



Aalto University
School of Engineering

Operation Management in Construction

Lecture #8 Integrating LBMS and Last Planner System

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Topics, Lecture #8

- **Learning objectives of Lecture #8**
- **Introduction to Last Planner System**
- **Integration of Last Planner System and LBMS**

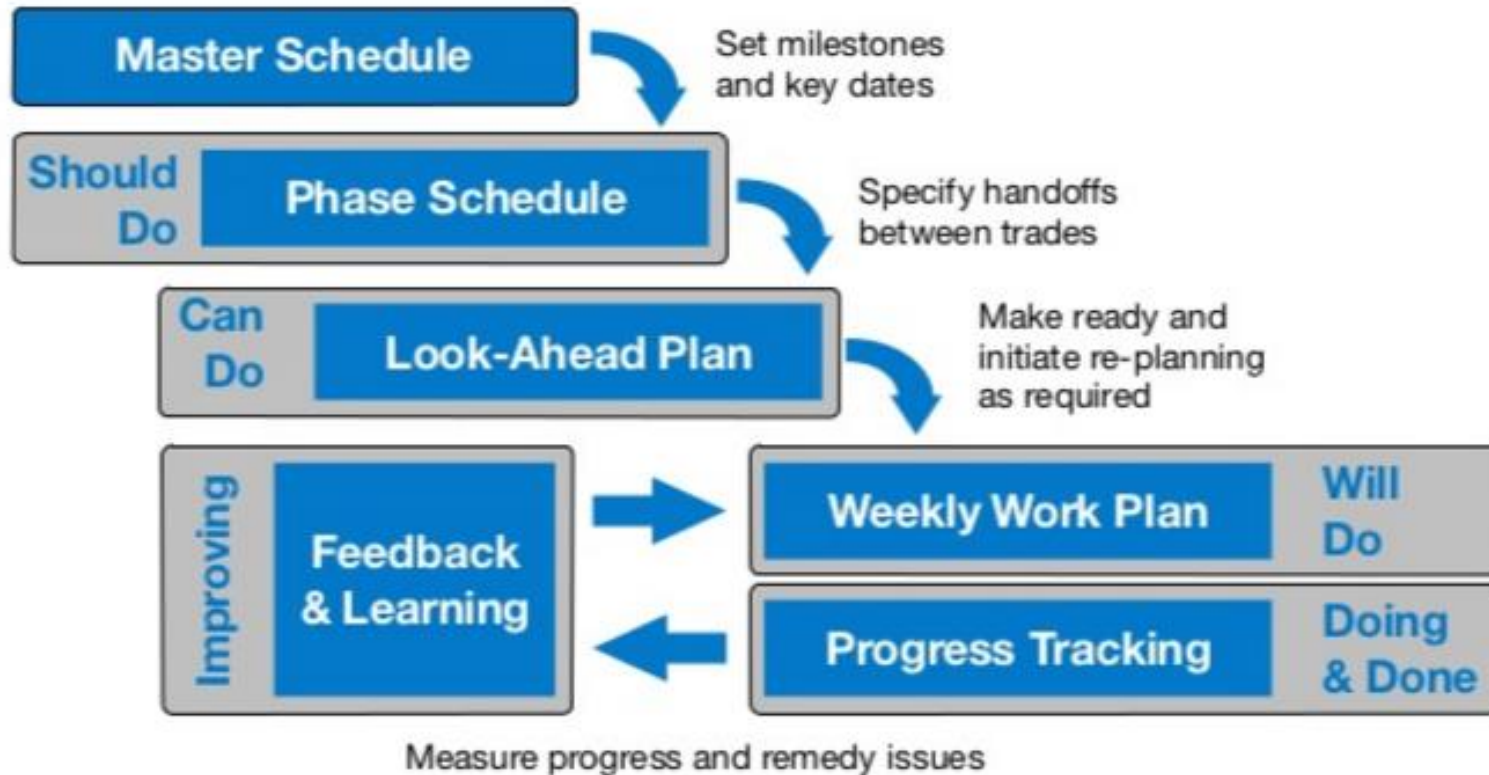
Intended learning objectives for this lecture

