Introduction to Lean Project Delivery

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Immersive Education Program

QR Code for Congress App

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AIA Approved Continuing Education

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Lean Journey to Mastery

Lean Construction

Continuous Improvement
Last Planner System®
Optimize the Whole
Respect for People
Plan-Do-Check-Act
Generating Value
A3 Thinking
Little's Law
Reliability
Takt Time
Pull vs Push
The 8 Wastes
Predictability
One-Piece Flow
Level Workflow
In-Place Quality
Standardized Work
Just-in-Time Delivery

Takt Planning
Relational Contracting
Shared Risk & Reward
Choosing by Advantages
Continuous Improvement
Integrated Project Delivery

Big Rooms & Work Clusters
Network of Commitments
Conditions of Satisfaction
Target Value Delivery
Milestone Planning
Phase Pull Planning

Percent Plan Complete
Weekly Work Planning
Make-Ready Planning
Prefabrication
Commitments
Daily Huddles
Andon Chord
Prototyping
Learning
Variation
Level Flow
Constraints
Takt Control
BIM / VDC / VR
McLeamy Curve
5S & Visual Control
Basic Action Workflow
Production System Design

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Table Introductions & Discussion Question

What are your **dissatisfactions** with the way projects are currently designed and constructed?

5 minute discussion

ELECT A SPOKESPERSON TO TAKE NOTES

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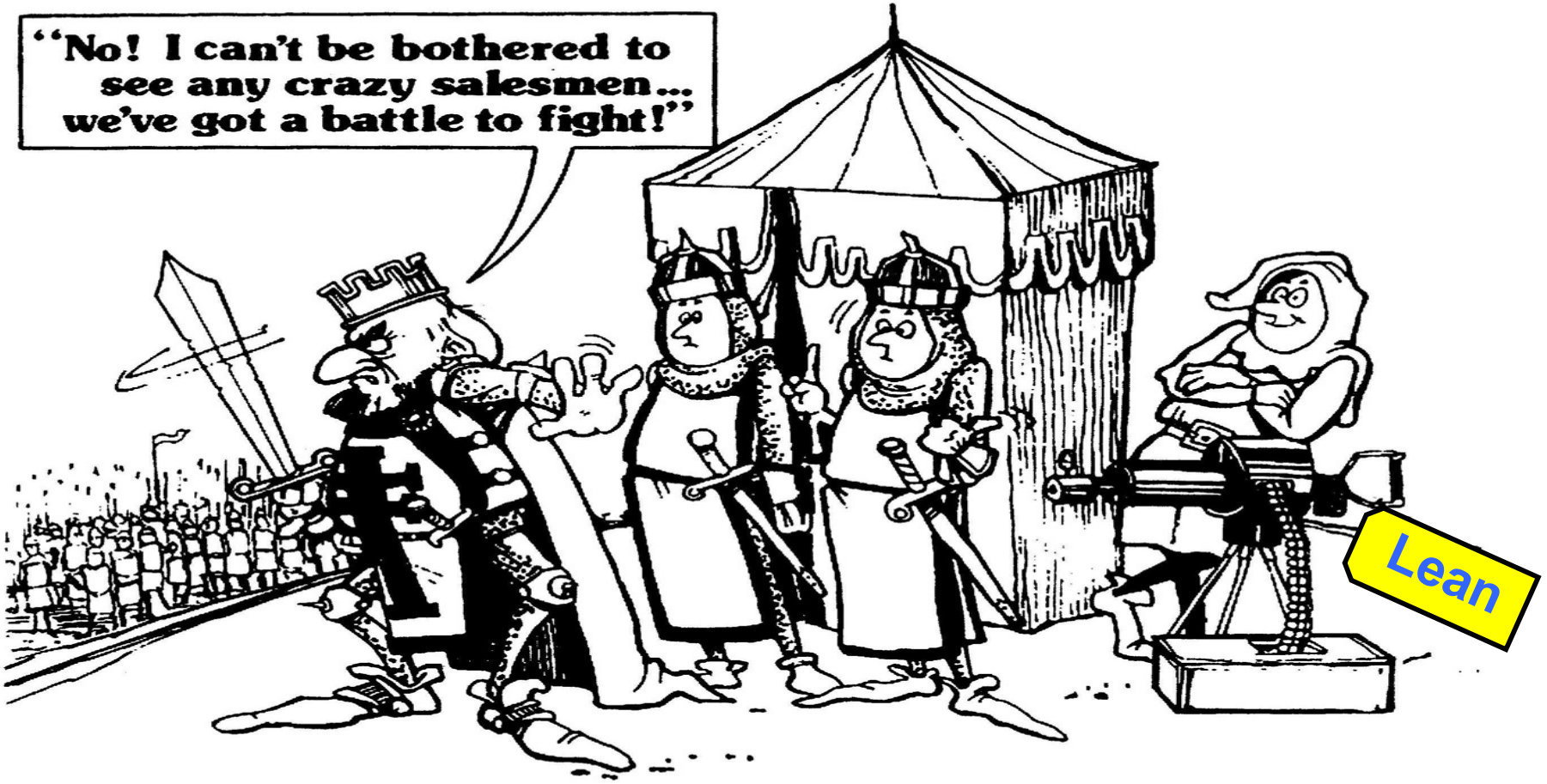

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Definition: **Lean Project Delivery**

An organized implementation of Lean Principles and tools combined to allow teams to operate in unison to create flow & eliminate waste.

The 6 Tenets of Lean

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Origins of Lean

- **Scientific Management** 1880-1930
- **Assembly Lines** 1903-1914
- **World War II** 1939-1945
- **Lean Manufacturing** 1945 - Present

Frederick Taylor

Rosie the Riveter

TOYOTA

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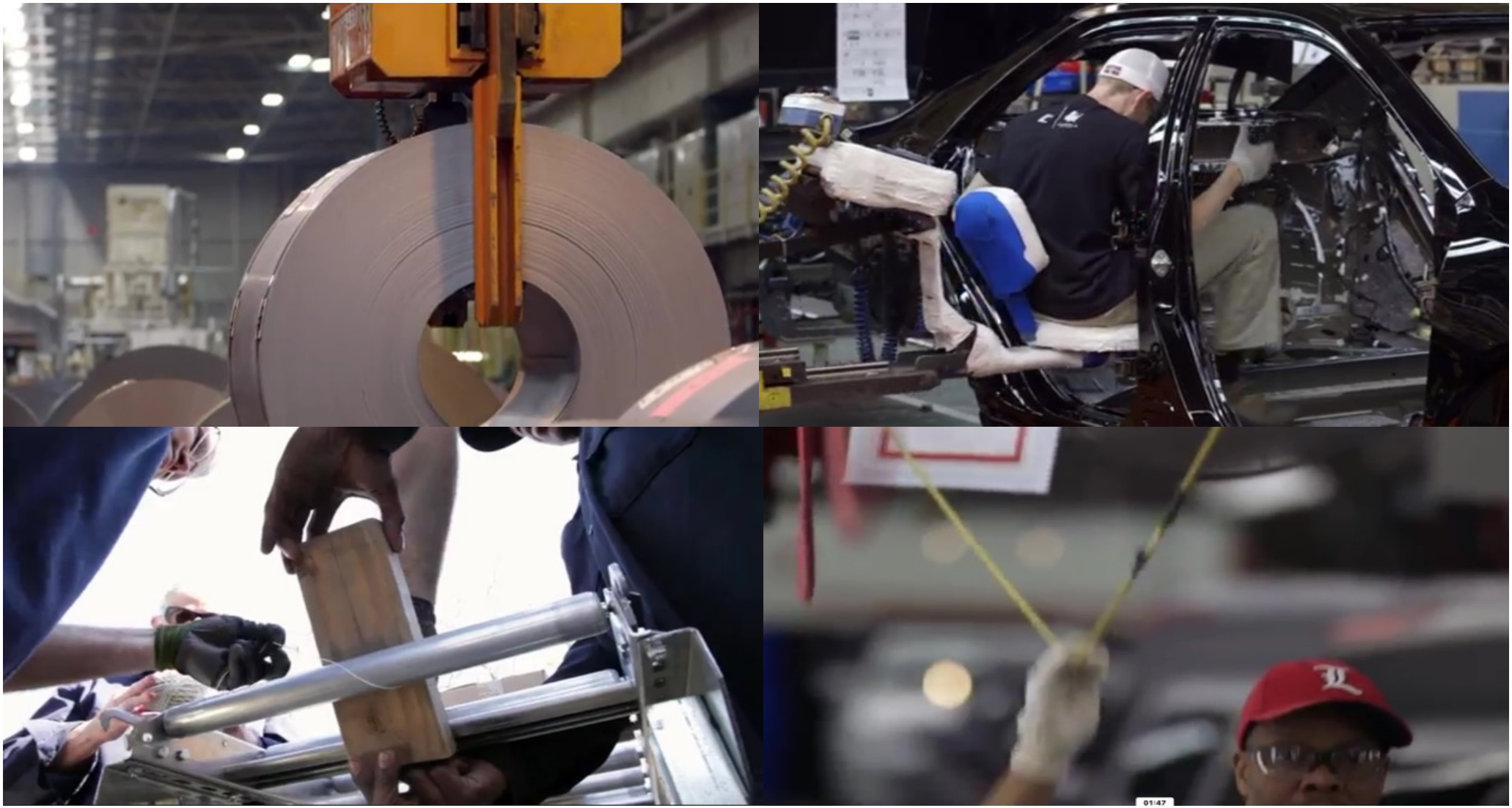
Meals Per Hour Video

Super Storm Sandy

TOYOTA



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Two Non-Negotiables

- **Respect for People**

- **Continuous Improvement**

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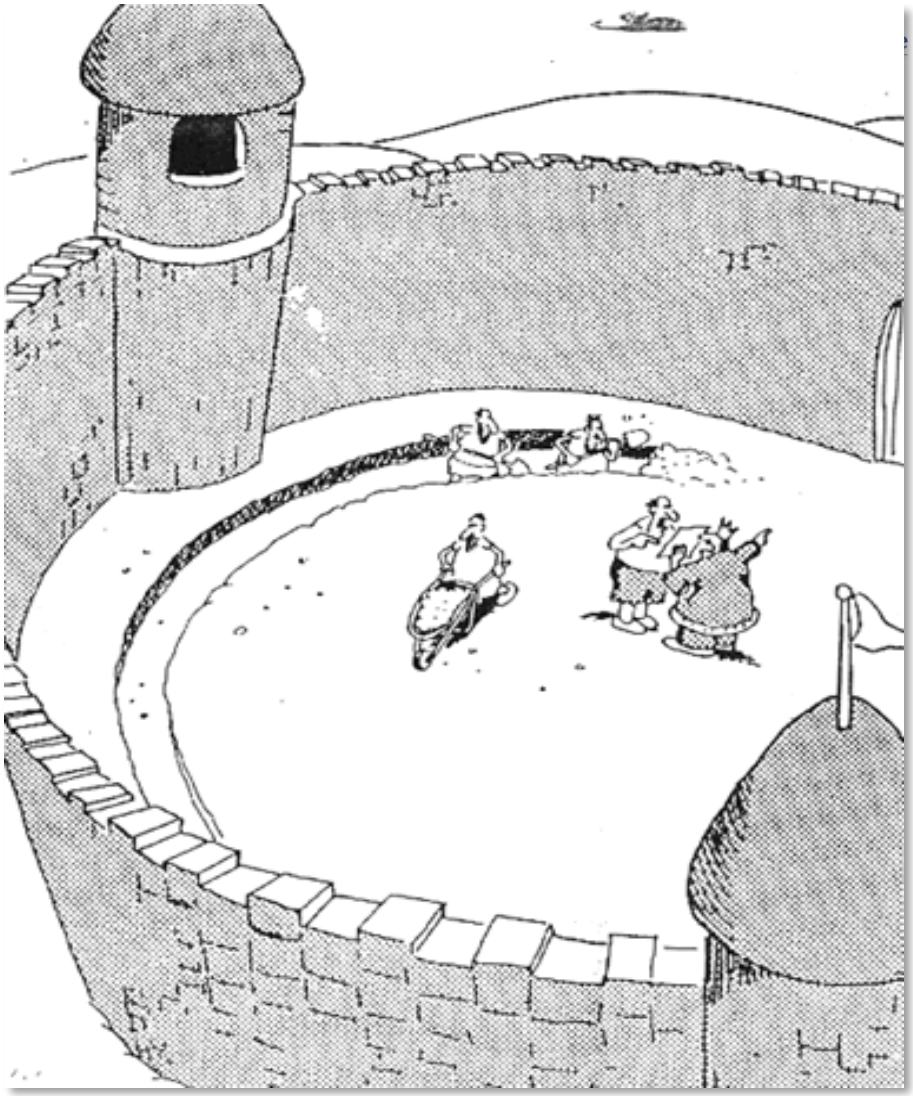
Traditional Delivery Outcomes…

