



Lean in Design & Construction: What Architects, Engineers and Owners Need to Know



Presented to HAAHE
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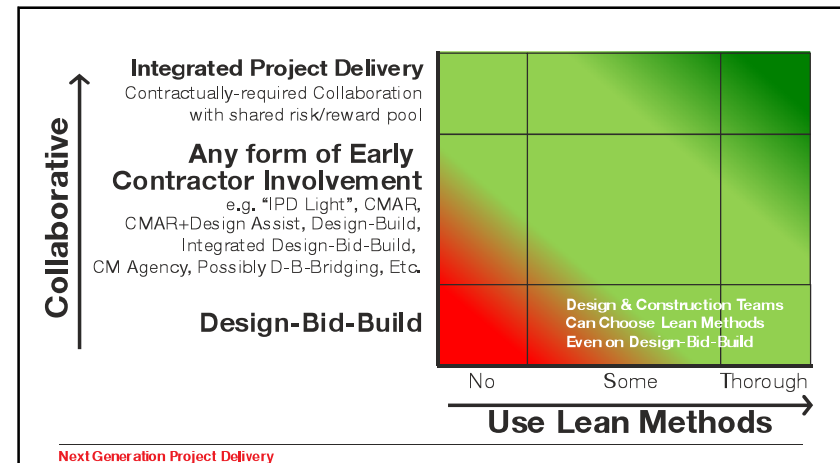
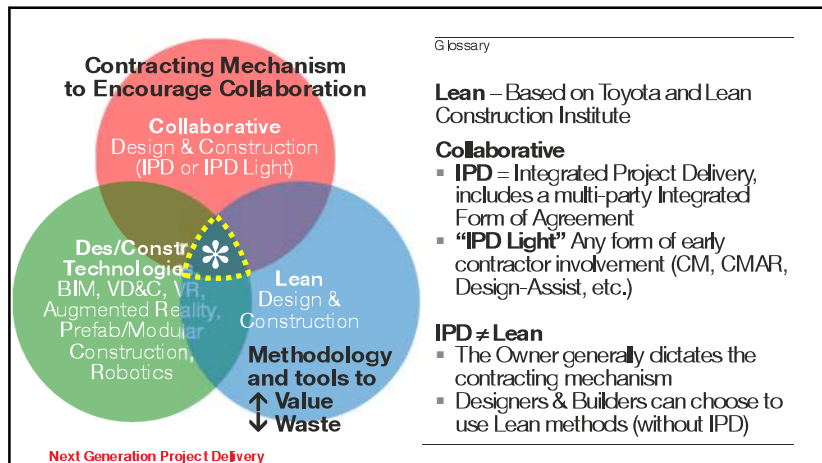
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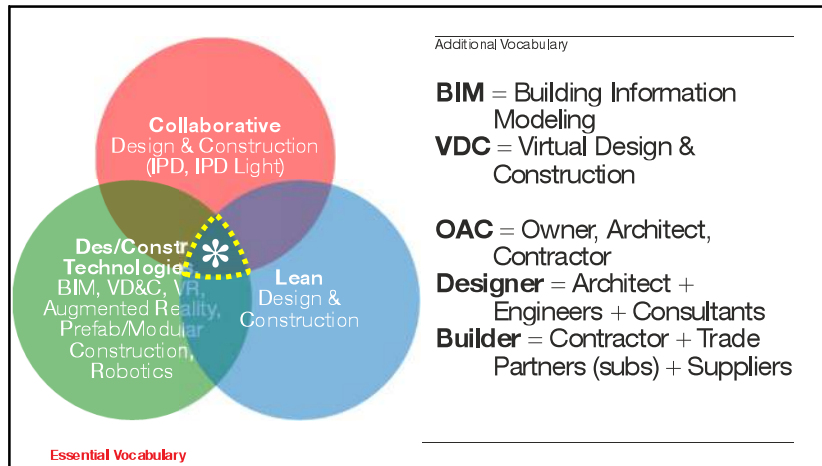
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WHAT'S ON MY MIND





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Very Brief Overview of Lean & LCI

Essential Vocabulary

1930s American engineer and statistician **W. Edwards Deming**: “**Continuous Improvement**” and the “**Deming Cycle**” (**PDCA**)

1950s Deming teaches post-war Japan

1988 Toyota’s Taiichi Ohno authors book about “Toyota Production System” developed in ’60s-’80s

1990 The term “**Lean**” was coined by Womack, Jones & Roos in “**The Machine that Changed the World**” about Toyota.

“Without data, you’re another person with an opinion.”