- **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



Copyright Ennova 2011

Phase scheduling



Look-ahead planning

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

5 Week Lookahead Plan																													
Project: HP Fl. Collins - Lab Relocation Discipline: Process Planner: Genevieve Phillips Checked By: x Prep. Dt: 3/13/98																													
Activity	Week Ending: 3/27/98					Week Ending: 4/3/98					Week Ending: 4/10/98					Week Ending: 4/17/98					OUTSTANDING NEEDS								
	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S		S	M	T	W	T	F	S	S
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			x														Final equipment and material usage from mech. and tool install
Create work plans					x					x							x							x	x	x			Final design dwgs for drains; plot time
Send package to QA/QC reviewer for drain design review																													Set of Package 2 review docs, dwgs
Start/complete QA/QC review																								x	x				

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*	

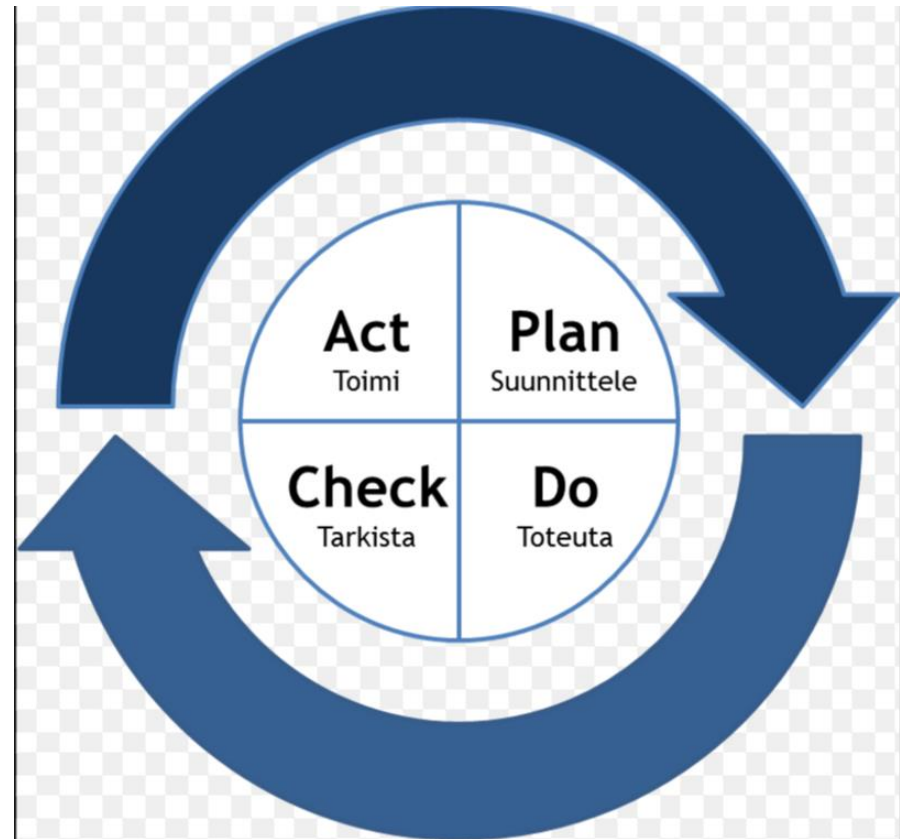
- **Commitments to assignments that CAN be done**
 - Defined
 - Sound
 - Ordered
 - Sized
- **Measuring PPC (percentage of plan completed)**

