Target Value Delivery

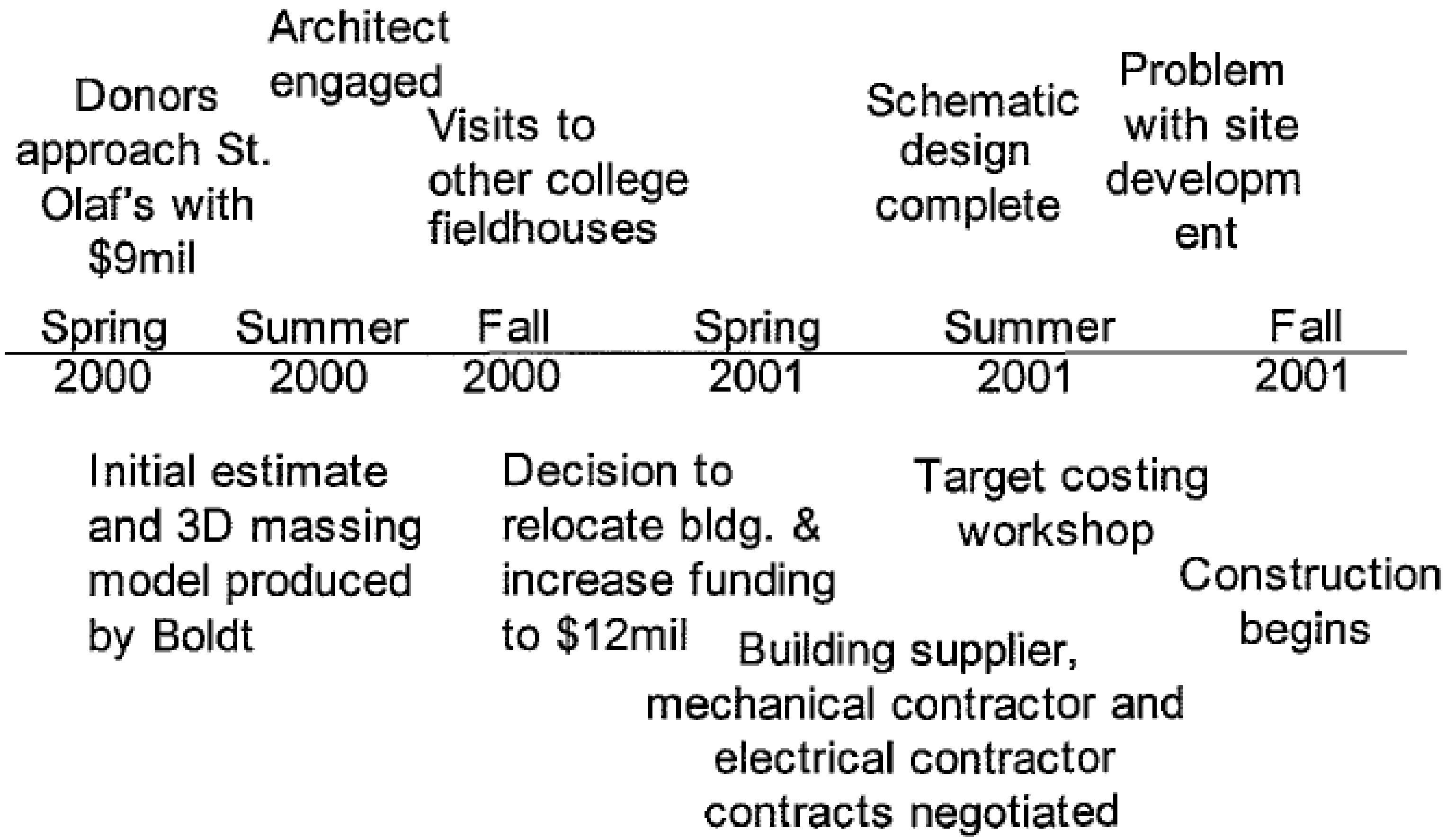
Glenn Ballard

LC DK

Nov 2020


St. Olaf’s College Fieldhouse

Timeline: St. Olaf’s College Fieldhouse Project



Worth/Cost Model

Value Engineering Study

Legend:	Const TOTAL per SF	D-B TOTAL per SF
Worth (Target)		
Current Estimate	101.06	105.86

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
11,178,100		343,115				11,521,215	12,067,681

Incl Design at $504,886+41600

NOTES:

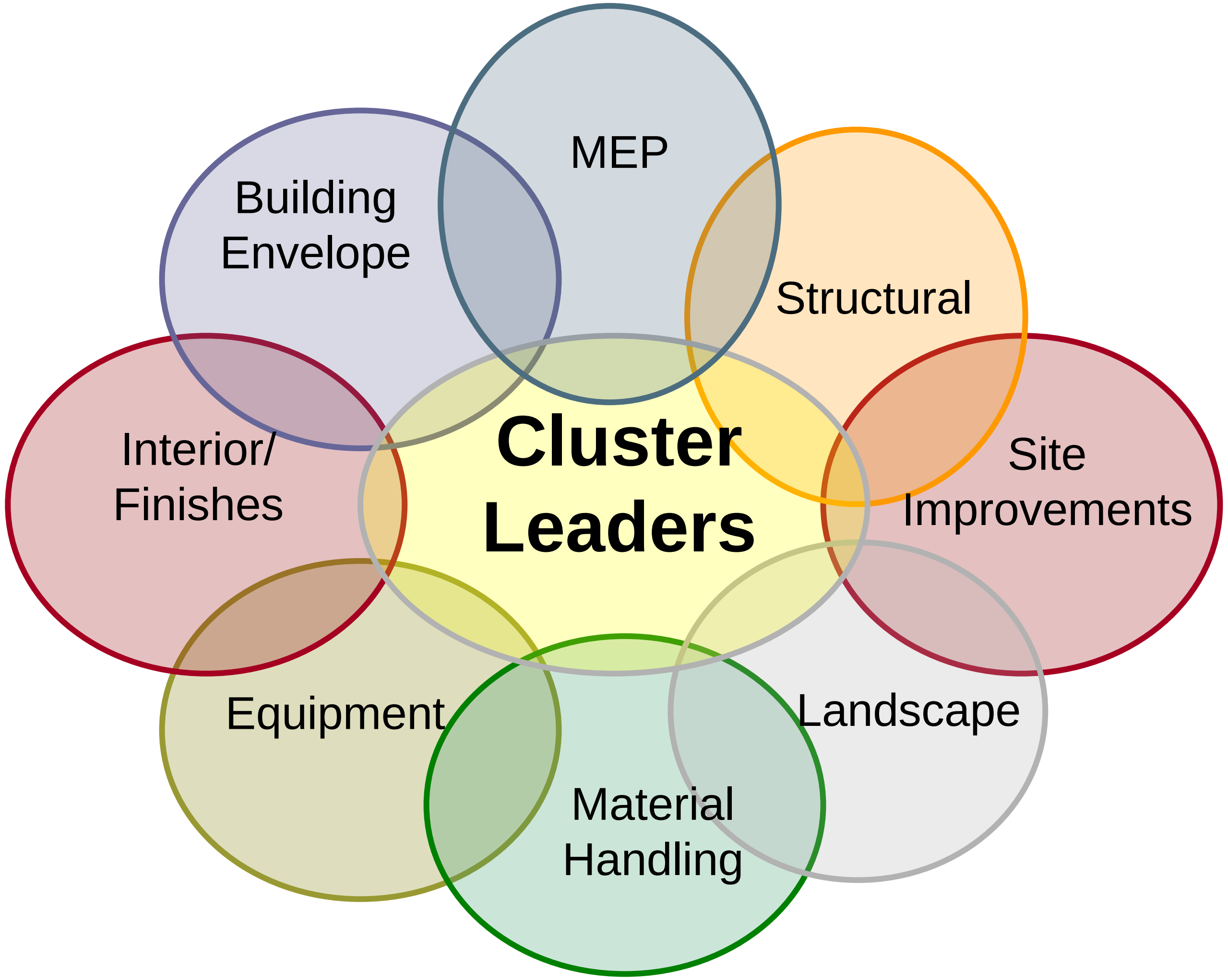
Bldg. Type:	Recreational
Target (SQFT)	114,000
Floors:	Single story plus mezzanines

SITE WORK	BUILDING
594,500	10,583,600

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	1,925,572
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: 425,179
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: 585,832
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: 326,787
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

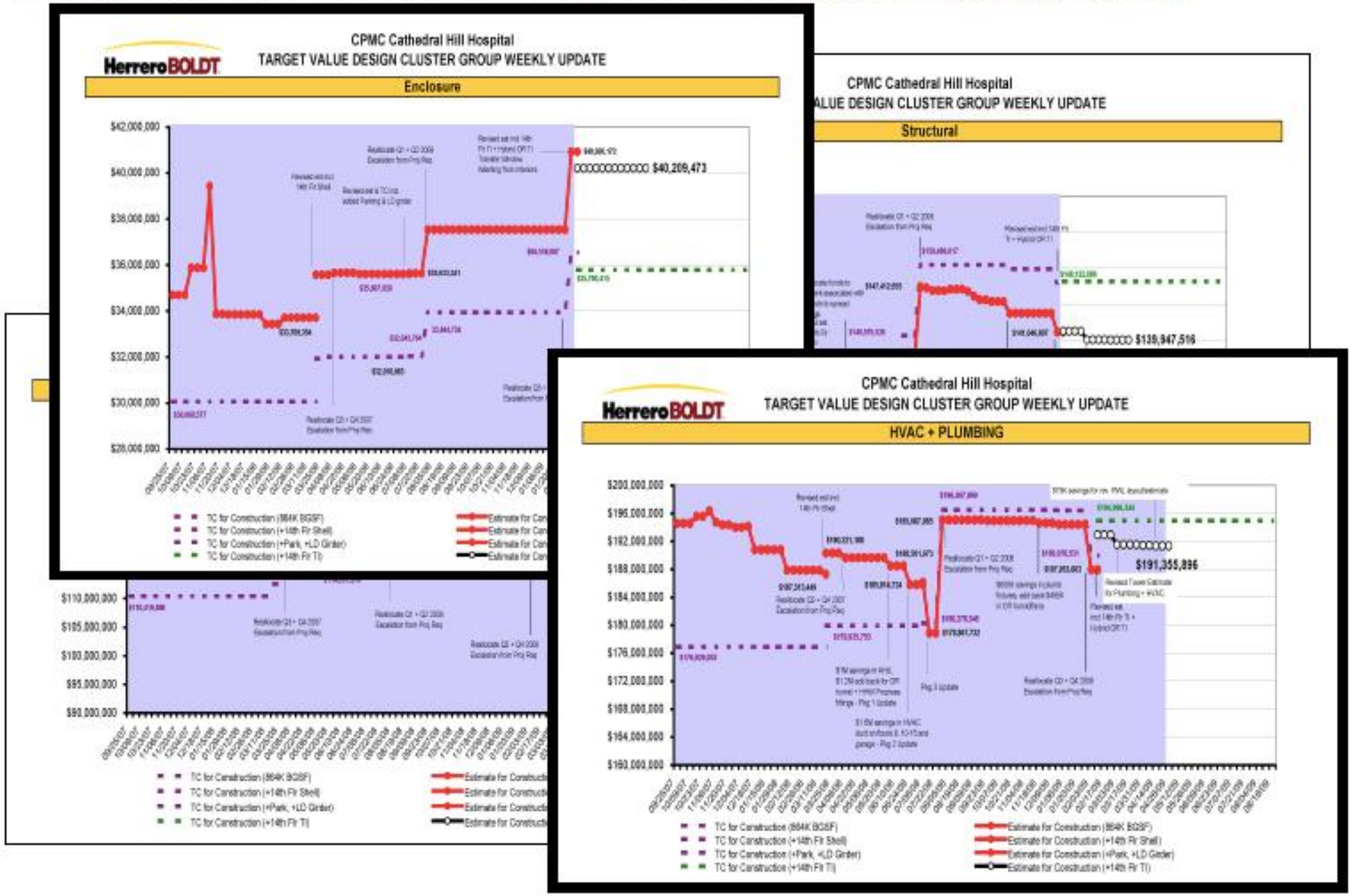
Table 1: Worth/Cost Model

Target Value Design Team Clusters



Cluster Targets

Mechanical, Electrical, Structural, Enclosure, Interiors, Gen. Conditions, Equipment, Furnishings, Technology



	St. Olaf Fieldhouse	Carleton College Recreation Ctr
Completion Date	August 2002	April 2000
Project Duration	14 months	24 months
Gross Square Feet	114,000	85,414
Total Cost (incl. A/E & CM fees)	$11,716,836	$13,533,179
Cost per square foot	$102.79	$158.44

