



Lean Construction Institute
Immersive Education Program

Introduction to Lean Project Delivery

Instructors: David MacNeel, Lauren Simone, Sam Burns

**25th LCI Congress
October 24, 2023
Detroit, Michigan**

Course Instructors



David MacNeel



Lauren Simone



Sam Burns



Learning Objectives



Understand the breakdowns with current project delivery methods, and discover the goals and benefits of implementing Lean.



Understand the Foundation of Lean as Six Tenets and identify the Eight Wastes as relevant to design and construction.

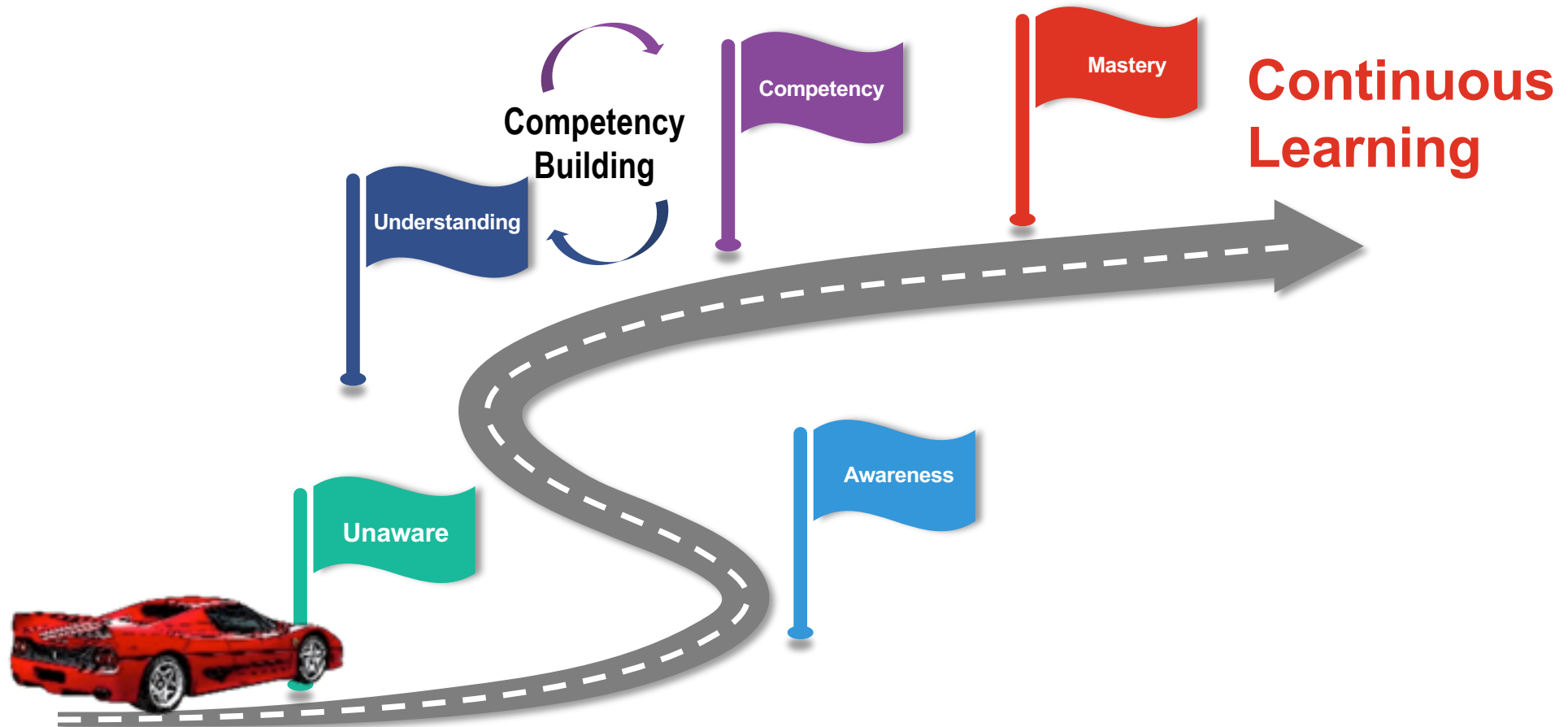


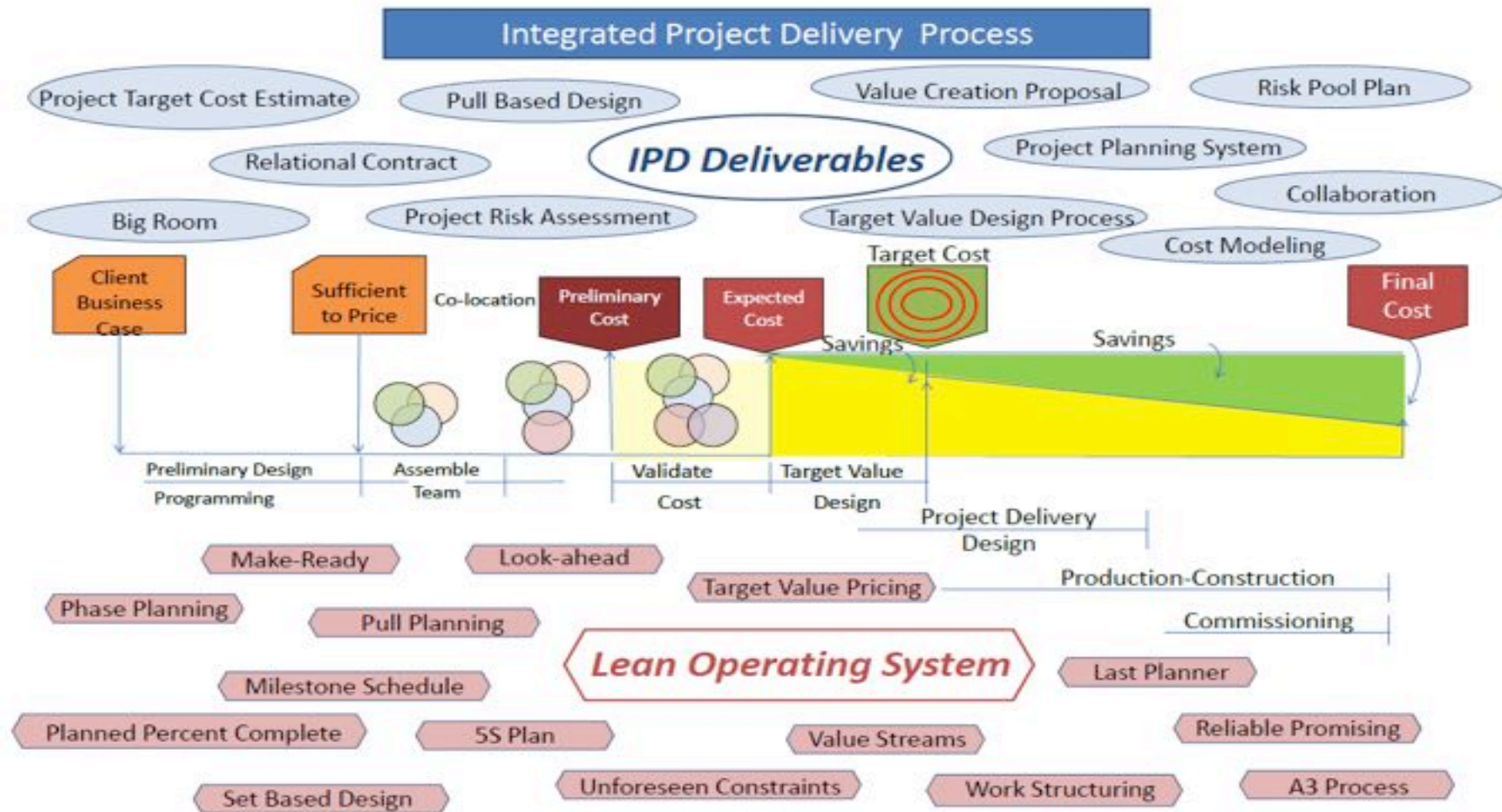
Recognize that Lean is a shift in thinking and behaviors leading to high-performing teams.

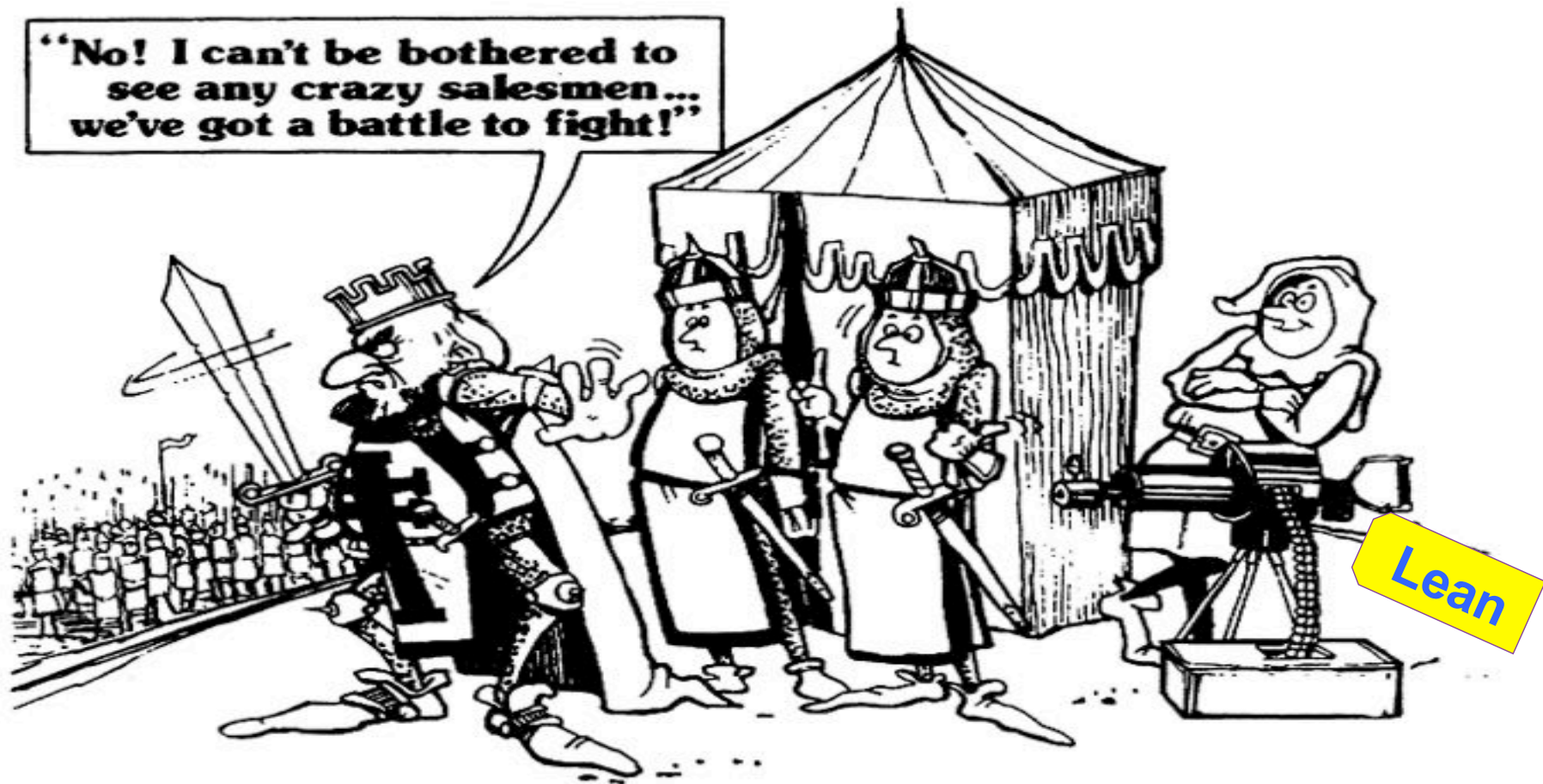


Discover key Lean practices and tools which result in increased collaboration and improved project outcomes.