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

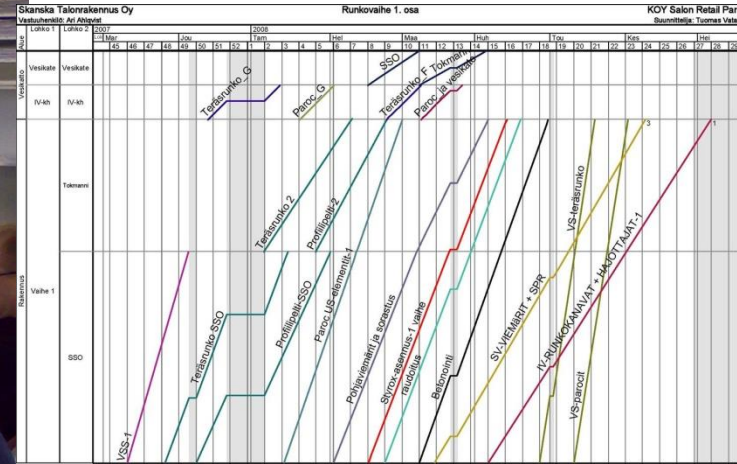


A3 documentation of improvement

Title: What you are talking about?					
I. Background Why are you talking about it? ↓	Owner/Date <table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>				
II. Current Conditions Where do things stand today? - Show visually using charts, graphs, drawings, maps, etc. What is the problem? ↓	V. Proposed Countermeasures What is your proposal to reach the future state, the target condition? How will your recommended countermeasures affect the root cause to achieve the target? ↓				
III. Goals/Targets What specific outcomes are required? ↓	VI. Plan What activities will be required for implementation and who will be responsible for what and when? What are the indicators of performance or progress? - Incorporate a Gantt chart or similar diagram that shows actions/outcomes, timeline, and responsibilities. May include details on specific means of implementation. ↓				
IV. Analysis What is the root cause(s) of the problem? - Choose the simplest problem-analysis tool that clearly shows the cause-and-effect relationship.	VII. Followup What issues can be anticipated? - Ensure ongoing PDCA. - Capture and share learning.				

