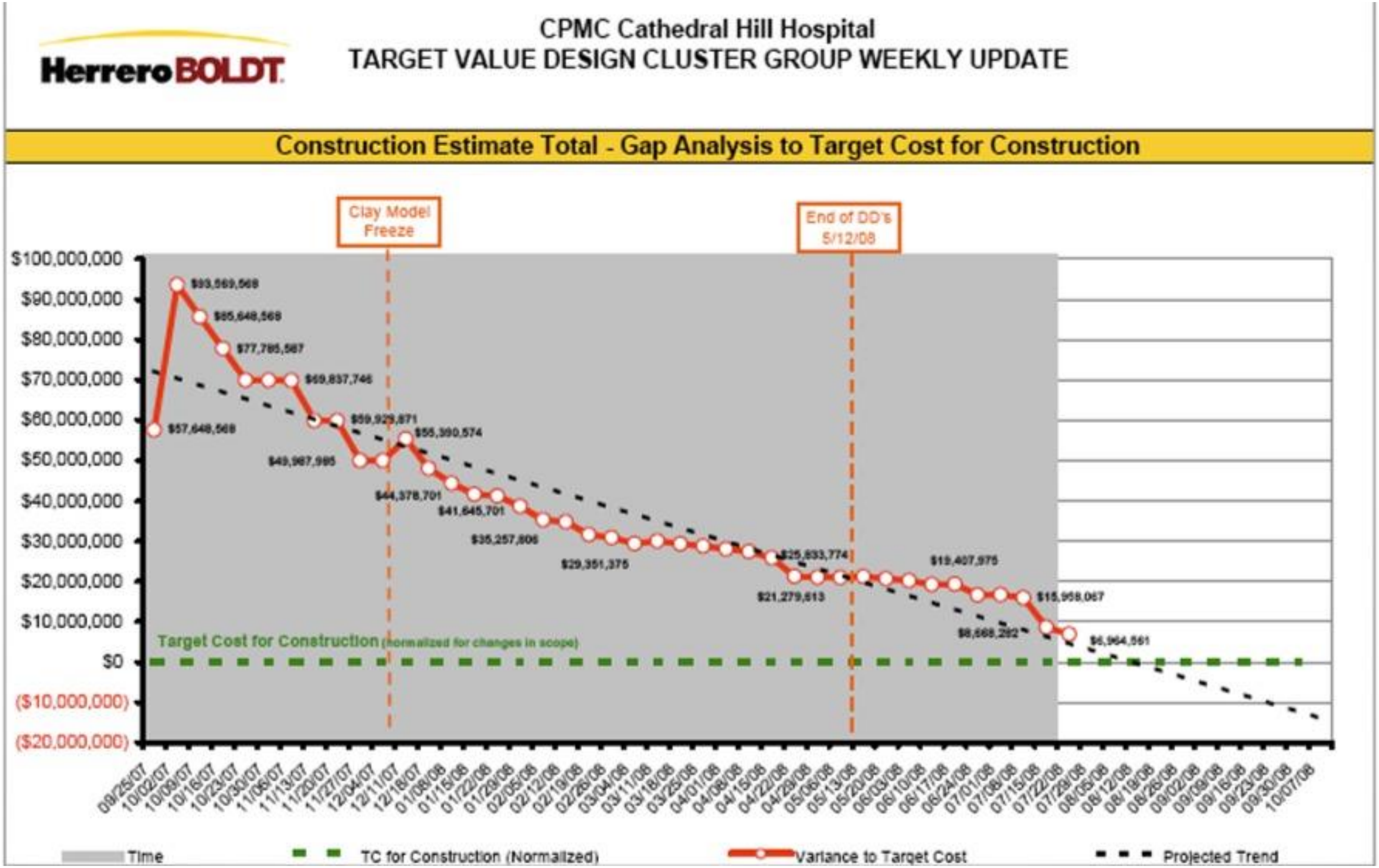
Incl Design at $504,886+41600

NOTES:

Bldg. Type:	Recreational
Target (SQFT)	114,000
Floors:	Single story plus mezzanines

SITE WORK	BUILDING
594,500	9,245,802

SITE WORK	SHELL	INTERIOR	MECHANICAL	ELECTRICAL	SPECIAL	GENERAL
Site GC OH&P	4,334,488	1,710,386	1,111,402	794,890	706,862	587,774
G10 Site Prep, Demo & Excav: 146,500	A10 Foundation A20 Basement: 1,006,004	C10 Interior Construction: 528,427	D20 Plumbing: 85,927	D5010 Service and Distribution: 739,390	E10 Specialties & Equipment: 492,534	Z1010 Project Administration
G20 Site Improvements: 373,000	B10 Superstructure: 1,218,797	C20 Stairs: 62,639	D30 HVAC: 824,160	D5020 Lighting & Branch Wiring	E20 Furnishings Fixed/Movable: 34,000	Z1030 General Conditions
G30+40 All Utilities: 75,000	B20 Exterior Closure: 2,007,061	C30 Interior Finishes: 1,069,320	D40 Fire Protection: 109,740	D5030 Security Comm/Data	F10 Special Construction: 89,520	Z1060 Fee
G90 Other Site Structures	B30 Roofing: 102,626	D10 Conveying: 50,000	Testing and Special Mech: 91,575	D5090 Other Electrical: 55,500	F20 Selective Demolition: 90,808	Z20 Risk and Contingency: 587,774

