LEAN CONSTRUCTION
CERTIFICATE OF MANAGEMENT

AGC's Lean Construction Education Program, Second Edition

Objectives of the Lean Construction Education Program

The purpose of this program is to develop the participant's level of awareness and understanding of Lean and Lean Construction practices and prepare you to take the CM-Lean credential exam.

The focus will be to reach understanding for construction phase practices and awareness for the other phases of project delivery.

When we are done, in addition to being ready to take the credentialing exam, participants will have a foundation in Lean principles to start learning by doing Lean Construction practices relevant to the construction phase of a project. Some of these practices include: the Last Planner System, the PDCA cycle, problem solving, waste removal, 5S, facilitation, planning for flow efficiency, and engaging people.

Unit 1: Introduction to Lean Construction (6 hours)

Lesson 1 – Why Lean?

The first two lessons answer the questions **Why Lean?** and **What is Lean?** Then it introduces participants to the six tenets of Lean Construction and explains how Respect for People is a fundamental goal of Lean as we work to develop people and make work an enriching experience.

Objectives

- Describe the current state of the construction delivery
- Describe the business case for Lean Construction
- Describe personal goals for attending this course

Lesson 2 – What is Lean & Respect for People

Objectives

- Define Lean Construction
- Describe the six tenets of Lean Construction
- Recognize Lean and Lean Construction history
- Explain respect for people as an end and means
- Recognize examples of respect for people

Lesson 3 – Generate Value, Remove Waste, & Optimize the Whole

Explains the way value is defined by the customer, and that each customer will define value differently. Instructors illustrate that non-value-adding activities are pure waste. Lean uses the principle of prioritizing flow efficiency as a key means to generate value and remove waste.

Objectives

- Define value & waste
- Distinguish between Value Added, EN Value Added, Non-Value-Added activities
- Describe how value is determined & generated

- Give examples of the 8 wastes
- Describe methods for waste identification and removal
- Describe identification and generation of value
- Recognize examples of the benefits of waste reduction
- Explain what it means to optimize the whole

Lesson 4 – Continuous Improvement

Defines continuous improvement, and provides an understanding of how Plan-Do-Check-Act, PDCA, supports continuous improvement. Participants will practice PDCA in a group exercise.

Objectives

- Define continuous improvement
- Describe how PDCA supports learning and improvement
- Describe each step in the PDCA cycle
- Use rapid iterative learning with PDCA to create continuous improvement through an interactive exercise

Unit 2: Process and Production Basics (6 hours)

Lesson 1 - Process, Efficiency & Variation

Provides a description of what a process and process flow are, then describes what makes a process efficient. From there instructors define what variation, what it looks like in our work, and what causes it, so in the next lesson we can see how variation impacts a process, its flow, and its efficiency and what that means for our projects.

Objectives

- Define a process, workflow, and capacity
- Define capacity utilization & 100% utilization
- Recognize examples of flow vs resource efficiency
- Define variation
- Give examples of variation
- Describe planning and execution failures
- Describe each of the major types of inputs to work activity: Directives, Pre-Requisite Work, and Resources
- Give examples of each of the major types of inputs to work activity: Directives, Pre-Requisite Work, and Resources

Lesson 2 - Law of Variation

Explains how variation, buffers, and consistency affect project performance, and identify the characteristics and consequences of unreliable workflow and reliable workflow. Participants will learn these lessons firsthand in the Parade of Trades simulation.

Objectives

- Explain how variation, buffers, and consistency affect project performance

- Identify the characteristics of unreliable workflow and reliable workflow
- Describe the consequences of unreliable workflow vs reliable workflow

Lesson 3 - Variation Mitigation

Describes buffers, buffer sizing and other means to mitigate variation. Participants learn specific techniques for reducing variation, and the importance of process consistency.

Objectives

- Identify the three types of buffers
- Give examples of the three types of buffers
- Explain how buffers enable smooth workflow
- Explain why buffers should be minimized
- Explain how to size buffers
- Give examples of each step of the Lower the River metaphor
- Define the importance of process consistency
- Explain how variation, buffers, and consistency affect project performance

Lesson 4 - 5S

Shows how 5S is another Lean method to help reduce variation on projects, and it does much more. It is a means for pursuing continuous improvement. It helps us reduce waste. It shows respect for people by improving their work environment and contributing to a safer workplace.

Objectives

- Define 5s
- Recognize examples of Sort, Straighten (Set in Order), Shine, Standardize, Sustain
- Describe 5S helps to improve flow, reduce waste, continuously improve, and shows respect for people

Unit 3: Production Systems (6 hours)

Lesson 1 - Lean Production Systems

The overall lesson objective is to introduce key terms and recognize aspects of common practice to create a Lean production system for construction that prioritizes flow efficiency.

Objectives

- Define Throughput, WIP, Cycle Time, & Takt Time
- Describe push in a production system
- Give examples of push in construction
- Explain the advantages, risks, and wastes associated with push
- List the principles for increasing flow efficiency in a Lean production system

Lesson 2 - Batch-Pull-Balance-Takt Simulation

Participants experience the effects of batching, pull, balancing and takt on a production system by completing the Batch, Pull, Balance, Takt Exercise.