Lean Journey to Mastery







Definition: **Lean**

Culture of respect and continuous improvement aimed at creating more value for the customer while identifying and eliminating waste.

Definition: Lean Project Delivery

An organized implementation of Lean Principles and tools combined to allow a team to operate in unison to create flow.



Origins of Lean

- **Scientific Management** 1880-1930



- **Assembly Lines** 1903-1914



- **World War II** 1939-1945

- **Lean Manufacturing** 1945 - present

Toyota Production System (TPS)



TOYOTA



Meals Per Hour Video

- Super Storm Sandy



Traditional Delivery Outcomes...

 **Risk is High**

 **~70% Late**

 **~73% Over Budget**

 **Rework and
Waste**

 **Teamwork is
Unreliable**

 **Low Satisfaction**

 **Low Profit Margins**

Brief History : Lean in Design & Construction



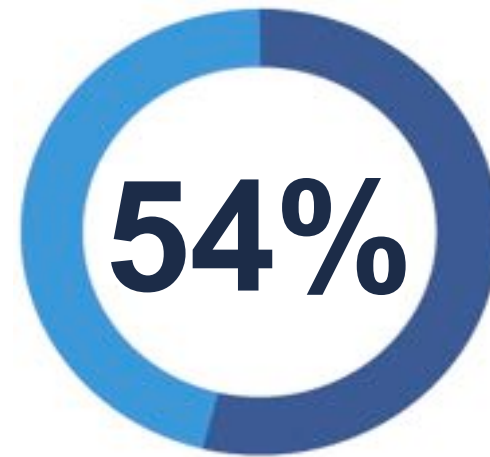
**Early 1990's:
Glenn Ballard &
Greg Howell**



**Problem: Ability of
front-line supervision to
plan and execute work**



Brief History : Lean in Design & Construction



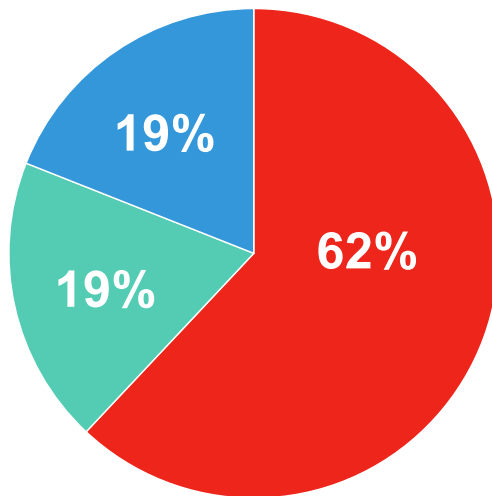
**Work completed
As-planned**

Overcoming Industry Inertia

How efficient are you?

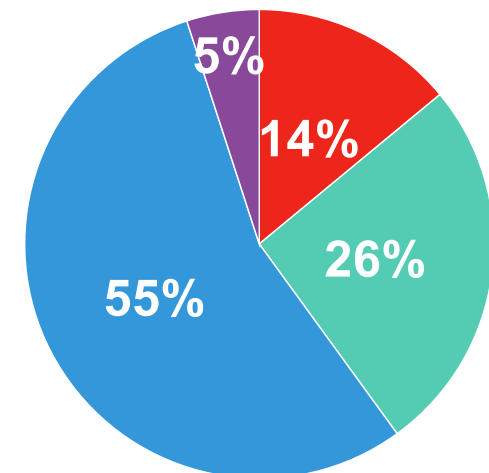
(By Level of Lean Engagement)

Lean Practitioners

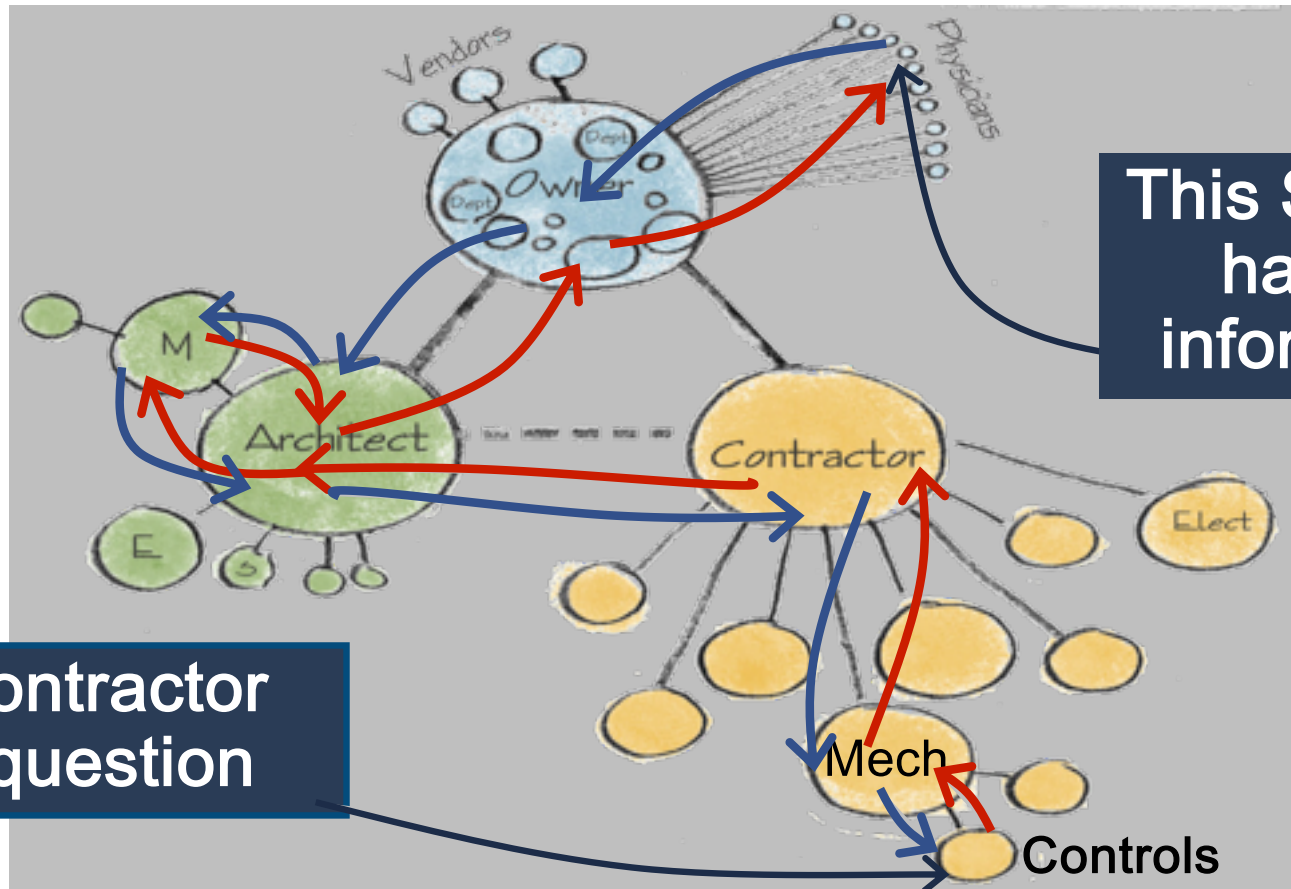


- Inefficient/Highly Inefficient
- Neutral
- Efficient/Highly Efficient
- Not Sure

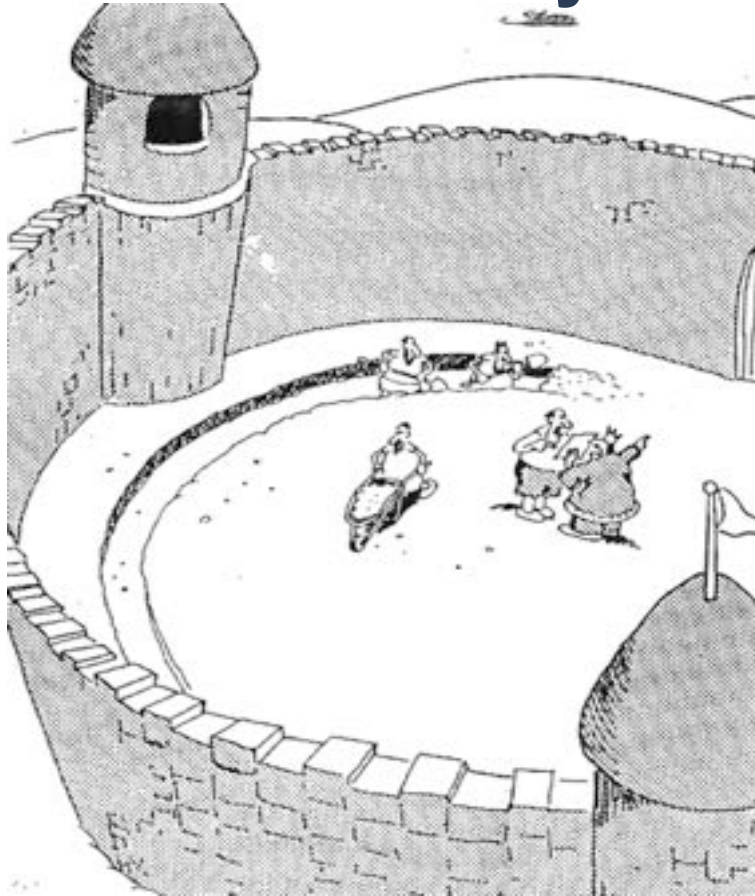
Non-Lean Practitioners



Traditional Structures Create Waste:



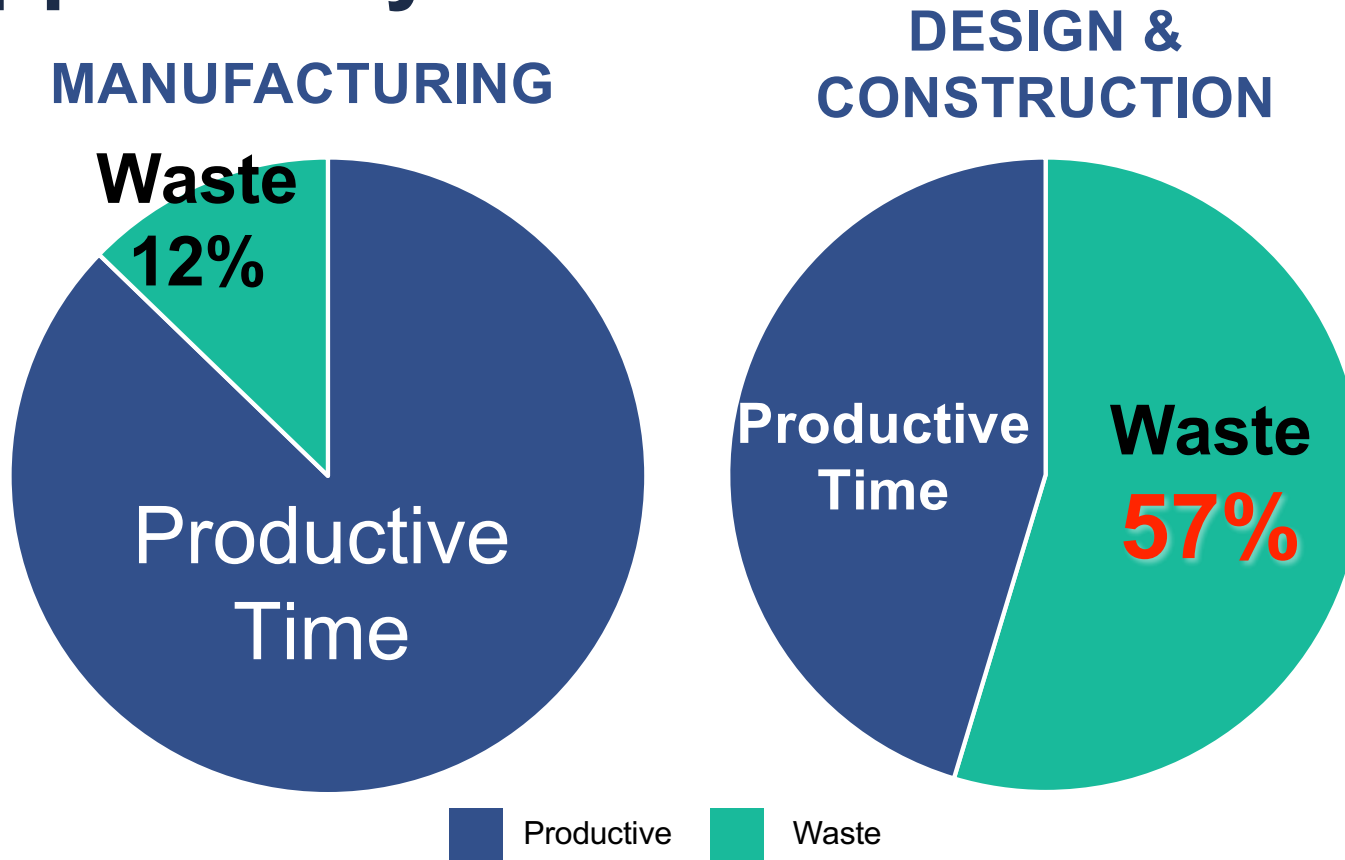
Traditional Delivery Outcomes...



“Suddenly, a heated exchange takes place between the King and the Moat Contractor...”

- *The Far Side* 1990

The Opportunity...



Why Lean?



Productivity is declining



Costs are skyrocketing



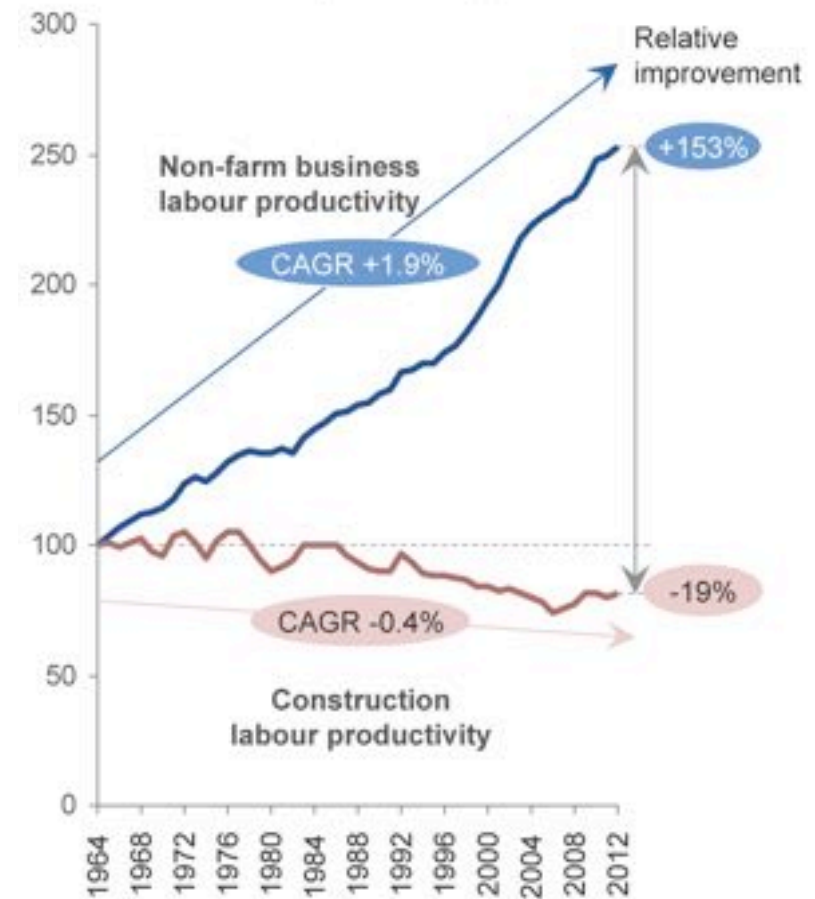
Injuries are too high



Workflows are unpredictable



**Workflow reliability
directly impacts the speed
and cost of projects**



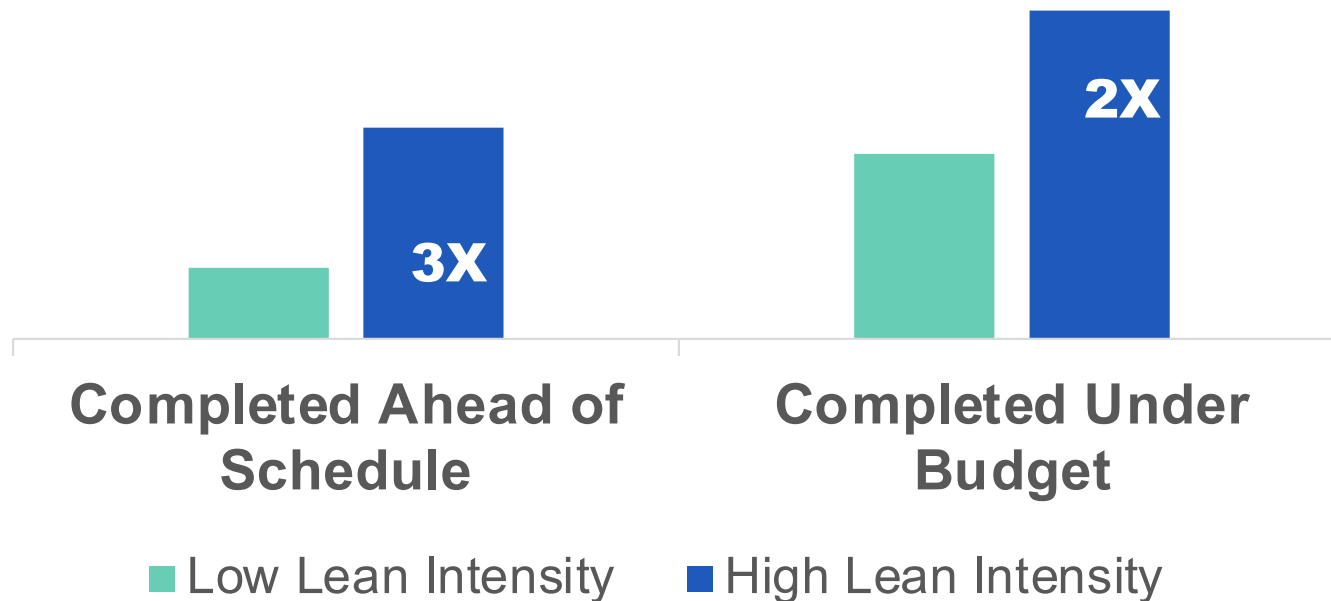
Lean Project Delivery Enables

-  **Collaborative Risk Management**
-  **On-time or Early Delivery**
-  **At or Below Budget**
-  **Less Waste and Rework**

-  **Team Reliability**
-  **Higher Customer Satisfaction**
-  **Fair Profits for all**

Correlation of Lean Intensity to Outcomes

(% Likelihood on Best projects)



Lean Metrics - UHS 160-Bed New Hospital

Temecula, California, IPD Contract + Last Planner System

30% schedule savings:

5 years (typical) vs 3.5 years (actual)

40% cost savings:

\$250MM (market) vs \$150MM (actual)

Results: Lean vs Traditional

- **Duration:** 6 months vs 9 months
- **Productivity:** 12% fewer labor hours
- **Overtime:** 17% vs 35%
- **Peak labor:** 270 Lean vs 420 Traditional
- **Total Cost:** 17% Less (\$30MM vs \$35MM)

Thyssen-Krupp Steel Mill — Mt Vernon, AL (2009)



Goals of Lean Design & Construction

- 1 **Achieve reliable workflow**
- 2 **Maximize value to the customer**
- 3 **Minimize waste**
- 4 **Optimize the whole,
not the parts**
- 5 **Develop a discipline of learning
and continuous improvement.**



Plan - Do - Check - Act (PDCA)

The Deming Cycle

**Improve
the System**

**Study the
Results**



Predict

**Take
Action, Try
it Out**

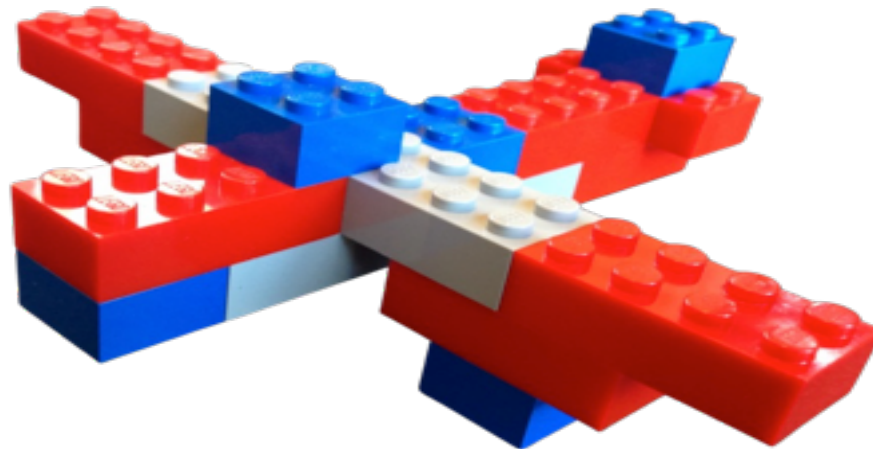
Benefits of Lean

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



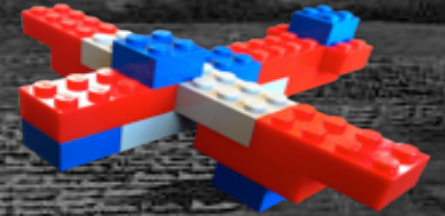
Production System Design Exercise

The Airplane Game



Lean Zone® Production Methodologies is a registered trademark of Visionary Products.

