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A Facilitators' Guide to the Last Planner® System:

A Repository of Facilitation Tips for Practitioners

By

Paul Ebbs and Christine Pasquire
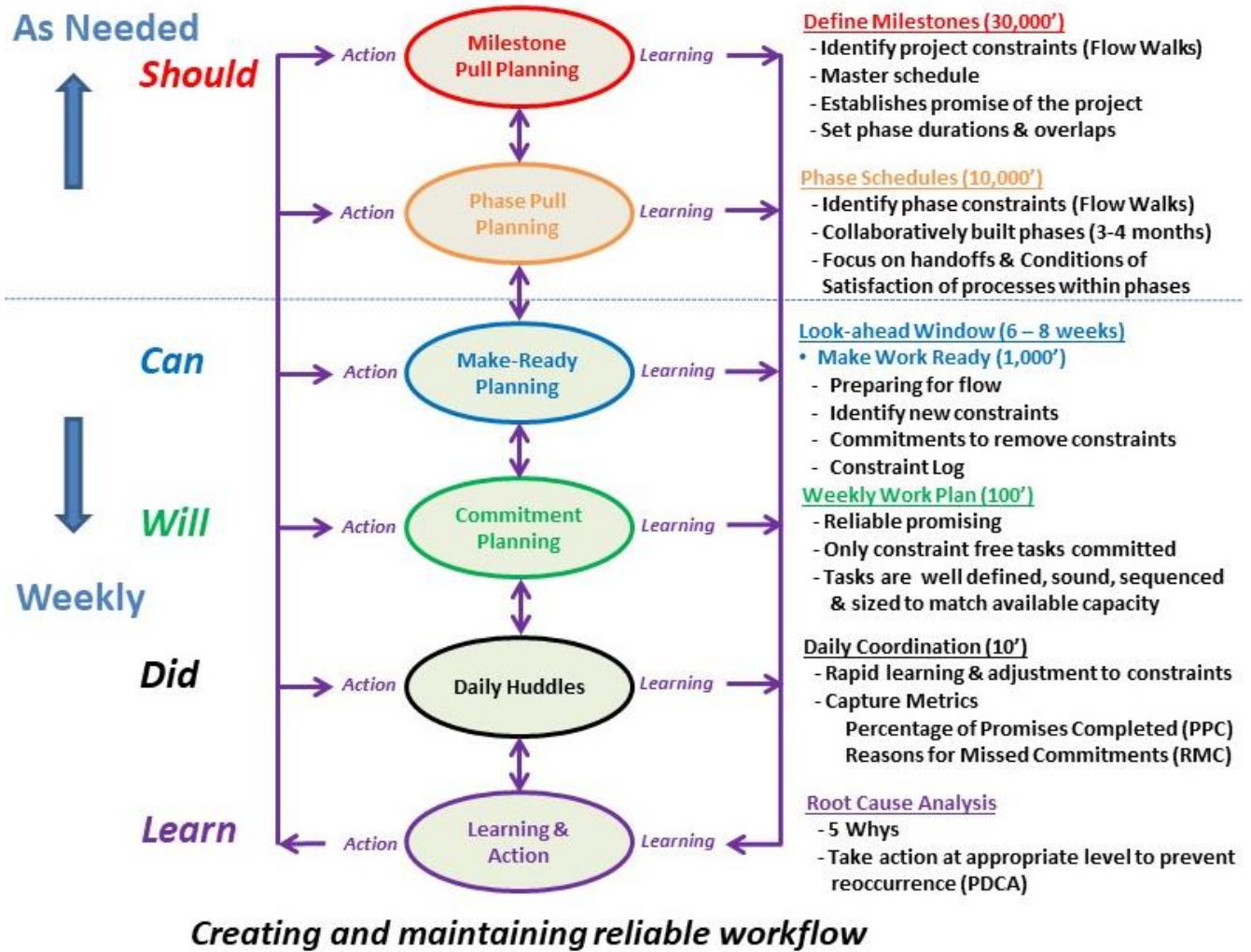
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Figure 1: Latest Last Planner® System[1] Schematic (after Glenn Ballard, Greg Howell, Hal Macomber and others)

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[1] "Last Planner" is a registered trademark of the Lean Construction Institute. For licensing or additional information, please contact www.leanconstruction.org

Testimonials

"The Facilitator's guide provides a clear understanding of how the Last Planner® process works and the best way to implement it. This is a great tool, but the jewel in the crown for me was the Facilitators' Checklist which is a useful two-page summary giving a step by step approach. I have used this during Last Planner sessions and found it to be a great prompt to make sure I'm not forgetting anything. Altogether the guide is an invaluable companion for anyone facilitating a Last Planner® session." Simon Watson (Jones Engineering Group, Ireland)

"It is a great summary of the important building blocks necessary to build an effective planning system from a facilitator's point of view, especially if they are starting to work with LPS. It is always good to have a list like this which can serve as a benchmark to drive the process, and as time passes people will get used to these items and won't even need the checklist." Thais Alves, PhD (Professor, San Diego State University)

In my role as LPS facilitator on a project the checklist was invaluable preparing for the pull plan sessions, prompting the flow walks and constraints generation process, and ensuring the reasons for missed tasks were recorded, analysed, and learnings actioned. This enhanced level of preparation allowed more time to create the correct mood in the room to facilitate the sessions. Increased PPC stability & reliability was attributed to, in part, the routine introduced by reference to the Guide & Checklist. I now use the Guide and Facilitators' Checklist as a template for LPS implementation on each new project. As a facilitator working across numerous projects, I intend incorporating the finalised checklist into our standard project set-up procedures, as well as using them as an auditing template towards achieving consistency in our LPS implementation." Willie Power (Productivity Manager, DPS Group, Cork Operations, Ireland)

About the Authors

Paul Ebbs has a BSc (Hons) in Construction Management and is a recipient of the Ivan Webb Gold Medal Award from the Master Builders and Contractors Association. As a co-founder of the Construction Innovation Lab in 2013 and Lean Construction Ireland in 2014, Paul is an advocate of innovation through research, lean project delivery and systems thinking. Paul has worked in Ireland, US and UK and on projects including golf course developments, social housing, healthcare, educational, decommissioning and critical infrastructure. He has industry experience as a mechanical technician, finishing foreman, site manager, project manager and low energy consultant. Paul is an author of International Group for Lean Construction (IGLC) papers, industry articles and blog posts. He is the chair of the 27th Annual IGLC Conference and co-chair of Lean in Public Sector (LIPS) in Dublin, Ireland, 2019. He is a lean practitioner having worked as a lean coach with Umstot Project and Facilities Solutions and as an action-based research fellow at the Centre for Lean Projects. His research led to the development of this guide and other social tools such as the Flow Walk. Paul is completing his PhD research on integrating project production risk with collaborative planning & control systems under Professor Christine Pasquire.

Christine Pasquire has a BSc Quantity Surveying, a PhD in Construction Management and is a Fellow of the Royal Institution of Chartered Surveyors. One of the original four directors of LCI UK Ltd, Christine has been a long-standing advocate, researcher and teacher of lean construction. She is currently Professor of Lean Project Management in the Centre for Lean Projects, Nottingham Trent University, UK. Christine's route to lean began 20 years ago with research into offsite manufacturing particularly in the Building Services sector and has grown to encompass the practicalities of lean implementation in both project and organisational transformation. Current research projects include applications of Takt and other forms of lean construction planning; measurement of the impact of lean on human performance; investigations into waste that is institutionalised within the systems and structures of design and construction and developing pathways for common understanding as a flow. She has published over 110 peer reviewed papers and completed in excess of £2,000,000 of funded research work in the field of construction management.

Executive Summary

The Facilitators Guide to the Last Planner® System (LPS) was created through action-research by the authors and validated by expert reviewers. It provides tips, recommendations for further reading (through hyperlinks & references) and checklists for new facilitators of the LPS. It is also designed to help lean practitioners develop a better understanding of each of the key components of the LPS - "should", "can", "will", "did" and "learn" – through a step by step approach. However, **this guide is only supplementary support. Only the basic elements of the LPS are covered. It does not replace training and coaching from an experienced LPS facilitator.**

This guide is best introduced through a Study Action Team™ (SAT) after training/coaching and "hands on" practical experience. Initial learning of key elements of the LPS is most effective when introduced to teams using action-based learning and simulations and followed up with sessions that incorporate more of the key elements of the LPS. The focus must be on learning a little and using it rather than learn a lot and lose a lot.

The guide includes the essential attendees (Last Planners) required at each of the different LPS sessions. Last Planners are the people who are closest to the work and responsible for project delivery. They range from architects and engineers to trade supervisors and inspectors. Each Last Planner must deeply understand their own work and any alternative methods for their work so that their contributions are effective to the team. They must have the authority to make decisions at each session to commit required resources. Their input is essential at each session. Efficient and effective execution of the project is achieved through the essential conversations and coordinated action(s). The sooner the Last Planners are engaged, the firmer the plan becomes. Some additional LPS facilitator guidance is in included in Appendix One, Two, Three, Four and Five. This includes key steps to pull planning, suggested LPS Ground Rules for effective sessions, Facilitator Checklists for LPS sessions along with some guidance how to use them, and suggested questions for LPS facilitators using the guide for a SAT session. Additionally, the authors recommend reading the practitioner's guide to using the Last Planner System – Path Clearing Approach (LPS-PCA) along with this guide.

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1.0 What is the Last Planner® System (LPS)?

The LPS is a socio-technical project production planning & control system that helps produce reliable work flow and rapid learning in programming, design, construction and commissioning of projects. The principles of the system apply to any work requiring coordination between people. LPS is a structured collaborative process that dramatically improves coordination and the identification of constraints on projects through effective conversations, shared understanding and reliable promising. This improves value on the project in the form of safety, quality, team morale (mood), and productivity that in turn reduce schedule & cost. A webinar providing a short overview of some of the key elements within the LPS can be found [here].

In the Lean Project Delivery System (LPDS) schema, the Production Planning & Control function is played by the LPS. It is a social system of Last Planners (those closest to the work) that serves as the back bone for implementing Lean Project Delivery. The LPS increases transparency, helps with accountability and team building. It stabilizes work variation and works towards continuous flow for Last Planners and ultimately improves project performance. Distinct from project controls, which has the job of setting project goals and tracking progress toward them, LPS has the job of doing what is needed to achieve goals, including collaborative planning (and re-planning as needed) how to reach project milestones; dictate the pace of production by making work ready so what SHOULD be done CAN be done; committing only to scheduled tasks that are well defined for performers, sized to performers' capabilities, sound, and in the right sequence; and learning from experience.[2]

1.1 Key Features of LPS

Those closest to the work plan what tasks should, can and will be done. She/he will be at the lowest level in their organisation that can make commitments and authorise resources. The closer the work gets, the more

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[2] The role of the LPS within a LPDS as defined largely by Glenn Ballard but with additions from Farook Hamzeh, Thais Alves, Cynthia Tsao and David Umstot

detailed the planning becomes. Plans are developed collaboratively at every level by all team members that can affect the schedule.

