Aalto University
School of Engineering

Operation Management in Construction Lecture #8 Integrating LBMS and Last Planner System

Olli Seppänen
Associate professor

Topics, Lecture #8

- **Learning objectives of Lecture #8**

- **Introduction to Last Planner System**
- **Integration of Last Planner System and location-based planning**

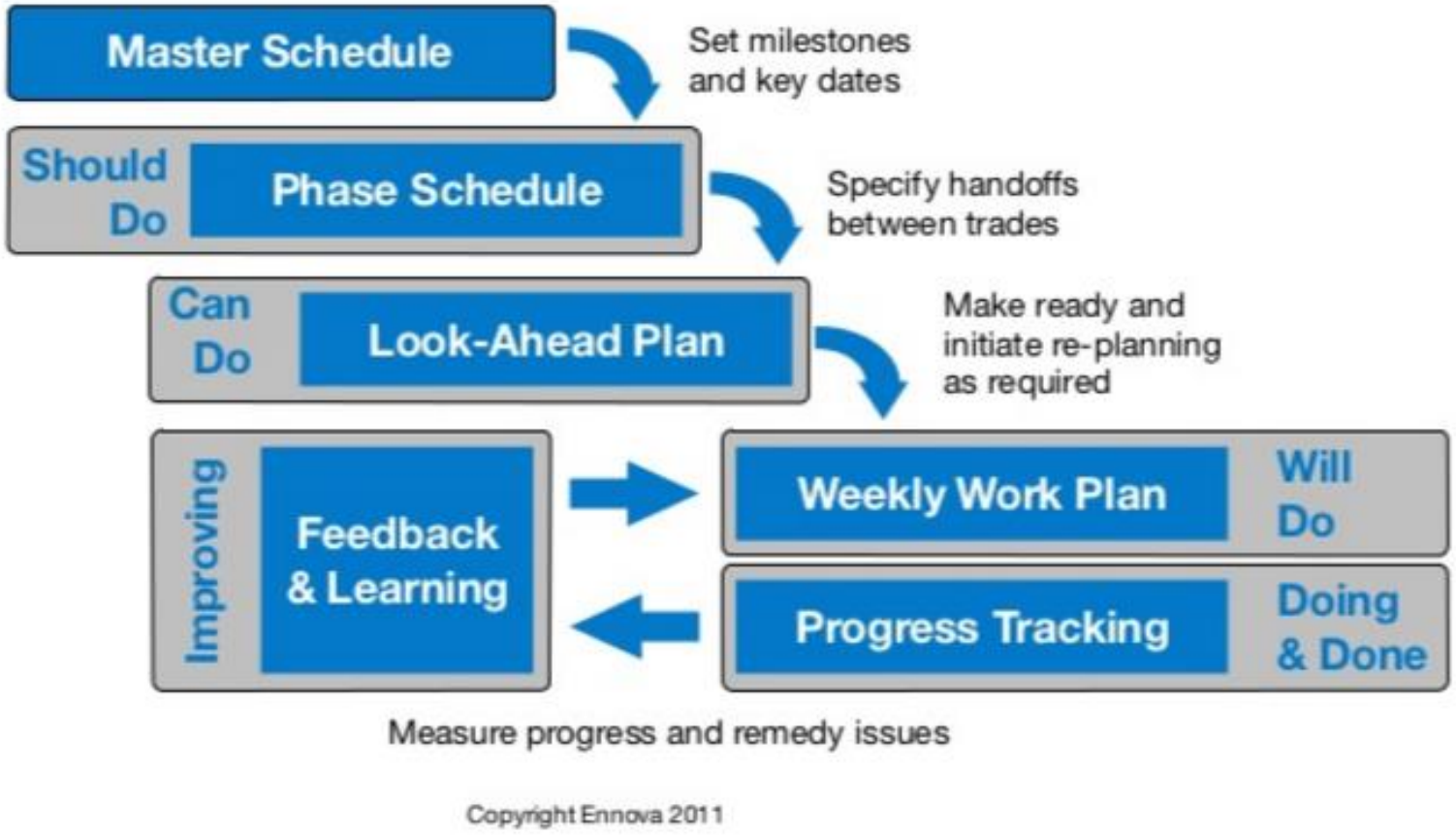
Intended learning objectives for this lecture

- ILO 5**: Students can explain** the significance of work and labor flow and how flow can be achieved in construction
  - *ILO reinforced – Lean Construction & Last Planner System*
- ILO 8**: Students can** make production control decisions based on the schedule using the Location Based Management System
  - *ILO reinforced – LBMS link to lean*