End of video 1

Integration of Last Planner System and LBMS



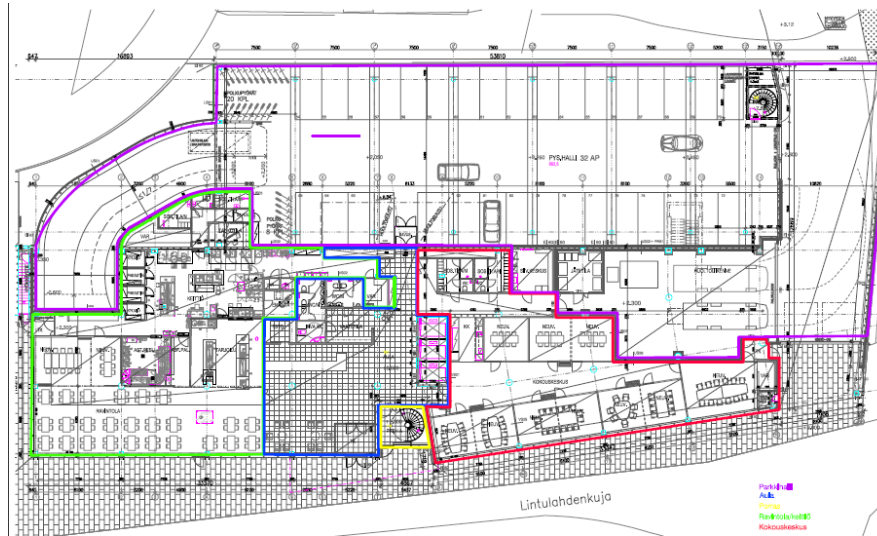
Master Schedule

- **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



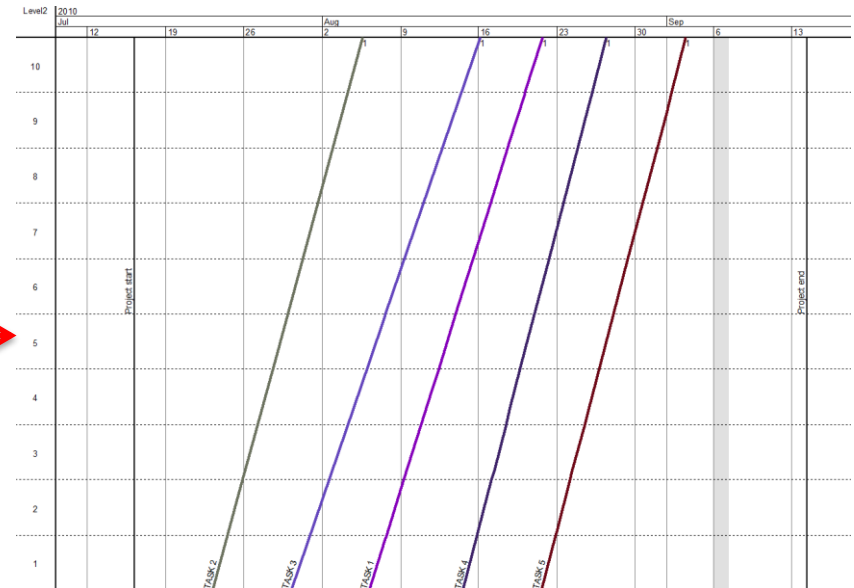
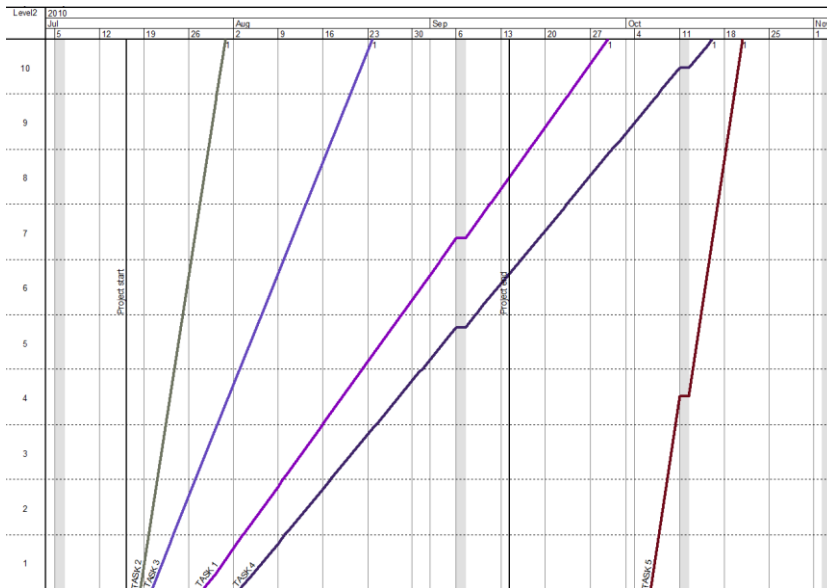
Seppänen, Ballard & Pesonen (2010)



Phase schedule homework

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

Phase schedule – collaborative optimization

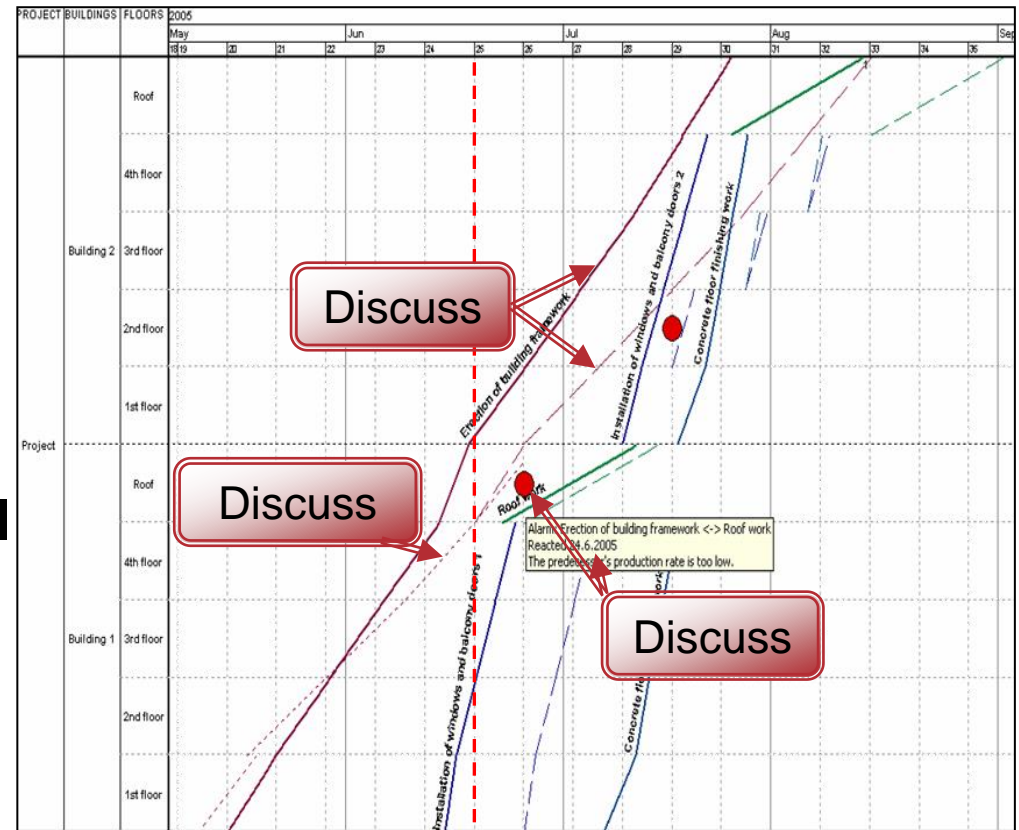


- Start with "optimum" crew
- Each optimization change requires a commitment!

