Takt Construction

Making the most of your Last Planner System® projects

Lean Construction Institute Congress — October 19, 2021

Lean Construction Institute

Provider Number H561

Introduction to Takt Planning

LCIV.ITP

Hal Macomber

Monday, October 19, 2020

4 LU Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

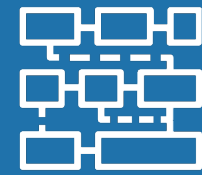
Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Course Description

Lean approaches construction as a project-based production system. Production systems can be designed based on sound operations science. This contrasts with industry's usual approach of merely scheduling activities. The Lean approach results in safer work, shorter durations and lower costs. This presentation will explain one of these approaches – Takt Planning. "Takt" is the German word for "beat." Takt planning establishes a beat for performing the work for a particular sequence of operations.

Learning Objectives



01.

Participants will learn five key distinctions for Lean Construction: Takt, flow unit, pull, resource efficiency and flow efficiency.

02.

Participants will learn four laws of operations: Little's Law, Law of Bottlenecks, the Law of Variation, and VUT equation.

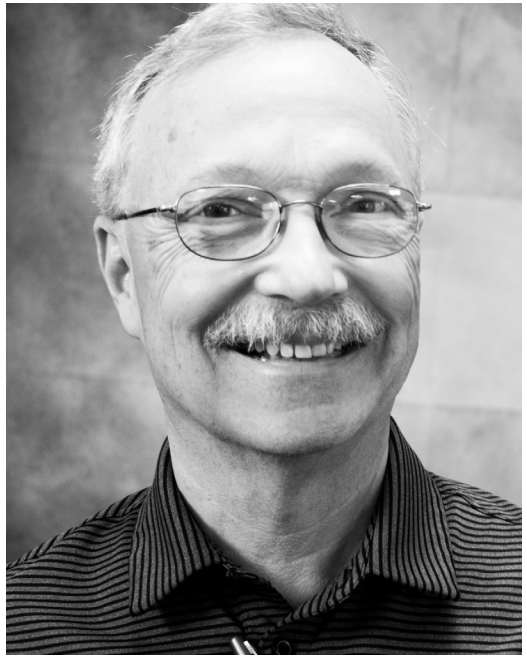
03.

Participants will learn implications operations laws have on the design of production systems.

04.

Participants will learn the opportunities and pitfalls of taking a Takt Planning approach to their projects.

welcome



Hal Macomber **George Hunt**

Project-based Production Systems

takt

A beat, rhythm or pace. Continuous pace for some aspect of operations.

flow unit

A significant element of the product the customer is buying used for structuring work to pursue continuous flow

pull

A control method for signaling work replenishment

resource efficiency

The ratio of
working time to **total time for performing an operation**

flow efficiency

The ratio of
value-added time to the **total duration** for starting and finishing the work on a flow unit

capacity buffer

Carrying extra capacity for the sake of responding to variation in productivity, available work and rework