Last Planner System(R)

- **A lean production control system**
- **Developed in the 1990s and 2000s in the US (Glenn Ballard & Greg Howell)**
  - CPM context – plans were terrible so the focus is on controlling
- **Widely adopted worldwide**
- **For many, lean construction = Last Planner System**
- **But how to combine with LBMS and/or takt?**

Last Planner System



Phase scheduling

Look-ahead planning

- **Break tasks into operations**
- **Figure out constraints**
- **Proactively remove constraints**

5 Week Lookahead Plan

Project: HP Ft. Collins - Lab Relocation
Discipline: Process
Planner: Genevieve Phillips
Checked By: x
Prep. Dt: 3/13/98

Activity	Week Ending: 3/27/98 M T W T F S S	Week Ending: 4/3/98 M T W T F S S	Week Ending: 4/10/98 M T W T F S S	Week Ending: 4/17/98 M T W T F S S	OUTSTANDING NEEDS
Provide construction support (q & a)	x x x	x x x x x	x x x x x	x x x x x	Need questions from subs.
Review submittal(s)		x x			Need submittals from sub.
Aid with tool install dsgn effort.	x x x x	x x x x x	x x x x x	x x x x x	Frozen layout, pkg 1 dwgs.
Design drains from tools to tunnel tie-ins.	x x x				Frozen layout, input from tool install on installation preferences
Help layout people complete a layout that will work well with tool install routing and drains into the tunnel.	x x				Correct tool list.
Complete Pkg 2 specifications		x x x x	x		Final equipment and material usage from mech. and tool install.
Create work plans	x	x	x	x	
Send package to QA/QC reviewer for drain design review				x x	Final design dwgs for drains; plot time
Start/complete QA/QC review				x x	Set of Package 2 review docs, dwgs

Weekly planning

Weekly work plan

project
Stage
area

Week commencing
Company
Prepared by
Date prepared

ref	Task description Criteria for release of assignments: defined, sound, ordered, sized	Final MakeReady needs Work that must and can be performed prior to the release of this task	who will do work	Period to perform the task							PPC analysis		
				M	T	W	T	F	S	S	Y	N	Reasons for incomplete*

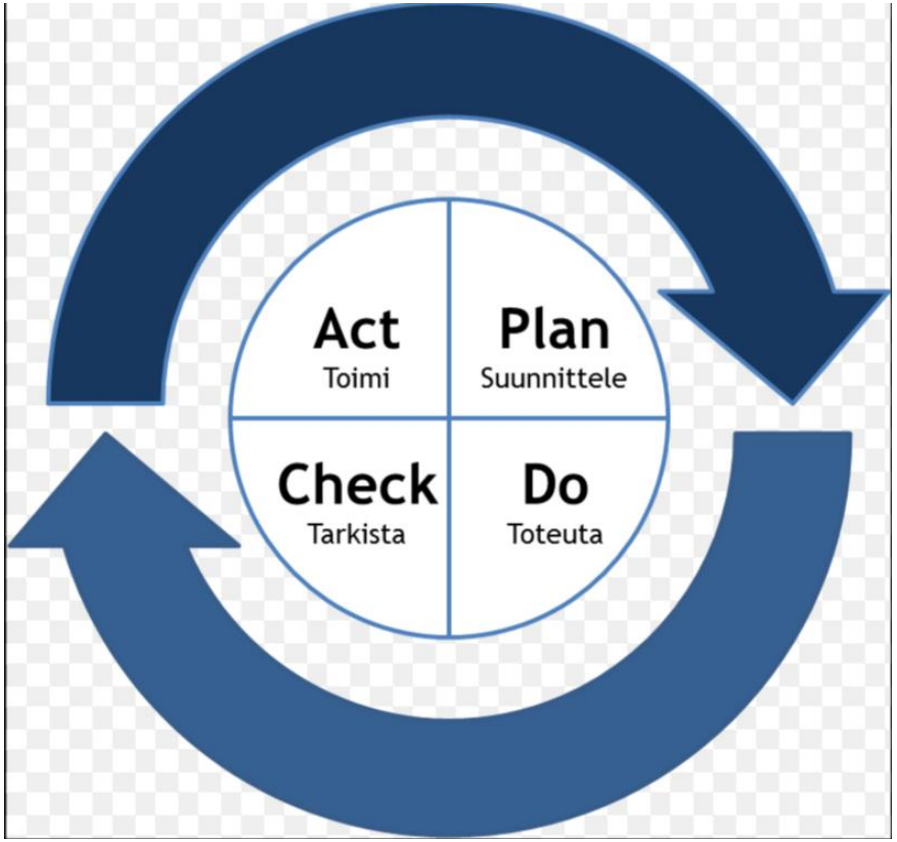
- **Commitments to assignments that CAN be done**
  - Defined
  - Sound
  - Ordered
  - Sized
- **Measuring PPC (percentage of plan completed)**

Root cause analysis – why did the tasks fail?

