



اجرا و مدیریت پروژه به روش اصول ناب (Lean Project Management)

The Last Planner System

ارائه دهندگان:

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Introduction



- Lean Construction strives to minimize costs and maximize value on each project completed, challenging all stakeholders to develop and apply better ways to manage the overall construction process.
- Throughout the construction process — planning, design, construction, activation, operations, maintenance, salvaging and recycling — the holistic pursuit of continuous improvement drives more efficient, effective and economical projects.
- To develop the tools needed to build lean, the Associated General Contractors of America (AGC) has developed the Lean Construction Education Program.

- The course is divided into three sessions:
 1. Session 1 revisits the LPS and introduces the concept of production planning, as contrasted with project management. We then consider the difference between reactive and proactive control. We also consider the role of the commitment — as the term is used in Lean Construction.
 2. Session 2 delves deeper into the LPS with a focus on the production planning pieces — the six-week lookahead, the weekly work plan and the daily huddles — and shows how each is created. We also look at documenting constraints and calculating the percent plan complete. Finally, we use the five whys to get to the root cause of a failure.

- The course is divided into three sessions:
3. Session 3 is largely dedicated to a simulation of the LPS using a sample project. A six-week look-ahead schedule is created. The simulation concludes with the weekly work planning meeting. We also look at methods to encourage subcontractor participation in the planning meetings.

Course Learning Objectives

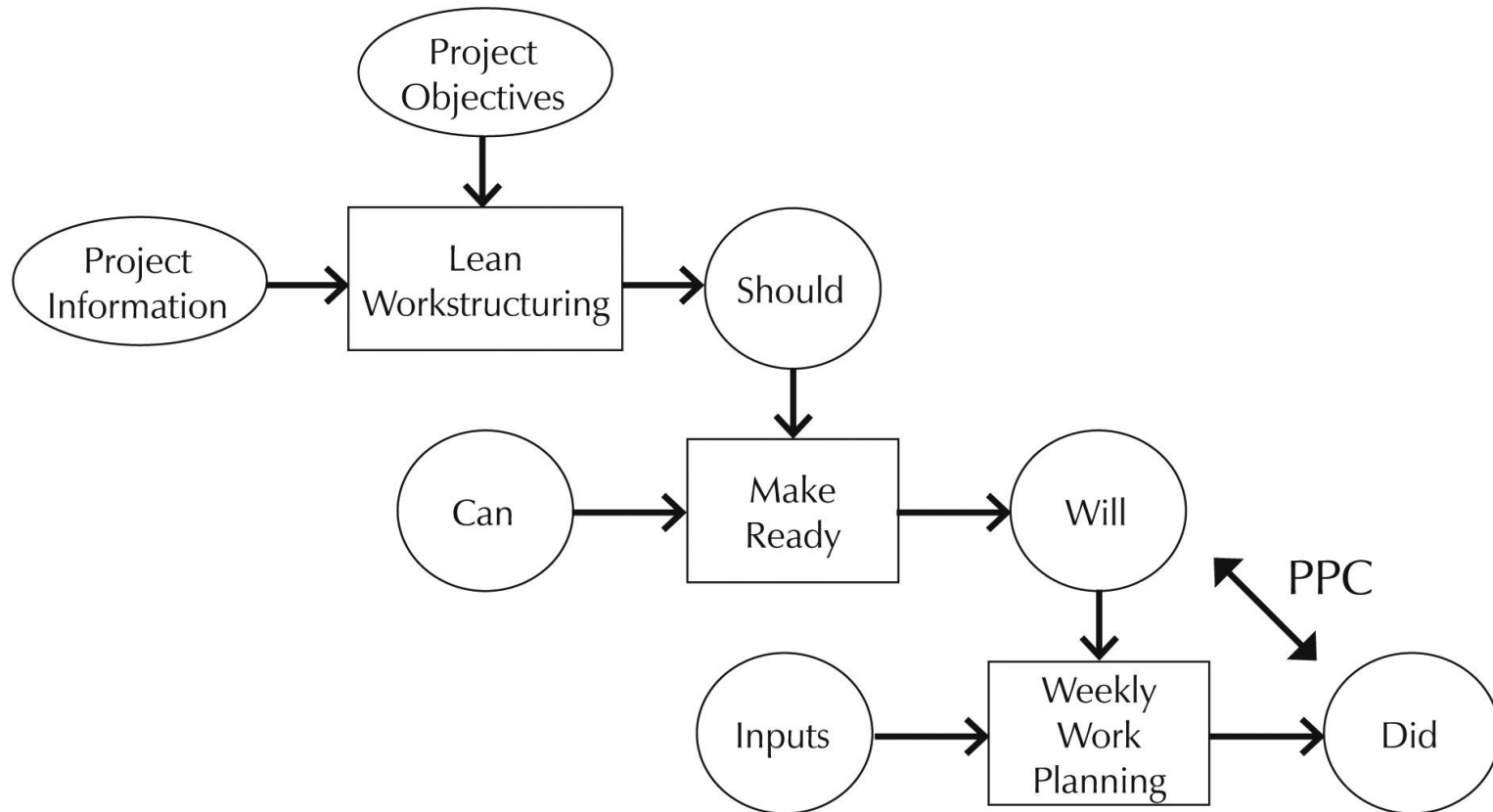


- Following this course, participants will be able to:
 - Apply the Last Planner System on a project;
 - Hold make-ready and weekly work planning sessions; and
 - Calculate, track and analyze percent plan complete for a project.

Session 1

- Following this session, you will be able to:
 - Define the differences between the Last Planner System and current planning practice;
 - Explain the difference between project management and production planning;
 - Define the concept of lean production planning as it applies to Lean Construction;
 - Distinguish the differences between reactive control and proactive planning; and
 - Recognize the steps involved in a lean project commitment.

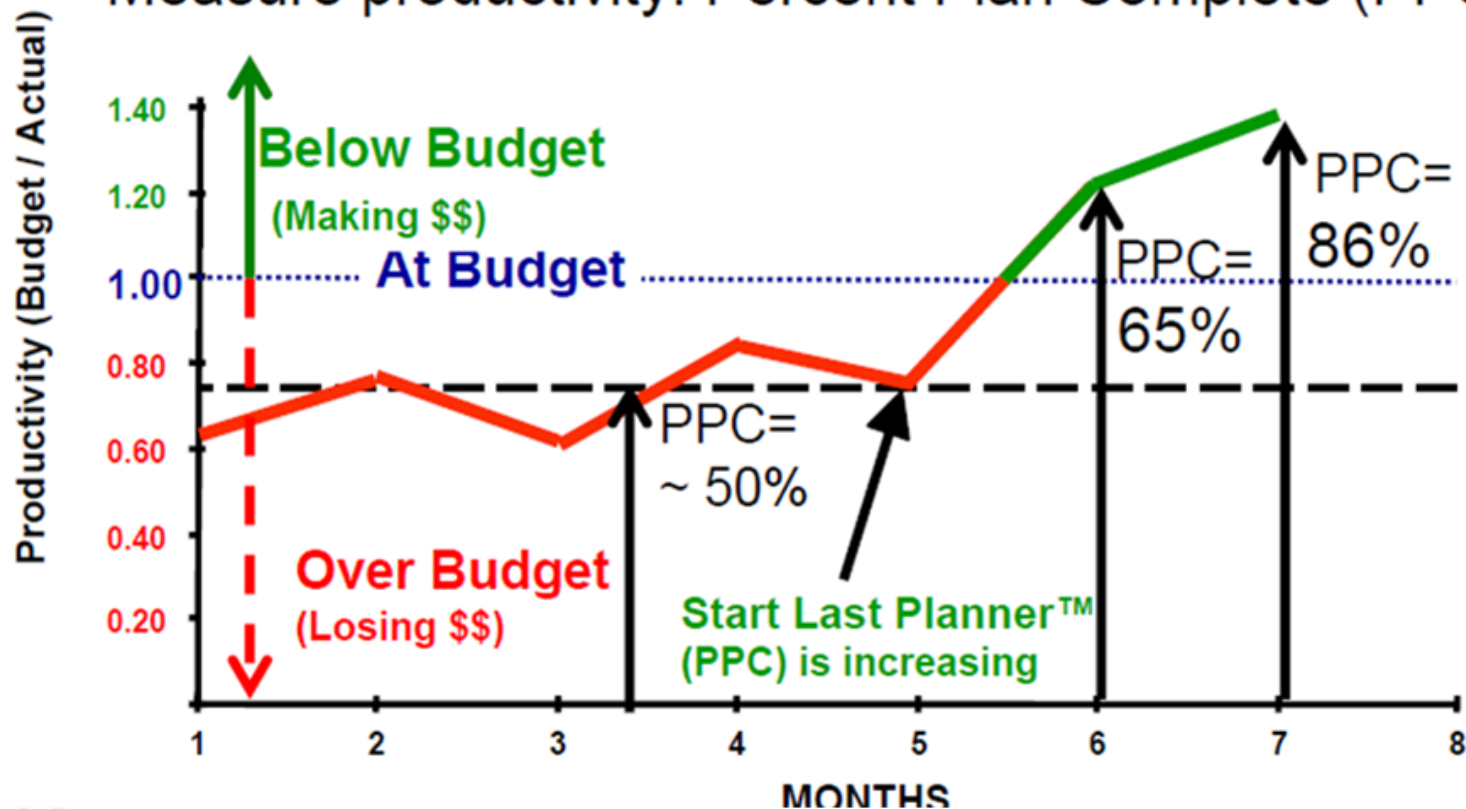
Introduction to the Last Planner System



Introduction to the Last Planner System

Productivity using Last Planner™

Measure productivity: Percent Plan Complete (PPC)

