CHAPTER 30

PRODUCTION SYSTEM DESIGN

Introduction

Lean/IPD project teams strive to create an environment where the construction process resembles a production environment. This is accomplished through detailed planning done by those directly responsible for doing the work. They are encouraged to have conversations about their work and specifically how they will hand it off to the next value creator. Attempts are made to identify and define standard processes and outcomes–and then improve upon those practices. Using a Plan-Do-Check-Act (PDCA) cycle is encouraged to offer flow, predictability and an environment for continuous improvement.

Lean/IPD project teams strive to create an environment where the construction process resembles a production environment.

As they begin to implement the Last Planner® System on their projects, project teams often struggle with how to use the system within the context of their existing and conventionally constructed project schedules. Those schedules are generally overly detailed, make large assumptions, and often prematurely attempt to predict the future in great detail. Additionally, it is generally assumed that scheduled activities will happen as expected months or often years after those schedules are first created.

Production System Design is fundamental to creating Milestone and Phase Plans that are better aligned with the principles of Lean/IPD. Creating Milestone and Phase Plans helps the team achieve project flow—and is a step that is often missed when teams begin to implement the Last Planner System® for Production Control.

Production System Design is the "Plan" part of the PDCA process. It is an iterative analytical process that recognizes the dynamic nature of project plans. It is done collaboratively with the key performers who are directly responsible for the various phases of the project. It should be created for the specific project.

1.0 Why

- It identifies the main phases of work, areas of standard activities within each of the phases, and areas of potential variation.
- It enlists input from the people directly involved in the work to identify critical handoffs and interface points between the phases.
- It provides the framework for implementing strategies to reduce variation.
- It identifies the main phases of work and lead times to start Phase Planning to achieve flow.
- It sets the pace for the work to identify what should be done week after week to maintain flow. It provides the starting point for Make Ready Planning to improve reliability.

Production System Design is the "Plan" part of the PDCA process.

2.0 When

- Teams begin this process at the start of the project to build a conceptual framework for the production system. Teams identify the main project phases,

then revisit and refine those phases as the work evolves to reflect the team's best understanding of the remaining work and the capabilities of the performers.

- Production System Design should be done at the project level to define the overall supply chain, the main project phases, long lead time items, and location breakdown structure. It should be done at the Phase Level to define standard activities and their preferred sequence within each of the phases.
- Teams should identify potential bottleneck trades before finalizing buy-out decisions.

3.0 How

Teams should:

- Collaborate with the people directly responsible for the work. Use PDCA approach to continually improve the details of the production system.
- Begin by identifying the main phases of work at the project level. A phase defines a group of activities of the same nature that releases a group of activities of another nature. For example plumbing and electrical are not phases, but rough-in and finishes are.
- Clearly identify the interface points between the phases of work and the requirements of the elements of the systems in each phase. For example, it is important to consider which areas in the building are served by a particular air handler in order to finalize the sequence of work within the floors in the building and align it with functional testing (this is key for proper location breakdown structure design).
- Identify which phases are unique and which phases can be defined by standard activities. Identify the interface points between unique and non-unique phases.
- Enlist input from the key performers of each phase to identify the standard activities and identify the areas in the project where the standard activities will occur. Use visual tools to illustrate the results (diagrams and flow maps).
- Review the standard activities with the key performers and inspectors and identify opportunities for built-in quality.
- Identify the areas of the project when unique phases occur and identify the interfaces to phases of standard activities.

- Identify the strategies that will be used to set the pace of the work and achieve flow. For example, the team may choose to fix the durations of standard activities and vary the crew sizes to maintain flow (this is known as Takt Time Strategy). Or the team may fix the locations and allow the durations to vary based on the production rates of the crews and the quantity of the work (this is known as the Location Based Management System strategy). Or the team may use a combination of the two strategies. The goal is to achieve flow and strike the right balance between flow and crew efficiency.
- Fill the details for the supply chain for each of the standard activities. Validate the results with each key performer responsible for standard activities. This includes the process to design, coordinate, detail, procure, fabricate, and deliver each of the systems defined by the standard activities in each batch. Adjust your Production System Design accordingly.
- Use this to begin the process of Make Ready Planning (or Lookahead Planning) to identify constraints, prioritize the constraints, and to incorporate the constraints into the weekly and daily workplans.
- Follow the Last Planner System® processes of Weekly Work Planning, Daily Commitment Management (Huddles) and Frequent Lessons Learned. Use the outcomes of those processes to inform and improve the Production System Design.

References

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Lamb, Eric (2013) How to Fix a Broken Scheduling System. ENR, September 30, 2013.

Seppänen, O., Ballard, G., and Pesonen, S. (2010). "The Combination of Last Planner System and Location-Based Management System." Lean Construction Journal, 6 (1) 43-54, 2010 issue.

Kenley, R. and Seppänen, O. (2010). Location-based Management for Construction. Planning, Scheduling and Control. Spon Press. London and New York..

Seppänen, O., Evinger, J. & Mouflard, C. (2014). Effects of the Location-Based Management System on Production Rates and Productivity. Construction Management and Economics, DOI: 10.1080/01446193.2013.853881

Seppänen, O. (2014). A Comparison of takt time and LBMS planning methods. Proceedings of the 22nd Annual Conference of the International Group for Lean Construction, Oslo, Norway. June 25th - June 27th, 2014.

PRODUCTION SYSTEM DESIGN

Quick Reference

For additional readings and information, please see the below information.

CHAPTER 30– PRODUCTION SYSTEM DESIGN

Additional Readings

Design of Construction Operations

Flow Driver - A System for Reducing Fabricator Lead Time

Implementing Pull Strategies in the AEC Industry

Lean Design - Process Tools -n- Techniques

Lean Project Delivery System

Lean Project Delivery System

Production System Design - Work Structuring Revisited

Commercial Terms to Support Lean Project Delivery

Discrete Event Simulation Enhanced Value Stream Mapping an Industrialized Construction Case Study

Rethinking Lookahead Planning to Optimize Construction Workflow

Three opportunities created by Lean Construction (new)