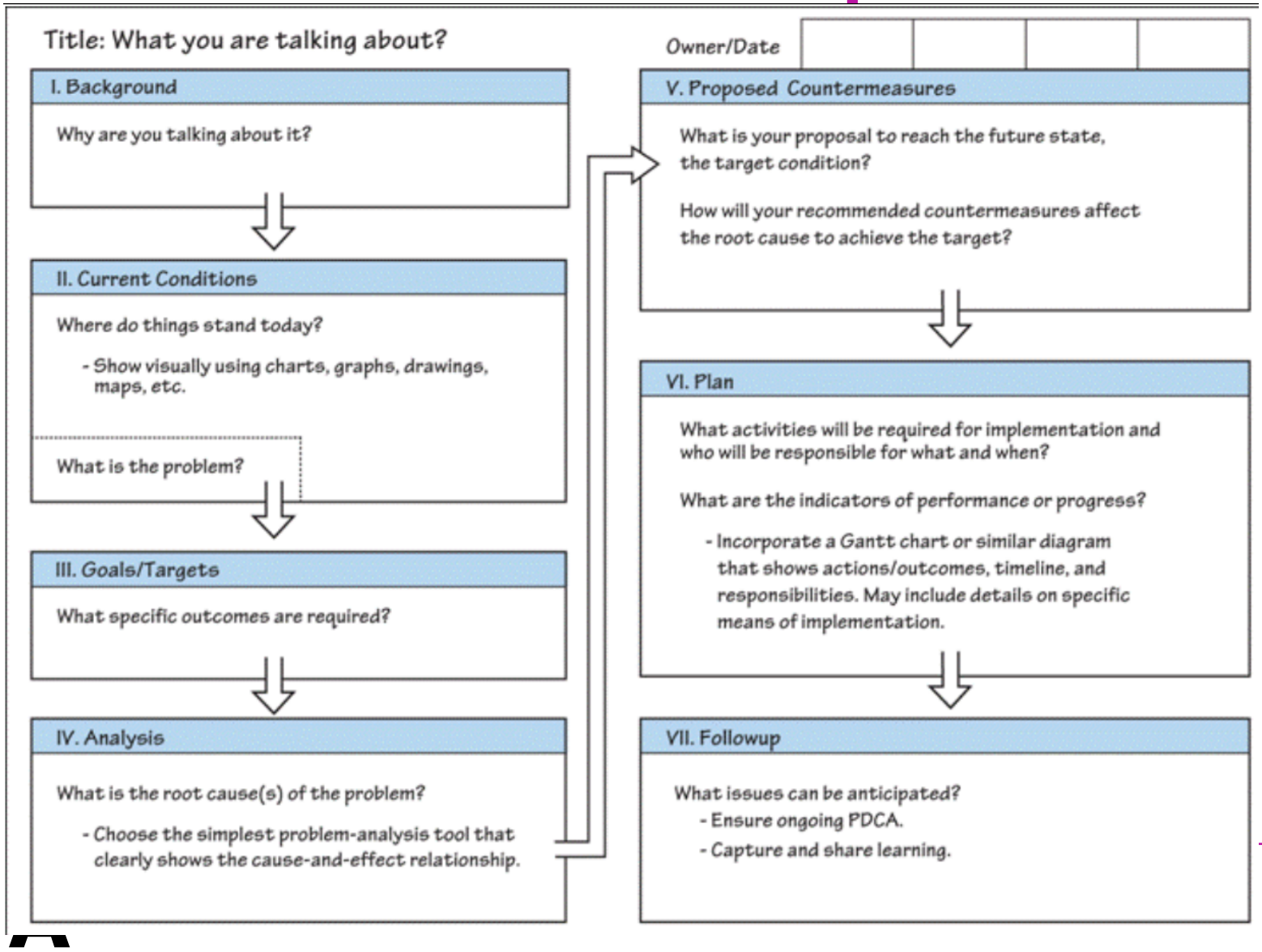
- **5-Why technique – ask 5 times why to get to the root cause**
- **Why did we not finish walls on the second floor?**
  - We did not have design
- **Why did we not have design?**
  - The designers started design from floor 5
- **Why?**
  - Floor 3-5 are repetitive and can be designed quickly
- **Why did speed impact sequence?**
  - Wall design was not scheduled by floor, sequence had not been planned
- **Why was the sequence not planned?**
  - Design meetings focus on design details, not on process