inventory buffer

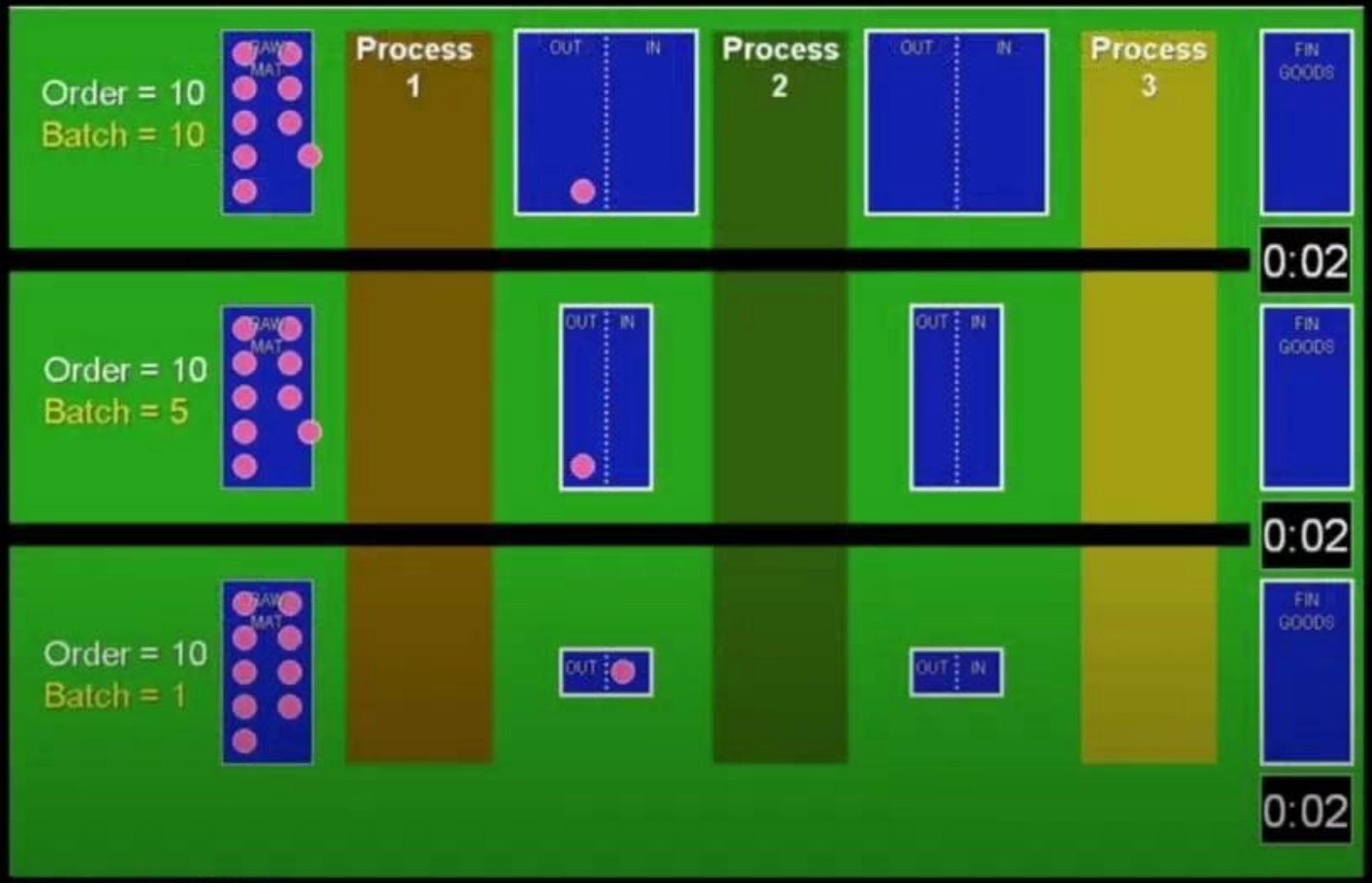
Maintaining extra material or work-in-process to accommodate variation in supply and in workloads

time buffer

Extra time in the process to synchronize the takt trains and to accommodate project externalities

Production Laws: Little's Law

the time average number of customers in a queueing system =