The levels of the LPS include[3]:

- Project to phase (Purpose to 30,000'; or boulders to rocks)

- Phase to process (30,000' to 10,000'; or rocks to gravel)

- Process to operation (10,000' to 1,000'; or gravel to sand)

- Operation to step (1,000' to 100'; or sand to grain)

- Step to elemental motion (100' to 1'; or grain to particle)

Keep master schedules at milestone level of detail. Use pull planning to inform the detail of the weekly/monthly plans. Schedules at every level of detail are highly visual and always in public view.

Reliable promising is at the heart of the LPS.

- Last Planners must feel they have the power to say "no" or "yes, if…".

    - If people always say yes, commitments highly unlikely to always be reliable.

Last Planners write, place and move their own tags (Post-It®) or digital sticky notes (for more advanced users).

- Everyone must understand that each tag they write is their commitment to their team.

    - No tag can be moved without a prior request and acceptance.

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[3] NB: The levels of detail in LPS differ to P6 (CPM) because the different levels interact with each other. The level detail within each level might contain similar detail but the process to get to this detail is very different!

Tasks must be well defined, sound, correctly sequenced and sized before they can begin.[4]

- **Well defined** tasks are clear e.g. verb + noun + location + responsible person

- "**Sound**" tasks are "made-ready" by screening for constraints against the 8 Flows.

- Constraints are revealed and removed as a team.

- Tasks are **sequenced** in order of dependency.

- Tasks are **sized** relative to available capacity.

Mistakes/reasons for missed commitments are trended and investigated for root cause(s).

- Countermeasures are developed collaboratively to improve team performance.

- The plan is kept "real" – missed commitments are re-adjusted and re-scheduled as necessary.

Planning system performance (PPC) is measured as a team, not individually. "One for all, all for one".

- Some teams report PPC at individual levels however the authors recommend a system approach.

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[4] Note: Traditionally Make-Ready sits between Phase Pull Planning & Weekly Work Commitment Planning. However, the authors propose elevating Make-Ready Planning from it's current position to form part of every level of planning. See Ebbs and Pasquire (2018). Make-Ready Planning using Flow Walks: A New Way to Collaboratively Identify Constraints. http://iglc.net/Papers/Details/1598

1.2 Key Success Factors

1. Carefully consider & incorporate the key step actions in the LPS-PCA into your LPS implementation strategy. If you are serious about sustaining success the LPS-PCA provides the necessary framework.

2. Support from the Project & Site Manager is key – their buy-in to use all elements of the LPS is critical to success.

3. Strong support of top executives (client & contractor) is essential to support middle management buy-in.

4. Create an open environment where trust, communication and collaboration can thrive.

5. Rank" is left at the door, this empowers all stakeholders to speak freely.

6. Without that openness, planning sessions will not be successful.

7. Start meetings on time, finish on time – respect people's time.

8. Issues raised at meetings not relevant to the whole team are logged in the "parking lot".

9. Teams need coaching. This will fade off as the team takes ownership of the plan and sessions.

10. Always focus on making activity flow efficient (optimise the project) rather than the efficiency of individual resources/tasks (optimising the piece).

11. Logistics matter: room size, long flat walls, WWCP boards, pre-printed tags, sharpies, etc.

12. Last Planners need to come prepared for meetings and daily huddles.

13. Make metrics visible and use them to improve the system.

14. Tightly couple learning with action – learn a bit and use it vs. learn a lot and lose it.

15. For sustainable results use all elements of the LPS – "Should, Can, Will, Did and Learn".

1.3 The LPS Facilitators Role

The facilitator plays several critical roles in sustaining the successful implementation of the LPS. These also include trainer and coach. The following characteristics are highly desirable:

- Previous experience co-facilitating lean simulations and every element of the LPS alongside a competent facilitator.

- Competency guiding the sessions they are facilitating.

- Good time management skills. Start & finish on time. People vote with their feet.

- Ability to train & coach other team members so the facilitator can rotate between sessions and build empathy for the facilitator role within the team.

- Command respect from their peers within the team.

- Possess the authority to set up sessions, create specific agendas and coordinate all necessary logistics (rooms, food, agendas, materials, project information, critical attendees) in enough time.

- Ability to help the team set goals and agree on ground rules and then gently remind Last Planners of the agreed ground rules if old behaviours begin to return.

- Recognise when a new role appears and assign someone to role-play if necessary.

- Ensure the names, roles & contact details of all Last Planners are captured on the Key Tag (Figure 4).

- Be a good observer and listener in order to recognise when a change of approach is needed.

- Recognise the use of language that fosters unreliable promises e.g. I should, I'll try, fingers crossed, that's the plan etc.

- Allow people to slowly learn how to use the system without criticising every mistake made.

- Don't drown people from the fire hose with too much information to retain during training and on-boarding.

- Ensure that a systems thinking approach is taken to recording and tracking PPC and missed commitments.

- Recognise that some Last Planners are quiet – suggestions may need to be solicited from them.

1.4 Who are the Last Planners?

Last Planners are the people closest to the work at the lowest level of responsibility in their respective organisations. As a rule of thumb, they will have several critical activities that would stop the project. They

must be able to make decisions at sessions and commit resources on behalf of their organisation (i.e. so the team can re-plan as necessary).[5]

1.5 Project Kick-Off Workshop

The goal of the project kick-off is to create a shared understanding of the project scope, goals and roles including how stakeholders work impacts on each other. It is a combination of action-based learning & implementation of LPS elements on a live or sample project – preferably a live project. Depending on the lean maturity of the team the kick-off workshop is held over 1 or 2 days which may include an introduction to lean with other Lean Construction Institute simulations such as Make-A-Card or Parade of Trades. The facilitator must ensure the necessary logistics (Section 1.3) are in place.

1.5.1 Essential Last Planners

In short, anyone who can critically affect the schedule during milestone or phase planning must attend. If they cannot attend, another individual will have to role play and create their activity tags (see Section 2.4.1) on their behalf. This is not ideal and will create more assumptions in the schedule requiring validation. Typical Last Planners required include but are not limited to client representatives (project manager, project engineer, clerk of works, SHEQ rep, etc.); main contractor supervision staff (project manager, site manager, planners, etc.); trade contractor foremen; key suppliers; senior leadership executives.

1.5.2 Villego® Last Planner® System Simulation

Villego is a simulation using Lego® that occurs over a period about 4 hours. The simulation is highly recommended as the Last Planners first experience of LPS although other simulations are available (see 1.5.3). Villego illustrates the benefits of Lean thinking using key lean concepts of flow, pull, Plan-Do-Check-

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[5] Note: Last Planners do not perform the role of a traditional planner i.e. being a "Last Planner" is not a specific job function but a role that is encompassed in your every day planning of work. Similar to how you plan activities in your personal life such as arriving for work on time, taking lunch, going to gym, watching your favourite programme, etc. etc.

Act, continuous improvement, detailed short-term planning and the lean behaviours promoted by the LPS[6].

The simulation provides a safe learning environment using a simple Lego project to expose the participants to the LPS principles through a hands-on "learn-by-doing" approach. Participants learn from the "Aha" moments experienced in the simulation. A short video of a Villego® workshop at San Diego Mesa College is available to view. Participants build a small Lego villa in each round. The first round uses traditional planning methods – plan the way you normally plan. The second round uses key elements of the LPS. Financial performance of each team is calculated after each round based on schedule, quality and safety performance. Figure 2 shows a team during one of the planning stages of Villego.

Figure 2: Villego LPS simulation (Source: Paul Ebbs)

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[6] Dan Fauchier and Thais Alves (2013). *The Last Planner System is the Gateway to Lean Behaviours*. In:, Formoso, C.T. & Tzortzopoulos, P., 21th Annual Conference of the International Group for Lean Construction. Fortaleza, Brazil, 31-2 Aug 2013. pp 559-568. Available at: http://iglc.net/Papers/Details/898

1.5.3 Other Last Planner® System Simulations

Other simulations used to teach and coach the LPS include:

- Parade of Trades (variation)

- Make-A-Card (batching, one-piece flow, pull, perception of quality)

- LEAPCON

- DPR Block Tower

- Lego® Airplane Game (like Make-A-Card)

- Red/Green Game (Trust)

- Helium Stick

- Silent Squares (silo thinking vs. collaboration)

- Repairperson Game (systems thinking)

1.6 Project Planning

Immediately following the Villego session the team should start to collaboratively develop the project plan. The authors recommend starting with [Flow Walks](7) to identify project production risks in advance of creating a plan. The next step focuses on creating collaborative Milestone and Phase Plans (what should be done) predominately through pull planning but including actions to treat the production risks and alternative set-based planning options identified during the initial Make-Ready Planning sessions.

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[7] i.e. Make-Ready Planning as per footnote #2 (further guidance on this follow in our next publication).

2.0 What "Should" be Done

What should be done on a project is established together with the logic and sequence of major activities including long lead items & major constraints. This is done on two levels: milestone & phase planning.
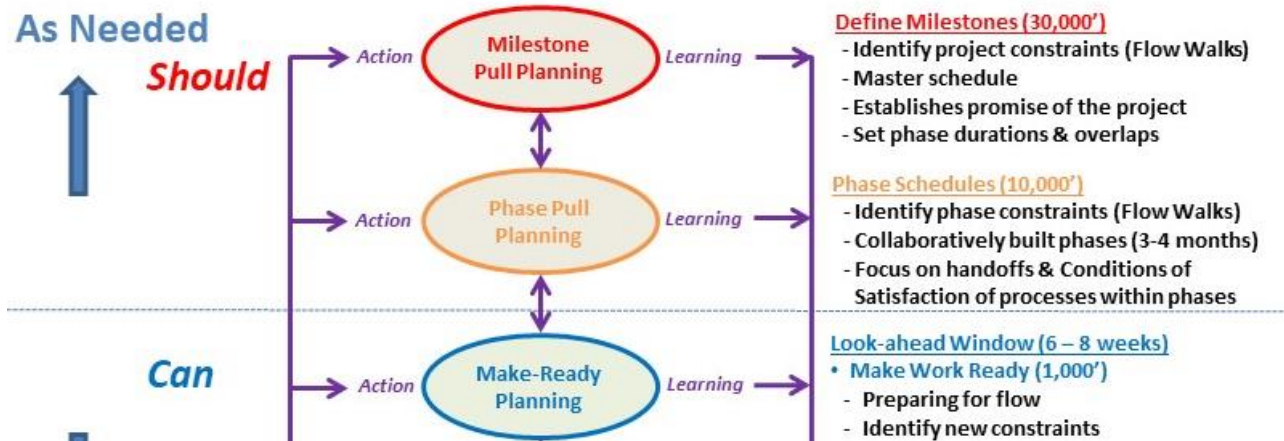
Figure 3: Key Elements of "Should"

2.1 Signing up to become a Last Planner

Every Last Planner picks a different colour tag and signs up to project key tag similar to Figure 4. They will write their name, company and contact details (phone number) onto their chosen colour.