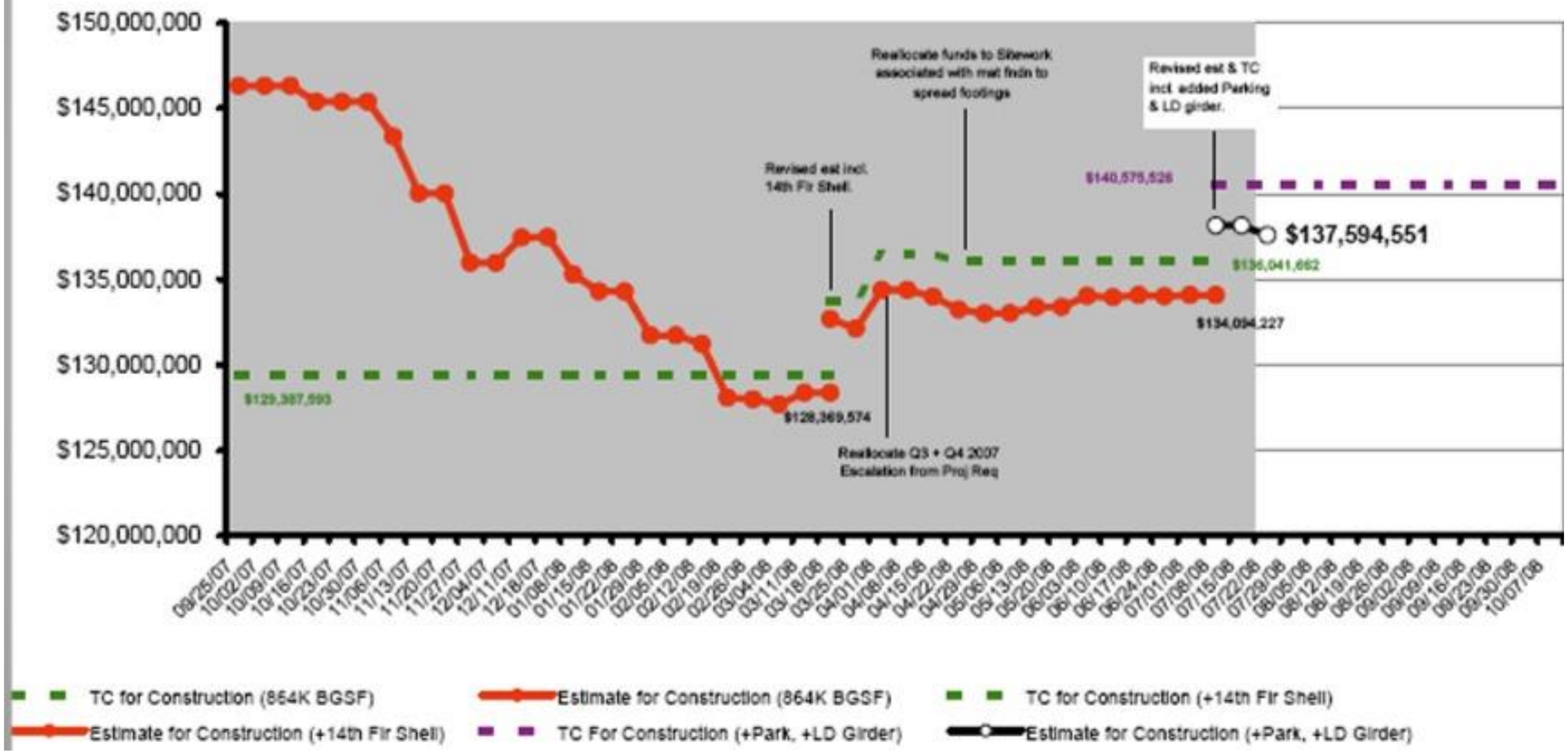


HerreroBOLDT
CPMC Cathedral Hill Hospital
TARGET VALUE DESIGN CLUSTER GROUP WEEKLY UPDATE
Construction Estimate Total - Gap Analysis to Target Cost for Construction
Clay Model Freeze
End of DD's 5/12/08
$100,000,000
$90,000,000
$80,000,000
$70,000,000
$60,000,000
$50,000,000
$40,000,000
$30,000,000
$20,000,000
$10,000,000
$0
($10,000,000)
($20,000,000)
Target Cost for Construction (normalized for changes in scope)
Time
TC for Construction (Normalized)
Variance to Target Cost
Projected Trend

