Advanced Work Packaging (AWP) and Lean Construction: A Comparison of Approaches

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Comparing Advanced Work Packaging (AWP) with Lean Construction and the Last Planner System®

Construction Industry Institute®

Lean Construction Institute
Transforming the Built Environment

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Introduction

Lean Construction and Advanced Work Packaging (AWP) are project delivery approaches with different origins but similar goals:

- **Lean Construction** emerged in the 1990s with the formation of the Lean Construction Institute (LCI), and the group kept its early focus on improving the reliability of weekly field commitments via the Last Planner System®. The concepts of relational contracting and Integrated Project Delivery (IPD) emerged from the LCI community not long after that institute was formed. Although Lean has been implemented on many large industrial projects, the IPD movement is most often associated with hospitals and health care projects.
- **AWP** found its origins in industrial construction. Its early focus was on delivering projects on schedule and on budget.

Both approaches have grown beyond their original mandates. Lean Construction and AWP have been applied to a variety of project types, sizes, and complexities. Although some initial evaluations of AWP and Lean Construction tended to identify differences in the two approaches, some practitioners began to realize that the two concepts share important common themes.

In the Lean spirit of "this, yet that" thinking, the Construction Industry Institute (CII) and the Lean Construction Institute (LCI) formed a Joint Working Group to explore how aspects of AWP and Lean Construction could be combined to become "stronger together." This is the first in a potential series of publications from the Joint Working Group comparing AWP with Lean Construction.

For questions or comments, please contact:

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Eric Crivella or Jamie Gerbrecht (Co-Chairs of the CII AWP Community for Business Advancement)

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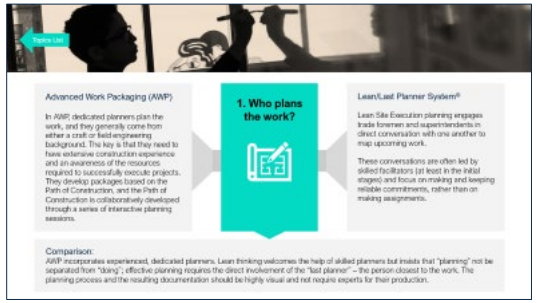
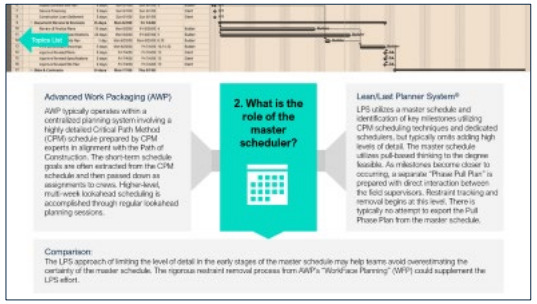
Thank you to the CII AWP + Lean Joint Working Group

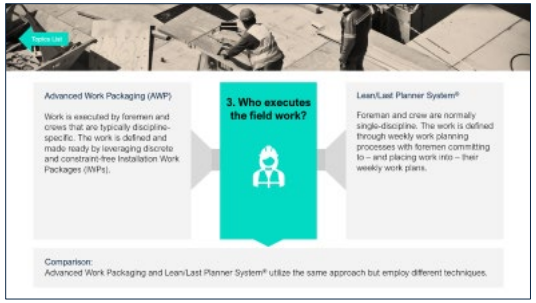
Comparison Topics:



1. Who plans the work?

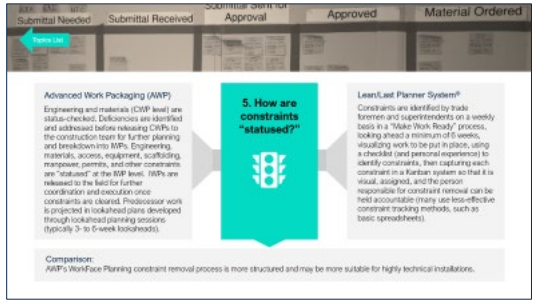


2. What's the role of the Master Scheduler?

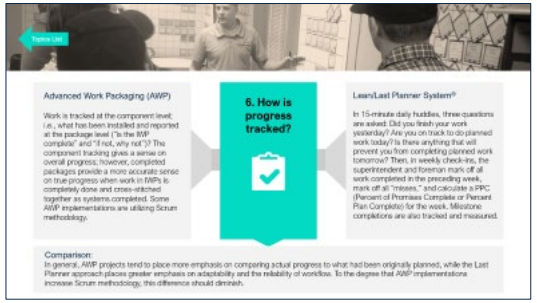


3. Who executes the work?

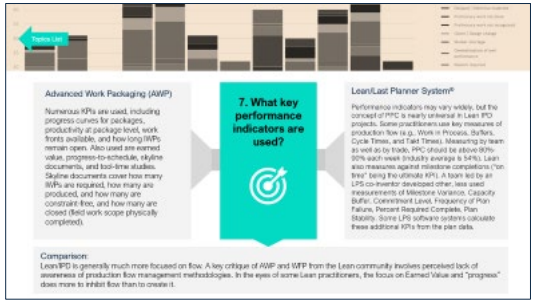
4. How is work packaged?



5. How are constraints statused?

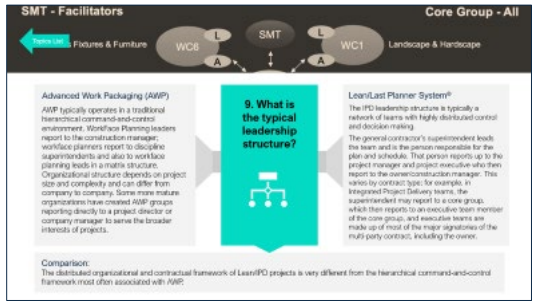


6. How is progress tracked?



7. What key performance indicators are used?

8. How is alignment created?



9. What is the leadership structure?

10. How are safety and Q/C addressed?

11. How are C&SU addressed?

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Topics List

1. Who plans the work?

Advanced Work Packaging (AWP)

In AWP, dedicated planners plan the work, and they generally come from either a craft or field engineering background. The key is that they need to have extensive construction experience and an awareness of the resources required to successfully execute projects. They develop packages based on the Path of Construction, and the Path of Construction is collaboratively developed through a series of interactive planning sessions.

Lean/Last Planner System®

Lean Site Execution planning engages trade foremen and superintendents in direct conversation with one another to map upcoming work.

These conversations are often led by skilled facilitators (at least in the initial stages) and focus on making and keeping reliable commitments, rather than on making assignments.

Comparison:

AWP incorporates experienced, dedicated planners. Lean thinking welcomes the help of skilled planners but insists that “planning” not be separated from “doing”; effective planning requires the direct involvement of the “last planner” – the person closest to the work. The planning process and the resulting documentation should be highly visual and not require experts for their production.

Advanced Work Packaging (AWP)

AWP typically operates within a centralized planning system involving a highly detailed Critical Path Method (CPM) schedule prepared by CPM experts in alignment with the Path of Construction. The short-term schedule goals are often extracted from the CPM schedule and then passed down as assignments to crews. Higher-level, multi-week lookahead scheduling is accomplished through regular lookahead planning sessions.

2. What is the role of the master scheduler?

Lean/Last Planner System®

LPS utilizes a master schedule and identification of key milestones utilizing CPM scheduling techniques and dedicated schedulers, but typically omits adding high levels of detail. The master schedule utilizes pull-based thinking to the degree feasible. As milestones become closer to occurring, a separate “Phase Pull Plan” is prepared with direct interaction between the field supervisors. Restraint tracking and removal begins at this level. There is typically no attempt to export the Pull Phase Plan from the master schedule.

Comparison:

The LPS approach of limiting the level of detail in the early stages of the master schedule may help teams avoid overestimating the certainty of the master schedule. The rigorous restraint removal process from AWP’s “WorkFace Planning” (WFP) could supplement the LPS effort.

Topics List

3. Who executes the field work?

Advanced Work Packaging (AWP)

Work is executed by foremen and crews that are typically discipline-specific. The work is defined and made ready by leveraging discrete and constraint-free Installation Work Packages (IWPs).

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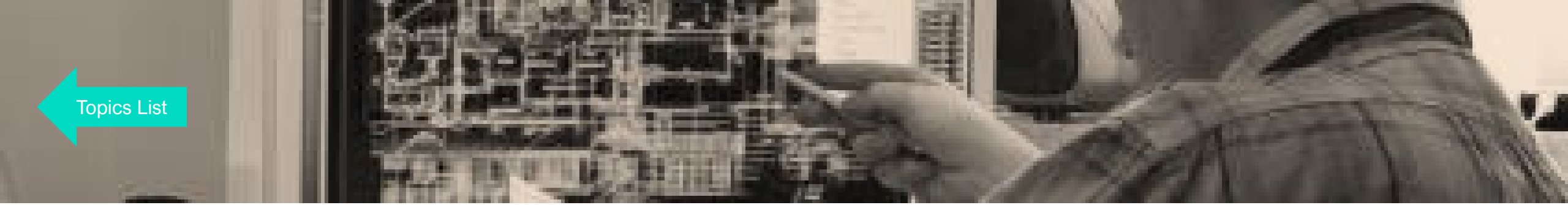
Foreman and crew are normally single-discipline. The work is defined through weekly work planning processes with foremen committing to – and placing work into – their weekly work plans.