Objectives

- Explain the effects of reducing batch size on production systems
- Explain the effects of pull control on production systems
- Explain the effects of balancing on production systems
- Describe Takt control of production systems
- Explain the effects of Takt control on production systems

Lesson 3 - Lean Production Systems – Pull

The focus is on Pull as part of the control for the system. Participants learn how pull helps manage variation and explain the impact of pull control on production systems.

Objectives

- Define pull as a method of control
- Describe how pull helps manage variation
- Explain the impact of pull control on production systems
- Describe the risks and advantages of pull strategies
- Recognize examples of pull strategies
- Describe ‘customer' beyond the commercial agreement

Lesson 4 - Lean Production Systems - Law of Bottlenecks & Balance, Little’s Law & Batching

The overall objective for this lesson is for participants to recognize the impact of batching on construction production and flow efficiency by looking at Little's Law and the risks and advantages of batching.

Objectives

- Describe bottlenecks
- Recognize balance in a production system
- Explain the advantages and risks associated with balancing work to the bottleneck
- Define Batching
- Compare the risks and advantages of large and small batches

Unit 4: Lean Thinking Applied to Field Production, Last Planner System (12 hours)

Lesson 1 - Introduction to Last Planner System® (LPS)

Describes how the LPS is a method of planning and control for the entire project. LPS is a common starting point for companies or projects embarking on a Lean journey. This lesson introduces LPS in terms of how it embodies the six tenets both in its design and goals in the context of field production.

Objectives

- Recognize common construction planning practices and their pitfalls
- Describe the Last Planner System® and its purpose
- Differentiate common construction planning practices from The Last Planner System®
- Explain who is the Last Planner

- Describe the dynamic shift between the CM/GC and other project participants to maximize the use of LPS
- Recognize best practices for Lean production planning
- Contrast reactive with proactive planning
- Recognize examples and advantages of using visuals in planning
- Contrast Lean work structuring and work breakdown structure

Lesson 2 - Details of the Last Planner System

Describes the ideal for running the full LPS. Participants will learn the different tools, visuals, and formats that are used, but their goal of each conversation is the same.

This lesson shows the steps of the Last Planner System and how it gets more detailed the closer teams get to the work. As the lesson progresses participants see the purpose of each level of the LPS, and how the levels of the LPS work together. Participants will identify methods to encourage trade partner participation in each level of the LPS, and measure to see if processes are being followed and achieving the desired results.

Objectives

- Define a project milestone
- Identify what makes a good milestone
- Describe the purpose of each level of the LPS
- Describe how the levels of the LPS work together
- Explain the benefits of each level of the LPS
- Identify the process for each level of the LPS
- Recognize methods to encourage trade partner participation in each level of the LPS
- Describe metrics for LPS
- Explain how to use LPS metric
- Calculate Percent Plan Complete (PPC)
- Use Pareto Analysis with Reasons of Variance
- Describe the shift in dynamic between trade partners and the Construction Manager
- Understand ways to begin using LPS

Unit 5: Lean Thinking Outside of Field Production (6 hours)

Lesson 1 - Lean Project Delivery

Describes how Lean is applied to the whole project delivery system. It explains the purpose and recognizes the advantages of cross-functional teams, and why value should be defined early in the project life cycle.

Objectives

- Describe how Lean is applied to the whole project delivery system
- Explain the purpose and recognize the advantages of cross-functional teams
- Explain why value should be defined early in the project life cycle
- Describe how to improve value
- Recognize key concepts of work structuring in a Lean project delivery system
- Outline the process of project definition
- Describe the purpose of the integrated form of agreement

Lesson 2 - Lean in the Supply Chain

Looks at improvements that can be made exclusively within the supply chain with an understanding of customer value but without involving changes by design or construction.

Objectives

- Define the supply chain
- Describe the goals of integrating Lean supply and assembly
- Give examples of integrating Lean supply and assembly
- Explain why you would use Value Stream Mapping of the supply chain
- Give examples of applying Lean to the supply chain at the company and industry level
- Describe prefabrication and modularization
- Explain why we need data and metrics for supply chain activities with examples
- Give examples of applying Lean to the supply chain in field execution
- Give examples of methods, attributes and objectives of Lean in the supply chain
- Differentiate the approaches to improvement between conventional and Lean supply chain management
- Describe and give examples of the ways Lean thinking is applied to the supply chain

Lesson 3 - Lean in Design

Describes how value creation in design focuses on identifying and meeting customer needs through efficient and effective design processes.

Objectives

- Recognize wastes in the design process
- Explain how Lean is applied in the design phase
- Describe Lean design methods

Lesson 4 - Process Improvement & Problem Solving

Explains how effective problem solving is focused on proactively preventing the same type of problem from occurring again because it addresses root causes. It creates a culture of problem solving where everyone brings problems forward and collaboratively works to resolve them.

Objectives

- Define a variety of A3 problem-solving tools
- Describe the steps of an A3 problem solving report
- Define the A3 problem solving process