Seppänen, Ballard & Pesonen (2010)

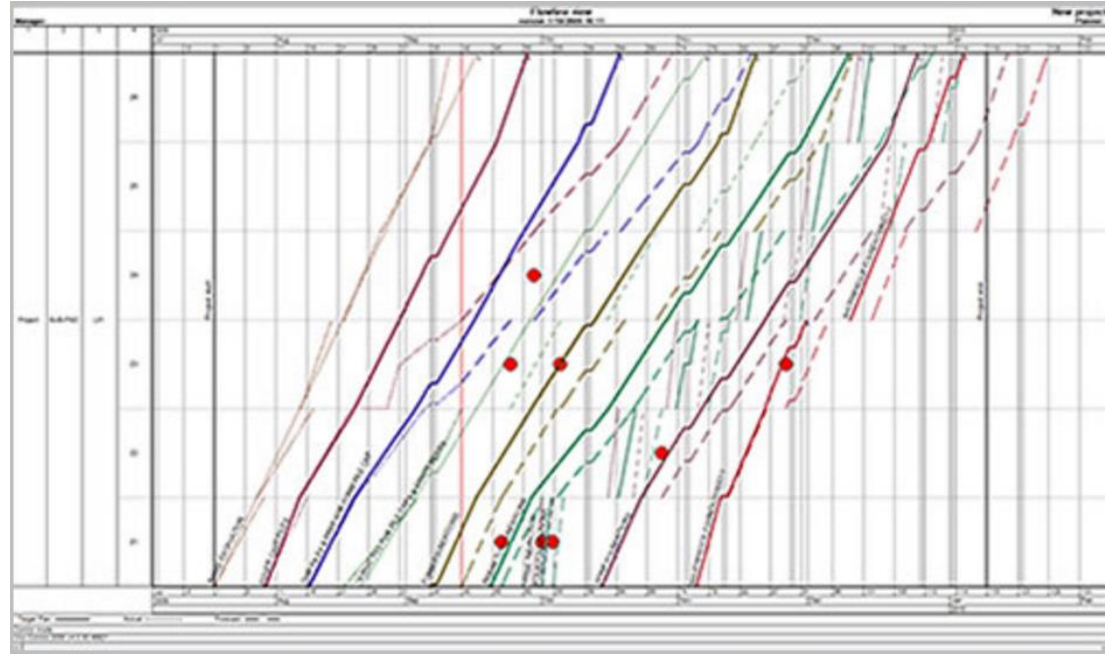
Look-ahead planning

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



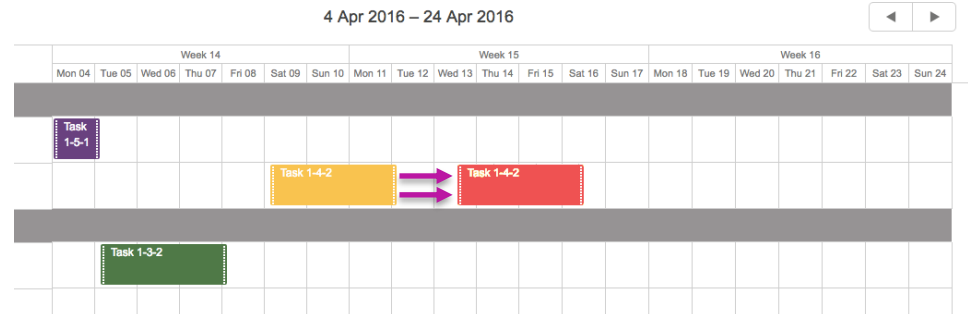
Look-ahead schedule

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

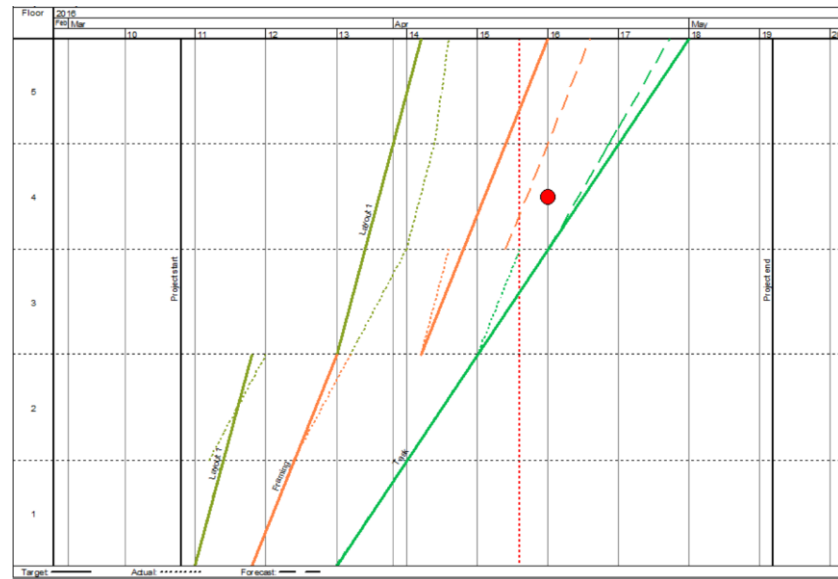


Weekly planning