Continuous improvement

- **How to prevent the problem from re-occurring?**
- **Lean requires continuous learning**

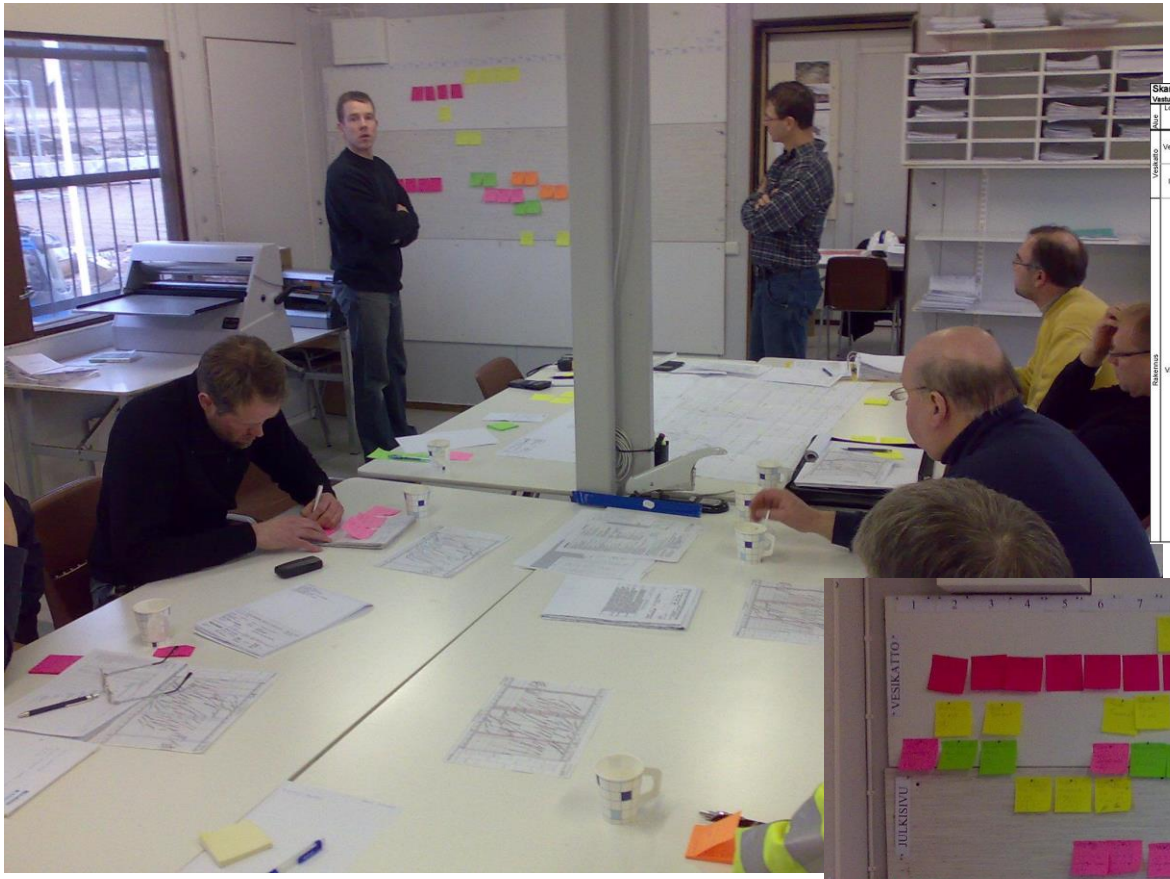


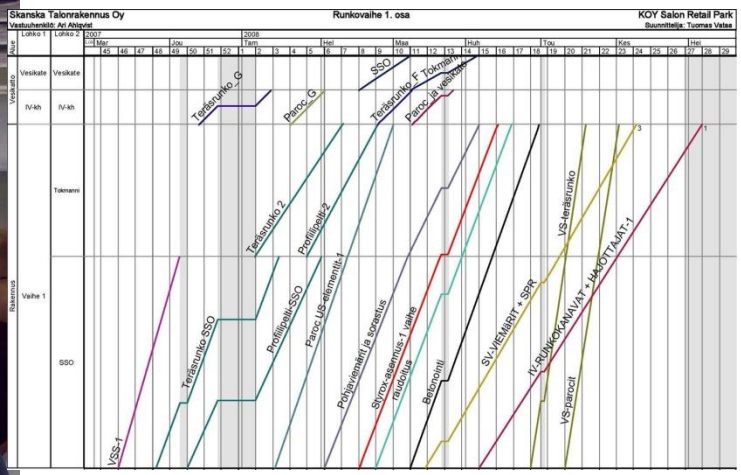
A3 documentation of improvement



End of video 1

Integration of Last Planner System and LBMS





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Seppänen, Ballard & Pesonen (2010)