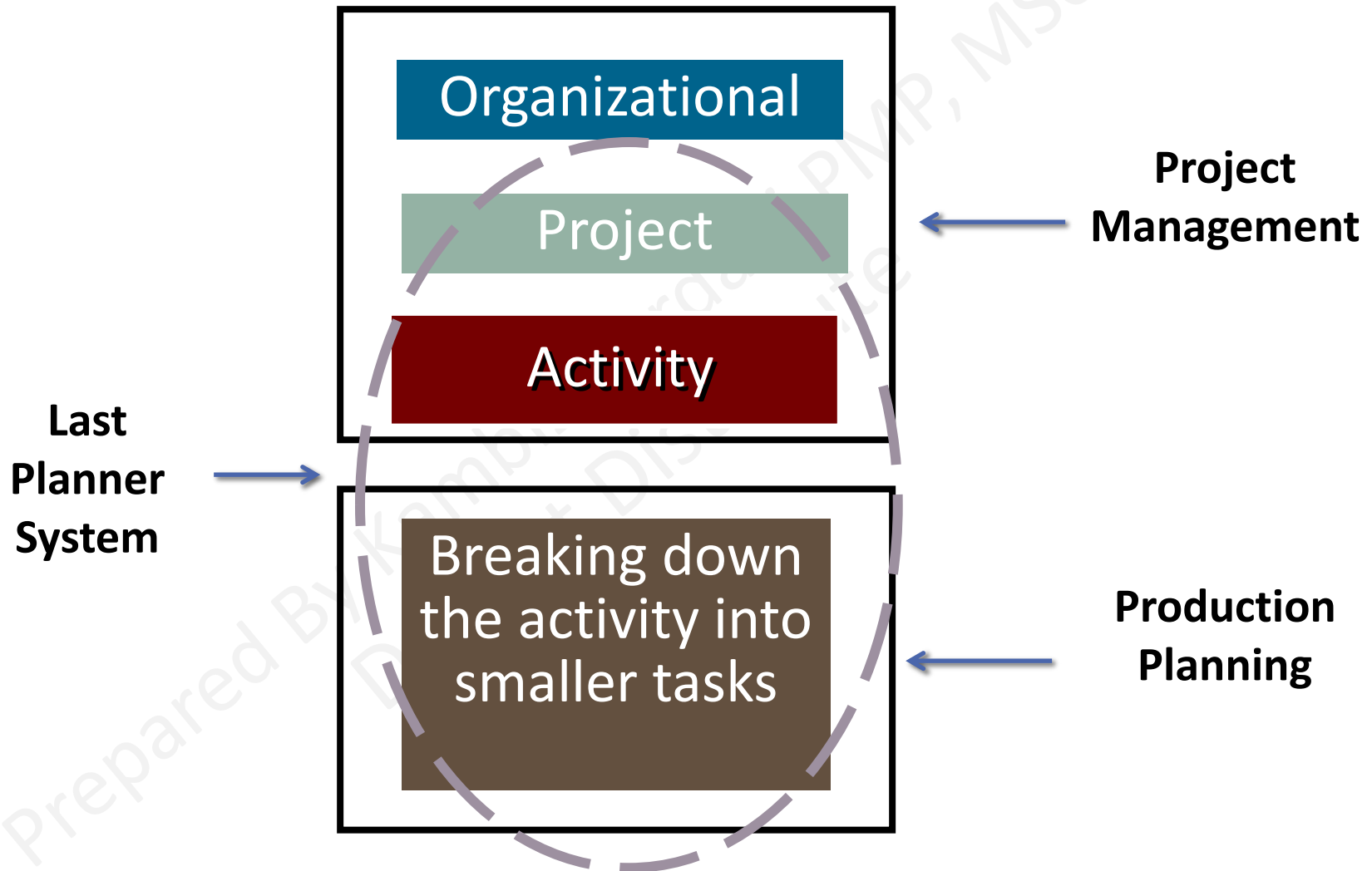


Introduction to the Last Planner System

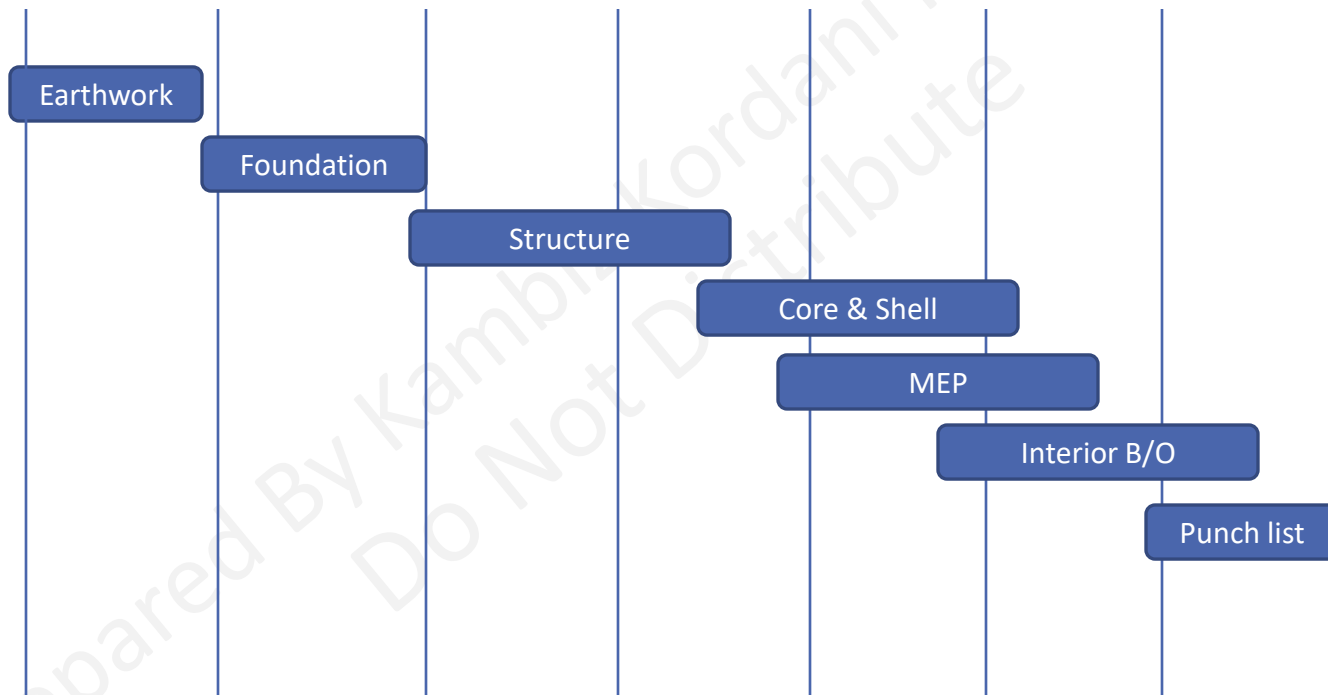


	Last Planner System	Current Planning Practice
The future	Plan for milestones with detailed activity developed by the individuals directing the field work. Planning what you know.	Perception that we can predict with detailed planning. Planning what you assume.
Objective	Predictable workflow. A ready team.	Short durations and high resource utilization.
Planning requires	Connected conversations.	An expert who knows.
Execution results from	Promises and handoffs. Saying no when necessary.	Superintendent dictating. Subcontractors always saying yes.
Source of improvement	Reporting loss of confidence or failure to keep a promise. People are the opportunity.	People doing what they are told.

Introduction to the Last Planner System



Project Management vs. Production Planning





- Lack of common language
- Lack of production knowledge
- Lack of team commitment
- Disregard for variation in performance

Contractual requirements

- Managing the contract requirements vs. what it takes for production planning
- Scheduling requirements
 - ☐ Project schedule vs. production planning
- Different schedules for different needs
 - ☐ Reporting/compliance vs. communication at job level (last planner)

Project Management vs. Production Planning



Project
Management



Setting a
schedule of
what should be
done by whom
and when, but
not *how*.

Project Management vs. Production Planning



Production
Planning



Running the job
to get the
promised
sequence for
day-to-day tasks

Breaking Down Activities



- Overhead rough-in for sheet metal ductwork
 - Overhead coordination
 - Install inserts in the slab above
 - Layout
 - Install hangers
 - Install sheet metal
 - Install accessories
 - Pressure testing
 - Insulation

Project Management vs. Production Planning



How do you distinguish between project management and production planning?

Do you see in your current practice a discrepancy between project management and production planning?

What kinds of activities are discussed in your weekly subcontractor meetings? What typical behaviors do you see?

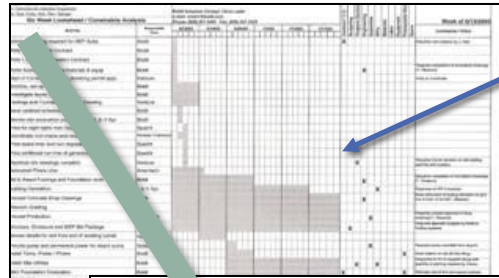
Where do you think we have the most problems that prevent us from finishing a project on time, at budget and at the desired quality?

Production planning is accomplished through:

- The selection of specific construction methods
- Designing production systems
- Reliably sequencing trade interactions

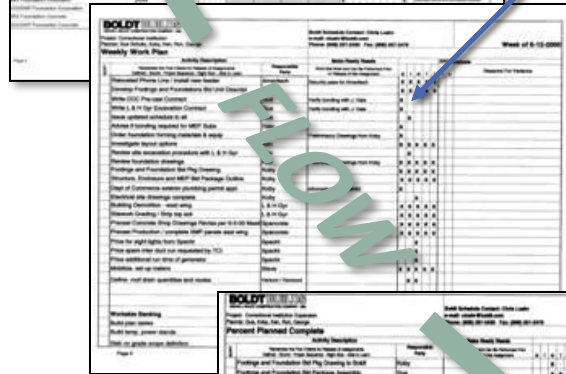
Production planning enables better performance at the system level by exposing workflow issues at the task levels

Lean Production Planning

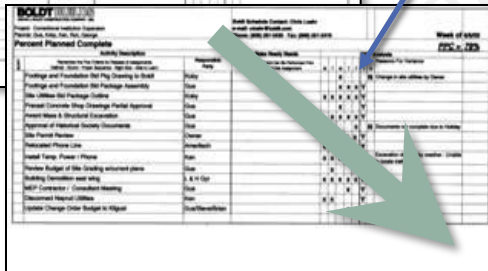


Shaping workflow;
identifying & removing
constraints

Decentralized planning
explicit quality assignments



Rapid learning
measurement



Collaborative team
commitment

Production planning system

Managing workflow

Building reliability

Best practices

- Use measurable activities
- Every handoff of work must be direct and you must understand each handoff
- A clear path for work to be completed with all directives, prerequisites and resources complete
- All components of the Last Planner System visible and transparent
- Continuous improvements are planned and measured