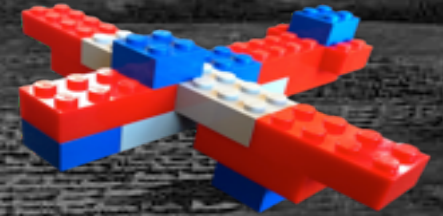
Airplane Simulation Debrief



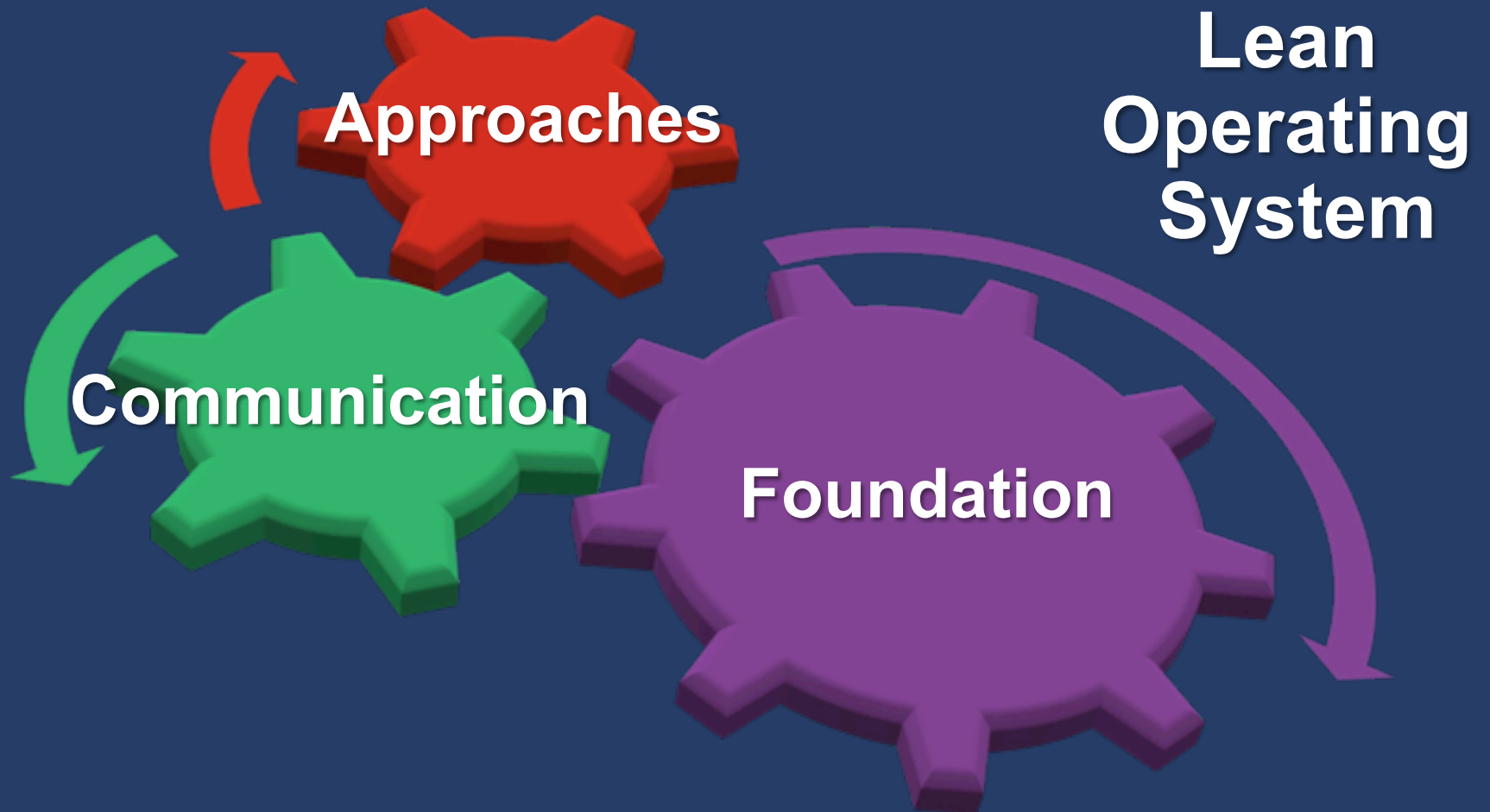
Discuss and answer the following questions:

- 1. What are the key points / lessons?**
- 2. What did we do (or change) to get so much better?**
- 3. How might these Key Points and Lessons apply to your work?**

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
- Encourage and enable performers to **collaborate** with one another to maintain steady workflow



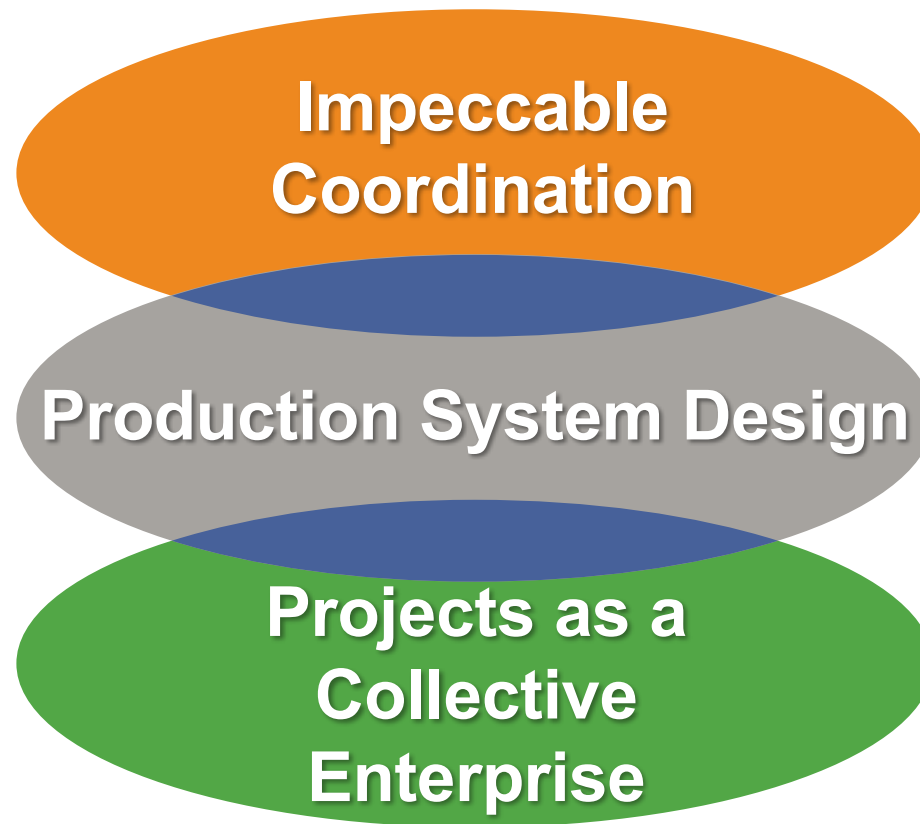
Lean Operating System

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



A Coherent Way to Manage Work in Projects

**Three
Connected
Opportunities**



Six Tenets of Lean

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



1. Respect for People

Toyota:

There is no limit to how far human wisdom can be developed.

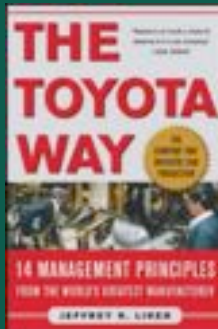
"Respect for People" is the attitude that values and acknowledges people's capacity for critical thinking.

2. Optimize the Whole

Value optimization encourages looking beyond the local and individual efforts to study the overall outcome in determining where value is added, or waste can be eliminated.

3. Generate Value

If it is not something the client is willing to pay for, it is non-value added. Everything else is waste, and therefore should be eliminated, simplified or reduced.



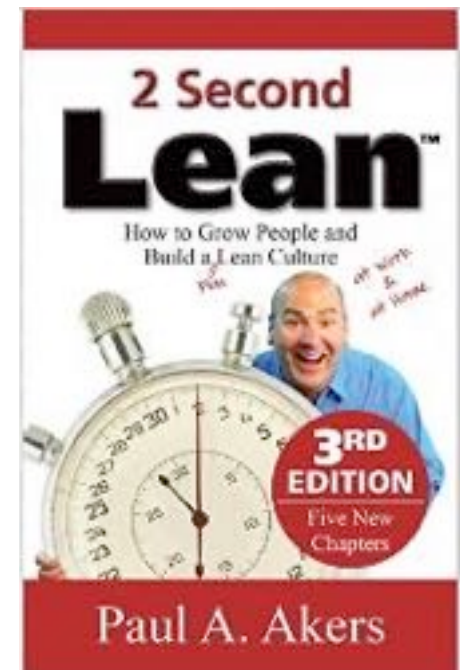
— “The Toyota Way” by J. Liker

4. Eliminate Waste

Waste is any activity that requires time or resources but does not create value as defined by the customer.

Removal of Waste

- Lean Burrito video by Paul Akers



8 Wastes: **DOWNTIME**

DEFECTS: Output, work, or information that causes work to be scrapped, or redone.

OVER/UNDER PRODUCTION: Not producing the right work at the right time in the right amount as needed by the downstream work.

WAITING: Time when work-in-progress or people are waiting for the next step in the process.

NOT UTILIZING TALENT: Losing time, ideas, skills, improvements and learning opportunities by not engaging or listening to teammates.

TRANSPORTATION: Creating inefficient movement of materials or information into or out of storage or between processes.

INVENTORY: Materials, information, or work-in-progress in quantities that create an excess or hidden buffer.

MOTION: Unnecessary movement by people, or movement that does not add value.

EXTRA PROCESSING: Taking unnecessary steps in a process.



5. Focus on Flow

Create flow by using ‘pull’ to organize processes so that work progresses through the system smoothly and without interruption.



