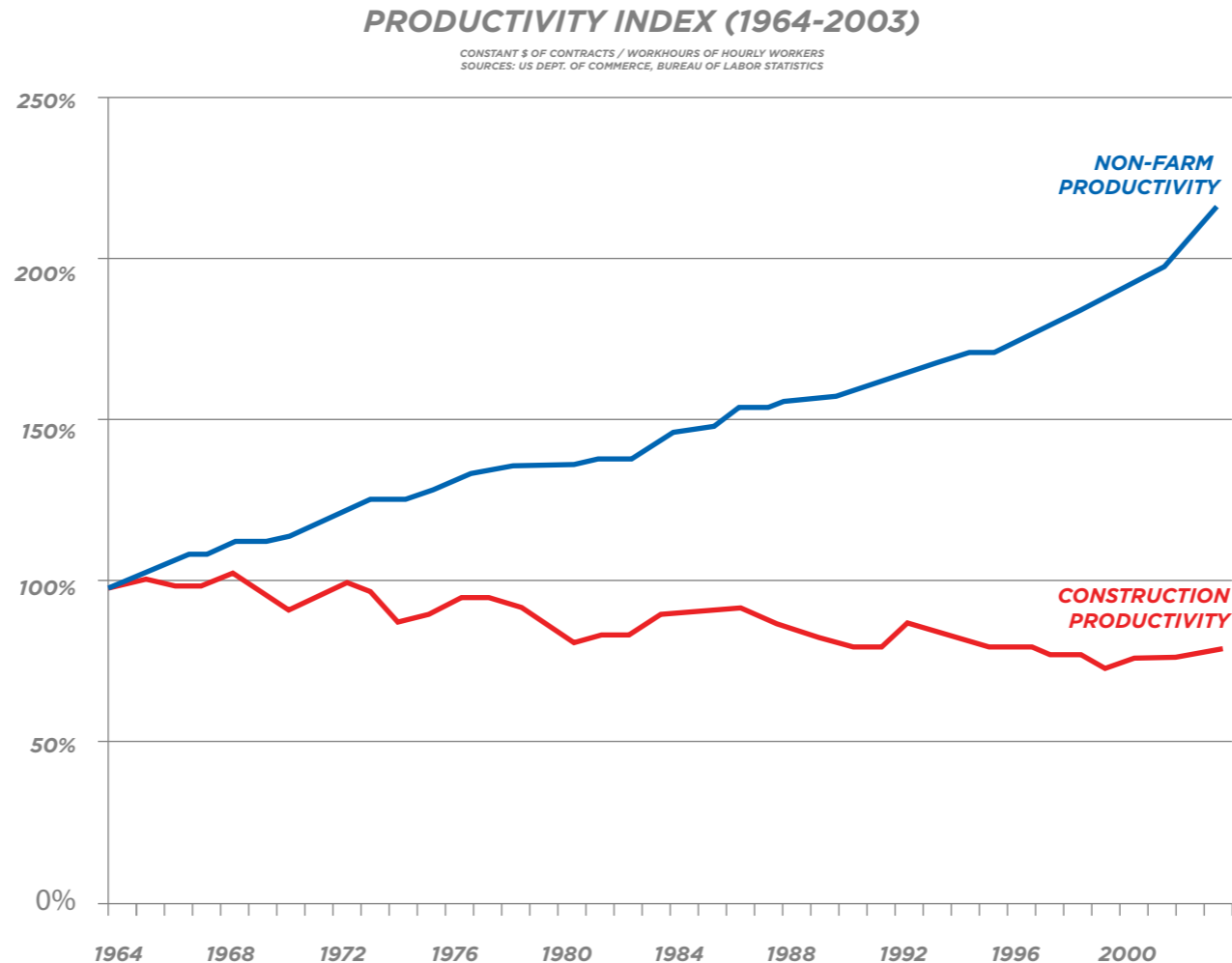


How and Why does Integrated Lean succeed?

Andrea J. Johnson, AIA LEED, University of Minnesota

Did You Know?

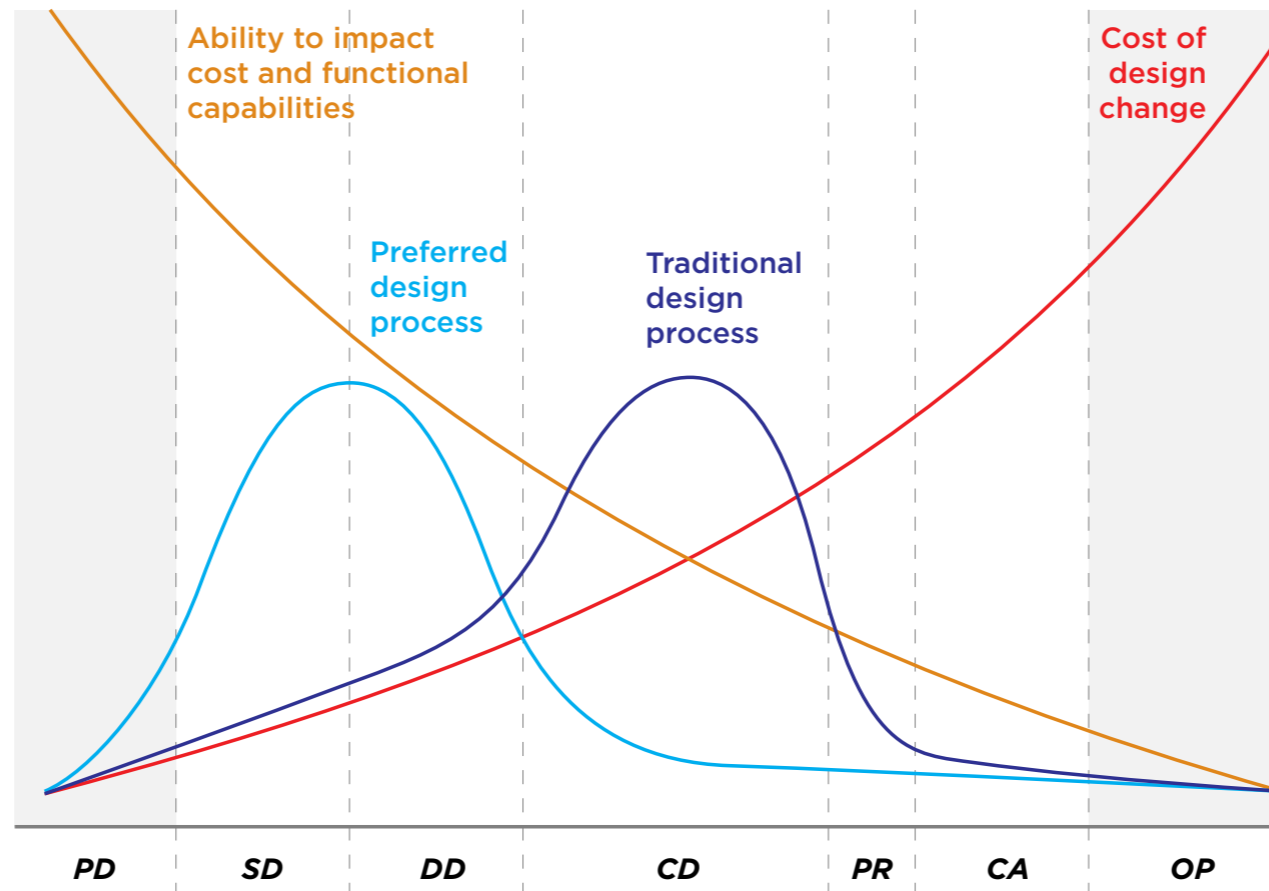
The construction industry lost productivity from 1964-2003...



...while all other non-farm industries more than doubled

Did You Know?