W. Edwards Deming

Pre-1990

Some Lean Vocabulary

Respect for People
- Ask for input from the people who do the work

Generate Value
- For the customer

Reduce Waste

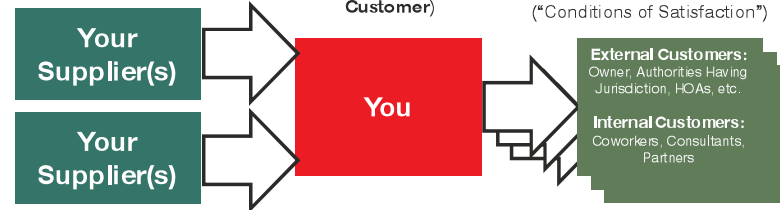
Go to Gemba
- Where the work is done

Data, Scientific Method
Make Work Visible
Continuous Improvement

Essential Vocabulary

Who is Your Customer?

Inputs (Information, Materials, etc.) from **Suppliers**. (You are their customer)



Lean Fundamentals

Because of its Toyota heritage, many people use Japanese phrases in Lean discussions:

Gemba = The place where value is created

Kaizen = Change for the better; continuous improvement; rapid improvement event

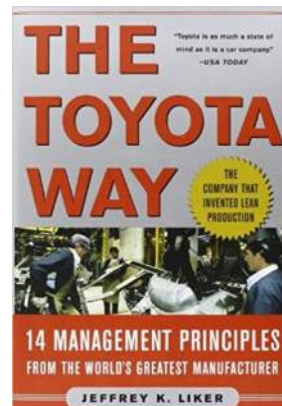
Kanban = "Signboard" to communicate the need for a product or service; generally to trigger movement of material

Poka-Yoke = Mistake Proofing

Lean Fundamentals

1. Long Term Philosophy
2. Create Continuous Flow
3. Use "Pull" Systems to Avoid Overproduction
4. Level out the Workload
5. Build a Culture of Stopping to Fix Problems, Get Quality Right First Time
6. Standardize Tasks
7. Use Visual Controls
8. Use only Reliable, Tested Technology
9. Grow Leaders
10. Develop Exceptional People & Teams
11. Help Partners & Suppliers Improve
12. Go and See for Yourself
13. Make Decisions Slowly By Consensus
14. Reflection, Continuous Improvement

2004 The Toyota Way



Lean should not be difficult for Architects and Engineers

Here's why...

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Lean is essentially applying the Scientific Method to Problem Solving & Improvement

1. Ask a Question or Identify a Problem
2. Background Research
3. Form a Hypothesis
4. Experiment & Observe
5. Draw a Conclusion



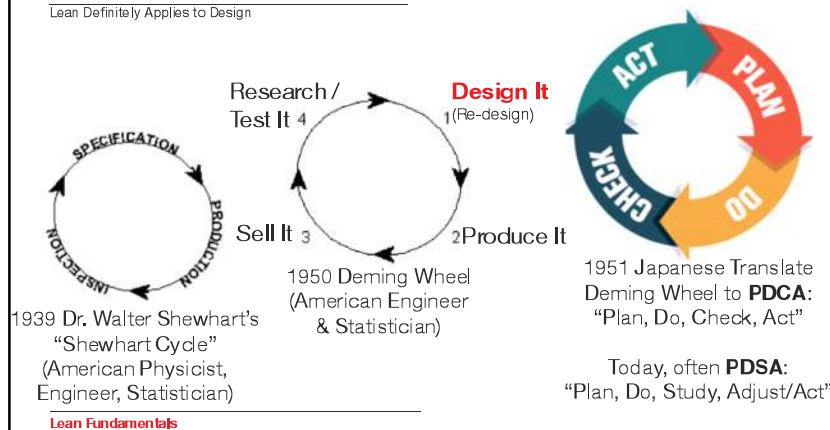
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Notice the Similarities to the 5 Stages of **Design Thinking**

1. Empathize (Listen, observe, understand the problem)
2. Define the Problem
3. Ideate
4. Prototype (Experiment)
5. Test

Lean Definitely Applies to Design



PDCA/PDSA for Architects & Engineers

4 **What Should We Adjust?**
Plus/Delta

3 **Study/ Test It.**
Does it achieve the goals? How did the users feel?