- **Risk is High**
- **Rework and Waste are High**
- **Cost & Schedule are Unpredictable**
- **Teamwork is Unreliable**
- **Profit Margins are Low**
- **Customer Satisfaction is Low**

Suddenly, a heated exchange takes place between the King and the Moat Contractor…

- The Far Side



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Brief History : Lean in Design & Construction

Glenn Ballard & Greg Howell

Early 1990s:

Troubled Refinery Project

The Problem:

The ability of front-line supervisors to reliably plan and execute work

Photo by C.Y. Tsao

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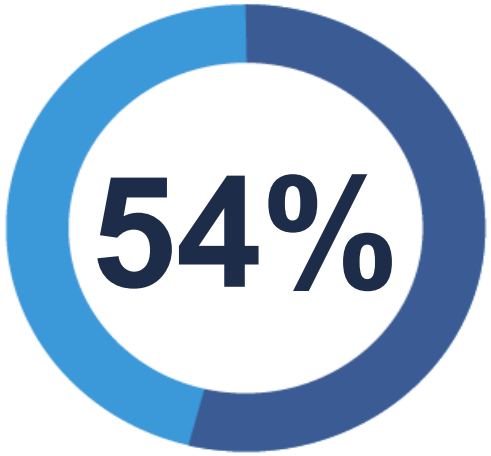
Brief History : Lean in Design & Construction

Research Findings:



Work Completed As-Planned

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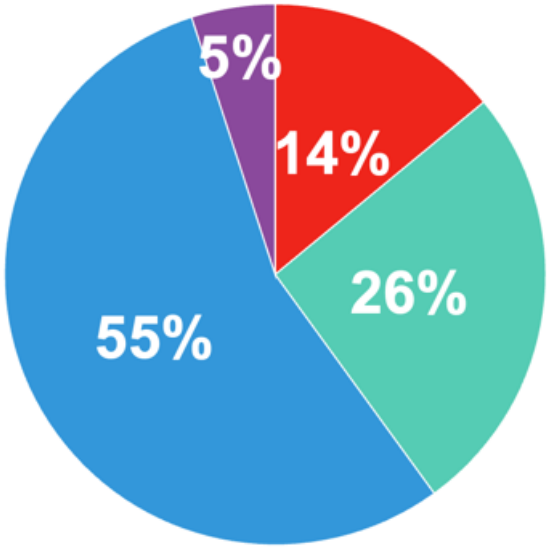
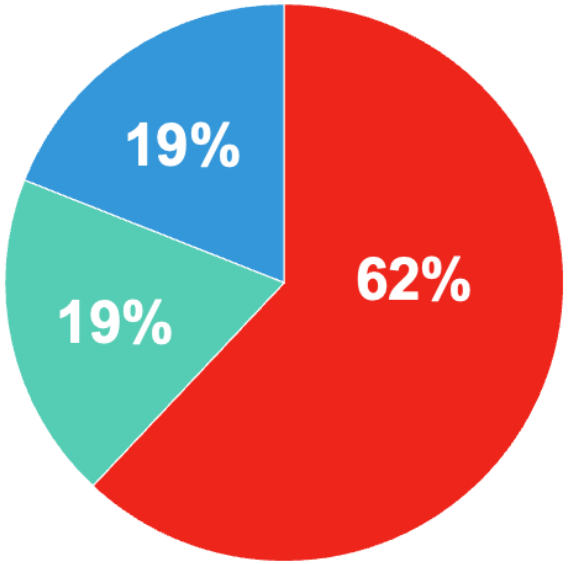
Survey: *How Efficient Are You?*

Non-Lean Practitioners



- Inefficient/Highly Inefficient
- Neutral
- Efficient/Highly Efficient
- Not Sure

Lean Practitioners



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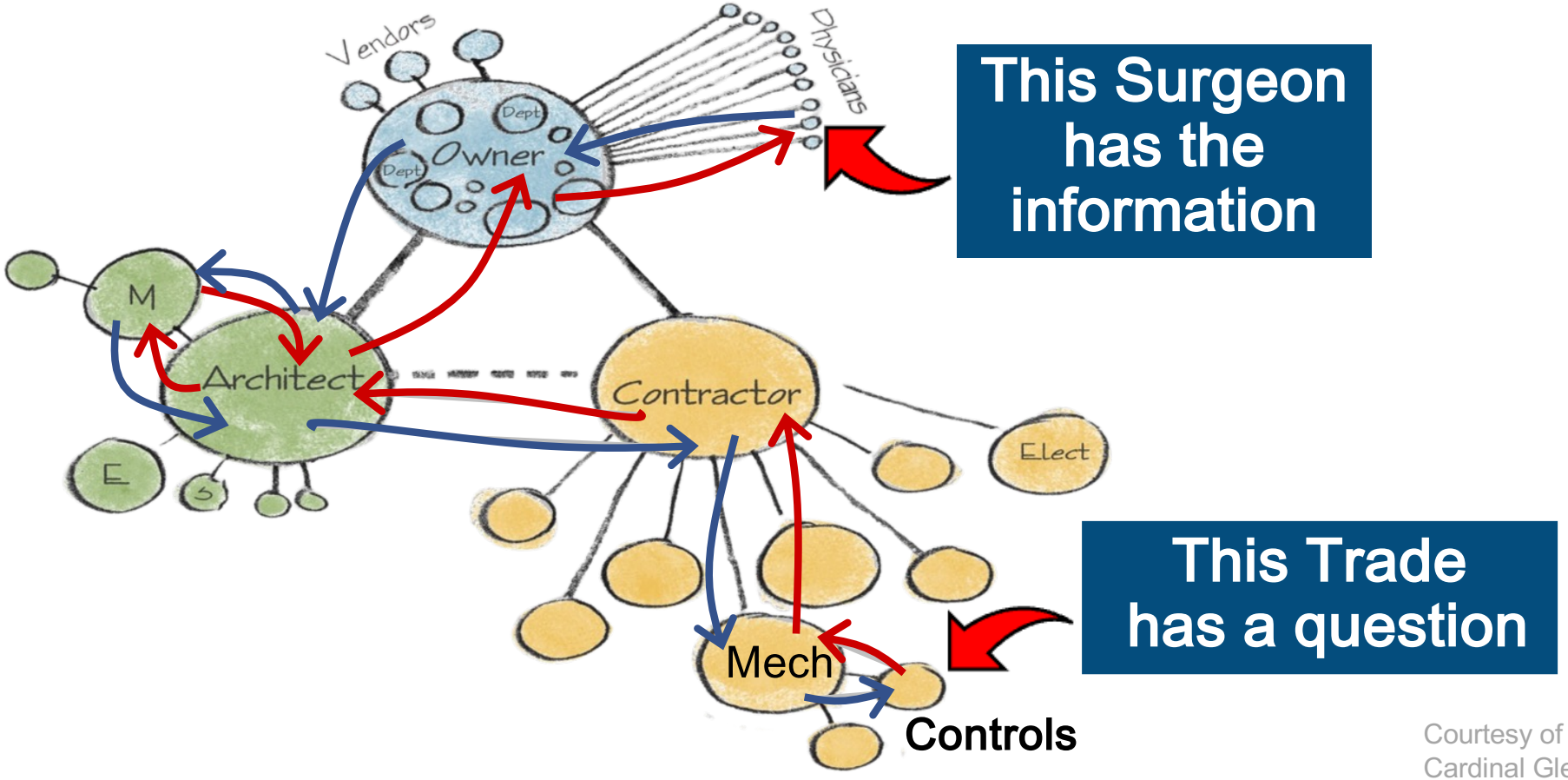
Traditional Structures Create Waste:



Courtesy of SSM
Cardinal Glennon

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Why Lean?

Workflow reliability directly impacts the cost and speed of projects.

Costs are Skyrocketing

Injuries are Too High

Workflows are Unpredictable

Productivity is Declining

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Lean Project Delivery Enables

- Collaborative Risk Management
- On-time or Early Delivery
- Costs at or Below Budget
- Less Waste and Rework
- Cost & Schedule Reliability
- Higher Customer Satisfaction
- Fair Profits for All

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Historical Data & Lean Intensity

70% to 90%
of projects are
Late,
Over Budget,
or Both

Correlation of Lean intensity to outcomes (% likelihood on best projects)

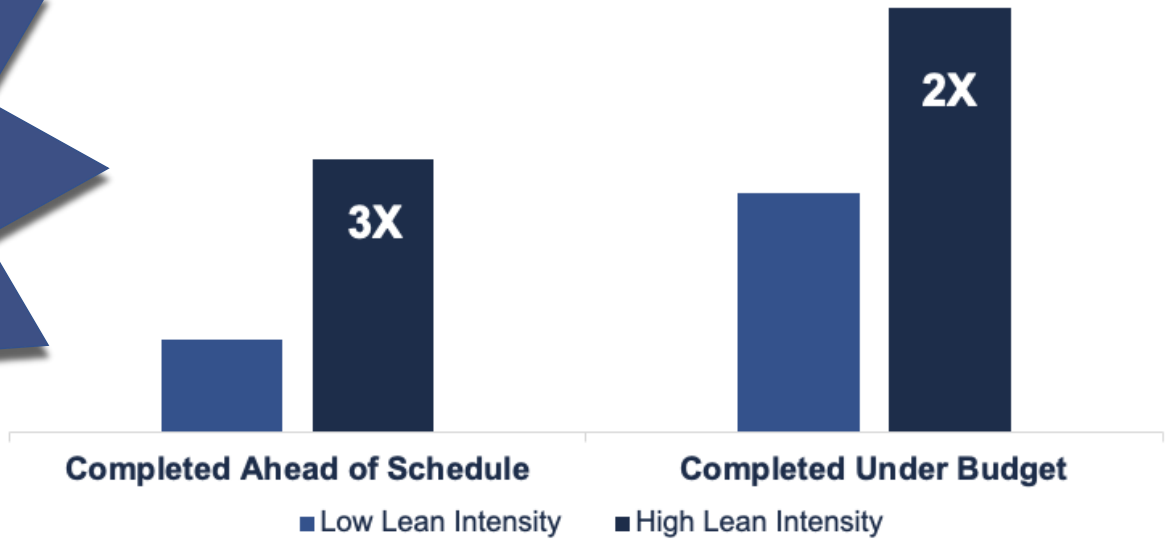

Image Courtesy of Baker Concrete Construction

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Goals of Lean Construction

- ✓ Make Work Flow
- ✓ Minimize Waste
- ✓ Maximize Value
- ✓ Optimize the Whole
- ✓ Continuously Improve

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Benefits of Lean

1. **Safer Work Environment**
2. **Cost & Schedule Predictability**
3. **Increased Productivity**
4. **High Stakeholder Satisfaction**
5. **Less Stress on Participants**

Photo Courtesy of WM Jordan

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Plan-Do-Check-Act (PDCA)

The Deming Cycle

Improve the System

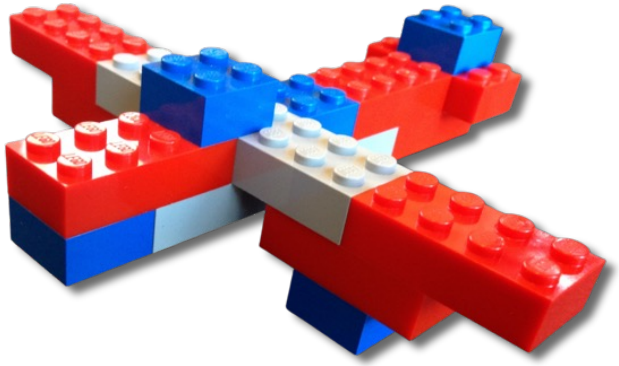
Predict

Study the Results

Take Action, Try it Out

Production System Design Exercise

The Airplane Game



Designing Work Processes for :

- Safety & Quality
- Flow & Productivity
- Flexibility
- Clean Handoffs
- Learning