Master Schedule

- **Overall production strategy**
- **Just enough detail to come up with reasonable:**
  - Milestones
  - Dates for long-lead items
  - 20-30 Flowlines
- **Focus on ”Space-critical tasks” that hand off entire locations to the next trade**
- **If subcontractors have not been selected yet, use General Contractor team’s information to develop**

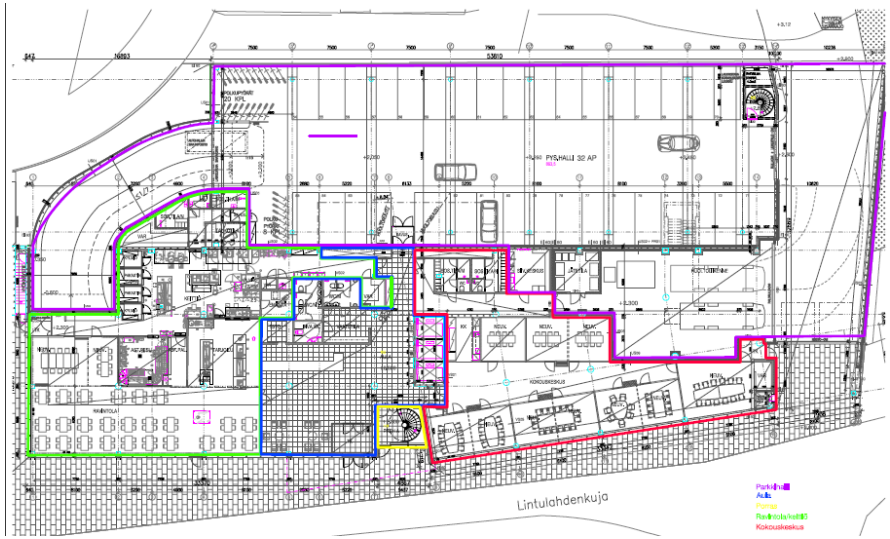
Phase Schedule

- **After subcontractors have been selected**

- **Replace master schedule data one phase at the time**
  - Just keep the end date and long lead-time items!

- **Collaborative optimization process**
  - Location Breakdown Structure (workshop 1)
  - Quantities and productivity (homework)
  - Collaborative schedule optimization (workshop 2)

