Introduction to Lean Project Delivery

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Detroit, Michigan

Course Instructors

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Immersive Education Program

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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.

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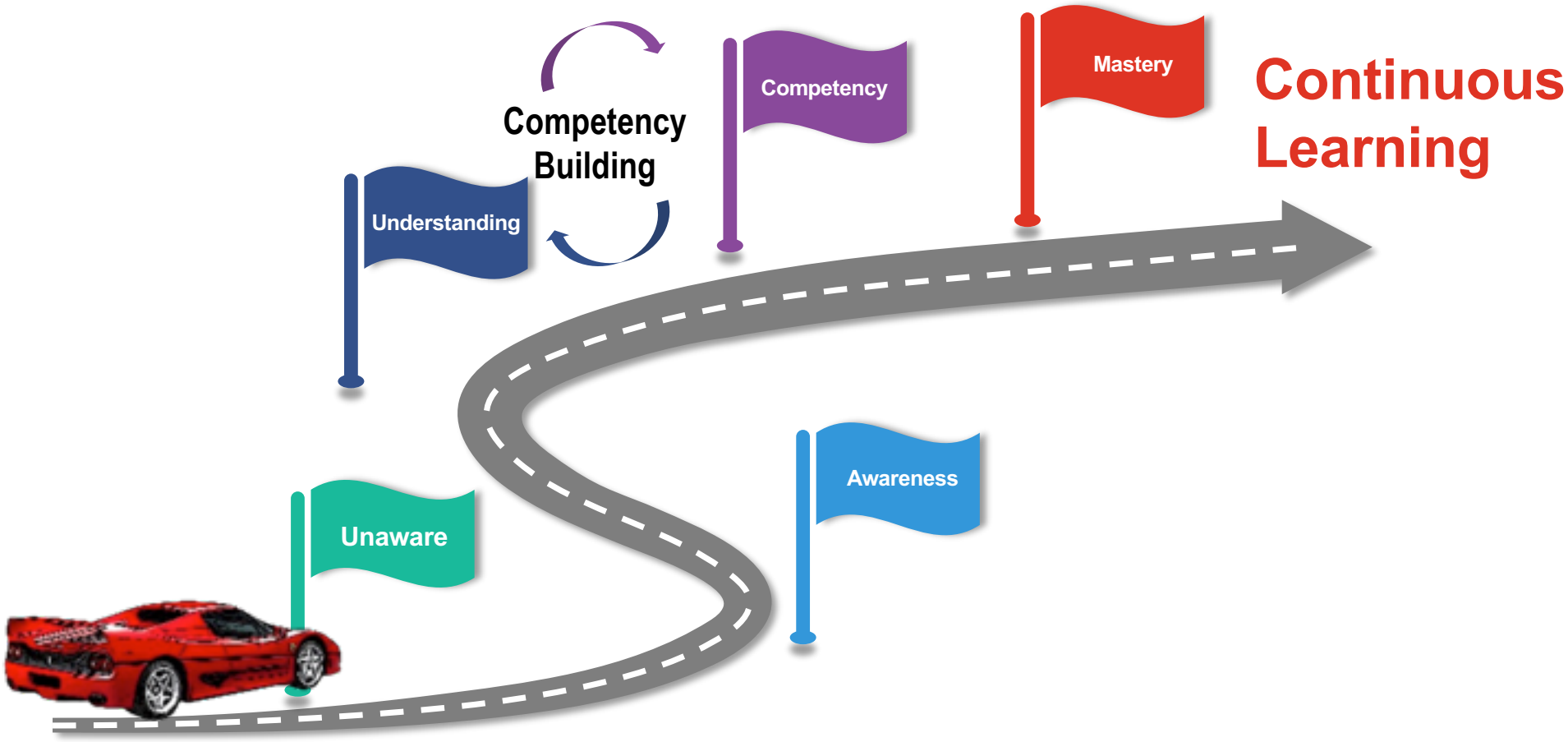
Lean Journey to Mastery



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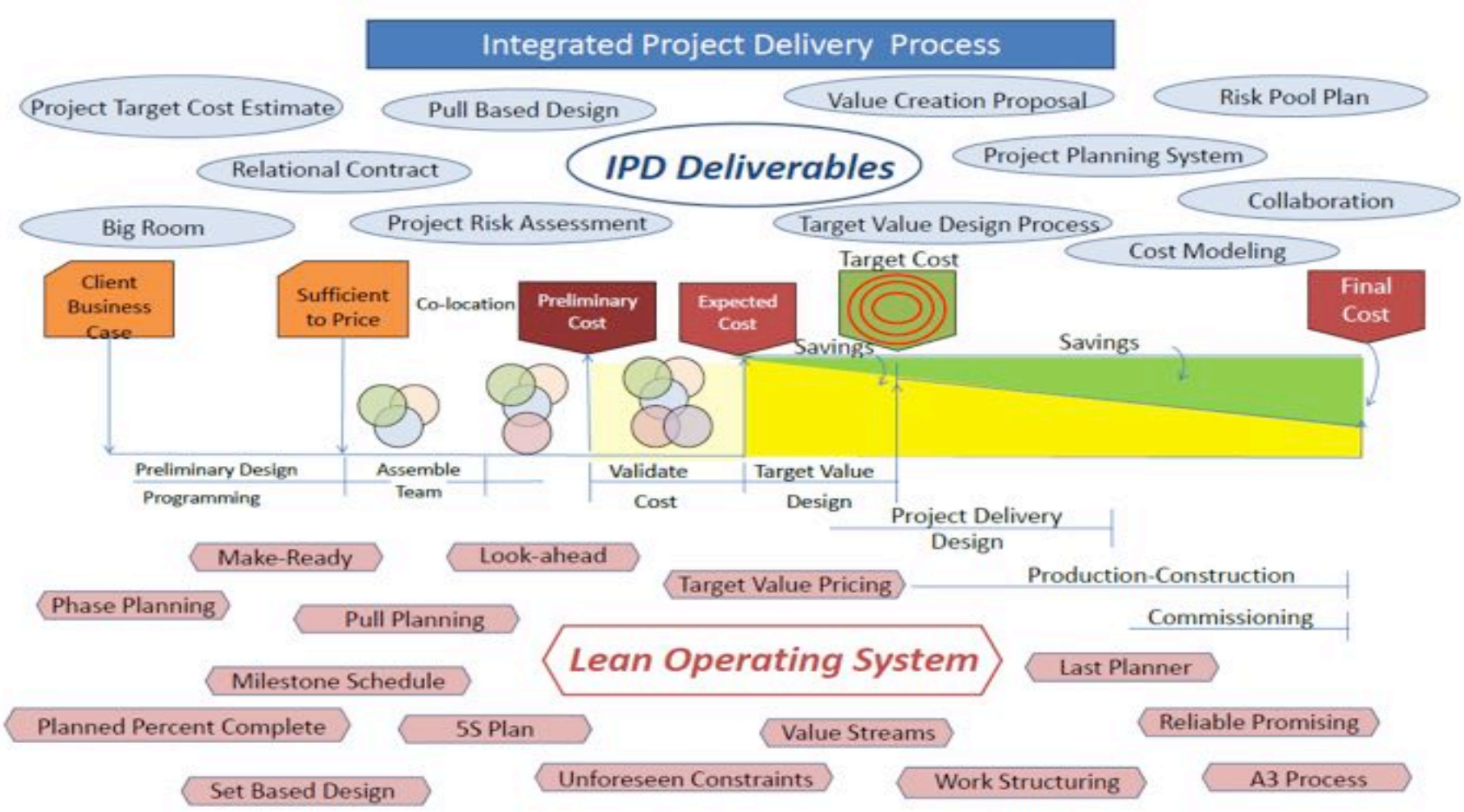

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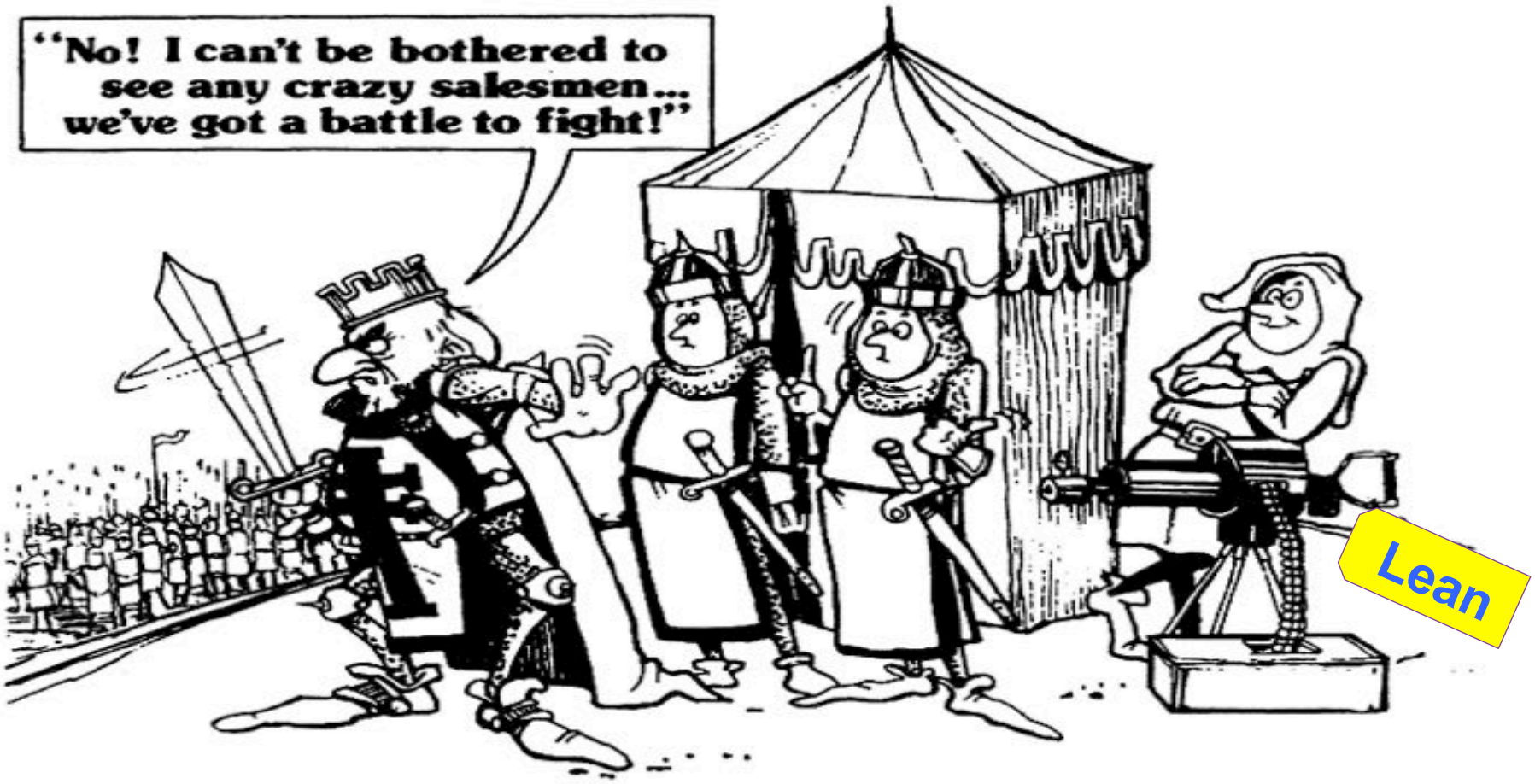

