SAN DIEGO COMMUNITY COLLEGE DISTRICT

Getting to Lean Project Delivery in Public Higher Education Institutions

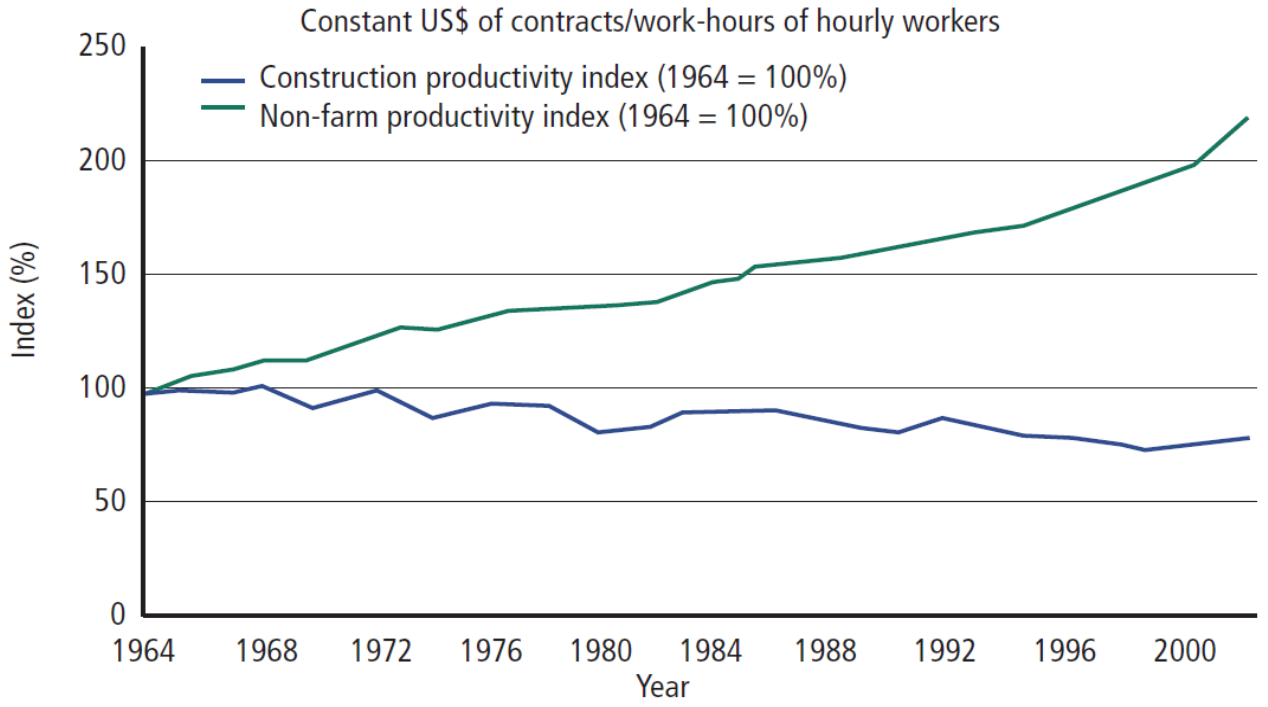
Presented to IFMA – AFC Spring Conference
San Diego, CA – June 13, 2013

Lean Construction

A World View – Extreme Lean!

Construction Productivity in the U.S.

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



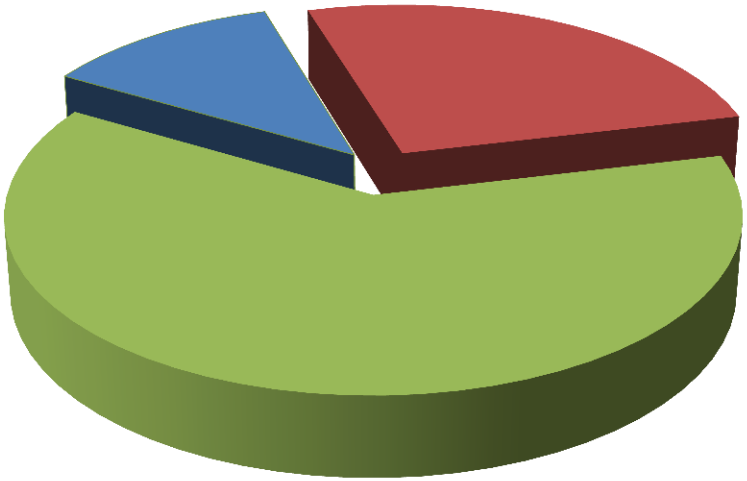
Source: US Department of Commerce, Bureau of Labor Statistics.

Construction Waste in the U.S.

Current Manufacturing

Support Activity 12%

Waste 26%

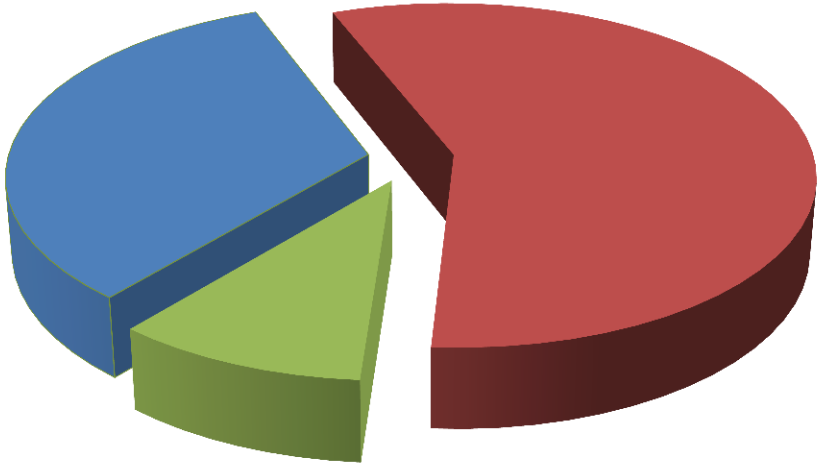


Value Added 62%

Current Construction

Support Activity 33%

Waste 57%



Value Added 10%

Source: Construction Industry Institute

Construction Waste in the U.S.

Typical Types of Construction Waste:

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

What is Lean Construction?

Shared principles:

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

The priority for all construction work is to:

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

(From Wikipedia)

Who is Going Lean?

UHS

Sutter Health
With You. For Life.

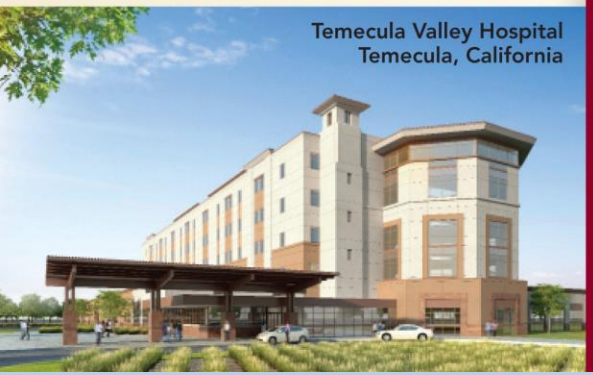
UCSF
University of California
San Francisco

SEAL OF THE CITY AND COUNTY OF SAN FRANCISCO

AMGEN

Walt Disney Imagineering

Why Go Lean?



UHS®

Lean Project

DELIVERY GUIDE

Why Go Lean?
(From UHS Lean Project Delivery Guide)

Fundamentals of Lean:

• To understand *value from the customer's perspective and to only* take *actions which deliver that value (thus eliminating waste).*

• Waste is disrespectful

1. to humanity – squanders scarce resources
2. to individuals – adds work
3. to clients – adds cost/time/aggravation

• Become a leaning organization through relentless reflection and continuous improvement as a team. Status quo is never acceptable.