Figure 4: Last Planners signing up to Key Tag

The colour tag chosen (see Section 2.4.2) is used by that Last Planner from there on. This facilitates three purposes:

1. To help others quickly find the owner of an activity.

2. The Key Tag becomes the Last Planner's "sign-up and commitment" to planning & controlling the work as a team. It is critical the "sign-up" is personal & not done on behalf of others.

3. It puts a name to a face.

2.2 What is Pull Planning?

The objective of the pull plan is to align all stakeholders to one goal that is clearly defined. Pull Planning is a process to collaboratively develop the plan by working backwards, starting from the end milestone (goal) on the far right, ask "what is the last big item that needs to be finished to complete the work?" e.g. handover complete. Then, working from right to left, ask "what needs to be completed to start the last milestone?" e.g. slab complete. This ensures that the logic of the work flow is accurately captured and identifies all necessary activities & durations and helps constraints get flushed out. This ensures reliable work flow is created and ensures what's needed for a successful handoff between activities and/or organisations is identified. Afterwards, a left to right (forward) pass needs to be conducted to ensure that the plan demonstrates a logical workflow sequence, as well as to aid in identifying opportunities for schedule improvement. Pull planning creates agile teams that can respond to changing conditions or creating multiple plans of the same activity that eliminates unnecessary work and reduces durations. The initial results of a pull plan usually identify that some or all of the plan needs to be re-planned based on the Last Planners initial estimation of durations or to ensure new conditions/constraints that were flushed out during the session are accommodated without pushing a milestone date forward. A short summary of the key steps to pull planning is in Appendix One[8].

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[8] Courtesy of The ReAlignment Group of California. Adapted and re-printed with permission

2.3 Milestone Planning

Milestone Pull Plans identify the strategy of the entire project as shown in the bottom of Figure 5. Some people refer to it as the master plan and take the milestones directly from a CPM schedule to inform the phase plan. However, in doing this, milestones are pushed rather than pulled to inform collaborative planning sessions. The Phase Pull Plan at the top of Figure 5 is only a section of the Milestone Plan. Typically, this is approximately 2 - 3 months long. Both the milestone and phase pull plans only represent what **SHOULD** be done.
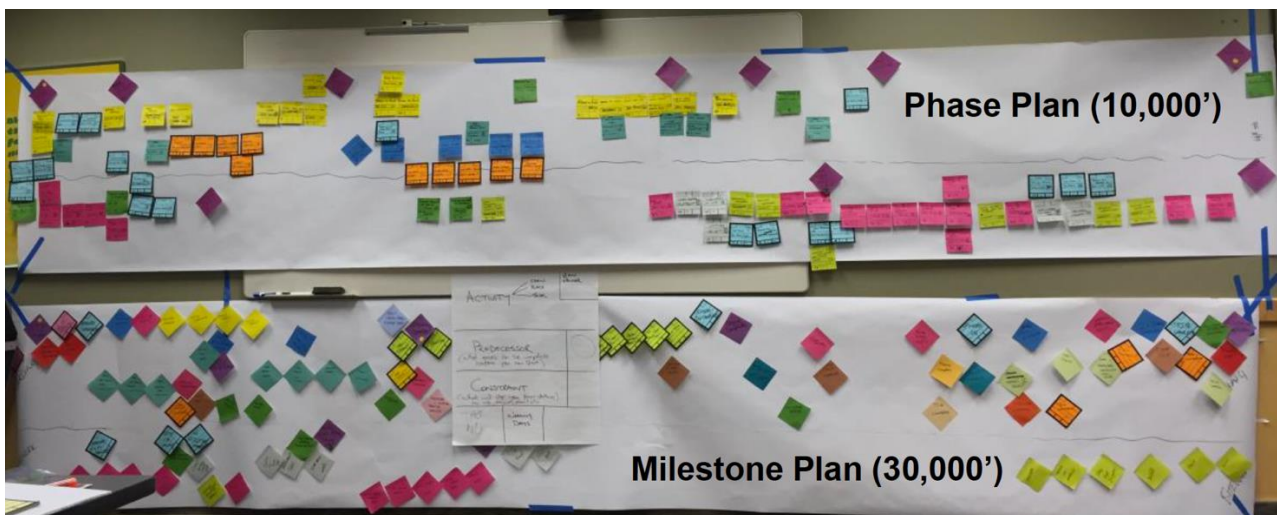
Figure 5: Milestone and Phase Plan Image (Source: Paul Ebbs)

Milestones are either "start" or "finish" moments in time and are not activities. They are always placed as diamond shapes on the plan. Typically, a total of around 50 to 100 high level milestones for all the project stakeholders are identified. Each milestone is relative to either key contract milestones or another Last Planner's milestone. It is a 30,000' view of the project with very little detail but includes:

1. Phase milestones – e.g. enabling works started/complete; raft removal complete; screed remediation complete.

2. Long lead items/documents – e.g. site set up complete; excavation complete; RAMS acknowledged; equipment orders.

3. Prefabrication opportunities – e.g. rebar design approved.

Major constraints impacting the milestones that emerge during the pull planning are recorded on the constraint log for discussion and actioned with the relevant stakeholders.

2.4 Phase Pull Planning

Next, the team takes a section of the milestone pull plan (usually no more than 2 – 3 months). The purpose is to specify the handoff between processes or organisations and clarify the conditions of satisfaction to be met. The phase plan is a 10,000' view of the project's processes with a greater level of detail than the milestone plan. As a rule of thumb, each milestone should have several activity tags associated with it, with durations of approximately 5 days each.

2.4.1 What is "the Tag"?

Each tag represents a commitment of work and duration from that Last Planner, as well as what they need completed by others so they can reliably perform their committed work. Each Last Planner (or discipline) uses separate designated colour tags and is responsible for filling out their own activities. An example tag is illustrated in Figure 6. Tags must reflect the needs of the team and the facilitator should help the team come to a consensus on a standard format. Pre-printing these tags is recommended once the team has trialled and agreed on the layout. Some more guidance on the tag can be found in Felipe Engineer's LPS Guidance Note in Appendix Four.

Colour by trade/designer/rep

Activity

- 1 crew, 1 place, 1 thing

Duration of activity

- Predecessor(s)
- Constraints

Unique Tag ID Numbers

Optional

- Crew Size

Figure 6: Sample Activity Tag

Other Key Features of a Tag:

1. A tag is a personal promise. The Last Planners are making a commitment with the information they provide. Making a promise to peers in public tends to make people more likely to fulfil that promise.

    a. It is important that everyone understands that when they fill out the tag, they are making a "*promise*" to their peers to complete a specific action. The facilitator should remind them of this frequently. See section 4.3 on how to make a reliable promise.

2. Ensure the necessary information is captured in a consistent and complete manner. Use verb + noun criteria so there is an action applied to the activity e.g. install (verb) rebar (noun).

3. No one can ever move someone else's tag without requesting and receiving permission from them. Ideally, the person who owns the tag moves it so that the hand-off criteria and activity sequence between Last Planners is fully understood. Treat tags like work items, an architect would not move an engineer's column, or a plumber would not move an electrician's cable – they would ask their peer to do so if possible!

4. It's critically important that the team clearly communicates the "handoff" criteria, i.e. what conditions must be satisfied/completed before the next Last Planner can do their work. This

avoids misunderstanding between parties and disruptions to the production flow. Missed handoffs are believed to be one of the biggest contributors to delays in work. This is a strong indicator of activities not made-ready.

2.4.3 Creating the Phase Plan

Each "tag" details the task to be completed, the prior work that needs to be finished (predecessor) and any items that will stop you from starting the task (constraints). Every "tag" must be linked to another "tag" (prior work) using each tag's unique ID#. This is like a license plate of a car and unique to every task. The tag ID# ensures that the customer (writing the tag) and the supplier (prior work) become aware of each other's needs and the conditions of satisfaction for handing off work. The customer (writing the tag) must go and find the tag (and supplier) with the prior work and write the unique tag ID# beside it e.g. #44 in the example tag (Figure 6). Requests are required to fill out additional tags of prior work if they cannot find the tag they need on the plan. This links the internal customer and supplier's work together. If the Last Planners are adamant no prior work is required, the facilitator should ask this question: "Can the activity start today?"

Once the initial phase plan is complete a "backward pass" is required to identify more predecessors and/or constraints. This is done collectively and is typically facilitated by the site/project manager or design lead. Each tag should be screened against the 8 Flows (see sub-section 3.4) to clarify if there is anything else that will prevent the activity from starting. Recommended questions the LPS facilitator should ask during the "backward pass" include:

1. What is the last activity to complete in order to start this work?

2. What is stopping you from starting your work?

3. Is there anything else that would prevent you from starting?

4. Is there any opportunity to start your work concurrently?

3.0 What *"Can"* be Done

Once the phase plan is created and agreeable to the whole team, the work that **SHOULD** be done is made ready so that it **CAN** be done. However, as noted earlier Make-Ready Planning does not begin at this point, rather making-ready continues at a more detail task specific level. The most common Reason for Missed Commitment (RMC) noted is usually "prior activity not complete". If you dig deeper through some 5 Why analysis you will usually find this is because the activity was not made-ready against the 8 Flows in the first place.

Figure 7: Key Elements of "CAN"

3.1 Essential Last Planners

In short, anyone that can critically affect the make-ready plan must attend. They must be able to make decisions and commit the required resources on behalf of their organisation. As a rule of thumb attendees will have activities over several days on the phase plan that impacts other work. If they cannot attend another individual will have to role play and create tags on their behalf or else, they may be able to join the call via video link or telephone. Identifying the constraints for removal, assigning the action items and creating the correct logic of work at a more detailed level becomes more difficult without the right people in the room who possess the right information. Production risks often emerge that were known by someone who was not involved in the planning sessions.

3.2 Making-Ready Planning

Each activity in the look-ahead window is screened for constraints (see sub-section 3.4). This is the main mechanism used to determine how and what work should be done, by when, and by whom. The size of the window is determined by the items with the longest lead time to remove a constraint (typically 6 to 8 weeks). Removing the constraint at the right time makes the work ready. Transforming what "should" be done into what "can" be done. Tasks then become ready for a commitment. It is impossible to make a reliable promise if you have not made-ready. If constraints that emerge during make-ready cannot be removed, re-planning may be required. Figure 8 shows a typical make-ready plan.