In a traditional process, the majority of design activities...



...occur when they are too late to optimize cost savings

Terms

INTEGRATED PROJECT DELIVERY (IPD)

The contractual project delivery method that creates shared risk/reward structures, fiscal transparency, and release of liability.

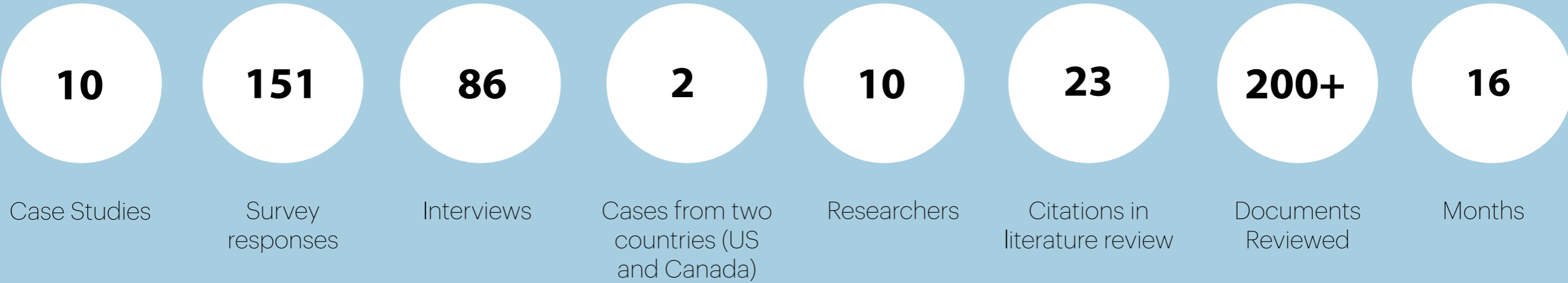
LEAN

Tools and processes intended to maximize value by reducing wasted time, wasted movement, and wasted human potential.

INTEGRATED PROJECT DELIVERY + LEAN

For many owners and teams, the choice to use Lean tools and processes is seen as an integral decision in choosing to pursue IPD. Lean and IPD are complementary.

Research Included...



INNOVATIVE PROJECT DELIVERY...

+Shared risk/reward

+Early involvement of all parties

IPD (Molenaar et al. 2014, AIA 2012, Kent and Becerik-Gerber 2010, Cohen 2010)

Other project delivery modes (Esmielli et al. 2013, Korkmaz et al 2010, Chan et al. 2001)

+Project stakeholders' level of experience

Molenaar et al. 2015, Esmielli et al. 2013; AIA 2012;

Kent and Becerik-Gerber 2010; Korkmaz et al. 2010, Chan et al. 2001

+Team tools and processes (ex. BIM, Lean)

Cheng 2015; Molenaar et al. 2015; Esmielli et al. 2013; AIA 2012;

Cho and Ballard 2011; Kent and Becerik-Gerber 2010; Cohen 2010

...HELP PRODUCE BETTER TEAM AND PROJECT OUTCOMES

Assumptions

- 1) Integrated delivery is superior to other more conventional delivery types**
- 2) Lean tools and processes increase the likelihood of success**

How and Why does Integrated Lean succeed?

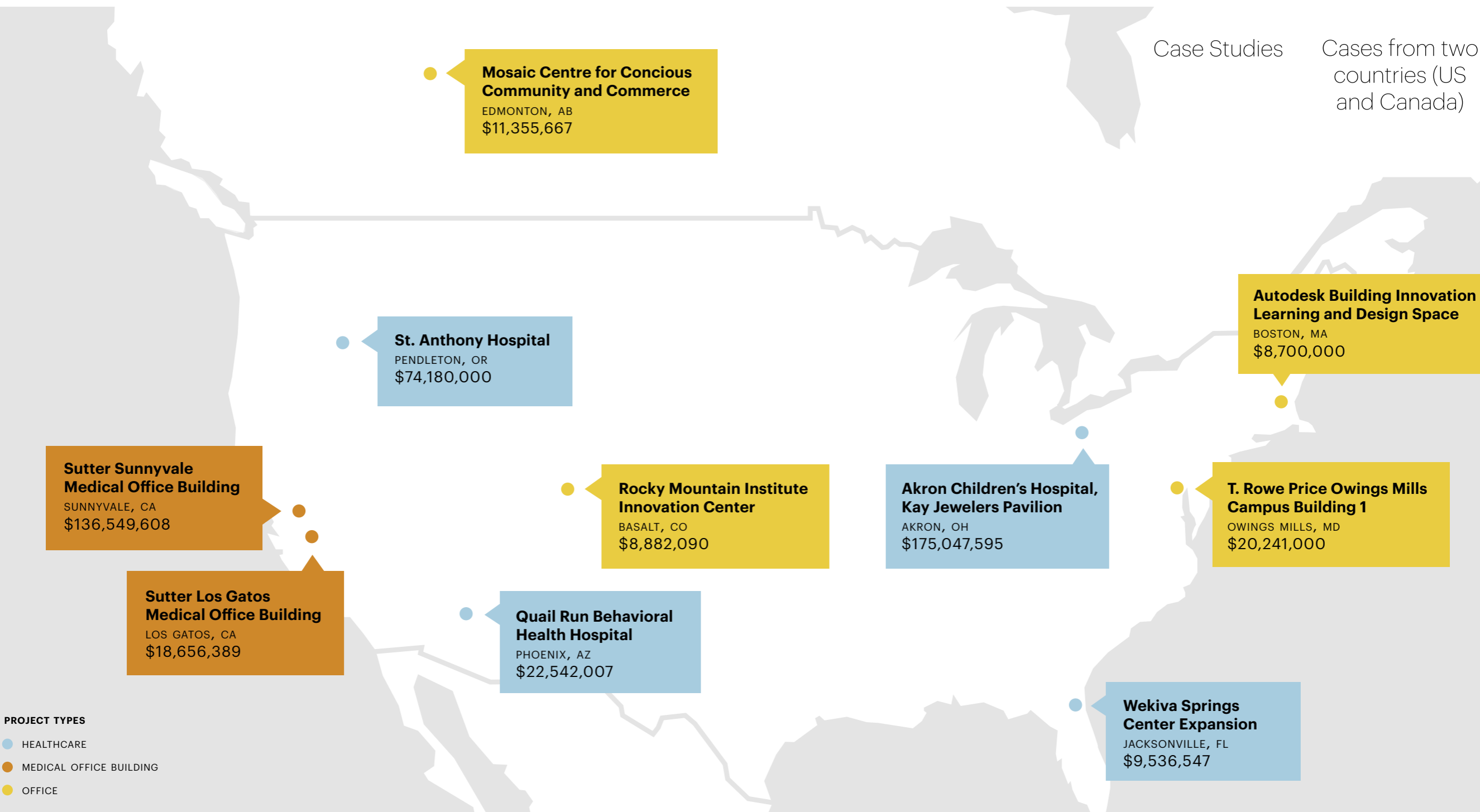
Distribution of Cases

10

2

Case Studies

Cases from two countries (US and Canada)