Today, often **PDSA**:
"Plan, Do, Study, Adjust"

1 **Revise/ Improve the Planning or Design Idea**

2 **Produce It. (Do)**
Calculations, Sketches, 3D Models, Mock-ups, etc.
To encourage experimentation, use simple materials.

Experiment. Do these complete cycles quickly!

Lean Fundamentals

People have learned that mimicking Toyota's **Toolsets & Skillsets** is not enough (5S, 5 Whys, A3s, Kaizen events, etc.)

Culture and **Mindset** are also essential.

- Coaching people to be **problem solvers**

2009 Toyota Kata by Mike Rother



Lean Construction Institute

Founded in 1997, **Lean Construction Institute (LCI)** seeks to improve the Construction and Design industries through Lean approaches to project design and delivery.

- Last Planner® System

Essential Vocabulary

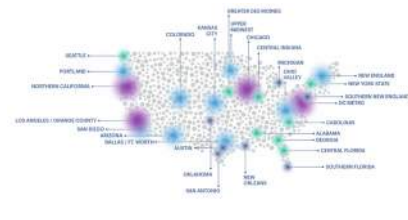


Lean Construction Institute

- Membership
- Events
- Training
- Communities of Practice
- Publications
- Research



Essential Vocabulary



LCI Owner Members (Partial List)

Advocate Aurora Health
Amgen
Athena Health
Austin City Public Works
Corning, Inc.
Eli Lilly and Company
Genentech
General Motors
Georgia-Pacific
Google
HCA The Healthcare Company
Intel
Kaiser Permanente

Lancaster General (Penn Medicine)
Lockheed Martin
Merck
Methodist Health System (Dallas)
Michigan State University
OU Medicine
P&G (Procter & Gamble)
State of TN – Dept Gen'l Services
Sutter Health
UHS of Delaware
University of California – San Fran
U of Washington – Capital Projects

Essential Vocabulary

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Dec 2016

- 81 Owner Responses
- 310 projects across U.S.
- Completed in last 5 years
- Construct'n cost ≥ \$10M
- Using various delivery methods
- Owners'-perceived best projects and typical projects

Research Studies Dodge Data & Analytics Report



Dodge Data & Analytics Study

“Very high Lean intensity projects”

- **Client was a Strategic Partner**
- **Ahead of Schedule**
- **Under Budget**
- **Design Excellence**

Research Studies Dodge Data & Analytics Report

Of the best projects Dodge found a statistically significant correlation between very high Lean intensity projects and likelihood for better client outcomes and design excellence. Lean intensity refers to the extent a project used the Lean methods studied, particularly those that are recognized as most effective.

% of Projects Achieving Outcome

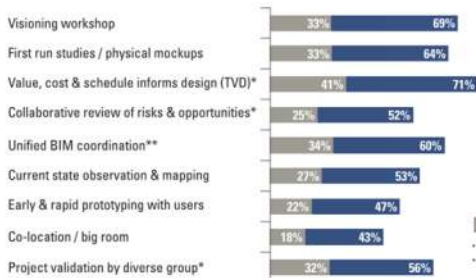


Outcome	Low Lean Intensity	Very High Lean Intensity
Clients: Client was a strategic partner during the design and construction process	37%	78%
Schedule: Final schedule was shorter than the original schedule	8%	33%
Budget: Final construction cost was lower than original budget	7%	53%
Design Excellence: Opportunities for true innovation, achieved a very high level of sustainability, progressive aesthetics	18%	36%

Image by Lean Construction Institute Oct 2017

WHY DID PROJECTS EXCEL?

Dodge also inquired about application of Lean methods on each project. The research found the following with the biggest utilization gap between best and typical projects.