the rate at which customers arrive times the length of time they spend in the system. It's the theory behind the practice of batching and queuing.



Video Courtesy of BMGI

Production Laws: Law of Bottlenecks

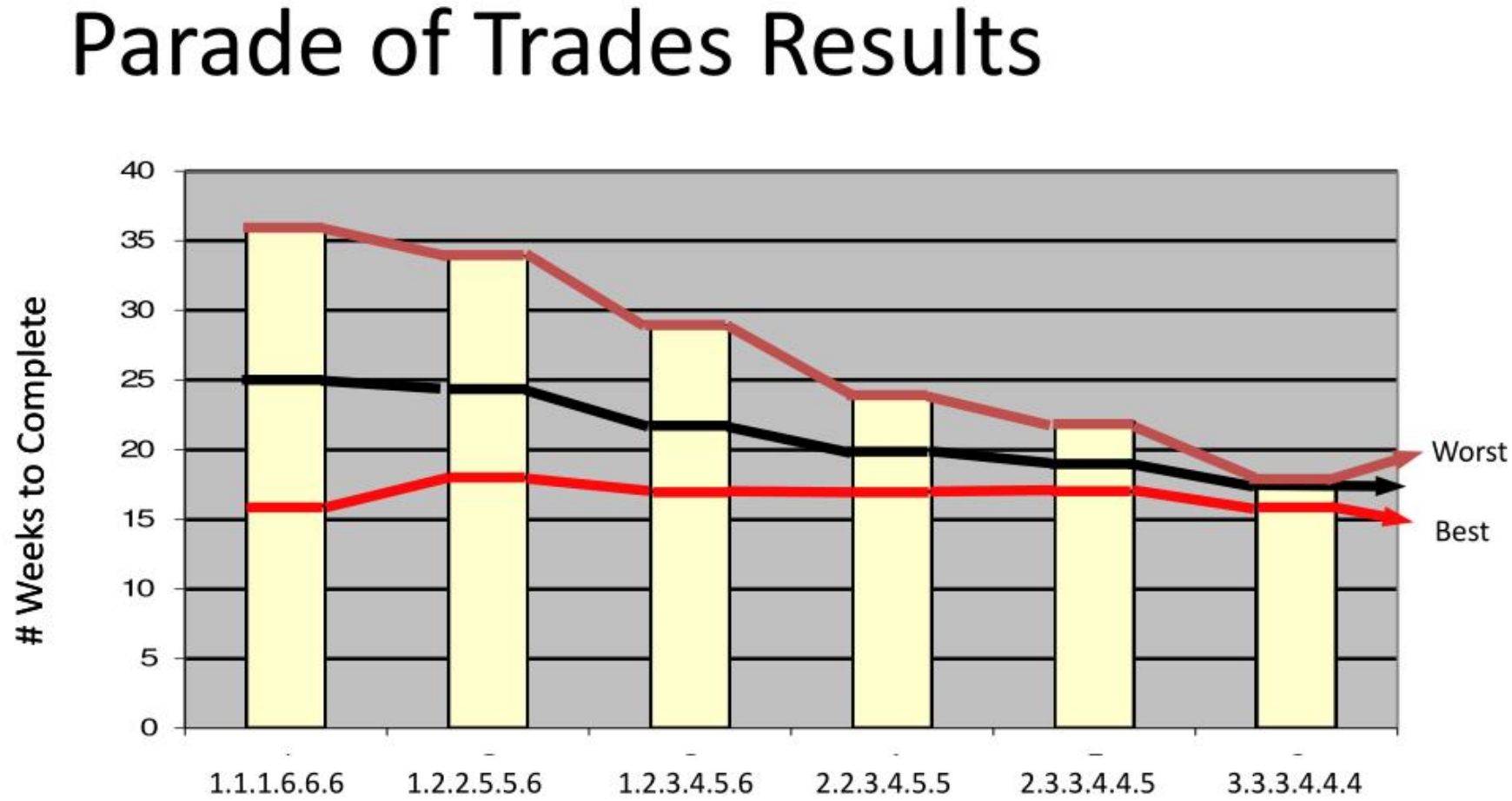
the system performance is limited by the slowest operation