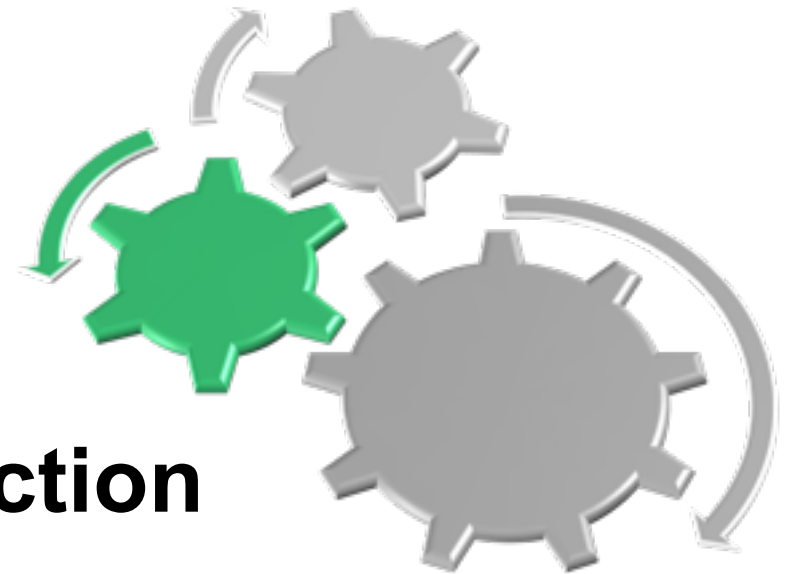
6. Continuous Improvement

Lean thinking demands a mindset of continuous improvement.



Lean Operating System

- Lean Foundation
- **Collaborative Communication**
 - **Project as a Promise**
 - **Conditions of Satisfaction**
- Approaches



Consider the Project as a Promise

- All groups can be viewed as operating as a ***network of promises*** or commitments, whether done well or poorly.
- The goal is ***to improve the quality of commitments and to actively take responsibility*** for managing them.
- LPS is a planning system based on developing a ***network of promises***, then delivering on the commitments.

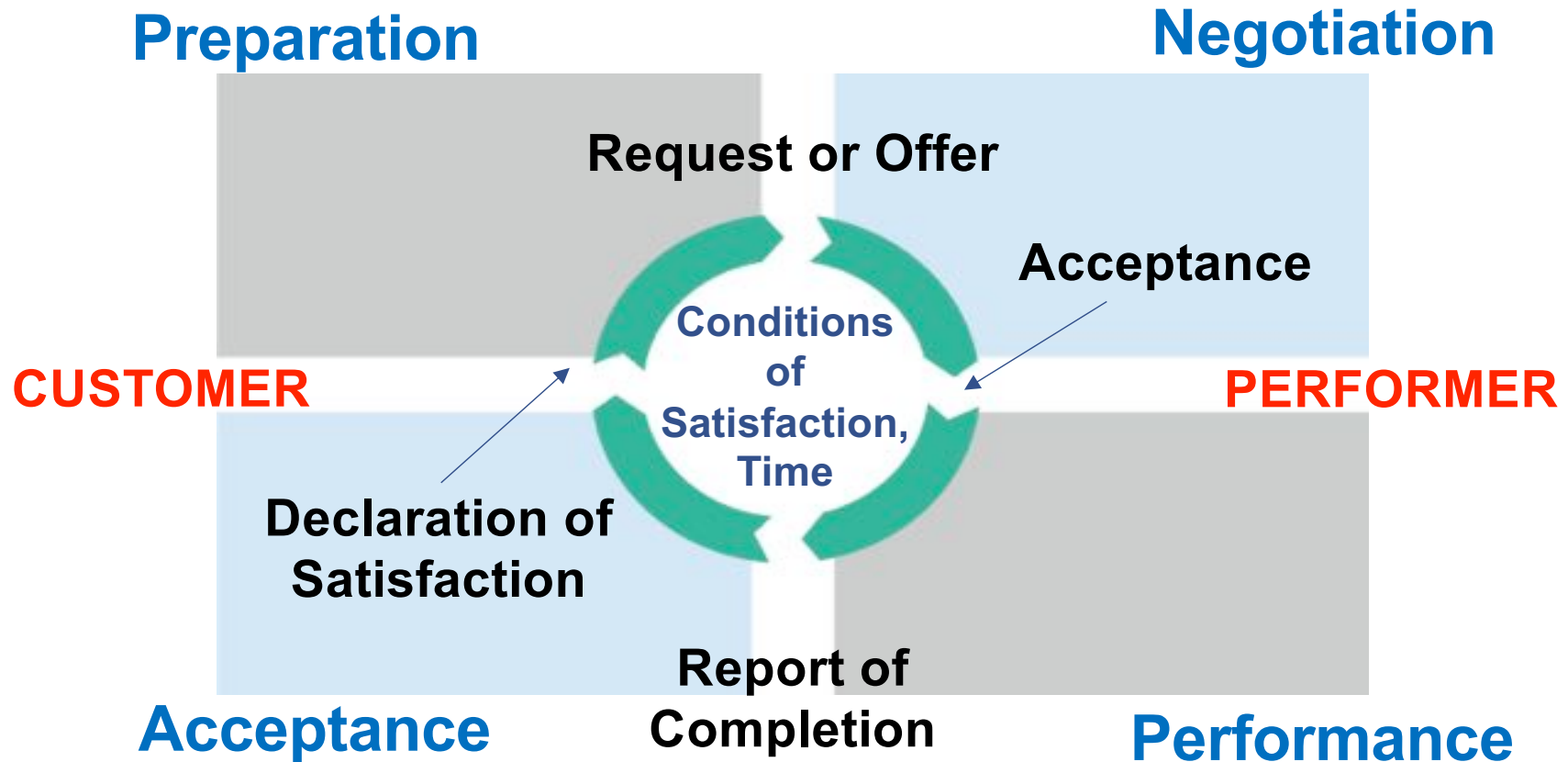


Elements of a Promise

- ***CUSTOMER:*** The person making the request.
- ***PERFORMER:*** The person fulfilling the request.
- ***NEGOTIATED CONDITIONS OF SATISFACTION (CoS)***
 - Are part of the language act of making a promise.
 - Are developed by the people involved in the request and promise.
 - Are mutually agreed to, measurable statements, that help to define the success of the project.
 - Inform the decision-making process.
 - Include a time frame.



Basic Action Workflow



Project Conditions of Satisfaction (CoS):

- Similar to a Project or Team Charter
- *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.**



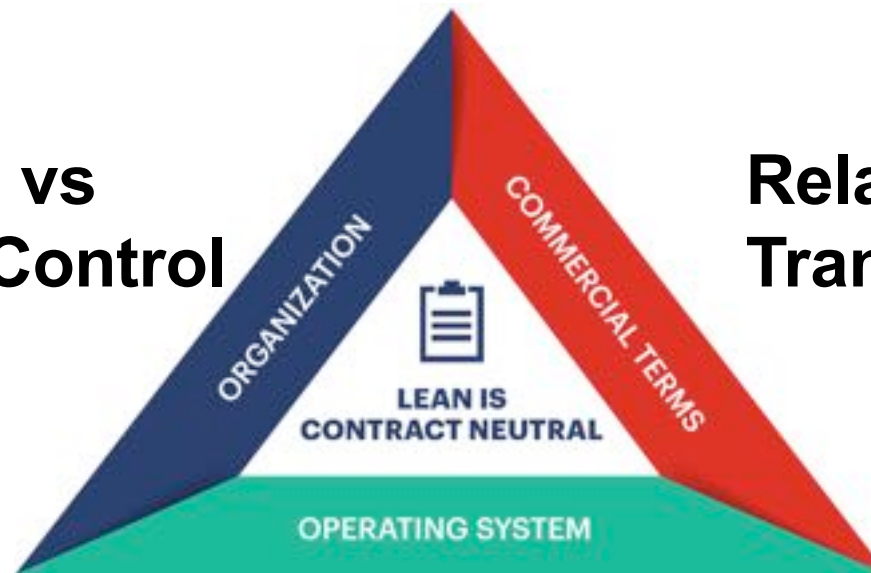
Lean Operating System

- Lean Foundation
- Collaborative Communication
- **Approaches:**
 - **Integrated Project Delivery (IPD)**
 - **Team Organization & Big Rooms**
 - **Target Value Delivery (TVD)**
 - **5S Implementation**
 - **Last Planner System® (LPS)**
 - **Related tools**



Project Elements: Lean vs Traditional

**Collaboration vs
Command & Control**



**Relational vs
Transactional**

Reliability Focus (Flow) vs CPM Scheduling (Push)

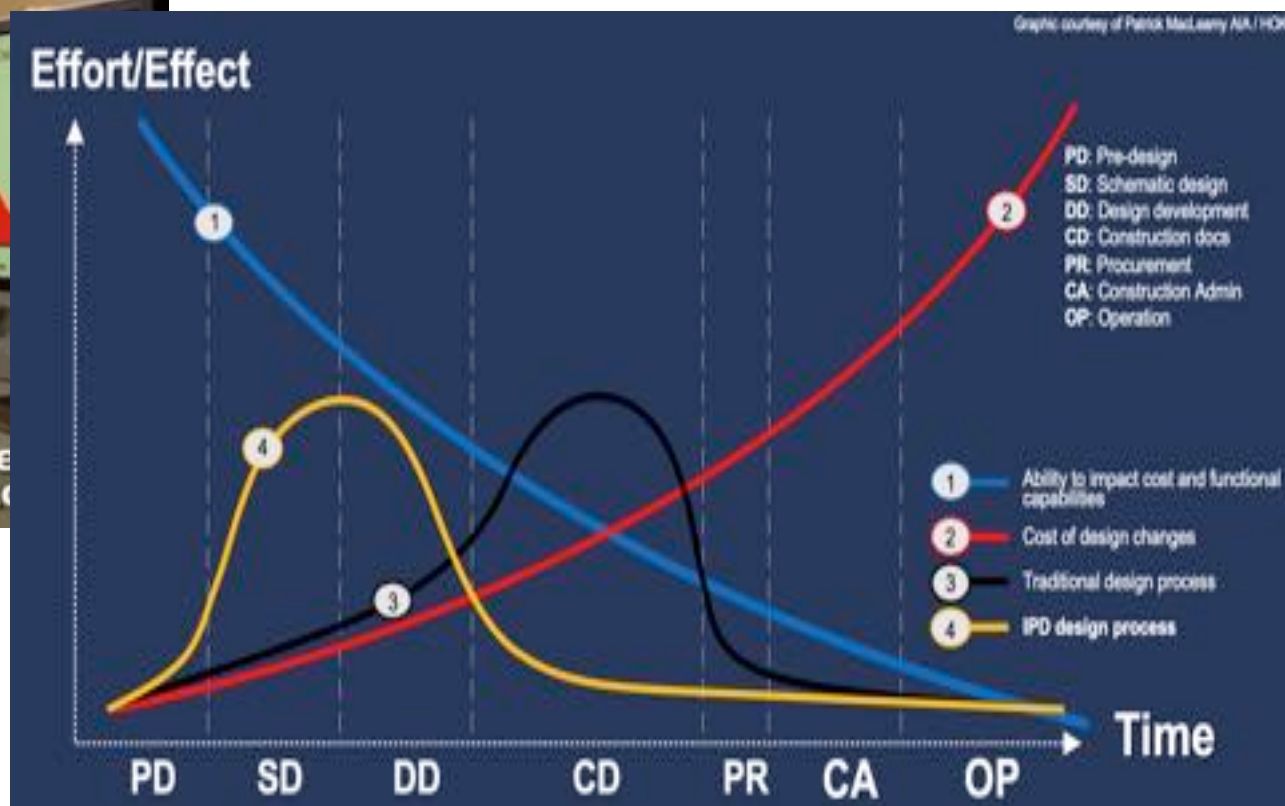
Integrated Project Delivery (IPD)

IPD is a project delivery approach that integrates people, systems, business structures and practices into a process that collaboratively harnesses the insights of all participants to reduce waste and optimize efficiency.