- Commitments compared to forecast
- If commitment too small, problem revealed one week earlier
- Subject both upcoming and past problems to root cause analysis

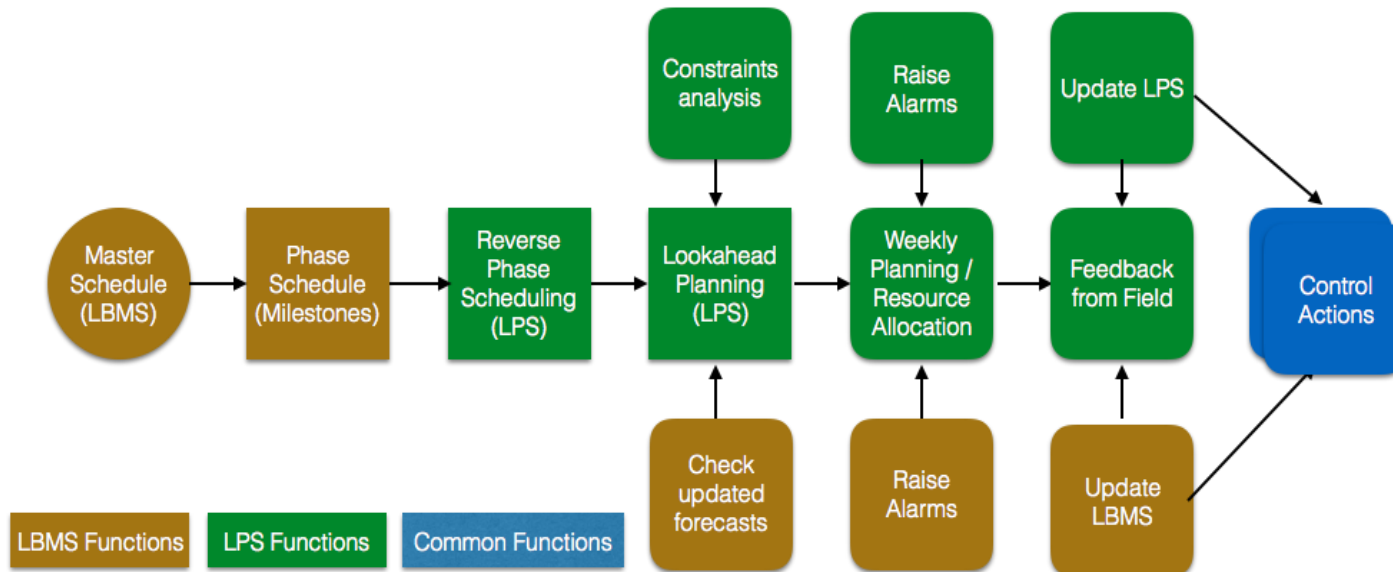


Commitments updated in LPS weekly plan



LBMS visualization based on actuals and commitments

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