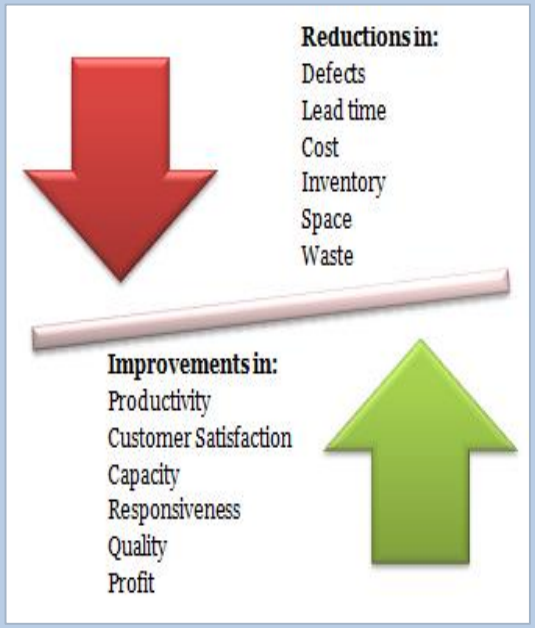
• Lean is about inspiration and empowerment. People are empowered to affect decisions and the work itself which not only delivers better projects, but leads to heightened satisfaction for all.

• Lean is about developing *principles that are right for your* organization & diligently practicing them to achieve high performance. It is not about *imitating the tools used by* Toyota in a particular manufacturing process.

Lean Philosophies

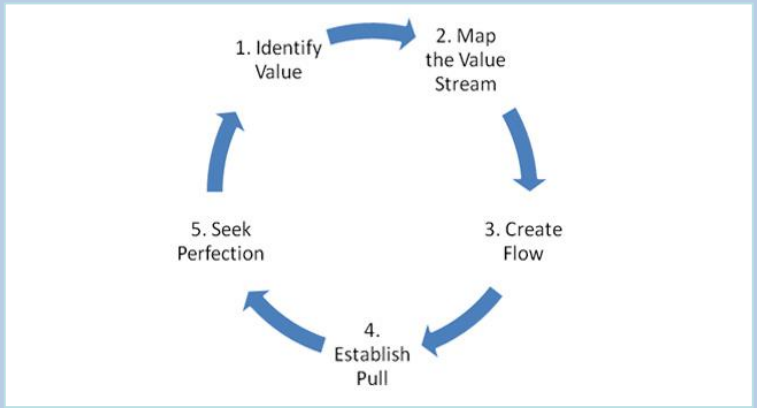
Lean Philosophies

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



Value

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



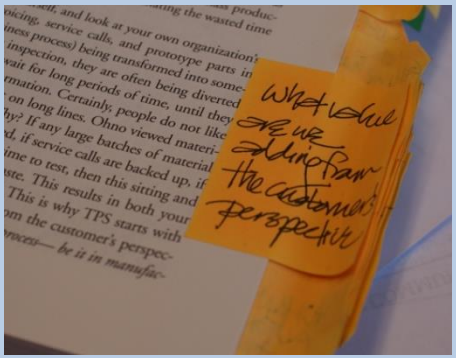
The Eight Wastes as Defined by Toyota (and Liker)

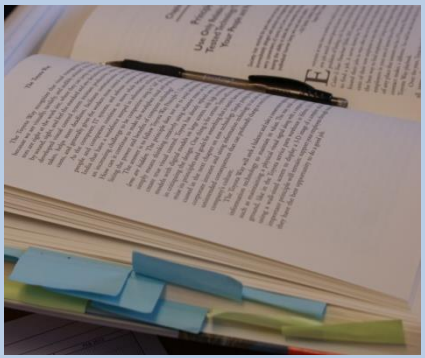
1. Overproduction
2. Waiting
3. Unnecessary transport
4. Overprocessing
5. Excess inventory
6. Unnecessary movement
7. Defects
8. Unused employee creativity

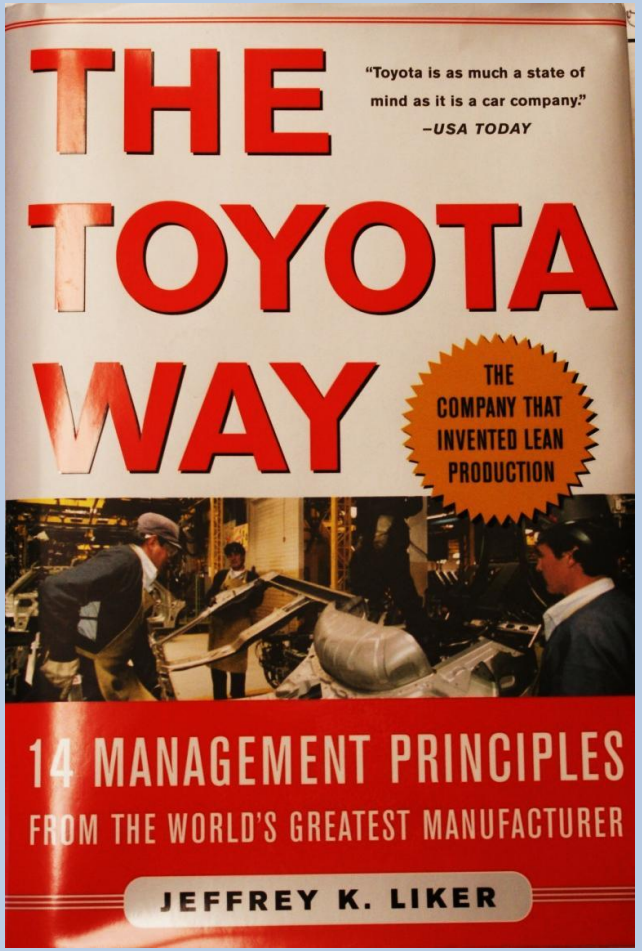
Why Did We Go Lean?