PROJECT TYPES

- HEALTHCARE
- MEDICAL OFFICE BUILDING
- OFFICE

Research Methodology

86

151

Interviews

Survey responses

NUMBER OF INTERVIEWS (PEOPLE INTERVIEWED)	ARCHITECTS	ENGINEERS, CONSULTANTS	BUILDERS	OWNER, OWNER CONSULTANTS	TOTAL
AKRON	2 (5)	2 (3)	2 (7)	1 (5)	7 (20)
*^ AUTODESK	1 (2)		2 (2)	3 (4)	6 (8)
SUTTER LOS GATOS	1 (2)	1 (1)	1 (1)	2 (2)	5 (6)
^ MOSAIC	1 (2)	2 (3)	5 (8)	1 (1)	9 (14)
QUAIL RUN	1 (2)	1 (3)	(3)	1 (2)	3 (10)
*ROCKY MOUNTAIN	1 (3)	1 (2)	1 (3)	2 (3)	5 (11)
ST. ANTHONY	1 (1)		1 (1)	3 (4)	5 (6)
SUTTER SUNNYVALE	1 (2)	1 (1)	1 (1)	2 (2)	5 (6)
*^ T. ROWE PRICE	1 (2)	2 (3)	3 (5)	2 (3)	8 (13)
WEKIVA SPRINGS	1 (1)	1 (1)	1 (1)	1 (1)	4 (4)
TOTAL	12 (23)	11 (17)	18(36)	4 (6)	60 (104)

NUMBER OF INTERVIEWS OF PROJECT PARTICIPANTS BY ROLE

* for this project, owner category includes owner and owner consultants

^ for this project, the builders category includes general contractors and trade partners

NUMBER OF SURVEY RESPONSES	ARCHITECTS	ENGINEERS, CONSULTANTS	^ BUILDERS	OWNER, OWNER CONSULTANTS	TOTAL
AKRON	3	1	13	2	19
AUTODESK	3	4	12	2	21
SUTTER LOS GATOS	1	1	2	1	5
MOSAIC	2	3	6	1	12
QUAIL RUN	2		5	3	10
*ROCKY MOUNTAIN	4	5	8	7	24
*ST. ANTHONY	8	6	6	2	22
SUTTER SUNNYVALE		3	3	1	7
*T. ROWE PRICE	2	4	4	3	13
WEKIVA SPRINGS	1	4	6	1	12
TOTAL	26	31	65	23	145

NUMBER OF COMPLETED SURVEYS BY PROJECT PARTICIPANTS BY ROLE

* for this project, owner category includes owner and owner consultants

^ for all projects, the builders category includes general contractors and trade partners

Documents

All teams provided documentation in each of these categories, though the specific artifacts varied:

Commercial and legal

- Request for proposal (RFP)
- Request for qualifications (RFQ) and criteria for selection
- IPD agreement and contract exhibits, such as risk/reward distribution, milestone payouts
- Budget and other financial documents

Decision-making

- Protocols for decisions
- Sample documents related to major decisions by the core team
- Sample communication of decisions to the larger team
- Documentation of goals
- Protocols for meetings
- Meeting schedules and agendas
- Sample meeting minutes

Lean, other tools and metrics

- Samples of A3s and, pull plans
- Samples of customized tools, screen shots
- Protocols on how tools were used, including dashboards
- Metrics, including key- performance indicators and other metrics tracked
- RFI logs
- Risk registries

BIM

- Execution plan
- Sample snap shots of models

Workspace environment

- Plans and photographs of shared workspaces

Project personnel

- Project directories
- Personnel lists
- Organizational charts

RESEARCH SPONSORS



INTEGRATED PROJECT DELIVERY ALLIANCE

Integrated Project Delivery Alliance (IPDA)

www.ipda.ca

IPDA explores and supports emergent practices demonstrating enhanced industry outcomes and provides a forum for the exchange of knowledge.



Lean Construction Institute (LCI)

www.leanconstruction.org

LCI operates as a catalyst to transform the industry through Lean project delivery using an operating system centered on a common language, fundamental principles, and basic practices.

RESEARCH TEAM

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Project Manager and Co-Author

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COPY EDITOR

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GRAPHIC LAYOUT

Dustin Hartford



Research Report

	Context			Legal Commercial			Leadership & Management			Processes & Lean				Alignment & Goals			Building Outcomes							
Executive Summary	At A Glance	Project Description	Project Timeline	Owner Identity & Interface	Choosing IPD & Lean	Team Selection	Developing Contract	Developing Parties	Champions	Decision Structure	On Board & Off Board	Clarity of Goals	Resources & Facilitation	Tools & Processes	Lean Effectiveness	BIM	Workplace	Team Alignment	Collaboration	Team Culture	Profit & Payout	Budget & Schedule	Building Outcomes	Project Credits
Research Methodology																								
Literature Review																								
Glossary/Definitions																								

COMPARATIVE ANALYSIS

Comparisons & Best Practices

AKRON CHILDREN'S HOSPITAL, KAY JEWELERS PAVILION

AUTODESK BUILDING INNOVATION LEARNING AND DESIGN SPACE

MOSAIC CENTRE FOR CONSCIOUS COMMUNITY AND COMMERCE

QUAIL RUN BEHAVIORAL HEALTH HOSPITAL

ROCKY MOUNTAIN INSTITUTE INNOVATION CENTER

ST. ANTHONY HOSPITAL

SUTTER MEDICAL OFFICE BUILDINGS (LOS GATOS & SUNNYVALE)

T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1

WEKIVA SPRINGS CENTER EXPANSION

Project Description

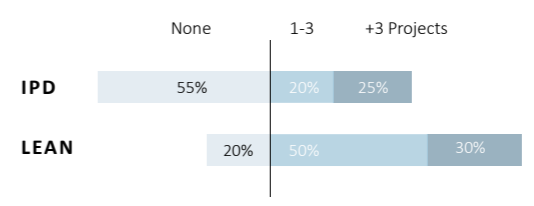
PROJECT	Akron Children's Hospital, Kay Jewelers Pavilion
LOCATION	Akron, OH
BUILDING TYPE	Healthcare
PROJECT TYPE	New Addition
CONTRACT	Custom
OWNER	Akron Children's Hospital
ARCHITECT	HKS & Hasenstab
CONTRACTOR	Boldt & Welty
PROJECT START	November 2013
COMPLETION	May 2015

Project Images



Photo Credits: Akron Children's Hospital

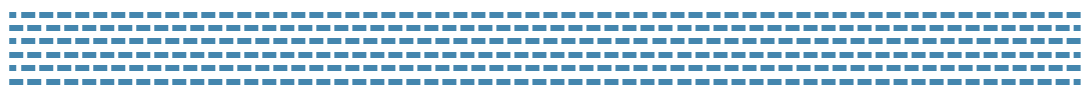
Project Delivery Experience



PROJECT PARTICIPANTS SURVEYED: 20

Approximately half of the team members were new to IPD, and half had some or extensive IPD experience. A majority had some experience in Lean, with the remaining having either no previous experience or substantial experience. Some of the national team members had worked together on prior projects, as well as the local team members with each other, but overall, the national and local teams did not have prior relationships with each other.

Building Size 365,000 sq. ft.



Budget \$175,047,595



Schedule 24 months design 22 months construction



How and Why:

IPD creates **need** to collaborate
Lean provides the **means**

+All projects in the study* were highly successful

regardless of project type, scope, geographic location, previous experience with IPD or Lean

+IPD establishes the terms for collaboration

financial incentives, baseline costs plus overhead, metrics of success

+Lean tools and processes facilitate collaboration

creates alignment around cost, schedule and other goals

**projects self-selected to respond to our request for participation and may not be representative of all IPD projects. However teams were candid about the challenges they faced and their lessons learned*

5 Myths...

BUSTED

- *Delivery matters less than choosing the right people – behaviors can't be dictated by a contract*
- *IPD contracts are too complicated, Lean tools are too rigid*
- *IPD only works on large complex healthcare projects – Teams new to IPD and Lean are at a disadvantage*
- *Owners aren't getting best value – or – Owners are getting value but the team is not making profit*
- *IPD and IPD-lite are essentially the same; financial incentives and release of liability are no big deal*

Myth #5...