Production Laws: Law of Variation

variation compounds with dependence

Reducing variation throughout the production process is the best way to improve project outcomes

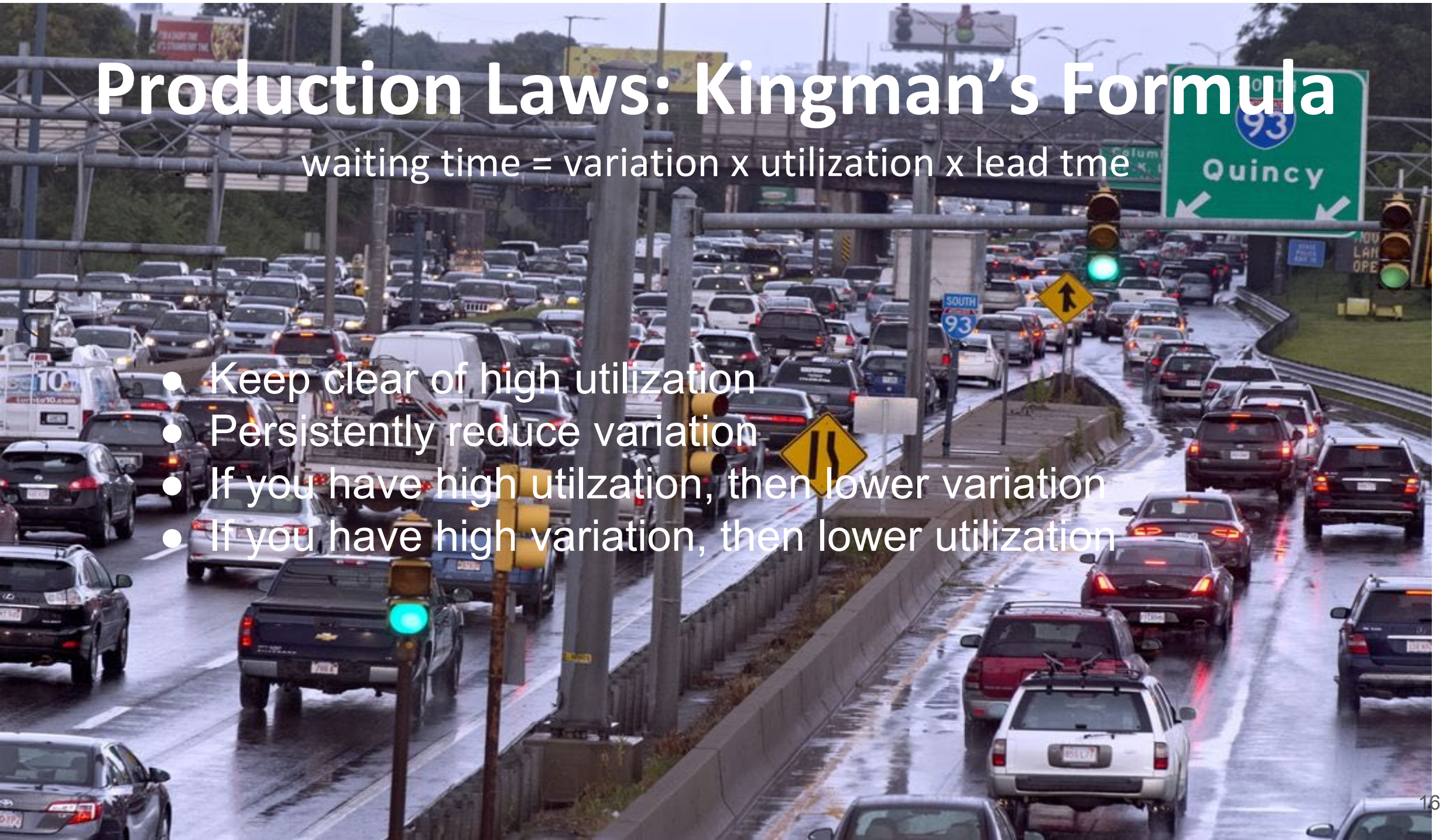
Parade of Trades



16

Production Laws: Kingman's Formula

waiting time = variation x utilization x lead tme



- Keep clear of high utilization
- Persistently reduce variation
- If you have high utilzation, then lower variation
- If you have high variation, then lower utilization

Production Laws: Pull vs Push

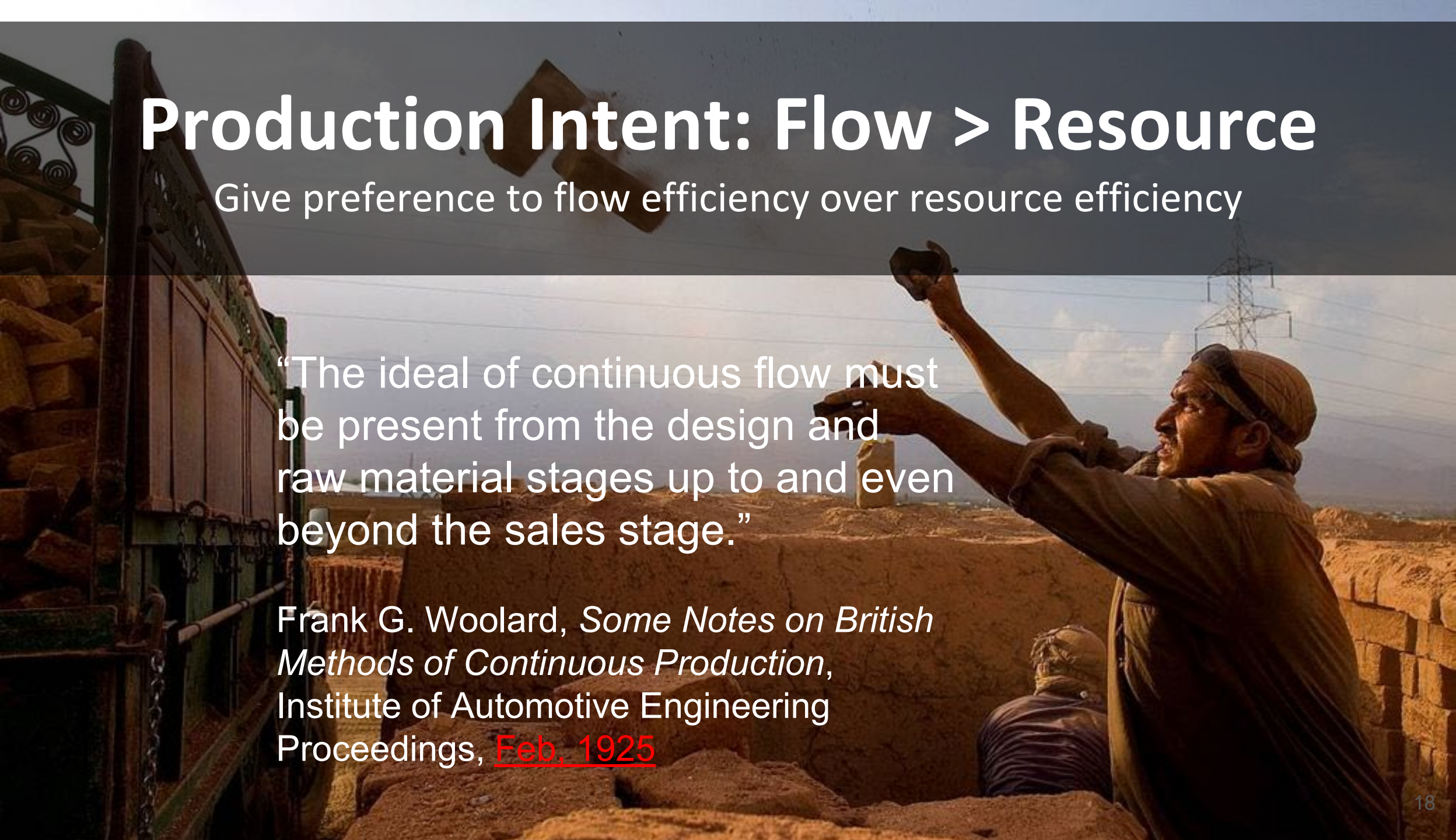
Use pull to advance work.