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Airplane Simulation Debrief

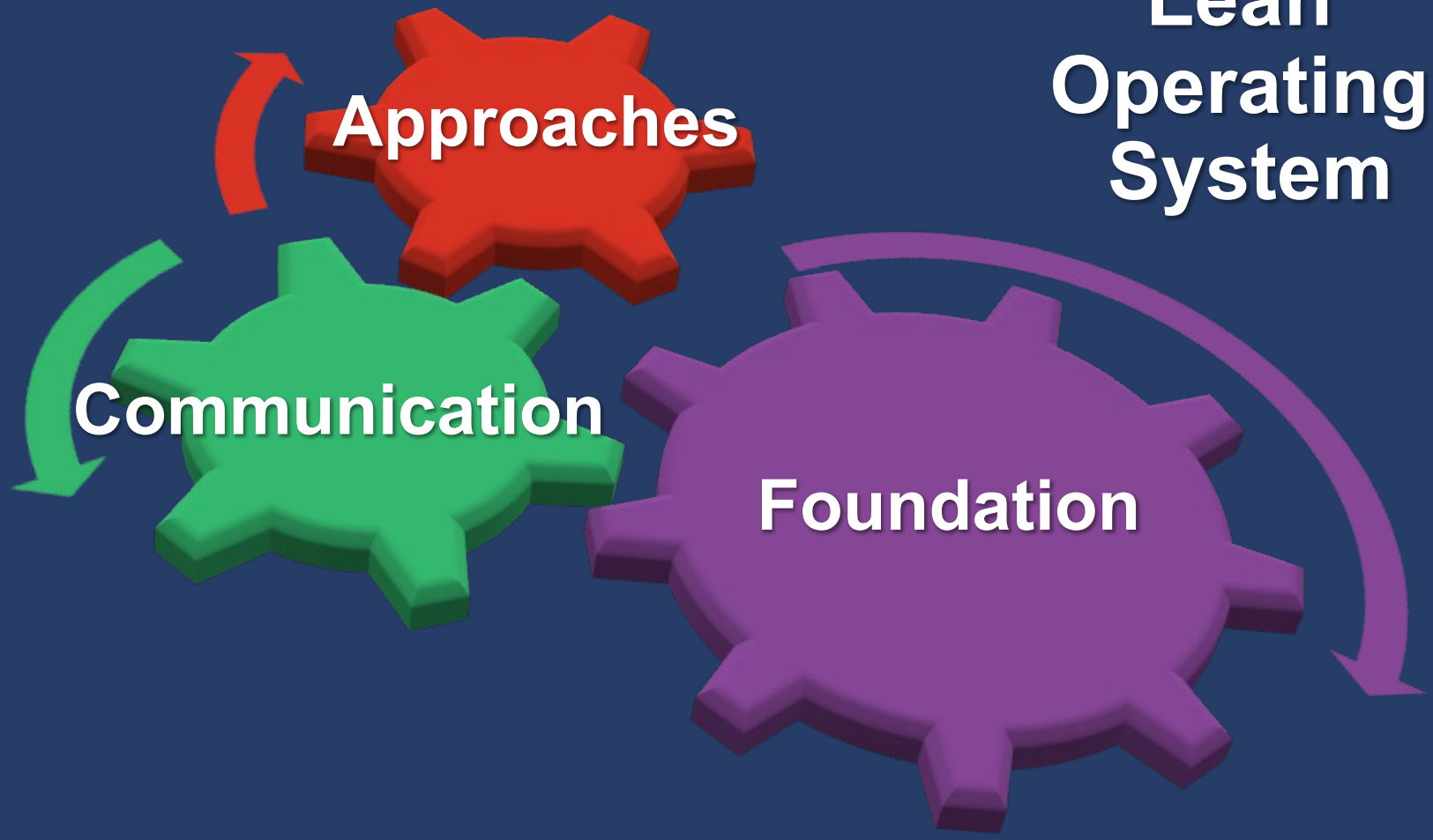
Discuss & Answer the following questions:

1. What are the Key Points/Lessons?
2. How might these Key Points and Lessons apply to your work?
   - **Breakdown all planes/parts to loose Legos and return them to the matching color bins**
   - **Return Instruction Cards (in order) & QC Gauges**

Airplane Game Lessons

- Release work from one party to the next by Pull instead of Push (1 piece flow)
- Minimize Batch Sizes to Reduce Cycle Time
- Make Everyone Responsible for QC
- Balance the Workload Between Trades
- Collaborate Continuously for Steady Workflow

Lean Operating System



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Lean Operating System

- **Lean Foundation**
  - Three Connected Opportunities
  - Six Tenets of Lean
  - 8 Wastes
  - PDCA Cycle

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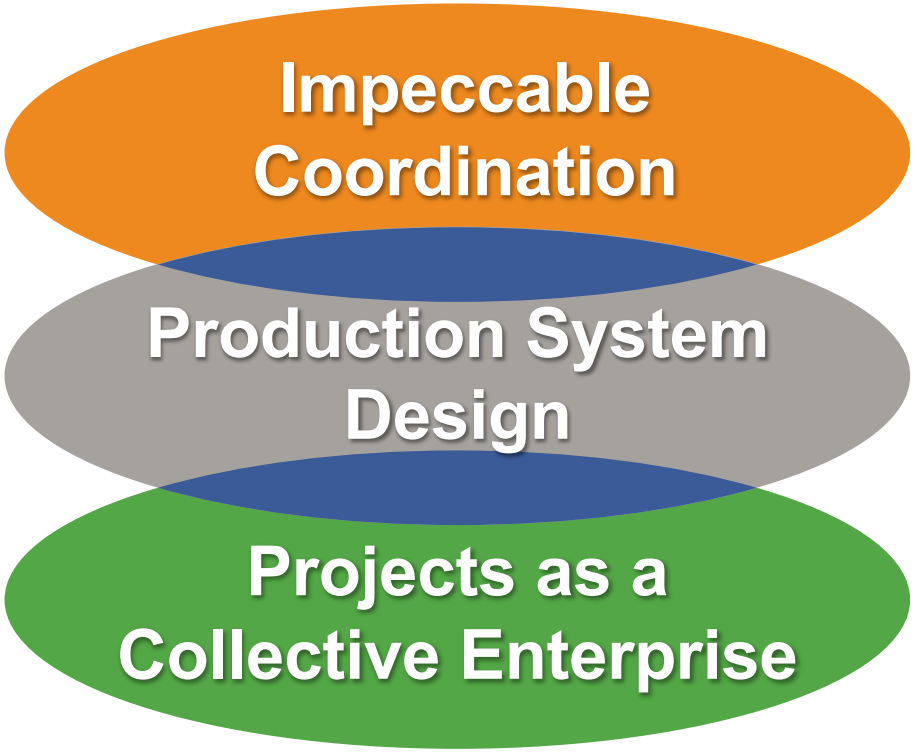
Three Connected Opportunities

A Coherent Way to Manage Work in Projects



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The Six Tenets of Lean

1. Respect for People
2. Optimize the Whole
3. Generate Value
4. Focus on Flow
5. Continuous Improvement
6. Eliminate Waste

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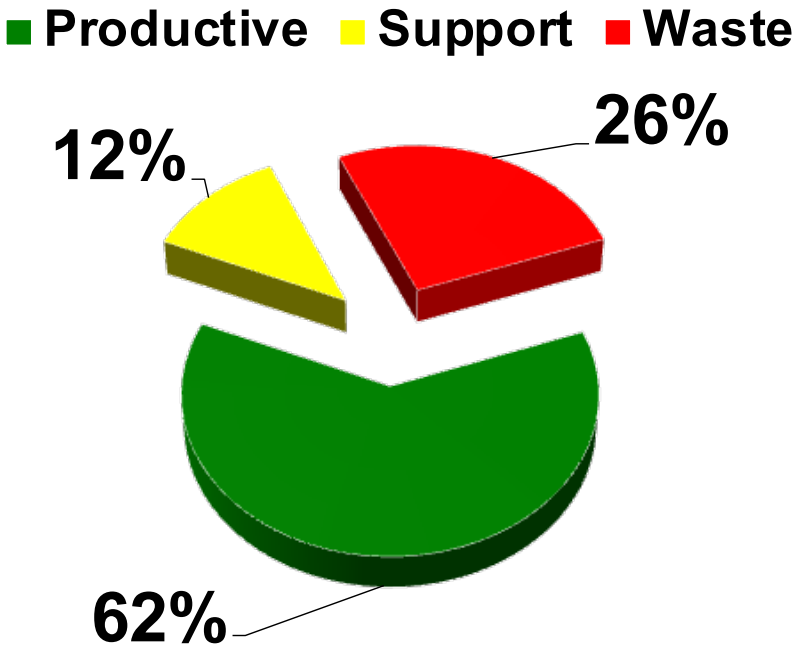
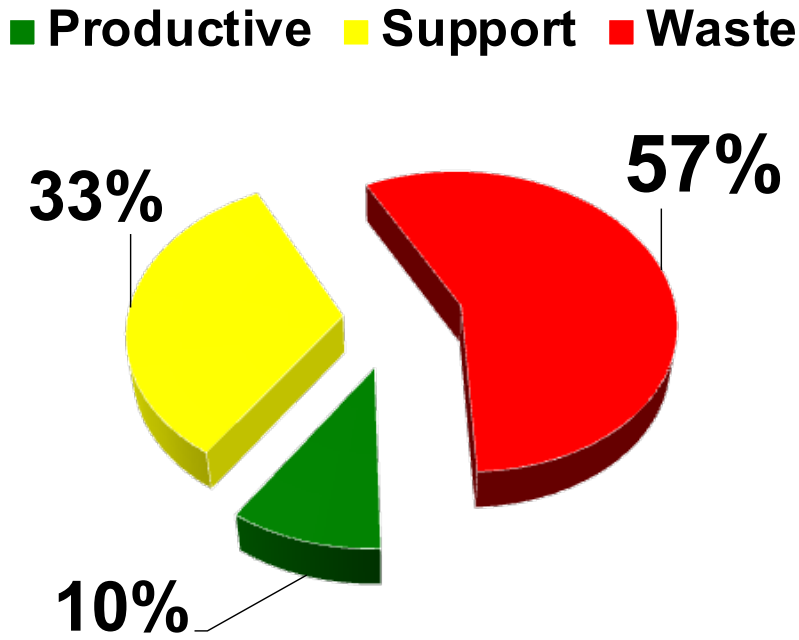
The Opportunity

Manufacturing



Construction



Construction Industry Institute (CII) Study

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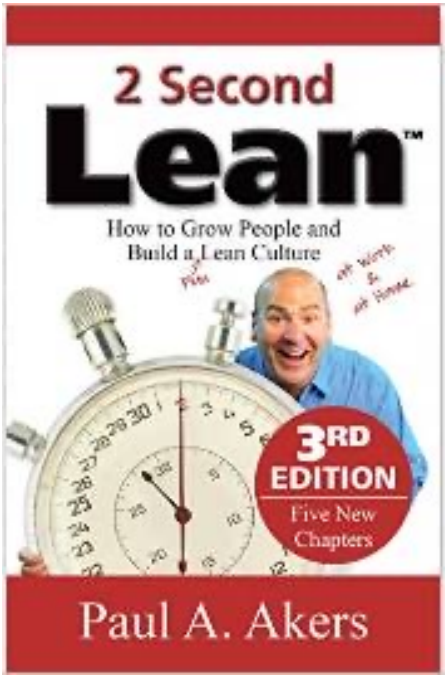
Removal of Waste

- Lean Burrito video by Paul Akers



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The 8 Wastes: DOWNTIME

Defects

Overproduction

Waiting

Non-utilization of talent

Transportation

Inventory

Motion

Extra processing

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Lean Operating System

- **Collaborative Communication**
  - **Basic Action Workflow**
  - **Projects as Networks of Commitments**