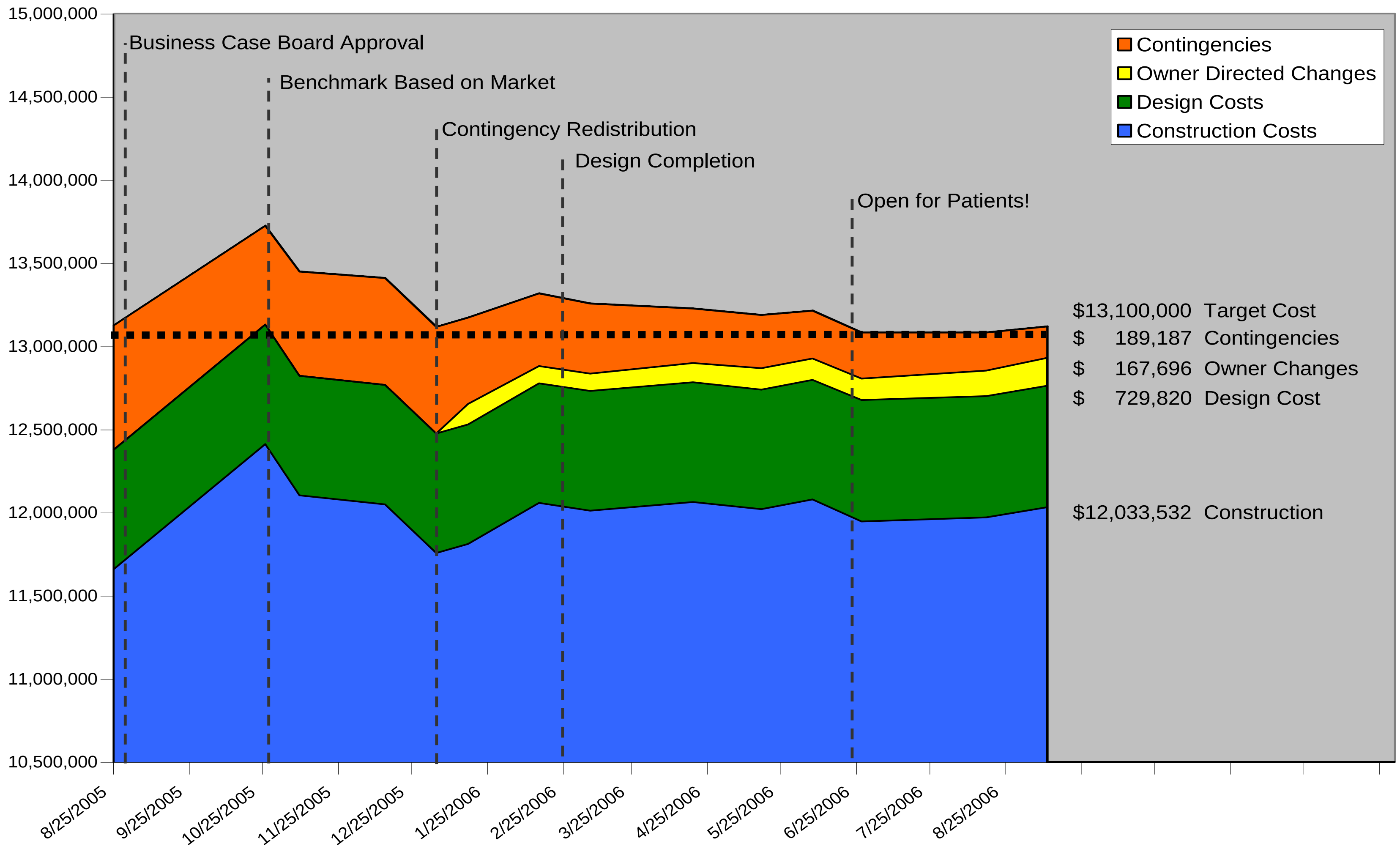
Ballard & Reiser 2004, The St. Olaf Fieldhouse project: a case study in designing to target cost. Available at iglc.net.

ThedaCare Shawano Ambulatory Care Center

Courtesy of the Boldt Company

Attachment B

The Boldt Company
37359 ThedaCare Shawano Ambulatory Care Center
Project Final Costs Comparison
Thursday, November 2, 2006

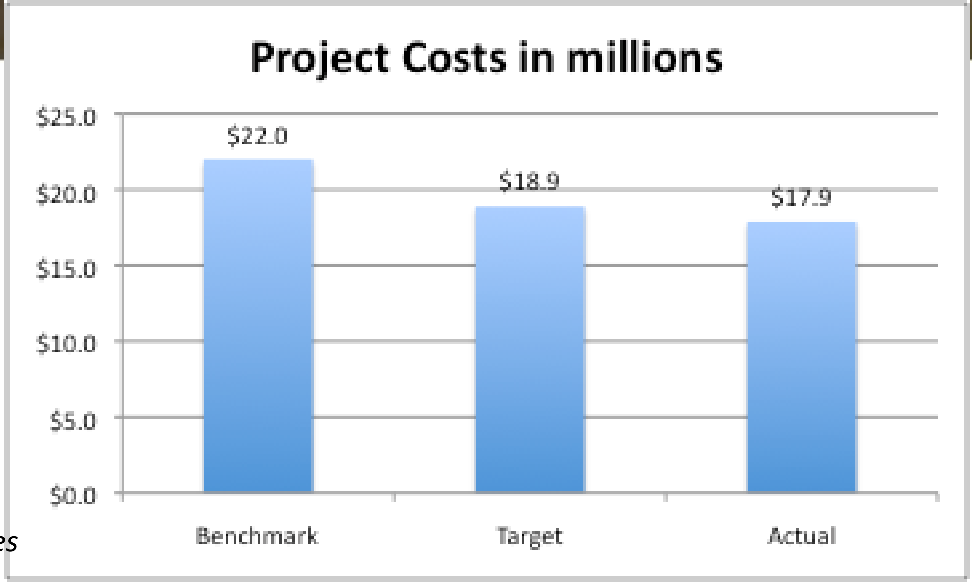


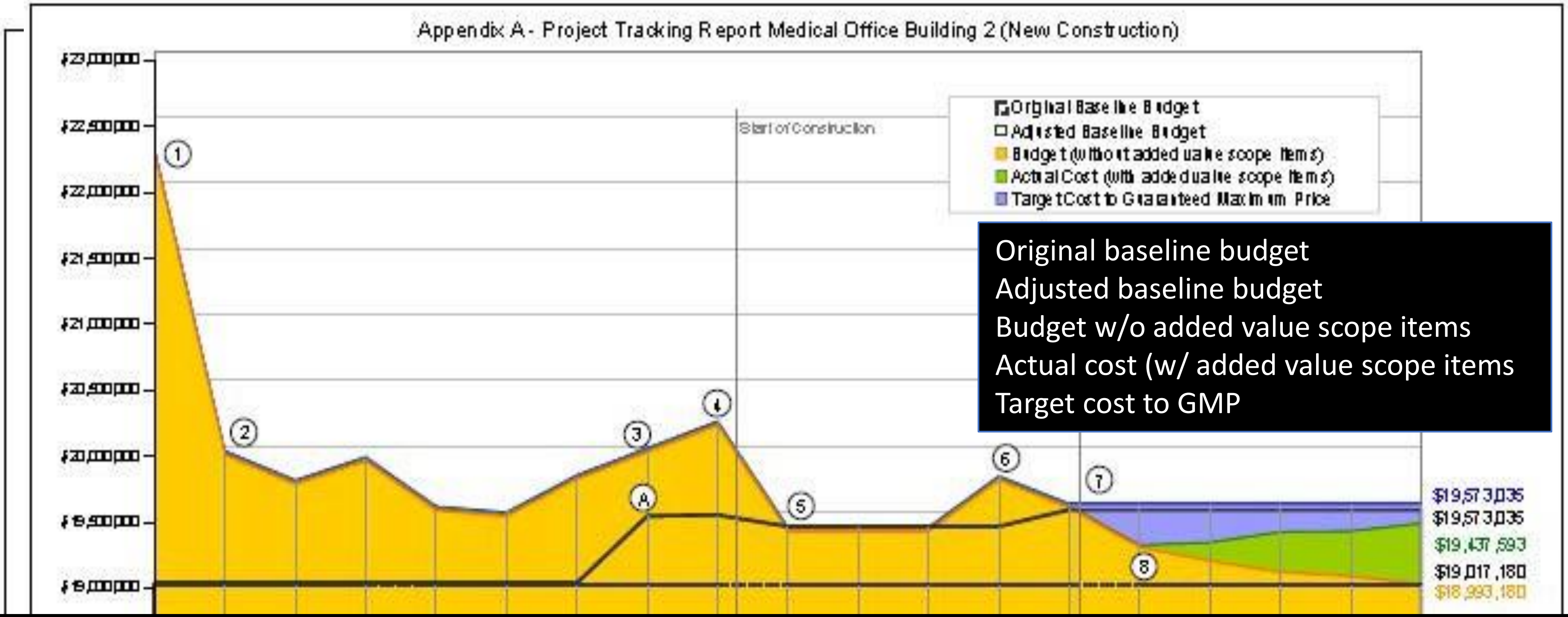
Courtesy of the Boldt Company

Shawano Project Data

- $842,000 in cost savings were invested in value-adding scope
- The remaining $45,000 in cost savings was returned to ThedaCare
- The project was completed 3.5 months earlier than the projected 15.5 months
- The revenue generated in that 3.5 months amounted to $978,000

Sutter Fairfield Medical Office Building





1. Original concept construction budget
2. Start of target cost process
3. Added to scope: stairs, canopy, track enclosure
4. Increase in steel cost
5. Removed 3% contingency for design completion
6. Flashing/Sheet Metal and Structural Steel buyout, Amendment #1 to IFOA (Site & Shell+Core GMP with TI allowances)
7. Savings from aggressive buyouts and $100K contingency release, IFOA Amendment #12 (TI GMP)
8. Projected savings from field productivity

A. Added scope of monumental stairs, canopy and track enclosure-relocation to baseline budget

Sutter Health’s 2012 Report

- Since they launched lean in 2004, Sutter Health had completed 22 ‘lean’ projects > $10 million, some much larger.
- “Lean” referred at minimum to use of target value delivery and last planner
- No projects were over budget or time
- All projects were ‘fit for purpose’
- Average cost 3.4% under budget
- Average cost 15% under market

Components of the current TVD benchmark (rated on a scale of 0 to 5)	SMCCV		ABSMC		UCSF	
	Mean	Stand. Dev.	Mean	Stand. Dev.	Mean	Stand. Dev.
1. With the help of key service providers, the customer develops and evaluates the project business case and decides whether to fund a feasibility study; in part based on the gap between the project's allowable and market cost.	**4.1**	0.8	**3.4**	1.3	**2.3**	1.7
2. The business case is based on a forecast of facility life cycle costs and benefits, preferably derived from an operations model; and includes specification of an allowable cost—what the customer is able and willing to pay to get life cycle benefits. Financing constraints are specified in the business case; limitations on the customer's ability to fund the investment required to obtain life cycle benefits.	**3.2**	1.3	**3.4**	1.1	**2.5**	1.5
3. The feasibility study involves all key members (designers, constructors, and customer stakeholders) of the team that will deliver the project if the study findings are positive.	**4.8**	0.5	**3.9**	0.9	**2.7**	1.8
4. Feasibility is assessed through aligning ends (what's wanted), means (conceptual design), and constraints (cost, time, location, ...). The project proceeds to funding only if alignment is achieved, or is judged achievable during the course of the project.	**4.7**	0.5	**3.9**	0.9	**3.2**	1.9
5. The feasibility study produces a detailed budget and schedule aligned with scope and quality requirements.	**4.4**	0.5	**4.1**	0.7	**2.8**	1.3
6. The customer is an active and permanent member of the project delivery team.	**4.8**	0.4	**3.7**	1.1	**4.2**	1.3
7. All team members understand the business case and stakeholder values.	**3.5**	0.9	**3.0**	1.0	**3.3**	1.4
8. Some form of relational contract is used to align the interests of project team members with project objectives.	**4.8**	0.4	**4.7**	0.5	**2.3**	1.7
9. A cardinal rule is agreed upon by project team members – cost and schedule targets cannot be exceeded, and only the customer can change target scope, quality, cost or schedule.	**4.5**	0.7	**3.9**	0.7	**4.0**	0.9
10. The cost, schedule and quality implications of design alternatives are discussed by team members (and external stakeholders when appropriate) prior to major investments of design time.	**3.9**	0.7	**3.1**	0.9	**3.7**	1.2
11. Cost estimating and budgeting is done continuously through intimate collaboration between members of the project team—'over the shoulder estimating'.	**4.1**	0.7	**3.1**	0.7	**3.8**	1.3
12. The Last Planner® system is used to coordinate the actions of team members.	**3.8**	1.8	**3.9**	0.7	**3.9**	1.1
13. Targets are set as stretch goals to spur innovation.	**4.2**	0.9	**3.6**	1.0	**3.8**	1.3
14. Target scope and cost are allocated to cross-functional TVD teams, typically by facility system; e.g., structural, mechanical, electrical, exterior, interiors, ...	**4.4**	0.7	**4.3**	0.8	**4.3**	0.8
15. TVD teams update their cost estimates and basis of estimate (scope) frequently. Example from a major hospital project during the period when TVD teams were heavily in design: estimate updates at most every three weeks.	**4.1**	0.7	**3.7**	0.8	**3.3**	1.3
16. The project cost estimate is updated frequently to reflect TVD team updates. This could be a plus/minus report with consolidated reports at greater intervals. Often project cost estimates are updated and reviewed in weekly meetings of TVD team coordinators and discipline leads, open to all project team members.	**4.5**	0.5	**4.0**	0.6	**4.0**	1.4
17. Co-location is strongly advised, at least when teams are newly formed. Co-location need not be permanent; team meetings can be held weekly or more frequently.	**4.5**	0.5	**4.3**	1.1	**4.6**	0.5
TVD SCORE (%)	85%		75%		69%	