Integrated Project Delivery (IPD)

- Contract Form – IFOA / Consensus Docs
Think “JV” between O/A/C/Key Trades
- Cost Plus
- Shared Risk & Shared Reward
- Conditions of Satisfaction (CoS)
- Combats the downfalls of traditional D-B-B

MacLeamy Curve Video



IPD Work Cluster Organization

Executive/Senior Management:

- Not involved in day-to-day of team
- Resolve conflicts

Core Team:

- Day-to-day leaders of the team

Work Cluster Leader:

- Coordination between work cluster & core team

Work Clusters:

- System oriented
- Cross discipline
- Stakeholder representation
- Form as needed



Big Room

- **Speed communication**
- **Improve decision-making**
- **Reduce ‘siloed’ thinking**
- **Rapidly Advance work**

Big Room is a commitment to a project, the team, and to working together!



Lean in Design



Lean Design

**Maximize
Innovation!**

***NOT about
“standardizing design”***

Lean
Production

**Minimize
Waste!**

Traditional vs. Target Value Delivery

Traditional: Cost is an *OUTPUT* of design



TVD: Cost is an INPUT of design

The goal of TVD:
Minimize the waste inherent in the design-estimate-redesign cycle(s) of the traditional approach.

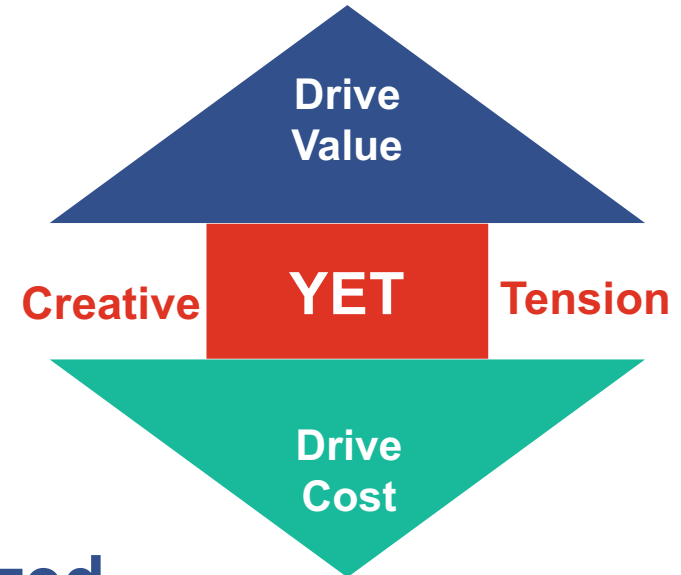
Traditional Delivery vs Target Value Delivery

Traditional Delivery:

- Work performed in silos – low visibility
- Early commitment to design solutions
- “Finish your work before I start mine” mentality

Target Value Delivery:

- Information is shared early and often
- Sets of solutions are carried & optimized holistically
- Continuous estimating and cost modeling based on concepts



A3 Thinking

- Pioneered by Toyota
- A disciplined and highly collaborative approach to Plan-Do-Check-Act
- A3 Applications:
 - Problem-Solving
 - Policy Deployment
 - Reporting
 - Capturing Decisions



(A3 = 11 x 17 paper size)

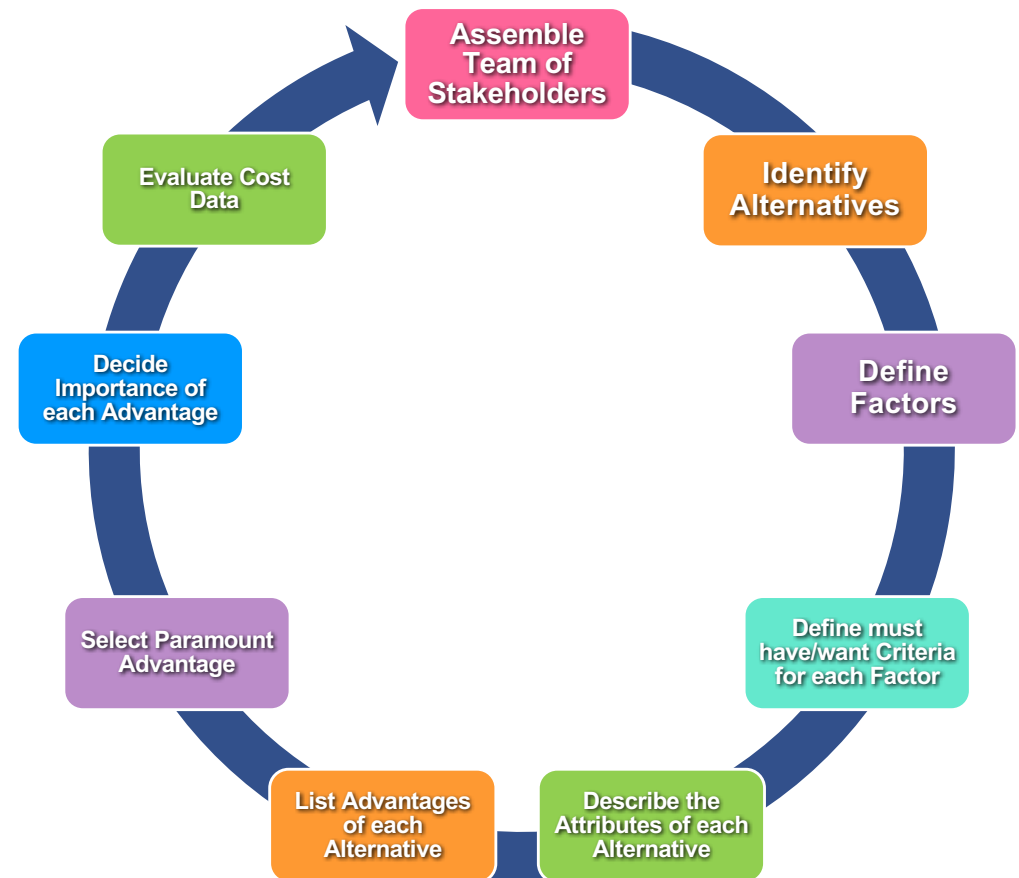
Choosing by Advantages (CBA)

A **sound** decision-making system for determining the **best decision** by looking at the **importance of the advantages** of each alternative.

		Alternative 1	Alternative 2	
		Central Plant Heating Hot Water System	Distributed Heating Hot Water	
Factor: Square feet of Mechanical Space Required				
Critic:	Alternative	3200 square feet	5100 sq ft required/17 rooms	
	Advantage	1300 Sq Ft.	2	
Factor: Access for Maintenance				
Critic:	Alternative	Outside secure perimeter	Inside secure perimeter	
	Advantage	Outside rather than in	4	
Factor: Quantity of Boilers & Standby				
Critic:	Alternative	3 duty plus 1 standby	20 duty + 7 Standby	
	Advantage	Less total boilers	5	
Factor: Ability to do Boiler Stack Heat Recovery				
Critic:	Alternative	10% increase in boiler efficiency	Not required	
	Advantage	Reduction X items	8	
Factor: Pumping Energy				
Critic:	Alternative	More required due to long distribution runs	Less required due to shorter piping runs	
	Advantage		500,000 Kwh per year	10
Factor: Construction Schedule				
Critic:	Alternative	Longer due to site distribution	Shorter - no site distribution required	
	Advantage		2 weeks	1
Total Importance			19	11
Capital Cost				

CBA Process Flow

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

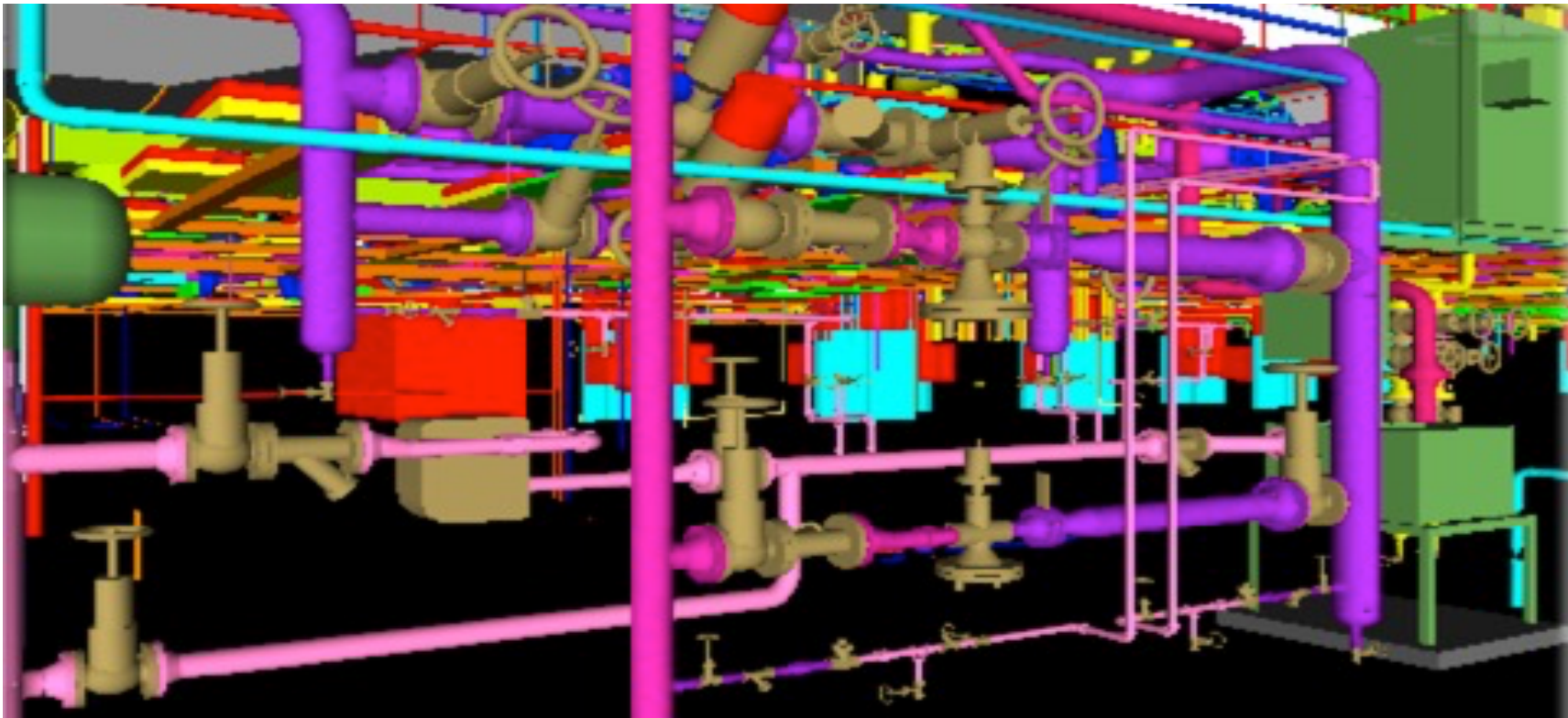


Prototyping - Production Preparation Process (3P)