Method	Low Lean Intensity	Very High Lean Intensity
Visioning workshop	33%	69%
First run studies / physical mockups	33%	64%
Value, cost & schedule informs design (TVD)*	41%	71%
Collaborative review of risks & opportunities*	25%	52%
Unified BIM coordination**	34%	60%
Current state observation & mapping	27%	53%
Early & rapid prototyping with users	22%	47%
Co-location / big room	18%	43%
Project validation by diverse group*	32%	56%

Image by Lean Construction Institute Oct 2017

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James Pease, Lean IPD, Sutter Health

- Expert in set up and structure of large, complex capital projects using Lean and IPD
- Has negotiated over \$650M in IPD contracts

“I believe the most important components are:

- ✓ A collaborative **validation process**
- ✓ An aligned **contract structure**
- ✓ **Target Value Design** (TVD)
- ✓ The use of **Last Planner®** System (LPS)
- ✓ Intentional implementation of available **technology”**

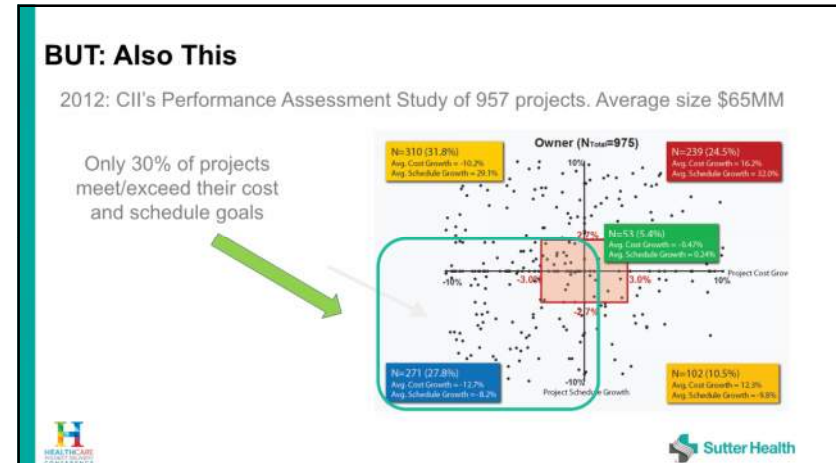
Lessons Learned, Best Practices Leading Practitioners



Sutter Health

- At least 8 hospitals
- \$5B-\$7Billion estimated
- 2008, 2013, 2030...

HEALTHCARE 2030 VISION Sutter Health



Sutter's Evolving Process

2000-2004 "Collaborate, Really Collaborate"
"Lean Intent" helped, but inconsistent schedule & budget

2005 "Change the Contract (a bit)"
Modified GMP Contract – Still inconsistent results

2006 "Change the Contract (a bit more)"
IPD Tri-Party Contract, No Shared Reward

2007 "Change the Contract (completely!)"

2007-2018 "Change Everything Else"

The "Everything Else" List (partial)

- Co-Location
- Target Value Design
- Last Planner ® System
- BIM for Risk Management
- Design for Fabrication
- Risk and Opportunity Tracking
- Cost to Complete Forecasting
- Takt Time / Location Based Scheduling
- Dashboarding / Visual Management
- Active Learning from Failures



RESULTS: It Works!



- 24 projects completed in the past 11 years
- \$3.1 Billion US



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* The Asterisk Slide

- If the Owner is deeply involved
- If the Owner is a committed partner
- If the Owner is open & transparent
- If the Owner leads the change



Integrated Project Delivery – An Action Guide for Leaders



FREE Download

LeanIPD.com/IPDGuide



Kent Hedges, UHS

- 6-1/2 years Lean and IPD Experience.
UHS embraced Lean & IPD more than 10 years ago.
1. Success begins and ends with a **culture of trust**.
 2. **Transparency** is a challenge for traditional-thinking builders within a truly collaborative team.
 3. **Conditions of Satisfaction** should be developed by core team leaders
 4. **IPD vs Lean** - IPD is typically the contract vehicle (shared risk/reward, profit pool); Lean is the focused attention to elimination of waste
 5. Develop a few **metrics** which measure the health of the project and team. E.g. \$ budget vs. actual, Percent Planned Completion, RFI goals, work schedule progress

Lessons Learned, Best Practices Leading Practitioners



Kyle Majchrowski, Ripple Intent, Banner

- Senior Project Executive at Banner Health
- Founded **Ripple Intent**, a non-profit group focused on improving people's experiences.
- Annual "**Improving Capital Projects**" Symposium + Quarterly "Booster Shot" Breakfasts in Denver, Portland, Phoenix
- "We are continually seeking to find a better way to work together."
- **Collaboration** can be taught and practiced. People flock to these events to learn **trust, reliability, humility, vulnerability, etc.**