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

Practicing the Toyota Way Business Principles

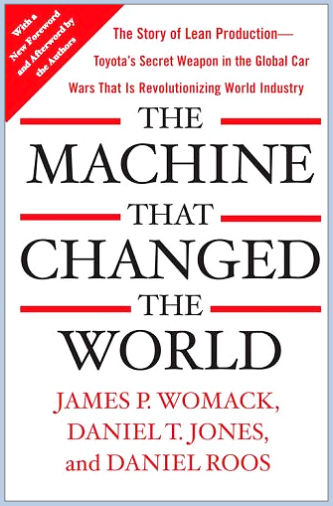


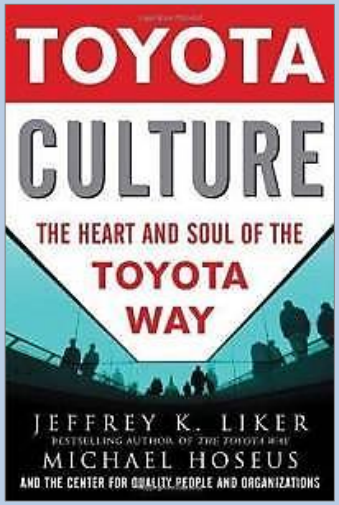


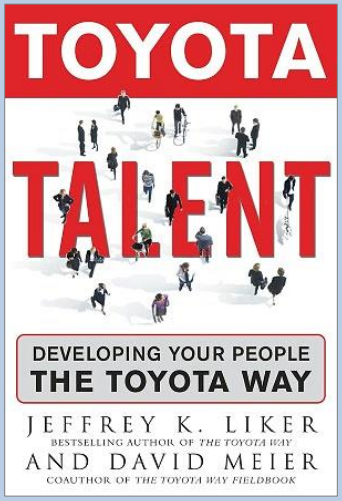


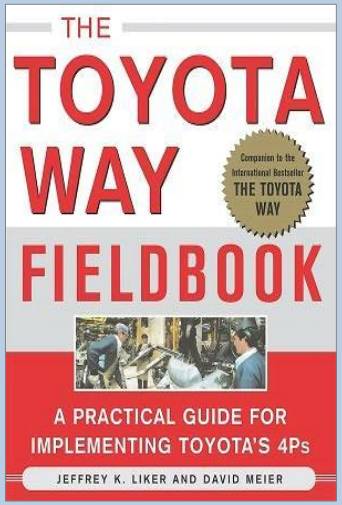
The Toyota Way Business Tools

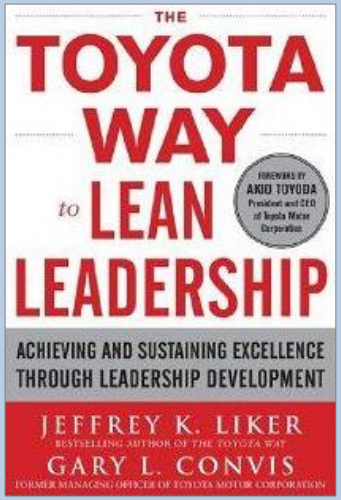
- The Machine that Changed the World – *James Womack*
- The Toyota Way – *Jeffrey Liker*











Early (and continued) Attitudes Toward Lean

Credit: Lean Construction Institute

- 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?

San Diego Community College District

Rainbow Report

#	Prop.	Campus	Project Description	Contract Manager Project Budget as of 2011_08_12	Contract Manager Commitments to 2011_09_02	Soft Cost	Hard Cost	FFE AV / IT	IT	Expenditures as of 2011_06_30	DSA Submit	DSA Approved	Board Approval	Construction Complete	Change Order Rate	Status
1	S	CE	ECC - Land Acquisition & Relocation Skills Center (Land $7.4M)	$ 31,650,000	$ 31,681,400	$ 11,297,890	$ 10,782,697	$ 1,560,878	$ 614,124	$ 31,737,281	Jan-06	Oct-06	May-07	Aug-09	8.0	100%
2	S	CE	West City Campus	$ 17,409,369	$ 17,409,369	$ 2,484,567	$ 13,482,064	$ 1,073,191	$ 369,546	$ 17,409,495	Oct-05	Nov-06	Jul-07	May-09	10.0	100%

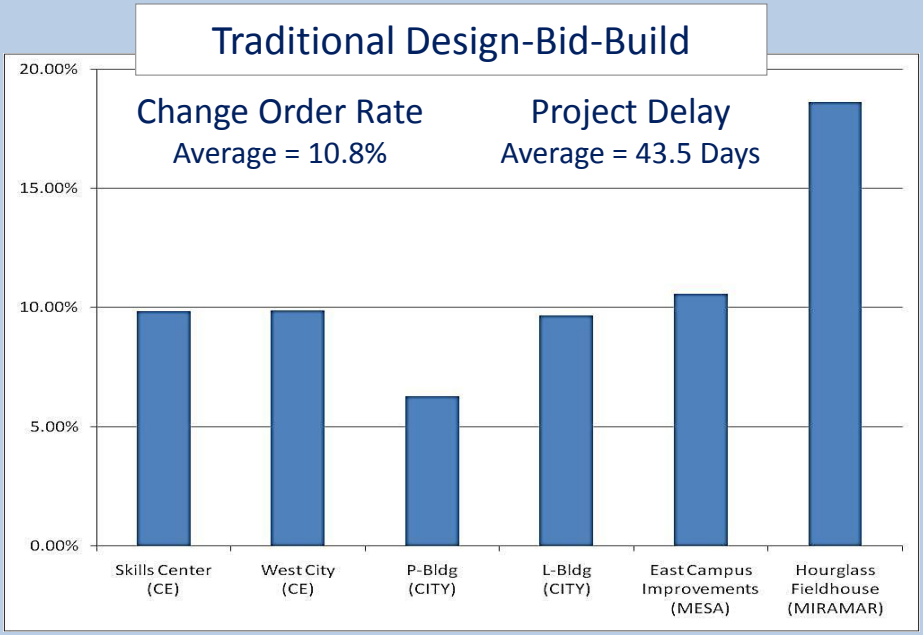
Miramar	Cafeteria/Bookstore & Student/Campus Center	$ 34,519,245	$ 31,515,776
Miramar	Aviation Maintenance Technology Center	$ 10,251,857	$ 8,475,465
Miramar	Parking Structure #1 & Police/Emergency Center	$ 17,848,765	$ 16,608,677
City	Infrastructure - Central Plant /Sewer & Storm Drain/ Data & IT projects	$ 19,441,050	$ 17,017,141
Mesa	Infrastructure - Fire Lane/Central Plant/IT/Stadium Restrooms	$ 8,127,797	$ 9,637,103
Miramar	Infrastructure Phase II	$ 41,564,305	$ 17,108,101
District	Proposition N Program Management	$ 41,992,026	$ 17,874,745
CE	Fire Science / EMT Training Facility	$ 13,000,000	$ 1,774,354
City	Science Building	$ 54,014,278	$ 14,369,196

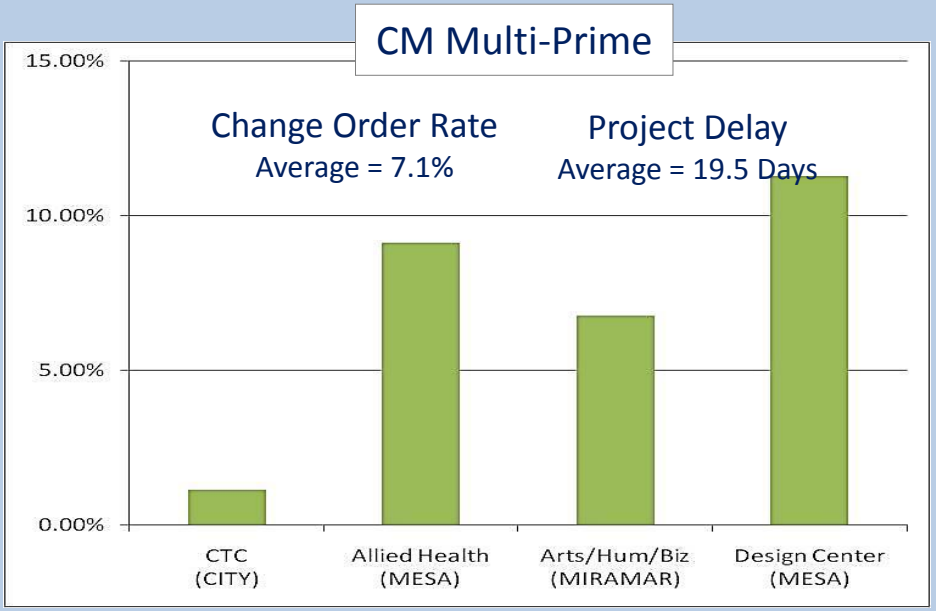
Legend:

- Project Completed
- Construction Phase
- Design/Bid Phase
- Ongoing
- Future Projects