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



Building Information Modeling (BIM) & Virtual Reality



Prefabrication

Examples:

- Plumbing Runs
- Headwalls
- Bathroom Pods



Last Planner System®

Reliability, Flow, Dependency & Variation

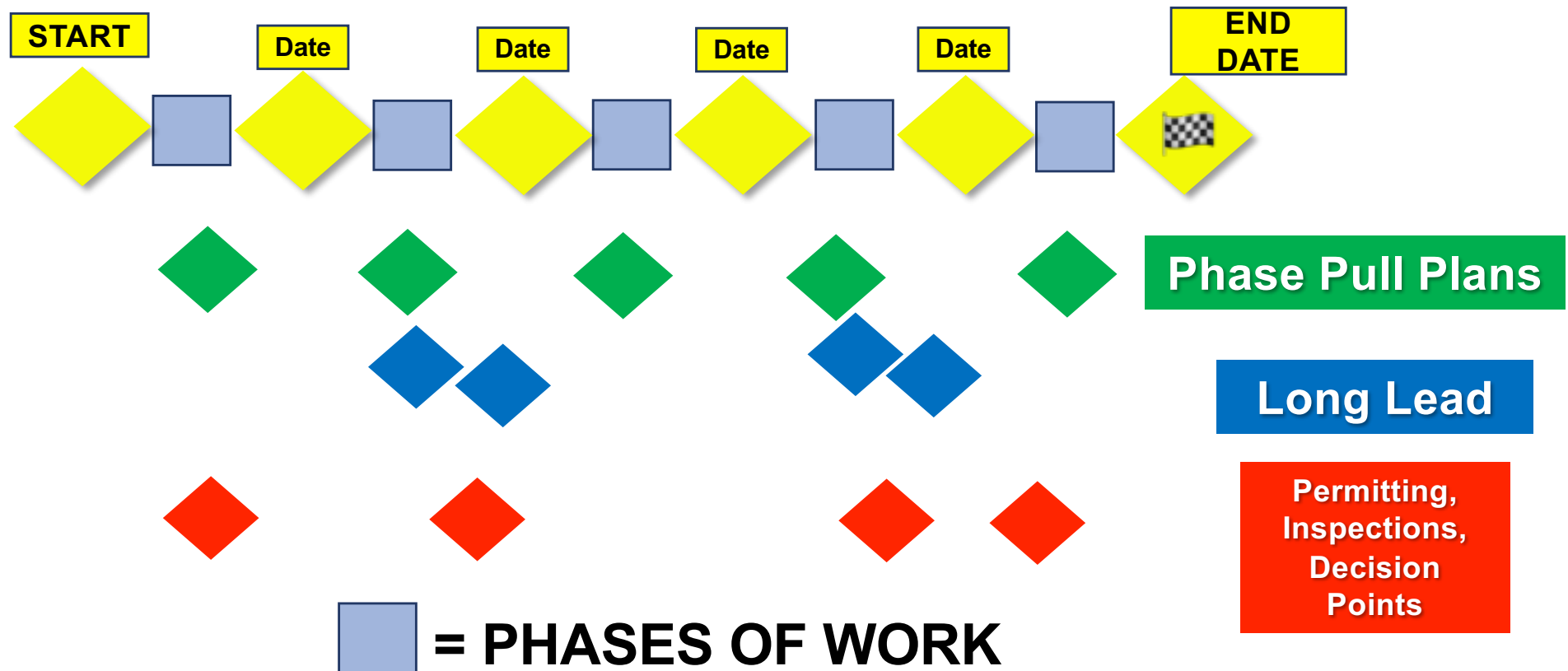




*“In preparing for battle, I have always found that plans are **useless**, but planning is **indispensable**.”*

- Dwight Eisenhower

Major & Interim Milestone Planning



Last Planner System[®] - Milestone Planning



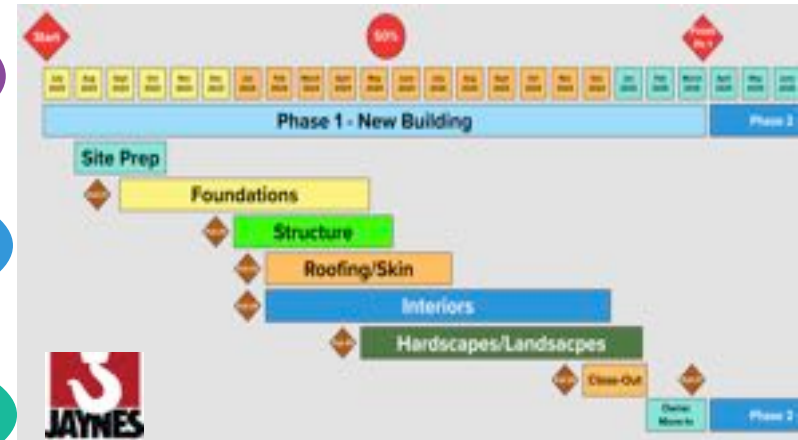
MAILESTONE
Planning

PHASE PULL
Planning

LOOKAHEAD
Planning

WEEKLY WORK
Planning

**LEARNING
& IMPROVING**



Last Planner System® - Phase Pull Planning



MAILESTONE
Planning

PHASE PULL
Planning

LOOKAHEAD
Planning

WEEKLY WORK
Planning

**LEARNING
& IMPROVING**

**Specify
Handoffs**



Last Planner System® - Lookahead Planning

MAILESTONE
Planning

PHASE PULL
Planning

LOOKAHEAD
Planning

WEEKLY WORK
Planning

**LEARNING
& IMPROVING**



**Make
Work
Ready**

Make-Ready Planning (6 weeks+)



Make Ready Example Video



**Pit Stops
1950 vs 2013**



Last Planner System® - Weekly Work Planning

MILESTONE
Planning

PHASE PULL
Planning

LOOKAHEAD
Planning

WEEKLY WORK
Planning

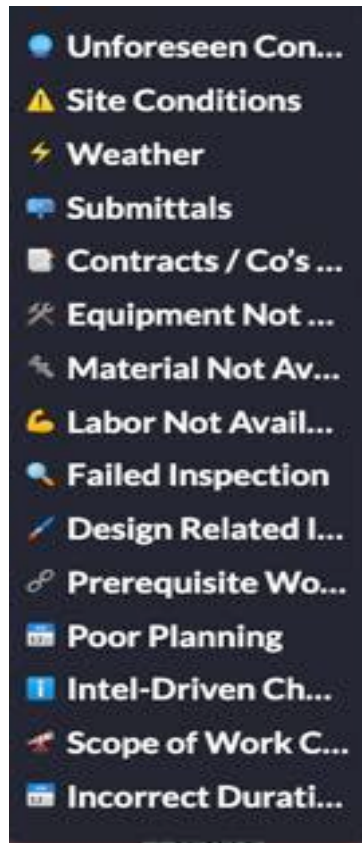
**LEARNING
& IMPROVING**



ALL TRADES COMBINED									
WEEK OF	AREA	ASSIGNMENT DESCRIPTION	COMMENTS - CONSTRAINTS - PREREQUISITE WORK - RELIABLE PROMISES NEEDED	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6
10-JUL-2017									
1	6	A	HAND DRYWALL						
2	6	A	TAPE & FINISH DRYWALL						
3	6	A	INSPECTION						
4	6	A	REMOVE LADDERS, INSTALL STAIR TOWER						
5	6	A	IN-WALL ELECTRIC						
6	6	B	IN-WALL WATER						
7	6	B	IN-WALL COVER UP INSPECTION						
8	7	A	DUET MAIN ROUGH-IN						
9	7	A	DUET BRANCH ROUGH-IN						
10	7	B	INSTALL CONDUIT						
11	7	B	PULL WIRE						
12	8	A	FRAME PRIORITY WALLS - WEST						
13	8	A	FRAME PRIORITY WALLS - EAST						
14	8	B	WALL LAYOUT						
15	8	B	INSTALL TOP & BOTTOM TRACK - PRIORITY WALLS						
16	8	B	INSTALL TOP & BOTTOM TRACK - ROOMS						
17	8	B	INSTALL DUCT HANGERS						
18	8	B	WALL LAYOUT						
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**Make
Reliable
Promises**