CPMC Cathedral Hill Hospital

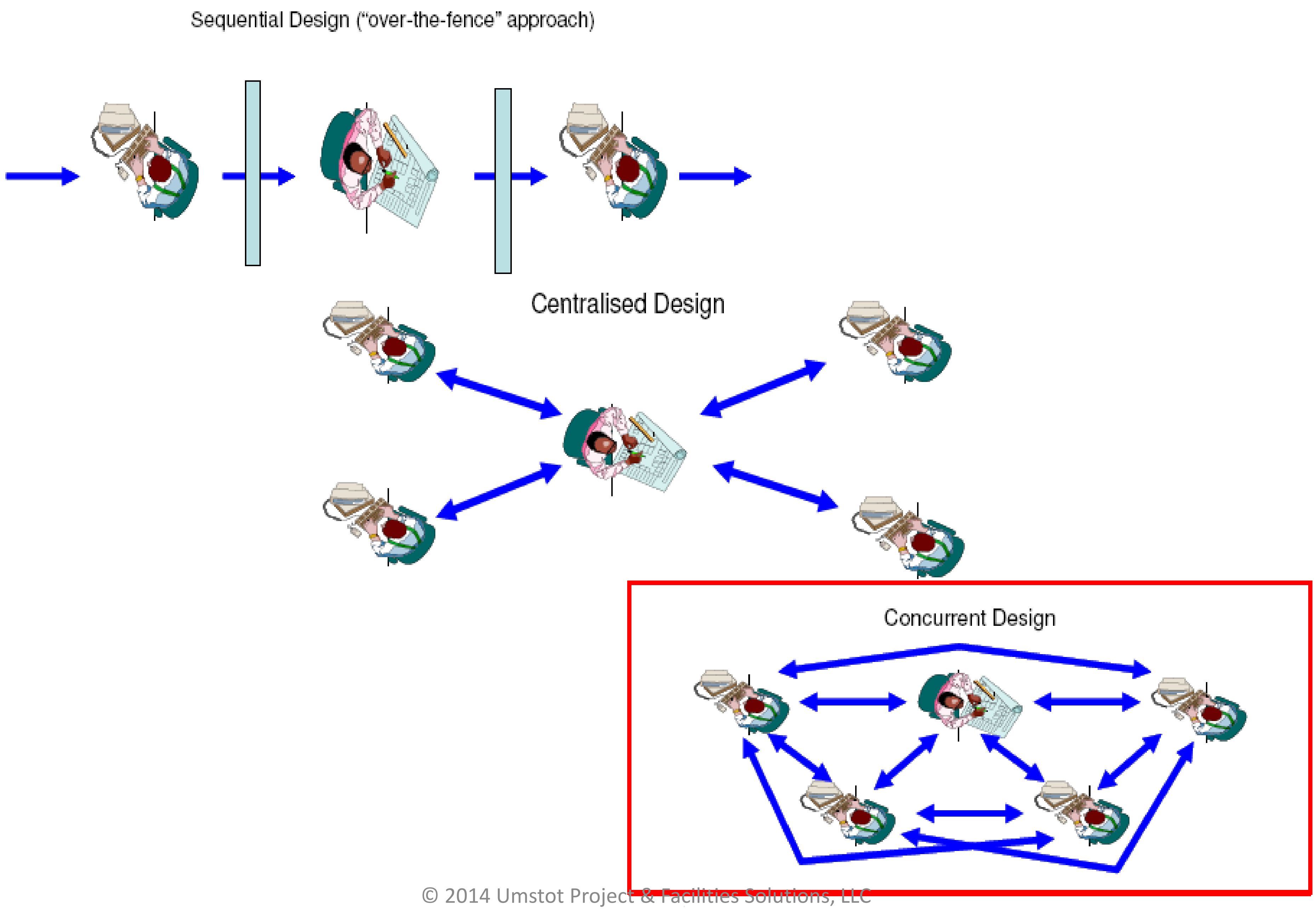
TARGET VALUE DESIGN CLUSTER GROUP WEEKLY UPDATE

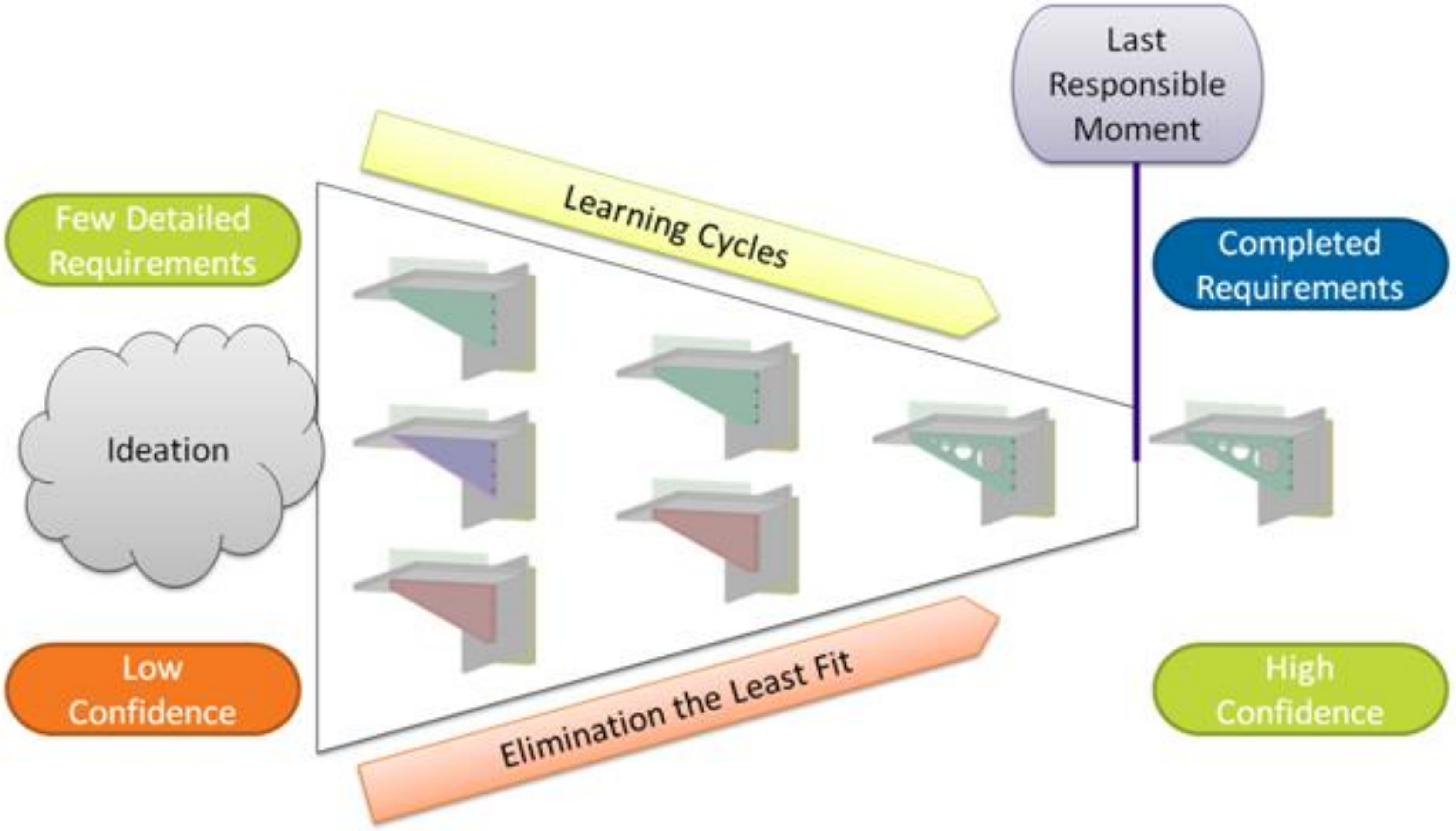
Structural



Set-Based Design/Concurrent Engineering

THE BASICS


Sequential Design ("over-the-fence" approach)
Centralised Design
Concurrent Design


Last
Responsible
Moment
Learning Cycles
Few Detailed
Requirements
Completed
Requirements
Ideation
Low
Confidence
Elimination the Least Fit
High
Confidence

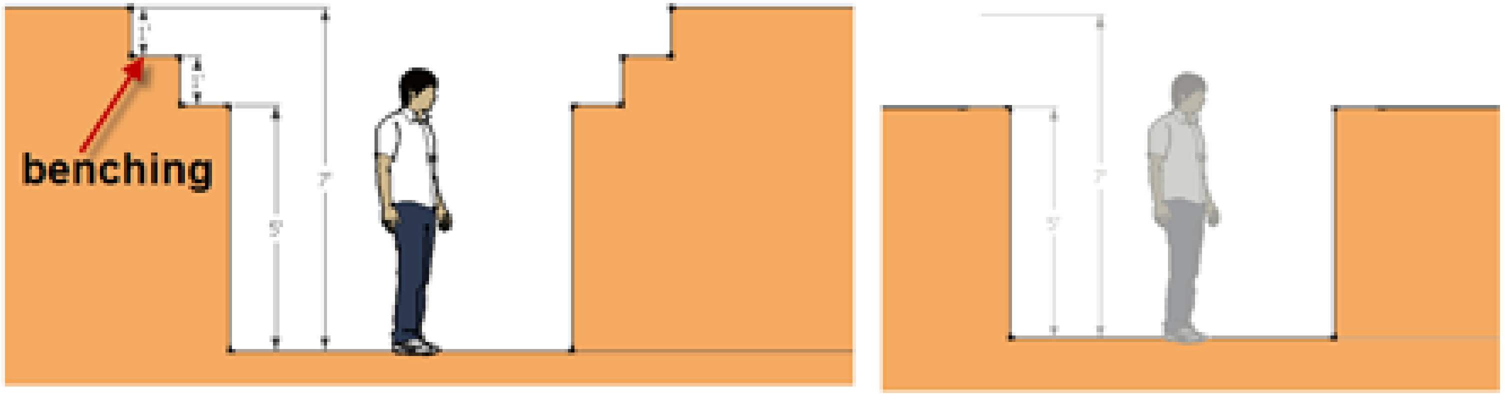
Quick Cost Comparison between DESIGN alternatives

Variance Report

Cheaper

	Unit Cost			Amount		
			Variance	CEILING HT	FULL HT	Variance
Estimate Totals						
Labor	94,581.196hrs	99,113.543hrs	-4,532.347hrs	7,324,519	7,672,694	(348,175)
Material				2,526,753	2,575,697	(48,944)
Subcontract				135,481	135,481	0
Equipment	515.920hrs	816.560hrs	-300.640hrs	155,588	176,231	(20,643)
Other				19,106	18,496	610
				10,161,447	10,578,599	(417,152)
Total				***10,161,447***	***10,578,599***	***(417,152)***