Comparison:
Advanced Work Packaging and Lean/Last Planner System® utilize the same approach but employ different techniques.



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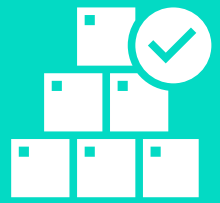
Advanced Work Packaging (AWP)

Work is typically defined and logically divided by Construction Work Areas (CWAs) involving multiple disciplines. Then, each Construction Work Package (CWP) focuses on a single discipline. Next, the work is broken into smaller Installation Work Packages (IWPs) that are assigned to work crews led by foremen. IWPs are typically single-discipline and focused on general construction execution, testing, turnover, or a variety of other purposes. Engineering Work Packages (EWPs) and Systems Work Packages (SWPs) are also used in AWP.

4. How is work packaged?

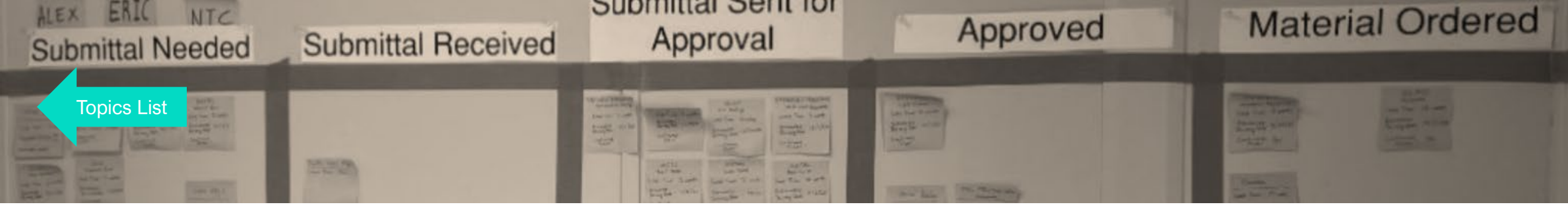


Lean/Last Planner System®

Work is typically packaged by trade discipline (e.g., structural, framing, drywall, electrical, etc.). In some more sophisticated projects, such as pharmaceutical or genetic processing, work may be packaged by system (often cutting across vertical floors or horizontal work areas), uniquely in multi-trade chunks. Some Lean/IPD projects utilize Fundamental Scope Blocks (FSBs) and Scope Activities in a structure that is very similar to CWPs and IWPs used in AWP.

Comparison:

Some Lean/IPD projects are already using a work packaging strategy very similar to AWP in many respects. The primary difference is the timing of their development and the degree to which trade partners are involved in creating them as part of a “Big Room” process.



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5. How are constraints “statused?”

Advanced Work Packaging (AWP)

Engineering and materials (CWP level) are status-checked. Deficiencies are identified and addressed before releasing CWPs to the construction team for further planning and breakdown into IWPs. Engineering, materials, access, equipment, scaffolding, manpower, permits, and other constraints are “statused” at the IWP level. IWPs are released to the field for further coordination and execution once constraints are cleared. Predecessor work is projected in lookahead plans developed through lookahead planning sessions (typically 3- to 6-week lookaheads).

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Constraints are identified by trade foremen and superintendents on a weekly basis in a “Make Work Ready” process, looking ahead a minimum of 6 weeks, visualizing work to be put in place, using a checklist (and personal experience) to identify constraints, then capturing each constraint in a Kanban system so that it is visual, assigned, and the person responsible for constraint removal can be held accountable (many use less-effective constraint tracking methods, such as basic spreadsheets).

Comparison:

AWP’s WorkFace Planning constraint removal process is more structured and may be more suitable for highly technical installations.

Topics List

6. How is progress tracked?

Advanced Work Packaging (AWP)

Work is tracked at the component level; i.e., what has been installed and reported at the package level ("is the IWP complete" and "if not, why not")? The component tracking gives a sense on overall progress; however, completed packages provide a more accurate sense on true progress when work in IWPs is completely done and cross-stitched together as systems completed. Some AWP implementations are utilizing Scrum methodology.