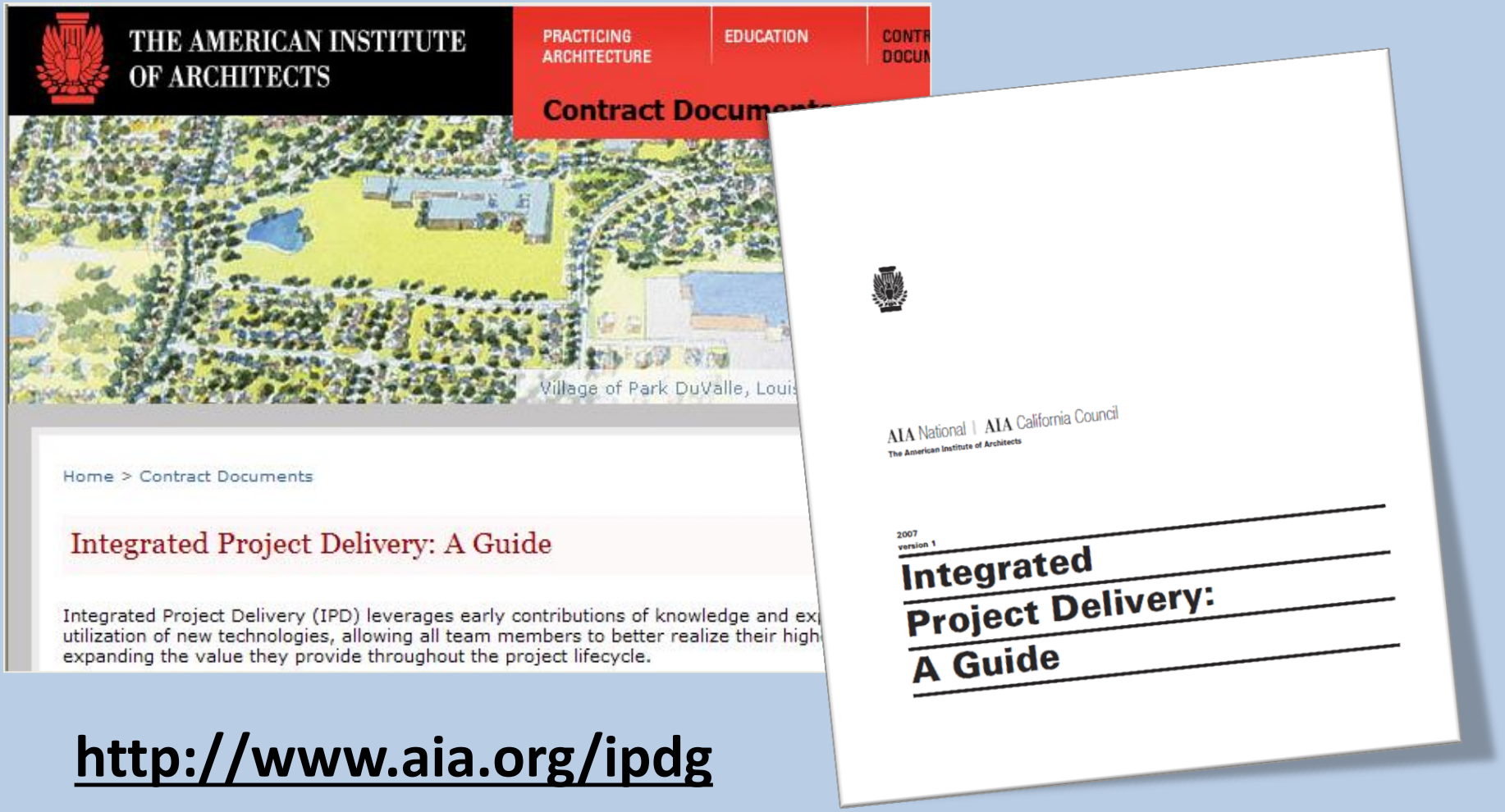
San Diego Community College District

Schedule Performance





Integrated Project Delivery (IPD)

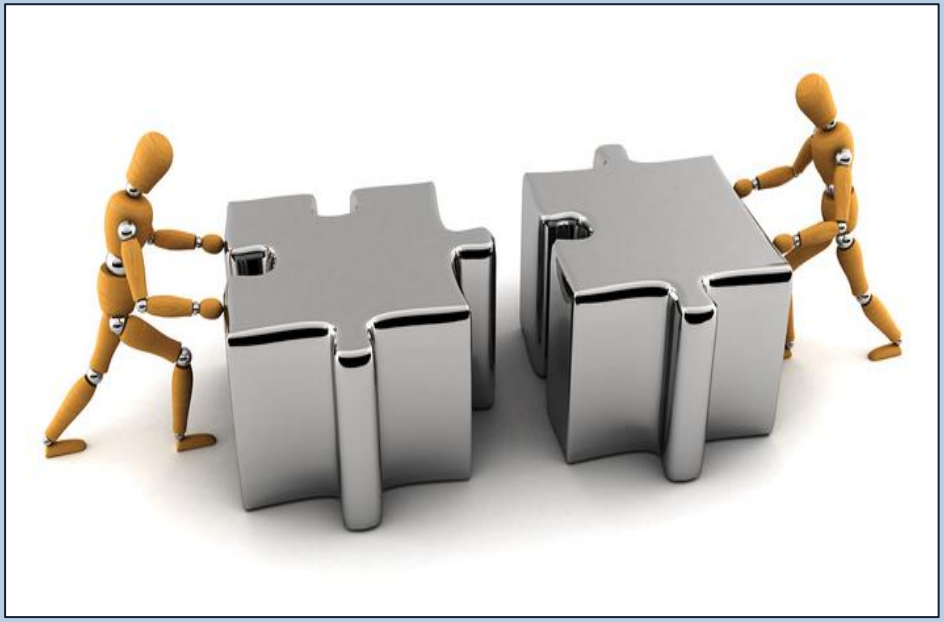


http://www.aia.org/ipdg

IPD – What Is It?