Lessons Learned, Best Practices Leading Practitioners

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What People Most Need to Hear

- The project can be very successful and everyone can make money.
 - Too many business people—including Owners, Architects, and Contractors—struggle with this notion. They believe you only succeed by “beating up” or “squeezing” others. Someone has to lose for you to win.
 - This hurts their ability to collaborate. Acknowledge it. Don’t ignore it.
- Kyle Majchrowski



Lessons Learned, Best Practices Leading Practitioners

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	NEW TARGET	MAY 2017	JAN 2018 BUDGET	JAN 2019	2019 - 2017
ED, IMAGING, LAB	21,400	21,400	27,600	24,900	-2,700
CLINICS	21,000	21,000	25,800	31,600	+5,800
FITNESS/REHAB/ WELLNESS	21,000	21,000	16,200	29,000	+8,800
PUBLIC/RETAIL					
PHARMACY	2,000	1,800	1,800	1,800	0
POOD	2,000	1,800	1,800	1,800	0
CONNECTIONS HUB					
TEACHING KITCHEN	1,500	1,500	1,500	1,500	0
COMMUNITY/ED/N	3,000	3,000	3,000	3,000	0
FRAGMENTED PLAN	6,000	6,000	6,000	6,000	0
OFFICE & STAFF	17,000	14,800	10,050	28,900	+11,850
BUILDING SUPPORT	24,000	16,800	23,000	24,700	+1,700
BUILDING GROSS SQUARE FEET	100,000	100,000	102,800	134,000	+31,200

Common Terms & Themes in Lean Design & Construction

- **Respect for People**
Request their input. Respect their time. Collaborate.
- **Vision/Partnering Session(s), On-Boarding**
- **Big Room** – Owners, Designers, Builders together.
- **Pull Planning, Last Planner®**
Reliable Promises
- **Target Value Design** – Pre-design budget
- **Set Based Design**
- **Experiment, Quick Iterations (PDSA)**
Mock-ups, Cardboard City, BIM, Virtual Reality, Sticky Notes
- **FMEA** – Failure Modes & Effects Analysis
- **Mistake Proofing** (Poka Yoke)
- **Choosing by Advantages**
- **A3s – Scientific Method**
- **Pluses/Deltas**



What Lean Design Looks Like

Big Room - A place for Collaboration

- Multiple Disciplines, including Contractor, Trade Partners (subs).
- Flexible furniture, room for big screens, flipcharts, stickies, etc.
- Meeting cadence depends on phase and scale of the project. It doesn't have to be the entire team every day.
- Regular discussion about data-driven analyses.
- Focus on value and eliminating waste (any cost not adding value)



Pull Planning, Last Planner® System

- Involve the people who will do the work (or their immediate supervisor) in Pull Planning (scheduling)
- Start from the end ("pull"). What do you need (from your suppliers) to do this step and how long is reasonable (and profitable)?
- "Reliable promise" "Last Responsible Moment"



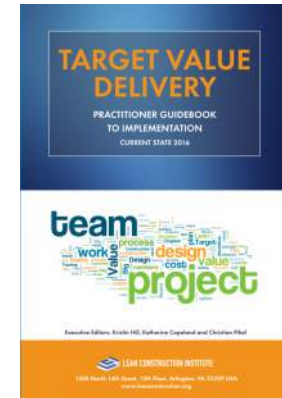
What Lean Design Looks Like

Target Value Delivery

- Not Target Value Design
- Establish cost budget prior to design based on research and benchmarks
- Continuous cost estimating to inform every design decision

Set-Based Design

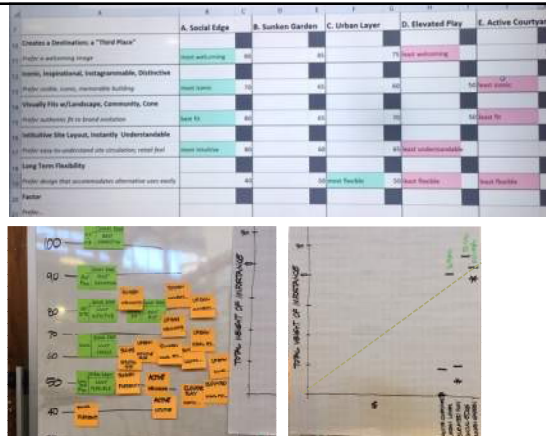
- Don't narrow options too quickly.
- Explore multiple options (until the "Last Responsible Moment") to find those that add the most value for the lowest cost