Flow where you can. Pull where you can’t.

~~Push where you must!~~

Production Intent: Flow > Resource

Give preference to flow efficiency over resource efficiency



"The ideal of continuous flow must be present from the design and raw material stages up to and even beyond the sales stage."

Frank G. Woolard, *Some Notes on British Methods of Continuous Production*, Institute of Automotive Engineering Proceedings, Feb, 1925

Production Laws Discussion

1. What are the implications of small batches?
2. What are the implications of managing bottlenecks?
3. What are the implications of law of variation?
4. What are the implications of high utilization?

Let's Takt

"Takt planning applies to all projects
— no exceptions —
including non-repetitive (sequential) work."

Dr. Iris Tommelein, Director of Project Production Systems Lab (P2SL), UC Berkeley, speaking at IGLC-28, July 2020

The Takt Process

Five stages that iterate

1. Collect data
2. Define zones and takt time
3. Identify trade sequences
4. Balance the plan
5. Finalize production schedule

Use bottlenecks and buffers for control

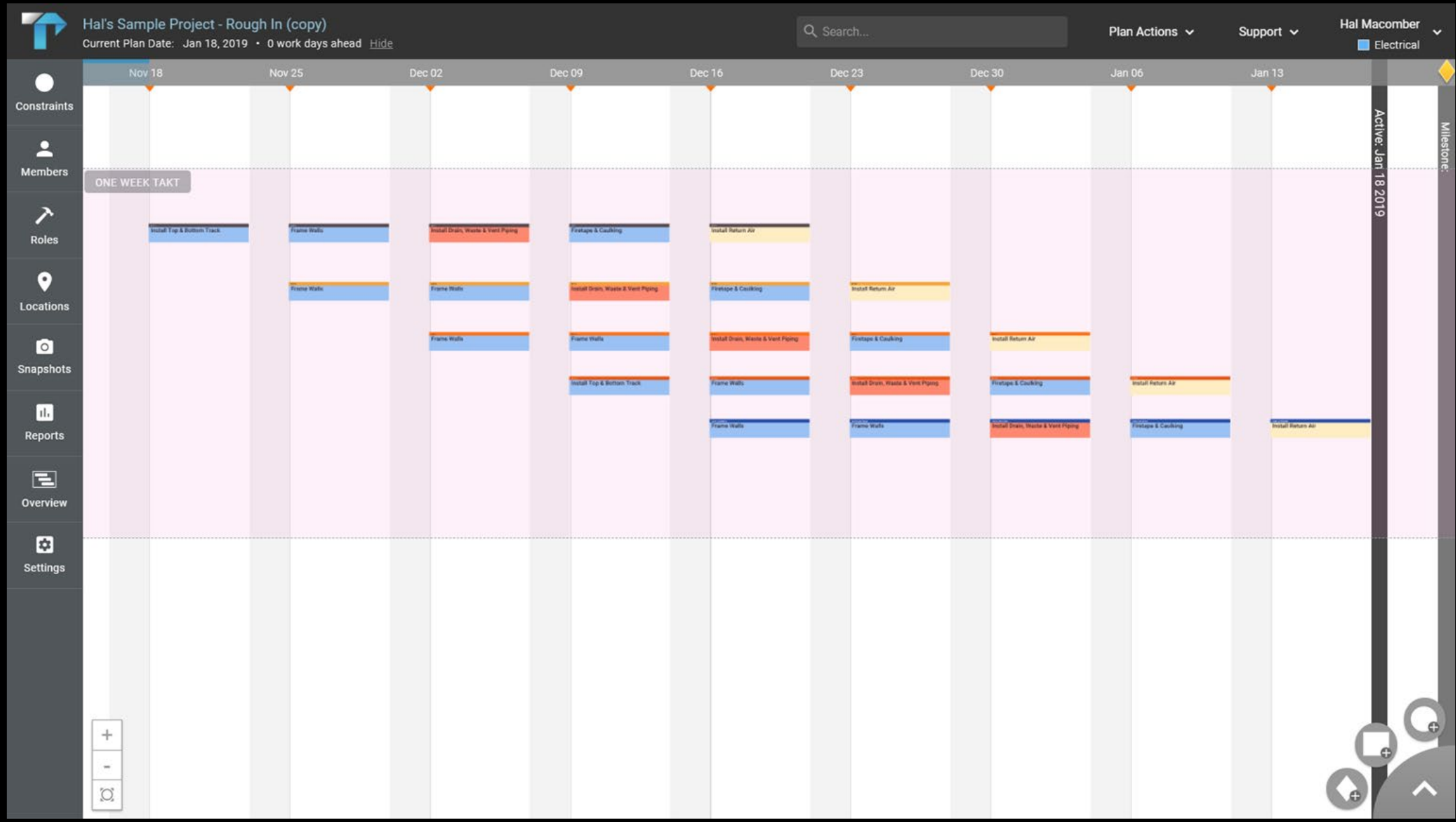
1. Limit the operations that perform at full takt (bottlenecks)
2. All time buffers are at the end of a phase plan or the project as a whole
3. Inventory buffers held as WIP - flow units
4. Assign stand-by (buffer) capacity to workable backlog