Figure 8: Make Ready Plan Image (Source: Paul Ebbs)

3.3 Key Steps to Create the Make-Ready Plan

The level of detail of task breakdown increases as each activity draws closer. The 10,000' activity tags created during the phase pull planning session are broken down into more detailed daily tags and are placed into the week the activity will happen. The activity details become much clearer (1,000') than the phase plan.

For example, the tag is similar to Figure 6 but it will have two separate tags created. The first tag (1 of 2) will be a carbon copy of the phase tag but will also include more detail - e.g.:

1. Activity = "Install rebar @ 1st Floor Zone B"; the next tag will state:

2. Activity = "Install rebar @ 1st Floor Zone C" but will only include the unique ID# and sequence (2 of 2)

The conditions of satisfaction (clear expectations) of handoff criteria needs to be clarified at this point. If desired, productivity rates/crew size/location for the different tasks can then be examined at the following weekly coordination meeting i.e. the LPS facilitator should ask was more or less planned work completed and do any resources need to be adjusted for the following week? Always try to have a key milestone at the end of the six to eight make-ready plan and several interim mini milestones at maximum intervals of 2 to 3 weeks apart. This focuses the team on near to immediate goals. If (and when) schedule slippage occurs the make ready plan can be "re-pulled" back from an interim milestone to keep production on track.

3.4 Screening the Make-Ready Plan for Constraints

All activities on the make-ready plan must be screened for any "known" constraints using each of the 8 Flows as a trigger:

1. **Previous activities**
2. **Materials**
3. **People**
4. **Equipment**
5. **Information**
6. **Safe space**
   a. **Physical**
   b. **Time**
   c. **Mental**
7. **External conditions**
8. **Shared understanding**
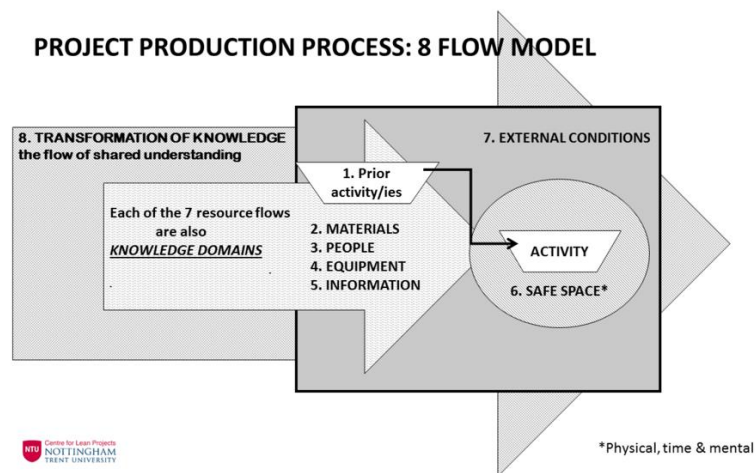
Figure 9: Project Production Process – 8 Flow Model (Source: Christine Pasquire)

It is important to use a system to identify constraints (e.g. a constraint log or different shaped and coloured post-its on the make-ready plan) to ensure quality discussions about "making work ready." This process documents the specific individuals required to remove any constraints in the coming weeks. The responsibility is spread throughout the team and it helps if the "go-to-person" to remove each type of constraint is identified in advance. Making-ready requires each task to be screened for constraints using the 8 flows as a trigger. For example, the LPS facilitator may ask questions like:

1. What activities do you need completed to start this work?

2. What materials are needed?

3. What authorisation is required to start this work and from who?

4. When do you need the crane and for how long?

5. What information is needed?

6. Are there any space constraints?

    a. Material laydown space?

    b. Do you have enough time available in your diary?

    c. Are you working on lots of other projects? Do you really have free head space for this?

7. Any inspections or regulatory requirements?

8. Are the conditions of satisfaction clear between customer and supplier?

Following the screening, the number of "tags" on the plan are likely to increase as further activities are identified to "make work ready" for activities to proceed over the next six to eight weeks.

3.5 The Constraint Log

The constraint log is typically created on a dedicated white board. Details of the constraints that will prevent work from starting and the last responsible moment they need to be resolved by in order to prevent disruption are recorded. The responsible parties to remove the constraints are also assigned. The constraint

log becomes a critical part to make work ready for the next six to eight weeks. Essentially, removing constraints clears the path for the work to proceed as planned.

Examples of constraints include RFIs, TQs, RAMS, authorisations, permits, isolation strategies, access, security, other projects, contractor or material approval etc. Timing rules for identifying and resolving a constraint may be different, e.g. material delivery too early without space may get damaged waiting to be installed.

3.6 Workable Backlog

The workable backlog is a "Plan B" of items that are not affecting the priority work and can be completed in isolation of the priority work. These activities can then be brought into the daily or weekly work plan in the event of work being unable to start due to a constraint. This ensures that if (and when) work does stop; there is already a "Plan B" for people to work on while the constraint to Plan A is being removed.

4.0 What "Will" be Done

This is also known as commitment planning and takes place at the weekly coordination meeting. Once the work has been made-ready, promises must be secured from every Last Planner using the four rules for reliable promising and commitment loop (sub-section 4.3) to ensure the critical activities that need to be done *WILL* be done.

Figure 10: Key Elements of "WILL"

4.1 Essential Attendees

As a rule of thumb, any Last Planners with tags on the previous or coming week's work plans need to attend and participate.

4.2 Commitment Planning

The first two weeks of the Make-Ready Plan are the only place firm commitments can be made. The commitments are "pulled" from the people that have created and placed the tags. This emphasizes the requirement that every Last Planner writes and places their own tags. Their tag is their promise and a promise turns into a commitment when action is taken to deliver.

4.3 Weekly Work Commitment Plan

The level of task breakdown in the Weekly Work Commitment Plan (WWCP) increases in so far as each stakeholder might create multiple daily tags especially if they have multiple daily activities i.e. each tag details 1 crew, 1 place, 1 thing. Any known constraints to an activity making it onto the WWCP must be removed before a reliable promise can be made and included in the WWCP. This supports smoother and more reliable workflow because the activities are then ready to be completed. Remember: the closer the work gets, the greater the detail of the task.

Greater detail = greater accuracy = more reliable promises

Tasks must be well defined, sound, correctly sequenced and sized before they can enter the WWCP in order to create reliable workflow.

1. Well defined tasks can be clearly understood e.g. verb + noun + location + responsible person.

2. "Sound" tasks are "made-ready" by screening for constraints against the 8 Flows.

3. Constraints are revealed and removed as a team in advance.

4. Tasks are sequenced in order of dependency.

5. Tasks are sized correctly based upon available capacity.

Figure 11 shows a typical WWCP. The tags turned in a diamond shape are missed commitments.
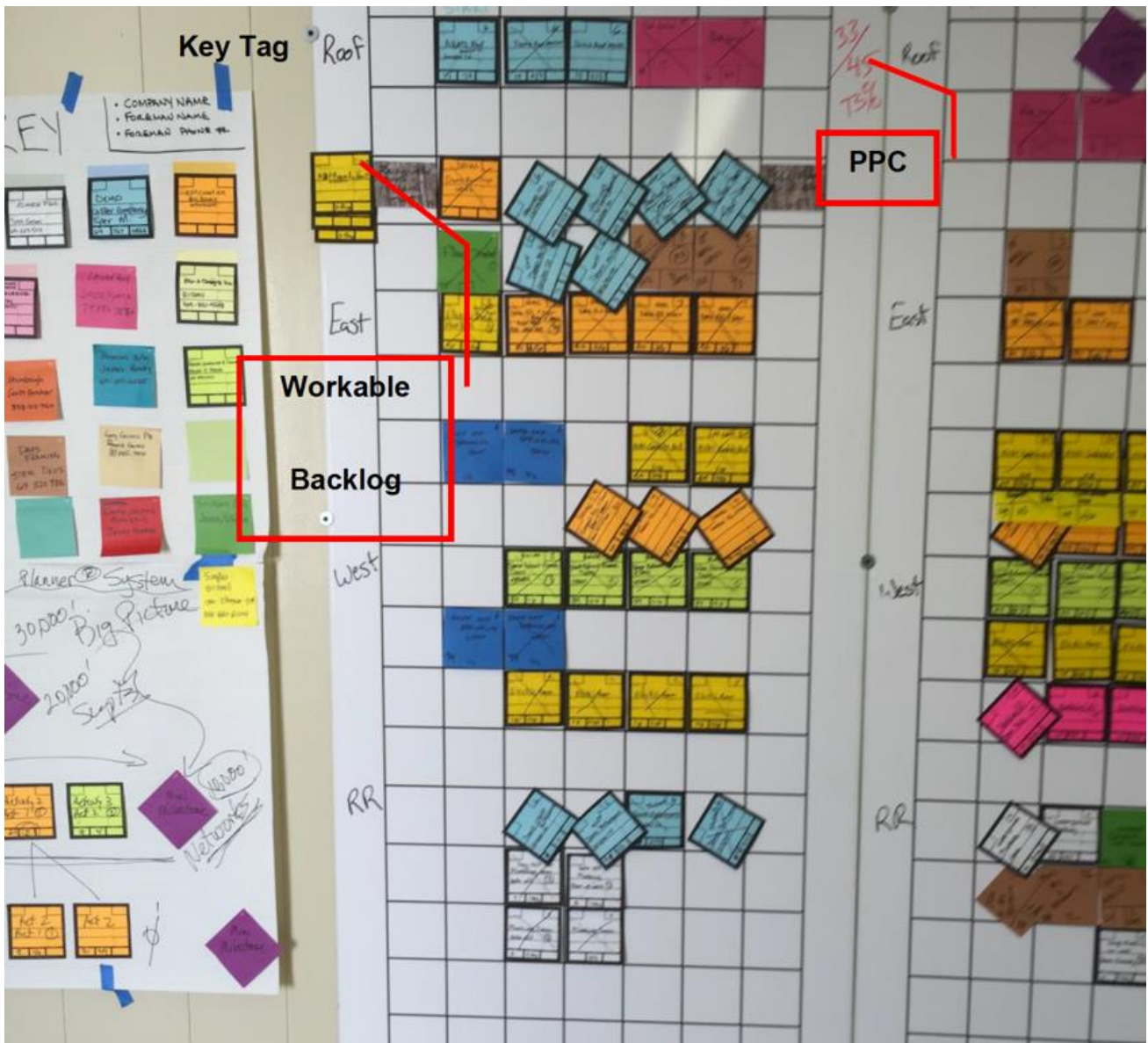
Figure 11: Weekly Work Commitment Plan Image (Source: Paul Ebbs)

While creating the WWCP, the team should always be looking for ways to improve the plan. This can be achieved by breaking work down into smaller chunks (batch sizes) so that follow on activities can commence earlier in smaller batches, rather than waiting for larger batches of work to be completed.

When target dates or milestones need to be compressed or are missed, the facilitator needs to ask the team "what can we do as a team to pull this back and meet the target date?"