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Definition: **Lean**

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

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Definition: **Lean Project Delivery**

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

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Origins of Lean

- **Scientific Management** 1880-1930
- **Assembly Lines** 1903-1914

- **World War II** 1939-1945
- **Lean Manufacturing** 1945 - present

Toyota Production System (TPS)

Ford

TOYOTA

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Meals Per Hour Video

- **Super Storm Sandy**

TOYOTA

https://youtu.be/EedMmMedj3M

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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**

Image Courtesy of C.Y Tsao

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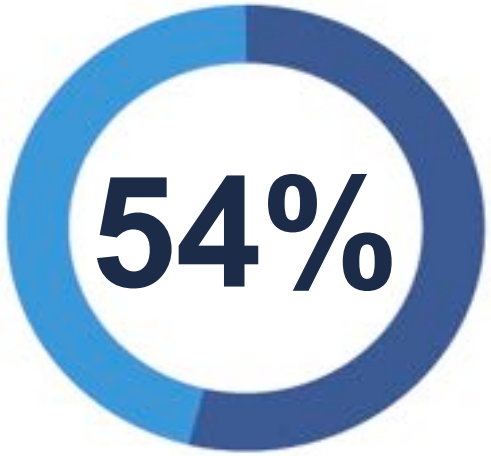
Brief History : Lean in Design & Construction



Work completed As-planned

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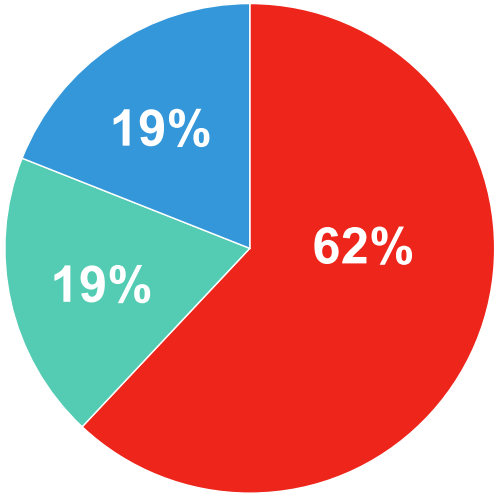
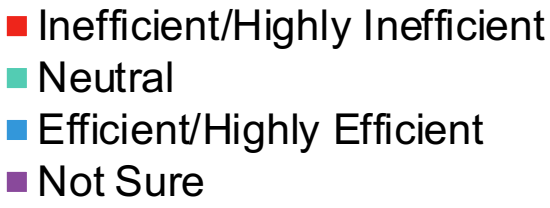
Overcoming Industry Inertia

How efficient are you?

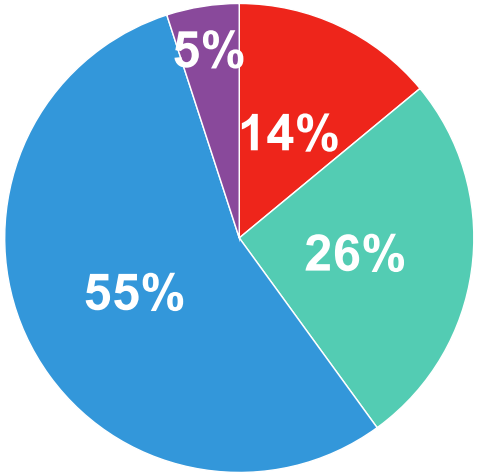
(By Level of Lean Engagement)

Lean Practitioners





Non-Lean Practitioners



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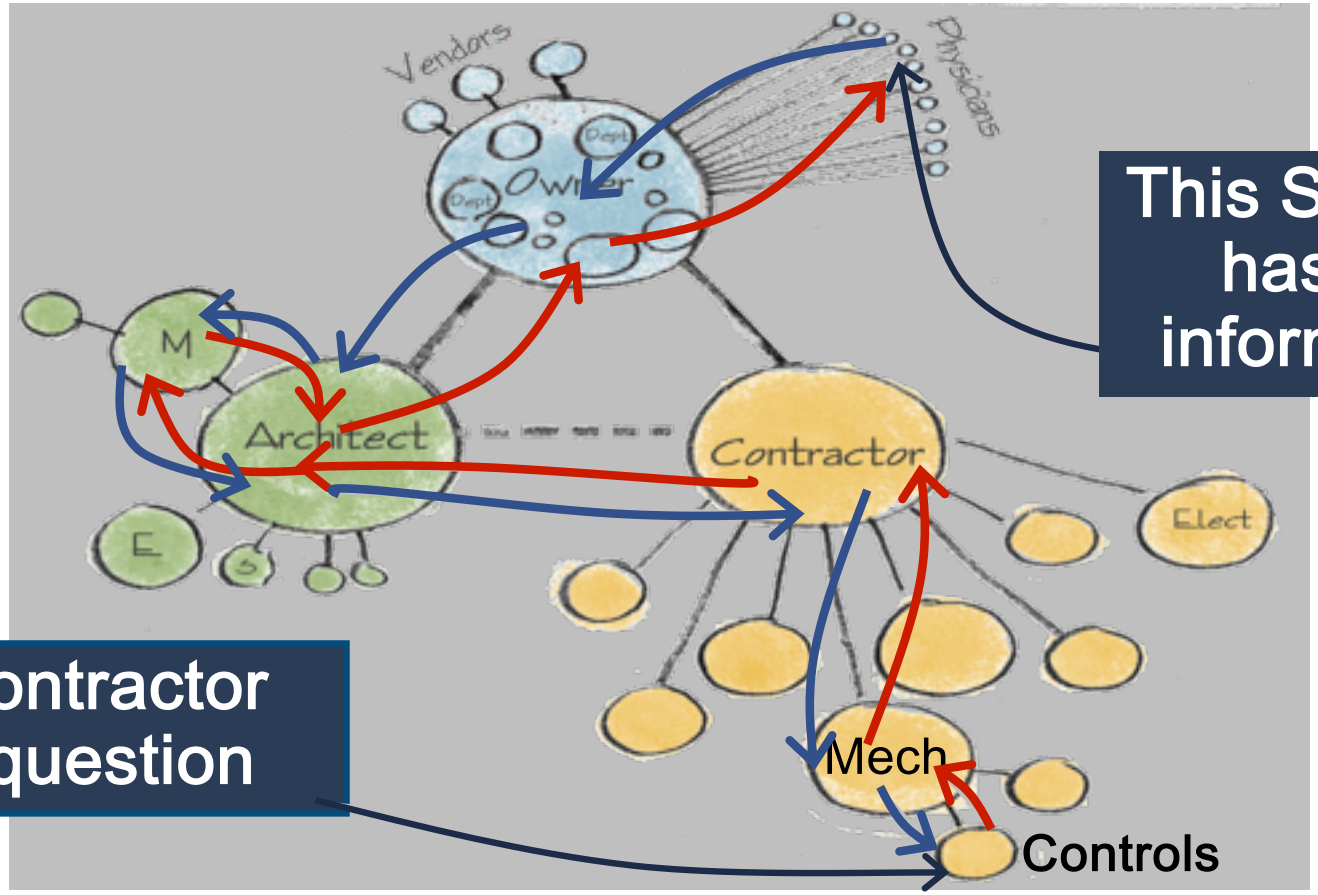
Traditional Structures Create Waste:



This Surgeon has the information

This Contractor has a question

Courtesy of SSM Cardinal Glennon

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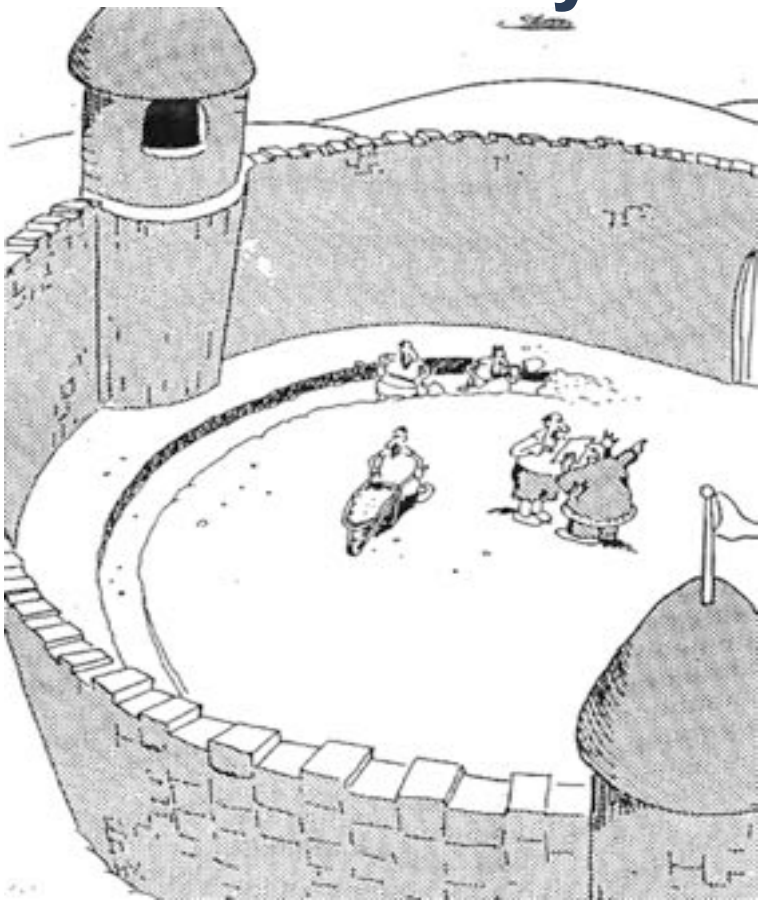
Traditional Delivery Outcomes…



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

- *The Far Side* 1990

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The Opportunity…

MANUFACTURING

DESIGN & CONSTRUCTION

Productive Waste

2004 Construction Industry Institute (CII) Study

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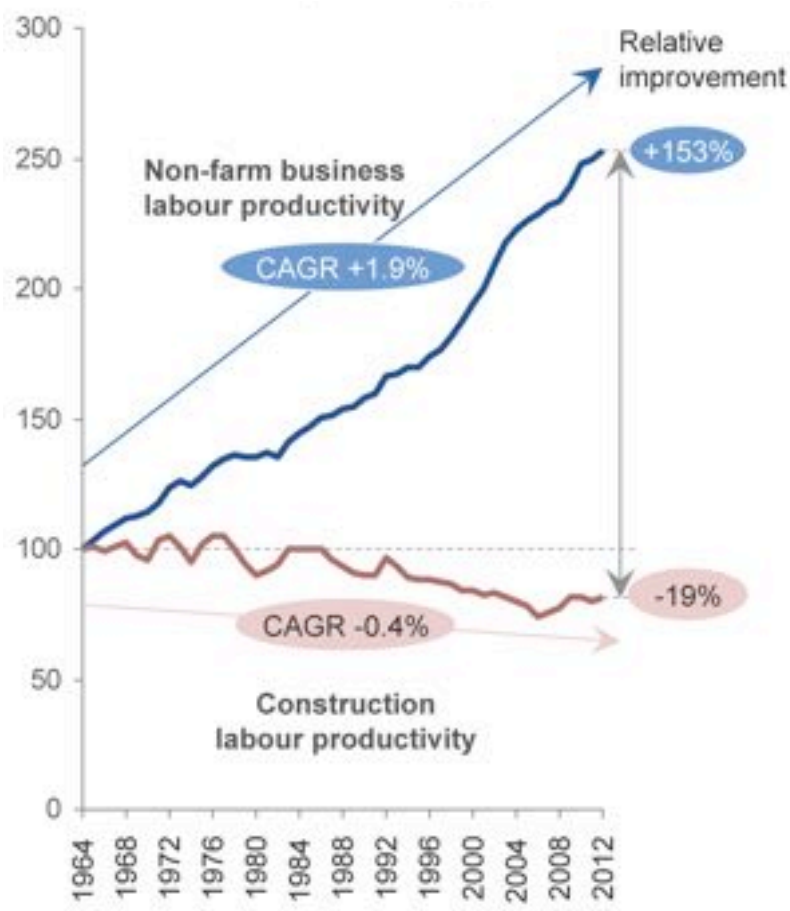
Why Lean?