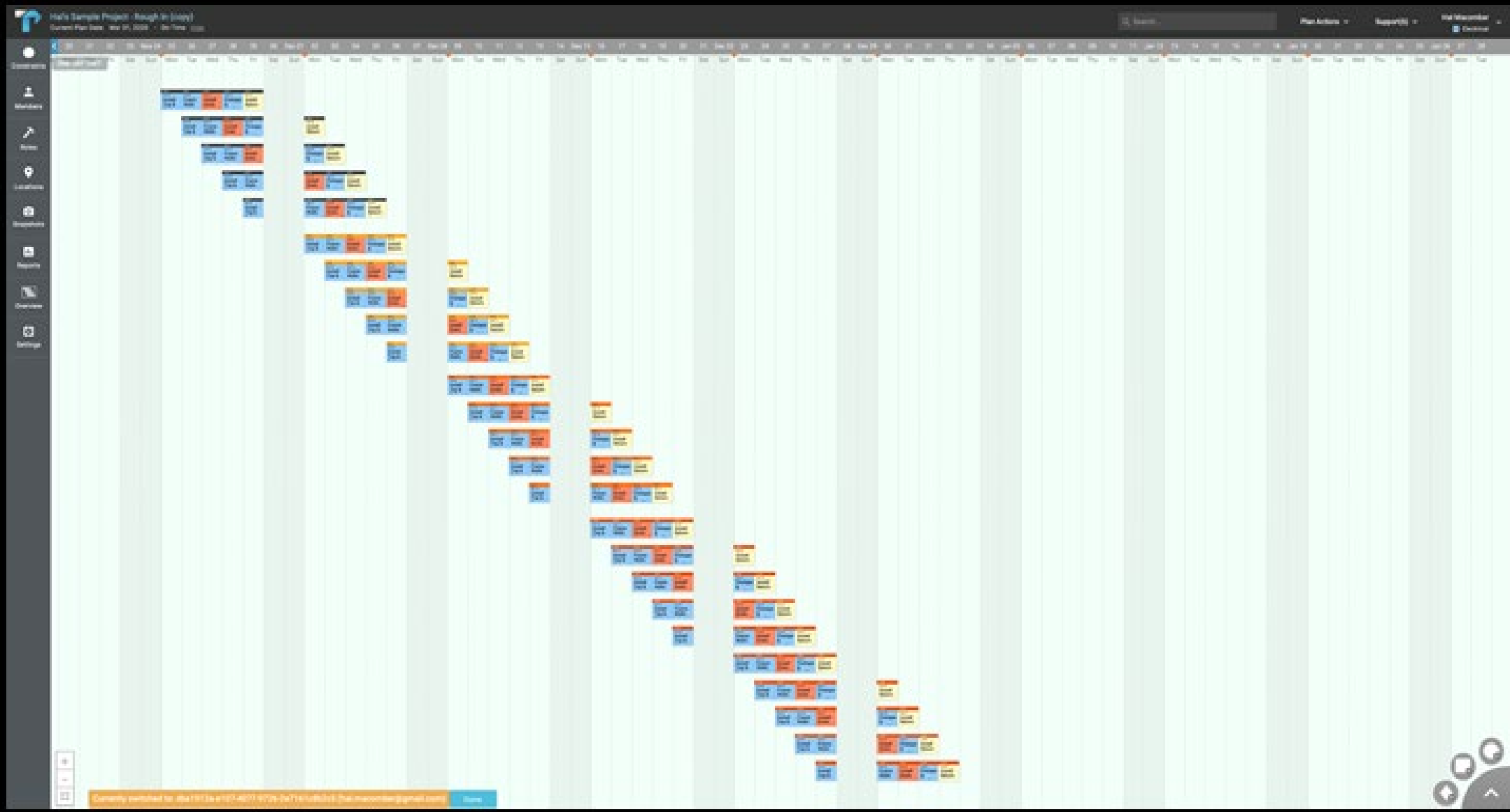
Rule of thumb: find the smallest crew that can do the most work in a day. Establish that as the batch. All other trades scale capacity to match that rate.