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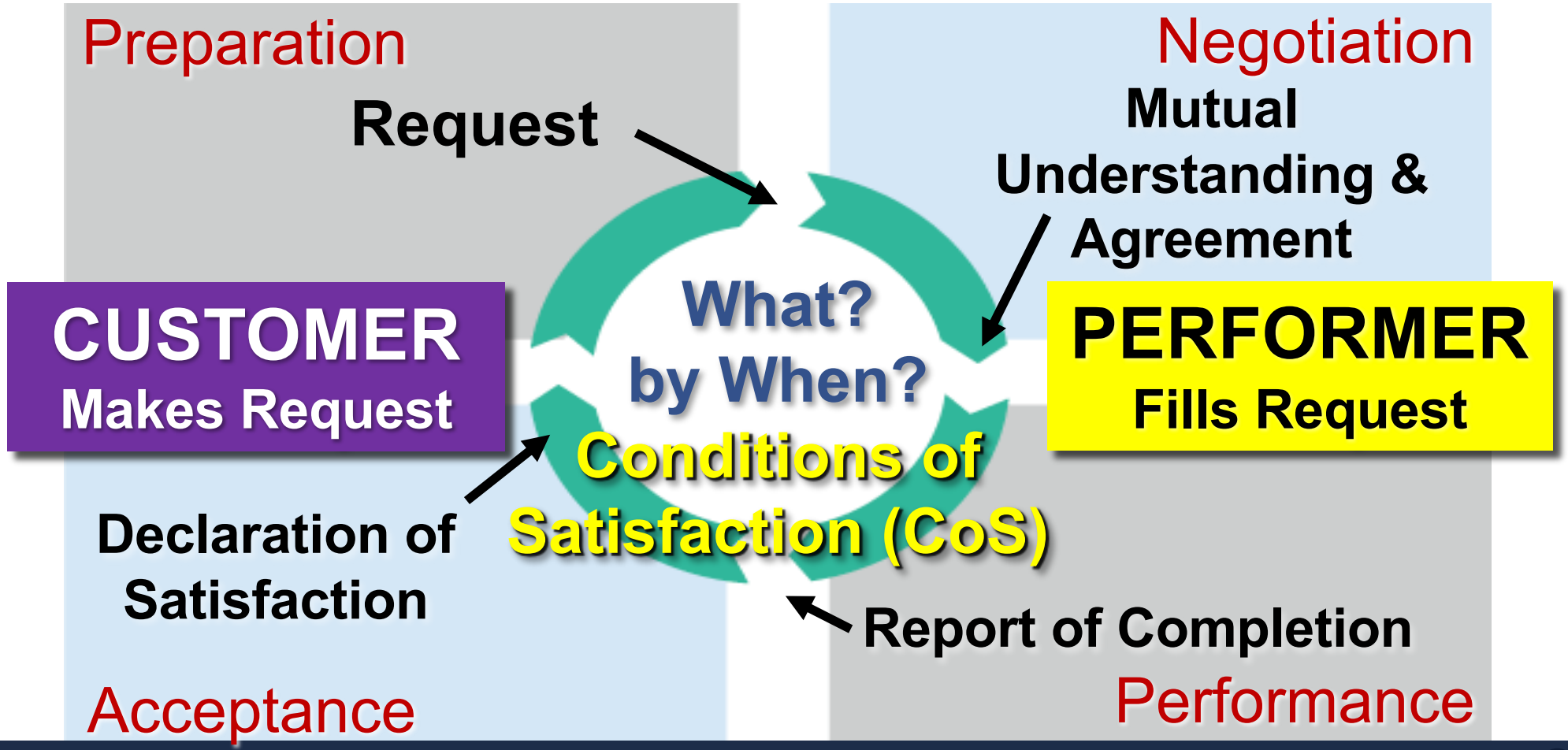
How Work Gets Done: Basic Action Workflow



Credit: Basic Action Workfolw by Dr. Fernando Flores

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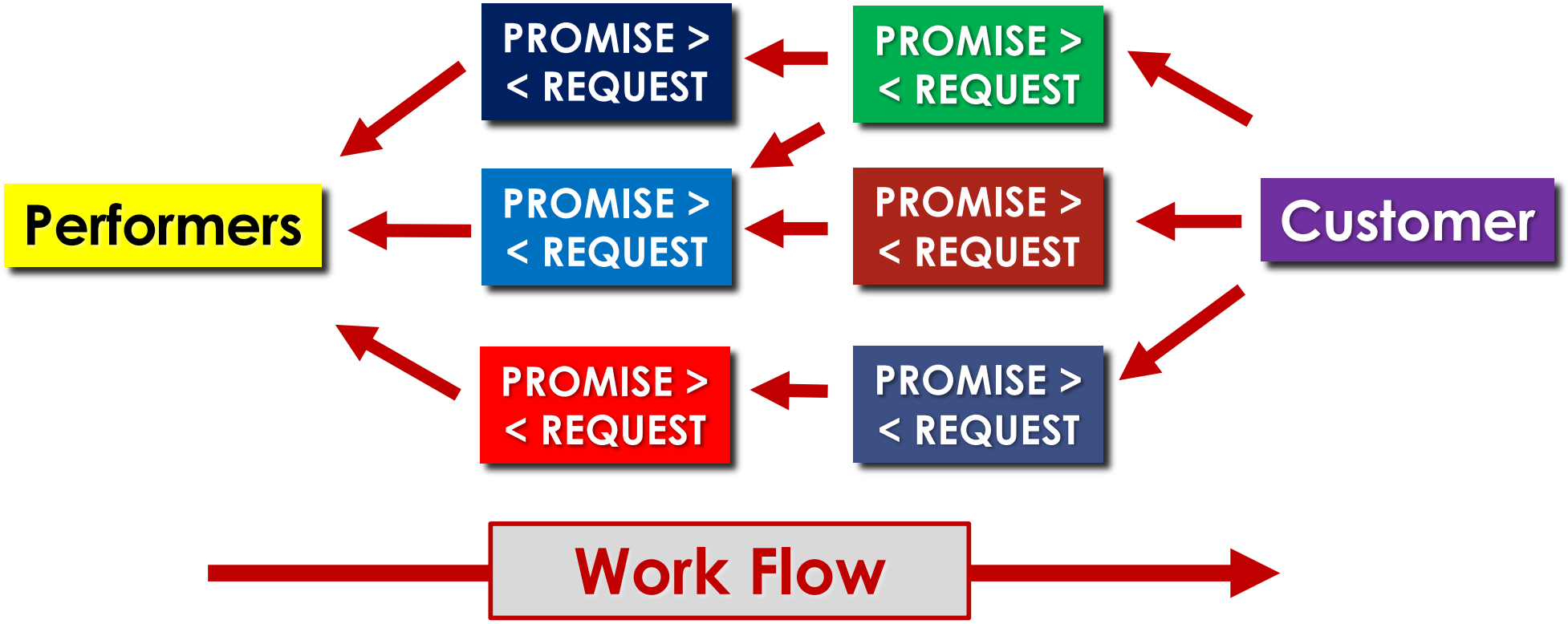
Projects as Networks of Commitments



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Projects as Networks of Commitments

- Activities are Linked by PROMISES (Commitments) between CUSTOMERS and PERFORMERS.
- The GOAL is to improve the RELIABILITY of COMMITMENTS.
- The team must take responsibility for, AND actively manage commitments.

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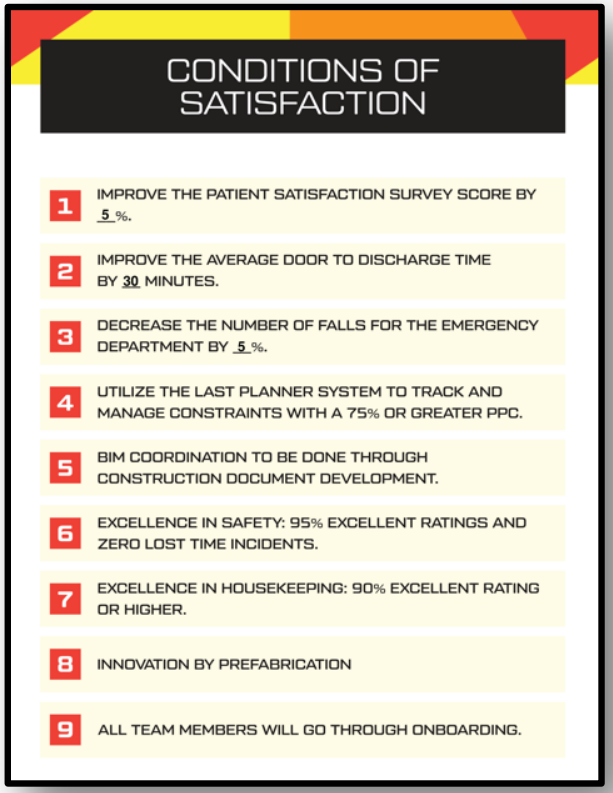
Conditions of Satisfaction (CoS)

- Project CoS & Activity CoS
- *Value Definition Statements* developed by the team
- Determines which *tests a project must pass* to be accepted as a success.
- **Inform the *decision-making process* of the team.**



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Lean Operating System

Approaches:

- Integrated Project Delivery (IPD)
- Target Value Delivery (TVD)
- 5S Implementation
- Last Planner System® (LPS)
- Related tools

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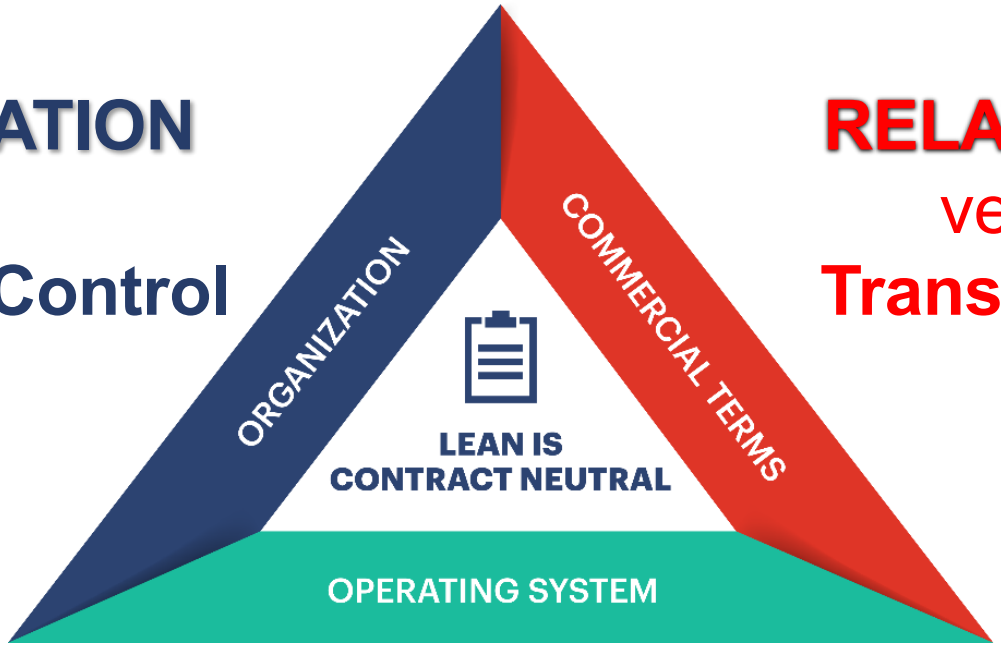
Project Elements: Lean vs Traditional

COLLABORATION
versus
Command & Control



RELATIONAL
versus
Transactional

RELIABILITY (Flow) vs CPM Scheduling (Push)

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Integrated Project Delivery (IPD)

- Relational Contracting + Lean to combat the downfalls of traditional D-B-B (silos)
  - Think “Joint Venture” between OAC & Key Trades
- Contract: IFOA or Consensus Docs
- Cost Plus with Shared Risk & Shared Reward
- Conditions of Satisfaction (CoS)

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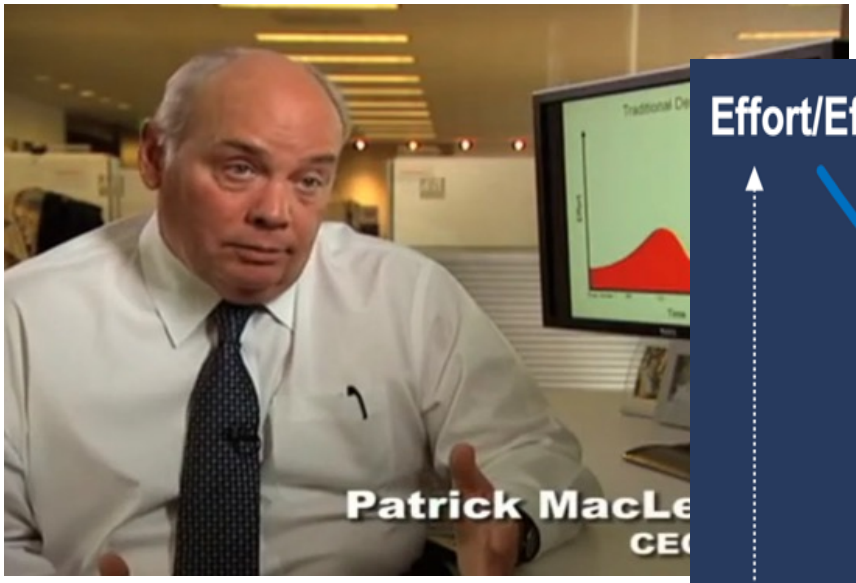
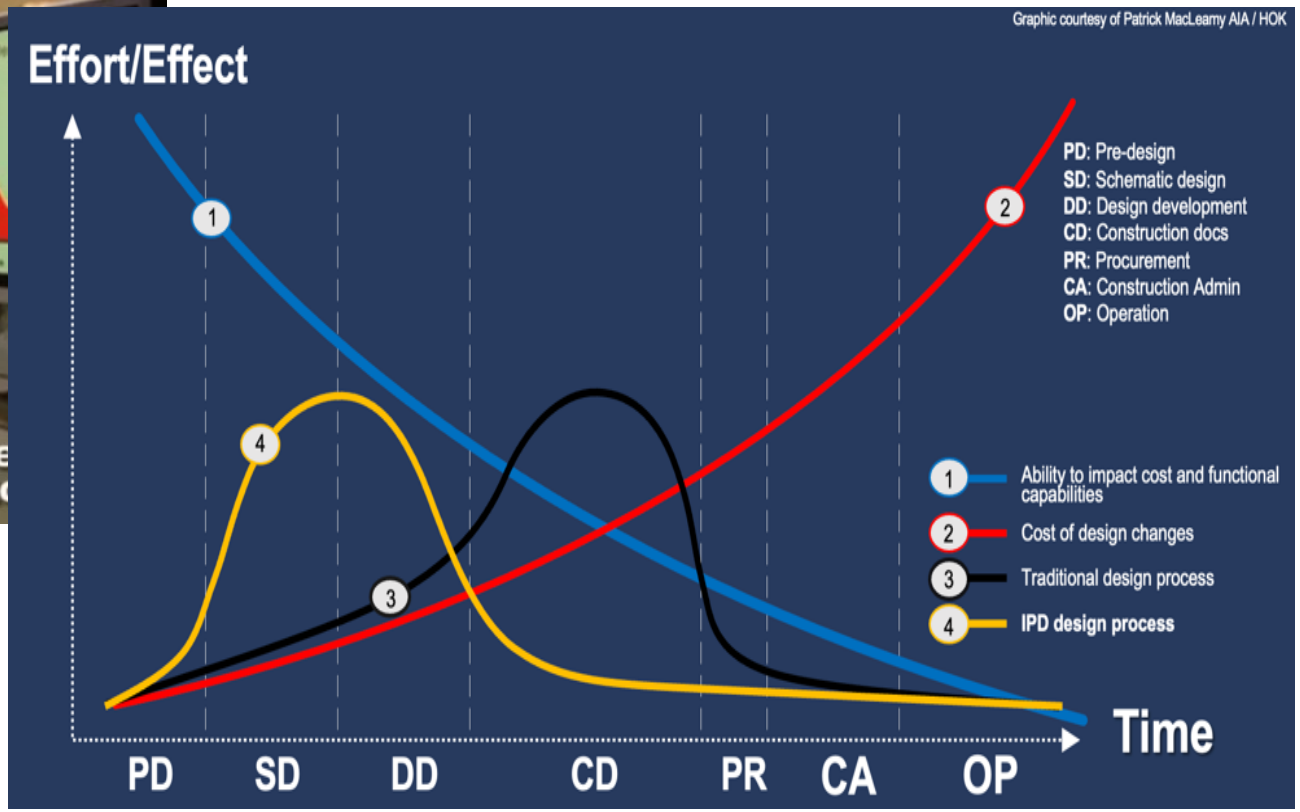
MacLeamy Curve Video