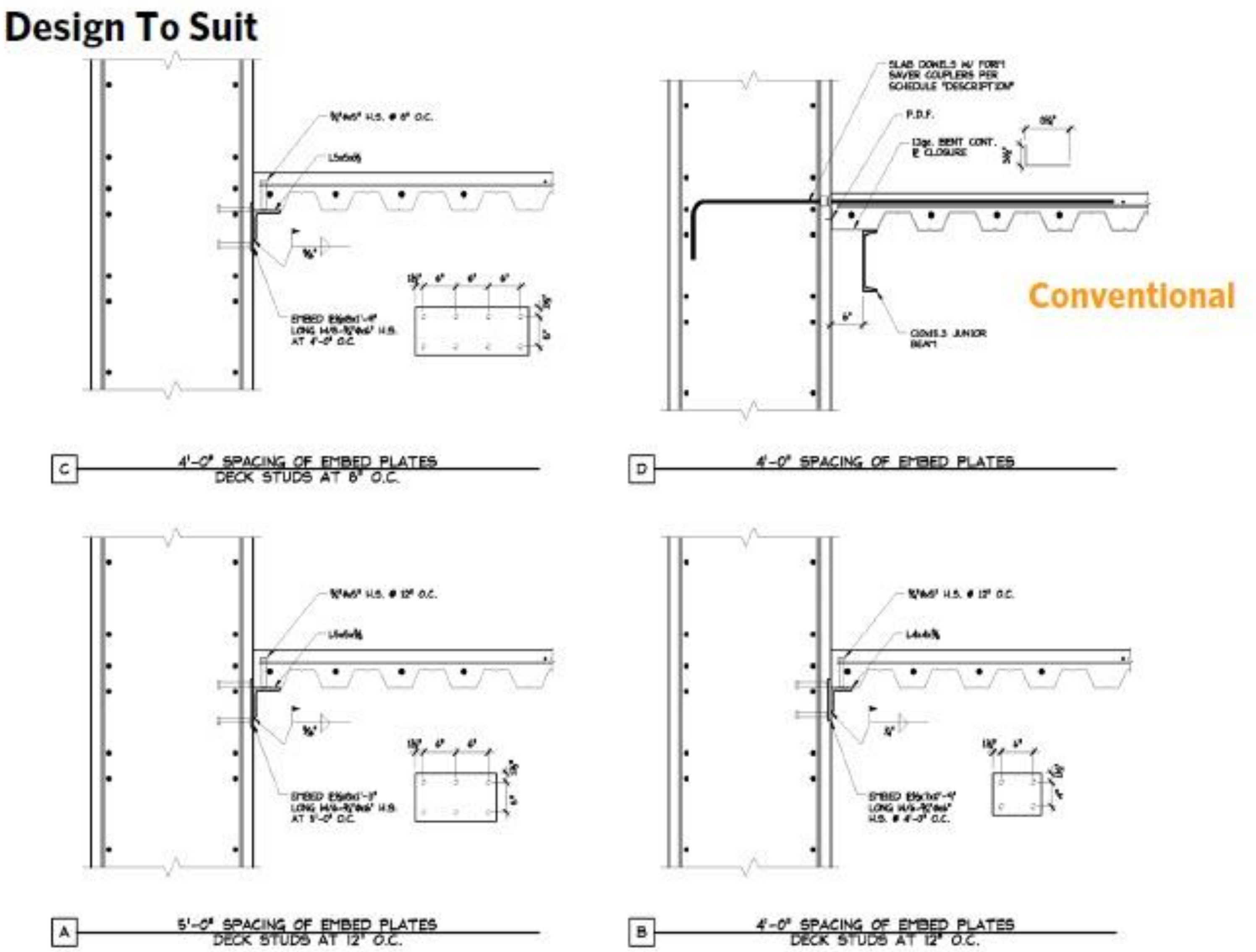
Quick Cost Comparison between CONSTRUCTION alternatives