Implications

when designing to Production Laws

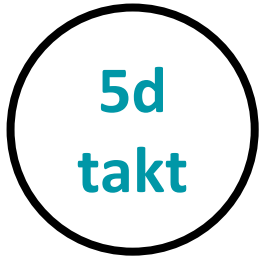
- Small batches always produce shorter projects than large batches
- Use bottlenecks to maintain pace through the process
- Pacing production through takt time planning counteracts the variation in operation times
- Size the crews to match the takt time
- Underload crews to create stand-by capacity
- Use workable backlog (inventory buffers) to maintain crew productivity
- Avoid high utilization coupled with variation
- Continuously improve the flow in the process by reducing variation





Choose Your Takt Wisely

5 floors, same 5-step process, same 5 days/trade/floor



- Ist floor finishes in **25 days**
- Project phase finishes in **45 days**

- 20% of 1st floor finishes in 5 days - whole floor finishes in 9 days
- Project phase finishes in 29 days - 53% of the time of a one week takt

Calculate Phase Plan Duration with Takt

(#train activities x takt) + ((#trains - 1) x takt)

Takt Discussion

1. How could takt help your current project?
2. How could takt help your project team?
3. What impediments do you see to adopt takt plans?
4. What drivers to you see to adopt takt plans?

MassArt Treehouse Residence, 2011

Background

- Suffolk Construction, Boston, MA
- 15 rooms/floor with 27 beds in one, two and three-room suites on 17 floors
- 10 month schedule
- Eight weeks behind when we started in July
- First Last Planner® System project for the team and the Boston office

Approach

- Full implementation of LPS practices using paper system
- Training for trade partner foremen
- Two day takt time
- About 25 operations per suite

Results

- Finished eight weeks early - picked up 16 weeks during 8 months
- Targeted use of overtime to counteract variation
- Suffolk management embraced Last Planner System

Sparrow Hospital Pediatric Nursing, 2016

Background

- Granger Construction, Lansing, MI
- 26 patient rooms, nursing core
- $3,100,000
- Six month schedule with desired finish by Christmas
- Eight week delayed start
- Active cardiac and nursing floors above and below
- Significant add'l scope mid-project
- First Last Planner® System project for the team

Approach

- Full implementation of LPS practices using Touchplan®
- Training for trade partner foremen
- One day takt time
- 20 operations per patient room

Results

- Finished six weeks early
- Added scope
- Granger staff & client enthusiastic to do more LPS projects with Touchplan

Lahey Clinic General Internal Medicine, 2018

Background

- Bond Brothers, Medford, MA
- 40,000 SqFt, 84 exam rooms + imaging + diagnostics
- $8,500,000
- Seven month schedule
- Six week delayed start
- Significant redesign mid-project
- Delays in owner provided equipment
- First Last Planner® System project for the team

Approach

- Full implementation of LPS practices using Touchplan®
- Training for trade partner foremen
- Study-Action Team using *This Is Lean*, by Modig and Ahlstrom
- One day takt time
- 16 operations per exam room

Results

- Finished five weeks early
- CM and trade partners returned over $300,000 to owner
- Bond & trade partners enthusiastic to do more LPS projects with Touchplan

Takt Time Comparisons

- Sparrow Pediatric Unit
  - 13 pairs of patient rooms
  - 20 operations each
  - Five day takt: 5 days/operation to finish half 100 days + 5 days for balance = **105 days**
  - One day takt: 20 days to finish the first pair + 12 days for balance = **32 days**

- Lahey General Internal Medicine
  - Two groups of 42 exam rooms (84 total) with dedicated crews for each group
  - 16 operations each
  - Five day takt: 5 days/operation to finish group x 16 groups = **80 days**
  - One day takt: 16 days to finish the first 7 rooms + 5 days for the balance = **21 days**

Patient rooms and exam rooms came off the critical path!

Effects of Short Takt Times

1

Primary effects (benefits) of a shorter project

- General conditions are reduced
- Exposure to safety hazards are reduced
- Construction period financing is reduced
- “First quality” improves because errors don’t propagate across the project.
- Lower project costs

2

Secondary effects (benefits) of a shorter project

- More frequent conversations with your “customer” results in learning and improving.
- Punchlists & worklists minimized (failure demand) & associated superfluous work reduced
- Trust and relationships build as performers declare complete to their “customer” on a frequent basis.
- Confidence builds as work is reliably completed.
- Significant reduction in project hassles

Begin Your Experiments with Takt

- Start with non-repetitive flow-units (seven or more hand-offs)
  - Use the five-step process collaboratively with trade partners
  - Set takt at one or two days
  - Have stand-by capacity available assigned to workable backlog
  - Conduct an end-of-day stand-up in the field for learning, adjusting and improving
  - Repeat one or two times for other flow units
- Repetitive flow-units
  - Use your refined approach
  - Put attention on reducing variation
  - Allocate more time for EOD stand-ups
  - Conduct a weekly retrospective: stop doing, start doing, continue doing

Always work from a hypothesis. It's essential for learning.