BUSTED

- *Delivery matters less than choosing the right people – behaviors can't be dictated by a contract*

“A team” behaviors can be fostered through:

- + attending to the risk/reward proportions within the teams
- + on-boarding processes
- + coaching, mentoring
- + culture of accountability
- + clear off-boarding processes

Onboarding Example

Team selection of the “right people” was seen as a critical element of success.

Owners’ processes included relying heavily on previous relationships, request for proposals, structured proposal evaluations, developing new processes, Lean processes (CBA), and consideration for the local building community.

Proportion of Team: Risk Reward/Contract

RISK/REWARD POOL 



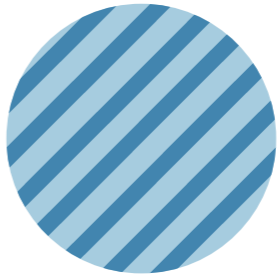
Akron
5 Signatories
24 Risk/Reward



Autodesk
7 Signatories
7 Risk/Reward



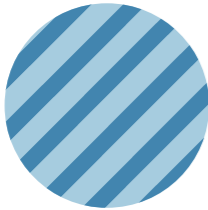
Mosaic
3 Signatories
14 Risk/Reward



Quail Run
7 Signatories
7 Risk/Reward



Rocky Mountain
3 Signatories
14 Risk/Reward



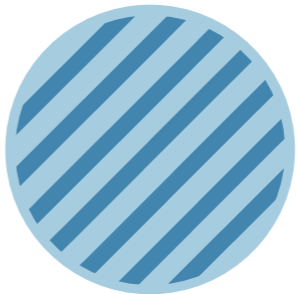
St. Anthony
4 Signatories
4 Risk/Reward



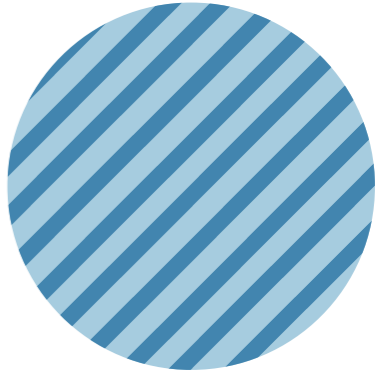
Sutter Los Gatos
3 Signatories
8 Risk/Reward



Sutter Sunnyvale
3 Signatories
12 Risk/Reward



T. Rowe Price
7 Signatories
8 Risk/Reward



Wekiva Springs
13 Signatories
13 Risk/Reward

Myth #4...

BUSTED

- *IPD contracts are too complicated, Lean tools are too rigid*

- + In the projects studied, teams used a wide variety of Lean tools and processes to varying degrees of “purity”
- + Most projects used customized IPD contracts but some templates are beginning to emerge
- + Investing time to understand the contract and design the project-specific Lean approach is part of an effective on-boarding process

Degree of Lean and Other Tools & Processes

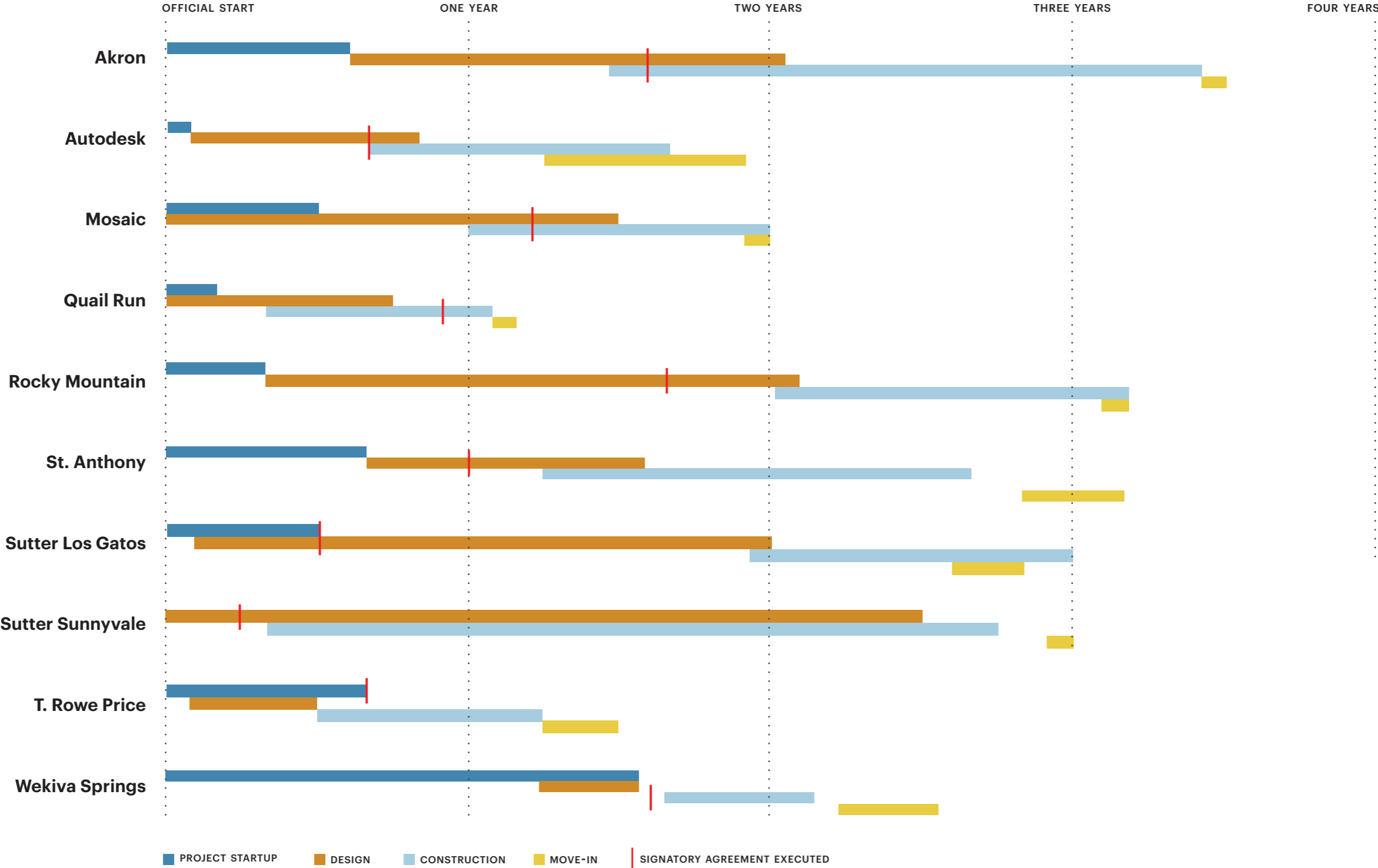
	Validation	Co-Location	Lean Tools and Processes						BIM
			Lean Team Formation		Goals	Workplace and Meeting	Cost and Decision	Project Management	
			Team Formation	Team Development					
Akron	●	●	●	●	●	●	●	●	◐
Autodesk		●	○	○	○	●	◐	○	●
Mosaic	◐	●	●	◐	◐	◐	◐	◐	◐
Quail Run		○	●	●	●	●	●	●	◐
Rocky Mountain	●	◐	◐	◐	◐	●	●	●	◐
St. Anthony	●	◐	●	◐	●	●	●	●	○
Sutter Los Gatos		◐	●	◐	◐	●	●	◐	●
Sutter Sunnyvale	●	○	◐	○	◐	◐	◐	◐	●
T. Rowe Price		◐	●	◐	◐	◐	◐	●	○
Wekiva Springs	◐	●	●	●	●	●	●	●	◐

- Done well, used often, helpful to the team
- ◐ Done but only somewhat helpful or mixed comments about effectiveness
- Did it but not seen as particularly effective by most of the team
- Did not have it

Team Quote on Developing Contract

“The sessions were very effective because, more important than hammering out the terms of the deal, it got everybody on the same page.”