Reactive Control

Superintendent becomes the firefighter

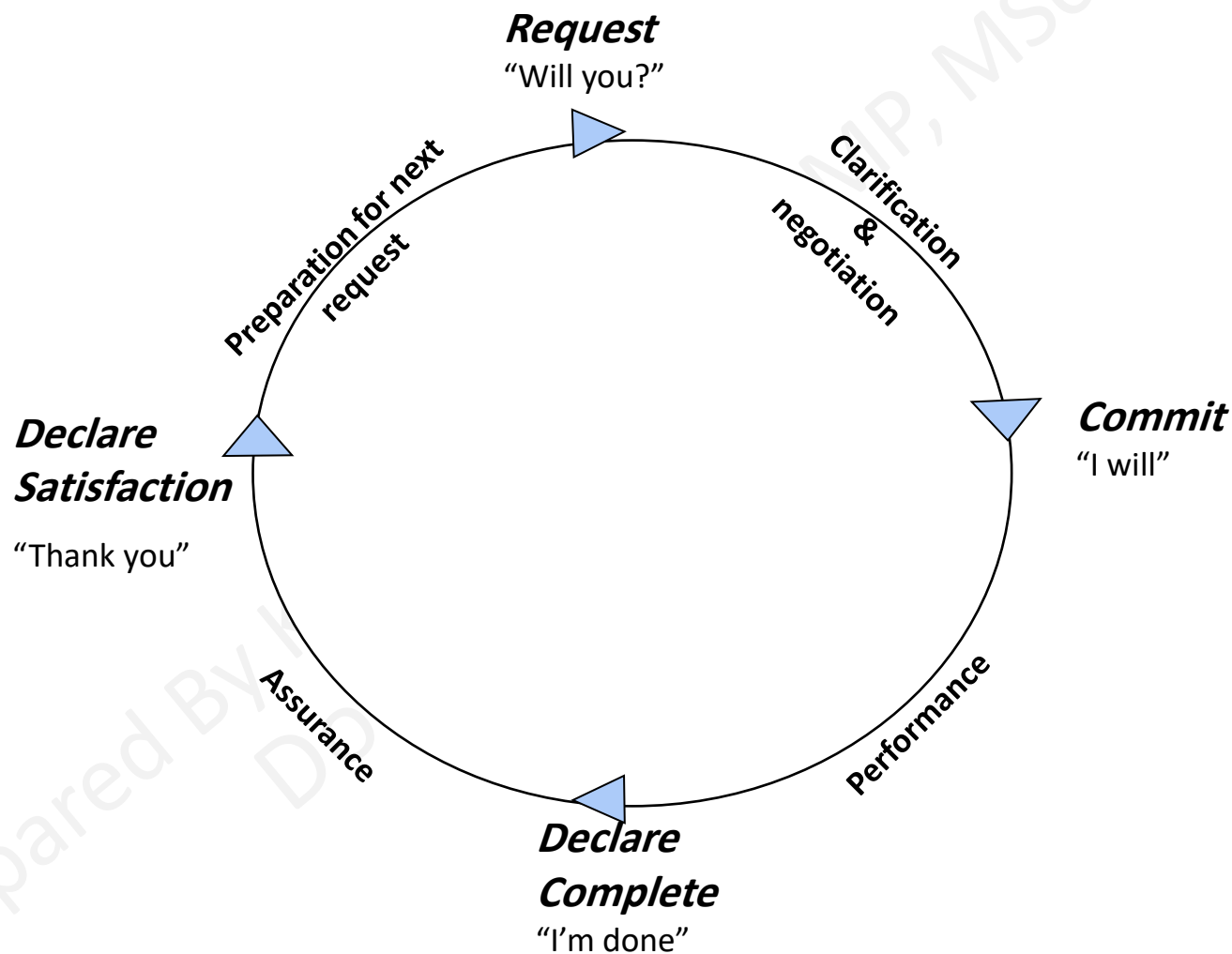
- Small problems overlooked
- Large problems get time and resources
- Project put on hold until the “fire” is put out
- Project continues
- Small problems continue to grow unchecked until they can’t be overlooked and the cycle continues

Proactive Planning

Last planner (foreman) identifies constraints before work is performed.

- The focus is on making work happen, not waiting until things go wrong to try to fix it;
- Fires are prevented by only making quality assignments, which means that last planner must be given the authority to reject bad assignments.

The Lean Commitment



The Lean Commitment



- Elements of commitment:
 - Definition – Assignments must be specific
 - Soundness – Design and prerequisite work are complete; materials are on hand
 - Safety – Promise to work safe and maintain a safe jobsite
 - Sequence – Constructability has been reviewed to determine this task is necessary at this point
 - Size – Planned task is achievable in time allotted by the crew in place
 - Learning – Tracking of complete/incomplete assignments

Session 2



- Following this session, you will be able to:
 - Differentiate among the five levels of the Last Planner System;
 - Identify the amount of detail and information to be included at each LPS level;
 - Recognize the importance of documenting and analyzing constraints;
 - Calculate the percent plan complete (PPC) for a week's worth of work;
 - Describe the uses of the PPC
 - Identify means to determine the root cause of a failure; and
 - Describe the purpose and outcomes of the daily huddle.

Levels of the Last Planner System

Master Scheduling Milestones

- Are we confident we can deliver the project within the set limits?
- Who holds the promise to make this happen?

Phase Scheduling Specify handoff

- Do we understand how we are going to do the work?
- Have we designed the network of commitments to make it happen?
- Are we confident we can deliver the milestones?

6-week Look-ahead/Make-ready Planning Rolling look ahead & launch

- Is the network of commitments active?
- Are reliable promises in place to make work ready in the right sequence and amounts to deliver the milestone?
- Are we confident the work will begin and end as planned?

Weekly Work Planning

Measure PPC, act on reasons for failure to keep promises

- How will we coordinate and adjust?
- Have we promised our tasks will be done as planned or said no?

Daily Huddles

Confirming your weekly plan and adjusting as required

- What have we learned?
- What needs changing so we can improve our performance?

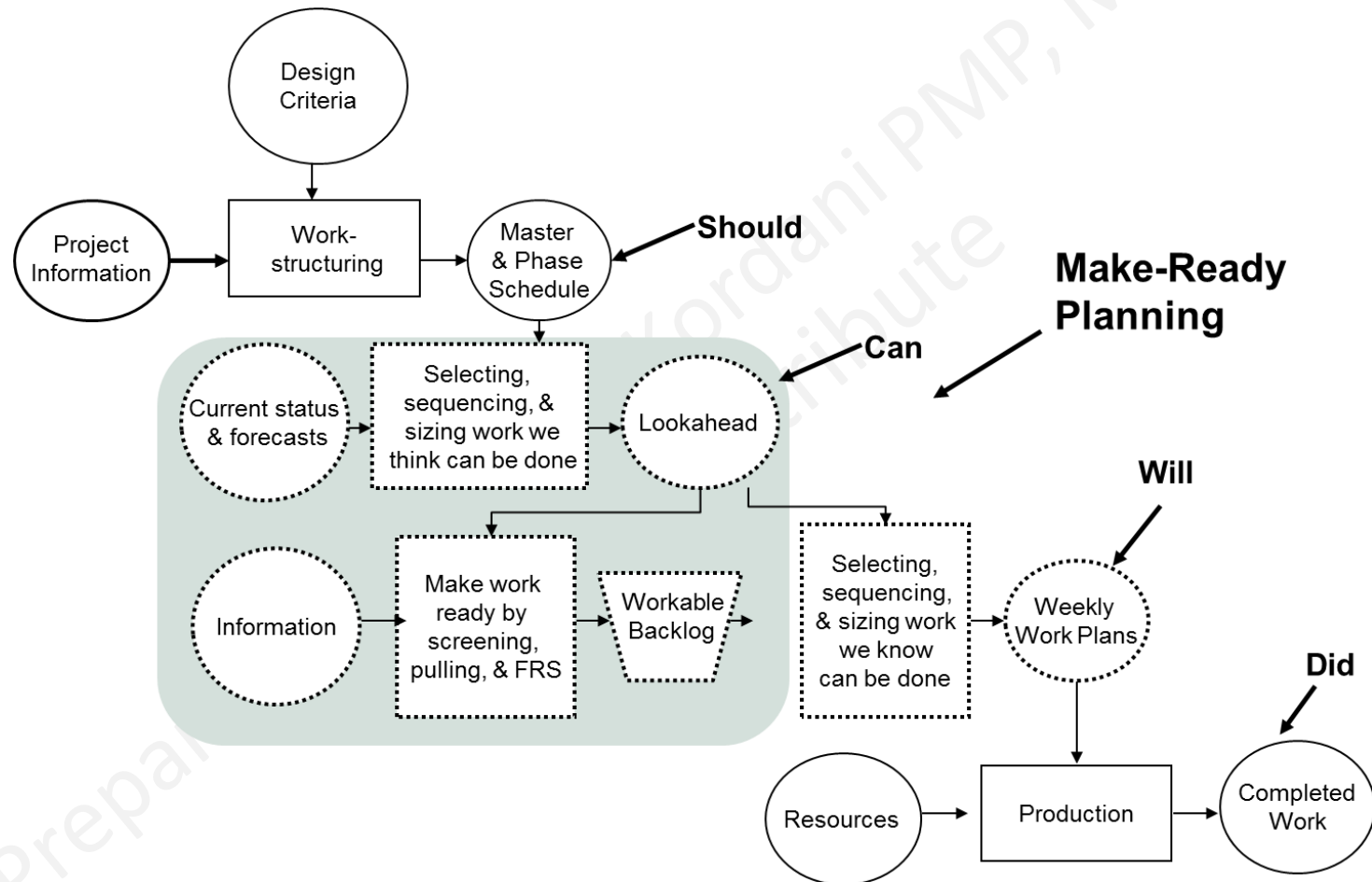
Master Schedules

Activity	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Site Utilities	■	■										
Excavation		■	■	■								
Foundations			■	■	■	■						
Structural Steel				■	■	■	■					
Exterior Framing						■	■	■	■			
Roof							■	■	■			
Doors & Windows							■	■	■			
MEP Overhead Rough-in							■	■	■	■		
Interior Framing								■	■	■		
Drywall									■	■	■	
Paint									■	■	■	■
Ceilings										■	■	■
MEP Trim out										■	■	■
Flooring										■	■	■
Casework										■	■	■
Punchlist												■
Substantial Completion												■