The weekly work boards are highly visual and provide three key benefits:

1. Simple visual cue.

2. Up-to-date information.

3. Show what is really possible.

4.3 Four Rules for Reliable Promising

Projects can be mapped out as a network of commitments and decisions that release work and value-adding activities. Making promises in public promotes care in ensuring they are reliable. Reliable promises build trust within the team. The most important prerequisite to making a reliable promise is that all Last Planners have the power and feel free to say "*no*" or "*yes, if…*"

Given the 4 rules below[9], you <u>must</u> say "NO" if have you any doubts about achieving a promise you will make to the team. This will trigger a path clearing activity on the 8 Flows. Otherwise you are stating "YES" without qualification - this is your commitment and will be used as the activity metric (PPC). So before making a promise:

1. Understand your customer's Condition for Satisfaction (CoS)[10].

2. Assess competency beforehand i.e. do you or the people under your leadership have the wherewithal to complete the activity to the CoS?

3. Ensure capacity is available and allocated.

4. Accept responsibility for failure and re-review the process for learning.

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[9] Macomber, H., Howell, G.A. & Reed, D. (2005). *Managing Promises with the Last Planner System: Closing in on Uninterrupted Flow.* In: 13th Annual Conference of the International Group for Lean Construction. Sydney, Australia, 19-21 Jul 2005. pp 13-18. http://iglc.net/Papers/Details/344

[10] A condition of satisfaction is the criteria that the person requesting the work places on the promise being declared completed to their satisfaction. See Figure 12.

Follow the four steps in the Commitment Loop (Figure 12). Every Last Planner (customer and supplier[11])

must understand each of the steps to ensure whatever action is taken is the right action, by the right person

at the right time. The future of the project is invented through the conversations between Last Planners by:

1. what is or what is not said;

2. what is or what is not heard;

3. what is or what is not understood; and

4. what action is or what action is not taken.

Figure 12: Commitment Loop (adapted from Fernando Flores & Hal Macomber and Greg Howell)

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[11] A customer is person waiting for and depending on the product of the promise. Also known as the "next customer". The supplier is the person making the promise to perform the action.

4.4 Missed Commitments and Re-Planning

Breakdowns in planning and coordinating action happen for many reasons. Typically, over 90% of the time they are related to system issues. When the system breaks down and commitments are missed it becomes the responsibility of those who made the promise to raise their hand to the group of interdependent people to which they belong to, as soon as they lose confidence that they will be able to fulfil their commitment. Someone within the team may be able to help mitigate against the emergent constraint. Additionally, it also provides time for re-planning and keeps the plan real.

Tracking missed commitments daily during the daily huddle facilitates re-planning and creates an opportunity for the facilitator to ask questions such as:

1. What can we do as a team to mitigate against the missed commitment?
2. Can we move the crew elsewhere or re-plan to work in another area considering this constraint?
3. Are there items on the workable backlog that we can fall back on?

4.5 Measuring Reliability with Percentage of Promises Completed (PPC)

The Percentage of Promises Completed (PPC) is the percentage of promises met vs. made. This gives the team a snapshot in time of the plan's reliability and a measure of how well the team can predict what is achievable. You will also hear PPC called "Percentage of Plan Completed", however, the authors and others prefer to replace plan with promise because we are measuring the actual promises rather than a proportion of work completed that is traditionally calculated in P6 or CPM schedules.

The Last Planner® System (LPS) was created by Glenn Ballard and Greg Howell in the 1990s to address the issue of poor workflow reliability which ultimately impacts productivity. In their study of 450 foremen's WWCP across seven sites in the US they found that the average PPC from one week to the next was 54%. This is an industry average for traditional projects, and it is at this rate that traditional project productivity is planned for. Typically, LPS improves PPC past 80% because the Last Planners gain a greater understanding of

the project and form better customer/supplier relationships with the other Last Planners connected to their work.

PPC is tracked weekly and is trended on a Pareto chart. However, PPC is not just a target to reach. While the goal is always to fulfil 100% of promises, if it is 100% week-in-week-out the team should stretch their targets. It is meaningless as a management tool per say – it is not a stick to beat people with. The facilitator must be mindful that some teams or individuals will play (game) the system. Also, we would draw caution to measuring PPC by individual, trade or design discipline as PPC is measuring the effectiveness of the system – not individual parts. For example, the root cause of a low PPC for one trade partner within the system may be that another design discipline or owner rep has not provided the correct information. Be mindful of monitoring system performance rather than attributing blame to another Last Planner.

Consistently hitting 100% PPC every week is usually a clear sign of Last Planners gaming the system and that either activity durations are exaggerated (sandbagging) or tasks that were due to be complete were not on the board. If 100% PPC is reached the LPS facilitator needs to ask questions like:

1. "What extra work was completed last week that was not on the WWCP?"
2. "Why were some activities completed quicker than expected?"
3. "How can we aim for more work to be completed next week?"

PPC is best used as a tool to measure the effectiveness of the planning system and team performance, not individual performance. PPC measures workflow reliability and how predictable the release of work between work crews is. It helps the team understand how well they are working together and improve their performance. This is done at a system level by recording the reasons for missed commitments (RMC) and then identifying root cause - not pointing the finger of blame at someone else. If teams are not capturing their RMC and acting to address root causes the same issues will reoccur. Project throughput, productivity, and progress rises and falls with PPC.

4.6 Other metrics used with PPC

- **Tasks Made Ready (TMR):** the ability of the team to identify and remove constraints before they impact an activity

- **Tasks Anticipated (TA)[12]:** how well the team can influence and predict the future

- **Reasons for Missed Commitments (RMC):** capturing the reasons why PPC is not 100%

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[12] Hamzeh, F.R. & Aridi, O.Z. 2013, 'Modeling the Last Planner System Metrics: A Case Study of an AEC Company ' In:, Formoso, C.T. & Tzortzopoulos, P., *21th Annual Conference of the International Group for Lean Construction.* Fortaleza, Brazil, 31-2 Aug 2013. pp 599-608. Available at: http://iglc.net/Papers/Details/907

5.0 Matching "DID and WILL"

Increasing the match between did and will helps us learn to do what we say we are going to do. Doing this daily helps the team identify and remove constraints to their daily work, re-plan as necessary and prevent unnecessary work from starting. This keeps the plan real and up-to-date.
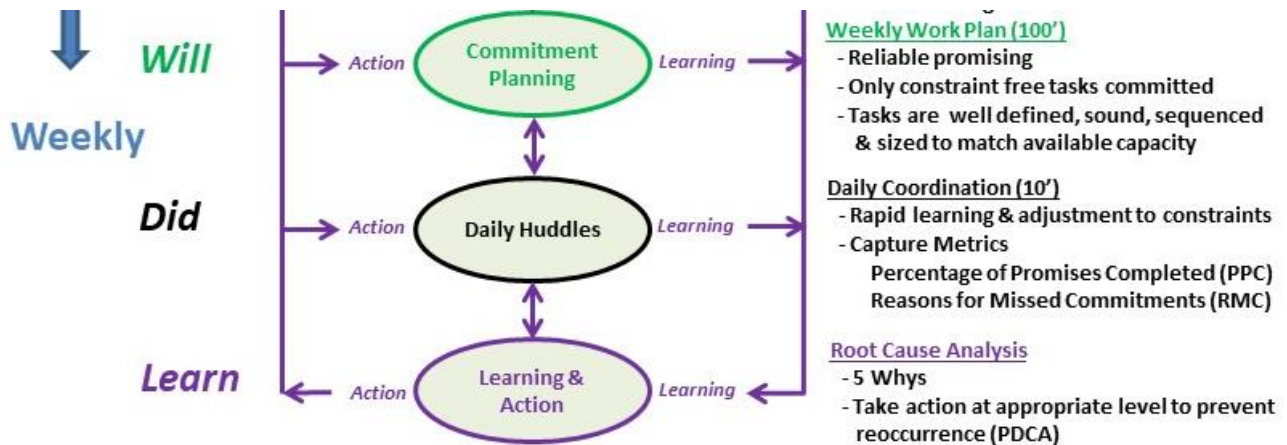
Figure 13: Key Elements of "Did"

5.1 Essential Last Planners

Any stakeholders with tags on the previous or coming day's work plans need to attend and participate.

5.1.1 Recording the Status of Last Planners' Commitments

The previous day's promise(s) must be marked up by the Last Planners as per Figure 14. The colours in each of the four tags in Figure 14 are for illustrative purposes only. Each Last Planner will have their own distinctive colour. What is important is how the tags are marked up so that daily and weekly progress can be quickly established simply by glancing at the board. It also speeds up the daily huddle because tags marked up as "done, done" (#3 in Figure 14) do not need to be spoken about.

Last Planner® System Visual Tag Management
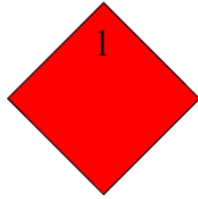
1. Turn tag into a diamond shape for missed commitments.

> •Write the reason(s) for the missed commitments on the back. NB: why not who…
>
> •Write a new tag for the new promise – do not move missed commitment.
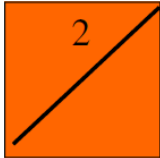
2. Put one stroke (left to right) through the tag if you complete your promise. This is called "done".

> •The person waiting on the work will complete the "X" (see 3).
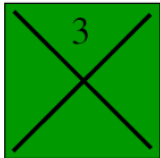
3. Put the second stroke (right to left) through the tag if the promise is confirmed 100% complete by the person waiting for the work or the PM (Project Manager). This is called "done, done".

> Note: Tags 1 and 2 should be updated before the daily huddle and check-in starts. Tag 3 can then be updated by the PM or the person waiting on the previous day's tag.

4. If the person with the commitment on the board is not at the meeting turn the tag upside down.

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Figure 14: LPS visual tag management

5.2 Daily Huddle

The team can put together a sound plan but, there must be a timely way to monitor the plan. This is just as important as creating it in order to confirm commitments are being met, issues are being recorded and tracked, and necessary communication and coordination continues to occur between the Last Planners. No matter how well the WWCP is thought out and prepared, there are often challenges that arise in the field that may cause some disruption to the original plan. Plans are only forecasts and forecasts are usually wrong. Mike Tyson famously said, "everyone has a plan until they are punched in the mouth". On projects how often do we metaphorically get a punch in the mouth? And what happens to the plan then? The Daily Huddle is a proven way that allows the team to re-plan when the team, or individual team members, get a punch in the mouth. This keeps the plan real to reflect any changes in circumstances.

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At the Daily Huddle any changes or variances that occurred in the last 24 hours are shared, and the team adjusts to those variances together.