Variation in Execution of Signatory Agreement



Myth #3...

BUSTED

- *IPD only works on large complex healthcare projects – Teams new to IPD and Lean are at a disadvantage*

- + There is no evidence that IPD is any less effective on small straightforward projects compared to large complex projects
- + Perception that there is a “right size” project for IPD has so far not been substantiated
- + Teams new to IPD and/or Lean experience had equally positive outcomes compared to teams with a mix of experience and teams with predominately experienced participants

Tools/Processes Proficiency Unrelated to Experience

		Validation	Co-Location	Lean Tools and Processes						BIM
				Lean Team Formation		Goals	Workplace and Meeting	Cost and Decision	Project Management	
				Team Formation	Team Development					
50%+ of team experienced in IPD/Lean	Akron	●	●	●	●	●	●	●	●	●
	Autodesk	●	●	○	○	○	●	●	○	●
0% of team experienced in IPD/Lean	Mosaic	●	●	●	●	●	●	●	●	●
	Quail Run	●	○	●	●	●	●	●	●	●
	Rocky Mountain	●	●	●	●	●	●	●	●	●
	St. Anthony	●	●	●	●	●	●	●	●	○
	Sutter Los Gatos	●	●	●	●	●	●	●	●	●
	Sutter Sunnyvale	●	○	●	○	●	●	●	●	●
	T. Rowe Price	●	●	●	●	●	●	●	●	○
	Wekiva Springs	●	●	●	●	●	●	●	●	●

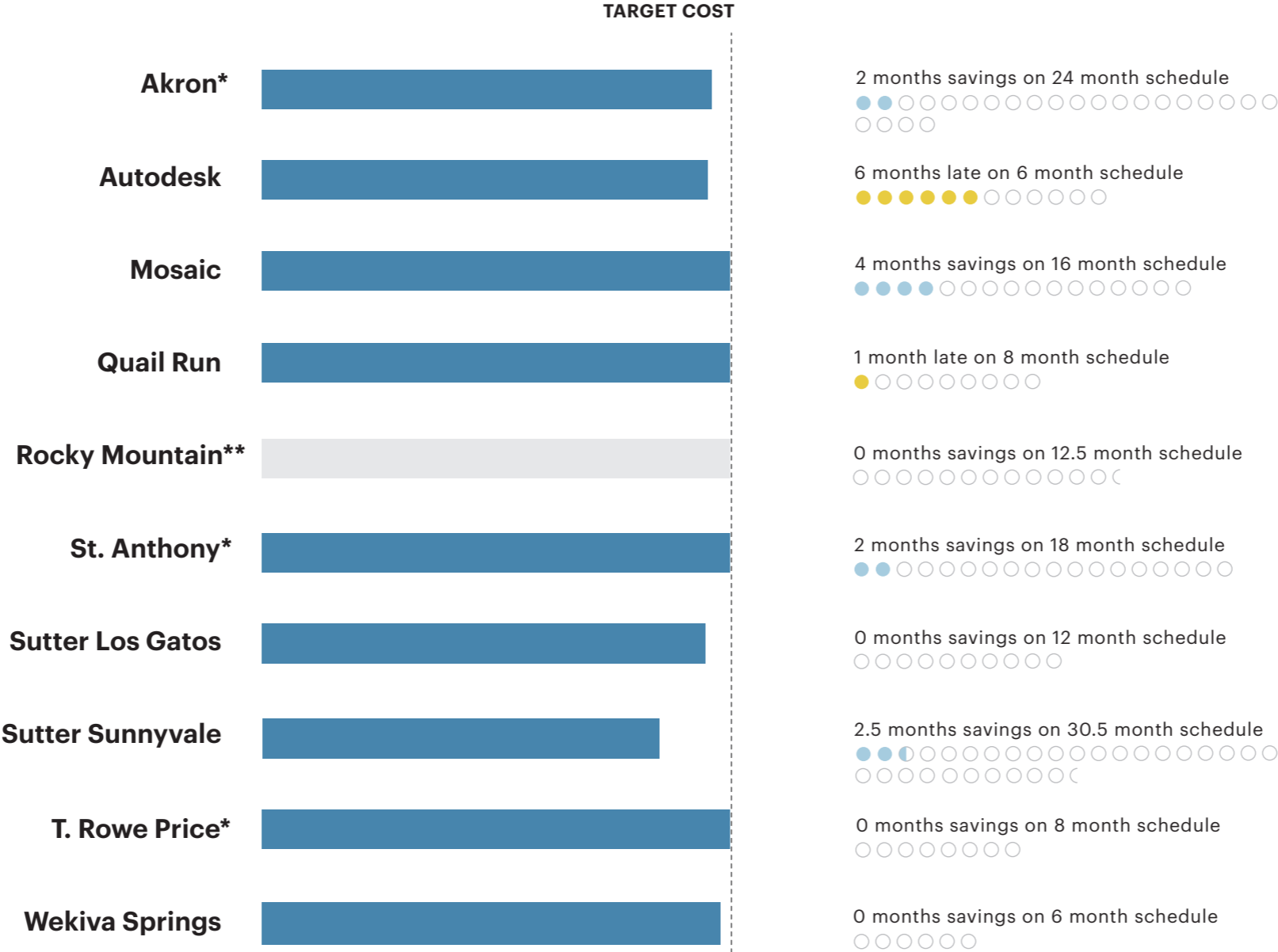
- Done well, used often, helpful to the team
- ◐ Done but only somewhat helpful or mixed comments about effectiveness
- Did it but not seen as particularly effective by most of the team
- Did not have it

Myth #2...

BUSTED

- *Owners aren't getting best value – or – Owners are getting value but the team is not making profit*
- + In all cases, target costs and schedules were aggressive
- + In most cases, validation studies confirmed those goals were feasible
- + 100% of the owners believed the projects met or exceeded expectations for budget and schedule, even though not all projects met the initially established targets
- + Many owners were able to “value-add” or “add-back” scope that had been considered out of reach during validation