Last Planner System® - Learning & Improving



MILESTONE
Planning

PHASE PULL
Planning

LOOKAHEAD
Planning

WEEKLY WORK
Planning

**LEARNING
& IMPROVING**



**Percent Plan Complete
& Variances**

Last Planner[®] System – 5 Connected Conversations



5S: A Starting Point with Lean

S_{ORT}
S_{TRAIGHTEN}
S_{HINE}
S_{TANDARDIZE}
S_{USTAIN}



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

5S Applications



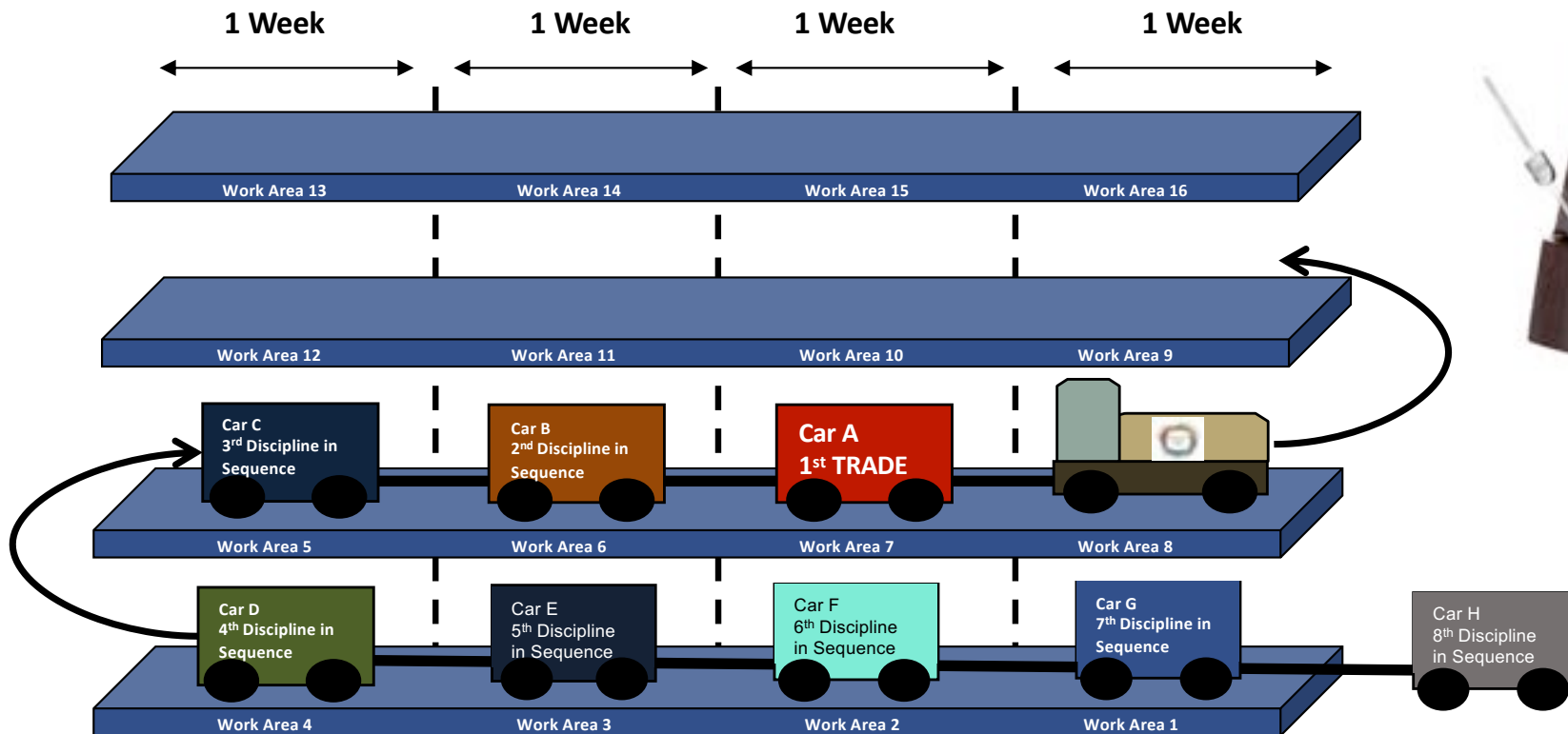
Job Trailer 5S: Before and After



INTRODUCTION TO LEAN PROJECT DELIVERY



Takt: Planning for FLOW



BOLD THINKING.

Takt : Define Work Areas



Little's Law

**Smaller Batches
Yield Faster
Completion
w/Same Effort**

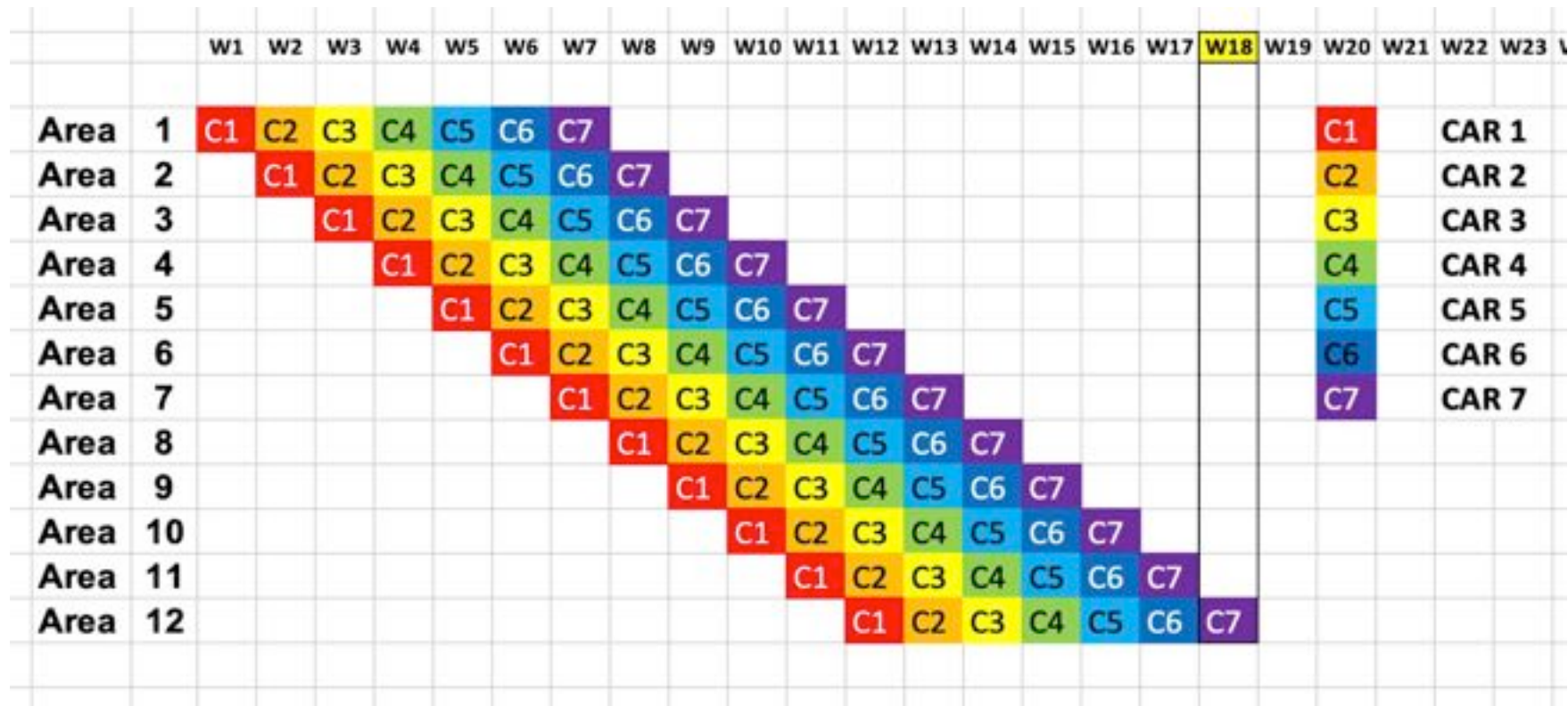
LITTLE'S LAW

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		

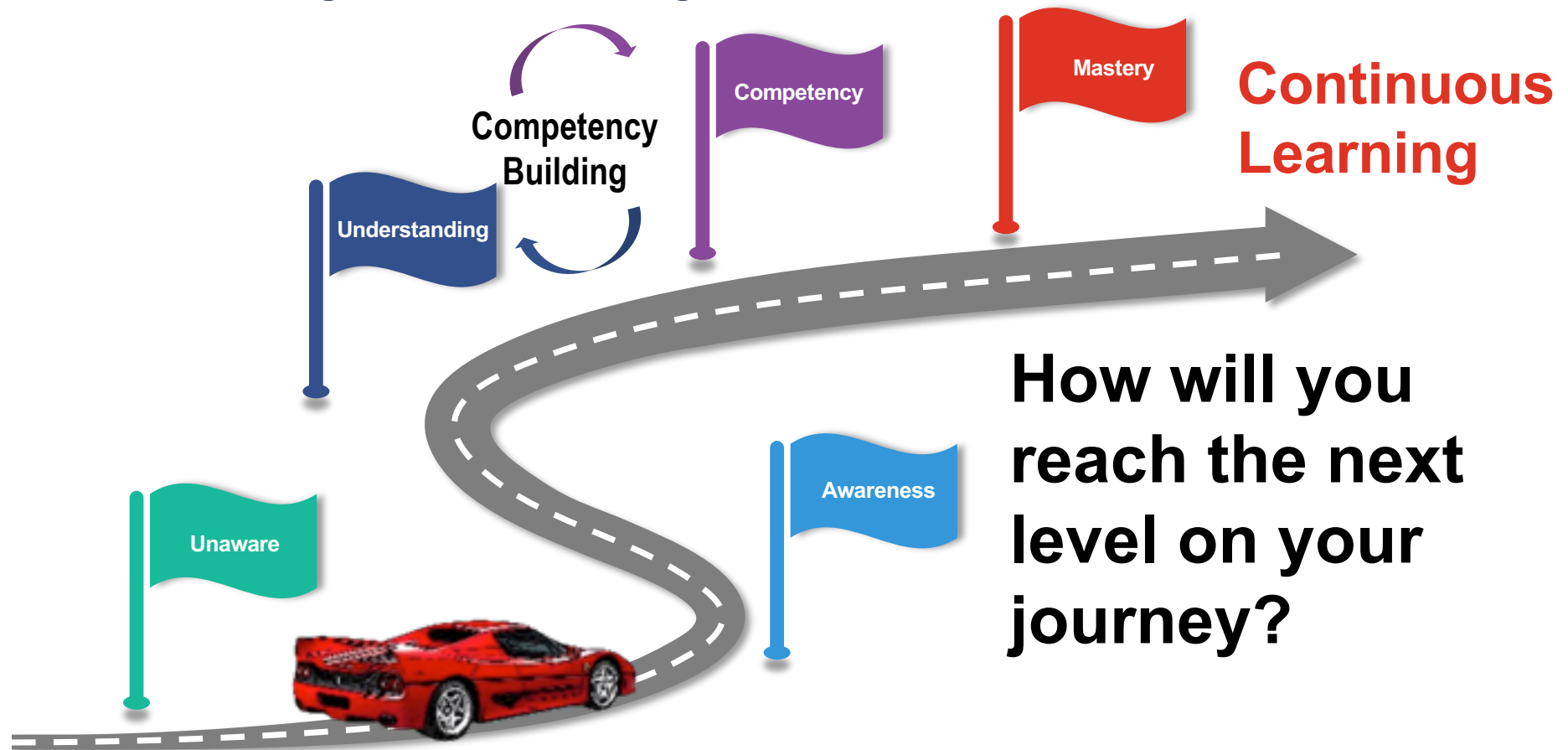
Basic Takt Plan



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



Lean Journey to Mastery



Discussion Question

Implementing Lean Design & Lean Construction

What new actions or ideas will you take back to your project?

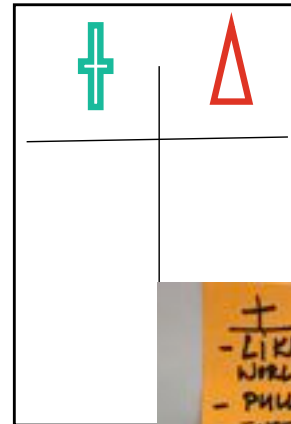
Conduct Plus/Delta

Plus: What produced value during the session?

“I LIKED...”

Delta: What could we change to improve the process or outcome?

“I WISH...”



+

- LIKED THE REAL WORLD EXAMPLES.
- FULL PLANNING
- INTERACTIVE
- BREAKOUT GROUP EXERCISES
- GOOD PRESENTATION!

+

- Good explanation of Lean tools
- Good practices
- Good speaker
- Good teamwork and participation

Δ

Additional exercises with real project examples

Δ

• TOO MANY SIDE CONVERSATIONS

• MORE PROJECTS IN THE WORLD THAT USE THIS

Questions?



LCI Certification



<https://leanconstruction.org/lean-certification/>

LCI Website Information



www.LeanConstruction.org



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