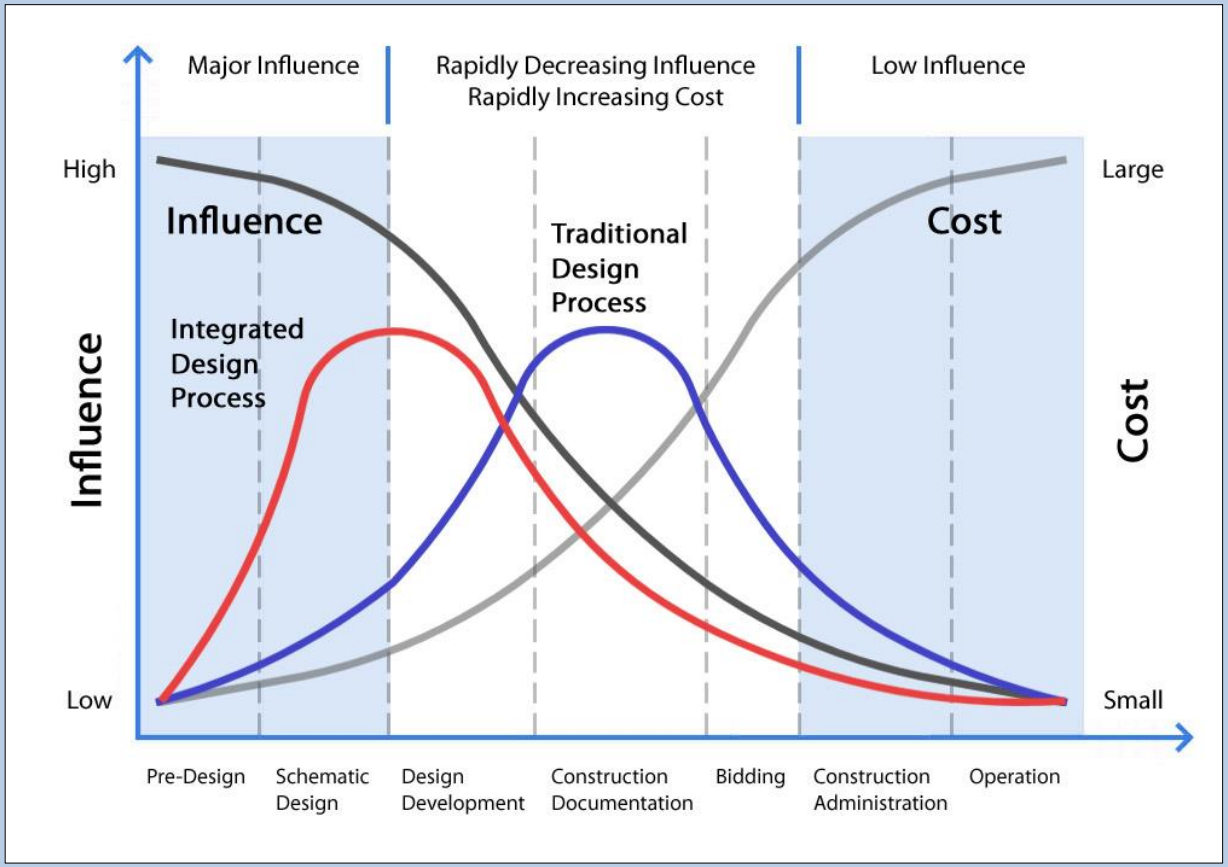
- Project delivery approach that integrates people, systems, business structures, and practices to optimize project results, increase value to the owner, reduce waste and maximize efficiency of project delivery.

- Distinguished by highly effective collaboration among the owner, prime designer and prime constructor commencing at early design through project completion.



IPD – Why Do It?

An integrated design process allows decisions to be made early when the opportunity for change is maximized and the cost of changes are minimized.



MacLeamy Curve

San Diego Community College District

Integrated Project Delivery Charter

Integrated Project Delivery Charter

SDCCD North City Campus Parking Structure

We, the Design Build Team for the SDCCD North City Campus Parking Structure, will be utilizing the Integrated Project Delivery (IPD) model for the design and construction of this project to integrate the people, systems, business structures, and practices into a process that collaboratively harnesses the talents and insights of all participants to optimize project results, increase value to the owner, reduce waste and maximize efficiency through all phases of design, fabrication, and construction.

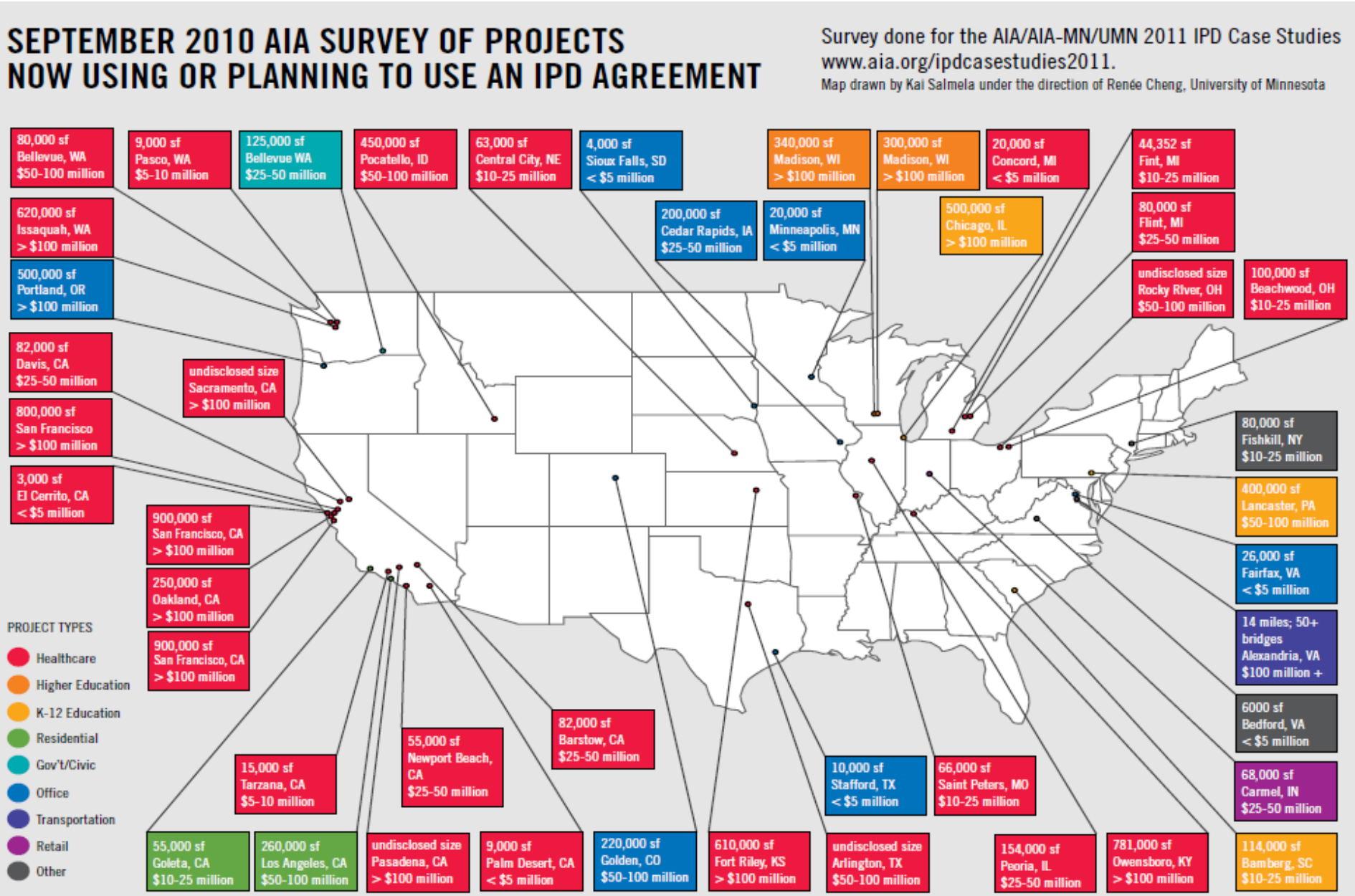
We, the undersigned, agree to achieve this mission by implementing the following objectives:

- **Mutual Respect and Trust** – we agree to foster an environment that promotes collaboration, and we are committed to working as a team in the best interests of the project.
- **Mutual Benefit and Reward** – we agree to a shared contingency and a shared savings to breakdown the silo mentality and reward a "what's best for the project" behavior.
- **Collaborative Innovation and Decision Making** – we agree to a team decision making structure where major decisions are made objectively and unanimously.