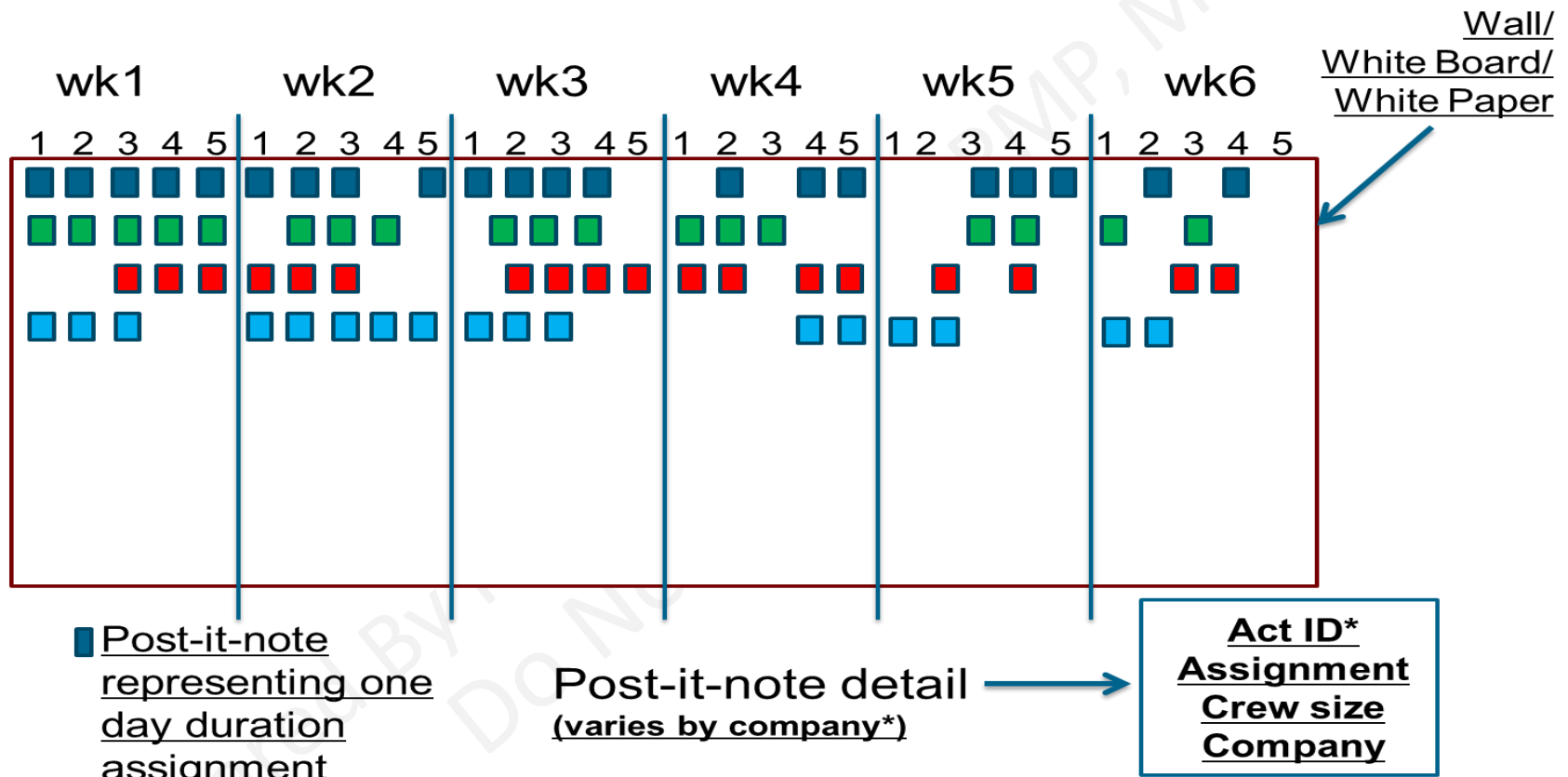
Phase Schedules

Activity	September															
	Wk 1				Wk 2				Wk 3				Wk 4			
Mech OH Rough - Area A																
Elec OH Rough - Area A																
Plbg OH Rough - Area A																
Int Framing - Area A																
Drywall - Area A																
Prime - Area A																
Grid - Area A																