Good practice is to hold the Daily Huddle prior to the WWCP meeting. However, the team should always decide the best time for them to have it (usually early or late in the day). The Daily Huddle tracks what was done yesterday (DID), being done (doing) and what is promised for today (WILL). Regarding yesterday, if the activity was finished, the "owner" of the tag puts a diagonal stroke (/) through the tag to indicate to the team that they are "done" (#2 Figure 14). Their understanding is that they have fulfilled their promise. Then, either the person waiting for the work or the PM/Site Manager will complete the "X" to report the work as complete – we call this "done, done". Sometimes a different coloured sharpie can be used to complete "done, done" – see Appendix Four. The handoff of work needs to be 100% complete and satisfy the conditions of satisfaction for those waiting on the work to be marked "done, done". This prevents defects passing down the line and helps the customer (waiting on tag) and supplier (writing tag) to understand what is required from one another.

If the commitment was missed, the tag is turned diagonal as per Figure 14 (#1). "5 Why" analysis is then written on the back of the tag for review at the next WWCP meeting. A new tag or "promise" is then created and placed on the WWCP and any constraints are logged and assigned (if required). This keeps the plan real because new constraints will always arise.

After quickly reviewing yesterday, the facilitator of the daily huddle turns to each team member and asks questions about what "WILL" be done today such as:

1. Is this your promise for today?
2. Is there any new constraints that could stop you from fulfilling your promise?
   o If any new constraints arise, they get logged and assigned.

Monitoring the plan is just as important as creating it. Remember, plans are only forecasts and forecasts are usually wrong. The team can put together a sound plan but, there must be a timely way to monitor the plan in order to confirm commitments are being met, issues are being recorded and tracked, and communication and coordination continues to occur between the Last Planners.

A proven way for monitoring the plan is through the process of the Daily Huddle. Any changes or variances that occurred in the last 24 hours are shared, and the team adjusts to those variances together. This keeps the plan real. No matter how well the WWCP is thought out and prepared, there are often challenges that arise. The process of planning is the most important element. As General Eisenhower famously said:

"Plans are nothing, planning is everything"

6.0 Root Cause Analysis: Learning from Plan Failures

"Insanity: doing the same thing over and over again and expecting different results"

Albert Einstein

Learning is the final and arguably the most important level of the LPS. It is critical to improving the system as it feeds back into all the other levels and elements. Plans fail for many different reasons. It may not be possible to prevent failure, but it is possible to prevent the same thing from happening again. Albert Einstein also stressed that "no problem can be solved from the same level of consciousness that created it." Analysing plan failures using root cause analysis techniques, prevents reoccurrence and automatically builds reliability into the system by implementing countermeasures to the issues. However, to successfully learn from failure, an open trusting environment must be created where the reasons why are investigated as opposed to pointing the finger of blame at who was responsible – Deming identified that 94% of the time it is the system that is at fault not the person.
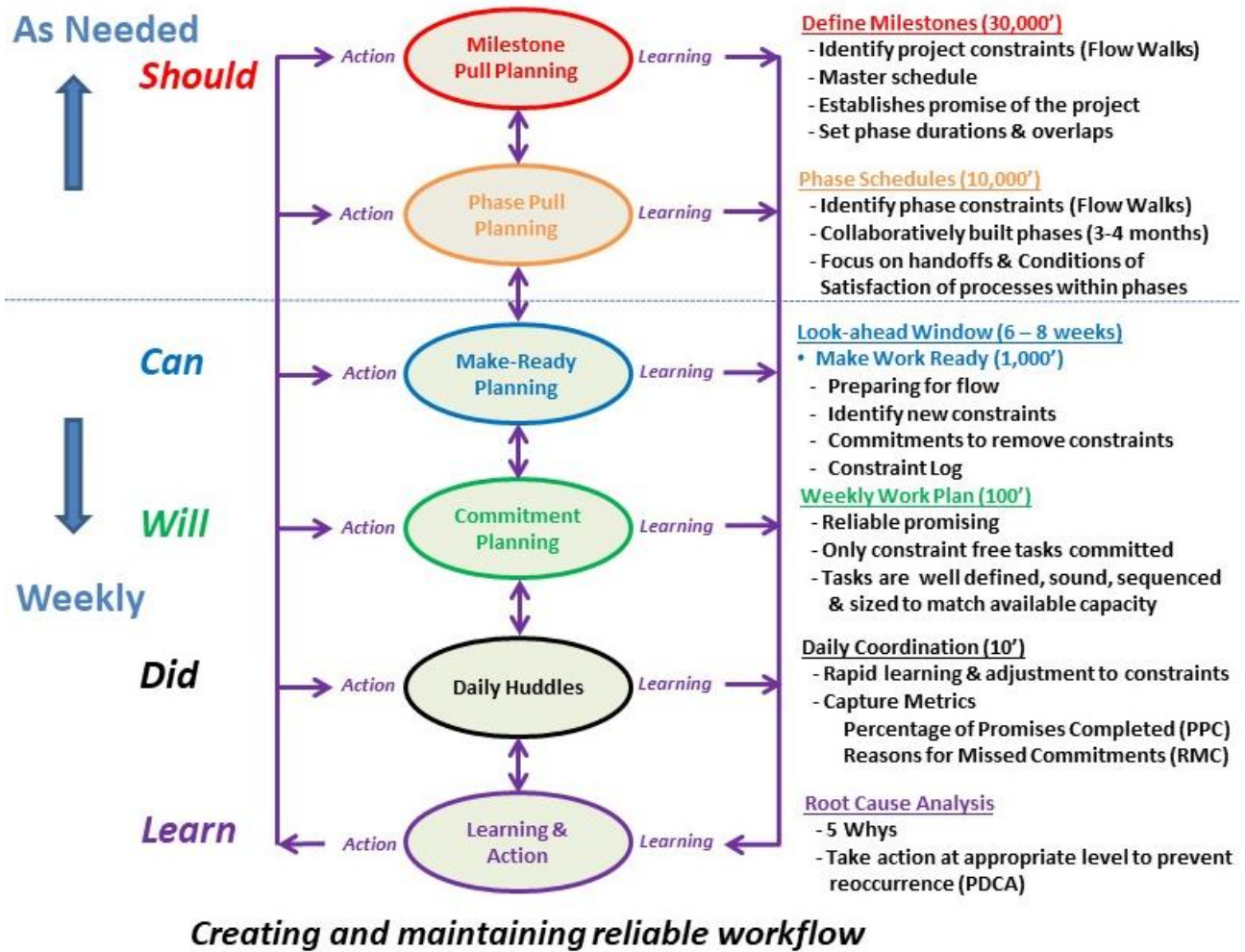
Figure 15: The Last Planner System Schematic

6.1 Essential Last Planners

Invite people who have been affected by the missed commitments and those who can authorise action to implement countermeasures. People who are 10 feet from a problem will understand it best. They are also highly likely to already know countermeasures to prevent the problem happening again in the future.

6.2 Recording Reasons for Missed Commitments

If PPC is below 100%, the next step is to record the reasons for missed commitments (RMC) on the back of each tag. You will find these reasons relate to the "8 Flows" (sub-section 3.4). If a commitment is missed for any reason, it is a variance and deviation to the plan. Missed commitments must be recorded and investigated. Needs and opportunities to improve the whole system are revealed. A visual chart can be easily

created to track RMC on a flipchart/whiteboard and/or an excel print out. Commonly, a lot of the same reasons will start occurring as time goes on. This is perfectly normal. It is also extremely beneficial information to have and trend. The RMC log will be created by the team at the start of the project but can be redefined in flight. The Flow Walk approach to collaboratively identify project production risks is a great way of creating a RMC list based on the 8 Flows. The list can be used to gauge the effectiveness of make-ready planning i.e. how well the team identified and mitigated production risks. The list is particularly useful to identify weaknesses in a specific support system or flow (material, people, information etc.). A team or organisation's RMC list might look similar to this:

1. **Bad planning/not prioritised**

2. **Prior commitment missed**

3. **Design issue**

4. **Failed inspection**

5. **Materials not available**

6. **Equipment not available**

7. **Labour not available**

8. **Information not available/updated**

9. **Submittals/approvals**

10. **Contracts/change orders**

11. **Owner decision**

12. **Weather**

13. **External constraint/unforeseen conditions**

Recording and really understanding why commitments are missed is critical to determining the root cause of the issue. The RMC log will then be used to identify categories with the biggest impact on the schedule. Root Cause Analysis (RCA) is used to develop countermeasures for these categories. The analysis is required

because the initial categories often do not provide enough detail why the commitment was missed. Categorisation without analysis does not prevent reoccurrence.

6.3 Getting to the Root Cause of Delays

Root cause analysis is performed in a separate and dedicated brainstorming session using fishbone diagrams and deeper 5 why analysis. Using 5 why analysis (asking why five times to each reason) helps get closer to the root cause of the issue. It is important that 5 why is used - not "5 who" - and to write the 5 whys on the back of the tag before the daily huddle. This is when the reasons are freshest in our heads. Countermeasures are then developed at the RCA sessions and deployed using the PDCA technique to ensure the root cause(s) are being addressed. The countermeasures generated ultimately translate into time and cost savings by reducing accidents, re-work and future RMC on the same issues.

Objective:	*Benefit:*
Quickly identify the problem	Finding the problem
Quickly solve the problem using 5 Why, or	Fixing the problem, then
Immediately swarm the problem using Root Cause Analysis, and	Finding the root cause
Devise countermeasures collaboratively to prevent reoccurrence	Fixing the process

Remember: 94% of the time the system is at fault and not the person, 5 why gets to the bottom of issues with the system (Deming)

Appendix One: The ReAlignment Group's Key Steps to Pull Planning

Key Steps to Pull Planning

1st step – Reconfirm the goal. Again, the goal (milestone) must be established and understood by all if the pull scheduling session is to be successful.

2nd step – Write the goal, a milestone or defined condition down on a tag, and place it at the end of the plotter paper in a diamond shape. When all the tags are on the paper, it can get a little confusing and the goal could get 'washed-out' with the other tags. Making the goal stand-out makes the process much simpler. Another option is to use slightly smaller standard post-it notes for the milestone(s). It's essential the milestone is singular with a shared understanding of the conditions for satisfaction. What's included/excluded in the milestone & what work gets released from it must be clearly communicated and understood.

3rd step – Ensure the stakeholders complete their own tags. It is imperative that the stakeholders fill out their own tags. If they are filling it out and placing the tag on the paper, they are taking ownership of their activity. If someone else completes the tag, it doesn't become the Last Planner's commitment. Remind the stakeholders that these tags represent their commitment to the team. It is their promise to complete the activity.

4th step – Reconfirm the goal. Once all the stakeholders have placed their tags on the wall, the pull planning can commence. Reconfirm the goal. At this stage, number the tags on the wall and write down the final number on the bottom of the sheet. As you proceed with the next step, new activities will be identified, and new tags will be created by the activity owners. Continue the number sequence with the new tags and update the last number on the bottom of the sheet. It's common to end up with 50-100% more tags at the end of the process than originally starting with.