https://youtu.be/oHHY7Cxl2_Y

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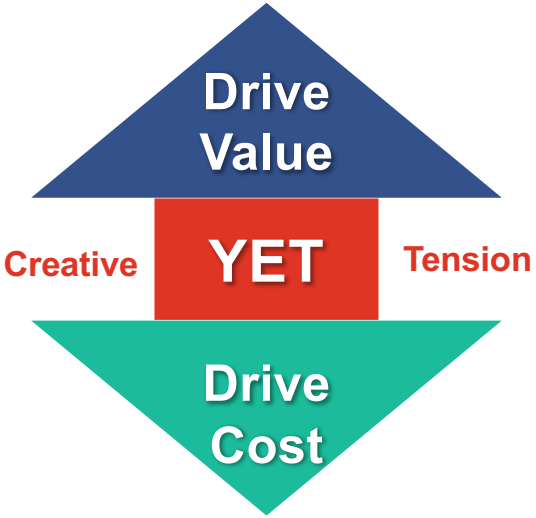
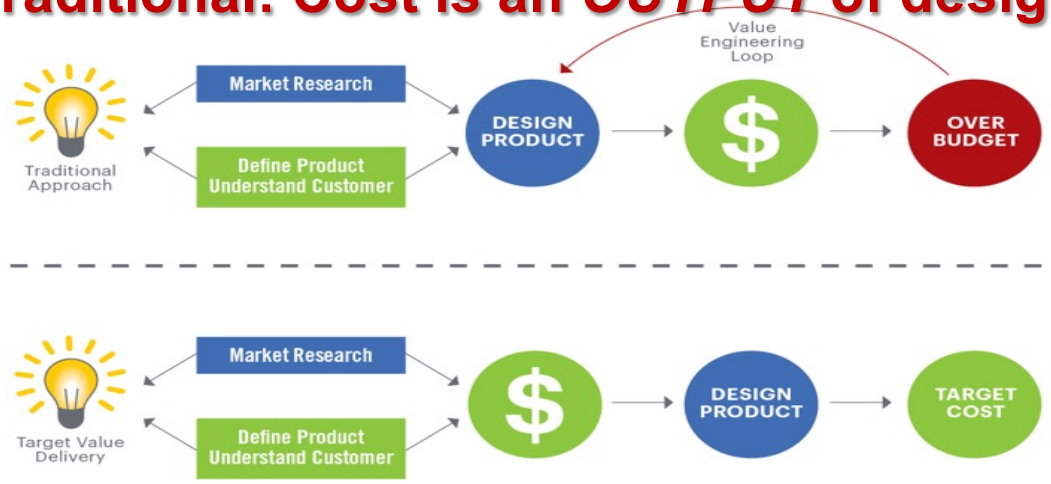
Target Value Delivery (TVD)

Goal: Minimize the waste inherent in the Traditional design-estimate-redesign cycle



Traditional: Cost is an *OUTPUT* of design



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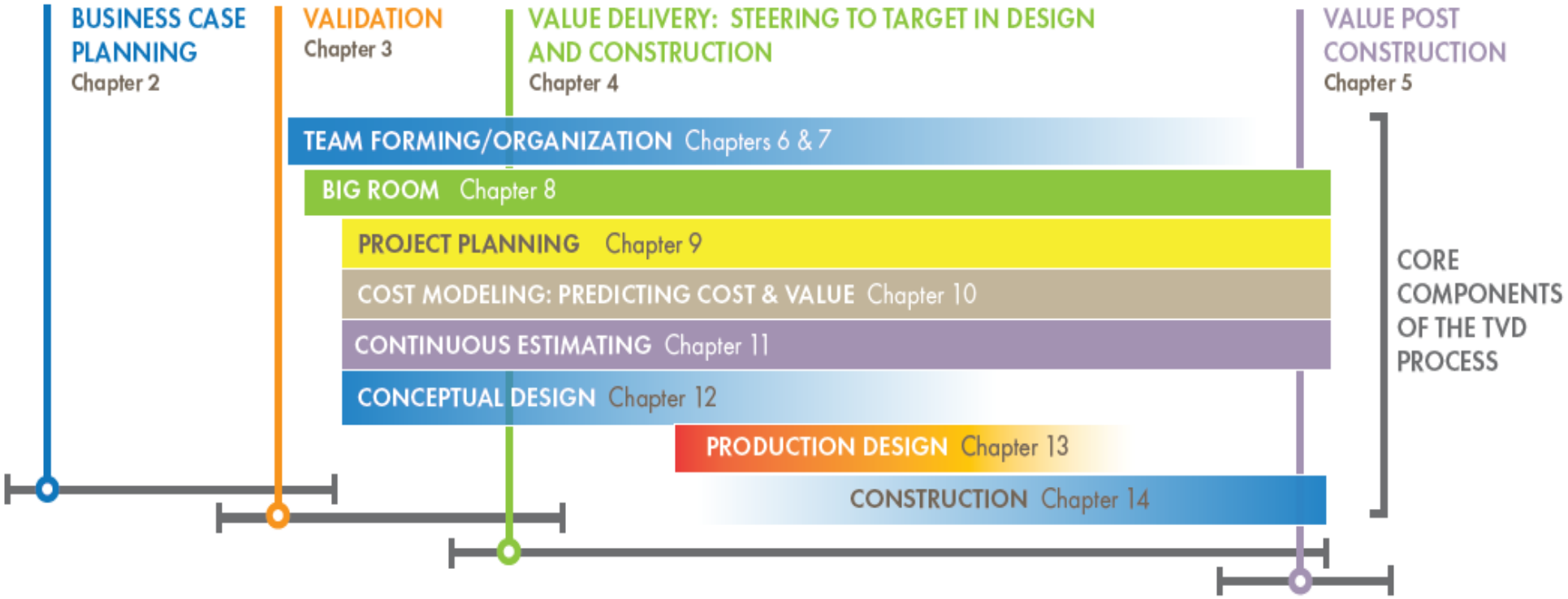
Target Value Delivery Overview



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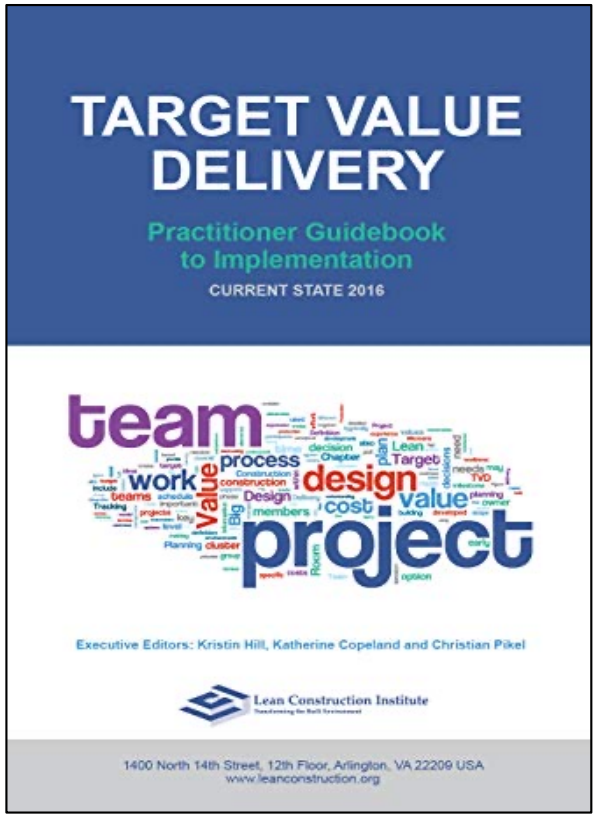
IPD & TVD Resources



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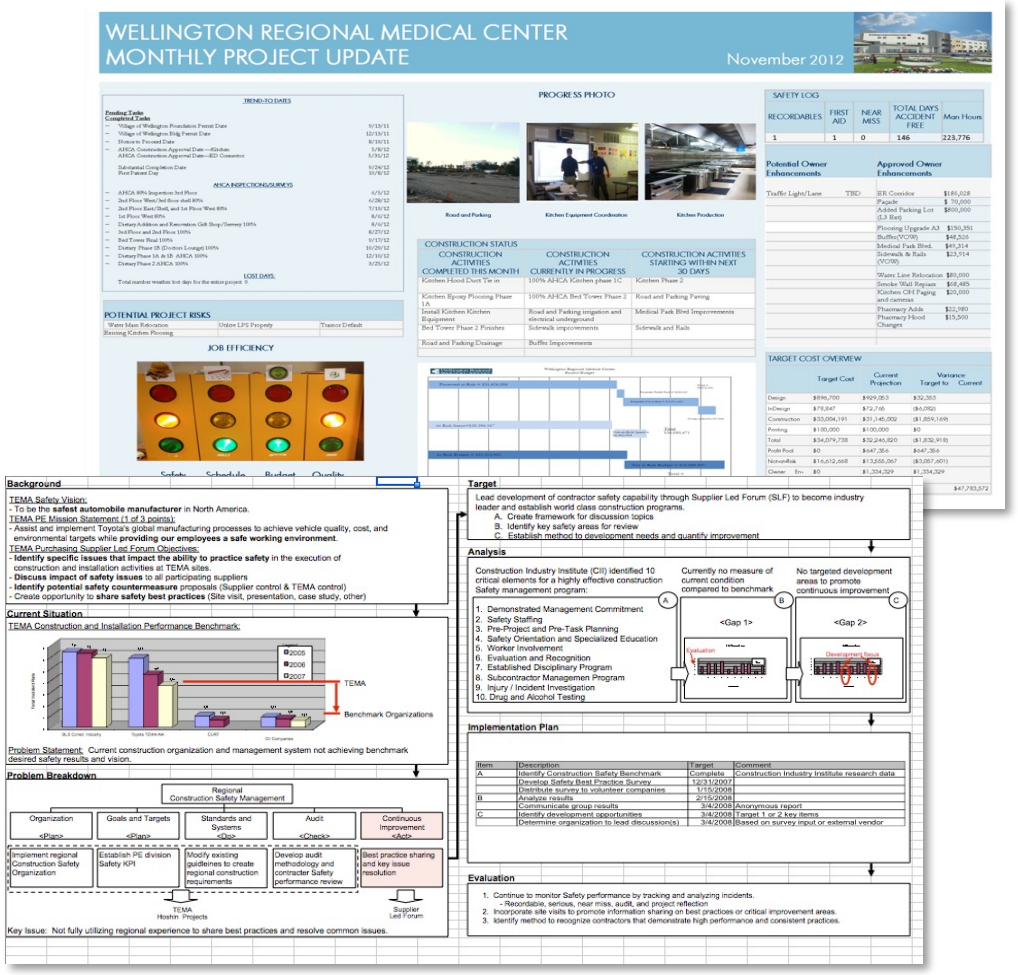
A3 Thinking

- A3 = 11 x 17 paper size
- Pioneered by Toyota
- Collaborative approach to Plan-Do-Check-Act A3 Applications:
  - Problem-Solving
  - Policy Deployment
  - Reporting
  - Capturing Decisions



Images Courtesy of On Point Lean Consulting & Robins & Morton

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Choosing by Advantages (CBA)

A decision-making system based on the **importance of the advantages** of each alternative.