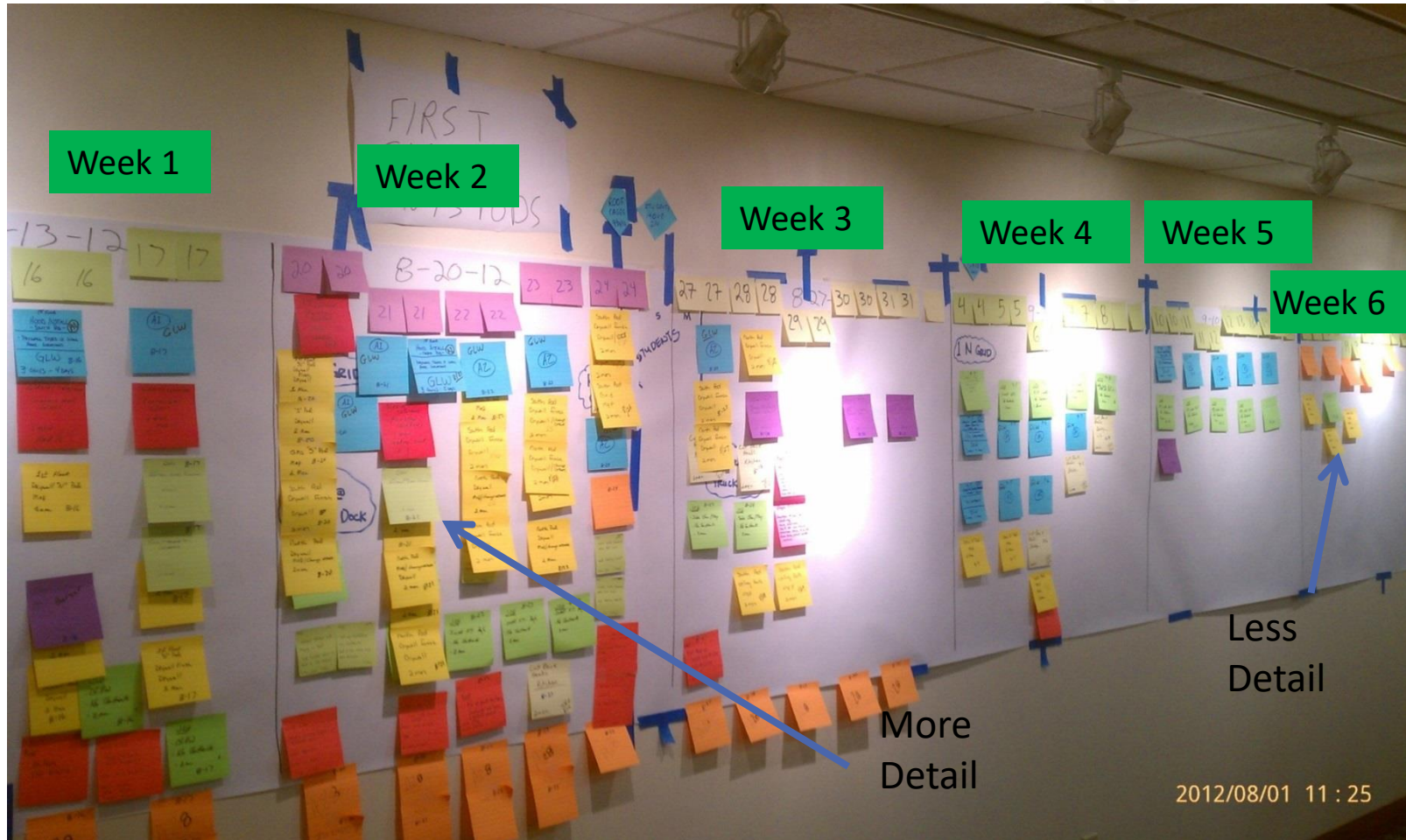
Six-week Look-ahead/Make-ready Planning



Six-week Look-ahead/Make-ready Planning



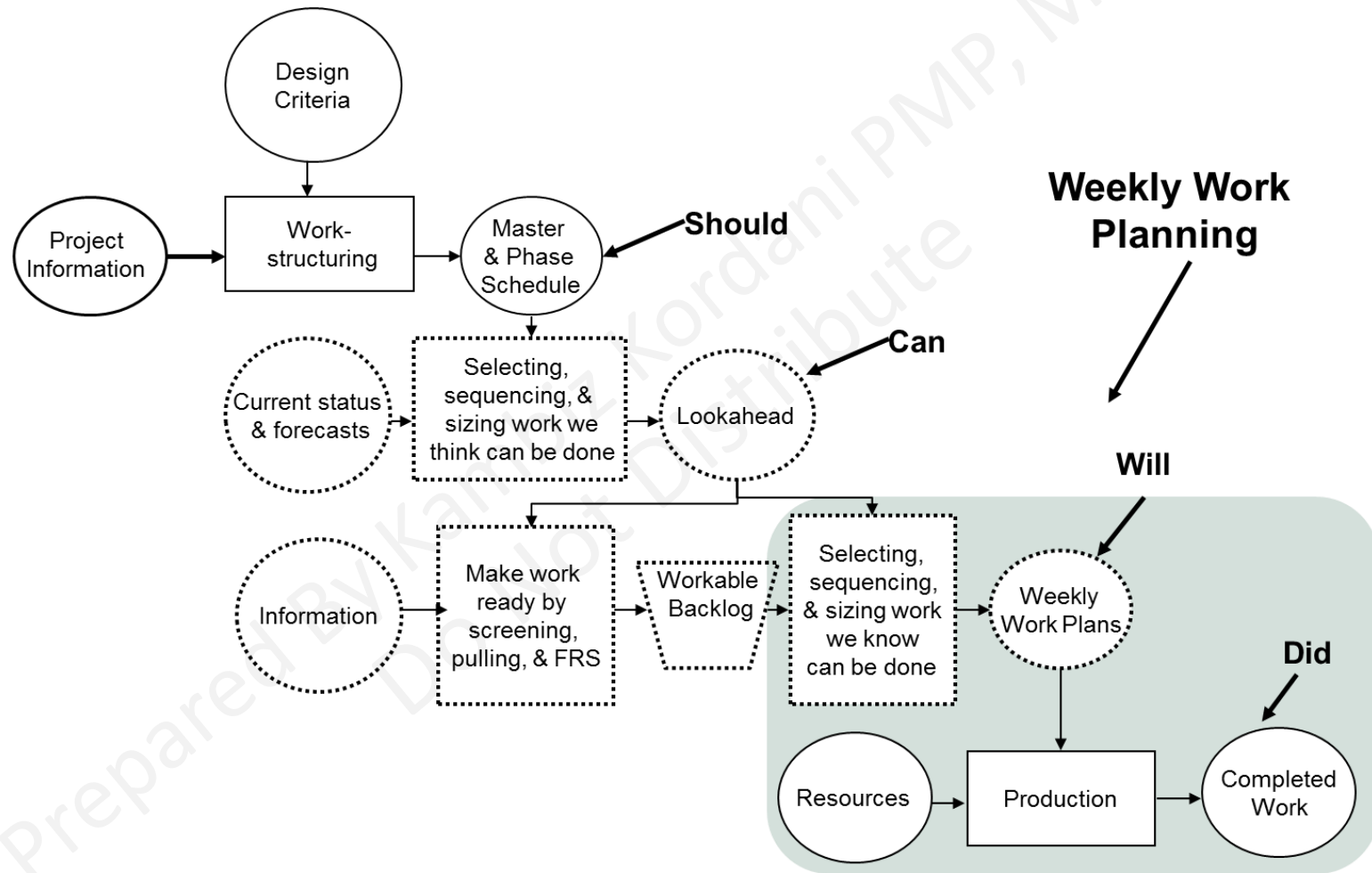
Six-week Look-ahead/Make-ready Planning



By: K.Kordani PMP, MSc

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Weekly Work Planning



Weekly Work Planning

		October - Week 3							
Activity	Sub.	M	T	W	Th	F	Complete	Reason	Notes
Area A									
Mech Trim	Mech								
Elec Trim	Elec								
Area B									
Elec Trim	Elec								
Plbg Trim	Plbg								
Area C									
Mech Trim	Mech								
Elec Trim	Elec								
Paint - Start	Painter								
Area D									
Mech Trim - Start	Mech								
Elec Trim	Elec								
Plbg Trim									

Weekly Work Planning



The whiteboard displays a weekly work plan with the following tasks and resources:

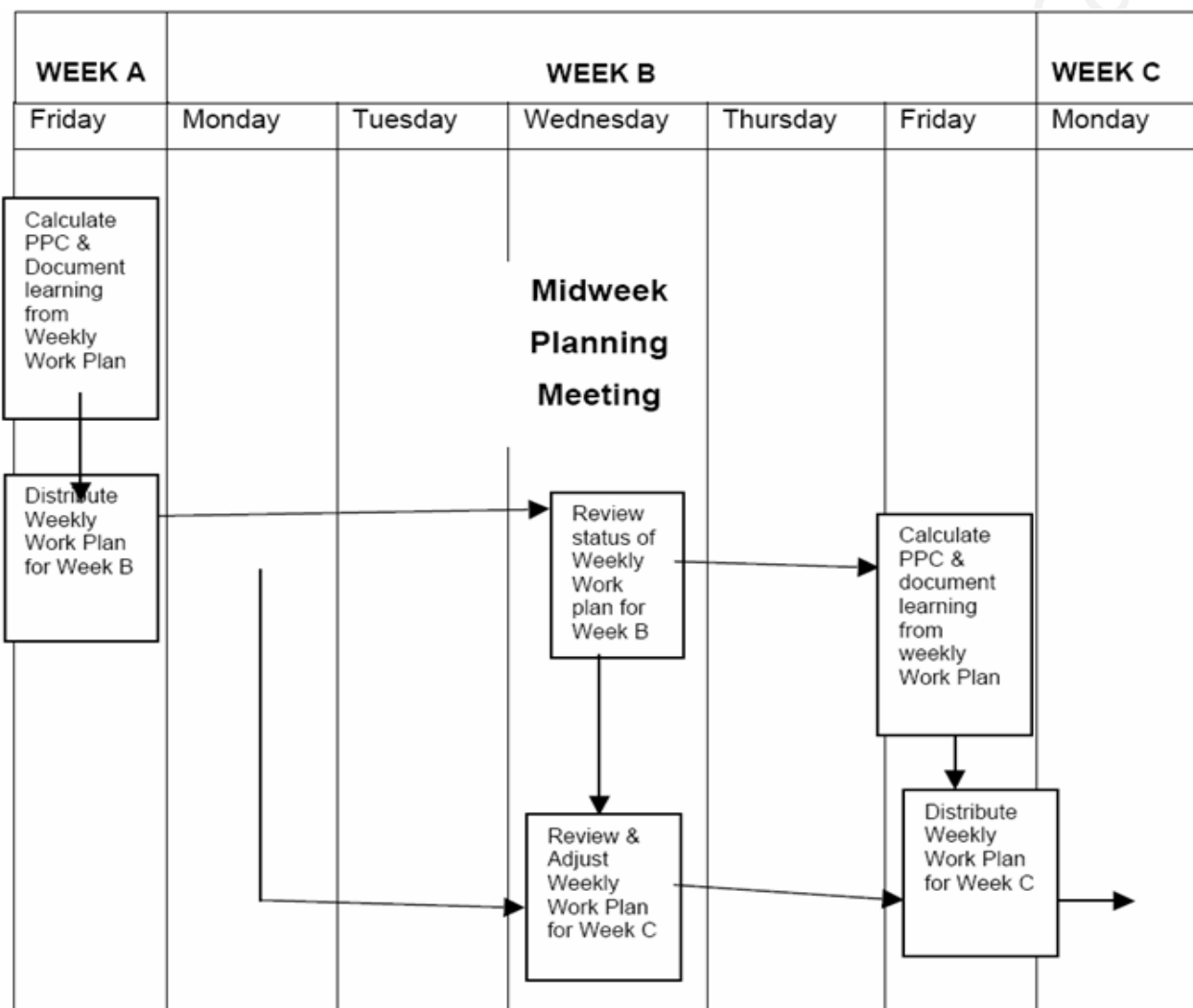
- GRID (Hand-drawn diagram):** A square box with a star symbol and the word "GRID" inside.
- Terrace Install Grid M.E.P. Rough in (Yellow notes):**
 - 8/6: 1 man
 - 8/7: 1 Man
 - 8/8: 1 man
 - 8/9: 1 Man
- Cut in Sprinkler Heads (Yellow notes):**
 - 8/8: Grid, 2 men
 - 8/9: Grid, 2 men
- JEG (Green notes):**
 - 8/6: Complete overhead rough piping, No Constraints, 20 men
 - 8/7: Complete overhead rough piping, No Constraints, 20 men
 - 8/8: Complete overhead rough piping, No Constraints, 20 men
 - 8/9: Complete overhead rough piping, No Constraints, 20 men
- DCI-Terrace (Red notes):**
 - Return grille for Temp. Kitchen
 - AC unit supply and return tie-in
 - Install Fan duct Expected Delivery Date of Telecom
- JEG/Sign (Green note):** 2012/08/01/11:25

SUNDT
FUND-RAISING, INC.

Weekly Work Planning

		October - Week 2							
Activity	Sub.	M	T	W	Th	F	Complete	Reason	Notes
Area A									
Mech Trim - Start	Mech						No	Manpower	Journeyman called in sick
Area B									
Grid	Ceiling						Yes		
Mech Trim	Mech						Yes		
Plumbing Trim	Plbg						Yes		
Area C									
Elec Trim	Elec						Yes		
Plumbing Trim	Plbg						No	Material	Late on W.; pushed activity completion to Th.
Area D									
Prime	Painter						Yes		
Grid	Ceiling						Yes		