- **Productivity is declining**
- **Costs are skyrocketing**
- **Injuries are too high**
- **Workflows are unpredictable**
- **Workflow reliability directly impacts the speed and cost of projects**



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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

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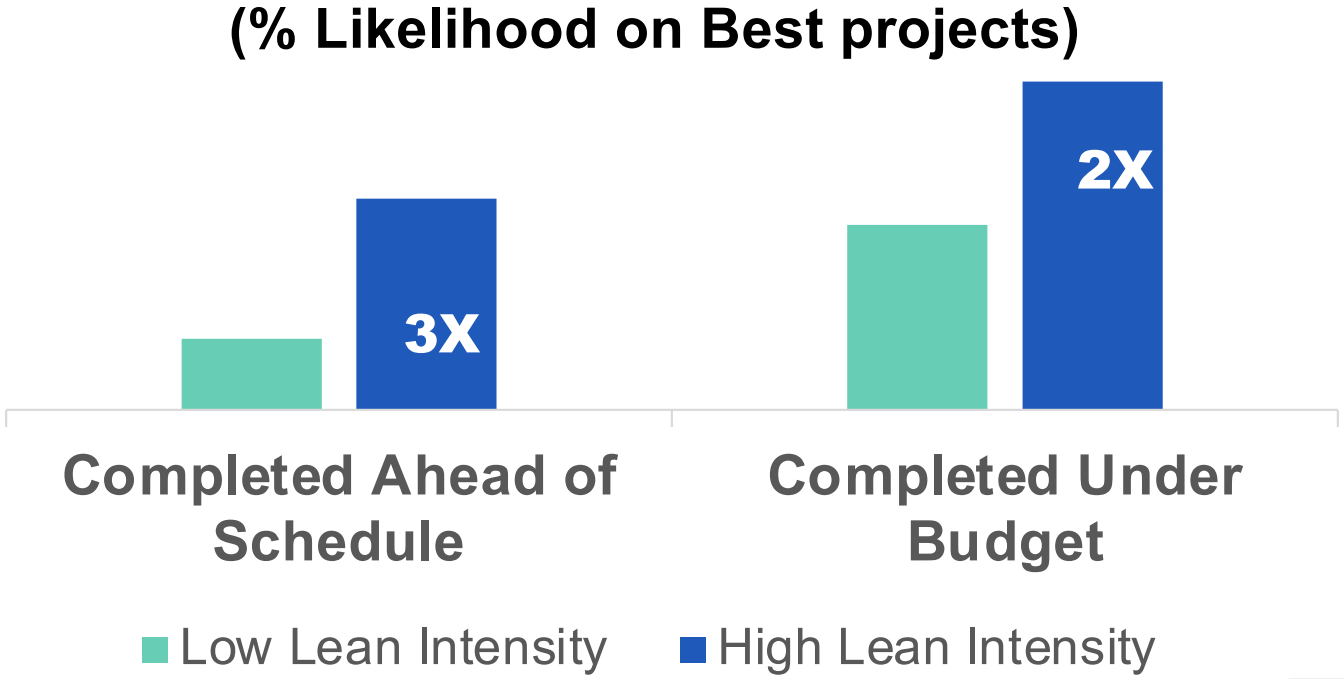
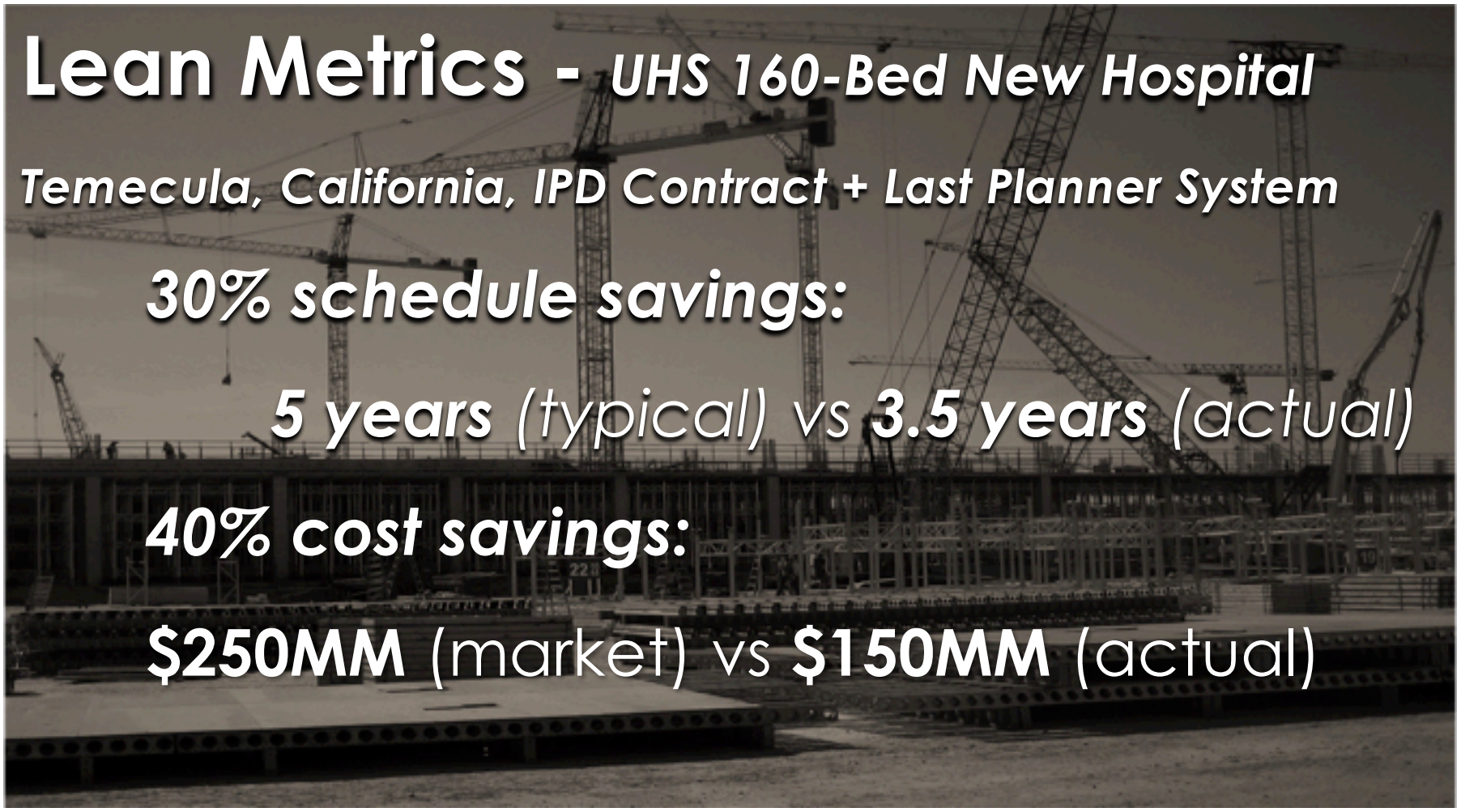
Correlation of Lean Intensity to Outcomes



DODGE DATA & ANALYTICS



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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)

BAKER CONCRETE CONSTRUCTION

Image Courtesy of Baker Concrete Construction

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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.**

Images Courtesy of On Point Lean Consulting

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Plan - Do - Check - Act (PDCA)

The Deming Cycle

Improve the System

Predict

Study the Results

Take Action, Try it Out

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Benefits of Lean

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

Images Courtesy of W.M. Jordan

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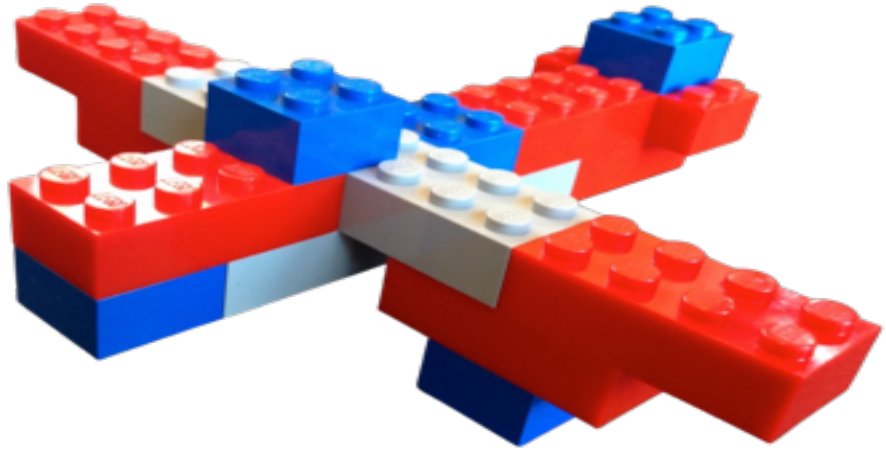
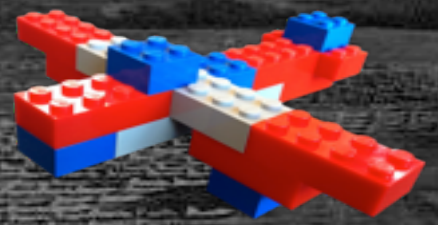
Production System Design Exercise