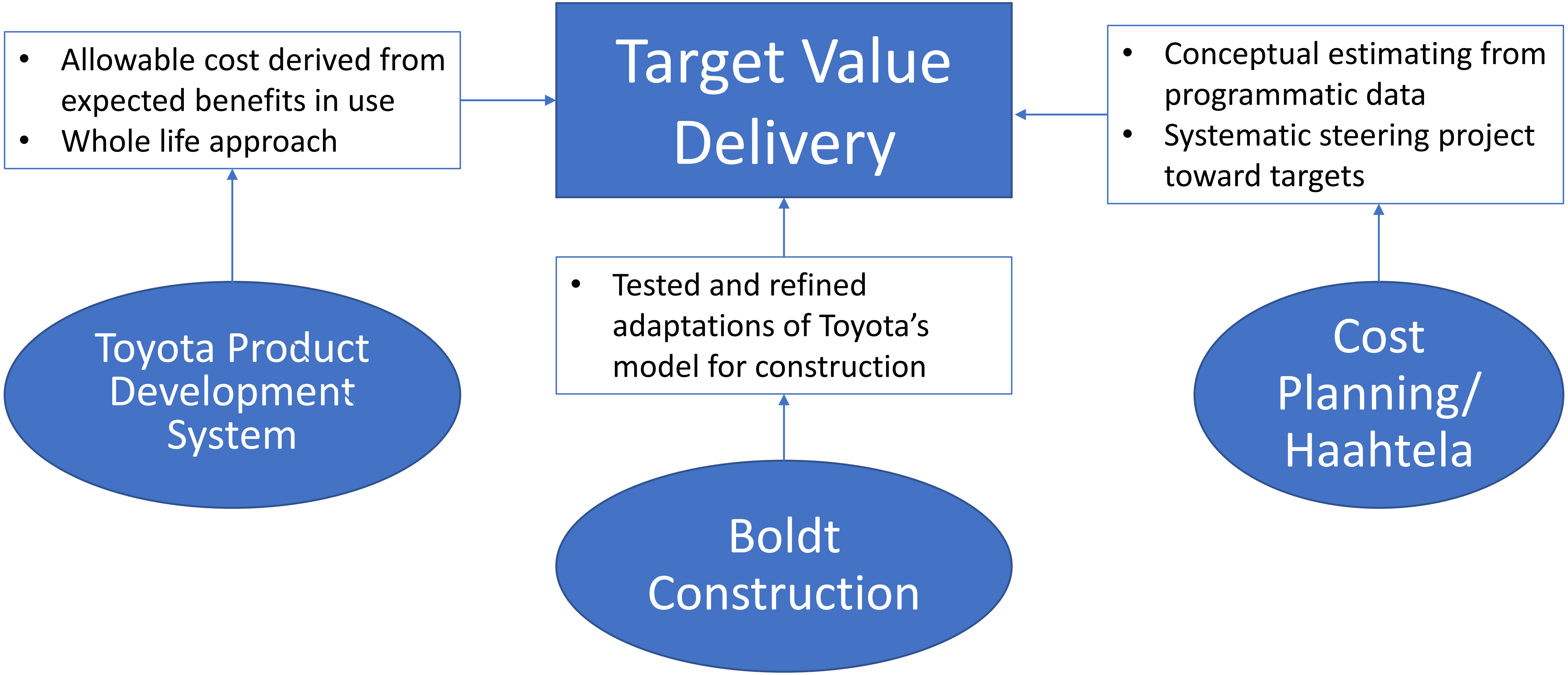
What is Target Value Delivery?

- A process for setting and steering to project targets that delivers value to stakeholders within their constraints—time, cost, location, etc.
- TVD has had several names. It came into Lean Construction with the name ‘target costing in construction’ to differentiate it from ‘target costing in product development’, which is used to manage product profitability. ‘Target value design’ came into use in Lean Construction because the fundamental target is delivery of value, not cost reduction for its own sake. Finally, I proposed ‘Target Value Delivery’ because value is not delivered until the project is constructed and released to the client for their use.

Target Value Delivery Process

1. Develop project business plan
2. Set targets for what's wanted and conditions of satisfaction/constraints on its delivery
3. Validate the proposed project and confirm targets
4. Steer design to targets
5. Steer construction to targets

Where did TVD come from?



Ashworth, A. and Perera, S. (2015). *Cost Studies of Buildings, 6th ed.* Routledge, London

Cost Planning

According to Ashworth & Perera, cost planning (p.303ff, Ch. 15) was developed in the 1950s, prior to which no method was available to estimate the cost of a building before it was designed and bids were received. Designs had often to be redrawn and too often what was delivered was not fit for purpose.

- Elemental cost planning, aka ‘designing to a cost’ (Ministry of Education)
  - Also called “target cost planning” since a cost limit is fixed and the design team must produce a design not to exceed that cost. Cost limits are calculated using the financial method of approximate estimating (e.g., cost per hospital bed) or by the interpolation method, where the cost is based on other similar schemes, taking into account spatial requirements and quality standards (interpolation method=benchmarking).
- Comparative cost planning, aka ‘costing a design’ (RICS)
  - Various design solutions are developed, then the one offering the best value for money is selected.

Haahtela, Y. (1980). *Normal Cost Procedure in Construction.* Helsinki University of Technology

Haahtela

The fundamentals of TVD emerged in Finland in 1980 (Haahtela, 1980) without awareness of target costing in Japanese product development or explicit reference to cost planning. That fact, together with the widespread inability to read Finnish (before Google Translate) delayed awareness of the Finnish development until the early 2000s, a time when Japanese target costing was adapted from product development for use in built environment projects (Ballard and Reiser, 2004). So it is important to understand both the Finnish development of target costing in construction and Japanese target costing in Lean Product Development in order to understand how Target Value Delivery came to have its current shape.

TPDS vs TPS

- The Toyota Production System (TPS) is a model for lean making.

- The Toyota Product Development System (TPDS) is a model for lean designing.

Toyota Product Development System

- Everyone who touches or is touched by a product during its life is involved in its design—integrated team vs sequential processing
- Design coordination is achieved through set based concurrent engineering
- The Chief Engineer of each product development project is the guardian of customer value

Key Points

A. Target Value Delivery is a process for setting and steering to project targets that deliver value to stakeholders within their constraints—time, cost, location, etc.

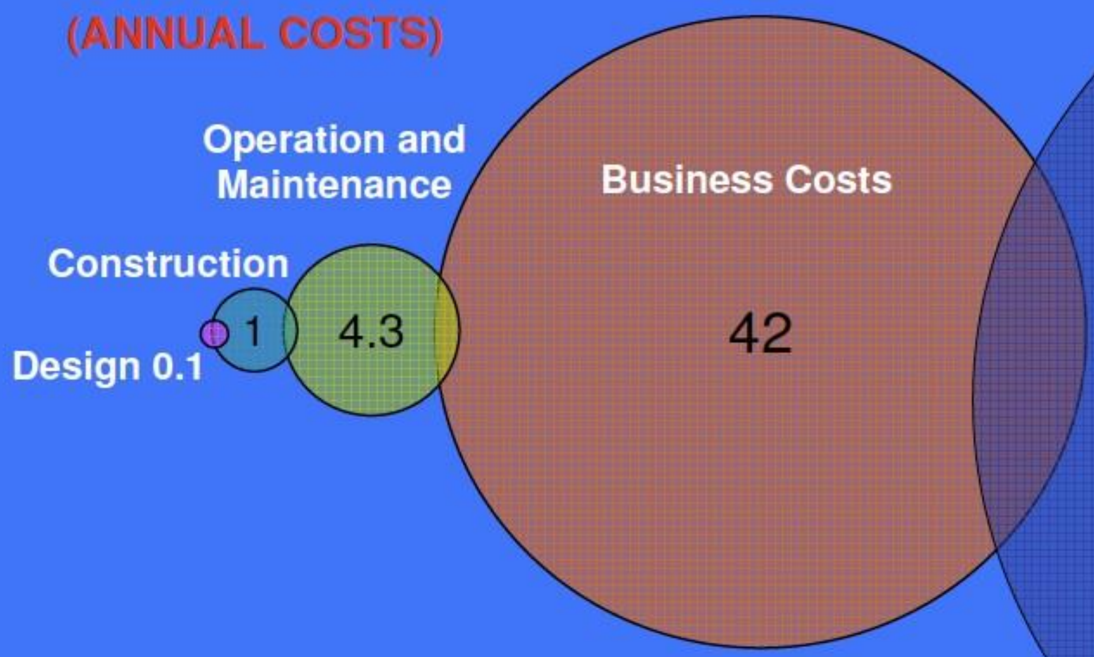
B. Target Value Delivery is the result of several historical influences:
   - Cost planning/Haahtela
   - Japanese target costing/Toyota’s Product Development System
   - The Boldt Company’s experimentation since 2002

How does TVD work?

- How are targets set?
- How is design steered to targets?
- How is construction steered to targets?

What HEALTHCARE customers really need

NHS Estates



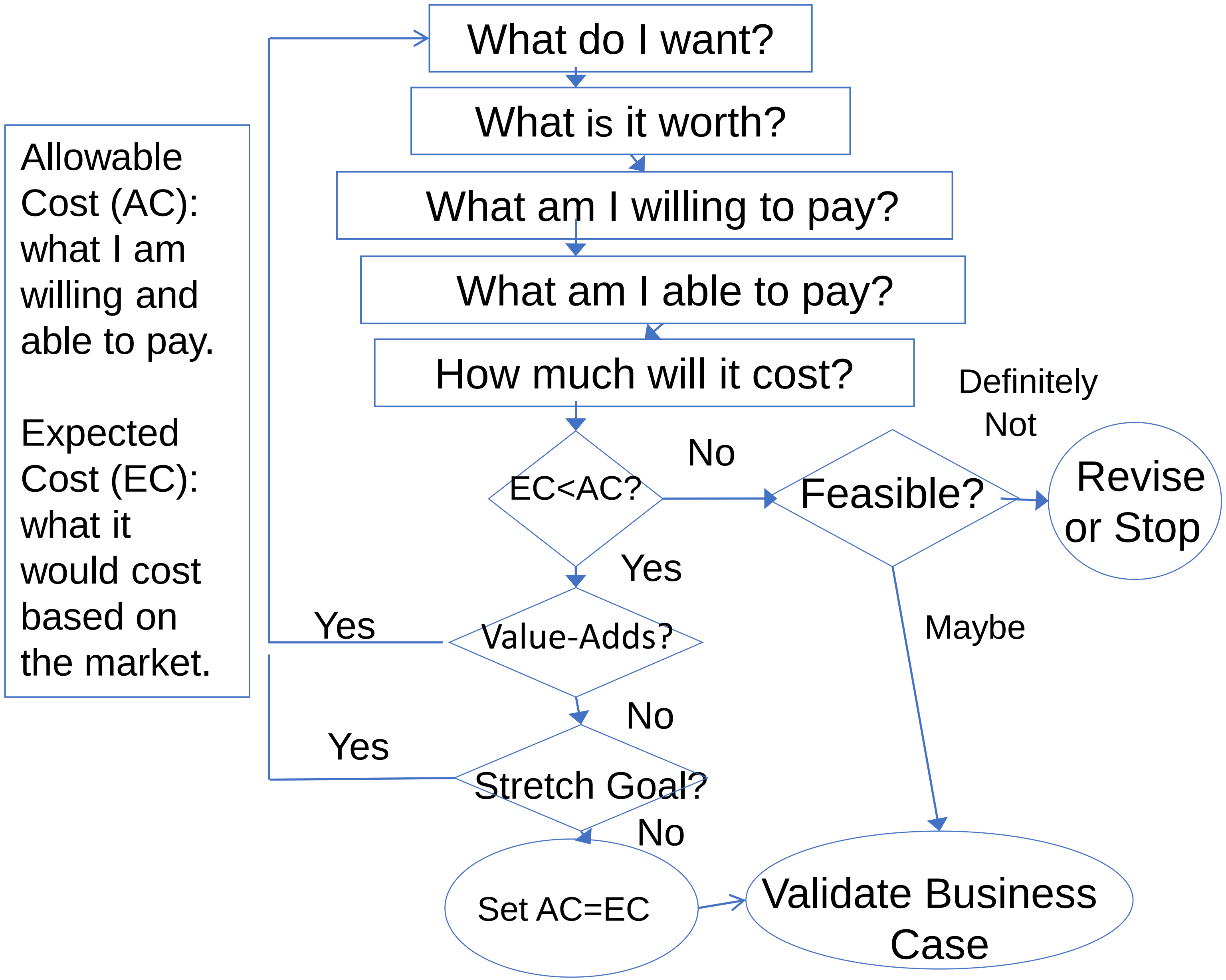
Healthcare outcomes

Clinical outcomes
Hospital-acquired infection rates
Safety outcomes
Medication error rates
Medication rates
Re-hospitalisation rates
Length of stays
Patient transfers
Costs per unit of service
Patient satisfaction
Visitor satisfaction
Staff morale
Staff turnover

From Evans, et al. 1998

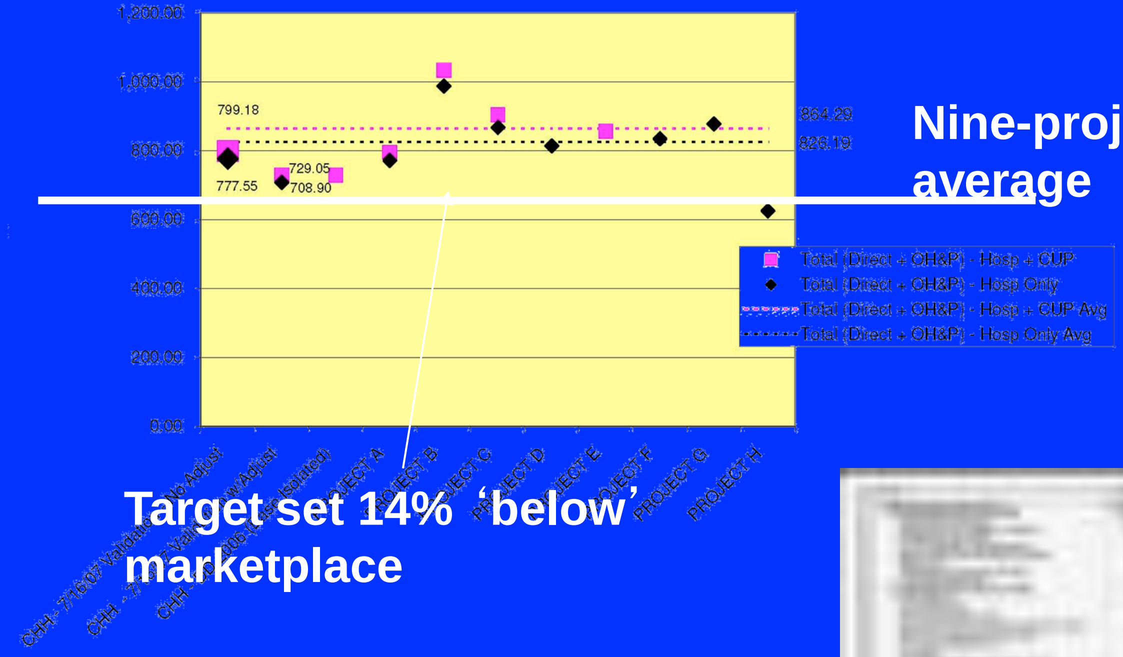
In moving from an idea to a go/no go decision, several key questions are asked and answered

A. What benefits are wanted?
B. What is the lowest acceptable ratio of benefits to costs? (allowable cost)
C. How does this project compare to others as an investment alternative?
D. Given the risks and uncertainties, can this project be completed successfully?
E. Answering those questions involves producing and assessing a business case, and identifying and assessing risks and opportunities in project delivery.