5th step – Pull. Starting from the goal, the facilitator should ask questions something like this:

- What is the activity immediately before the goal is considered met? or
  - What is the last activity that allows this goal to be completed?

- What are the conditions of satisfaction?

  - Does the person waiting for the work need all of it or just part of it? e.g. can a portion of design information or a portion of the area to work be released?

- This process needs to be repeated until you reach the beginning of the process. This is the most important part of the process. Your time and focus needs to be fixed on the planning wall during this process. This is a very repetitive process and you will be asking a lot of the same questions many times. The focus of this needs to be on flushing out and ensuring logic ties, <u>NOT</u> focusing on durations on the first backwards pass.

6th step – Forward pass. A forward pass is reviewing the plan from the beginning to the end. This allows the team to review the plan the way that they are most used to. You are also looking to see if there are any opportunities to alter the relationships of the activities (e.g. instead of Finish-to-Start maybe the team agrees to a start-to-start with a lag on a set of activities). It's during the forward pass where the team can focus on plan optimisation through either an expedited start or through duration reduction with additional resources. Opportunities also may exist to break activities down into sub activities which will release subsequent work earlier, and/or refinement of what's really needed to get started.

Appendix Two: Suggested Ground Rule for Efficient and Effective Last Planner System Sessions

Introduction

By setting and following the right ground rules, a team is more likely to have efficient and effective LPS sessions. Slipping back to old behaviours and routines regularly happens. Team ground rules are one way of aligning everyone to the desired team behaviours. The suggested ground rules are not prescriptive but can be used as a guide to current best practice. Ground rules that are created and agreed by the team are more likely to stick. It is important that every team develops, agrees, and reviews their own ground rules by consensus. The Last Planners must set the rules of engagement. It is their meeting to coordinate actions.

10 Ground Rules for Efficient and Effective LPS Sessions[13]

1. Send meeting invitations with clear goals & stretch goals out at least five days before the session.

2. Start and finish on time.

3. Discourage personal electronic devices – focus on the meeting goals & stretch goals.

4. Last Planners write and move their own tags – tags are their commitments.

5. Arrive with pre-prepared activity tags in the agreed team format.

6. Use the 8 Flows as a trigger to screen tasks for constraints.

7. Empower Last Planners to say "no" or "yes, I can if…"

8. Emphasize systems thinking – ask why not who.

9. Continuously record and trend PPC and RMC as a team – not individually.

10. Rotate the facilitator once the team are competent using the LPS.

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[13] See blog post for more details http://leanconstructionblog.com/10-Tips-for-Efficient-and-Effective-Last-Planner-System-Sessions.html

Appendix Three: LPS Facilitator

Checklists

Introduction

This section provides a brief overview of the checklists and their intended use. They were developed following a request from a project team for some guidance on LPS while the researcher was at IGLC Boston 2016. They were designed, developed and tested through several action research cycles with project teams. There are six sections within the checklists. The first section has checklists for every type of meeting required under the LPS. The subsequent sections have specific checklists to consider at each level of planning: Milestone and Phase Planning (SHOULD); Make Ready (CAN); Weekly Work Commitment (WILL); Daily Huddle (DID); and Root Cause Analysis (LEARN). The checklists are not exhaustive and should evolve as the team develops LPS facilitator capacity and capability.

How to use the LPS Facilitator Checklists

The checklists can be used as a refresher before any session to ensure the team stays on task with the desired elements. It can also be used by the LPS facilitator to check back how well she/he facilitated the session. Finally, the checklists could be used by an expert coach to evaluate new LPS facilitators relative to their own personal evaluation. The expert coach and the new LPS facilitator could then choose one area for improvement to focus on and gradually build up LPS facilitation skills.

**NOTE: The checklists are just one perspective of the LPS facilitation requirements. They are merely a starting point to build upon and improve. Additions, comments and feedback from other LPS facilitators are welcome. The authors have also provided blank checklists to help improve this guide. Please send us your feedback and thoughts!

Last Planner® System Facilitator Checklists

Session		#	Check	Y	N
Last Planner® System Assessment Checklists					
Date:		**Project:**		**Facilitator:**	
"Should - Can - Will - Did - Learn"	**Every session**	A	Invite sent > 5 days ago with clear goals, stretch goals and objectives		
		B	Started & finished on time and followed agenda		
		C	Pull plan was created from right to left back from milestones		
		D	Expected collaborative behaviours clarified at start		
		E	Team stuck to agreed ground rules		
		F	Side-bar conversations outside of agenda stopped and in parking lot		
		G	Parking lot items discussed with relevant Last Planners after meeting		
		H	Vague language was challenged "what makes that a yes or a no?"		
		I	All essential Last Planners attended		
		J	All Last Planners appeared open and transparent		
		K	All Last Planners were here and present during the whole meeting		
		L	PM or Site Manager walked through the plan at the relevant level of detail		
		M	Enough of the specific colour post-its, markers, stationary etc are in stock		
		N	Time, date, location and attendees for next session agreed at end		
"Should"	**Milestone Pull Planning**	1a	Every Last Planner "signed-up" to the project Key Tag		
		1b	Key contract milestones identified in advance		
		1c	All milestones have either "start" or "completed" included in the description		
		1d	All milestones relate to key moments in time (not activities)		
		1e	All Last Planners have milestones on the completed plan		
		1f	Team agrees on the logic and sequence of events		
		1g			
		1h			
"Should"	**Phase Pull Planning**	2a	All tags are consistent and as per agreed standard tag format		
		2b	Tags are generally at around 5 day duration length		
		2c	All tags relate to the key milestones of every Last Planner		
		2d	The backward pass identified additional tags/constraints		
		2e	The forward pass identified additional tags/constraints		
		2f			
"Can"	**Make-Ready Planning**	3a	The 1st tag for each activity is a carbon copy of the phase pulll plan tag		
		3b	Subsequent tags have more detail than the 1st tag		
		3c	Phase pull plan tags are in make-ready plan, constraint log or workable backlog		
		3d	Every activity was screened for constraints against the 8 Flows		
		3e	All constraints have been captured on either the constraint log or a tag		
		3f	Mini milestones set for every 2 - 3 weeks		
		3g	Workable backlog exists		
		3h	Valuable work has been prioritised over non-essential tasks		
		3i	Activity durations appear realistic		
		3j			

Last Planner® System Facilitator Checklists

Last Planner® System Assessment Checklists					
Date:		**Project:**		**Facilitator:**	
Session	**#**	**Check**		**Y**	**N**
"Will" / **Commitment Planning**	4a	The daily huddle meeting took place in advance of session			
	4b	All of last weeks tags updated beforehand			
	4c	At a glance planned progress is clear & visible on the boards			
	4d	PPC was calculated, recorded and trended in advance			
	4e	Activities that were completed last week but not planned for were captured			
	4f	Next two weeks of the make-ready plan was walked through			
	4g	All tasks for the next week are well defined, sound, sequenced and sized to match Last Planners capabilities and capacities			
	4h	Six-week make-ready plan reviewed & re-planned as required			
	4i	New constraints were identified during make-ready review & re-plan			
	4j	Constraint log reviewed and updated prior to session			
	4k	Constraint log reviewed and updated after session			
	4l				
	4m				
"Did and Doing" / **Daily Huddles**	5a	Yesterday's tags updated as per "done, done" key tag (Figure 14)			
	5b	Yesterday's PPC recorded			
	5c	Reason for Missed Commitment (RMC) category noted on back of relevant tags			
	5d	5 why captured on the back of every missed commitment tag			
	5e	New constraints that appeared today were logged and actioned			
	5f	Items not on the weekly plan but in progress were captured			
	5g	New tags created for new promises including constraint removal			
	5h	At the end of the huddle the facilitator asked each Last Planner individually:			
		- Is this your promise to complete today?			
		- Do you need any support to complete your promise?			
		- Is there anything that will stop you from completing your promise?			
	5i	New constraints/issues noted in the parking lots were discussed afterwards			
	5j				
	5k				
"Learn" / **Root Cause Analysis & Action**	6a	RMC log was used to identify the issue(s) to highlight issues to investigate			
	6b	5 why analysis was used			
	6c	Fishbone diagrams were used to flush out cause and effect			
	6d	A3 Problem Solving template used to generate countermeasures			
	6e	All affected stakeholders contributed to developing countermeasures			
	6f	Problem solving was focused on system issues vs blaming people (why vs who)			
	6g	The PDCA follow-up protocol was agreed at end of session			
	6h				
	6i				
	6j				
	6k				

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Last Planner® System Facilitator Checklists

Last Planner® System Assessment Checklists					
Date:			Project:	Facilitator:	
Session		**#**	**Check**	**Y**	**N**
"Should - Can - Will - Did - Learn"	Every session	A			
		B			
		C			
		D			
		E			
		F			
		G			
		H			
		I			
		J			
		K			
		L			
		M			
		N			
"Should"	Milestone Pull Planning	1a			
		1b			
		1c			
		1d			
		1e			
		1f			
		1g			
		1h			
"Should"	Phase Pull Planning	2a			
		2b			
		2c			
		2d			
		2e			
		2f			
"Can"	Make-Ready Planning	3a			
		3b			
		3c			
		3d			
		3e			
		3f			
		3g			
		3h			
		3i			
		3j			

Session		#	Check	Y	N
"Will"	**Commitment Planning**	4a			
		4b			
		4c			
		4d			
		4e			
		4f			
		4g			
		4h			
		4i			
		4j			
		4k			
		4l			
		4m			
		4n			
"Did and Doing'	**Daily Huddles**	5a			
		5b			
		5c			
		5d			
		5e			
		5f			
		5g			
		5h			
		5i			
		5j			
		5k			
		5l			
		5m			
		5n			
"Learn"	**Root Cause Analysis & Action**	6a			
		6b			
		6c			
		6d			
		6e			
		6f			
		6g			
		6h			
		6i			
		6j			
		6k			

The table is titled **Last Planner® System Assessment Checklists** with fields for Date:, Project:, and Facilitator:

Appendix Four: Felipe Engineer's

LPS Guide

McCarthy Last Planner® System (LPS) Checklist

Principles	⇒	Process	⇒	Implementation

Principles

Last Planner® System Overview
Should-Can-Will-Did Planning

As Needed — Should
Weekly — Can / Will / Did

Master Planning
- Milestones
- Master Schedule
- Establishes promise of project

Pull Planning
- Phase Schedule
- Collaboratively built plan
- Focus on handoffs

Make-Ready Planning
- Look-ahead Plan
- Make work ready
  - Identify constraints
  - Commitments to remove constraints
  - Constraint Log

Weekly Work Planning
- Weekly work plan
- Reliable promising

Learning
- Daily coordination
- PPC
- Rapid learning

Creating and maintaining reliable workflow

The Last Planner® System is designed to make work flow more predictably and effectively. LPS is the collaborative commitment-based planning system that integrates schedules and commitments. How do we keep our promises? A project is a very big promise delivered by people in an ever changing network of promises.

