

A FIELD GUIDE & COMPLETE COURSE

PULL PLANNING MASTERY

*Reliable Construction Flow with the
Last Planner System*

PHASE PLANNING * MAKE-READY * WEEKLY PROMISES * PPC

LONDON WULFE

Construction Operations Edition - 2026

PULL PLANNING MASTERY

A Field Guide and Complete Course for Reliable Construction Flow

LAST PLANNER SYSTEM® • PHASE PLANNING • MAKE-READY • WEEKLY PROMISES

Prepared for London Wulfe
Construction Operations Edition • 2026

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This original course book teaches pull planning and related Lean construction practices using public principles, field-experience patterns, and independently developed examples. It is not an authorized reproduction of proprietary AGC, Lean Construction Institute, or Last Planner System® course materials, and it does not replace credential-required instruction.

Standards and regulations change. Project teams must verify the contract documents, approved submittals, current editions of applicable codes and standards, manufacturer requirements, and the controlling authority having jurisdiction before executing work.

Core premise

A pull plan is not a prettier CPM schedule. It is a collaborative production-design conversation that begins at a required milestone and works backward through the handoffs needed to make that milestone achievable.

How to Use This Book

The book works in three modes: self-study, facilitated team training, and project deployment. Each chapter includes learning objectives, field application, facilitator prompts, common failure modes, and an assignment. The workbook templates can be printed, rebuilt on a wall, or transferred into a digital planning platform.

Learning Path	Best For	Recommended Pace
Accelerated	Experienced superintendent, PM, or trade foreman	Two chapters per week plus one live pull session
Team course	Project leadership and trade partners	One chapter and workshop per week
Project deployment	Active project implementing Last Planner	Read each chapter immediately before the related planning cycle

Course Map

Part I — Foundations

1. Pull Thinking
2. Last Planner System Architecture
3. Production Flow, Variation, and Work-in-Process

Part II — Designing the Pull Plan

4. Preparing the Session
5. Milestones and Conditions of Satisfaction
6. Building the Plan Backward
7. Handoffs, Durations, and Crew Logic
8. Facilitation and Reliable Promising

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- 10.** Constraint Management
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PART I — FOUNDATIONS

1. Pull Thinking

LEARNING OBJECTIVES

- Distinguish push scheduling from pull production control.
- Explain why completion of downstream work defines upstream demand.
- Recognize when visible activity is increasing work-in-process rather than value.

From schedule to production system

Traditional schedules often describe what management hopes will happen. Pull planning asks the people responsible for performing the work to design the chain of conditions and handoffs that must occur for a milestone to be achieved. The conversation starts with the customer need or milestone, then moves backward: What must be true immediately before this? Who creates that condition? What does that person need from others?

Push versus pull

A push plan releases work because a date says it should start. A pull system releases work because the downstream customer is ready and the prerequisites are satisfied. Construction cannot become a pure factory, but teams can still control release, reduce premature starts, limit stacking of trades, and protect flow.

Flow over local efficiency

Keeping every crew busy can make the project slower. When areas are opened before design, material, access, inspection, or predecessor work is ready, crews create partial work, remobilization, congestion, and rework. Pull planning optimizes the whole project rather than the utilization percentage of one crew.

Respect for people

The strongest plan uses the knowledge of the people closest to the work. Trade foremen and field leaders understand sequence, access, production rates, crew capability, and hidden prerequisites. Inviting them only after the plan is finalized wastes expertise and damages commitment.

FIELD ASSIGNMENT

Choose one recent delayed activity. Draw a backward chain of at least five prerequisites and identify where work was pushed before the downstream condition was ready.

FACILITATOR QUESTIONS

- What is the downstream customer actually asking for?
- Which assumption is least certain?
- Whose knowledge is missing from this conversation?
- What would make this activity unready?

- How will we know the handoff is complete?

KNOWLEDGE CHECK

1. State the main purpose of the chapter in one sentence.
2. Identify one common field failure this practice prevents.
3. Name the evidence that would show the practice is working.

2. Last Planner System Architecture

LEARNING OBJECTIVES

- Locate pull planning within the complete Last Planner System®.
- Explain the Should-Can-Will-Did-Learn planning conversations.
- Avoid treating a one-time sticky-note meeting as implementation.

The connected levels

Milestone planning establishes major required dates. Phase pull planning defines the handoffs that should occur. Make-ready planning determines what can occur by screening and removing constraints. Weekly Work Planning records what trade leaders will promise. Daily huddles manage today. PPC and variance review determine what did occur and what the team must learn.

Increasing detail

The planning system becomes more detailed as work approaches. A milestone may be months away, a phase activity may span days, a weekly promise should be specific enough to verify, and a daily commitment should be clear to the crew. Each level must connect to the next rather than compete with it.

The last planner

The last planner is the person closest to the work who has authority to make a commitment for that work. Titles vary. On one project it may be a foreman; on another, a superintendent or discipline lead. The test is whether the person understands the work, controls the resources, and can say yes or no responsibly.

Planning is a conversation

Boards and software are records of agreements. The production value comes from requests, offers, negotiation, declarations of completion, and learning. A perfect board with weak conversations is still a weak system. Resist the temptation to treat the system as a menu: pull planning is one part of a holistic system, not the whole of it.

FIELD ASSIGNMENT

Map an active project across Should, Can, Will, Did, and Learn. Identify the meeting, owner, output, and frequency for each level.

FACILITATOR QUESTIONS

- What is the downstream customer actually asking for?
- Which assumption is least certain?
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3. Production Flow, Variation, and Work-in-Process

LEARNING OBJECTIVES

- Explain how variability propagates through dependent work.
- Use buffers deliberately rather than hiding contingency everywhere.
- Recognize the relationship among throughput, cycle time, and work-in-process.