Allowable Cost (AC): what I am willing and able to pay.
Expected Cost (EC): what it would cost based on the market.
What do I want?
What is it worth?
What am I willing to pay?
What am I able to pay?
How much will it cost?
EC<AC?
No
Feasible?
Definitely Not
Revise or Stop
Yes
Value-Adds?
Yes
Maybe
No
Yes
Stretch Goal?
No
Set AC=EC
Validate Business Case

Setting the target cost and project schedule



Nine-project marketplace average

Target set 14% ‘below’ marketplace

Key Points

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B. Target Value Delivery is the result of several historical influences:
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C. Allowable cost is not an estimate but rather what a client is willing and able to pay to get what they want.

D. Targets are set through gap analysis of allowable versus expected cost.

E. Expected cost is set by benchmarking similar 'buildings' or by modeling what's wanted and costing the model.

F. Decisions to fund a project consider feasibility; i.e., if the project can be delivered with acceptable risk.

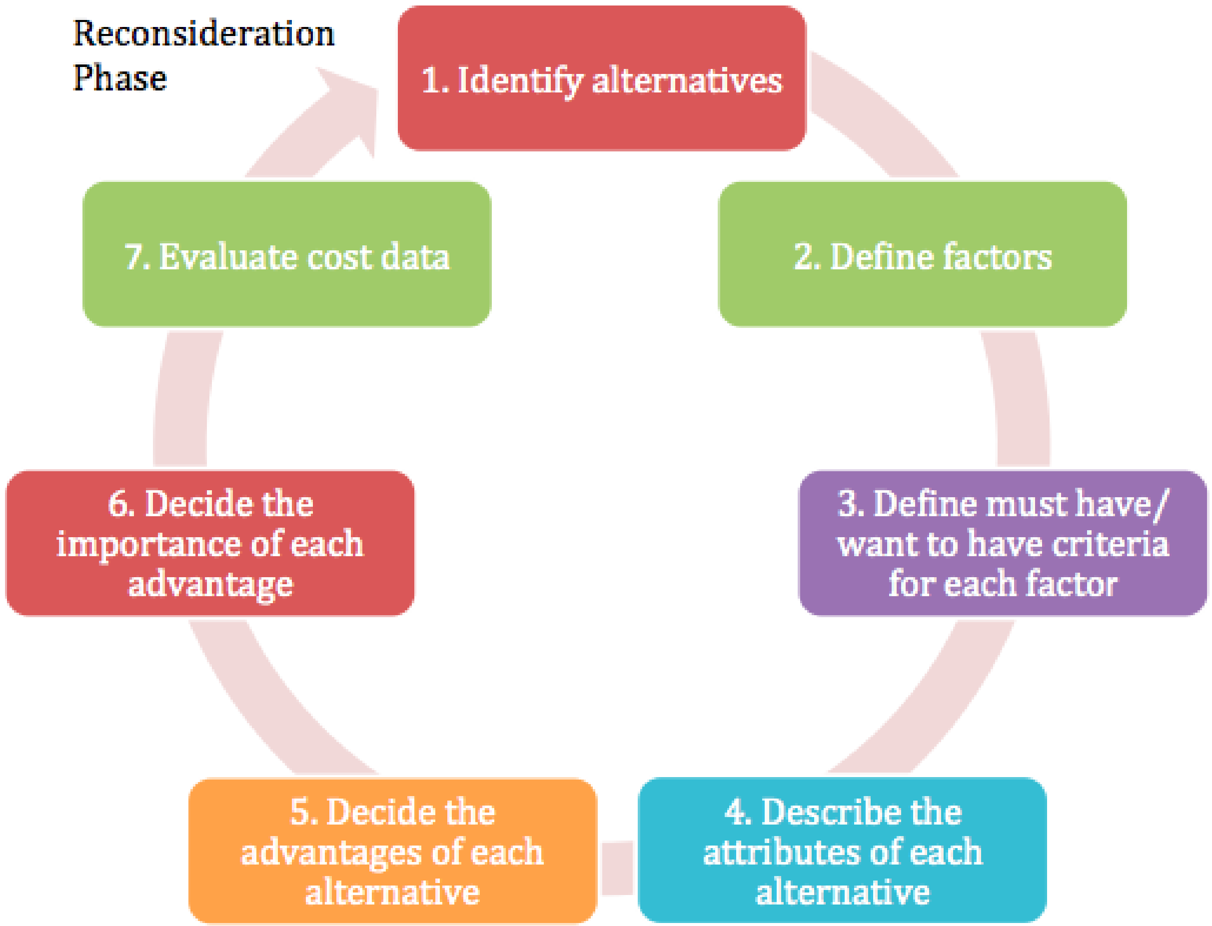
Steering to Targets

- To decide if to fund ‘this’ project, only the total project target cost is needed. That doesn’t work for steering design because design decisions are made by system and component, so the target cost must be allocated accordingly.
- Target cost allocation to systems and components doesn’t work for construction, which needs the project target cost allocated to work packages.

Steering to Targets in Design

“Co-operation between two models, Cost Model and BIM, forms a steering mechanism in the design phase, i.e. goals, fast feedback loops and transparent platform for decision making. Co-operation ensures creativity in design and steering within target cost.” (Ari Pennanen, Haahtela)

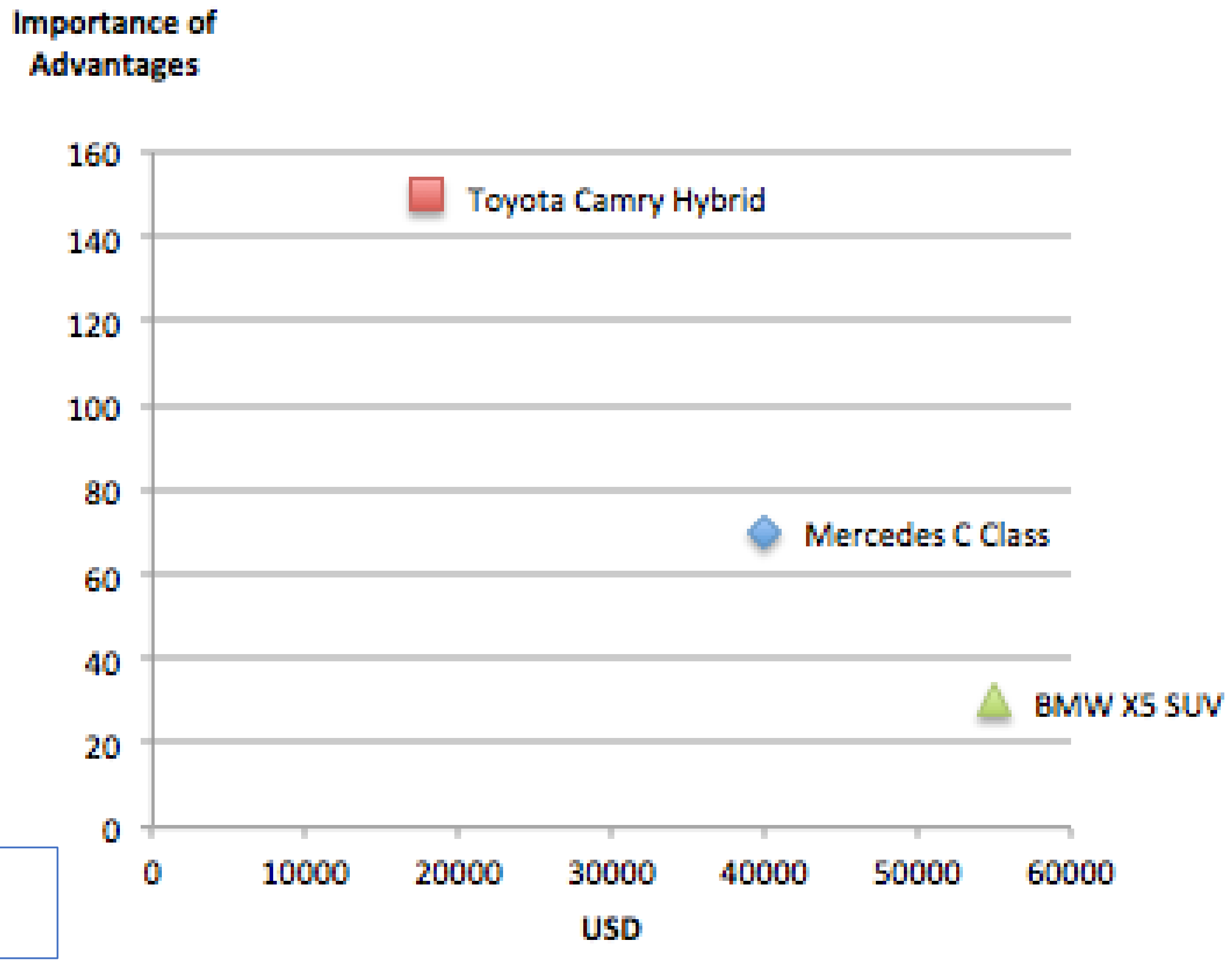
CBA Steps



Reconsideration Phase
1. Identify alternatives
2. Define factors
3. Define must have/ want to have criteria for each factor
4. Describe the attributes of each alternative
5. Decide the advantages of each alternative
6. Decide the importance of each advantage
7. Evaluate cost data

Choosing By Advantages Study of: Heating Hot Water System		Alternative 1		Alternative 2	
		Central Plant Heating Hot Water System		Distributed Heating Hot Water	
Factor: Square feet of Mechanical Space Required					
Criteria:	Attribute	3200 square feet		5100 sq ft required/17 rooms	
	Advantage	1300 Sq Ft.			
Factor: Access for Maintenance					
Criteria:	Attribute	Outside secure perimeter		Inside secure perimeter	
	Advantage	Outside rather than in			
Factor: Quantity of Boilers & Standby					
Criteria:	Attribute	3 duty plus 1 standby		20 duty +7 Standby	
	Advantage	Less total boilers			
Factor: Ability to do Boiler Stack Heat Recovery					
Criteria:	Attribute	10% increase in boiler efficeincy		Not required	
	Advantage	Reduction X therms			
Factor: Pumping Energy					
Criteria:	Attribute	More required due to long distribution runs		Less required due to shorter piping runs	
	Advantage			500,000 KwH per year	
Factor: Construction Schedule					
Criteria:	Attribute	Longer due to site distribution		Shorter - no site distribution required	
	Advantage			2 weeks	
	Total Importance		0		0
	Capital Cost				

Courtesy of Paz Arroyo



Courtesy of Lean Construction Blog

The Lean Ideal

Give customers, internal and external, exactly what they need to accomplish their purposes, with no waste.

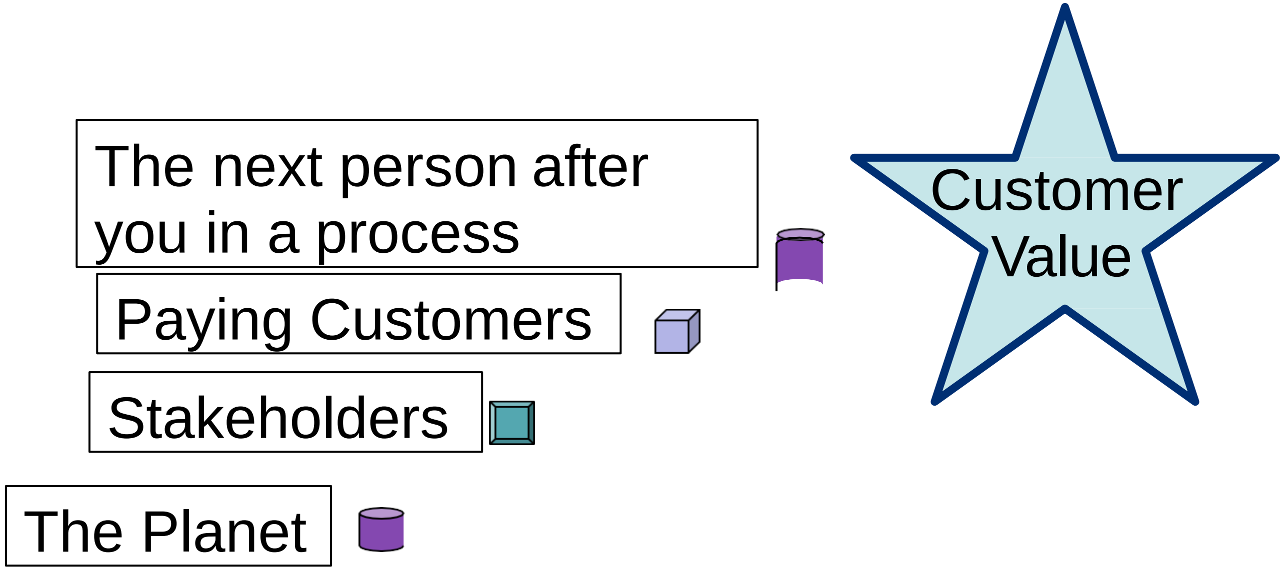


Figure 1.10

Results of VE Programs (Million U.S. $)

Agency	Annual Approximate Expenditure	Period	Annual Program Cost	Annual Savings	% Savings
EPA	1,100	1981 - Present	3 - 5	30	2 - 3
Federal Highways	10 - 20.000	1981 - Present	Varies Widely	150 - 200	1.5
Corps of Engineers	3,400	1965 - Present	3	200	5 - 7
Naval Facilities - Engineering Command	2,400	1964 - Present	2.5	100	3 - 5
Veterans Administration	200	1988 - Present	0.5	10	3 - 5
School Facilities State of Washington	200	1984 - Present	4	5 - 10	3 - 5
Office of Management and Budget, NYC	2,000 1,700	1984-87-88 Present	1 to 1.5	80 200 - 400	3 - 5 10 - 20
Design & Construction United Technology	300	1984 - 1985	0.5	36	12
GDMW - MODA Saudi Arabia	2,000	1986 - Present	3	150	5 - 10