Consistent Value for Owner



● Final project cost

* Significant project savings were used to increase project scope

** Target comparison to final cost not available

○ One month construction schedule

● One month schedule savings

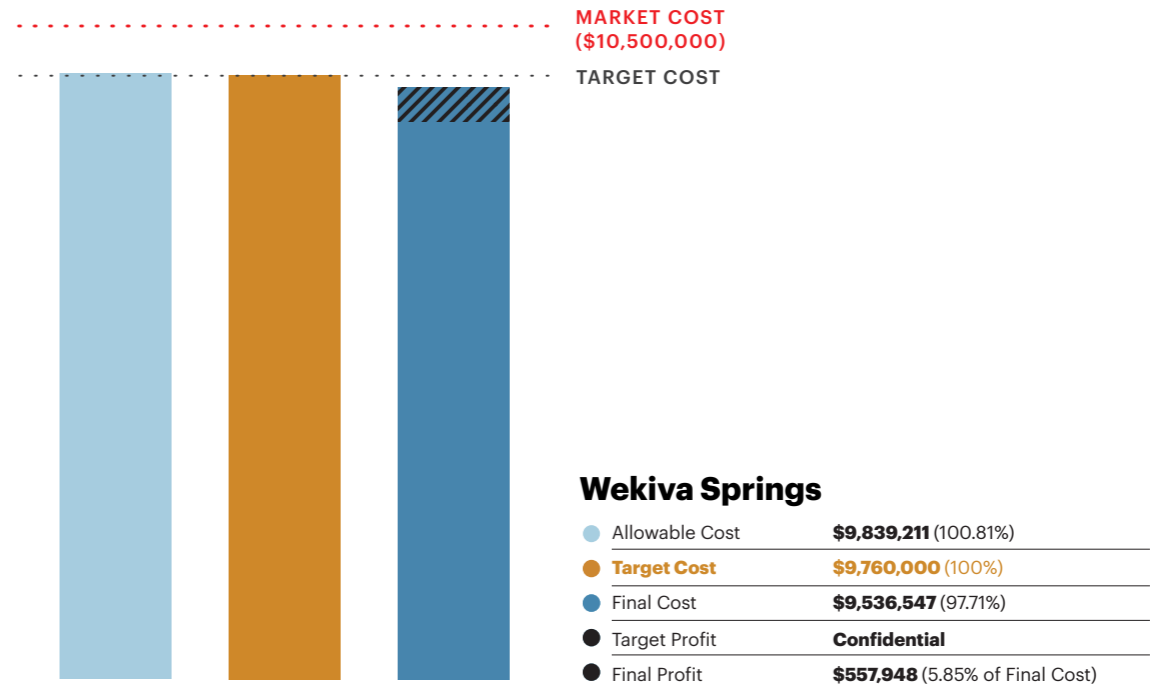
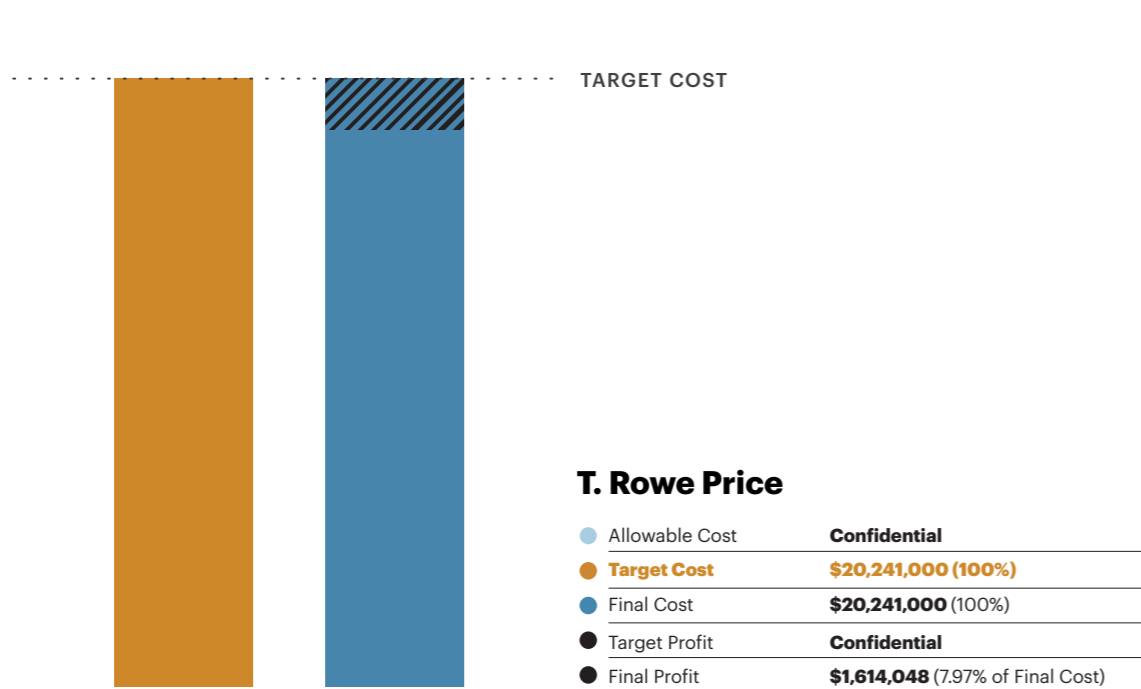
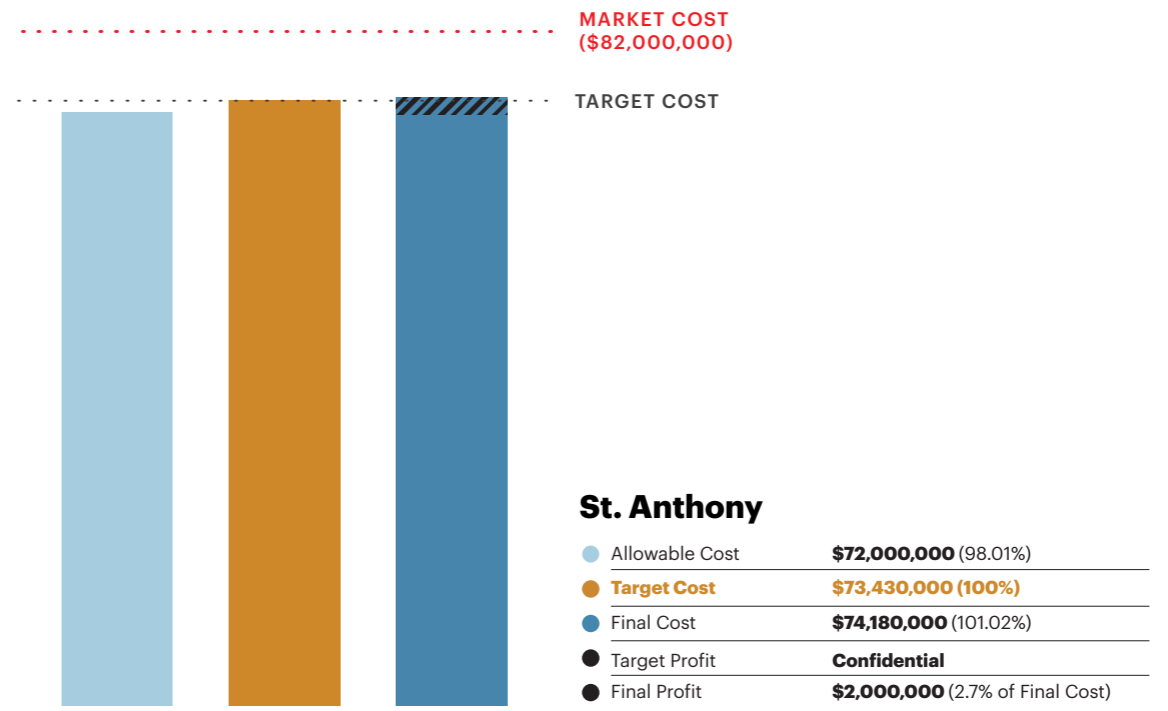
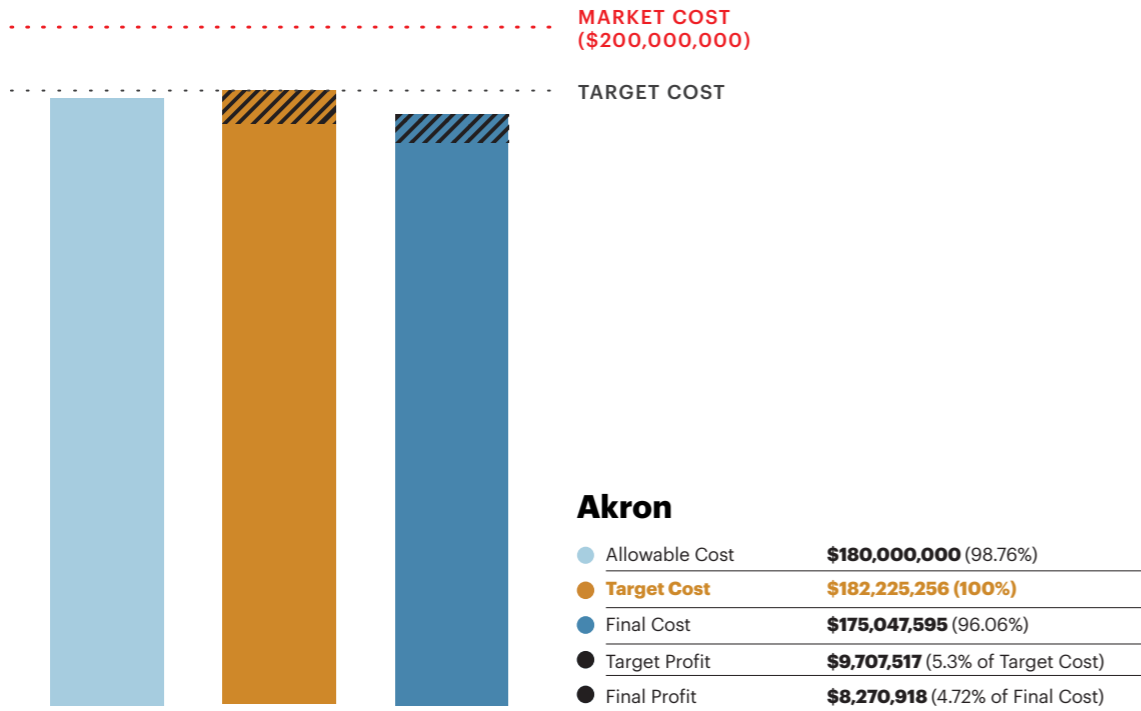
● Over schedule by one month