Collaborative LBS definition + tasks

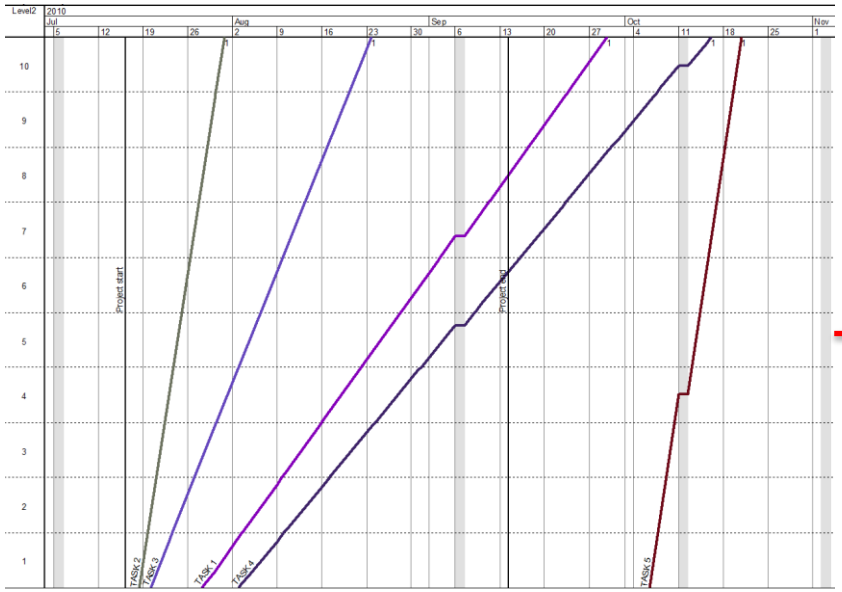


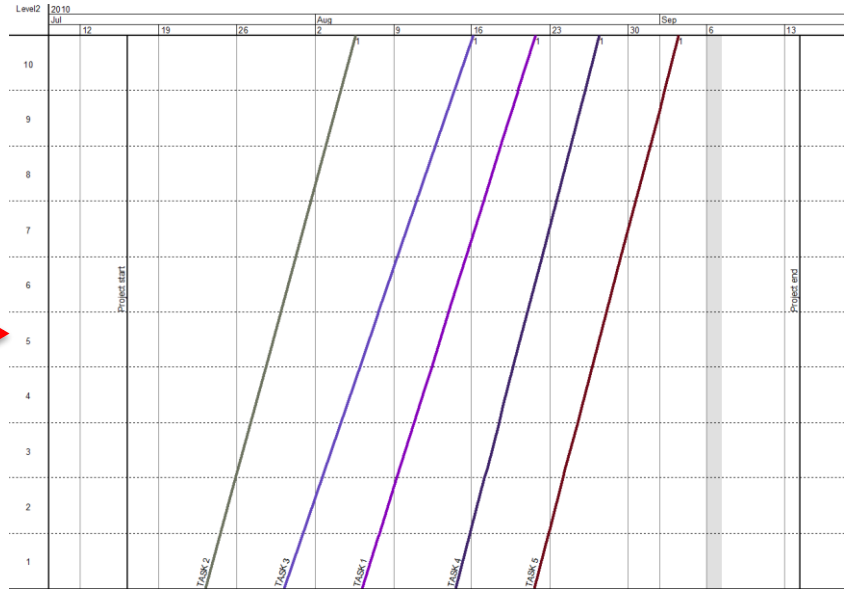
Seppänen, Ballard & Pesonen (2010)

Phase schedule homework

- **Homework assignment for subcontractors**
- **Quantities + productivity for each task (= sticky note) and location**

Phase schedule – collaborative optimization



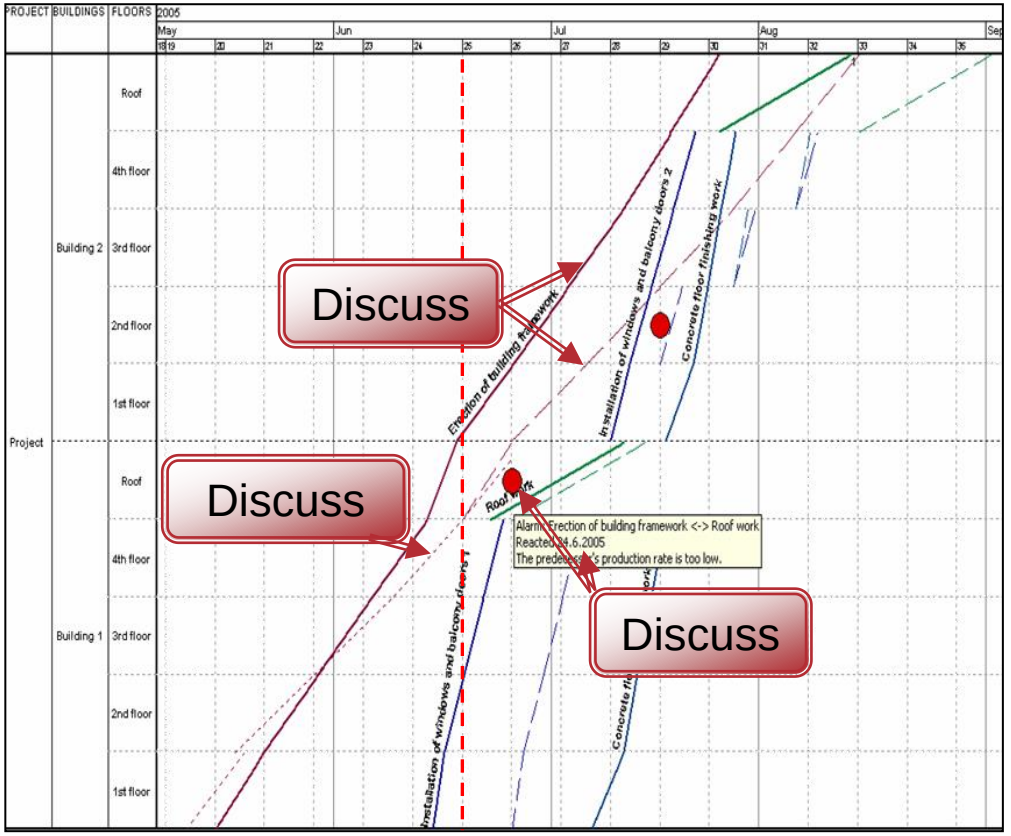


- **Start with ”optimum” crew**
- **Each optimization change requires a commitment!**