Weekly Planning Cycle

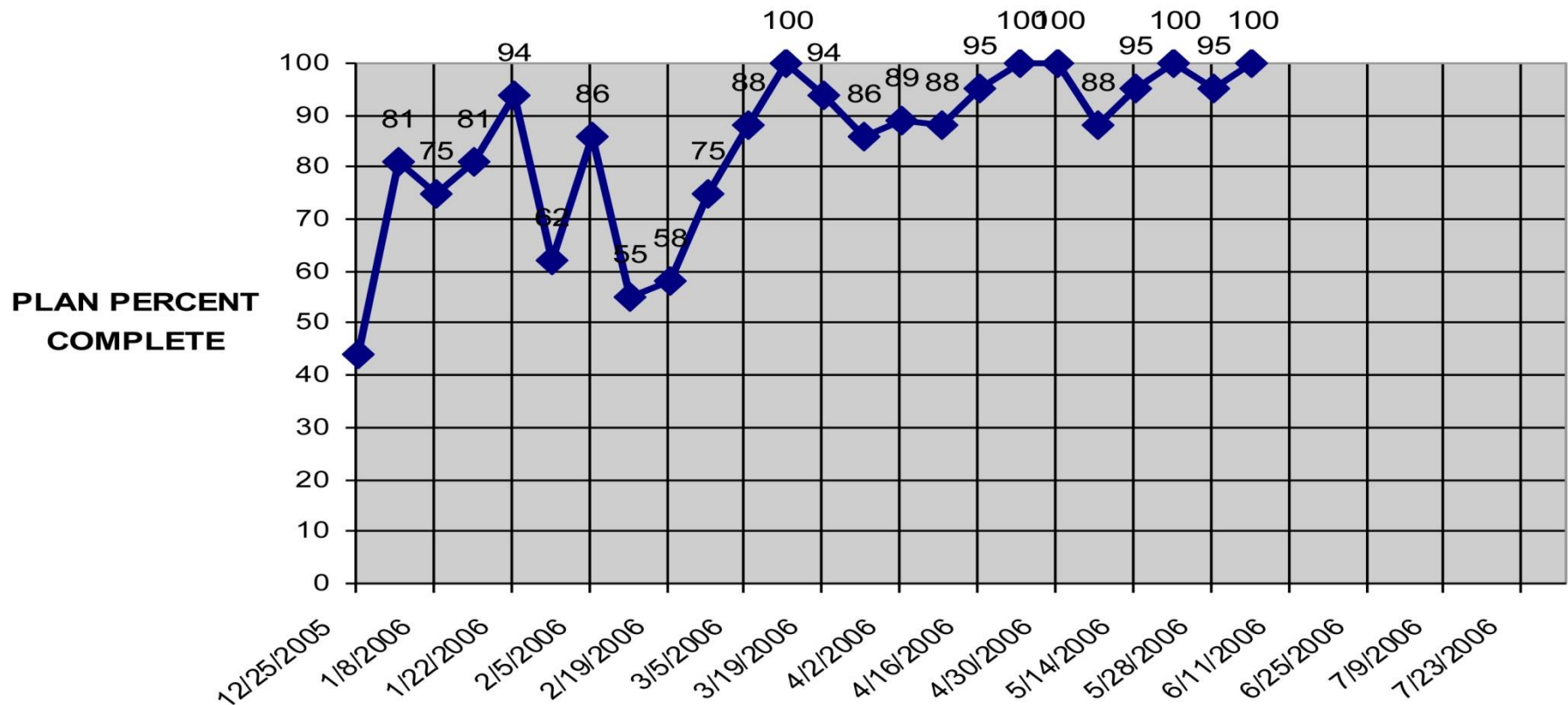


Percent Plan Complete

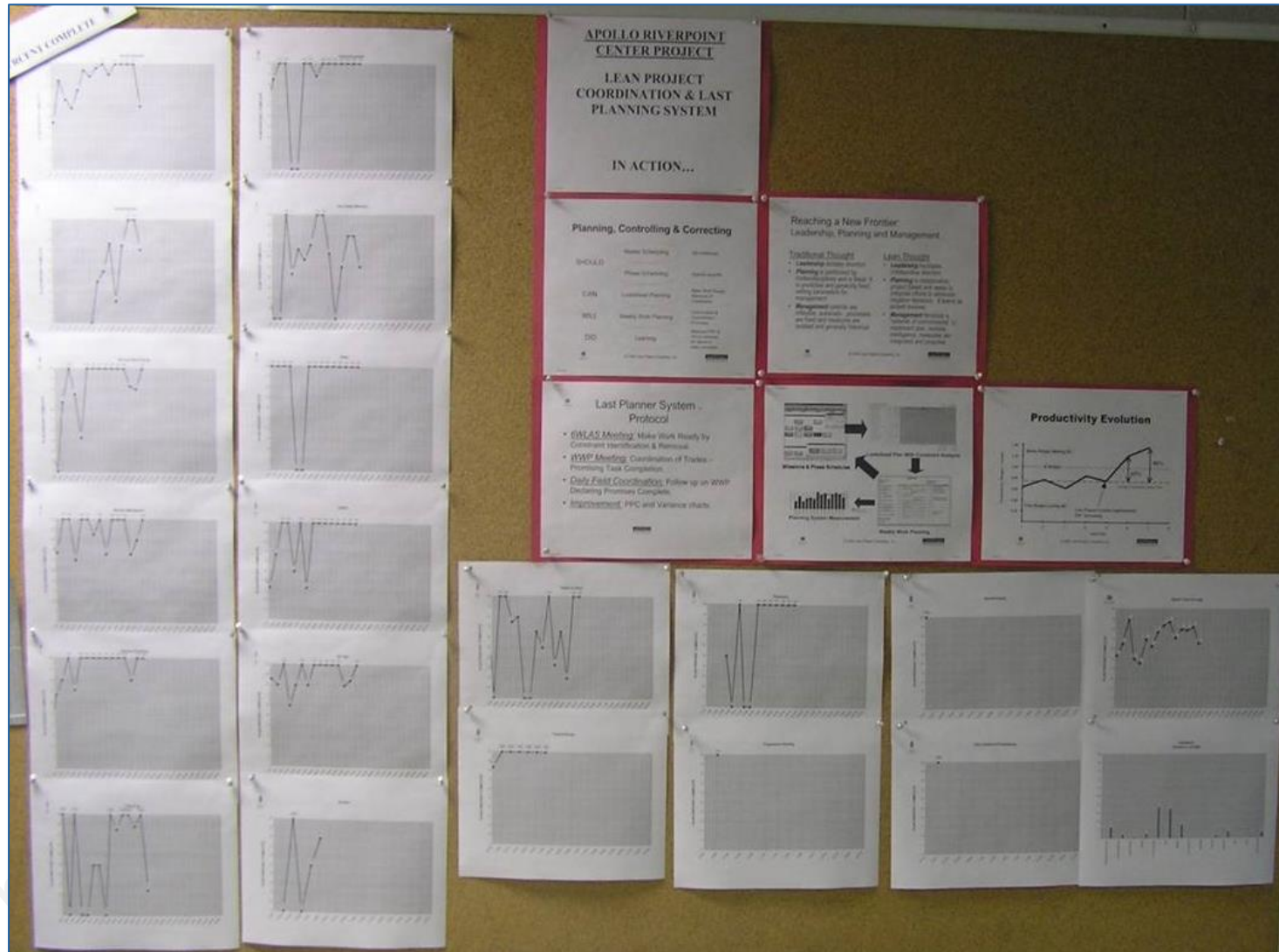
Completed Weekly Assignments

PPC =

Total Weekly Promised Assignments



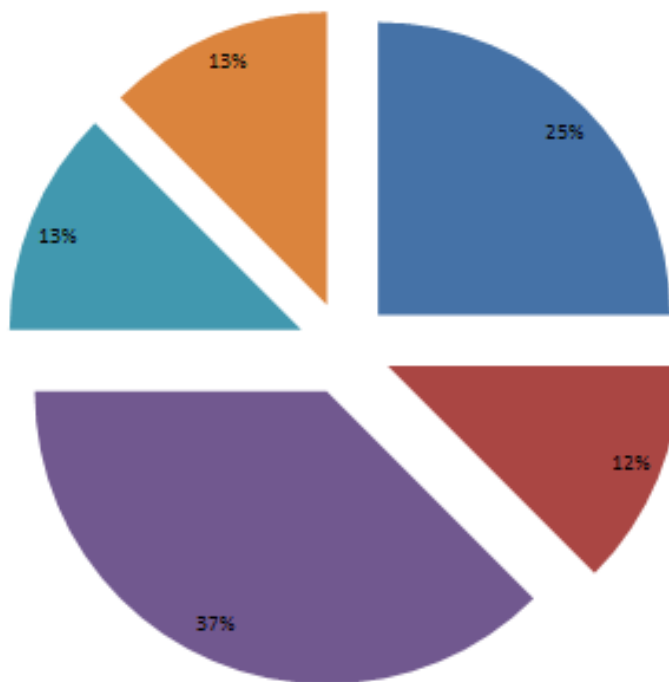
Percent Plan Complete



Reasons Analysis for PPC

Week 20

- Inclement Weather
- Inadequate Manpower
- Lack of/Failure of Machinery
- Design (RFI, Submittals, Etc.)
- Make Ready
- Materials
- Poor Scheduling



By: K.Kordani PMP, MSc

Reasons Analysis for PPC

5 Why's and Therefore Analysis	
Problem Statement:	Prepare to Conduct 5 Why's <u>Describe the Problem:</u>
Why?	Prepare a Question Checklist:
Why?	
Why?	
Why?	
Why?	
Root Cause:	
Corrective Actions:	
Preventive Actions:	

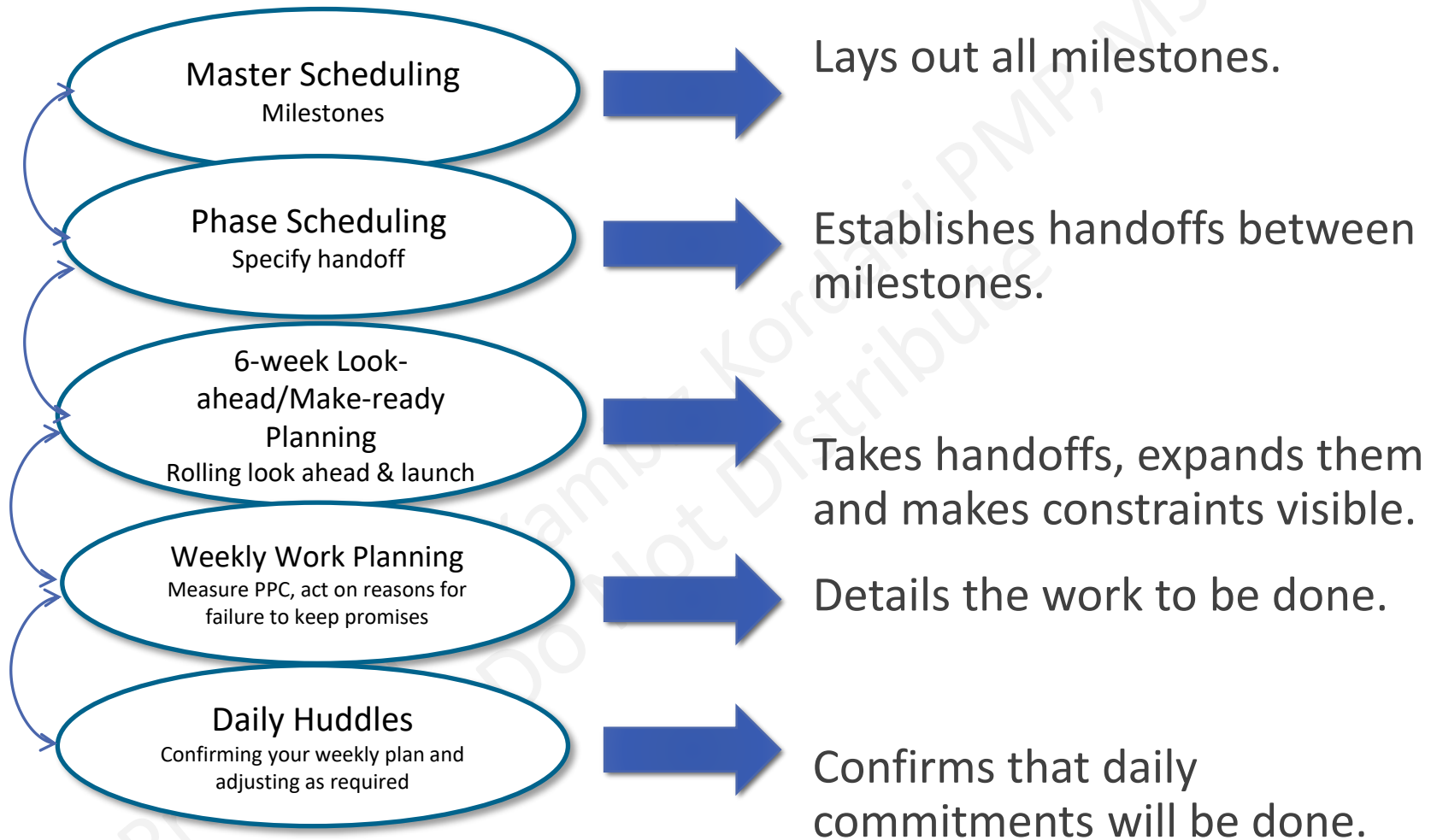
Notes: Using the "5 Why's" does not mean that the team must identify 5 reasons or causes for the cause. Rather, the tool is a means to narrow down potential causes of the cause to ultimately identify the root cause. Each "Why" must be verified by FMEA.