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.	2		
Factor: Access for Maintenance					
Criteria:	Attribute	Outside secure perimeter		Inside secure perimeter	
	Advantage	Outside rather than in	4		
Factor: Quantity of Boilers & Standby					
Criteria:	Attribute	3 duty plus 1 standby		20 duty +7 Standby	
	Advantage	Less total boilers	5		
Factor: Ability to do Boiler Stack Heat Recovery					
Criteria:	Attribute	10% increase in boiler efficeincy		Not required	
	Advantage	Reduction X therms	8		
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	10
Factor: Construction Schedule					
Criteria:	Attribute	Longer due to site distribution		Shorter - no site distribution required	
	Advantage			2 weeks	1
	Total Importance		19		11
	Capital Cost				

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CBA Process Flow

- **CBA has a distinct vocabulary and methodology.**
- **It is highly recommended to seek a knowledgeable CBA facilitator to ensure proper implementation.**

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Prototyping

- **Full Size Mock-ups**
- **Clarifies Requirements**
- **Gains Agreement**

Images Courtesy of Cone Health

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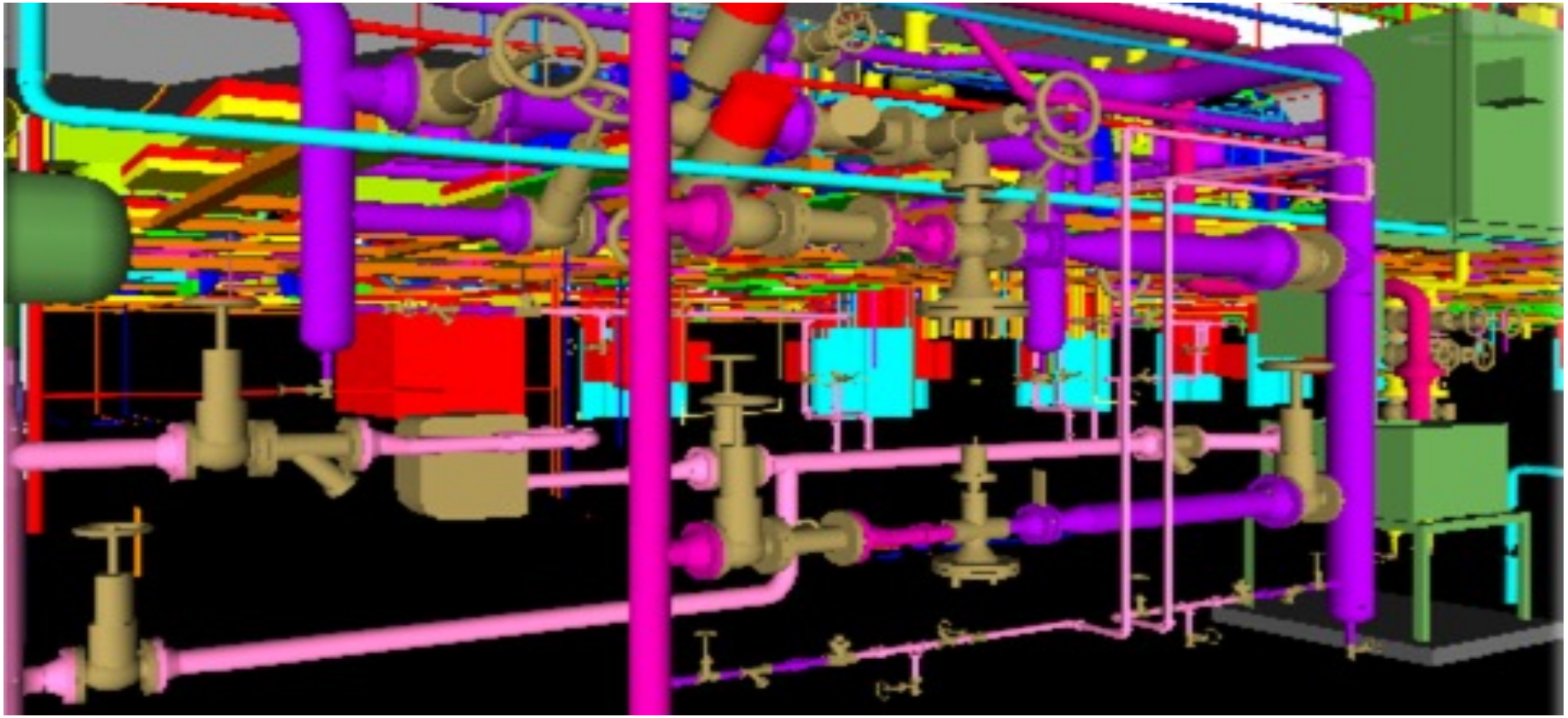
Building Information Modeling (BIM) & Virtual Reality (VR)



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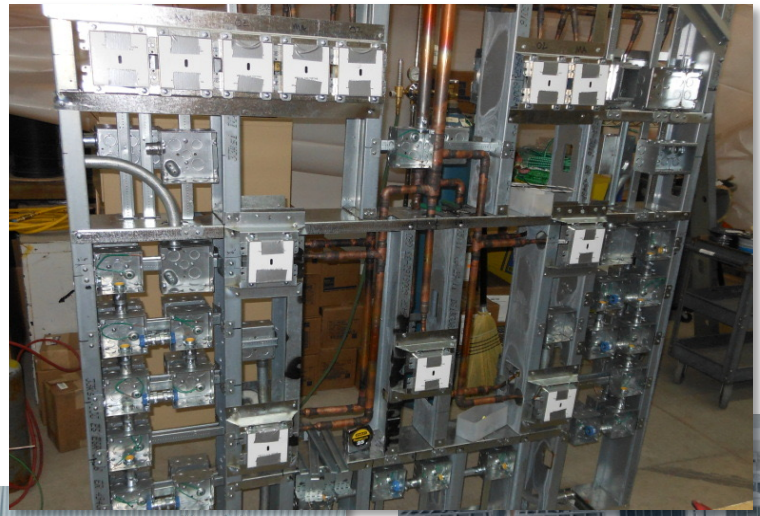
Prefabrication

Examples:

- Plumbing Runs
- Headwalls
- Bathroom Pods



Images Courtesy of Southland Industries and KHS&S

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5S: A Starting Point with Lean

SORT
STRAIGHTEN
SHINE
STANDARDIZE
SUSTAIN

A disciplined approach to maintaining order in the workplace, using visual controls to eliminate waste.

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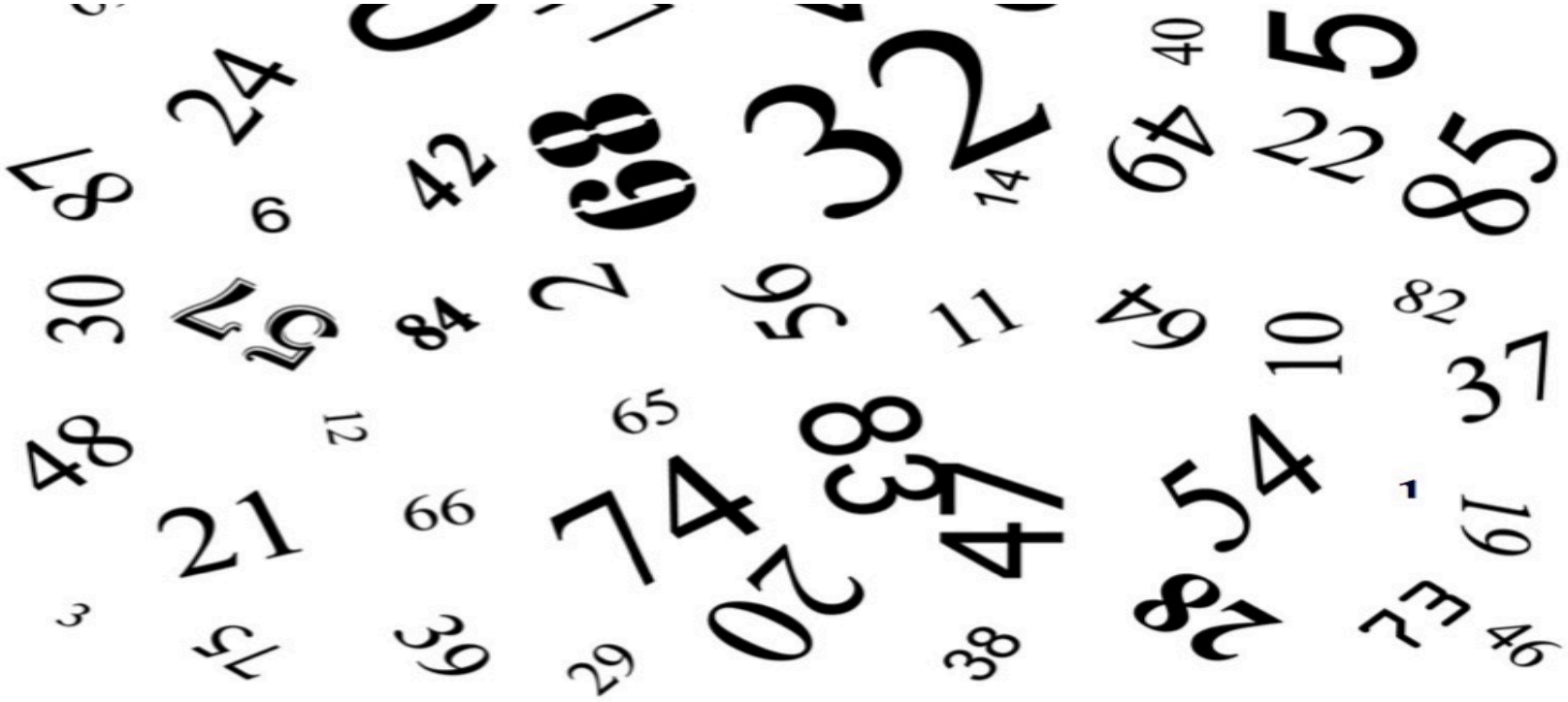
Find the Number Exercise



Find the Number Exercise was developed by Pathway to Lean

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Warehouse 5S: Before and After

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5S Applications

Images Courtesy of PCL and KHS&S

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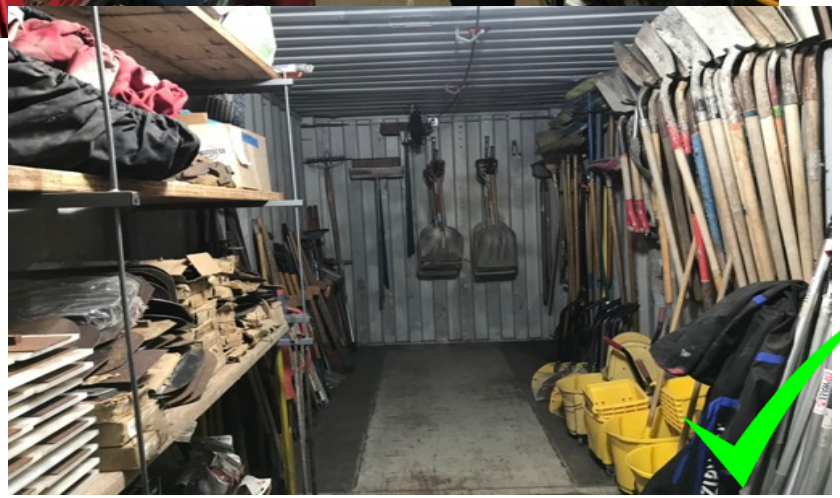

Images Courtesy of PCL Construction

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Last Planner System® – 5 Connected Conversations

MILESTONE
Planning

PHASE PULL
Planning

MAKE-READY
Planning

WEEKLY WORK
Planning

LEARNING & IMPROVING

Goals:
RELIABILITY
FLOW
PREDICTABILITY

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Last Planner System® - Milestone Planning