Legacy Building Services

NTD Architecture

IPD Programs in the United States



Design-Build Statute in California for Community Colleges

- **As of January 1, 2008, Community Colleges can use design build under SB614.**
  - Must be at least $2.5M in value
  - Requires project-specific Board resolution
- **Need to evaluate the project based on five minimum criteria.**
  - Price (10%)
  - Technical Experience (10%)
  - Life cycle cost over 15 years (10%)
  - Skilled Labor Force (10%)
  - Safety Record (10%)

San Diego Community College District

Design-Build Scoring Criteria and Weight

	1	2	3	4	5	6	7		
	TECHNICAL EXPERTISE / 20%	DESIGN EXCELLENCE/ 20%	LIFE CYCLE COST/ 10%	SKILLED LABOR FORCE AVAILABILITY/ 10%	PRICE/ 20%	COMMITMENT TO DIVERSITY/ 10%	SAFETY RECORD / 10%	TOTAL	RANK
Point Value	200	200	100	100	200	100	100	1000	
FIRM									
Balfour Beatty	193	190	90	100	200	77	100	950	1
McCarthy Construction	198	193	96	100	180	76	85	928	2
Hensel Phelps	188	188	85	100	180	82	95	918	3
TB Penick	183	178	95	100	180	74	95	904	4
PCL Construction	174	171	92	100	180	82	100	899	5
Davis Reed Construction	156	171	86	100	200	75	90	878	6
Swinerton	164	173	80	100	160	93	100	870	7
Rudolph and Sletten	166	174	78	100	190	76	85	869	8
Turner Construction	171	178	73	100	160	74	100	856	9
Harper	158	164	75	100	180	67	95	839	10
Tilden-Coil	171	148	68	100	180	69	100	836	11
CW Driver	174	175	91	100	180	0	100	820	12

Mesa College Fitness Center Project

Schedule Performance

Is Critical Path Scheduling Obsolete?

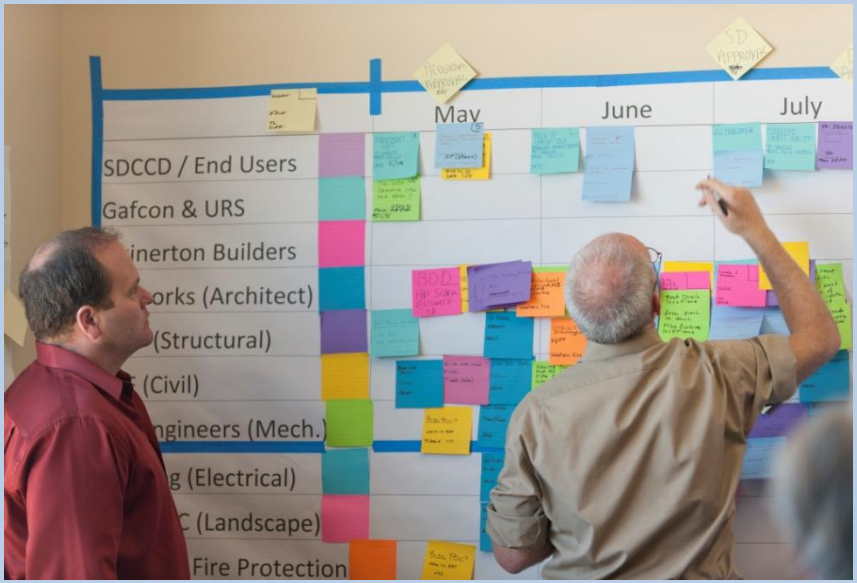
Schedule Performance

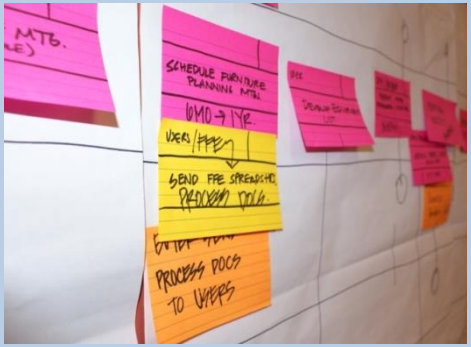
- SDCCD Experience:
  30 Major Projects with CPM Scheduling
  3 (10%) finished on time

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

- LastPlanner pull system – a better way
  (typically 80-90% percent promises kept)