To check the logic of the 5 Why's, start with the Root Cause and read each statement in reverse order and say, either "Therefore" or "Because" between each statement.

Daily Huddles



LPS Summary



Session 3



- Following this session, you will be able to:
 - Explain the make-ready planning process;
 - Conduct a make-ready planning session;
 - Explain the weekly work planning process;
 - Conduct a weekly work planning session; and
 - Apply methods to encourage subcontractor participation.

Make-ready Planning Case Study



- Project overview:
 - ✓ An elementary school with an overall schedule of 12 months
 - ✓ It is a green field, new construction project
 - ✓ At the dry-in to ceiling cover-up phase
 - ✓ We are in Week 21

Make-ready Planning Case Study



Activity

Contractor Name

Optional items:

- Duration
- Give and get
- Crew size
- Dates
- Known constraints

Make-ready Planning Case Study



Subcontractors at this phase:

- Ceiling
- Ceramic Tile
- Drywall
- Electrical
- Fire Proofing
- Fire Protection
- Mechanical
- Plumbing
- Steel Erector

All subcontractors place their sticky notes on the make-ready plan.

Make-ready Planning Case Study

Typical make-ready plan.



Make-ready Planning Case Study



What are the key points or lessons for you?

Was there dialogue about where to put sticky notes?

Did anyone place more than the basic information on their sticky notes?

- What did you add?
- Why?
- Did anyone else find it helpful?

Did anyone change their placement based on a conversation with another sub?

- Who initiated the conversation?
- How did it go – was the other sub reluctant to change?

Running the Make-ready Meeting



Your role as GC/facilitator:

- Require participation from all subcontractors
- Don't dictate; engage the subcontractors in a conversation
- Ensure milestones will be met
- Start with the last subcontractor and work backward
- Identify the critical path
- Check reliability before tightening the schedule
- Look for inefficiencies in the schedule
- Acknowledge buffers

Questions to ask of subcontractors

- What do you need to start?
- Can you help me understand your placement?
- Can you think of a way we can pull something up to fill that gap?
- What do you actually need (the “give”) before this task can start?
- Can you start work without that give?
- Can you help me understand your logic?
- Are you waiting on anyone or do you control your own destiny?
- Do you have any workable backlog we can put on the board?
- Could you complete the work with a different size (smaller, larger, two) crew?
- Do you need a buffer?

Running the Make-ready Meeting



Introducing subcontractors to their role:

- Ask experienced subcontractors to help the newcomers;
- If no one has LPS experience, hold a training session;
- Ask subcontractors to come to a meeting where they can just observe the process;
- Offer to write the sticky notes as the foreman dictates or have the foreman color the work on a floor plan; and
- Invite subs with a lot of work to create their sticky notes ahead of time so there's more meeting time for discussion.

Running the Make-ready Meeting

The constraint board

LINBECK				2 Week Look Ahead Board																			
ject Name: ACH PHASE 1B2				Project #: 1976																			
ca Causes: 1. Inclement Weather 2. Inadequate Manpower 3. Lack of/Failure of Machinery 4. Design (RFI, Submittals, Etc.) 5. Make Ready 6. Materials 7. Poor Scheduling																							
TASKS				Constraints																			
FABULOUS FLOORING																							
BLDG. D: 1ST FLOOR OFFICES - PREP & INSTALL CARPET																							
BLDG. D: 1ST FLOOR APARTMENTS - PREP & INSTALL CARPET																							
BLDG. D: 1ST FLOOR KITCHEN/DINING - PREP & INSTALL TILE																							
BLDG. D: 2ND FLOOR OFFICES - PREP & INSTALL CARPET																							
BLDG. D: 2ND FLOOR N. APARTMENTS - INSTALL VCT																							
BLDG. D: 2ND FLOOR S. APARTMENTS - INSTALL VCT																							
TAYLOR PAINTING																							
BLDG. A: 1ST FLOOR - TEXTURE & PRIME WALLS																							
BLDG. A: 1ST FLOOR - PAINT WALLS																							
BLDG. A: 2ND FLOOR - PAINT CASEWORK																							
BLDG. D: 1ST FLOOR - PAINT WALLS																							
BLDG. D: 2ND FLOOR - PAINT WALLS																							
EAGLE PLUMBING																							
BLDG. D: 1ST & 2ND FLOOR - INSTALL LAVATORY FIXTURES																							

Running the Weekly Work Planning Meeting



- ☐ Start the discussion with the subcontractor who has the critical path.
- ☐ All subcontractors need to participate.
- ☐ Have everyone stand around the weekly work plan.
- ☐ Ask the subcontractors to color their work areas on a floor plan.

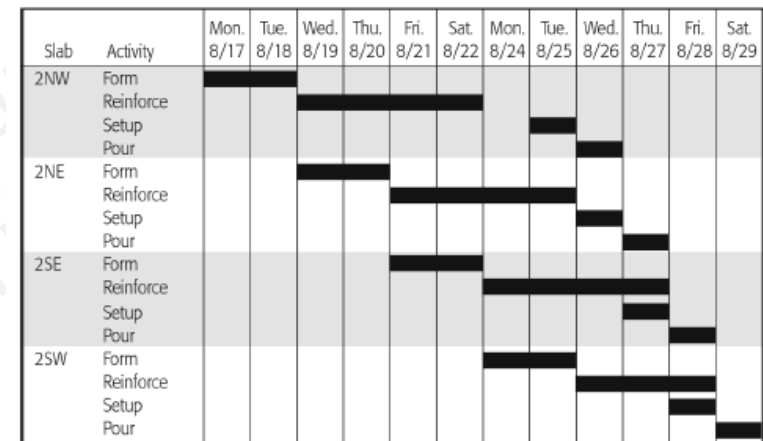
The Daily Huddle



- ☐ Short, standing meeting to confirm work.
- ☐ Should not be used as an opportunity to update the weekly work plan.
- ☐ Create a parking lot for items that come up during the day to discuss at tomorrow's meeting.

Communicating the Plan

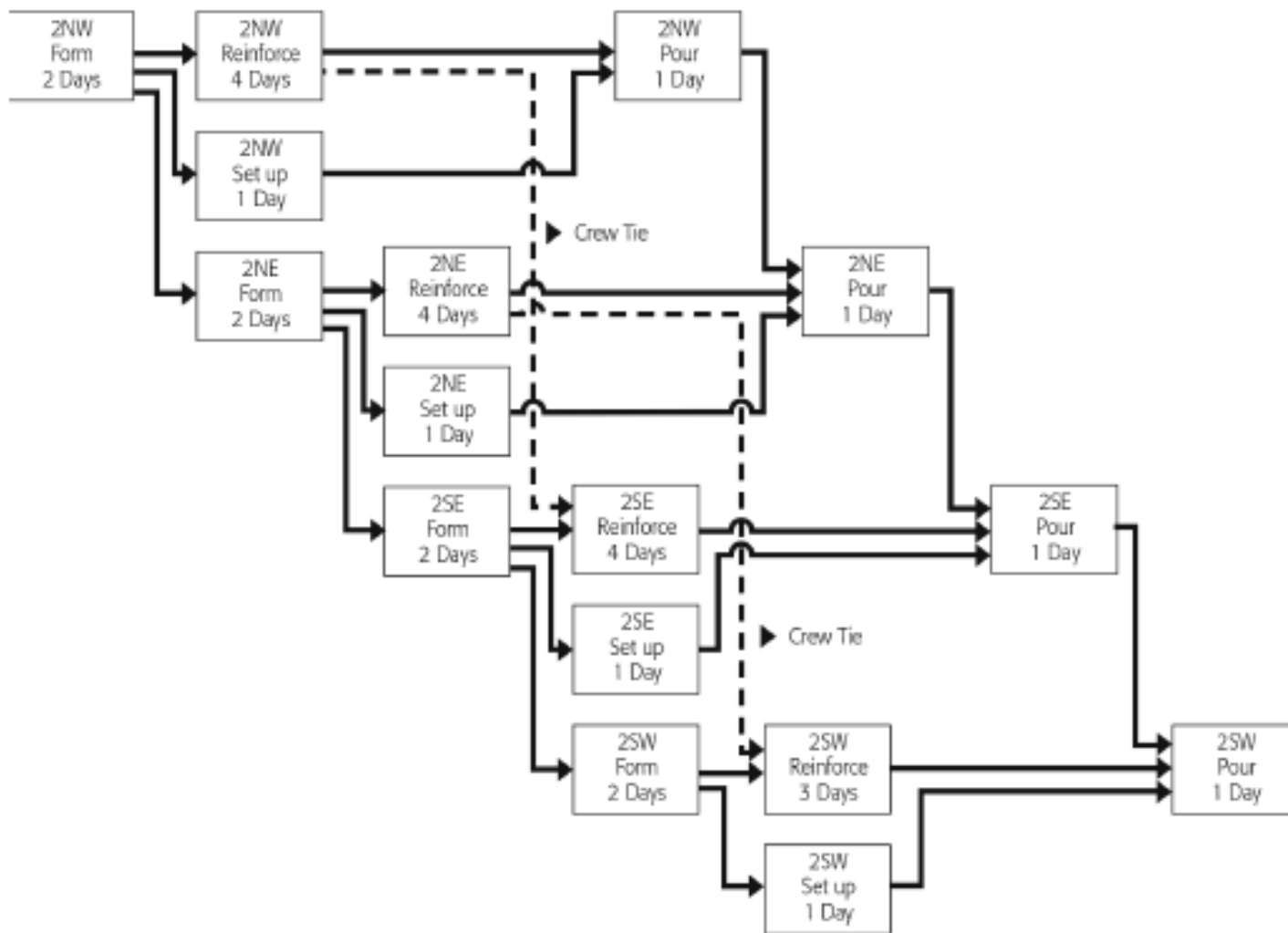
SLAB	ACTIVITY	DURATION (WORKDAYS)	START DATE	FINISH DATE
2NW	FORM	2	17AUGXX	18AUGXX
	REINFORCE	4	19AUGXX	22AUGXX
	SET UP	1	25AUGXX	25AUGXX
	POUR	1	26AUGXX	26AUGXX
2NE	FORM	2	19AUGXX	20AUGXX
	REINFORCE	4	21AUGXX	25AUGXX
	SET UP	1	26AUGXX	26AUGXX
	POUR	1	27AUGXX	27AUGXX
2SE	FORM	2	21AUGXX	22AUGXX
	REINFORCE	4	24AUGXX	27AUGXX
	SET UP	1	27AUGXX	27AUGXX
	POUR	1	28AUGXX	28AUGXX
2SW	FORM	2	24AUGXX	25AUGXX
	REINFORCE	3	26AUGXX	28AUGXX
	SET UP	1	28AUGXX	28AUGXX
	POUR	1	29AUGXX	29AUGXX