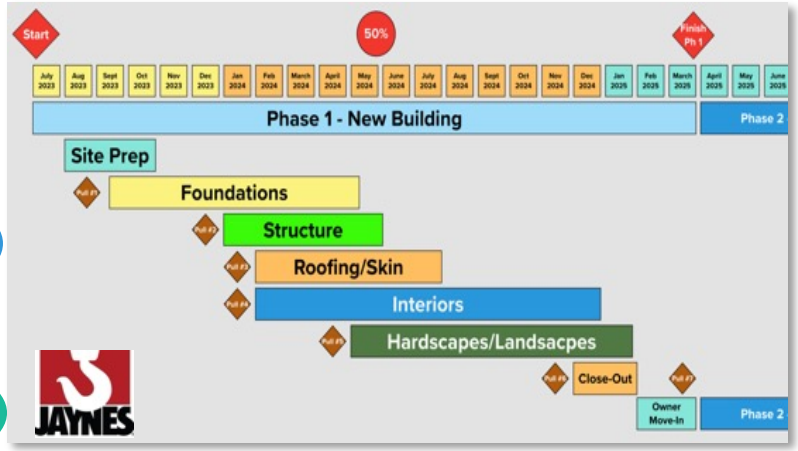
MILESTONE Planning

PHASE PULL Planning

MAKE-READY Planning

WEEKLY WORK Planning

LEARNING & IMPROVING



Images Courtesy of W.M. Jordan & Jaynes Corporation

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Last Planner System® - Phase Pull Planning

MILESTONE
Planning

PHASE PULL
Planning

LOOKAHEAD
Planning

WEEKLY WORK
Planning

LEARNING & IMPROVING

Specify Handoffs

Images Courtesy of W.M. Jordan & On Point Lean Consulting

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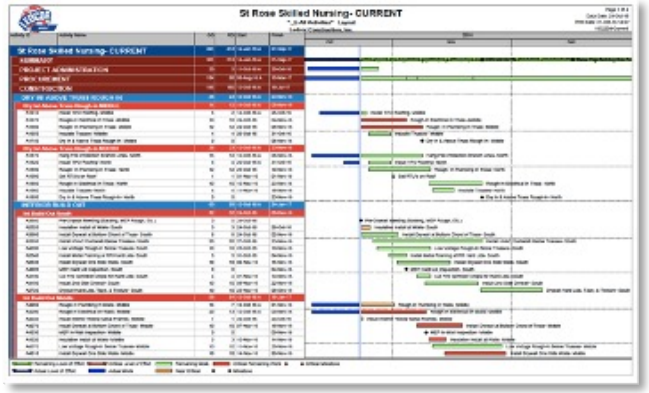
Last Planner System® - Lookahead Planning



MILESTONE
Planning

PHASE PULL
Planning

MAKE-READY
Planning

WEEKLY WORK
Planning

LEARNING
& IMPROVING

Make Work Ready

Image Courtesy of Ledcor

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Make-Ready Planning (6 weeks+)

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Make Ready Example Video

https://youtu.be/UllGl3laGAo

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Last Planner System® - Weekly Work Planning

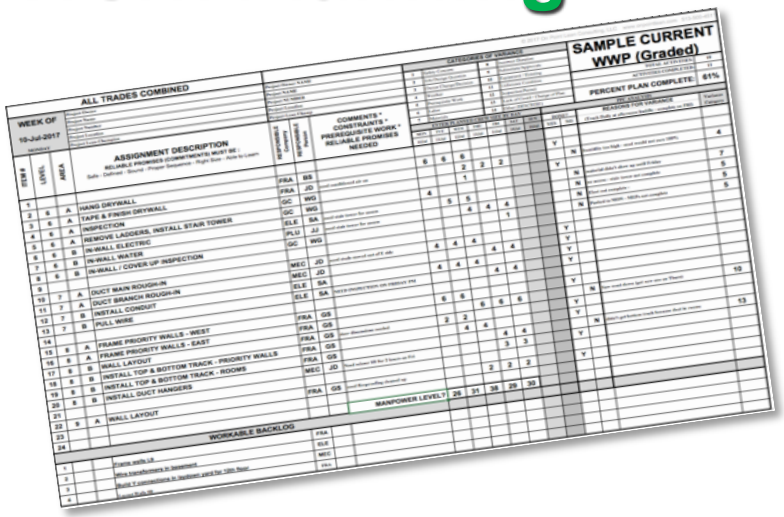
MILESTONE
Planning

PHASE PULL
Planning

MAKE-READY
Planning

WEEKLY WORK
Planning

LEARNING
& IMPROVING



Make Reliable Promises

Images Courtesy of On Point Lean Consulting

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Last Planner System® - Learning & Improving

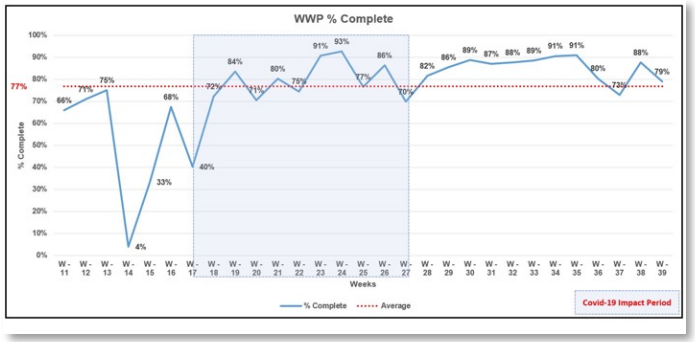
MILESTONE
Planning

PHASE PULL
Planning

MAKE-READY
Planning

WEEKLY WORK
Planning

LEARNING & IMPROVING



Percent Plan Complete & Variances

Images Courtesy of On Point Lean Consulting

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Last Planner System® - Summary

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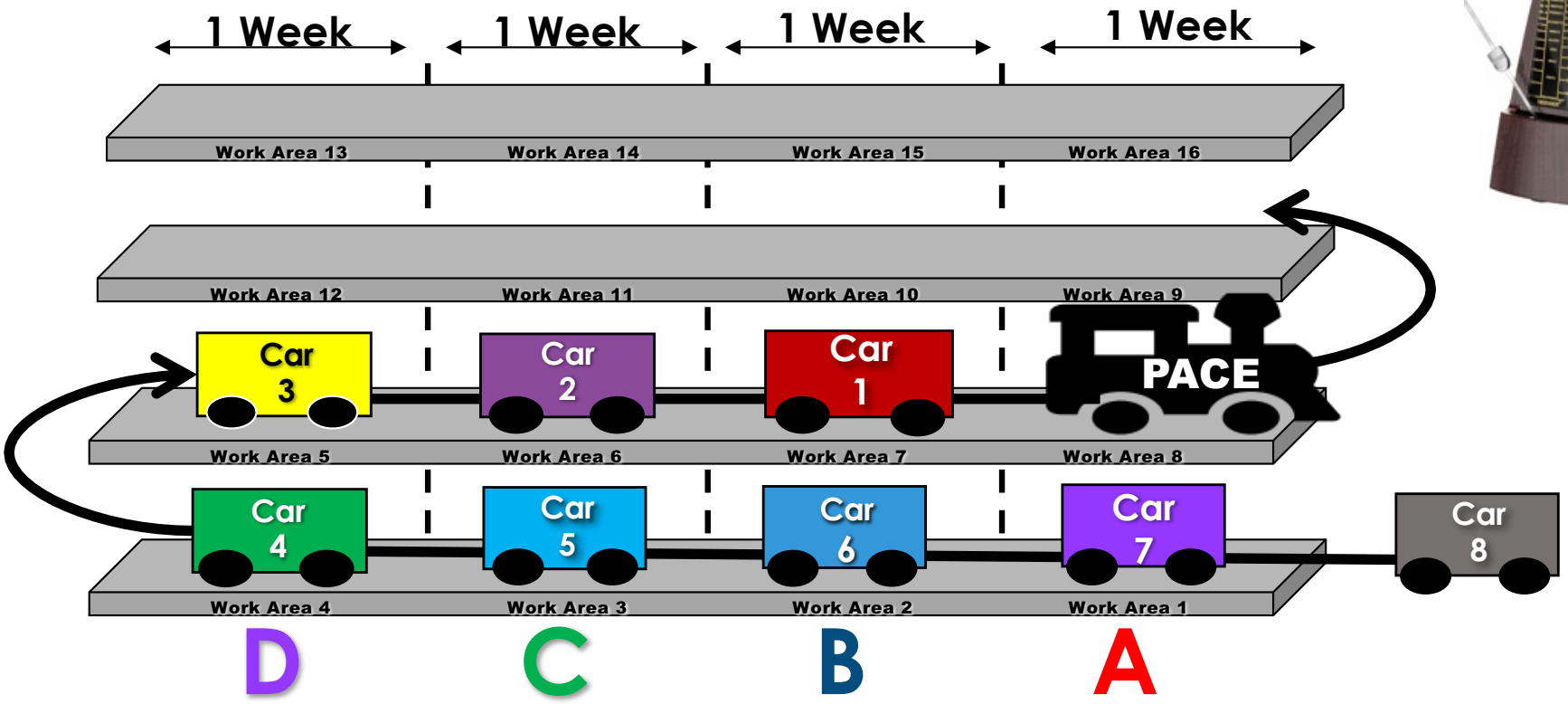
Takt: Planning for FLOW



BOLD THINKING

Image Courtesy of Boldt

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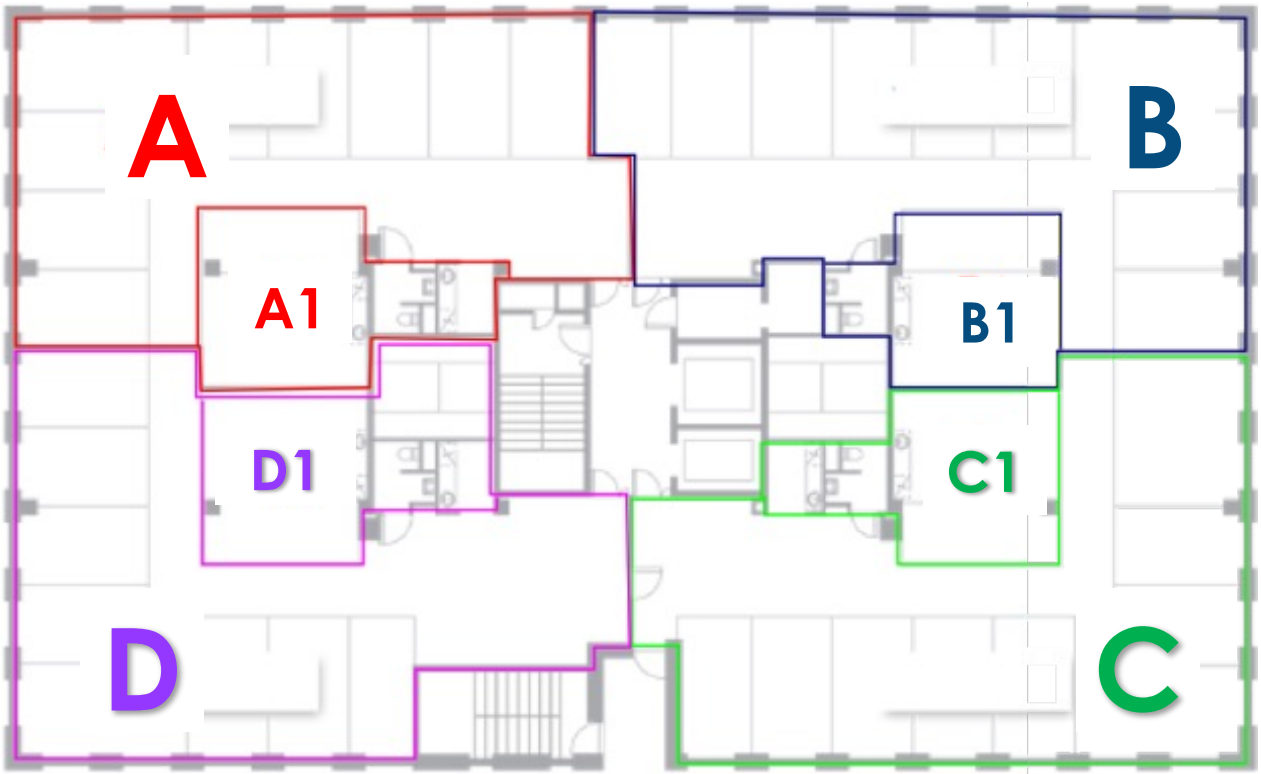
Takt : Define Work Areas



Size Areas to Level the Workload

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Little's Law

Smaller Batches Yield Faster Completion With the Same Level of Effort

FINISH TO START	Duration	START DAY		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9
ACTIVITY X	15 days	1		15								
ACTIVITY Y	15 days	16					15					
ACTIVITY Z	15 days	26	baseline							15		
										Total = 45 days		