What Lean Design Looks Like

Choosing By Advantages

- A method to evaluate options by weighing the advantages against the costs



What Lean Design Looks Like

A3 - Record of Decisions

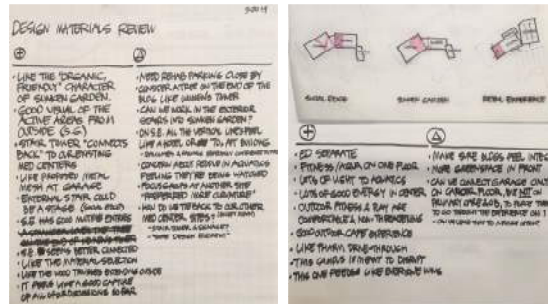
- A3 originally referred to the paper size (approx. 11x17)
- The purpose is to summarize a thorough analysis succinctly
- An A3 represents both the scientific method and PDCA
- Information generally includes:
 - Background
 - Current Condition
 - Goal/Target Condition
 - Root Cause Analysis
 - Countermeasures Studied
 - Results
 - Next Steps/Action Items



What Lean Design Looks Like

Pluses/Deltas

- Valuable for Evaluating Design Alternatives (Options A, B, C)
- Conclude Meetings with $+\Delta$ (Continuous Improvement)



What Lean Design Looks Like

Lean Design applied to **Building Design**

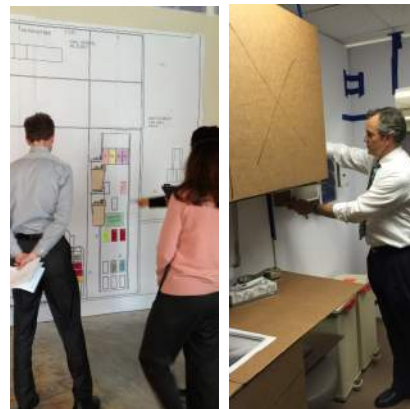
Programming

- **Team Partnering** with Owner & Contractors
- **Vision & Goal-Setting** to document Owner's "Conditions of Satisfaction"
- **Thorough Programming** including scope, schedule and budget *(Not just a space list!)*



Explore Design Alternatives (Countermeasures)

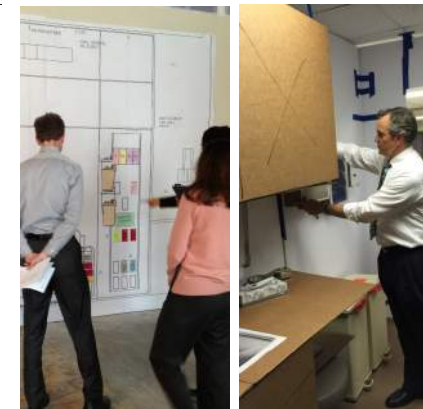
- Plan/Do/Study/Adjust
- Iterate & Learn Quickly
 - Words, Diagrams, Sketches
 - “Gaming” blocks
 - Mock-ups
 - Simulation Modeling