Steering to Targets in Construction

	Goal	Value	Current	Trending
SAFETY				
LOST TIME INCIDENT RATE	< 0.3 (GOAL)	0.2 (PROJECT TO DATE)	0 (NOV. INCIDENT COUNT)	– (TRENDING)
TOTAL INCIDENT RATE	< 1.5 (GOAL)	1.5 (PROJECT TO DATE)	1 (NOV. INCIDENT COUNT)	↑ (TRENDING)
RECORDABLE INCIDENT RATE	< 1.0 (GOAL)	1.4 (PROJECT TO DATE)	1 (NOV. INCIDENT COUNT)	↑ (TRENDING)
CSI PARTICIPATION: FOREMAN	100% (GOAL)	83% (PROJECT AVERAGE)	97% (CURRENT MONTH)	↑ (TRENDING)
PREDICTIVE SOLUTIONS PARTICIPATION: SUPTs, APMs, PEs	100% (GOAL)	87% (PROJECT AVERAGE)	95% (CURRENT MONTH)	↑ (TRENDING)
PREDICTIVE SOLUTIONS PARTICIPATION: DIRECTORS, PMs, Sr. PMs	100% (GOAL)	90% (PROJECT AVERAGE)	89% (CURRENT MONTH)	↓ (TRENDING)
PREDICTIVE SOLUTIONS PARTICIPATION: SAFETY MGR, SAFETY ENGR	100% (GOAL)	100% (PROJECT AVERAGE)	100% (CURRENT MONTH)	– (TRENDING)
PEOPLE				
LOCAL BUSINESS ENTERPRISE ON PROJECT	> 14% (GOAL)	14.3% (PROJECT AVERAGE)	15.0% (CURRENT MONTH'S AVG)	↓ (TRENDING)
LOCAL RESIDENT EMPLOYEE (JOURNEYMEN & APPRENTICES)	> 30% (GOAL)	28.9% (PROJECT AVERAGE)	23.1% (CURRENT MONTH'S AVG)	↓ (TRENDING)
PROJECT TEAM USE OF ALT. TRANSPORTATION	50% (GOAL)	50% (PROJECT AVERAGE)	65% (CURRENT MONTH)	↑ (TRENDING)
TEAM SURVEY: PULSE REPORT SCORE	≥ 5.0 (GOAL)	5.6 (PROJECT AVERAGE)	5.7 (CURRENT MONTH)	↑ (TRENDING)
PULSE REPORT PARTICIPATION RATE	80% (GOAL)	45% (PROJECT AVERAGE)	71% (CURRENT MONTH)	↑ (TRENDING)
QUALITY				
INSPECTION PASS RATE	100% (GOAL)	99.7% (PROJECT AVERAGE)	99.7% (CURRENT MONTH)	↓ (TRENDING)
RE-INSPECTIONS OUTSTANDING FOR > 3 DAYS	0 (GOAL)	32 (PROJECT TOTAL)	6 (CURRENT MONTH)	↑ (TRENDING)
DEFECTS FOUND (DELIVERED & INSTALLED)	0 (GOAL)	7 (PROJECT TOTAL)	0 (CURRENT MONTH)	– (TRENDING)
PRODUCTION / SCHEDULE				
INTERMEDIATE MILESTONE PERFORMANCE (ON TIME OR FASTER)	15/15 (GOAL)	10/11 (PROJECT TO DATE)	0/0 (CURRENT MONTH)	– (TRENDING)
TOTAL SCHEDULE SAVINGS	> 3% (GOAL)	0% (PROJECT TO DATE)	0% (CURRENT MONTH)	– (TRENDING)
FIELD LABOR SAVINGS	> 10% (GOAL)	19.0% (LAST MONTH'S AVG)	20.0% (CURRENT MONTH'S AVG)	↑ (TRENDING)
COST				
WORK IN PLACE VARIANCE	-5%≤WIP≤5% (GOAL)	-5% (PROJECT AVG VARIANCE)	-14% (CURRENT MONTH)	↓ (TRENDING)
CONTINGENCY BALANCE	≥ $61,319,931 (GOAL)	$50,131,526 (LAST MONTH)	$48,234,833 (CURRENT MONTH)	↓ (TRENDING)

Courtesy of Sutter Health

Can TVD be done without some form of IPD?

Yes, TVD can be done without IPD, heavy or light. In fact, prior to their participation in the TVD research group, Haahtela's projects all were design-bid-build, without shared risk and reward commercial terms.

TVD and Collaborative Contracts

- Setting targets is agreeing to goals as opposed to simply predicting (as in weather forecasting) what the project will cost.
- Hypothesis: The willingness of project players to commit to goals is higher when they participate in setting them and when they have a stake in their achievement. That’s why Project Alliancing and Integrated Project Delivery projects have been so successful in meeting or beating challenging targets.

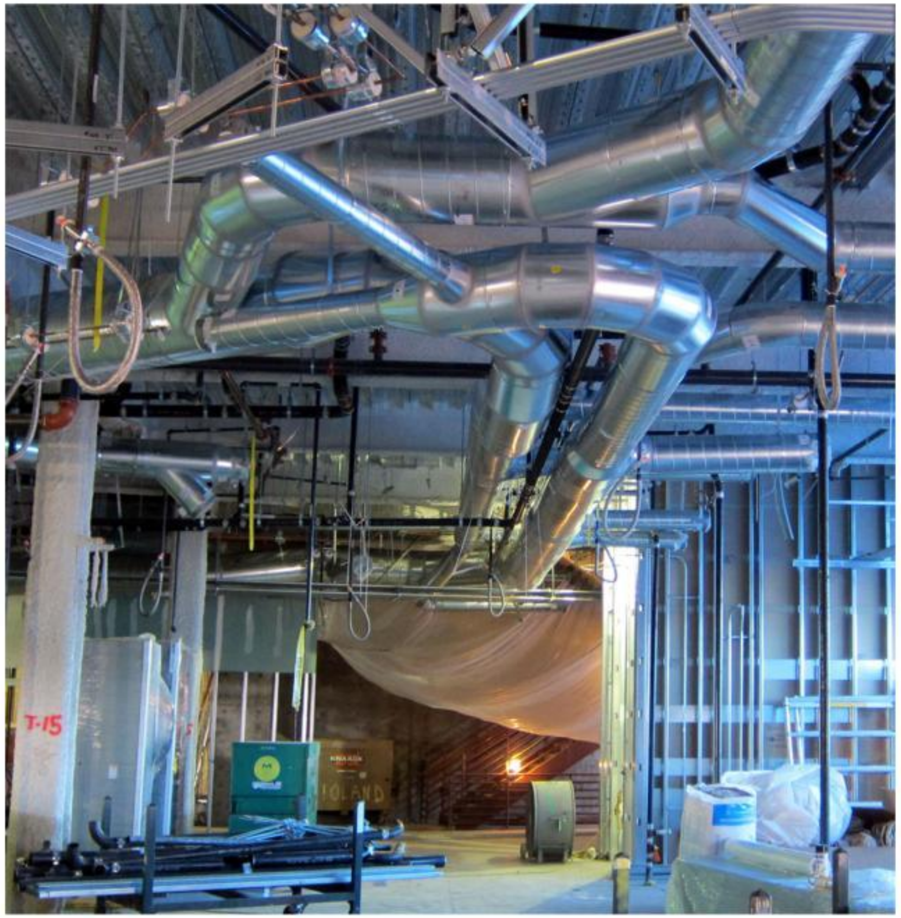
Eden Medical Center Replacement Hospital

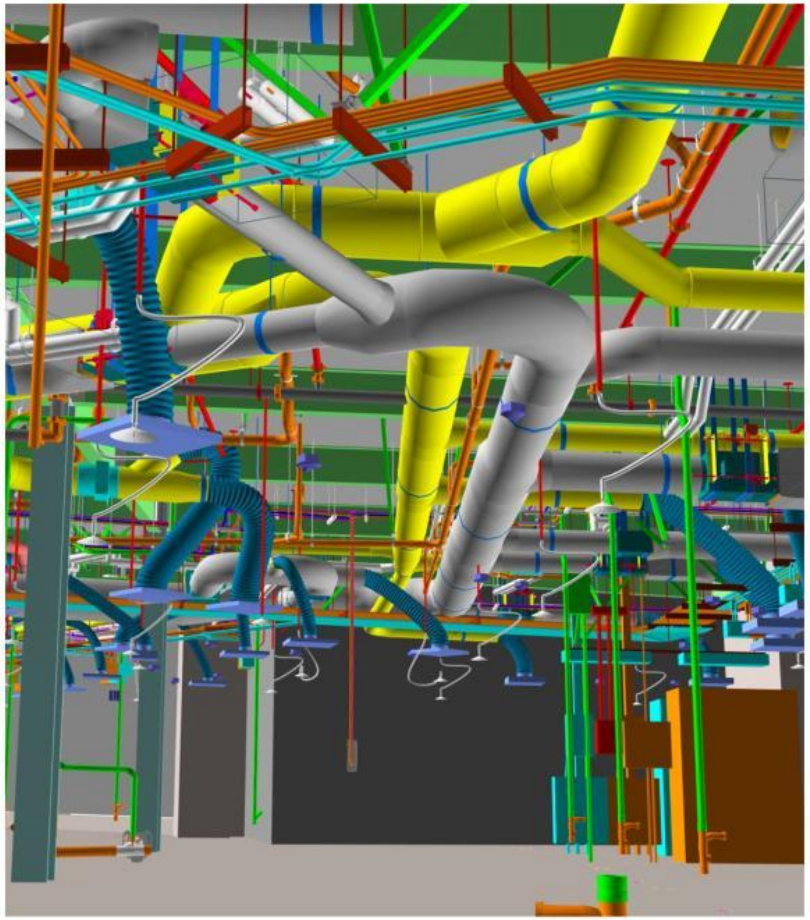
- **$309M Project Budget**
- **130 licensed beds, 223,000 SF**
- **Completion: 3Q 2012**

Performance – Eden Medical Center

- Ahead of schedule and under budget
- No compromise to space program or sustainability goals
- Construction rework 15-80% less than trade baselines
- Productivity 5-20% greater than trade baselines
- Mechanical/Plumbing installed exactly to the model 99% of the time
- Electrical installed exactly to the model 71% of the time
- Framing installed exactly to the model 79% of the time
- Fewer RFI's, Change Orders and failed inspections than Sutter 'legacy' projects
- 'Tool time' significantly higher than industry standards

Eden Medical Center – adherence to the model





Sutter Medical Center Castro Valley

Target Value Design

Tuesday, January 11, 11

Construction Budget Summary

Original EMP: $228,197,957
Preliminary Change Orders: $4,923,778
Total Projected EMP: $233,121,735

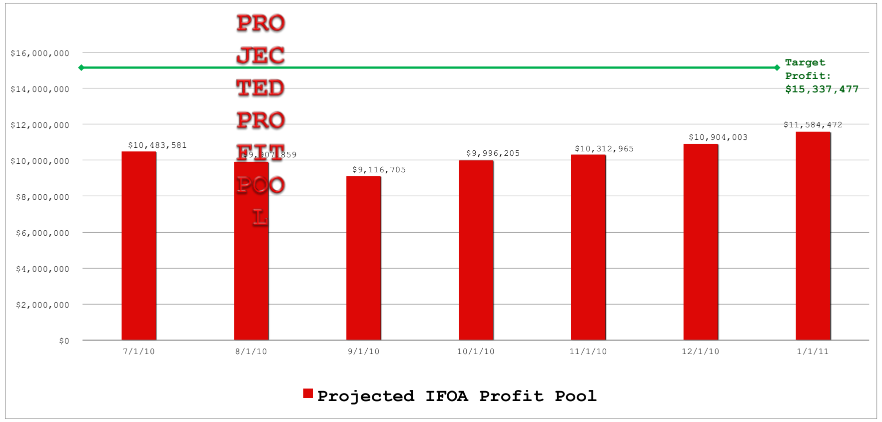
Total Projected Actual Cost *: $221,537,265
Total Assessed Cost of Risk (incl. in above): ($55,750)

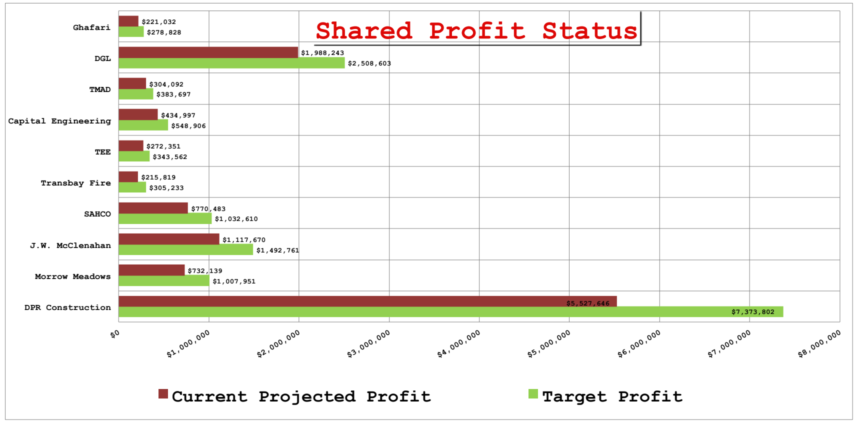
* incl. contingencies, warranty, and assessed risk