The Airplane Game



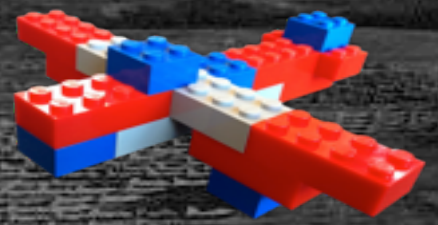
Airplane Simulation Debrief



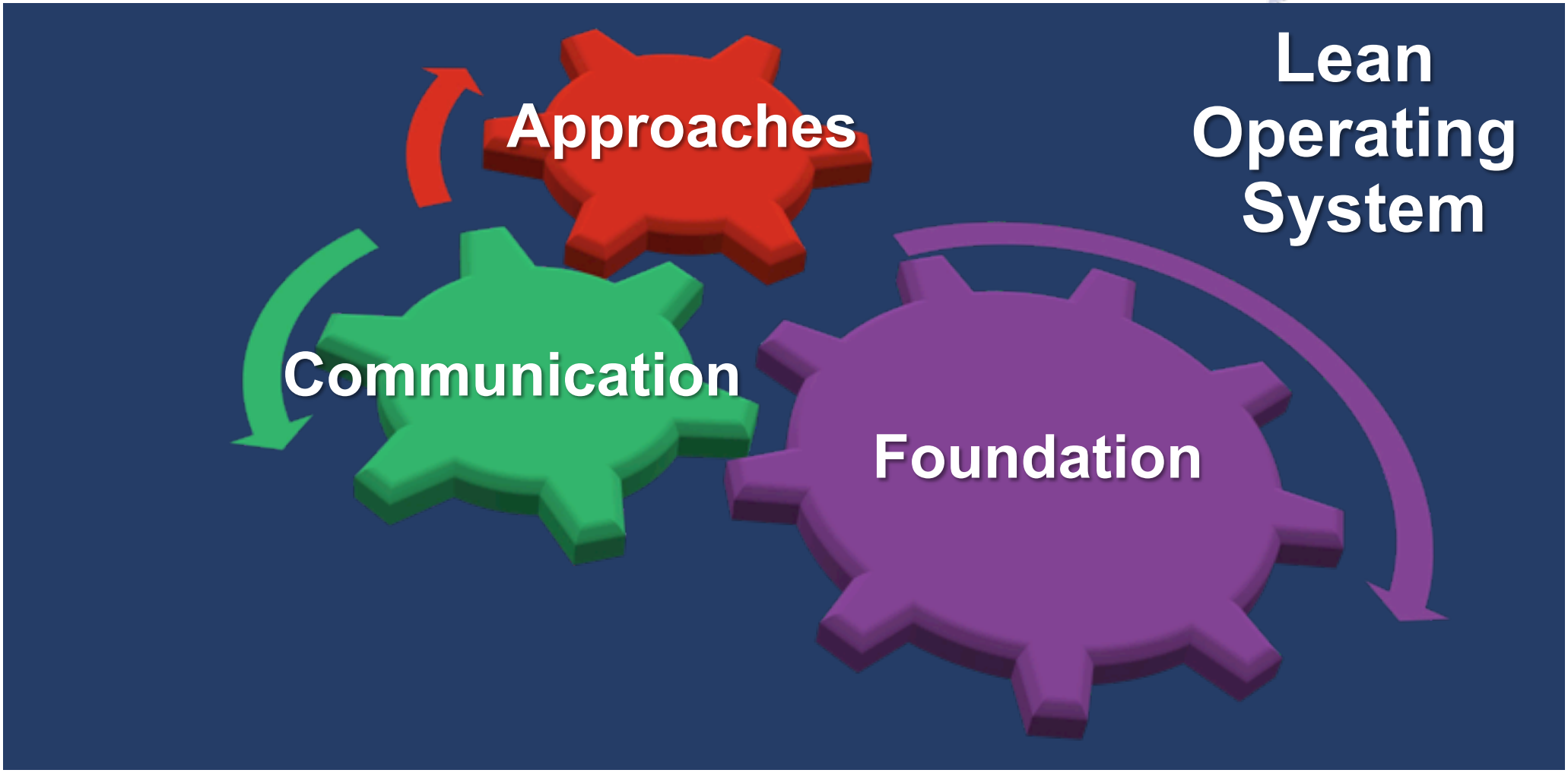
Discuss and answer the following questions:

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



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Lean Operating System

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

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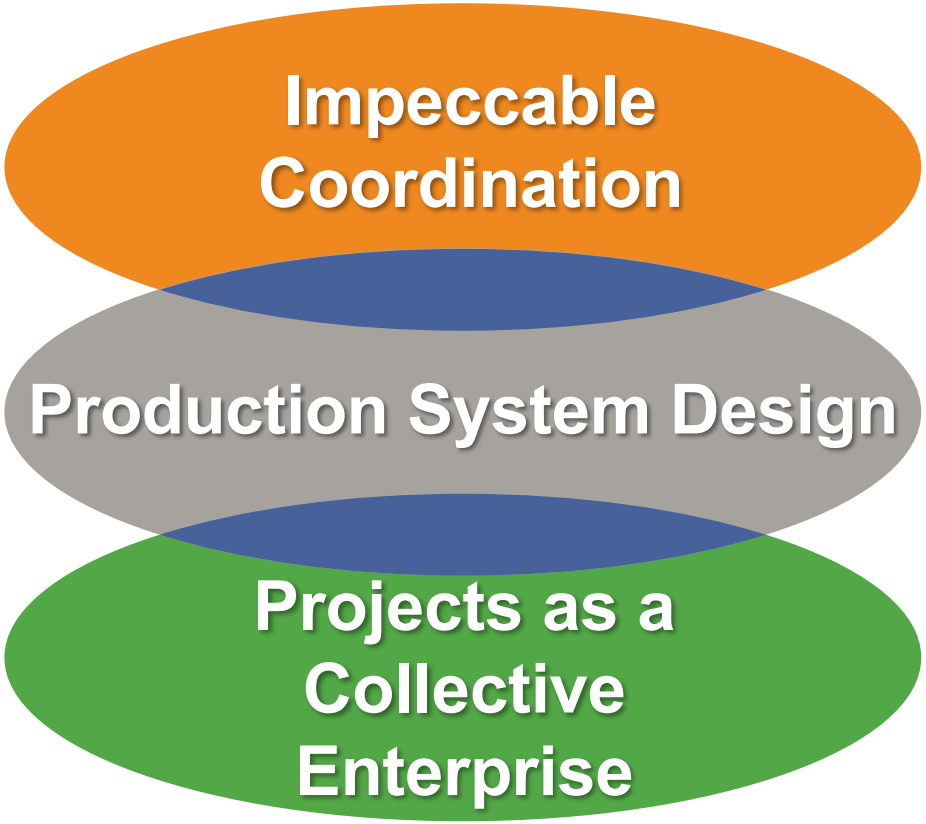
A Coherent Way to Manage Work in Projects

Three Connected Opportunities



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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

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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.

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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.

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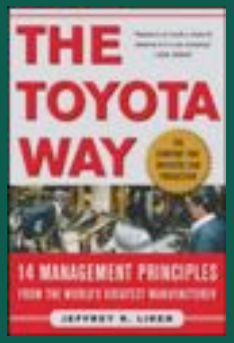
3. Generate Value

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

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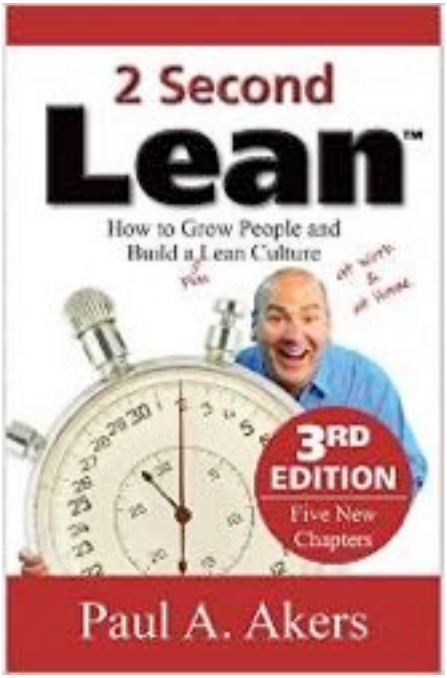
4. Eliminate Waste

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



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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.

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5. Focus on Flow

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

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6. Continuous Improvement

Lean thinking demands a mindset of continuous improvement.

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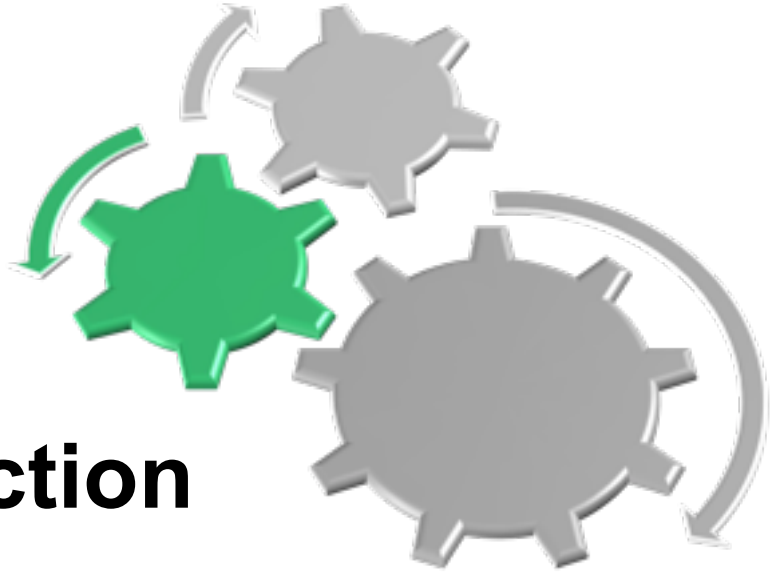
Lean Operating System

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



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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.**

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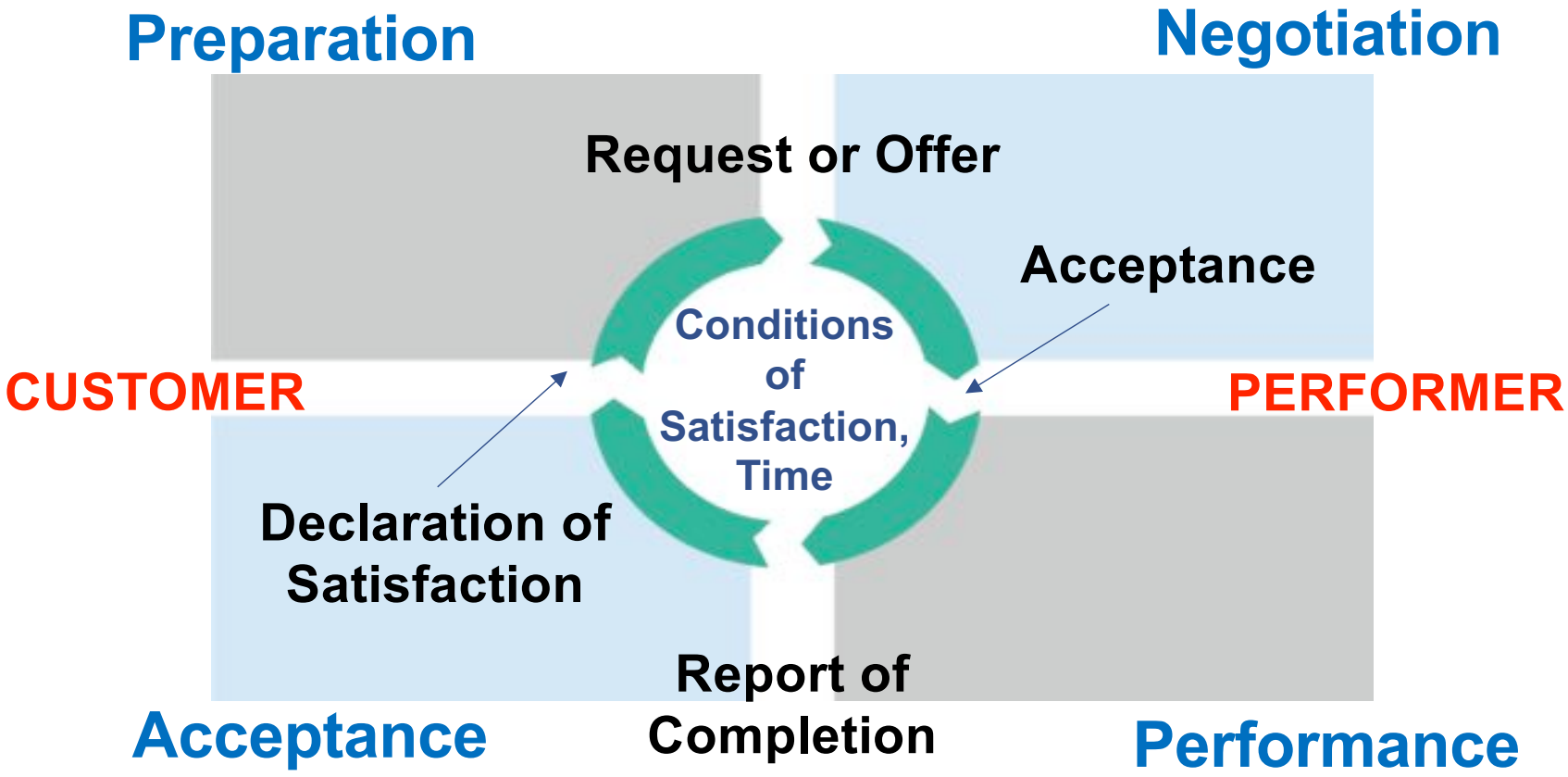
Elements of a Promise