Seppänen, Ballard & Pesonen (2010)

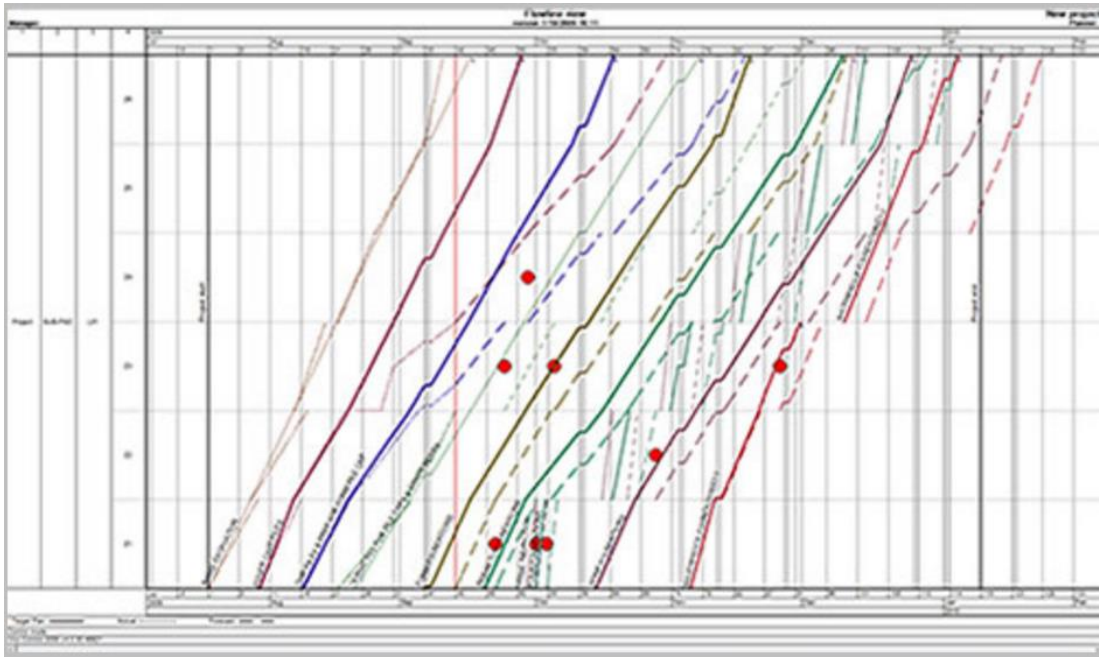
Look-ahead planning

- **LPS: identify constraints**
- **LBMS: prevent cascading delays, forecasting and alarms**
- **Both LPS and LBMS reveal problems – root cause analysis and continuous improvement**



Look-ahead schedule

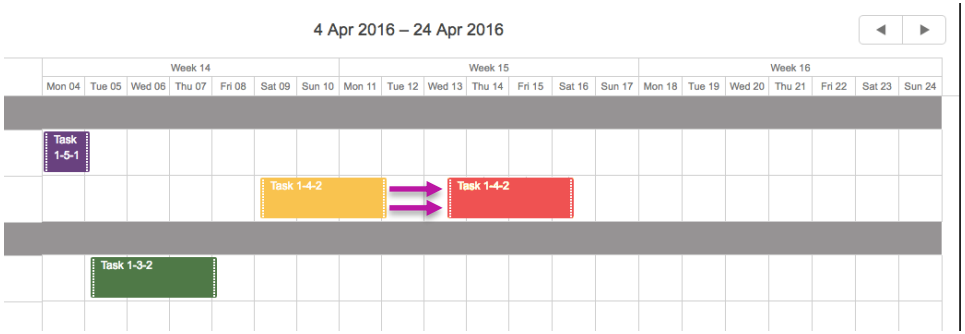
- **Control actions collaboratively with the team during look-ahead scheduling**
- **Each problem discussed and resolved**