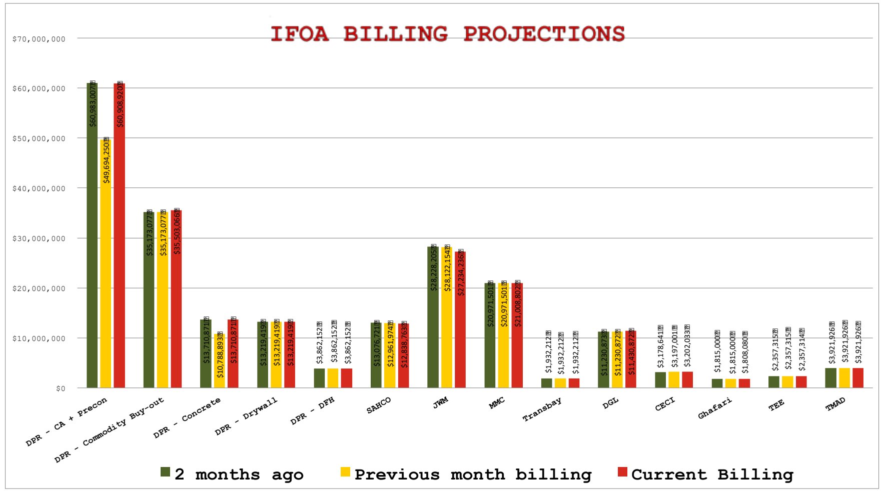
Total Target Profit: $15,337,477
Current Projected Profit: $11,584,472

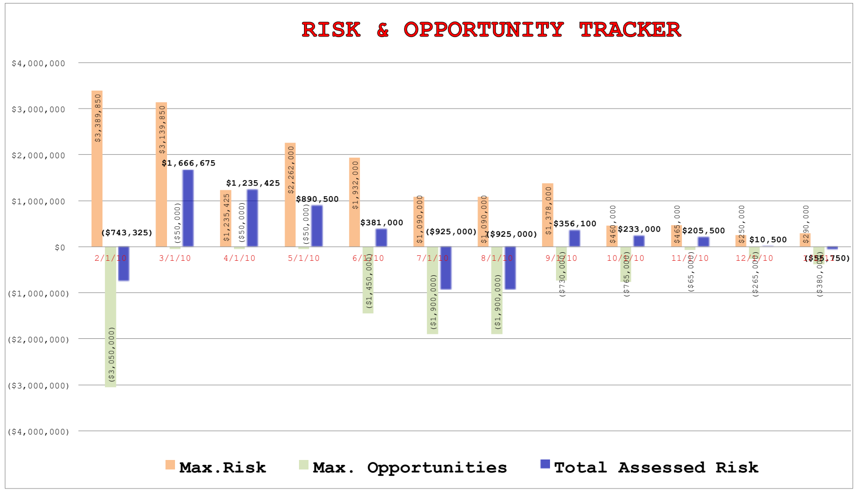
TOTAL COST REDUCTION REQUIRED TO REACH PROFIT GOAL:

$3,753,005









Key Points

A. Target Value Delivery is a process for setting and steering to project targets that deliver value to stakeholders within their constraints—time, cost, location, etc.

B. Target Value Delivery is the result of several historical influences:
   - Cost planning/Haahtela
   - Japanese target costing/Toyota's Product Development System
   - The Boldt Company's experimentation since 2002

C. Allowable cost is not an estimate but rather what a client is willing and able to pay to get what they want.

D. Targets are set through gap analysis of allowable versus expected cost.

E. Expected cost is set by benchmarking similar 'buildings' or by modeling what's wanted and costing the model.

F. Decisions to fund a project are/should consider feasibility; i.e., if the project can be delivered with acceptable risk.

Key Points

G. The 1st rule in TVD: Targets for what’s wanted and for constraints on its delivery cannot be exceeded.

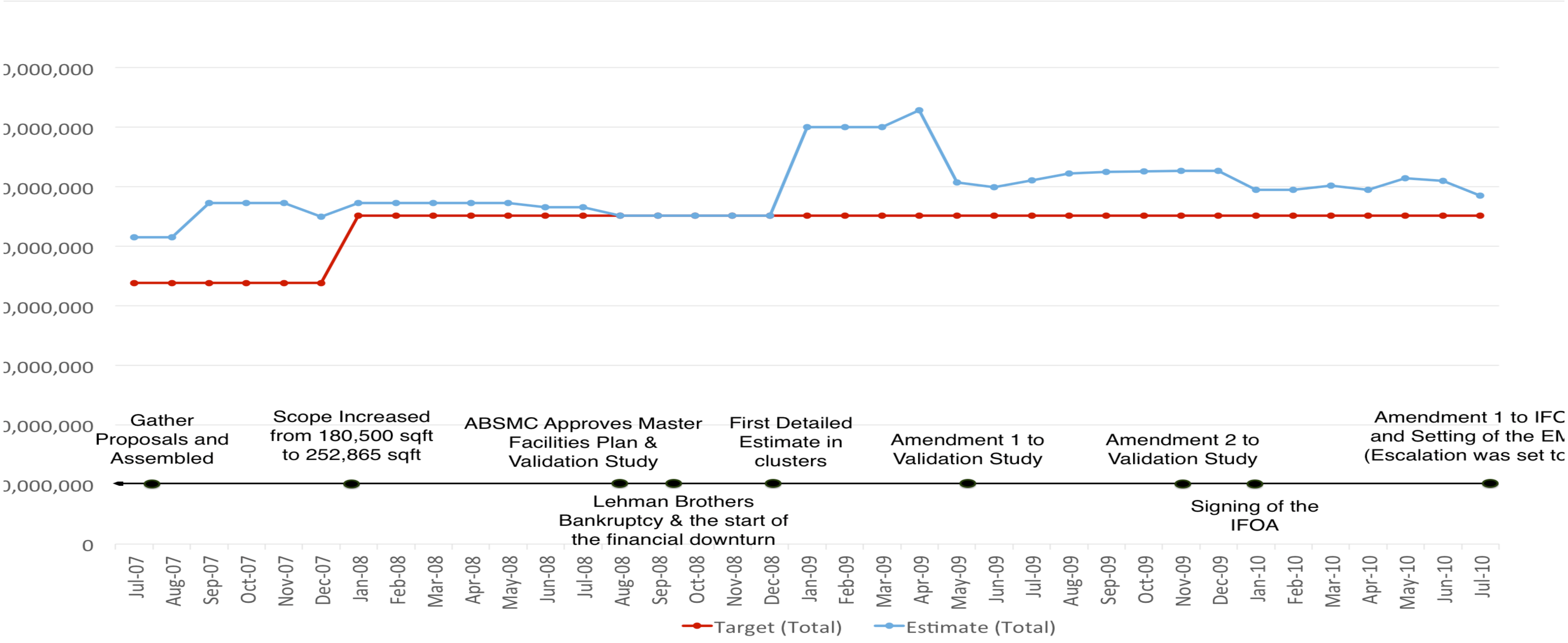
H. The 2nd rule in TVD: The client can change targets for what’s wanted and constraints any time they wish, but should assure that service providers do not suffer financially from that change.

I. Steering to targets in design is done by comparing the cost of proposed designs for systems and components against their cost in the Cost Model. Any increases in cost must be met by decreases in costs of other systems or components.

J. Steering to targets in construction is done by comparing the cost of work packages against their cost in the Cost Model. Any increases in cost must be met by decreases in costs of other work packages.

How TVD can go wrong

Target cost not aligned with target scope



"How to make shared risk & reward sustainable", www.iglc.net

Is the client able & willing to play their part?

A. Will you pursue the lean ideal, follow lean principles & use lean methods & tools?

B. Will you share your project objectives and allowable cost?

C. Will you strive to assure the profitability of designers and constructors?

D. Will you commit a person with decision making authority to work day-to-day on the project?

Are designers and constructors willing and able to play their parts?

A. At first, no design or construction firms may have experience with IPD, so the key question in selection is: Are you willing to develop your lean capabilities on this project?

B. Are you willing to put your profit at risk and to open your books for reimbursement of cost of work?

C. Are designers willing to include constructors in the design phase of the project?

D. Are constructors willing to learn how to contribute in the design phase of the project?

Key Points

A. Target Value Delivery is a process for setting and steering to project targets that deliver value to stakeholders within their constraints—time, cost, location, etc.

B. Target Value Delivery is the result of several historical influences:
   - Cost planning/Haahtela
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E. Expected cost is set by benchmarking similar 'buildings' or by modeling what's wanted and costing the model.

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Key Points

G. The 1st primary rule in TVD: Targets for what’s wanted and for constraints on its delivery cannot be exceeded.
H. The 2nd primary rule in TVD: The client can change targets for what’s wanted and constraints any time they wish.
I. Steering to targets in design is done by comparing the cost of proposed designs for systems and components against their cost in the Cost Model. Any increases in cost must be met by decreases in costs of other systems or components.
J. Steering to targets in construction is done by comparing the cost of work packages against their cost in the Cost Model. Any increases in cost must be met by decreases in costs of other work packages.
K. As far as can be determined from available reports, TVD projects have performed very well in delivering target net benefits to clients.
L. TVD projects can go wrong if TVD principles and processes are not followed.

Reports on TVD Project Performance

- Ballard, G., Dilsworth, B., Do. D., Low, W., Mosley, J., Phillips, P., Reed, D., Sargent, Z., Tillmann, P., Wood and Wood, N. (2015). How to make shared risk and reward sustainable. *Proceedings of the 23rd annual conference of the International Group for Lean Construction*. Available at iglc.net.
- Cheng, R., ed. (2016). Motivation and Means: How and Why IPD and Lean lead to Success. Available at http://arch.design.umn.edu/directory/chengr/
- Denerolle, S. (2013). The Application of Target Value Design to the Design Phase of 3 Hospital Projects. Project Production Systems Laboratory, University of California Berkeley. Available at p2sl.berkeley.edu
- Do, D., Chen, C., Ballard, G., and Tommelein, I. (2014). Target Value Design as a method for controlling project cost overruns. *Proceedings of the 24th annual conference of the International Group for Lean Construction*. Available at iglc.net.
- Do, D., Ballard, G. and Tillmann, P. (2015a). The application of target value design in the design and construction of the UHS Temecula Valley Hospital. *Project Production Systems Laboratory,* University of California Berkeley. Available at p2sl.berkeley.edu.
- Do, D., Ballard, G. and Tommelein, I. (2015b). An analysis of potential misalignments of commercial incentives in Integrated Project Delivery and Target Value Design. *Proceedings of the 23rd annual conference of the International Group for Lean Construction*. Available at iglc.net.
- Zimina, D., Ballard, G. and Pasquire, C., 2012. Target value design: using collaboration and a lean approach to reduce construction cost. *Construction Management and Economics*, *30*(5), pp.383-398.

Limitations of TVD

A. When projects involve new materials and technologies, that challenges both modeling what’s wanted and costing what’s modeled.
B. When projects change targets in mid-flight, that challenges steering to targets.
C. When cost escalation is significant and unpredictable, that challenges coming to agreement about risk allocation.

Target Value Delivery Research Group: Objectives

1. to discover or develop methods of setting and steering to targets that produce expected costs substantially more accurate than the -20%/+30% specified in the literature , and
2. to explain the process for delivering projects with such cost accuracy.

TVD Research Group Membership

Michael Bade.	UCSF.	Michael.Bade@ucsf.edu
Glenn Ballard.	P2SL.	ballard@ce.berkeley.edu
Phil Bartkowski.	DPR	philipb@dpr.com
Rachel Bartling.	HDR	Rachel.Bartling@hdrinc.com
Jayme Couchene.	Boldt	jayme.couchene@boldt.com
Mike Doiel	HDR.	Mike.Doiel@hdrinc.com
Frode Drevland	NTNU	frode.drevland@ntnu.no
Matt Goldsberry	HDR	matthew.goldsberry@hdrinc.com
Sulyn Gomez	P2SL.	sulyn@berkeley.edu
Yrjana Haahtela.	Haahtela	yrjana.haahtela@haahtela.fi
Trevor Hietpas	Boldt	Trevor.Hietpas@boldt.com
John Huggett.	Boldt	John.Huggett@boldt.com
Ole Jonny Klakegg	NTNU.	ole.jonny.klakegg@ntnu.no

Paul Martin.	UC Davis	psmmartin@ucdavis.edu
Peter Morris.	AECOM	peter.morris@aecom.com
Nick Papadopoulos	Eos Group	nickp@eosgroup.com
Ari Pennanen.	Haahtela	ari.pennanen@haahtela.fi
Michael Peterson	Mortenson	michael.peterson@mortenson.com
Dean Reed	DPR	DeanR@dpr.com
Mark Sands	PerformanceBuilding	msands@buildingcatalyst.com
Laurie Spitler.	Autodesk	laurie.spitler@autodesk.com
Clark Taylor.	Mortenson	clark.taylor@mortenson.com
Patricia Tillmann	UCSF	patricia.tillmann@gmail.com
Iris Tommelein	P2SL	tommelein@ce.berkeley.edu
Olav Torp	NTNU	olav.torp@ntnu.no
Jason Wu	Fong & Chan Arch.	jwu@fca-arch.vomq