- ***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



Credit: Dr. Fernando Flores

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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.**

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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**

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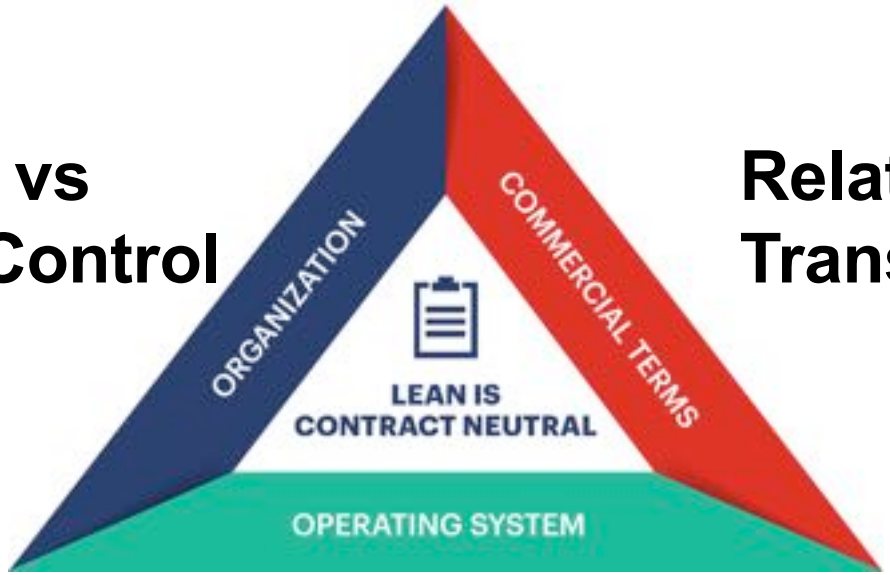
Project Elements: Lean vs Traditional

Collaboration vs Command & Control



Relational vs Transactional

Reliability Focus (Flow) vs CPM Scheduling (Push)

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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.

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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

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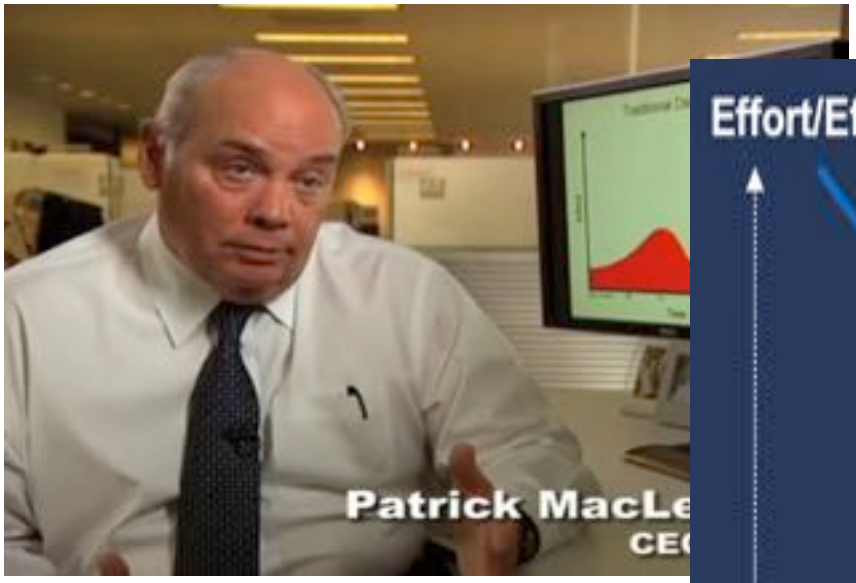
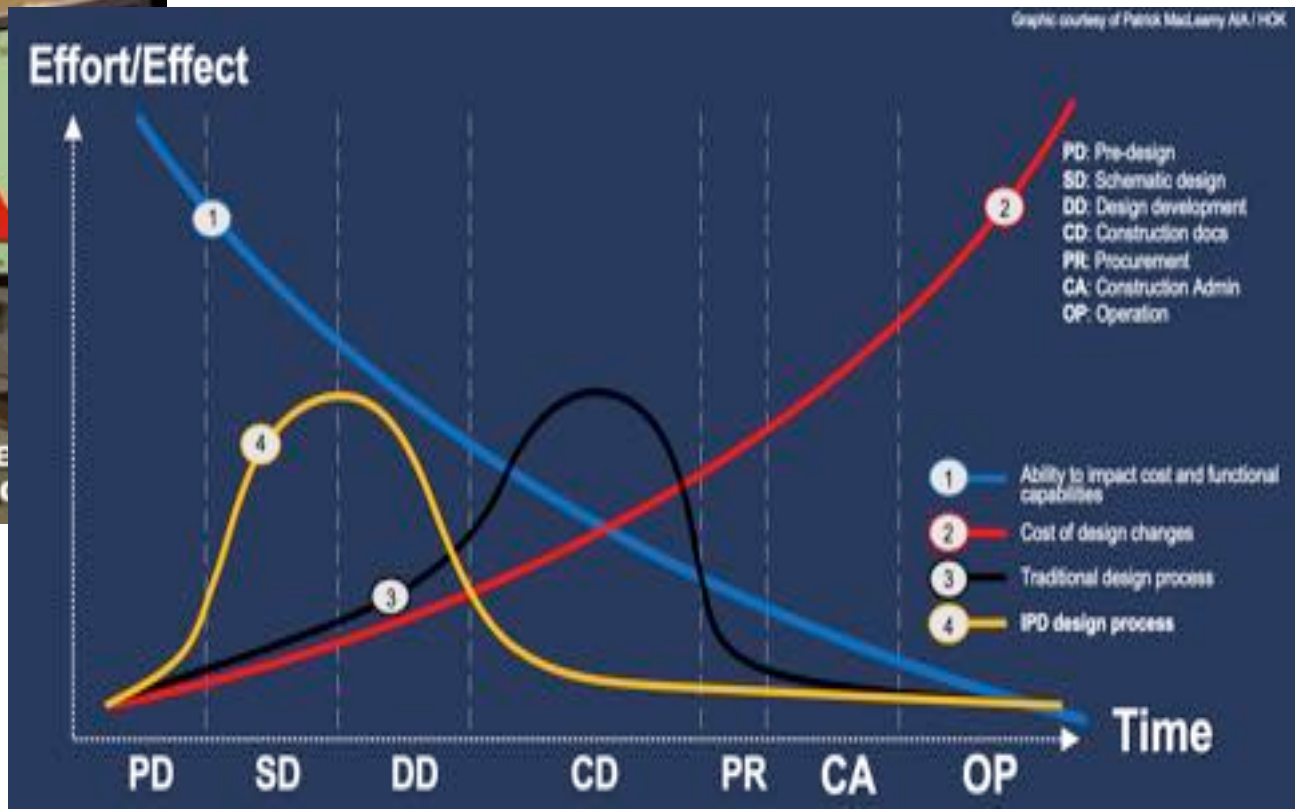
MacLeamy Curve Video





https://youtu.be/oHHY7Cxl2_Y

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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

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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!

Images Courtesy of InsideOut & On Point Lean Consulting

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Lean in Design

Lean Design

Maximize Innovation!

NOT about "standardizing design"

Lean Production

Minimize Waste!

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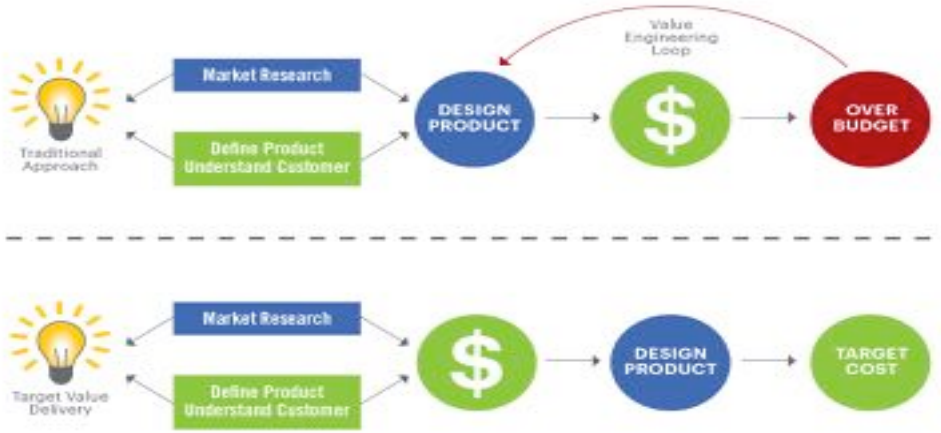
Traditional vs. Target Value Delivery

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

Traditional: Cost is an *OUTPUT* of design



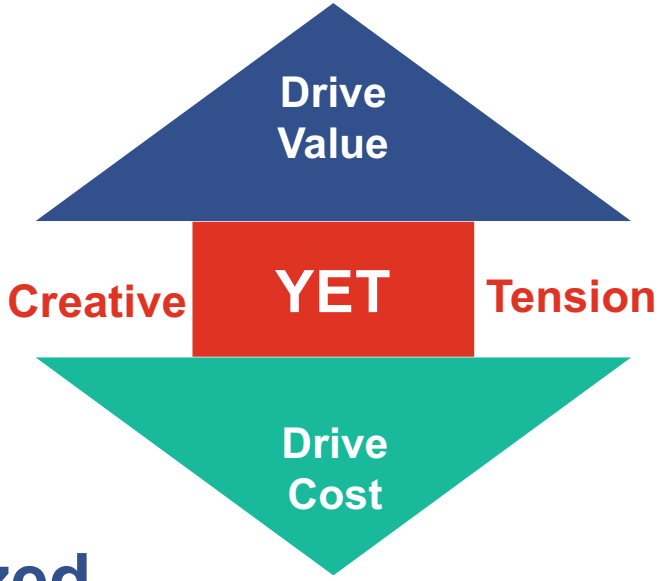
TVD: Cost is an *INPUT* of design

Graphic Courtesy of HKS Architects

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

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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)

Images Courtesy of On Point Lean Consulting

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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.