Myth #2...

BUSTED

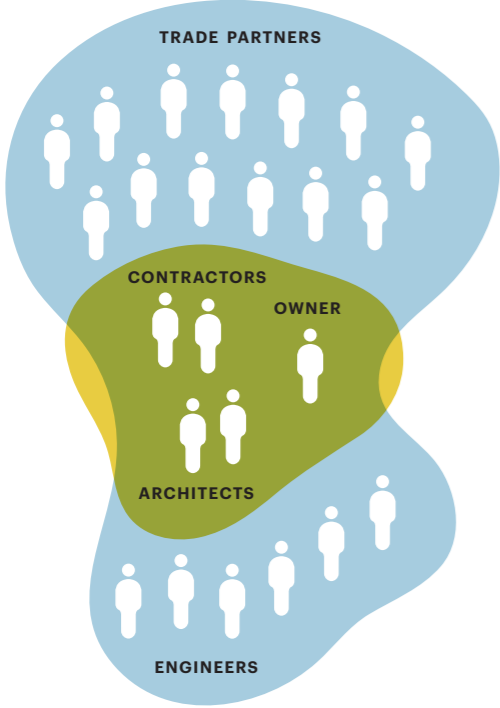
- *Owners aren't getting best value – or – Owners are getting value but the team is not making profit*
- + Profit on the project teams varied: ranging from double market rates to slightly below
- + Significant majority of the team members believed their investments in the project were worthwhile
- + Significant majority of participants are seeking additional IPD and Lean experiences and would recommend it to others
- + Contingency and value-add scope additions makes financial picture hard to have precise understanding

Profit for Teams: Return on Investment

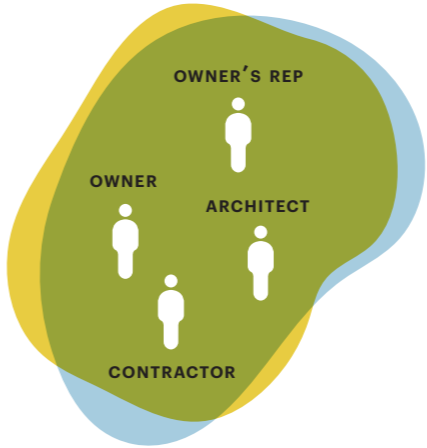


Who Has Skin in the Game?

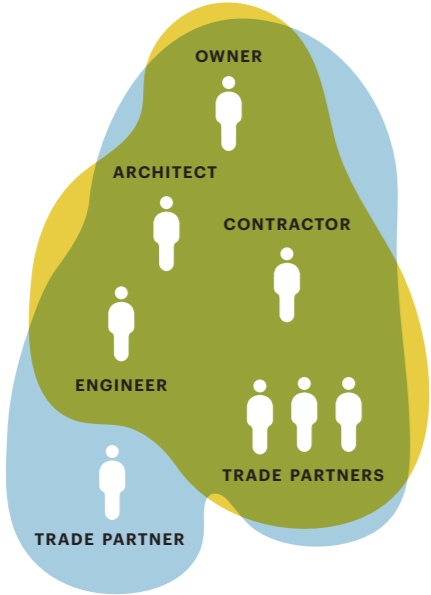
RISK/REWARD POOL [ORIGINAL CONTRACT PARTIES (diagonal stripes) ADDITIONAL CONTRACT PARTIES (yellow)



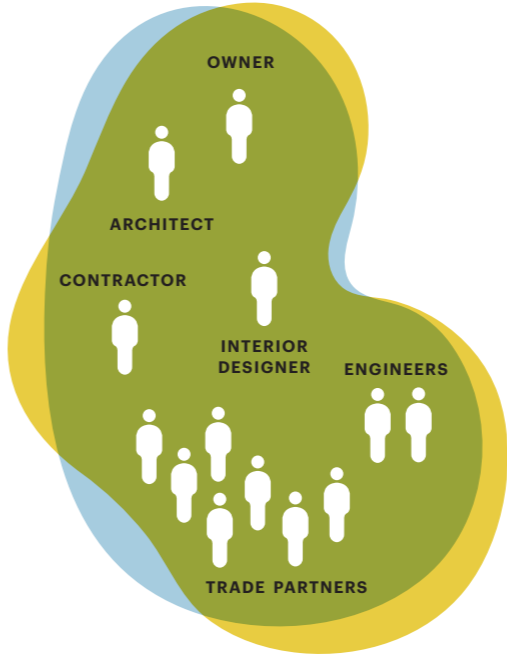
Akron
5 Signatories
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St. Anthony
4 Signatories
4 Risk/Reward



T. Rowe Price
7 Signatories
8 Risk/Reward



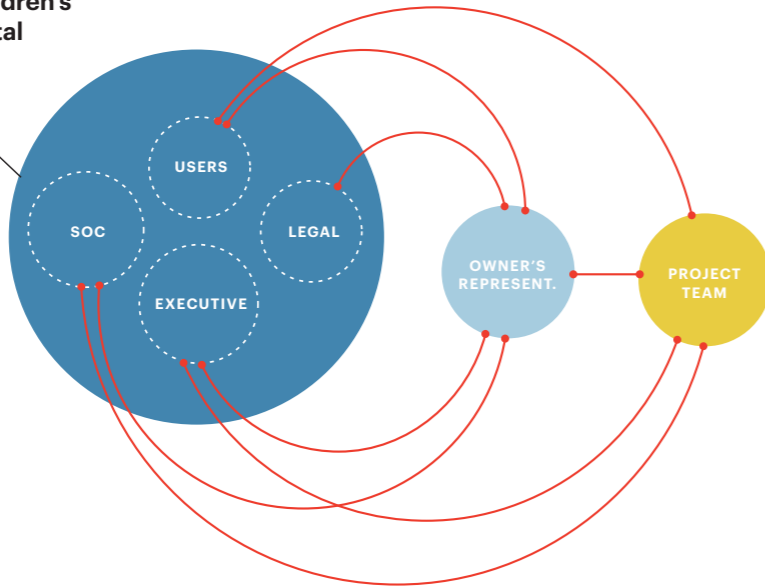
Wekiva Springs
13 Signatories
13 Risk/Reward