The goal of system is to continually improve the reliability of our predictions for the work that is reliably promised.
- ❑ Use visual controls to make problems visible. Jobsite examples include: calendars, labeled work areas, logistics maps, BIM, Signage, Safety Tape (Red/Yellow), etc.
- ❑ Standardize tasks to allow for continuous improvements and team member empowerment. Jobsite examples include safety orientation, onboarding, RFI processing etc.
- ❑ Build a team that stops to fix problems to get quality right the first time. Jobsite examples include removing constraints (bottlenecks), mockups, etc.
- ❑ Level out the workload. Jobsite examples include: preventing high production trades to "bury" or overproduce at the expense of others, etc.
- ❑ Use "pull" systems to avoid overproduction. Jobsite examples include: milestone schedules, weekly work plans, sticky note pull plans, etc.
- ❑ Create continuous process flow to bring problems to the surface. Jobsite examples include: Daily huddles, crane schedules, etc.

Process

Your process must include each of the following five conversations:

1. Master Schedules:
- ❑ Identify major milestones and overall project timeline
- ❑ Identify and assign contractual reporting as required

2. Phase Planning:
- ❑ Identify the work and work flows within each phase
- ❑ Teams may use pull planning - start with the milestone and work backwards
- ❑ Validate logic and sequence by checking left to right
- ❑ Get commitments by Managers with input from their teams

3. Look Ahead Planning (Start of Pull Planning):
- ❑ Identify the work that will be done daily with diminishing levels of granularity over the **look ahead period usually six weeks**
- ❑ Identify constraints and obtain commitments for constraint removal
- ❑ Make work ready by removing constraints and plan to do work that releases other work to contribute to ever improving job flow
- ❑ Assemble materials, resources and other necessary items to allow work to release as it becomes available

4. Weekly Work Planning:
- ❑ Plan work that will be done through the people doing it (designers/builders)
- ❑ Facilitate negotiations between working trades for where, what, and when
- ❑ Deeply understand the nature of the work to be handed off to the next party making sure it meets that receiving person's expectations
- ❑ Empower each receiver of the hand-off to judge the quality of the work handed off so that quality is ever increasing while minimizing/eliminating rework
- ❑ Manage the work that will be done on any given day by a brief stand-up meeting to ensure that all trades are committed to the day's plan with all necessary resources and constraints removed to accomplish the work
- ❑ **Only commit work in 2-week small batches** that have constraints cleared to make reliable promises
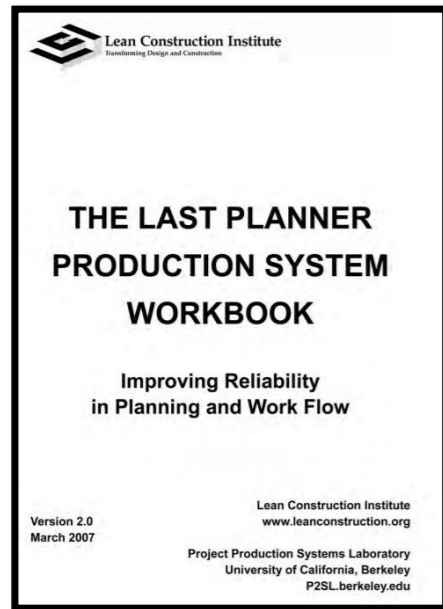
5. Lessons Learned:
- ❑ Discuss work not accomplished, why, and what effect that has on existing commitments during daily check-ins
- ❑ Track Plan Percent Complete (PPC) and plan variance
- ❑ Regularly consider what to keep doing, stop, and start (process level)

Lean Construction Institute
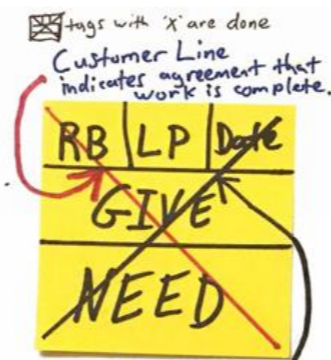Transforming Design and Construction

Implementation

The Last Planner® in construction is typically implemented by the general superintendent and in preconstruction it is someone of similar authority over the actual progress and project deliverables. Either champion may utilize an LPS facilitator.
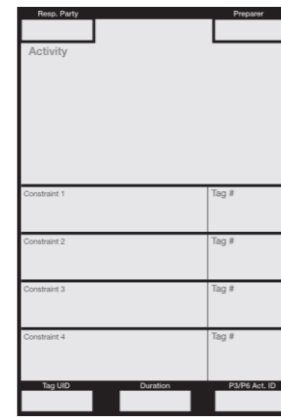
- ❑ Include owner (or representative), design partners, trade partners, McCarthy staff, inspectors, and key vendors/suppliers to participate as stakeholders in Last Planner® meetings
- ❑ The LPS champion leads the pull plan sessions every week and is:
  - o Supported by project team at all levels, given the appropriate resources to accomplish the goals of the system and should have experience on several previous LPS implementations
  - o Actively training new LPS project champions with the assistance of qualified coaches as necessary (coach stands down as the project team stands up)
- ❑ The Champion's duties include:
  - o Preparing the pull plan boards or other visuals
  - o Ensuring that all Last Planners understand their obligations to participate in the process
  - o Walking through the assignments every week ensuing work was accomplished as planned
  - o Making sure that resources or constraints are appropriately managed to assure that work can be done as planned
  - o Developing countermeasures to deal with issues discovered from the variance reporting
  - o Facilitating the re-planning process for work that was not accomplished
- ❑ The Project Leadership duties include:
  - o Management support of the planning efforts - providing resources to support the efforts and making resources available for any reporting that might be required including resources for compiling and reporting on PPC and variance
  - o Routine participation in the planning meetings to show support by removing constraints while developing and empowering the team
  - o Providing team celebration and socialization events that promote collaboration on the project

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THE LAST PLANNER PRODUCTION SYSTEM WORKBOOK

Improving Reliability in Planning and Work Flow

Version 2.0
March 2007

Lean Construction Institute
www.leanconstruction.org

Project Production Systems Laboratory
University of California, Berkeley
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Revision (4) 05.01.2018

LPS Projects Finish 20%- 30% Faster!

Key Last Planner System Terms (Facilitator / LPS Champion Align Team on Standard Definitions):
Diamonds, Daily Check-ins, Handoffs, Percent Plan Complete (PPC), PDCA, Plus/Delta, Tags, Weekly check-ins, Variance, Root Cause Analysis, LPS, LP

Last Planner System Checklists:

Daily Check-in:
1. LP Marks diagonal line for each completed tags "/"
2. LPS Champion marks a diagonal Line on agreed LP mark "X" Diamond tag is work missed - (Brief Variance Conversation)
3. LP sets new recommitted tags
4. Confirm promises, LP asks for Individual commitments
5. LPS Champion reviews handoffs to identify and get tags made for constraints
6. Encourage the Team + End Meeting with Plus/Delta

Weekly Check-in and Make Ready Planning:
1. Follow Daily Check-in steps 1 – 5
2. Record PPC and post on LPS Board
3. Record and review week's variances (team learning)
4. At week 4 of current plan, perform a new LPS session
5. Encourage the Team + End Meeting with Plus/Delta

Most Common Reasons for Variance:
1. Bad Planning
2. Prerequisite Work
3. Design Issue /RFI
4. Failed Inspection
5. Labor not Available
6. Materials not Available
7. Equipment not Available
8. Contracts / Change Orders
9. Submittals
10. Weather
11. I Forgot
12. No Update (Missing Information)
13. Unforeseen Conditions
14. _____

Last Planner System Onboarding Guide:
Use LPS facilitator for initial meetings to setup and sustain teamwork

Needed Supplies
Schedule   Key Drawing Sheets   Markers   Date Tags   Tags (Unique Color for Each LP)
Butcher Paper or Tag friendly surface

Session Agenda
1. Introduction
2. (3) Time Boxes
3. Plan, Do, Check, Act

Session Steps:
1a. Introductions, Name, Firm, Work

1b. Lean Construction Definition, LPS Origins, Principles and Successes

1c. Reliability Chain

1d. Session Goal (LPS Lead)

1e. Review Key Last Planner System Terms – "Pull" definitions from the team, use standard definitions

2a. 30-min. Timebox 1 *Forward Pass*   Milestone> Phase> Lookahead (6-week) > Weekly Work Plan
Give team option to pull backwards from milestone or place tags forward to milestone

2b. LP produce and place tags

2c. Talk through "Need" / "Give"

3a. 30-min. Timebox 2 *Forward Pass*

3b. Check Handoffs (Constraints/Bottlenecks)

3c. Each "Need" gets a tag and owned by another LP

3d. Do another forward pass

4a. 30-min. Timebox 3 *Backward Pass*

5a. End Session with Plus / Delta

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Appendix Five: Study Action Team^{TM} Guidance for Facilitators Guide to the Last Planner System

Introduction

This final section provides a brief overview of Study Action Teams (SAT) and a suggested list of questions for the SAT facilitator.

What is a Study Action Team^{TM}?

SATs are a Lean method used to develop shared mind-sets within project teams towards a particular subject matter. They incorporate reading, discussion and group learning. The short articles from Hill et al., (2007) and Slivon and Macomber (2010) provide more guidance.[14] The following question set could be used as a guide to base the discussion on. The aim of the discussion and learning is to make the participants think about the current way of doing business and how the use of the LPS could help improve this.

Suggested SAT Question Set

1. What are we trying to improve/solve/change with the use of the LPS?

2. What challenges need to be overcome in order to successfully implement LPS?

3. What is required to have a functional system?

4. What is your opinion concerning the LPS approach?

5. What did you find interesting in the guide? Why?

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[14] Hill, K., Slivon, C., & Draper, J. (2007). *Another Approach to Transforming Project Delivery: Creating a Shared Mind.* In: C.L. Pasquire & P. Tzortzopoulos, 15th Annual Conference of the International Group for Lean Construction. East Lansing, Michigan, USA, 18-20 Jul 2007. pp 417-422. Retrieved February 4, 2016, from

http://iglc.net/Papers/Details/492

Slivon, C., & Macomber, H. (2010). *Study-Action-Teams: Opening Minds for Organizational Change.* Lean Project Consulting. Retrieved May 25, 2016 from http://www.lcicanada.ca/wp-content/uploads/2015/11/Opening-Minds-for-Organizational-Change-LPC.pdf

6. What is different to what you already know or do?

7. What appears like what you already know or do?

8. What are the pros and cons of the LPS based on your LPS experience?

9. What are your takeaways from the guide? i.e. in 12 words or less what did you learn from the guide?

10. What can you start doing differently today based on what you learned from the reading?