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 other 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 efficiency		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	0
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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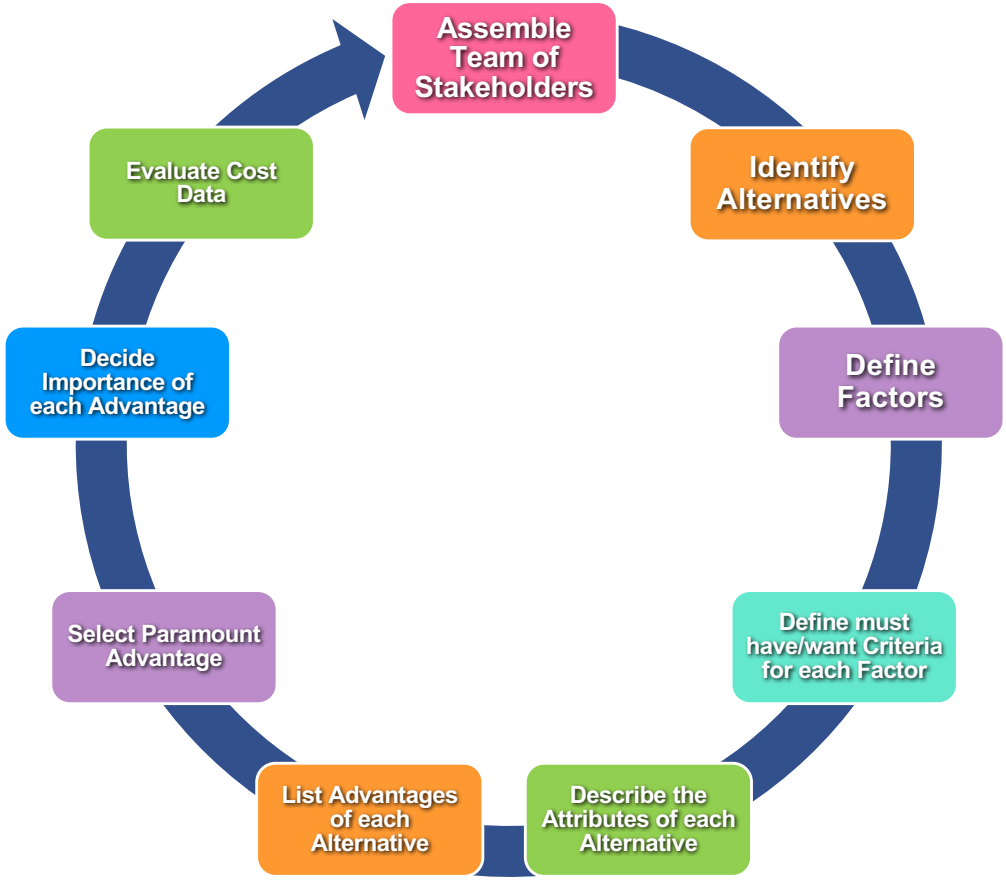
CBA Process Flow

- **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 - Production Preparation Process (3P)

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

Images Courtesy of Cone Health

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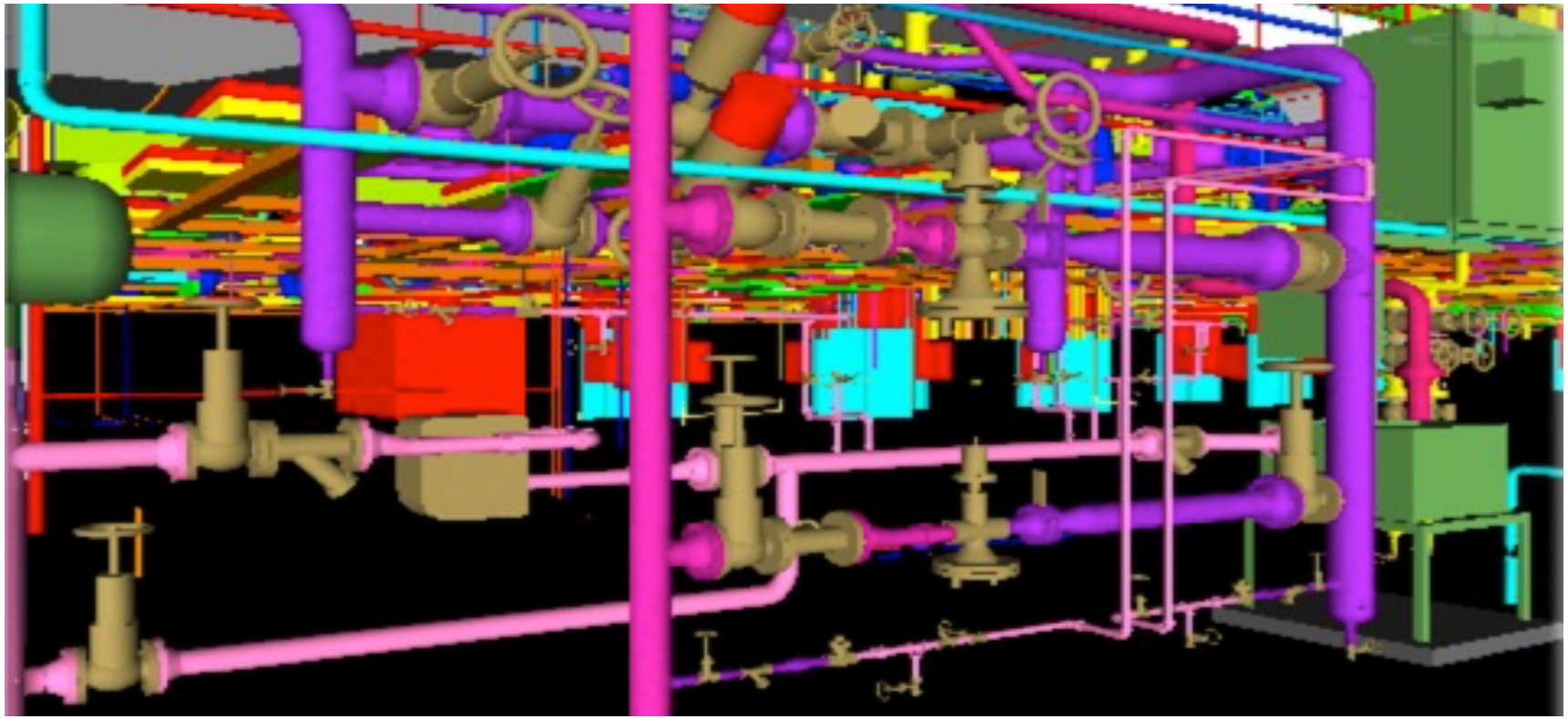
Building Information Modeling (BIM) & Virtual Reality



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Prefabrication

Examples:

- Plumbing Runs
- Headwalls
- Bathroom Pods

Images Courtesy of Southland Industries and KHS&S

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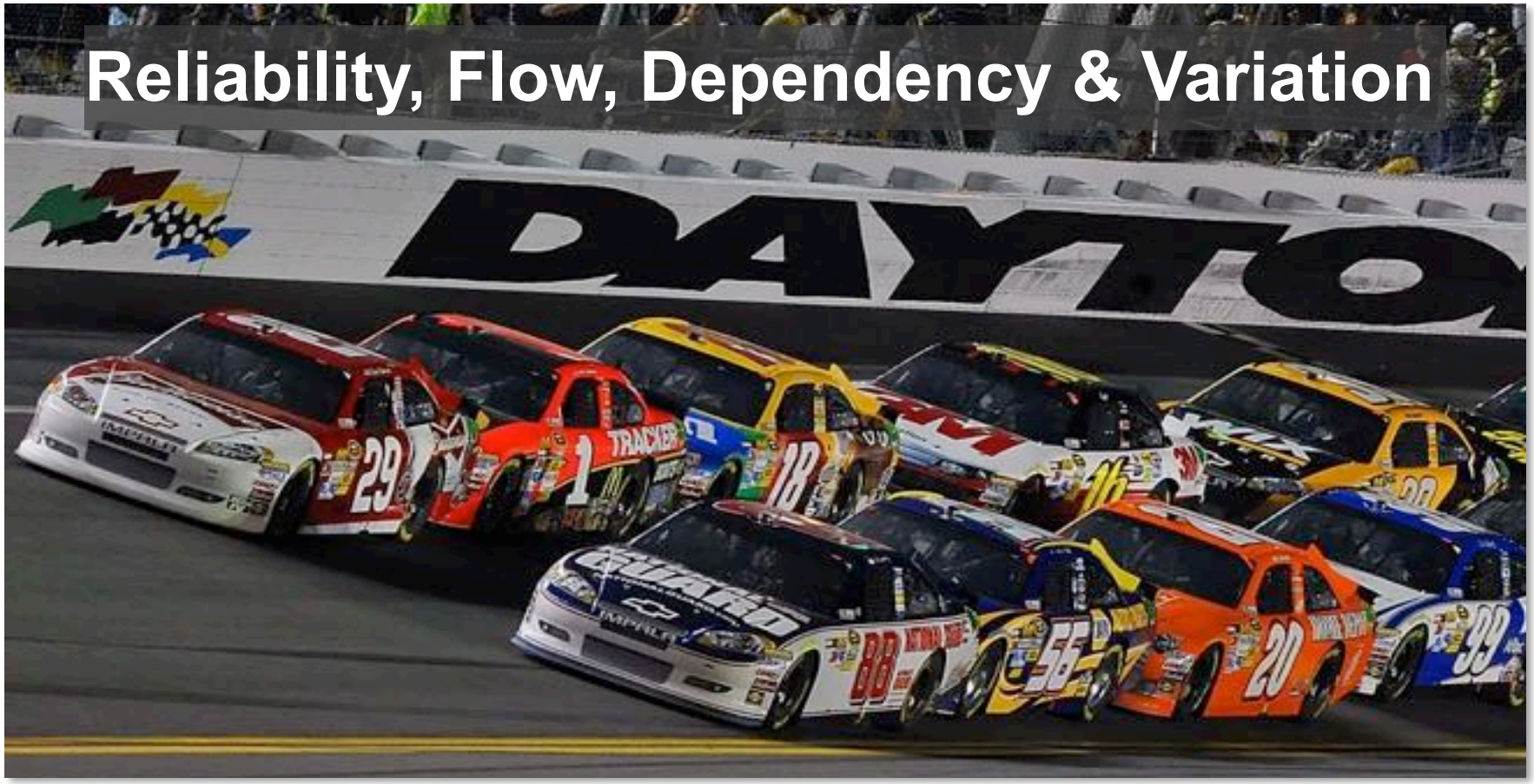
Last Planner System®