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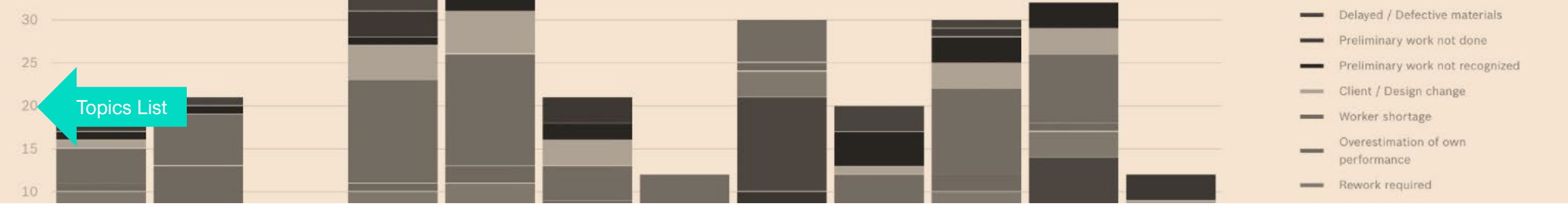
In 15-minute daily huddles, three questions are asked: Did you finish your work yesterday? Are you on track to do planned work today? Is there anything that will prevent you from completing planned work tomorrow? Then, in weekly check-ins, the superintendent and foreman mark off all work completed in the preceding week, mark off all "misses," and calculate a PPC (Percent of Promises Complete or Percent Plan Complete) for the week. Milestone completions are also tracked and measured.

Comparison:

In general, AWP projects tend to place more emphasis on comparing actual progress to what had been originally planned, while the Last Planner approach places greater emphasis on adaptability and the reliability of workflow. To the degree that AWP implementations increase Scrum methodology, this difference should diminish.



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Advanced Work Packaging (AWP)

Numerous KPIs are used, including progress curves for packages, productivity at package level, work fronts available, and how long IWPs remain open. Also used are earned value, progress-to-schedule, skyline documents, and tool-time studies. Skyline documents cover how many IWPs are required, how many are produced, and how many are constraint-free, and how many are closed (field work scope physically completed).

7. What key performance indicators are used?

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Performance indicators may vary widely, but the concept of PPC is nearly universal in Lean IPD projects. Some practitioners use key measures of production flow (e.g., Work in Process, Buffers, Cycle Times, and Takt Times). Measuring by team as well as by trade, PPC should be above 80%-90% each week (industry average is 54%). Lean also measures against milestone completions (“on time” being the ultimate KPI). A team led by an LPS co-inventor developed other, less used measurements of Milestone Variance, Capacity Buffer, Commitment Level, Frequency of Plan Failure, Percent Required Complete, Plan Stability. Some LPS software systems calculate these additional KPIs from the plan data.

Comparison:

Lean/IPD is generally much more focused on flow. A key critique of AWP and WFP from the Lean community involves perceived lack of awareness of production flow management methodologies. In the eyes of some Lean practitioners, the focus on Earned Value and “progress” does more to inhibit flow than to create it.

Topics List

Advanced Work Packaging (AWP)

Alignment is created through interactive planning sessions beginning with development of the Path of Construction. Alignment occurs in defining and prioritizing CWPs, subsequent EWPs, and sometimes Procurement Work Packages (PWPs). Alignment continues to occur at the IWP level with scoping, sequencing, and integrating the IWPs.

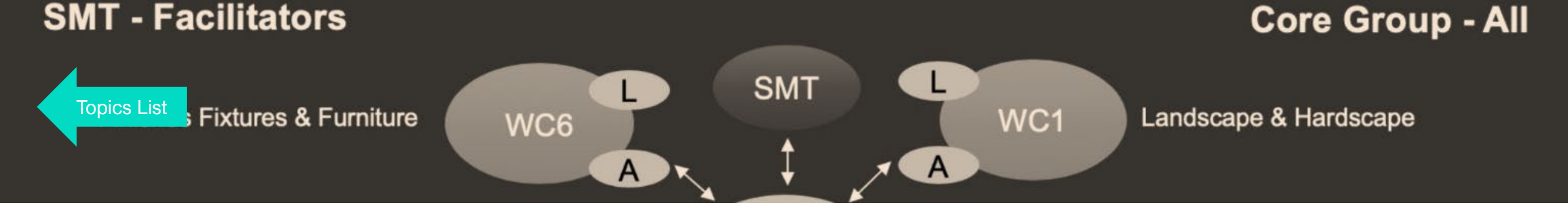
8. How is alignment created?