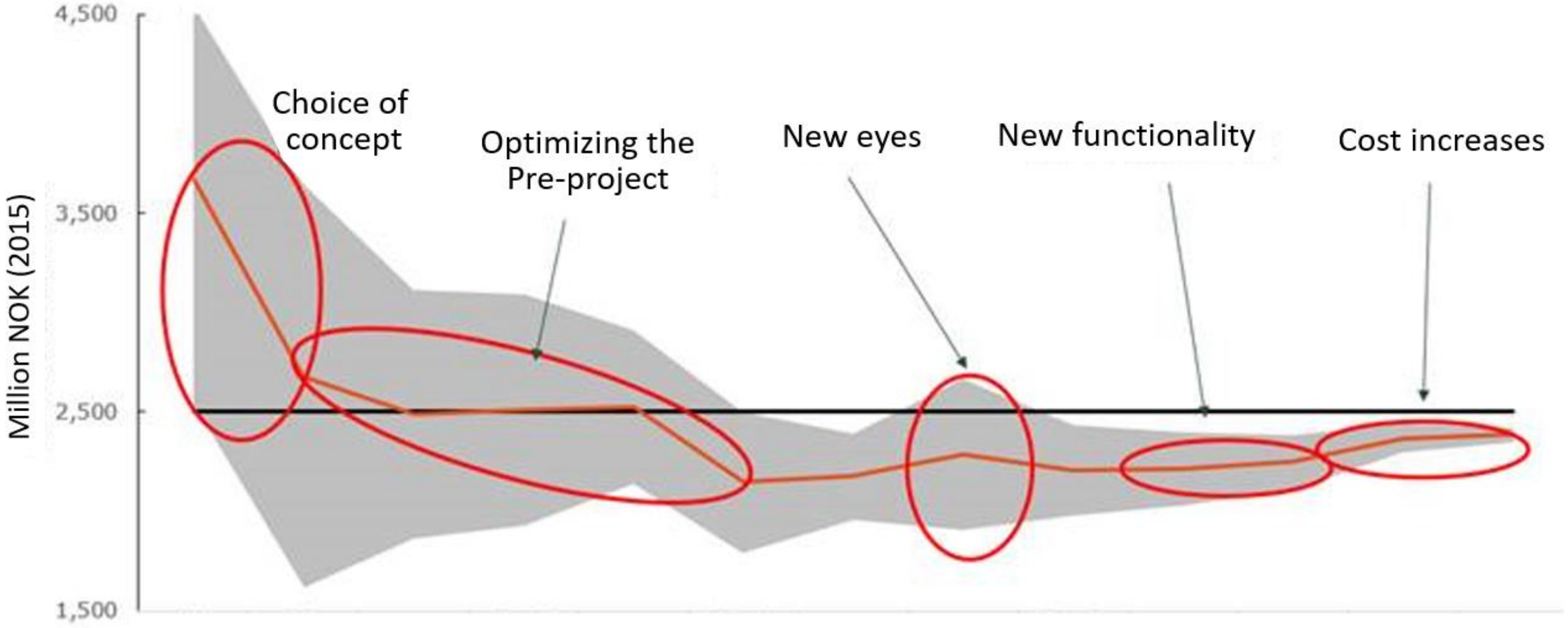
Norwegian National Police Response Center

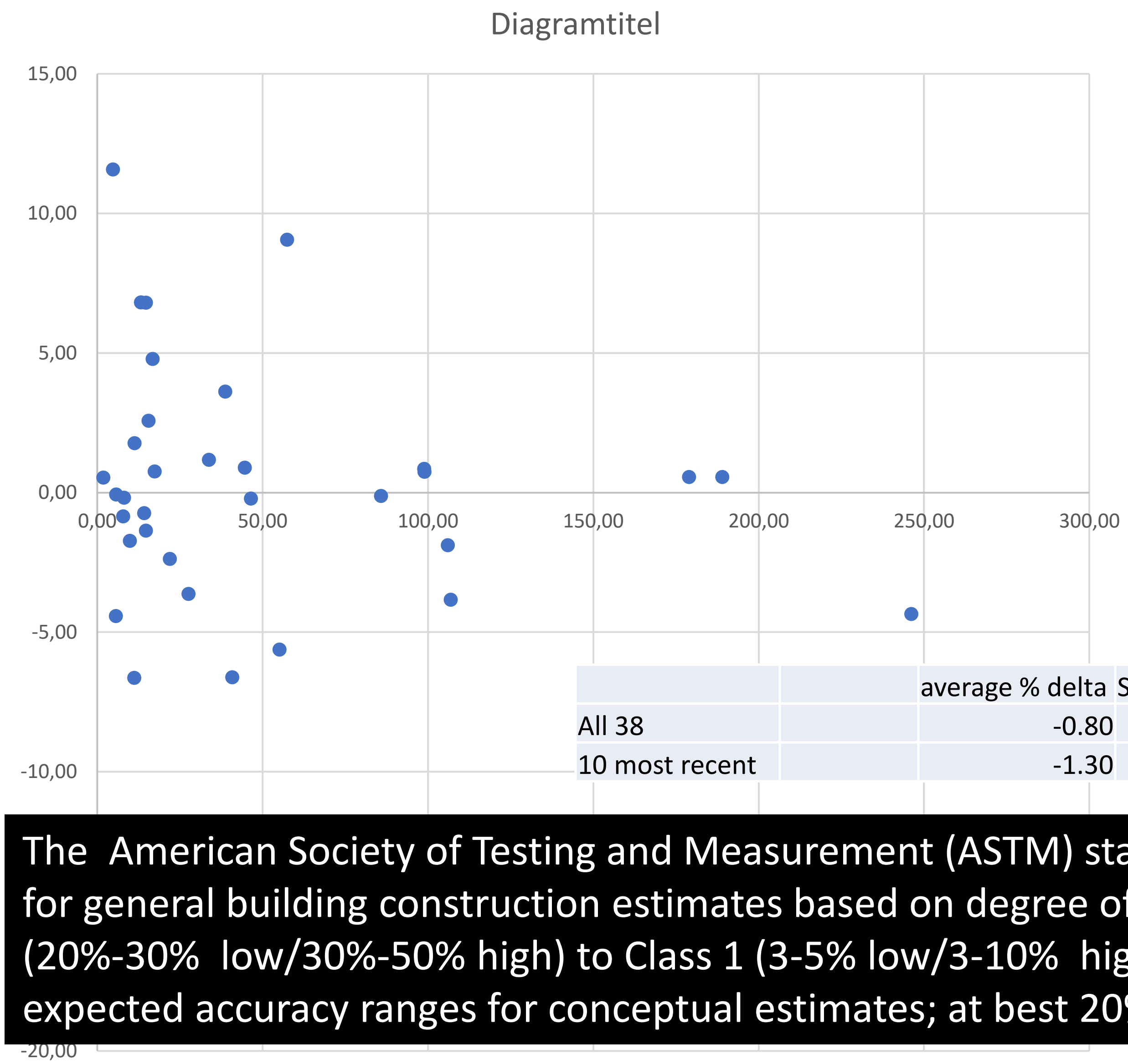
No.	Owner's requirements
	MUST HAVE
1	Colocated delta-force, bomb squad, hostage negotiation unit and the helicopter service in one new National Police Response Center (NPRC).
2	The NPRC should be operational 24/7.
3	Response time: Available resources must be sufficient for highly effective action (time to deploy and capacity for response).
4	Response quality: Access to training facilities with adequate capacity for individual and collective training.
5	Fast and flexible access to roads.
6	Satisfy requirements for safe flying in challenging weather and limited sight conditions.
7	Possibility for landing of large helicopters with transport and lifting capacities to allow for defence support or resque helicopters.
	SHOULD HAVE
1	Possibility to station large helicopters with transport capacity, including hangar facilities for the NPRC.
2	Necessary flexibility for future needs.
3	No major noice nusiance for neighbors
4	Available quartering and training capacity for personel outside the national response resources (NPRC)

Setting Target Cost

- Maximum Allowable cost for the pre-defined scope: 2,5 billion NOK (2015).
- Maximum Allowable cost for the total project, including any additional scope decided by the Owner: 2,8 billion NOK (2015).

Steering Cost to Benefit Targets





		average % delta	Std Deviation	Range		Ave. under	Ave. over
All 38		-0.80	4.9	-15	11.6	-3.5	3.3
10 most recent		-1.30	3.2	-6.6	2.6	-3.8	1.3

The American Society of Testing and Measurement (ASTM) standard provides typical accuracy ranges for general building construction estimates based on degree of project definition, ranging from Class 5 (20%-30% low/30%-50% high) to Class 1 (3-5% low/3-10% high). Class 5 is taken to represent the expected accuracy ranges for conceptual estimates; at best 20% low and 30% high.

Haahtela’s TaKu

What is it?

A software for producing building information models that takes input from the voice of the customer and produces an estimated cost for what’s wanted.

How does it work?

By embedding algorithms and formulas used by architects and engineers to move from ‘I want to be able to hear a pin drop from any seat in the theater’ to the material and labor costs of components and systems. Change the requirement and the estimate changes accordingly.

Target costing information model

Same information as designers use

Number of luminaries needed is based on illuminance required

N= ExA/(FxnxUfxMf)
where
E is illuminance required
A is size of the space
F is efficiency of the lamp
n is number of lamps in the luminaire
Uf is a certain factor (dealing with the absorption of surfaces)
Mf is a factor (dealing with probability that lamps work)

It is not necessary to produce first a design solution to count the number of luminaries (or size of main switchboard, or…) as the designers use the same formula to determine the number of luminaries, to size switchboards, etc.

Target costing information model

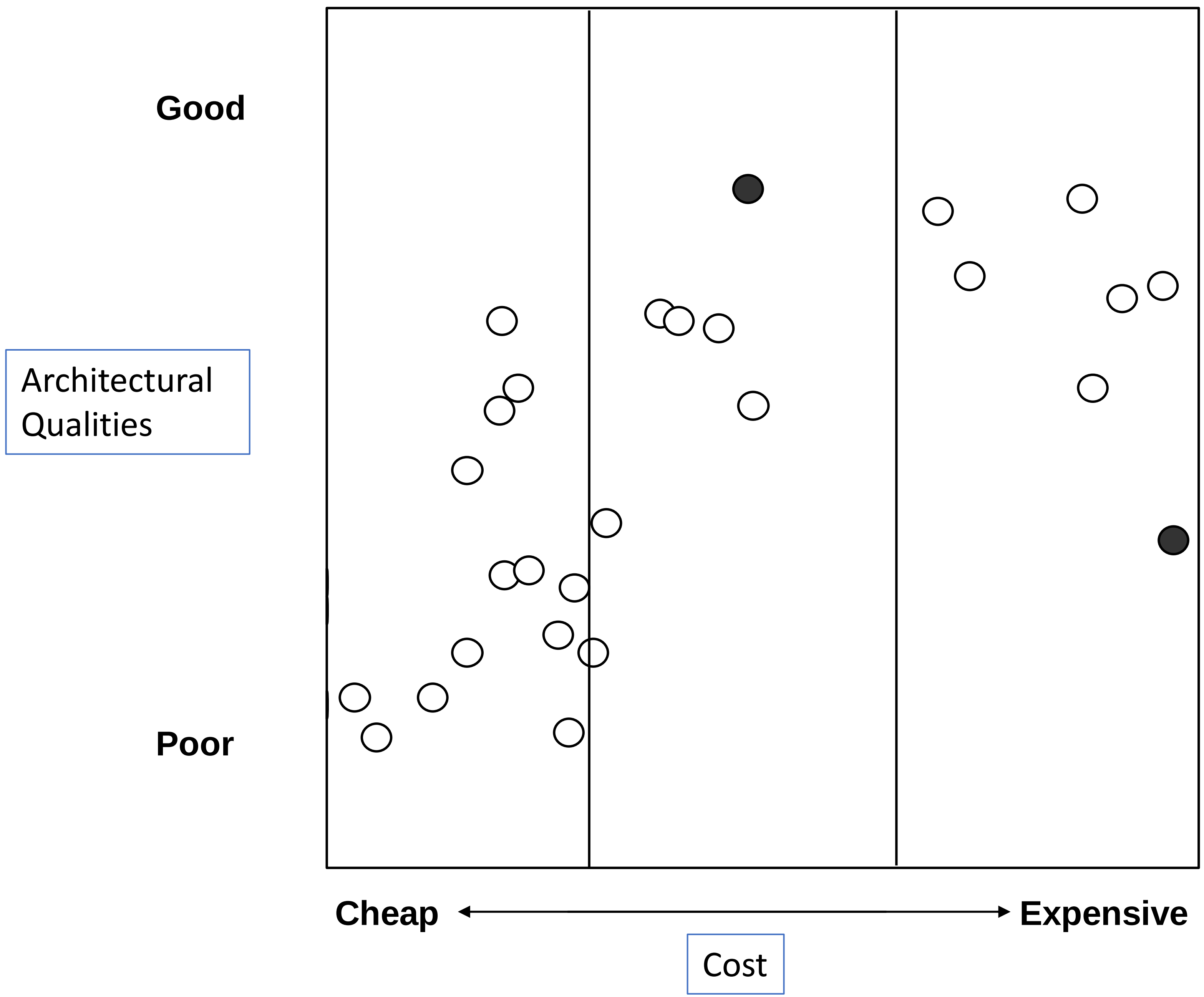
Same information as design uses

Number of lifts needed and performance of the lifts is based on waiting time

Round-Trip Time= Travel time + Stopping time + Transfer time
Travel time = (2 x Storeys x height of the floor) / Velocity
Stopping time = etc