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

- Dwight Eisenhower

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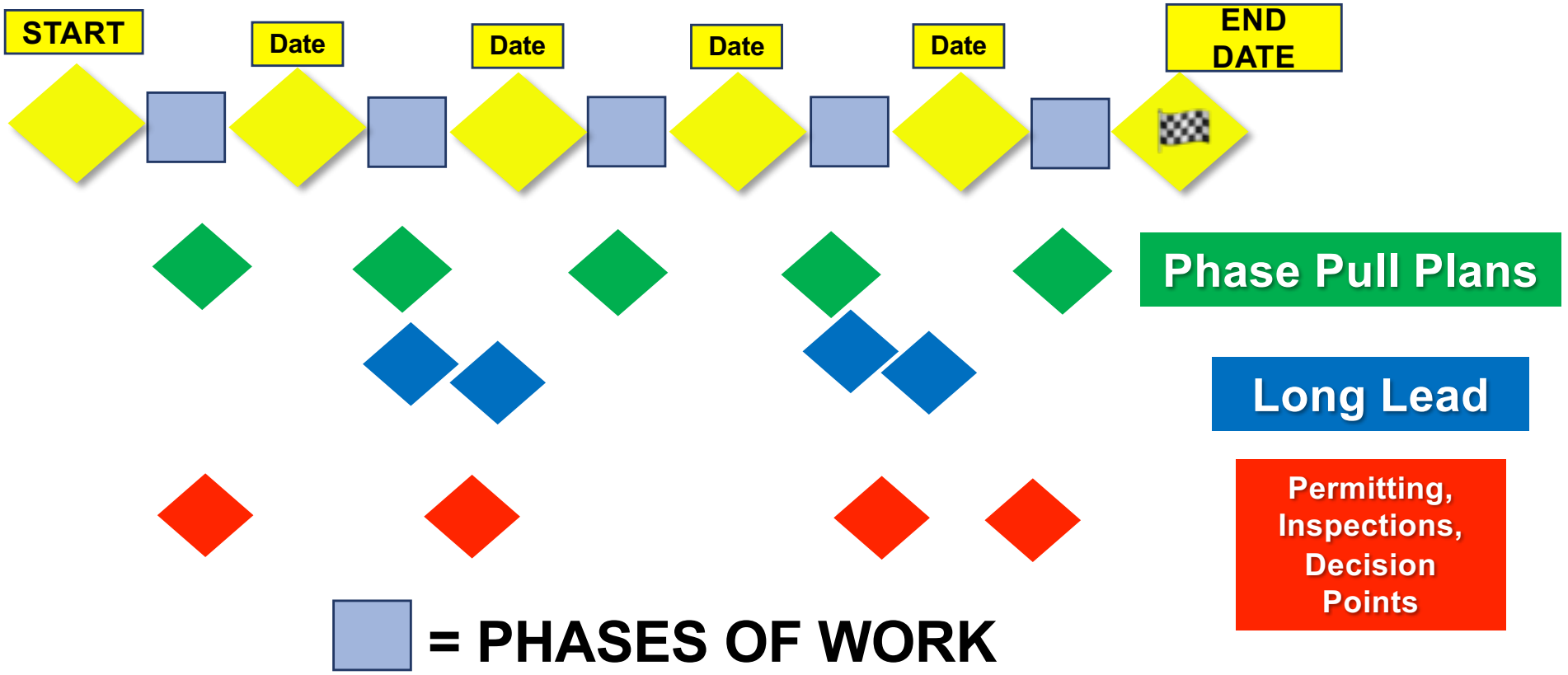
Major & Interim Milestone Planning



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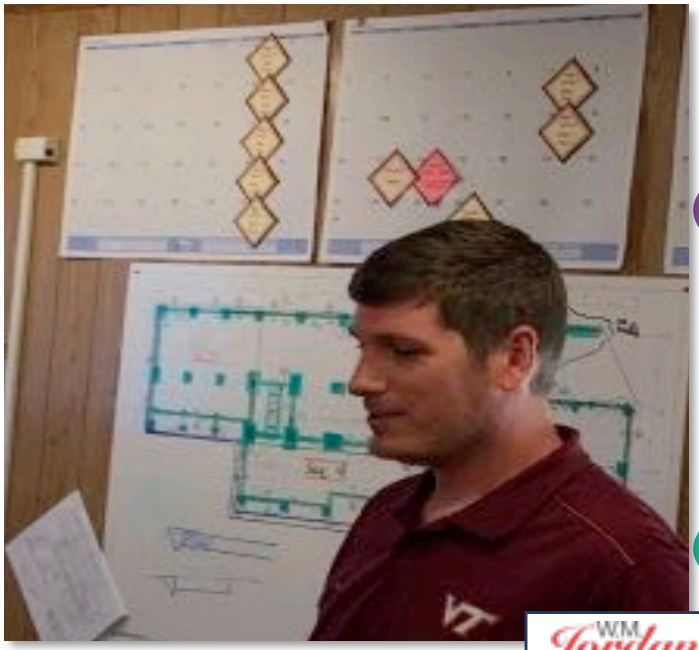
Last Planner System® - Milestone Planning



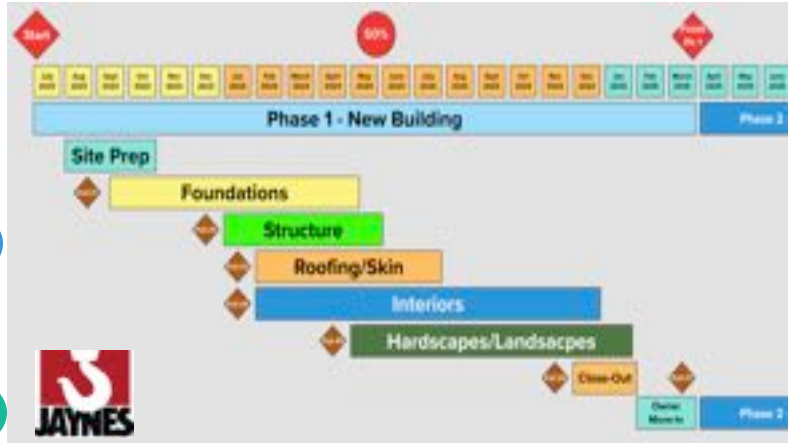
MILESTONE
Planning

PHASE PULL
Planning

LOOKAHEAD
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

LOOKAHEAD
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

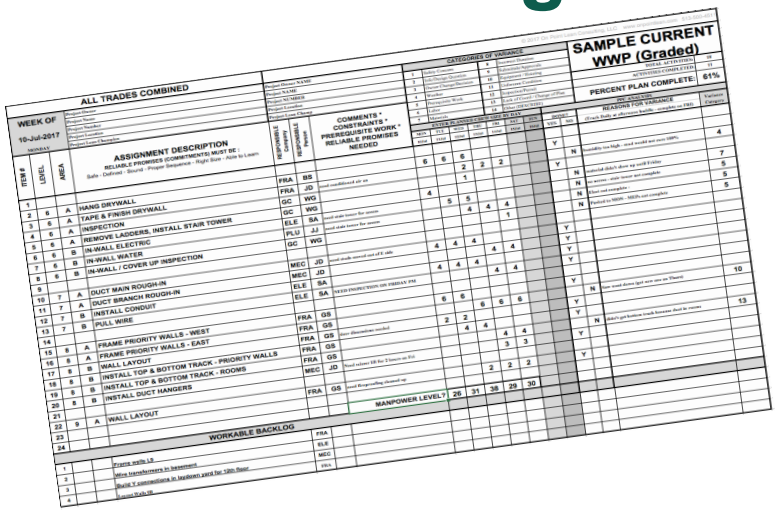
MILESTONE
Planning

PHASE PULL
Planning

LOOKAHEAD
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

LOOKAHEAD
Planning

WEEKLY WORK
Planning

LEARNING & IMPROVING

Percent Plan Complete & Variances

Images Courtesy of On Point Lean Consulting

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Last Planner® System – 5 Connected Conversations

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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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5S Applications

Images Courtesy of PCL and KHS&S

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Job Trailer 5S: Before and After

Images Courtesy of On Point Lean Consulting

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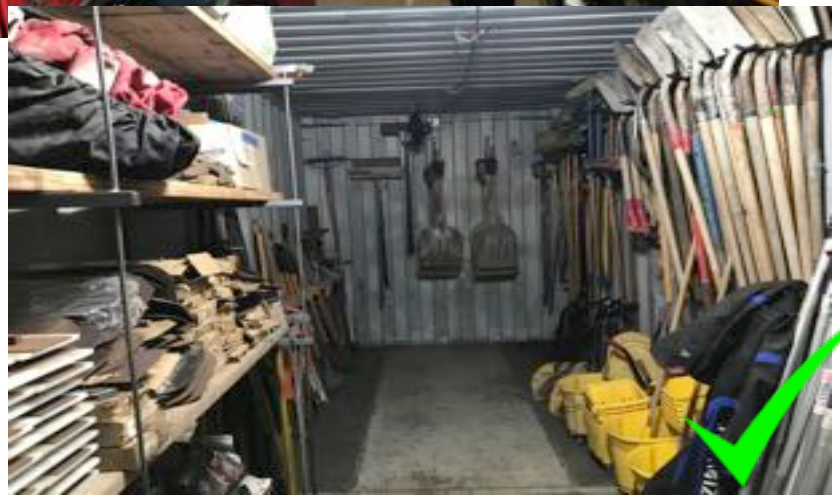