Over excavation of subgrade worked cheaper compared to benching for pile caps

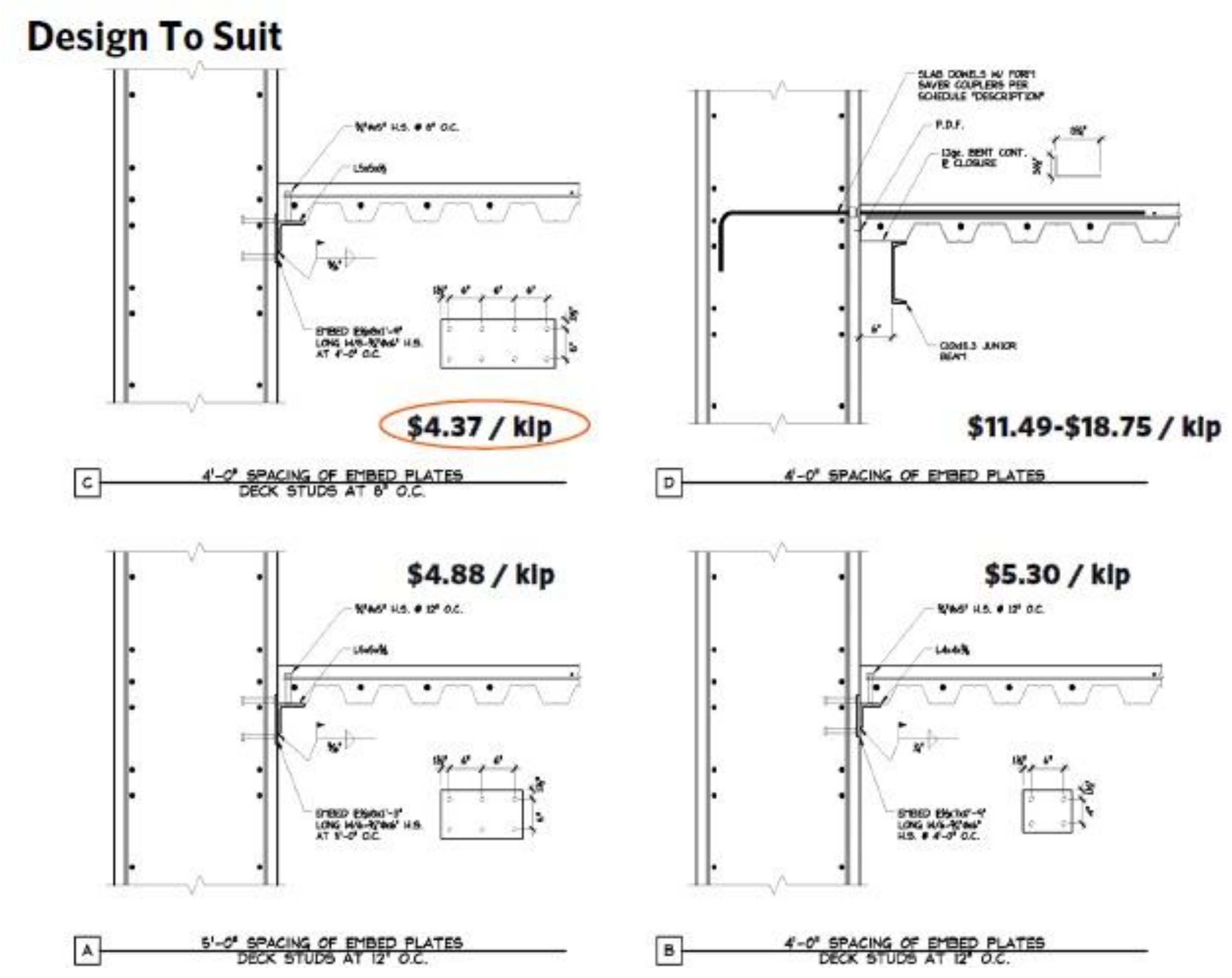
Rebar Alternatives

Set-Based Design – Connection Example



Courtesy: Tipping Mar

Set-Based Design – Connection Example



Courtesy: Tipping Mar

A3 Report for Structural System Set-Based Design

A3 No	Theme / Title			Champion	Collaborator	Additional Collaborators	Sponsor	Customer Group	Sign-off
S-001	Structural System Selection Comparison			Aldrin Orue	Jorge Rivera	Patrick Meek			
	Discipline	Element	Date Opened	Path Forward Date	Category	*A3 Status*			
	Structural	Framing	12/7/2010	12/13/2010	N/A	Idea Development	Sponsor Identified	A3 Development	Customer accepts	Integration

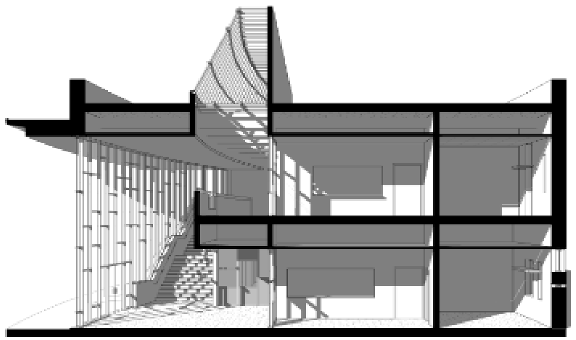
Section 1 - Background - Relevance to Project

Comparison of structural system options to determine which option is the most appropriate and efficient for the facility while meeting project goals of cost, schedule, and aesthetics.

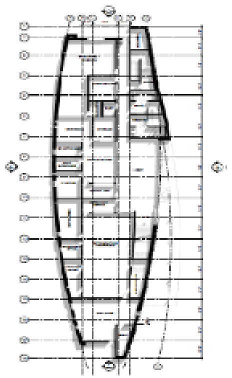
Section 2 - Current Condition

Two-story 15,000 SF facility located in San Diego CA with an open high bay lobby area. A facility of this size and type is typically constructed of a steel frame system due to the many advantages of steel as noted in the following sections below. A comparison analysis with other structural systems will be performed to make sure that advantages from other systems are not overlooked and properly evaluated.

Section 2 - Current Condition - Design



3D Section



Level 1 Floor Plan

Section 3 - Analysis

SHOULD CRITERIA

	Structural System Options	Construction Schedule	Flexibility	Durability (Life Cycle)	Cost	Sustainability	Sound Atuniation	Floor Vibration	Total
	Structural System								
1	Steel System	+	+	+	+	+	+	+	7
2	Concrete System	0	0	+	0	+	+	+	4
3	Masonry System	0	0	+	+	+	0	0	3
4	Wood	+	0	0	+	0	0	0	2

\+ Meets "Should" Criteria
0 Does Not Meet "Should" Criteria

Section 3 - Analysis

Option	Advantages
Steel	1. Lower Cost 2. More Flexible (modifications and attachments) 3. Faster Erection Time 4. Lighter System 5. Much More Accommodating in Architectural Design 6. More Durable Material 7. Better Sound and Floor Vibration Qualities 8. Easier Construction
Concrete / Masonry	1. Shorter Lead Time Required to Erect Superstructure 2. Much More Durable Material 3. Much More Thermal Mass 4. Much More Sustainable (Due to Local Resources) 5. Much Better Sound and Floor Vibration Qualities
Wood	1. Much Easier Construction 2. Shorter Lead Time 3. Much Lighter System

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

Need structural analysis to determine preliminary steel member sizes to confirm steel option.

Section 5 - Recommendations

Based on the current information at hand the option of a steel structural system is recommended.