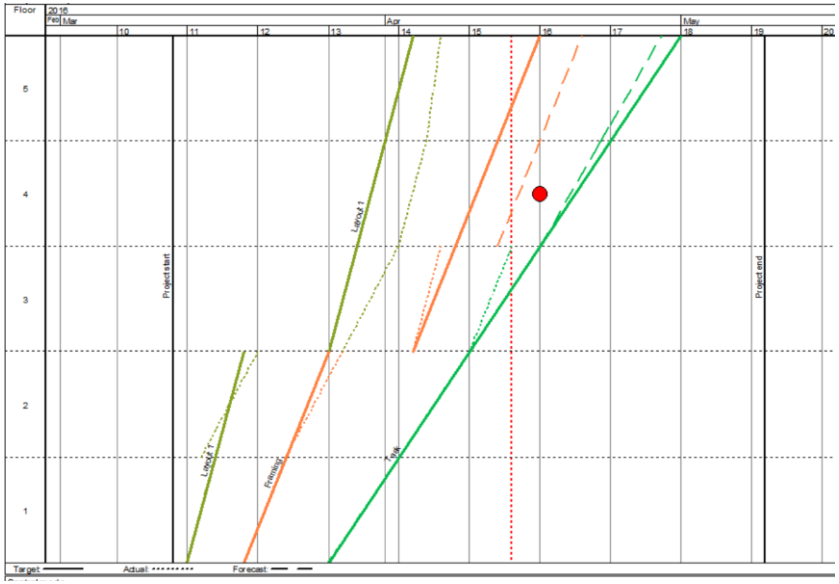
Weekly planning

- Commitments compared to forecast
- If commitment too small, problem revealed one week earlier

- Subject both upcoming and past problems to root cause analysis



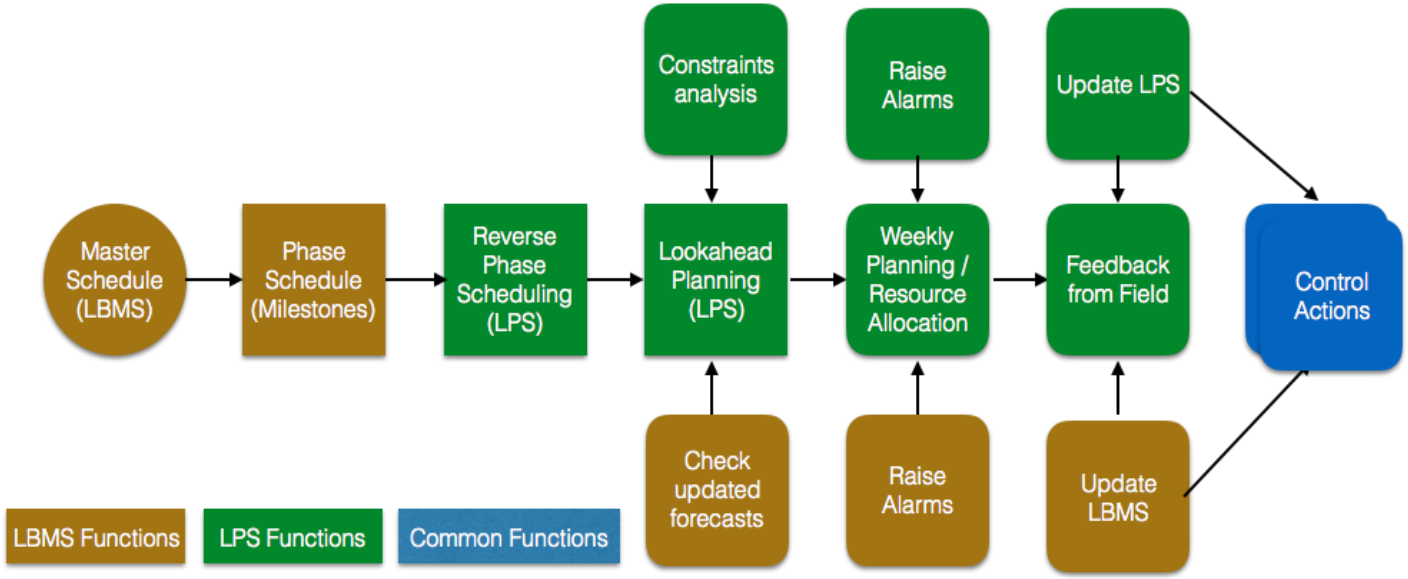
Commitments updated in LPS weekly plan



LBMS visualization based on actuals and commitments

Dave, Seppänen & Modrich (2016)

Combined process.



Dave, Seppänen & Modrich (2016)

- **More problems for root cause analysis and cont. learning**

Suggested weekly integrated process

- Identify tasks and locations in the look-ahead window
- Break down tasks and locations to operations
- Identify, assign and remove constraints
- Review actual production to identify ongoing production problems
- Review forecasts and alarms to identify future production problems
- Root cause analysis and resolution for problems
- Re-Plan to address current and upcoming problems
- Release constraint-free operations, tasks and locations to workable backlog
- Prepare for upcoming operations (First Run Studies, mock-ups etc.)

Thank you
Questions & Comments