What Lean Design Looks Like

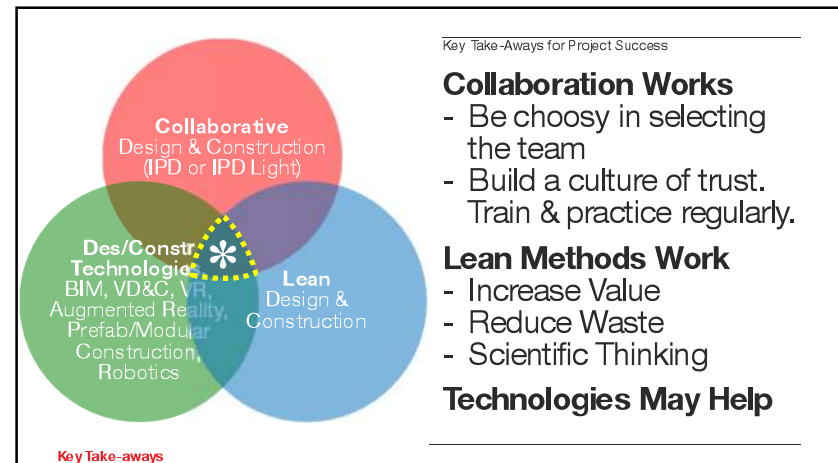
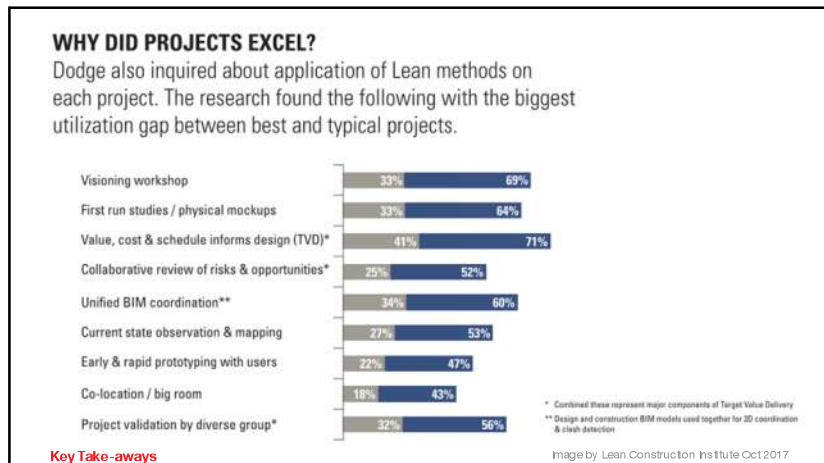
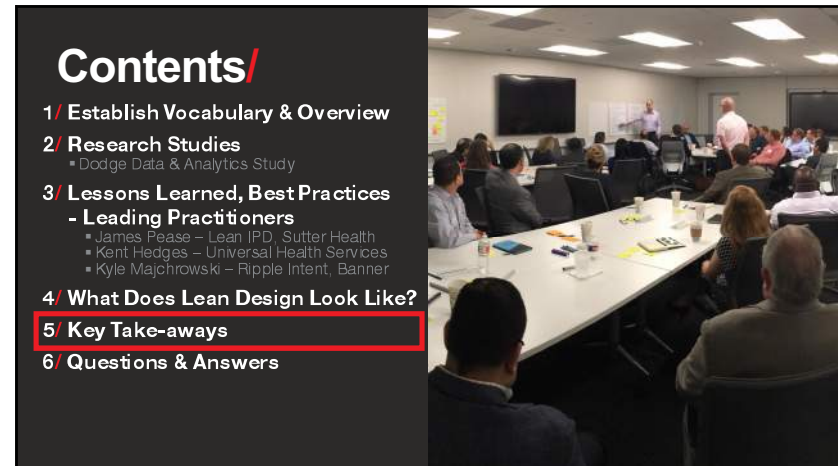
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 - Simulation Modeling
- Visual Communication
 - 3D BIM
 - Virtual Reality

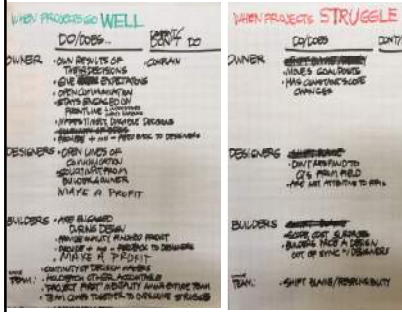


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WHEN PROJECTS GO WELL

OWNER *DOES...* **DOES NOT DO**

- OWNERS OF THE PROJECTS
- GIVE BIDDING INSTRUCTIONS
- DO NOT COMMUNICATE
- ARE NOT ENGAGED IN THE PROJECT
- DO NOT HAVE A CLEAR VISION
- DO NOT HAVE A CLEAR SCOPE
- DO NOT HAVE A CLEAR BUDGET
- DO NOT HAVE A CLEAR SCHEDULE
- DO NOT HAVE A CLEAR TEAM
- DO NOT HAVE A CLEAR GOAL
- DO NOT HAVE A CLEAR RESPONSIBILITY

DESIGNERS *DOES...* **DOES NOT DO**

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WHEN PROJECTS STRUGGLE

OWNER *DOES...* **DOES NOT DO**

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Qualities of a "Good Owner"

- Establishes a Culture of Trust & Respect
- Deeply Involved
- A Committed Partner
- Open & Transparent
- Leads the Change

Key Take-aways

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