Pull Planning



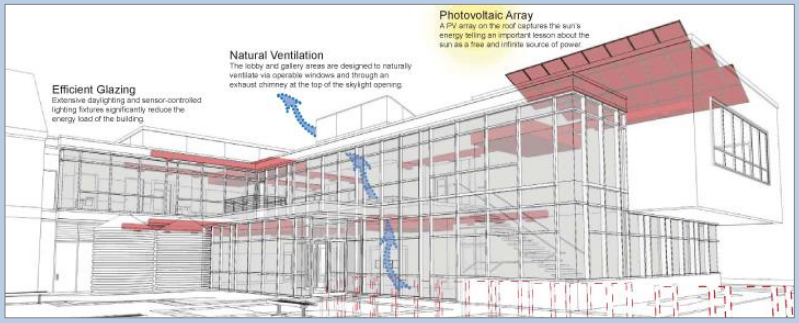


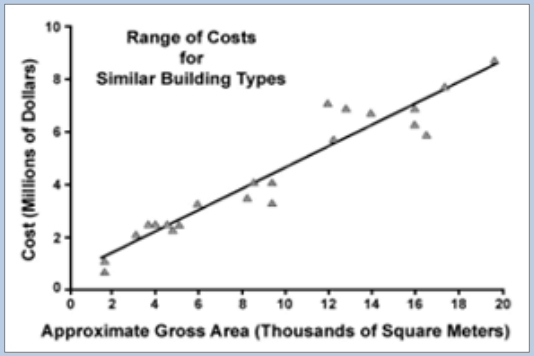
Pull Planning

Pull Planning Workshop

Target Costing – Project Budget Development

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

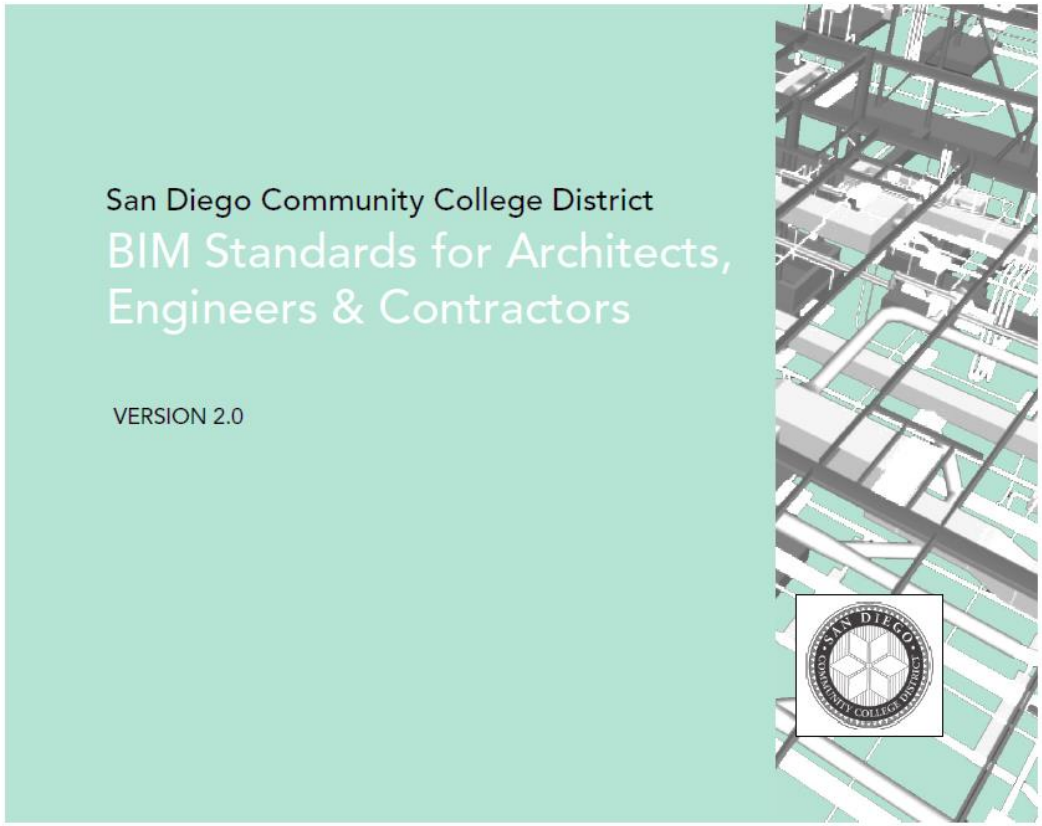




	SPACE DESCRIPTION	2024 ASF	Quantity	Extended 2024 ASF	Extended 2007 ASF	Variance	2007 Room Nos., Comments
BUILDING – Life Sciences	32-Seat Dry Lecture/Lab-Biology	1,600	x 1.0	1,600	836	764	*supplements* A202
	32-Seat Wet Lab-Biology/Botany	1,728	x 1.0	1,728	1,092	636	*supplements* A210
	32-Seat Wet Lab-Biotech/Microbiology	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**	
BUILDING – 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**	

San Diego Community College District

BIM Standards



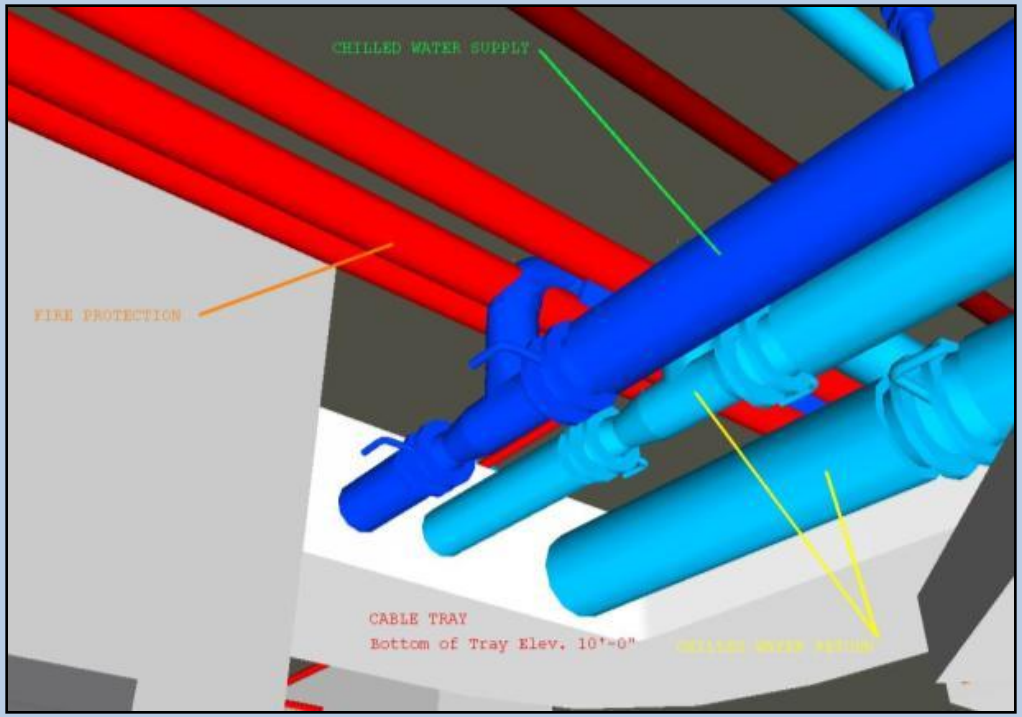
http://public.sdccdprops-n.com/Design/SDCCD%20-%20Building%20Design%20Standards/SDCCD%20BIM%20Standards%20Version%202.pdf

BIM Clash Detection

- **Building Construction**

  Mechanical piping hits cable tray and fire protection piping in ceiling space

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



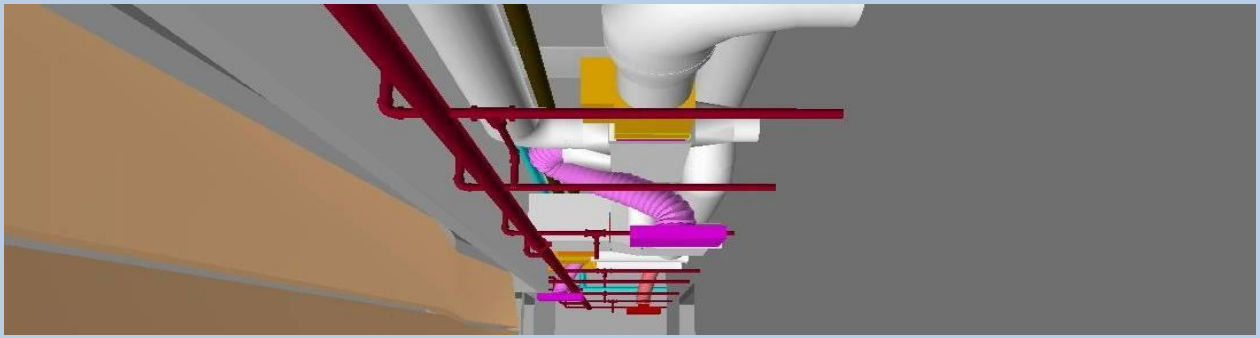
- **Number of Clashes Shown in Example = 9**
- **Savings per Clash Resolved = $3,372.00**