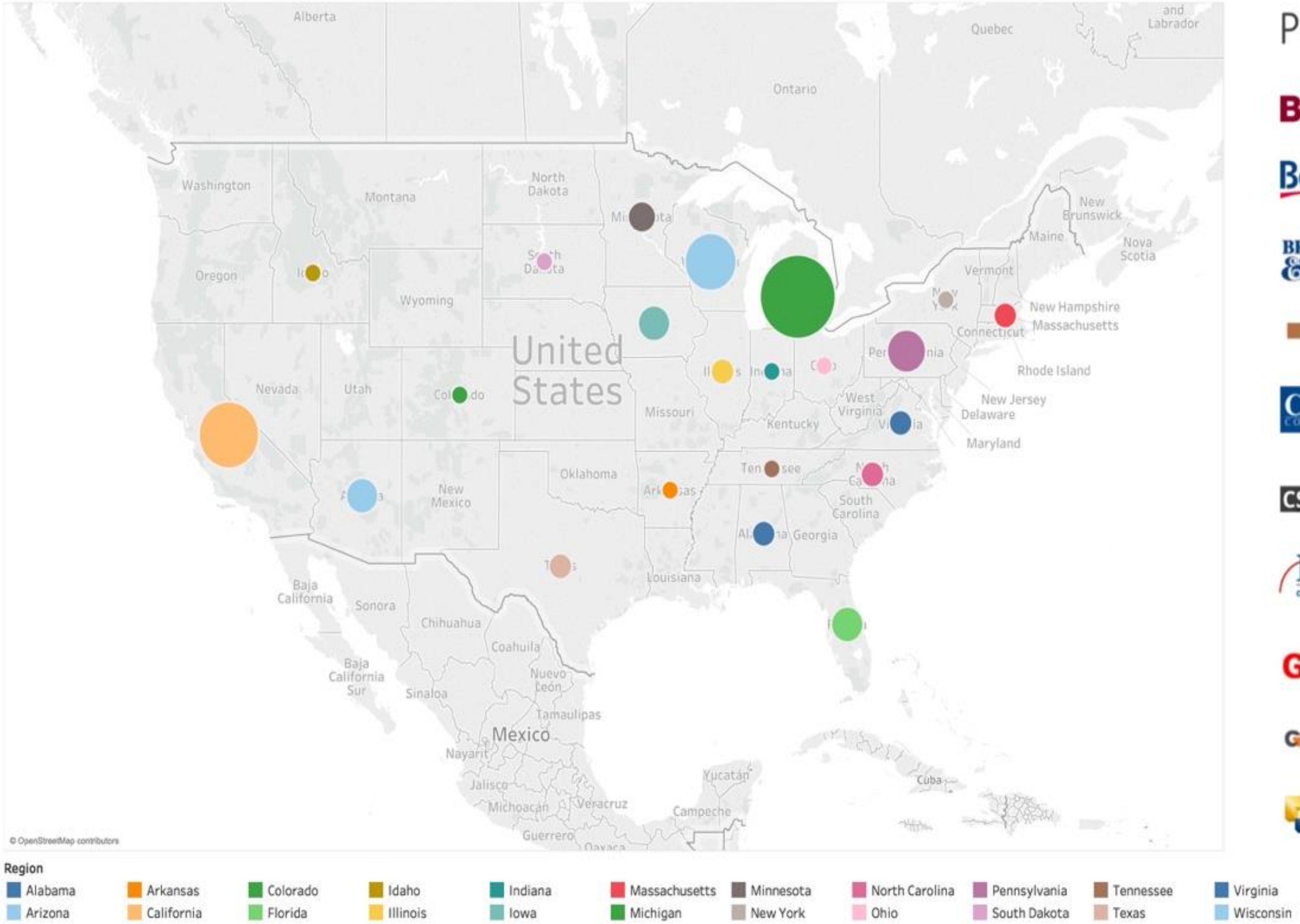
Waiting time = (Round trip time) / (2*number of lifts)

Recommended waiting intervals
-Offices 30 sec
-Hotels 60 sec
-etc


Good
Architectural
Qualities
Poor
Cheap
Expensive
Cost

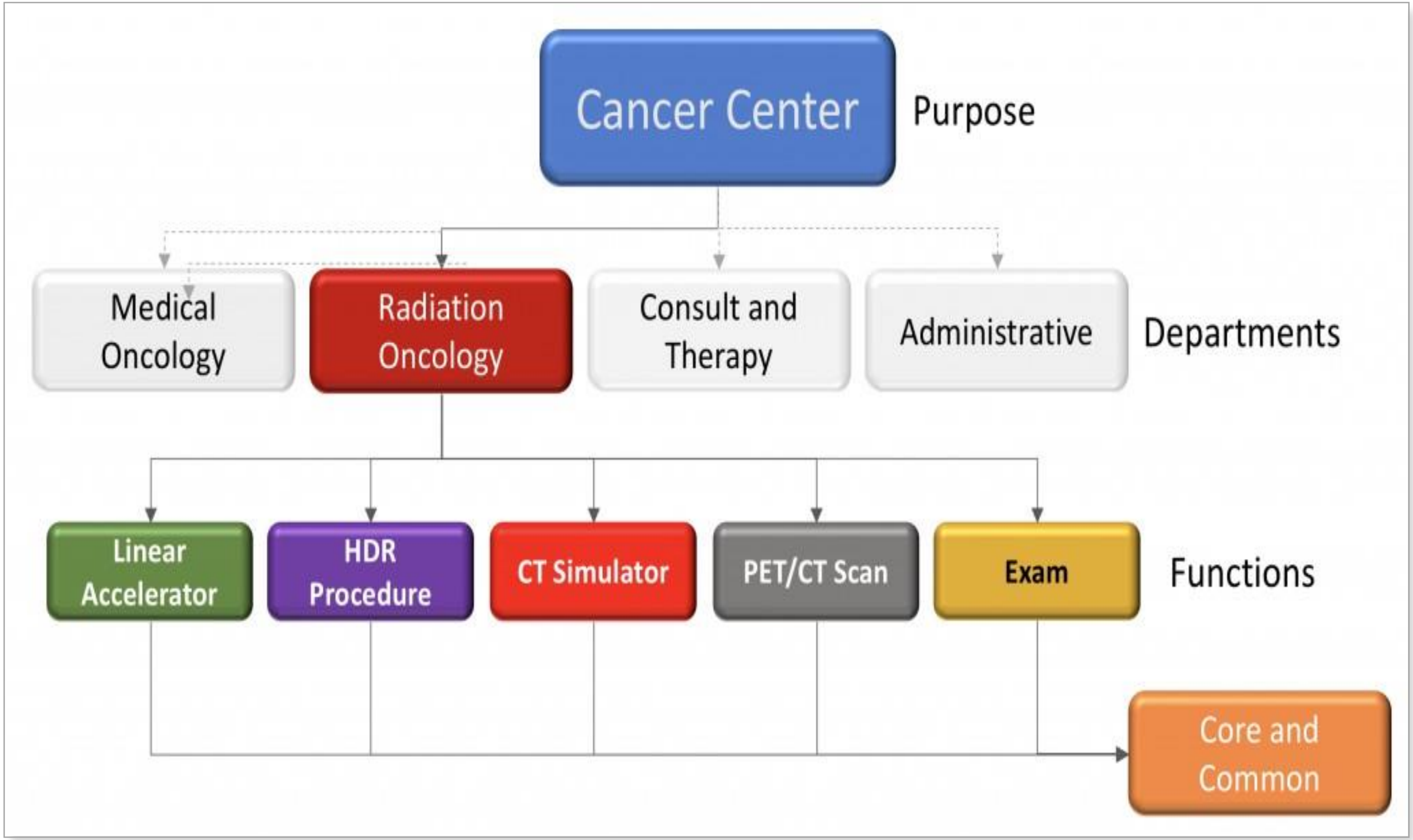
Building Catalyst

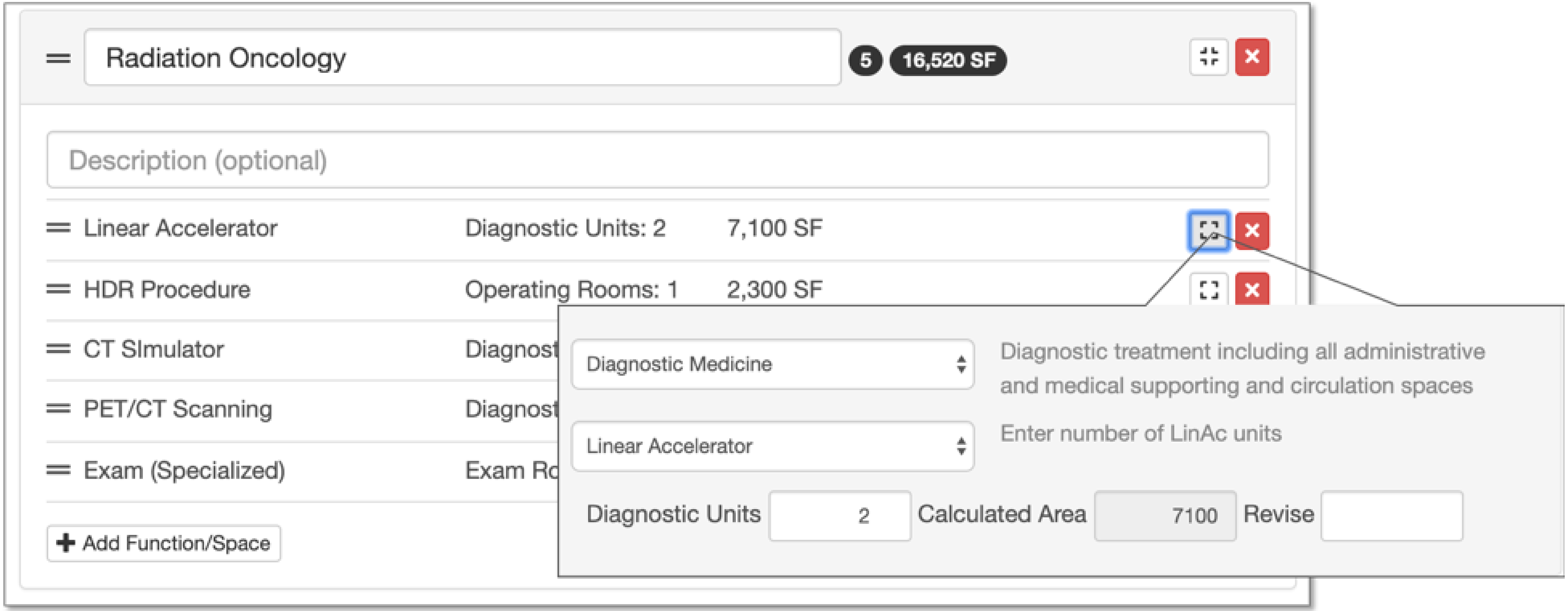
Map



Project Producers

BOLDT
mascaro
Bouma
McCARTHY
BRASFIELD & GORRIE
NABHOLZ
CHRISTMAN
pinnacle
CLARK CONSTRUCTION
RYAN
CSMGROUP
RUDOLPH AND SLETTEN
DPR CONSTRUCTION
SKANSKA
Gilbane
SOLTEK PACIFIC CONSTRUCTION
GRANGER
TRIANGLE
Hathaway Dinwiddie
WEITZ


Cancer Center
Purpose
Medical Oncology
Radiation Oncology
Consult and Therapy
Administrative
Departments
Linear Accelerator
HDR Procedure
CT Simulator
PET/CT Scan
Exam
Functions
Core and Common



Radiation Oncology
5
16,520 SF
Description (optional)
Linear Accelerator
Diagnostic Units: 2
7,100 SF
HDR Procedure
Operating Rooms: 1
2,300 SF
CT SImulator
PET/CT Scanning
Exam (Specialized)
Add Function/Space
Diagnostic Medicine
Diagnostic treatment including all administrative and medical supporting and circulation spaces
Linear Accelerator
Enter number of LinAc units
Diagnostic Units
2
Calculated Area
7100
Revise

Key Building Quantities

☐ **Revisions considered "Actual or Target" instead of "Approximate"**

Roof Structure **23,097 SF** Revise

Floor Structure **18,981 SF** Revise

Grade Slab **21,351 SF** Revise

Basement Wall **0 SF** Revise

Exterior Building Glazing **5,693 SF** Revise

Exterior Non-enclosure Wall **2,613 SF** Revise

Exterior Insulated/Opaque Wall **14,464 SF** Revise

Structured Parking Wall (Above Grade) **0 SF** Revise

Exterior Wall Above and Below Grade **22,770 SF**

Exterior Railing **0 LF** Revise

Exterior Ceilings & Soffits **1,746 SF** Revise

Low Slope Roof **21,942 SF** Revise

Pitched Roof **1,440 SF** Revise

Green Roof **0 SF** Revise

Total Roof Area ~~23,418 SF~~ 23,382SF

Total Building Envelope Area ~~47,936 SF~~ 47,898SF

Total Scope Area (Gross Building + Envelope) ~~88,332 SF~~ 88,231SF

Solar Screening **0 SF** Revise

Skylights **0 SF** Revise

Solar Panel **0 SF** Revise

Exterior Doors **9 EA** Revise

Interior Doors **146 EA** Revise

Total Doors ~~156 EA~~ 155EA

Common Wall **0 LF** Revise

Shaftwall **264 LF** Revise

Partitions **4,435 LF** Revise

Total Interior Partitions/Walls ~~4,704 LF~~ 4,699LF

Wall Base **10,514 LF** Revise

Interior Wall Surface **99,447 SF** Revise

Next Steps for TVD Research Group

Publish a book to include more detailed explanations than are possible here, together with chapters describing how an owner, an agency CM, a design firm, and a main contractor do TVD. We have committed to providing the manuscript to the publisher by end of March 2021.

How does risk management figure in the TVD process?

Risks and opportunities are assessed and mitigations incorporated into a project execution plan prior to making a Go/No Go decision. If the remaining risk is considered acceptable, the project is often compared to competing investment opportunities. If it survives that test, it is funded. In the course of project delivery, the project ‘radar’ is always on, searching for risks and opportunities on the path toward completion.

How do you handle “unknown unknowns” when working with budget estimations for a new project?

If unknown unknowns can be made known, provision can be made for them in the project execution plan and the cost for doing so incorporated into the project cost estimate. “made known” means understanding the uncertainty well enough to size countermeasures to it. For example, a more exact demand forecast for some function to be performed in/with the constructed asset might still be lacking when the project needs to start. Options can be developed and evaluated to see if the ‘cost’ (time or money) is worth the expected benefit. An example was provided in the Last Planner System webinar earlier this year.

If unknown unknowns cannot be made known, the best that can be done is to make the project team more flexible to change. Organizational integration, aligned commercial interests and increasing psychological safety have been shown to increase flexibility.

How does TVD account for changes in a project? In my experience no projects design ends the same as it began.

The client can change targets during the course of project delivery, but commercial terms should be structured so that the service providers do not suffer financially.

Changes in design tend to happen that provide a better solution than one previously agreed. That doesn't necessarily change project targets, but such changes may require a reallocation of target costs to the cross-functional TVD teams. An example might be to agree a different type of structural design that is more expensive, but the reduction in MEP costs is expected to be greater than the increase in cost for the structure. Alternatively, a change in MEP design might reduce operations and maintenance costs, and so warrant an increase in allowable cost. That would constitute a change in targets.

What are good and useful financial incentives for consultants and contractors in a TVD environment?

How can the project management create a best possible financial awareness across the project team?

What can be a good and effective way of creating financial transparency (and thus awareness) in a project team?

Have I answered tkese questions satisfactorily?

More Questions or Comments?