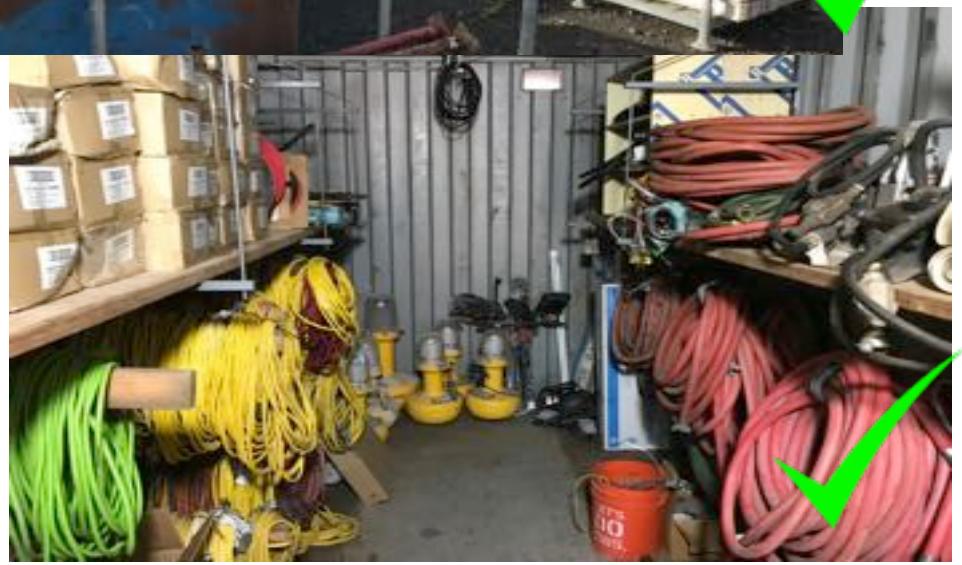

Images Courtesy of PCL Construction

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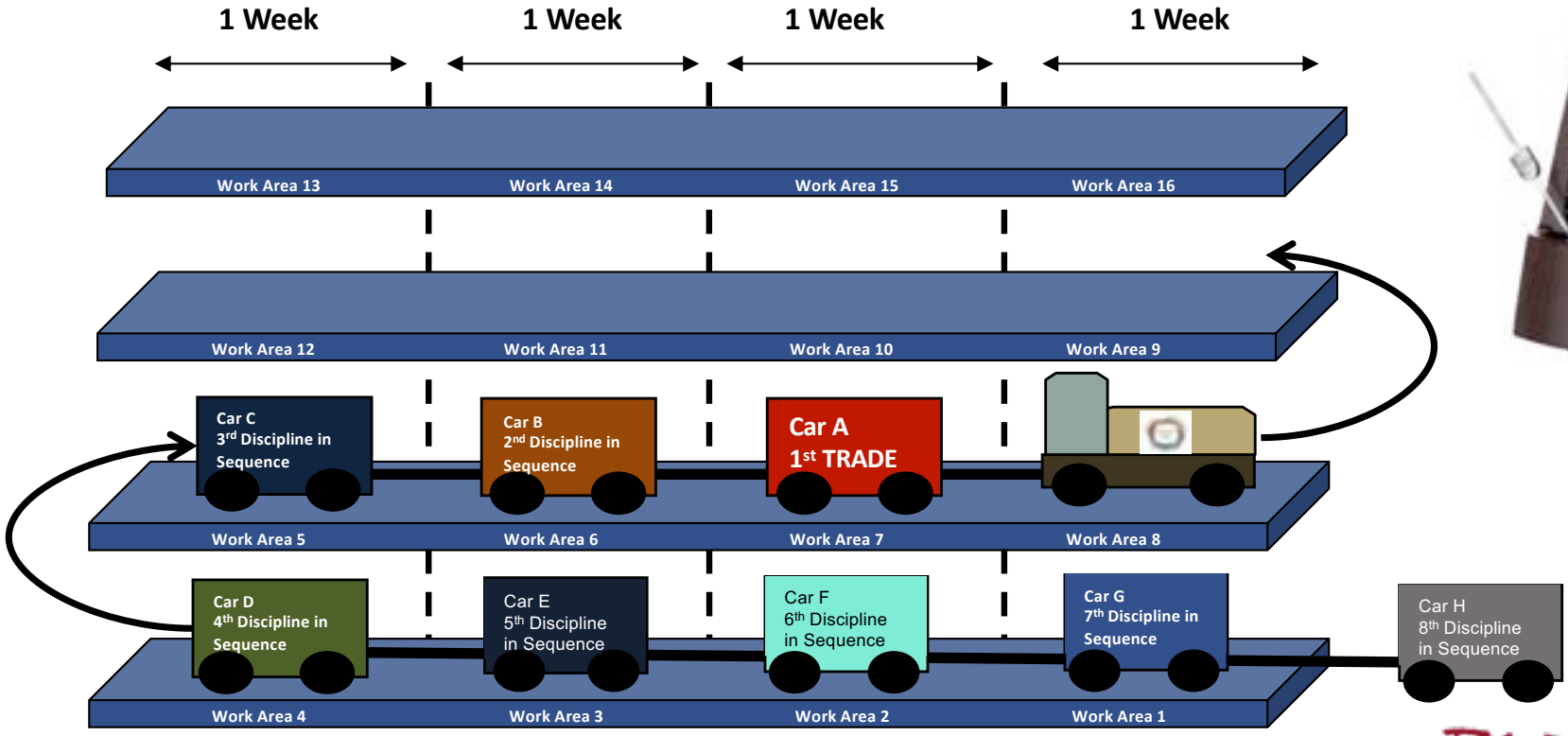
Takt: Planning for FLOW



BOLD THINKING

Image Courtesy of Boldt

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Takt : Define Work Areas

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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		

Image Courtesy of On Point Lean Consulting

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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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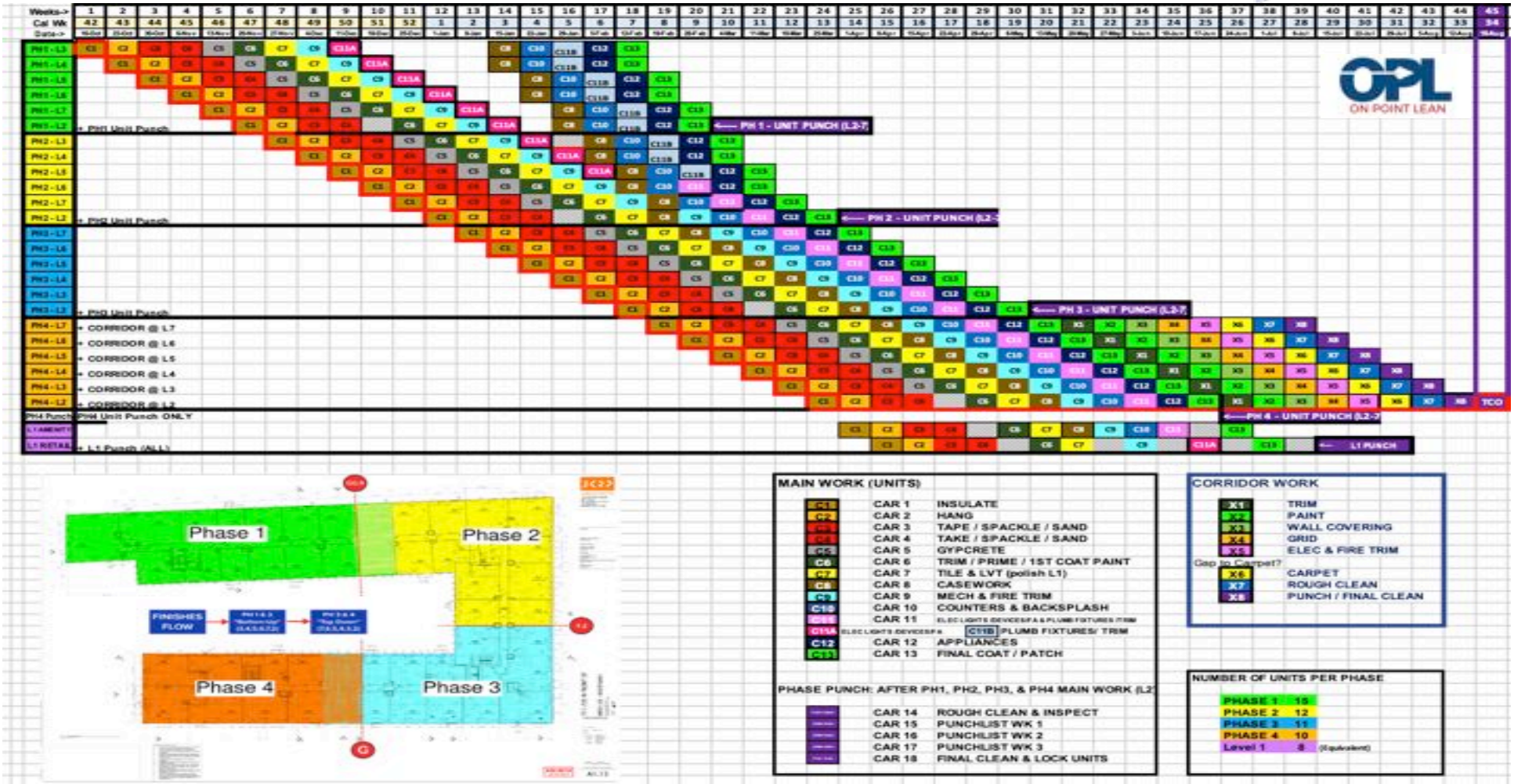

Image Courtesy of On Point Lean Consulting

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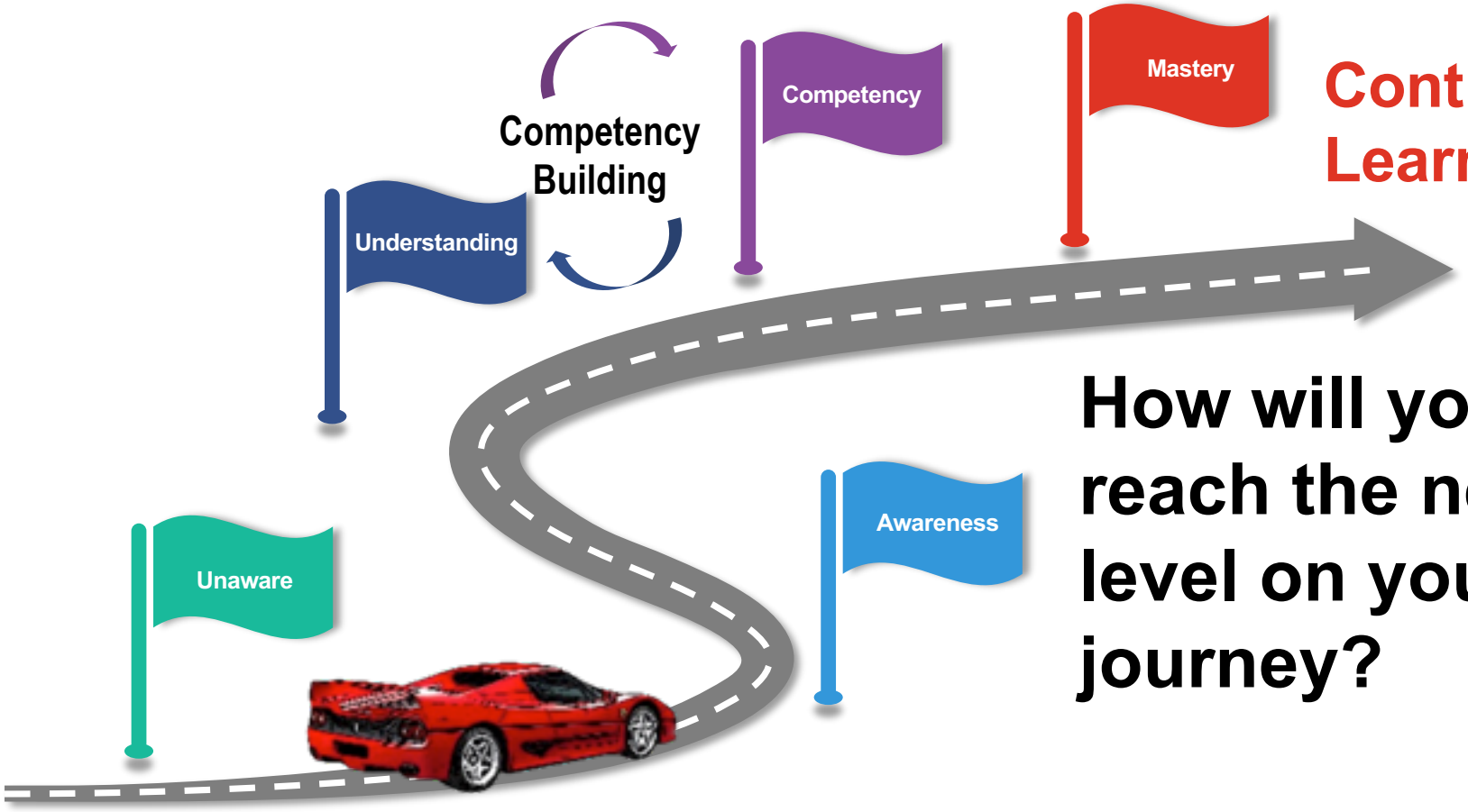
Lean Journey to Mastery



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Discussion Question

Implementing Lean Design & Lean Construction

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

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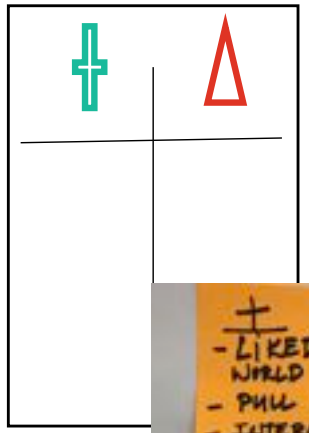
Conduct Plus/Delta

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…"



Questions?

LCI Certification

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

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LCI Website Information

www.LeanConstruction.org

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Last Planner System Trademark

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- Last Planner System®
- LPS®
- Last Planner®
  - In reference to the person not the system

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Immersive Education Program

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