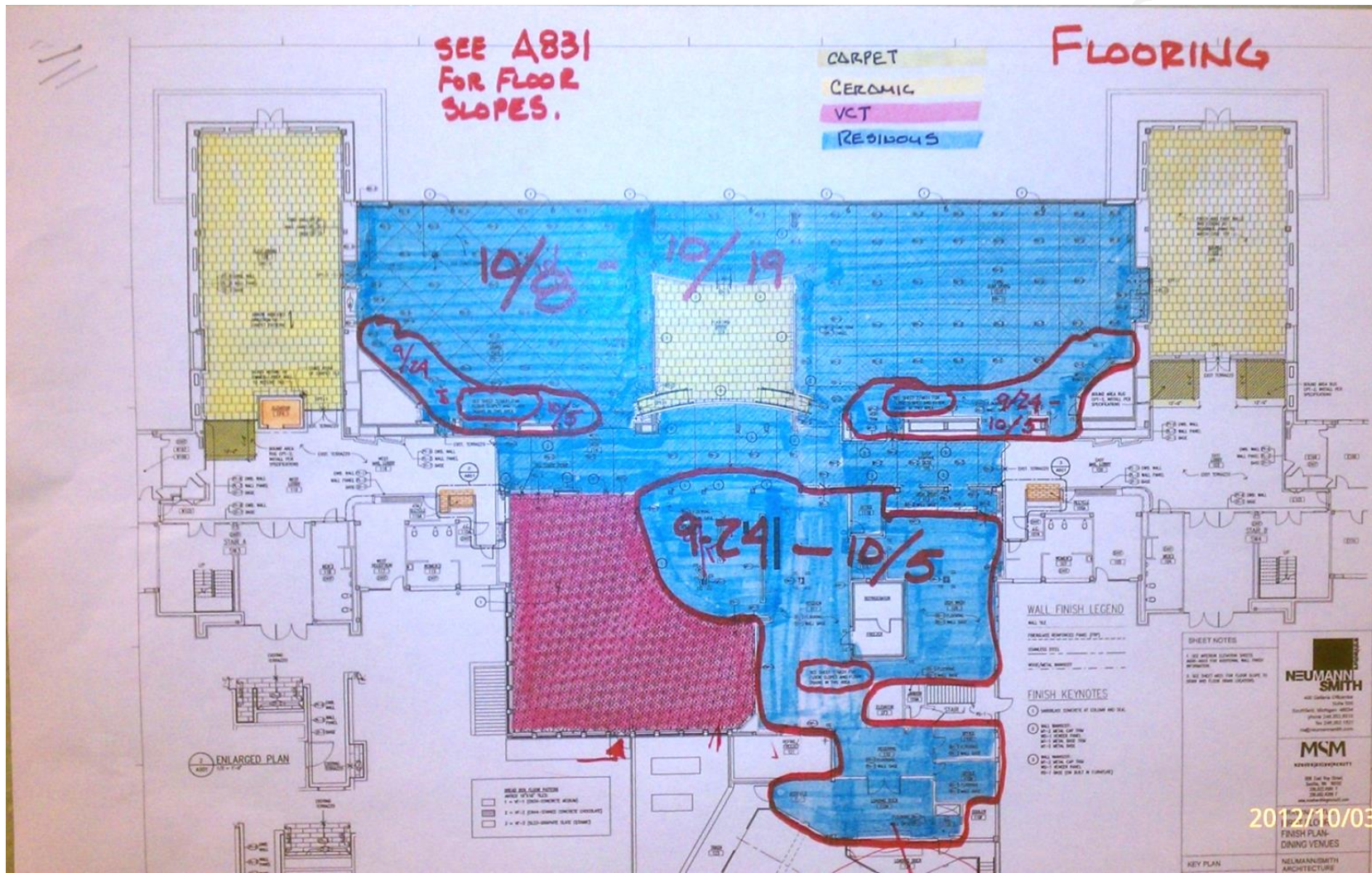
Bar chart

Data list

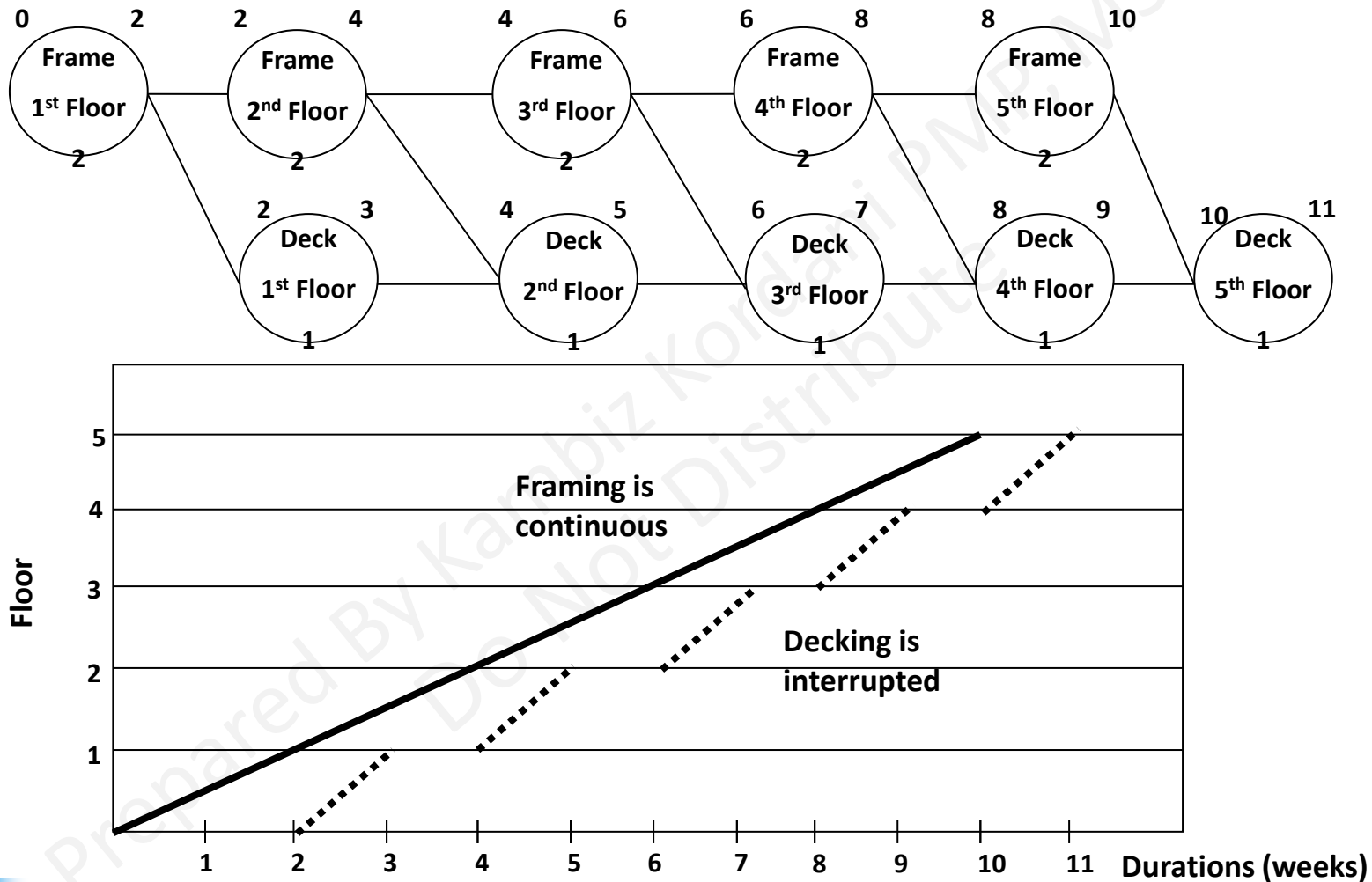
Communicating the Plan



Communicating the Plan



Communicating the Plan



Course Summary



- The lower levels of the LPS – make-ready, weekly work planning and daily huddle – fall below where traditional project planning ends;
- LPS works in a collaborative environment in which subcontractors discuss constraints and handoffs;
- Superintendents do not dictate the schedule in the LPS;
- Tracking assignment completion is key to learning and continuous improvement.