Team Quote

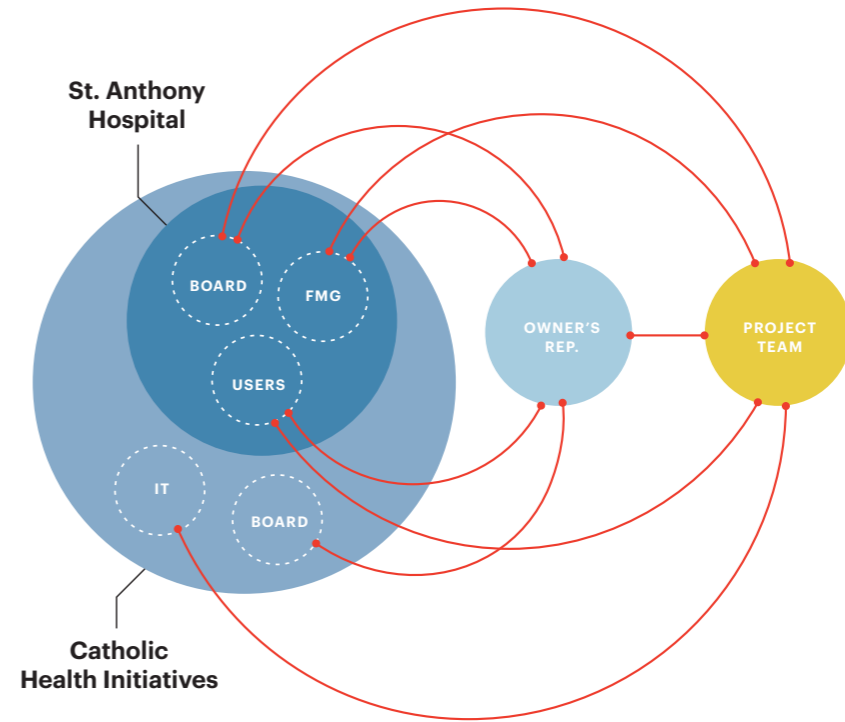
“They did a very good job of documenting and relaying how financial incentives were tied to project goals in real time. Everyone had a sense of what was going on, and we could make informed decisions how to move next if there was a particular problem or area of concern regarding the finances or schedule.”

Team's connection to owner decision-makers

Akron Children's Hospital

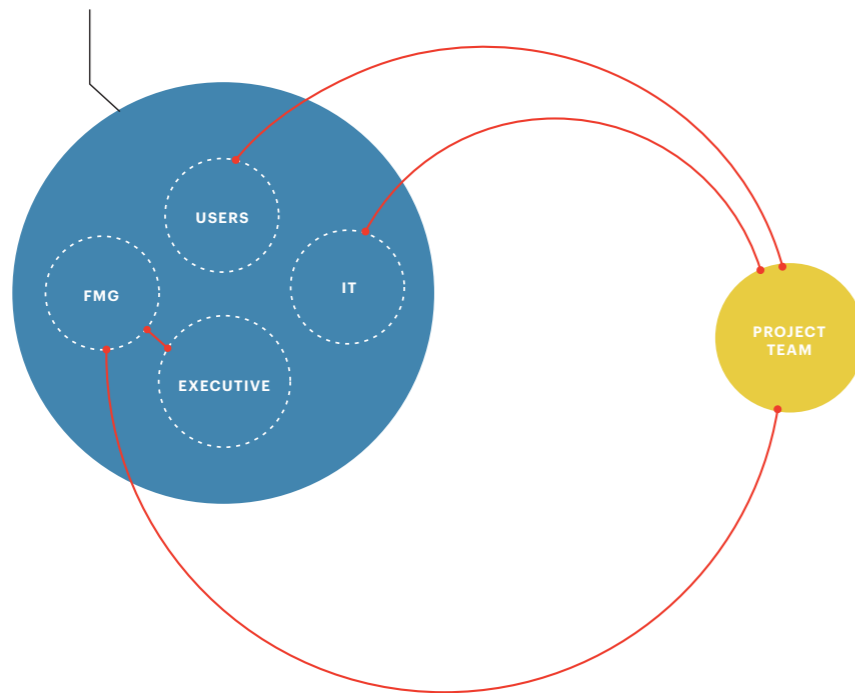


St. Anthony Hospital

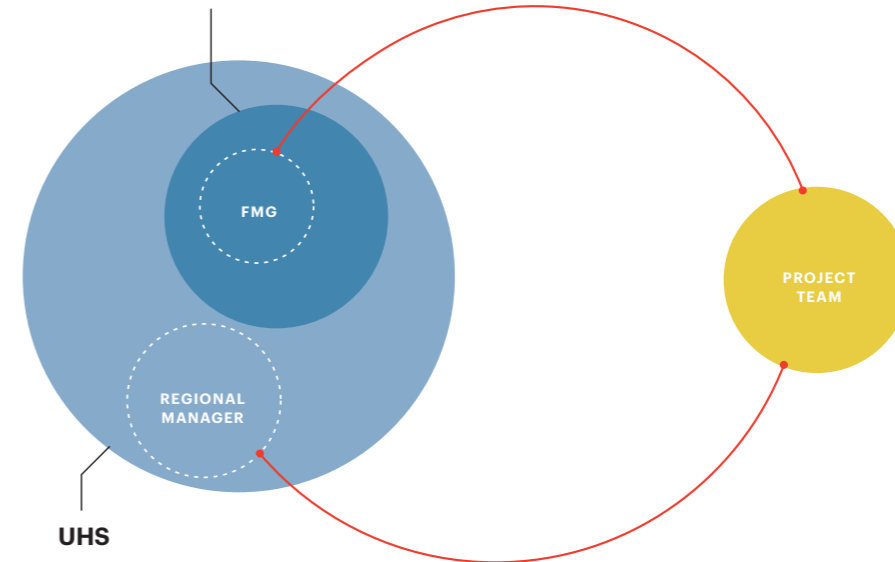


Catholic Health Initiatives

T. Rowe Price



Wekiva



UHS

Myth #1...

BUSTED

- *IPD and IPD-lite are essentially the same; financial incentives and release of liability are no big deal*
- + Many teams noted a significant increase in collaborative behavior (and fun!) between those parties in the risk/reward pool compared to those that were not
- + “Team First” or “Project First” behavior was cited as critically important to success by every team
- + These projects demonstrated remarkable RESILIENCE in face of significant challenge that would likely have derailed a project delivered with typical methods

Team Quotes

“If it weren’t for the IPD agreement, I guarantee you we would all be in litigation right now instead of completing this project.”

“If it weren’t for Lean and IPD, we wouldn’t be in this building right now, on schedule and on budget.”

Conclusions and Future Research Needed

- **Documenting positive case studies adds to the body of evidence on the effectiveness of Lean and IPD. But we also know that teams with more positive outcomes are more willing to participate in research**
- **Rigorous comparison begins to illuminate the mechanisms and motivation that are key to success**
- **Future research goals:**
 - Develop rules of thumb for number, proportion and diversity of participants in the risk/reward pool
 - Define and validate the methods for on-boarding and team building
 - Better understand differing motivation for designers who have different financial stake and different business structures than constructors
 - Develop shared measures and metrics of success that can drive improvement industry-wide

Selected Tactical Takeaways

SET TARGETS

- +Establish business case and define goals

BUILD THE TEAM

- +Contract key stakeholders early to align and validate targets/goals

LEARN AS A TEAM

- +Train and provide on-going coaching/support for key lean methods

SUPPORT THE TEAM

- +Contracts should support a good team culture and adoption of lean practices

Report Findings

Our major finding was a striking uniformity of success for all the teams in this study, regardless of project type, scope, geographic location, or previous experience with IPD and Lean.

The second finding was that the powerful complementary strength of IPD and Lean supports success.

Download Full Report



www.ipda.ca



www.leanconstruction.org



Integrated Lean Project Delivery: Case Studies

THANK YOU

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