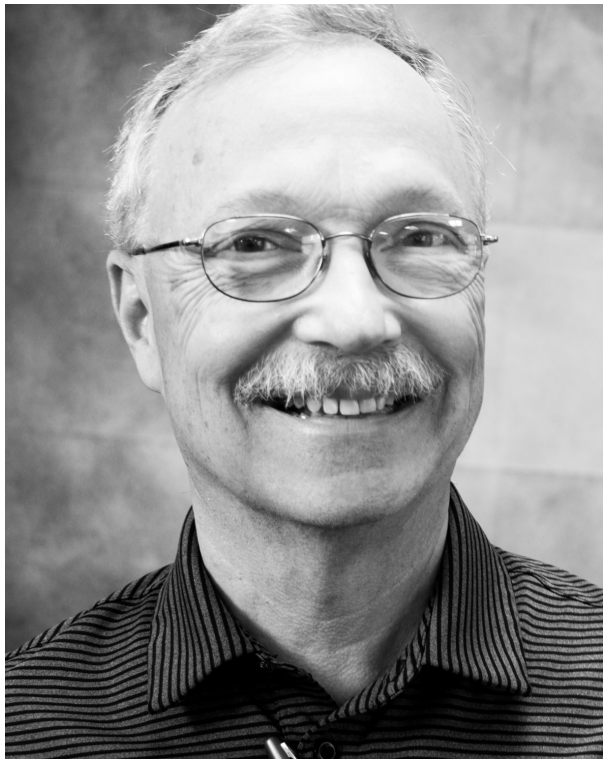
Action Discussion

1. What new possibilities do you see from the cases?
2. What support do you or your team need to start?
3. What conversation will you have? With whom?
4. What hesitancy do you have? From others?

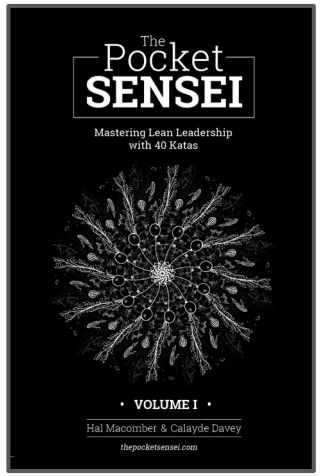
Learn More

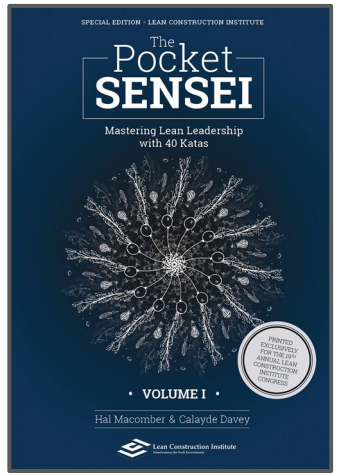
Contact us for help adopting Takt Time Planning on your Last Planner® System projects takt@touchplan.io

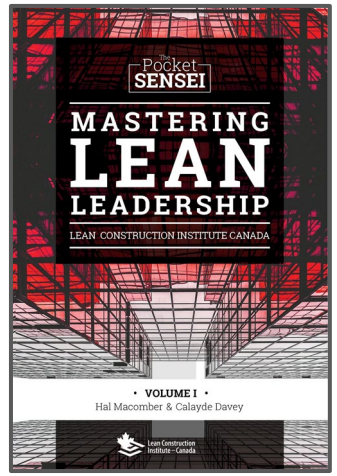
- Sparrow Pediatric Unit Takt Time Case http://info.touchplan.io/blog/granger-case-study
- Lahey Clinic GIM Takt Time Case http://info.touchplan.io/blog/bond-case-study
- Touchplan conversation with Hal Macomber and Dr. Colin Milberg on takt time planning https://www.touchplan.io/blog/takt-time-planning-and-laws-of-production-getting-the-most-out-of-lps
- Project Production Systems Laboratory (P2SL) research initiative on Takt Planning led by Dr. Iris Tommelein http://p2sl.berkeley.edu/research/initiatives/takt-planning/
- *Collaborative Takt Time Planning of Non-Repetitive Work*, Tommelein https://goo.gl/tW9cdA

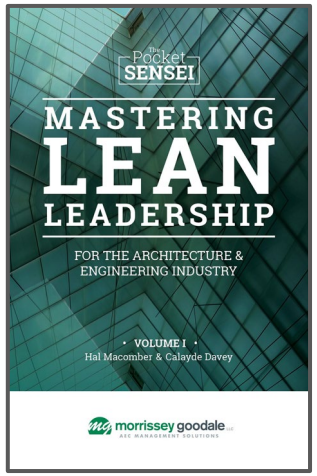


The Pocket Sensei: Mastering Lean Leadership with 40 Katas
www.thepocketsensei.com









Hal Macomber

Executive Vice President

Touchplan

hal@touchplan.io

508-566-5233

This concludes The American Institute of Architects Continuing Education Systems Course

Lean Construction Institute info@leanconstruction.org