Section 6 - Path Forward/Follow-up

1. Structural analysis to determine preliminary steel member sizes- Aldrin Orue
2. Confirm structural steel member sizes with budget - Dustin Smith
3. Confirm structural system selection with entire team and approve A3- Aldrin Orue
4. Incorporate/proceed with structural steel design- Aldrin Orue

San Diego Community College District

EXPERIENCE WITH LEAN AND TVD

SDCCD Completed TVD Projects

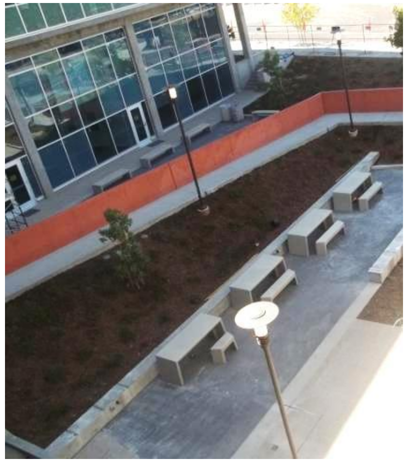
City College Math & Social Sciences

Project Budget: $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.



SDCCD TVD Projects in Construction

Mesa College

Social and Behavioral Sciences Building

Budget: $36.9 million

Construction Start: December 2012

Targeted Completion: September 2014

The Social and Behavioral Sciences building will consist of approximately 66,000 GSF of new laboratories and classrooms for the Behavioral Sciences and Social Sciences programs. The building will include labs for the Psychology and Speech programs. Tracking LEED Gold.

SDCCD Completed TVD Projects

Miramar College - Fire Science/

EMT Training Facility

Budget: $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.

SDCCD TVD Projects in Construction

Miramar College – Science Building Expansion

Budget: $31.7 million

Construction Start: October 2013

Targeted 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.

SDCCD TVD Projects in Construction

Mesa College Fitness Center

Budget: $10.4 million

Construction Start: June 2014

Targeted Completion: June 2015

The Fitness Center will be an approximately 25,000 gross square feet facility to house Mesa College's Health Service program and Physical Conditioning program.

SDCCD TVD Renovation Design/Build Projects

City College:

M Building: $6.2M; 15k sq ft

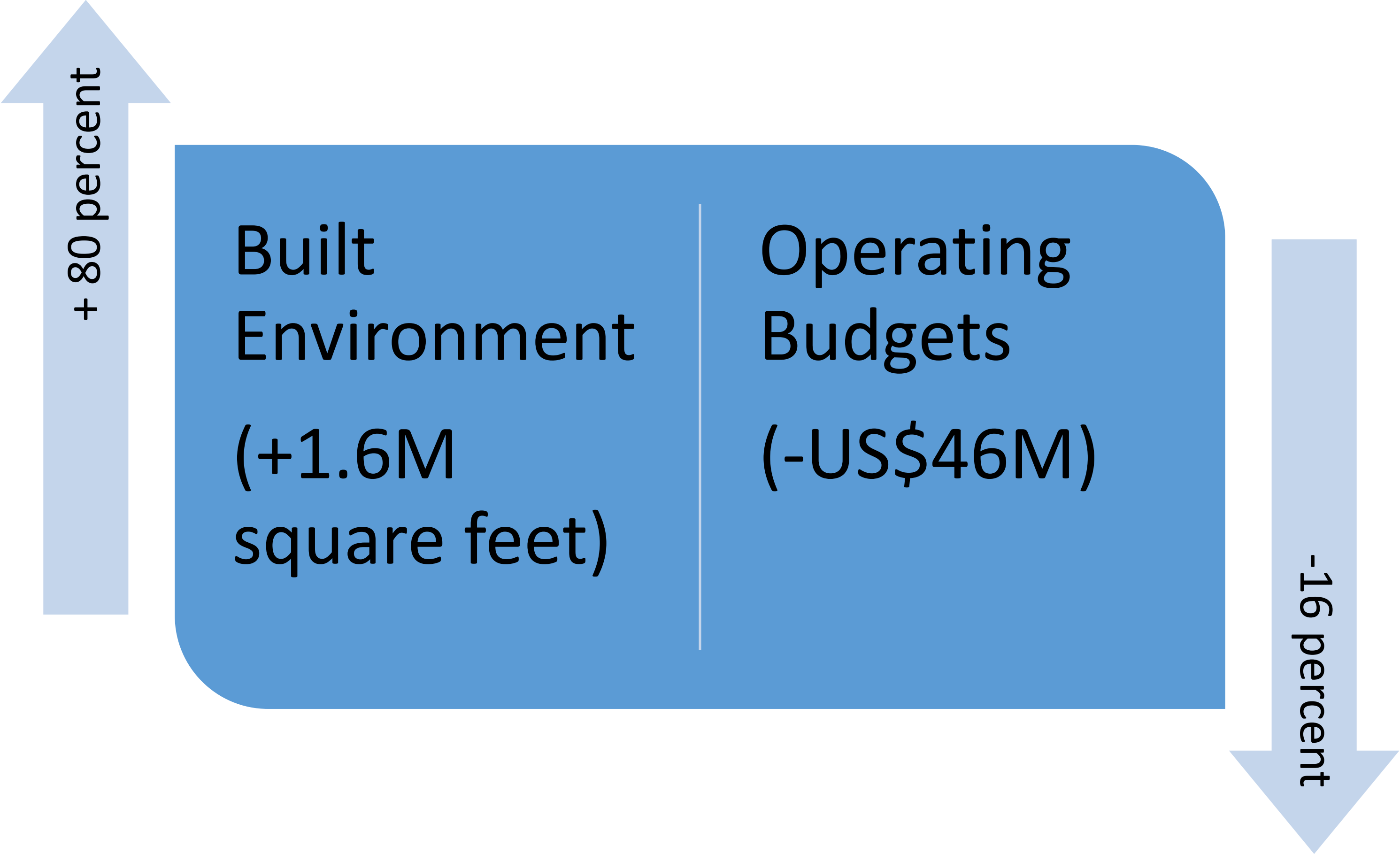
C Building: $20.1M; 31k sq ft

A, D and T Buildings: $48M; more than 130k sq ft in 3 separate buildings

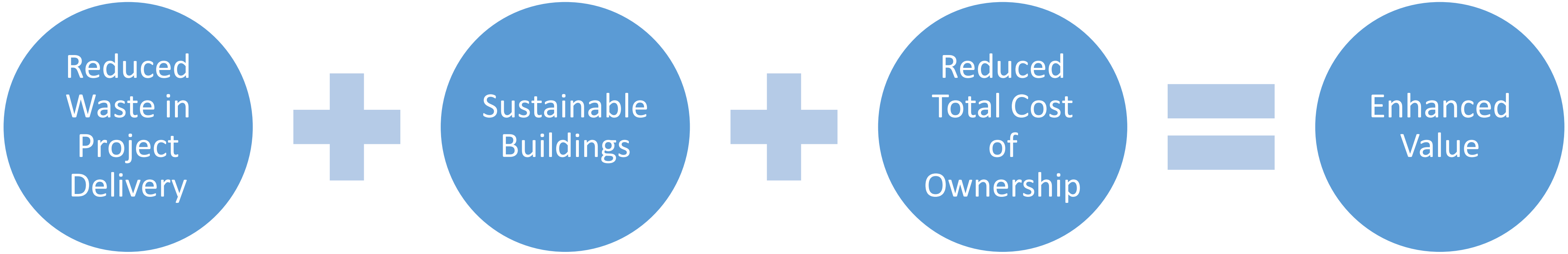
Wouldn't It Be Nice If You Could...

- 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%

Why Did San Diego CCD Migrate to Lean?



Public Owner Benefits



By the Numbers – The Database

35
COMPLETED
PROJECTS

US$584M
CONTRACT
VALUE

8000
CHANGE
ORDERS

Change Order Analysis

Pre-Lean

- 7.73% Total COs
- 2.99% E&O COs

Post-Lean

- 4.43% Total COs
- 1.88% E&O COs

Target Costing

11 Projects

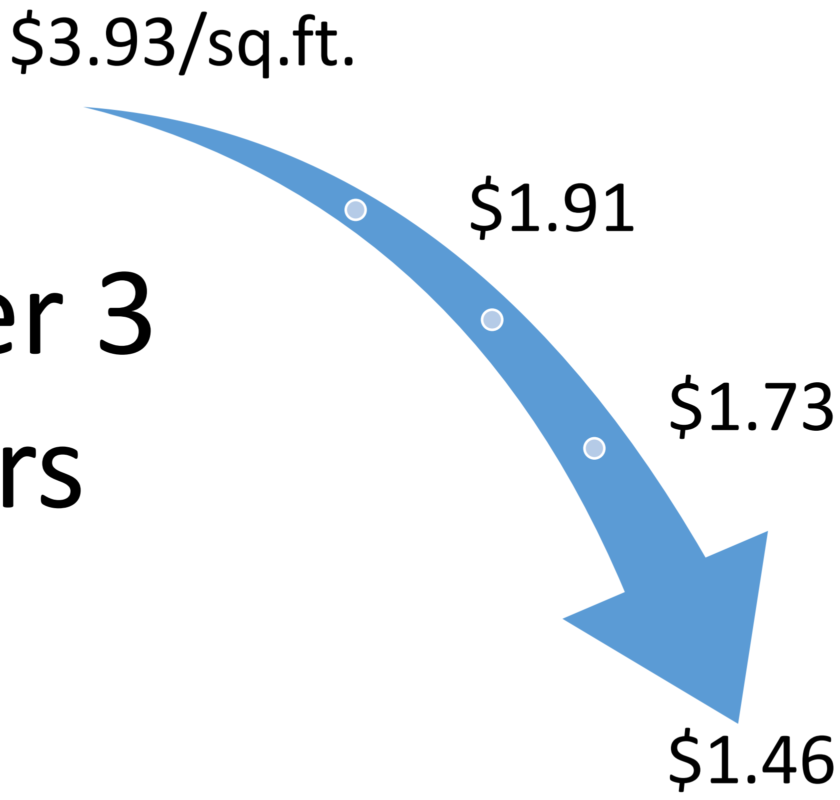
Avg. Value:

US$21.8M

83% Met Target Cost; Avg. 7% Below Target Cost

Value as Reduced Maintenance Costs

Over 3 Years



US$34.6 Million of Waste Eliminated

- US$13.6M Total Savings in Reduced COs
- US$7.7M Total Savings To Date with TVD
- US$13.3M Total Savings over 3 Years in Maintenance Costs

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

Questions?

David Umstot, PE, CEM

Umstot Project & Facilities Solutions, LLC

www.umstotsolutions.com

david.umstot@umstotsolutions.com

619.201.8483 (O)

619.384.3231 (M)