Lean/Last Planner System®

Alignment is created through interactive development of the scope and construction methodology in “Big Room” arrangements. Alignment in LPS includes: pull-planning the handoffs between trades (each specifying its predecessor and any constraints per task), highly visual communication (displays of the current plan on the wall of a common area), alignment of human behavior of trade foremen through daily and weekly collaborative meetings, and focusing on the same milestone across trades so all are aligned to the goal.

Comparison:

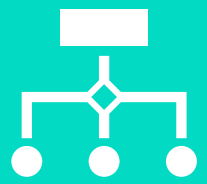
AWP includes emphasis on creating integrated documents that are passed on to work teams (i.e., constraint-free IWPs to field work crews), while IPD focuses on integrating teams that then produce the documents they need.



Advanced Work Packaging (AWP)

AWP typically operates in a traditional hierarchical command-and-control environment. WorkFace Planning leaders report to the construction manager; workface planners report to discipline superintendents and also to workface planning leads in a matrix structure. Organizational structure depends on project size and complexity and can differ from company to company. Some more mature organizations have created AWP groups reporting directly to a project director or company manager to serve the broader interests of projects.

9. What is the typical leadership structure?



Lean/Last Planner System®

The IPD leadership structure is typically a network of teams with highly distributed control and decision making.

The general contractor's superintendent leads the team and is the person responsible for the plan and schedule. That person reports up to the project manager and project executive who then report to the owner/construction manager. This varies by contract type; for example, in Integrated Project Delivery teams, the superintendent may report to a core group, which then reports to an executive team member of the core group, and executive teams are made up of most of the major signatories of the multi-party contract, including the owner.

Comparison:

The distributed organizational and contractual framework of Lean/IPD projects is very different from the hierarchical command-and-control framework most often associated with AWP.

Topics List

Advanced Work Packaging (AWP)

Through effective interactive planning and collaboration, safety can be incorporated into design engineering (EWPs), CWPs, and IWPs. Within the work packages, specific safety issues that need to be addressed while executing the work are identified. Standard industry safety methods are also used while executing the work. IWPs can include safety tools such as job hazard analysis and field level risk assessment forms.

Quality control (QC) elements addressed in the inspection and test plan can be either referenced or included in IWPs (and SWPs) as applicable. Timeliness of QC is aided by the opportunity to perform QC by IWP or by groupings of IWPs.

10. How are safety and quality control addressed?

Lean/Last Planner System®

Lean/IPD projects utilize highly formal safety programs but often with further emphasis on the “Respect for People” value of Lean thinking.

General contractor projects over $1 million often have a full-time safety coordinator (to train, inspect, enforce on site). Most have a quality control lead (or team) working with the superintendent and interfacing with third-party inspectors. Often, each trade foreman is expected to document the safety plan and quality assurance plan before work begins. In projects using Lean more robustly, each follow-on trade has to accept the work of the previous trade or point out issues to correct before follow-on work proceeds (a construction version of Toyota’s “pulling the Andon cord”).

Comparison:

Both AWP and Lean have professional teams focus on safety and quality; place a high emphasis on the safety of workers; and emphasize that quality is about providing value to the customer. Lean is expanding its definition of safety to include mental health, work-life balance, and issues reflective of respect for people. Lean often makes follow-on trades take responsibility to QC the work completed before them.

Topics List

Advanced Work Packaging (AWP)

Current state: all IWPs are mapped to a turnover package (TOP).

Future state: timely mapping to System Work Packages (SWPs) which are mapped to the TOPs; IWPs mapped to system and tag level; punch-list process utilized to complete subsystems.

11. How are commissioning and startup (CSU) addressed?

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Commissioning planning typically begins early or mid-project with the owner/CM, commissioning agent, PM/superintendent, and affected trades (e.g., mechanical, electrical, plumbing, fire suppression, elevators) participating in planning meetings, creating pull plans, and clarifying detailed, clear Conditions of Satisfaction for what constitutes “ready for commissioning and startup.”

Comparison:

Recently, AWP has placed greater attention on addressing commissioning and startup phases, resulting in recommendations that are starting to be incorporated into AWP systems. Because of the nature of many Lean projects (hospital and pharmacare), the complexity has required third-party commissioning agents and, as a result, commissioning and startup issues are less common.