Courtesy Sundt Construction

Change Order Metrics – BIM vs. No BIM

Change Orders

	Errors & Omissions	Total
BIM:	1.1%	4.1%
No BIM	3.3%	8.6%



Schedule Impacts – BIM vs. No BIM

Average Days of Delay

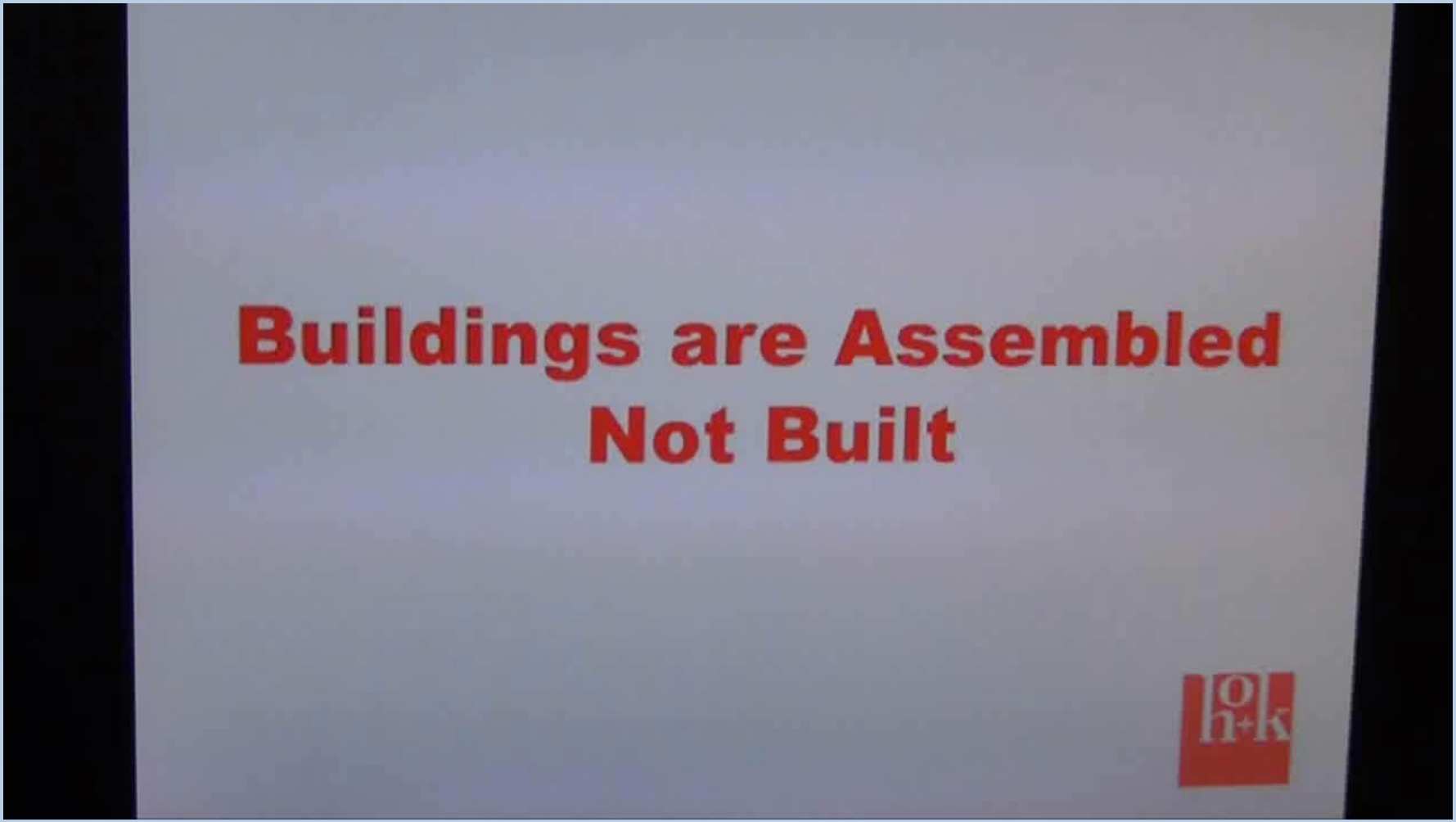
BIM: 24.5

No BIM: 79.6

San Diego Community College District

BIM Integration: Mesa College Social & Behavioral Sciences Building

MacLeamy – Buildings Are Assembled Not Built



Off-site Fabrication Trends

Exterior skin – Mesa College Math & Science Building

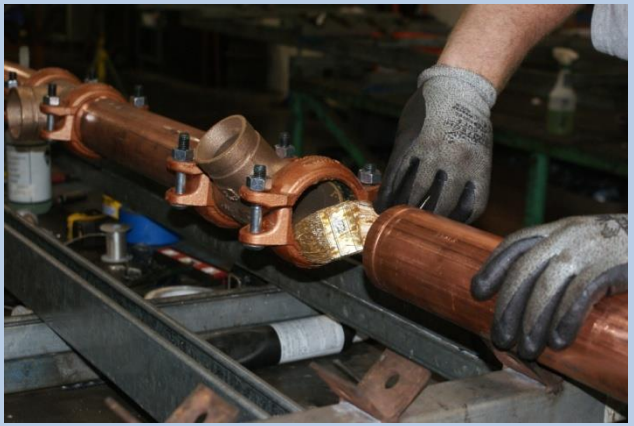
Columns and Double Ts – City College Arts & Humanities Building

Off-site Pre-Fabrication Trends

Mechanical systems off-site racking –
Mesa College Math & Science Building

Off-site Pre-Fabrication Trends



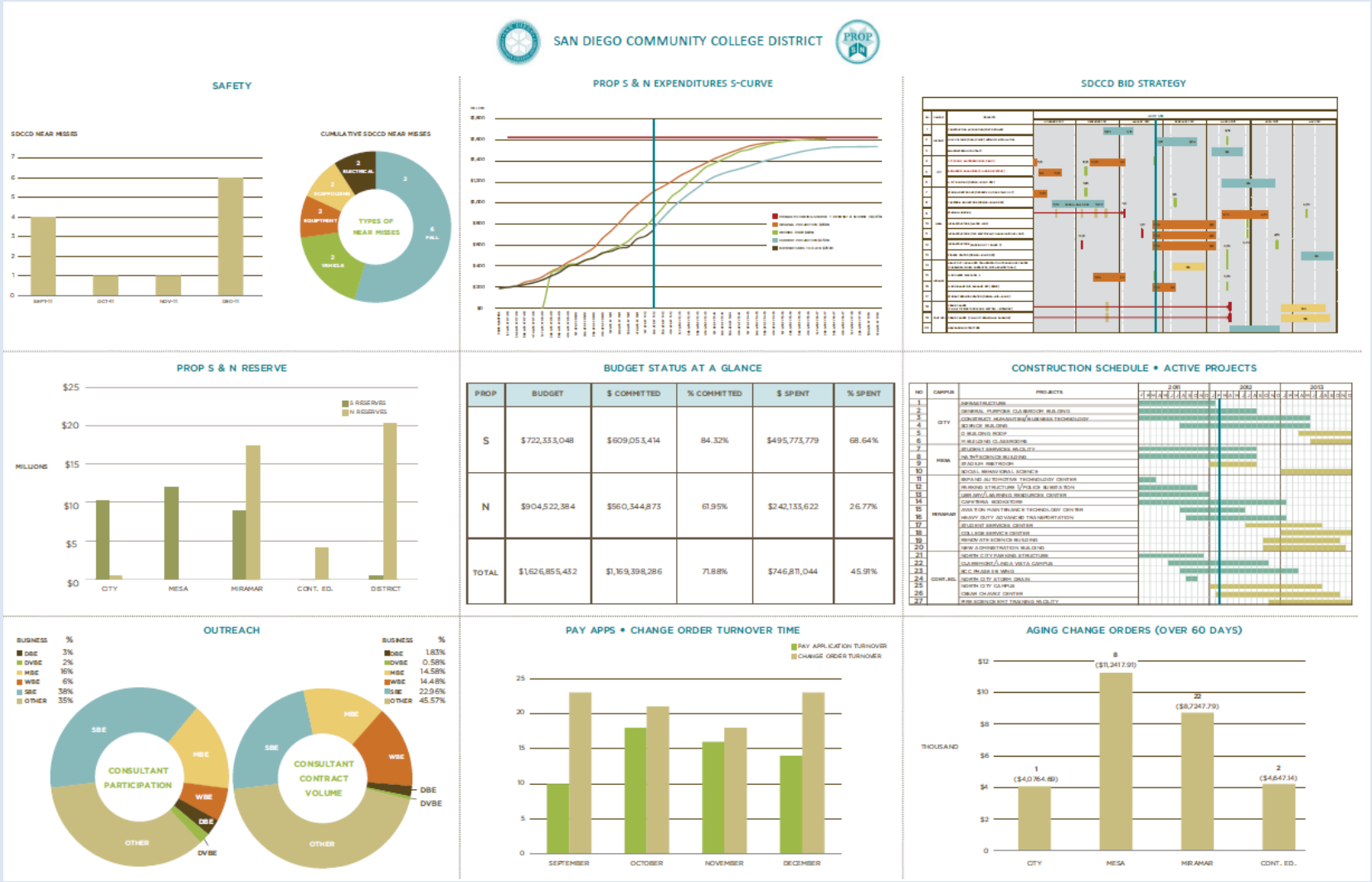




Pre-fabrication warehouse – University Mechanical & Engineering

Off-site Pre-Fabrication Trends

Program A3 Report



Questions?

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