START TO START, +1 WEEK	Duration	START DAY		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9
ACTIVITY X	15 days	1		5	5	5						
ACTIVITY Y	15 days	6	% faster		5	5	5					
ACTIVITY Z	15 days	11	44%			5	5	5				
										Total = 25 days		

START TO START, +1 DAY	Duration	START DAY		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9
ACTIVITY X	15 days	1		days 1-15								
ACTIVITY Y	15 days	2	% faster		days 2-16							
ACTIVITY Z	15 days	3	32%			days 3-17						
										Total = 17 days		

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Basic Takt Plan

		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16	W17	W18	W19	W20	W21	W22	W23
Area	1	C1	C2	C3	C4	C5	C6	C7													C1		CAR 1	
Area	2		C1	C2	C3	C4	C5	C6	C7												C2		CAR 2	
Area	3			C1	C2	C3	C4	C5	C6	C7											C3		CAR 3	
Area	4				C1	C2	C3	C4	C5	C6	C7										C4		CAR 4	
Area	5					C1	C2	C3	C4	C5	C6	C7									C5		CAR 5	
Area	6						C1	C2	C3	C4	C5	C6	C7								C6		CAR 6	
Area	7							C1	C2	C3	C4	C5	C6	C7							C7		CAR 7	
Area	8								C1	C2	C3	C4	C5	C6	C7									
Area	9									C1	C2	C3	C4	C5	C6	C7								
Area	10										C1	C2	C3	C4	C5	C6	C7							
Area	11											C1	C2	C3	C4	C5	C6	C7						
Area	12												C1	C2	C3	C4	C5	C6	C7					

TOTAL DURATION (in weeks) = # of Cars + # of areas – 1

Image Courtesy of On Point Lean Consulting

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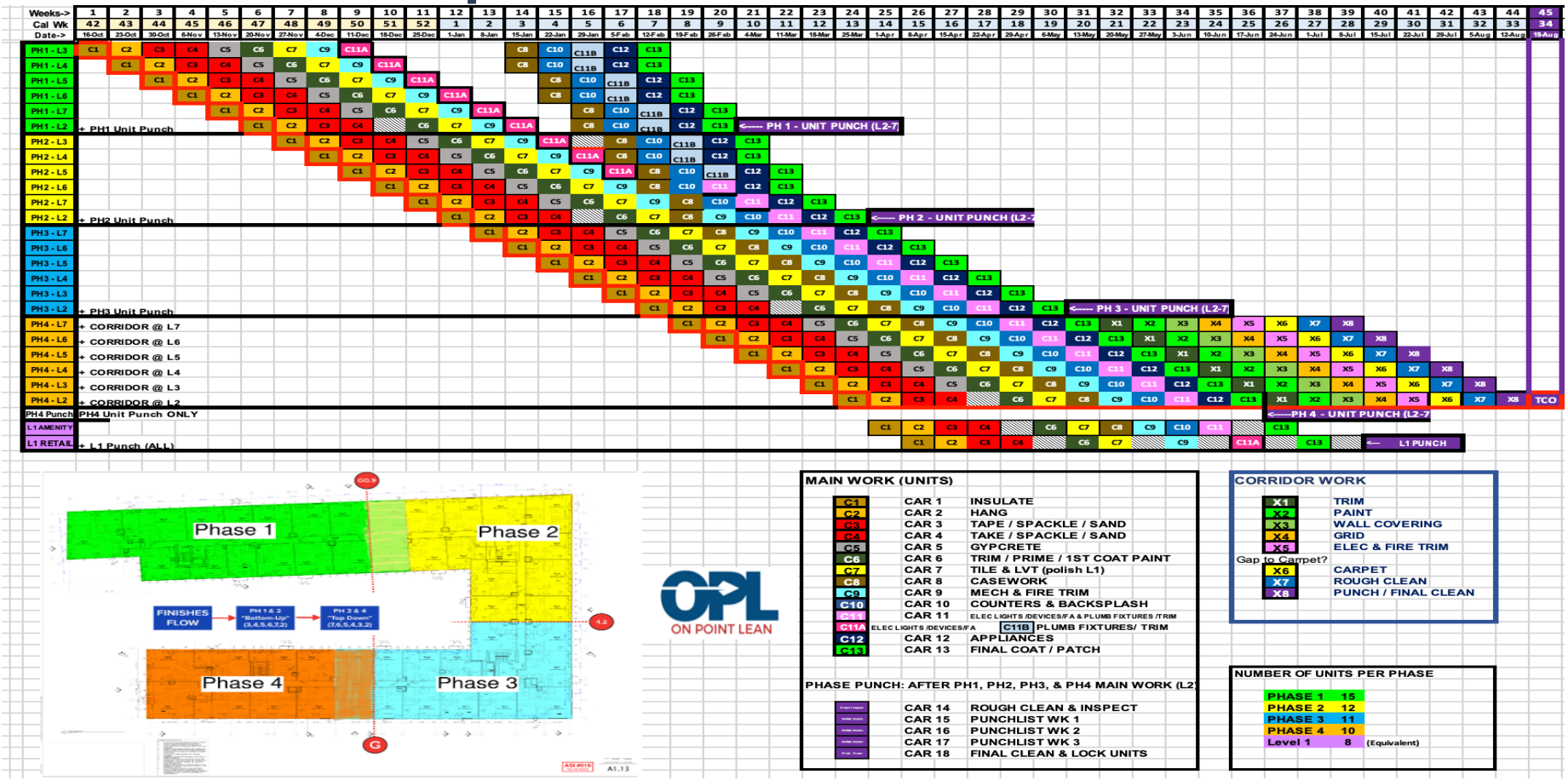
Takt Plan Example



ON POINT LEAN

MAIN WORK (UNITS)

C1	CAR 1	INSULATE
C2	CAR 2	HANG
C3	CAR 3	TAPE / SPACKLE / SAND
C4	CAR 4	TAKE / SPACKLE / SAND
C5	CAR 5	GYPCRETE
C6	CAR 6	TRIM / PRIME / 1ST COAT PAINT
C7	CAR 7	TILE & LVT (polish L1)
C8	CAR 8	CASEWORK
C9	CAR 9	MECH & FIRE TRIM
C10	CAR 10	COUNTERS & BACKSPLASH
C11	CAR 11	ELEC LIGHTS /DEVICES/FA & PLUMB FIXTURES /TRIM
C11A	ELEC LIGHTS /DEVICES/FA	
C11B	PLUMB FIXTURES/ TRIM	
C12	CAR 12	APPLIANCES
C13	CAR 13	FINAL COAT / PATCH

PHASE PUNCH: AFTER PH1, PH2, PH3, & PH4 MAIN WORK (L2

	CAR 14	ROUGH CLEAN & INSPECT
	CAR 15	PUNCHLIST WK 1
	CAR 16	PUNCHLIST WK 2
	CAR 17	PUNCHLIST WK 3
	CAR 18	FINAL CLEAN & LOCK UNITS

CORRIDOR WORK

X1	TRIM
X2	PAINT
X3	WALL COVERING
X4	GRID
X5	ELEC & FIRE TRIM
Gap to Carpet?	
X6	CARPET
X7	ROUGH CLEAN
X8	PUNCH / FINAL CLEAN

NUMBER OF UNITS PER PHASE

PHASE 1	15	
PHASE 2	12	
PHASE 3	11	
PHASE 4	10	
Level 1	8	(Equivalent)

Image Courtesy of On Point Lean Consulting

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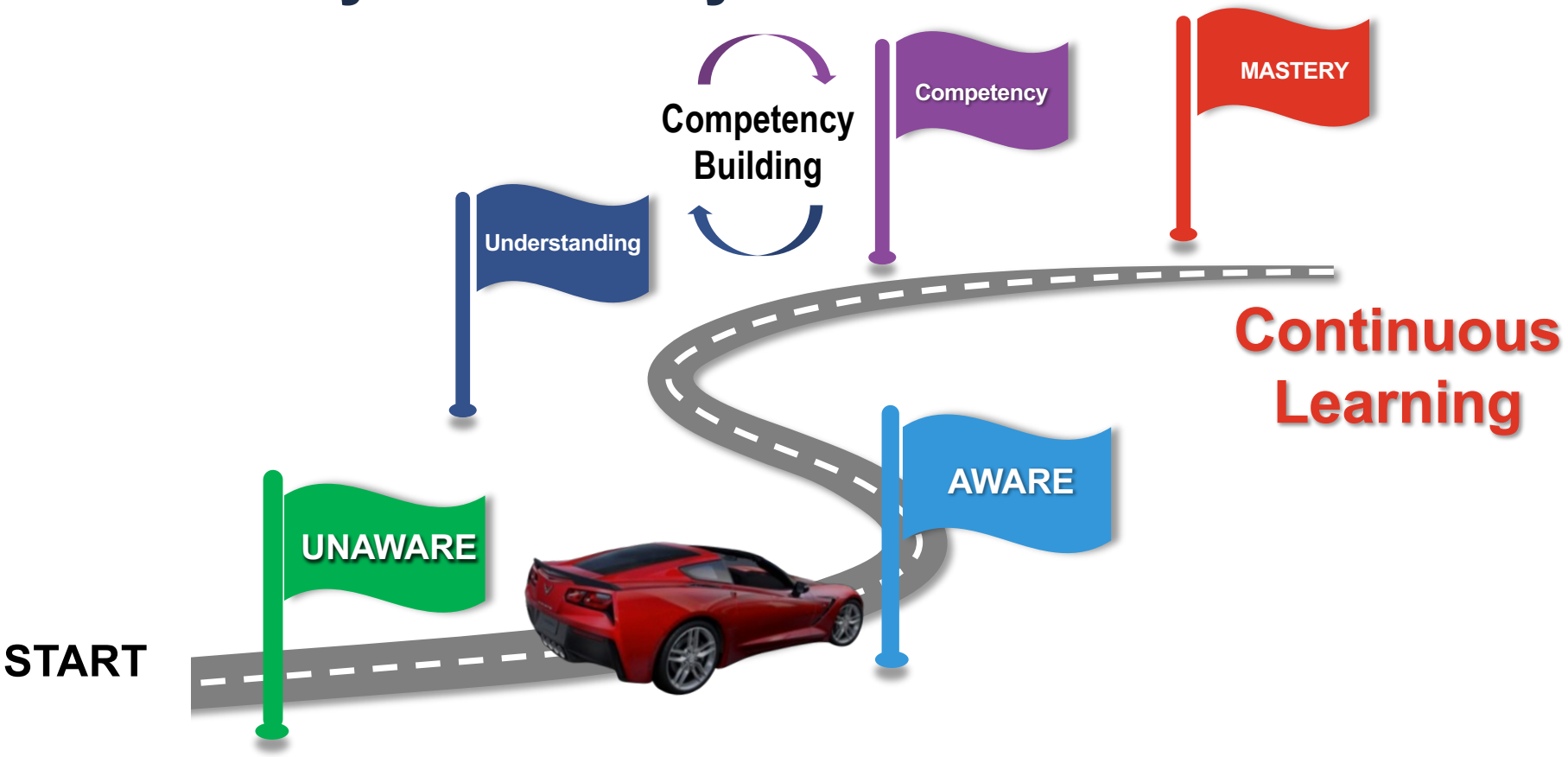
Lean Journey to Mastery



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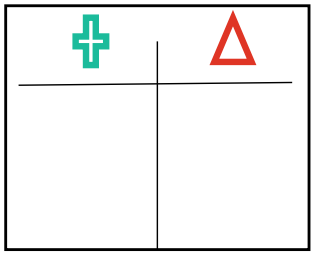
Plus/Deltas

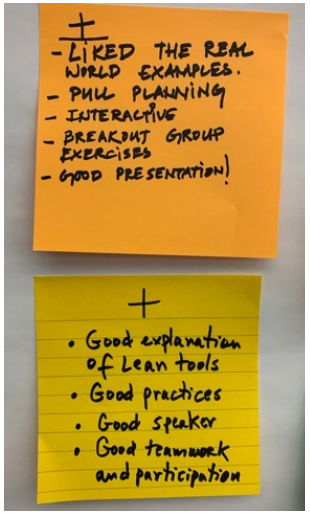


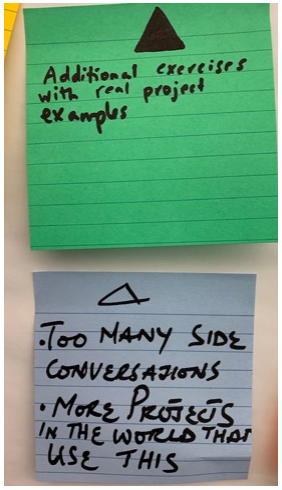
Plus: What produced <u>value</u> during the session?

"I LIKED…"

Delta: What could we <u>change</u> <u>to improve</u> the process or outcome?

"I WISH…"





QR Code for Congress App

Questions?

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Immersive Education Program

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