Dependency plus variation

Construction activities are dependent: downstream work cannot fully proceed until upstream conditions exist. Variability in approvals, deliveries, labor, equipment, inspections, and production rates compounds through that chain. A deterministic date alone does not remove uncertainty.

Work-in-process

More open work fronts can feel productive while increasing cycle time and coordination demand. Limit the number of areas in progress, define finish criteria, and favor completing a smaller batch before opening another. This reduces punch work and makes status visible.

Buffers with purpose

Time, capacity, inventory, and workable-backlog buffers can protect flow, but every buffer has a cost. Use buffers at known points of uncertainty and make them visible. Hidden padding destroys trust because nobody knows where protection exists.

Batch size

Large batches delay feedback and increase the amount at risk. Smaller zones, rooms, pours, or system segments can create faster handoffs, earlier quality checks, and smoother crew movement, provided setup and mobilization costs are considered.

Takt and steady rhythm

Many teams now pair pull planning with takt production — dividing work into equal zones and moving trades through them on a fixed beat. Takt makes flow visible, sizes work to a common rhythm, and sharpens handoff discipline. Where a takt plan is built on real quantities and historical production rates, it can extend confidently toward completion and be refined as each trade mobilizes. Pull planning and takt are complementary: takt sets the rhythm and zones; pull planning designs the handoffs that keep the beat reliable.

FIELD ASSIGNMENT

Break one phase into alternative batch sizes. Compare handoff frequency, setup cost, congestion, inspection load, and learning speed.

FACILITATOR QUESTIONS

- What is the downstream customer actually asking for?
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PART II — DESIGNING THE PULL PLAN

4. Preparing the Session

LEARNING OBJECTIVES

- Define session purpose and boundaries.
- Select empowered participants and prepare information.
- Build a room and agenda that support collaboration.

Choose the planning horizon

Pull a phase that has a meaningful customer milestone and enough detail to plan collaboratively. Typical phases include foundations, dry-in, above-ceiling closure, turnover of a floor, startup, or commissioning. Avoid pulling an entire multiyear project in one session.

Invite the right people

Include the owner of the milestone, superintendent, scheduler or planner, design and VDC representatives as needed, safety and quality voices, and the trade last planners who will perform the work. Substitutes without authority create tentative promises and follow-up meetings.

Pre-session package

Issue the milestone definition, relevant CPM dates, drawings, model views, logistics constraints, procurement status, known inspections, calendar assumptions, and decision deadlines before the session. Ask every participant to arrive with crew assumptions, durations, predecessors, material needs, and questions.

Room setup

Provide a long time-scaled wall or digital canvas, separate lanes by trade or workstream, sticky notes or cards, markers, constraint tags, milestone cards, and a visible parking lot. For hybrid sessions, use one source of truth and a facilitator dedicated to remote participation.

Agenda discipline

Open with purpose, boundaries, rules, and milestone conditions. Build backward first. Validate forward second. Review constraints and compression opportunities. Confirm owners and next steps. Do not let the meeting become a general coordination meeting, and keep a parking lot for issues that are not about the sequence of work.

FIELD ASSIGNMENT

Draft a two-hour session charter for an upcoming phase, including participants, prework, boundaries, milestone, and decision rules.

FACILITATOR QUESTIONS

- What is the downstream customer actually asking for?
- Which assumption is least certain?

- Whose knowledge is missing from this conversation?
- What would make this activity unready?
- How will we know the handoff is complete?

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5. Milestones and Conditions of Satisfaction

LEARNING OBJECTIVES

- Write outcome-based milestones.
- Define objective Conditions of Satisfaction.
- Separate milestone achievement from vague percentage completion.

Milestone as customer need

A milestone should describe a usable state, not merely an activity label. “Level 3 overhead complete” is ambiguous. “Level 3 ceilings may close in Areas A–D with inspections accepted, testing complete, access panels coordinated, and punch items below the agreed threshold” is testable.

Conditions of Satisfaction

Conditions of Satisfaction, or CoS, define what the receiver needs in order to accept the handoff. They may include approved inspections, tolerances, cleanliness, documentation, access, safety controls, temporary services, test results, or owner signoff.

Acceptance authority

Name who can declare the milestone complete. Completion should not depend on a person who is absent, unaware, or unauthorized. When authority having jurisdiction or owner representatives are required, their lead time becomes part of the plan.

Intermediate milestones

Long phases need internal checkpoints. Place intermediate milestones at zone turnovers, system energization, enclosure, inspection packages, or release points. These create shorter feedback cycles and reveal slippage earlier.

FIELD ASSIGNMENT

Write the milestone and at least eight Conditions of Satisfaction for one phase. Have the downstream customer review and revise them.

FACILITATOR QUESTIONS

- What is the downstream customer actually asking for?
- Which assumption is least certain?
- Whose knowledge is missing from this conversation?
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6. Building the Plan Backward

LEARNING OBJECTIVES

- Facilitate backward planning from milestone to start.
- Write actionable activity cards.
- Validate logic forward after the backward pass.

Start at done

Place the required milestone on the right side of the time scale. Ask: What is the last handoff required immediately before this outcome can be accepted? The responsible last planner writes and places that activity, then names what must be received before it can start.

Card anatomy

Each card should contain an action and object, location or batch, responsible trade, duration, crew or capacity assumption when material, predecessor handoff, and completion criteria. “Electrical” is not an activity. “Install and label branch wiring, Rooms 301–312, crew of four, two days” can be discussed.

One voice at a time, whole system in view

The facilitator should draw information from the responsible trade while keeping the full group engaged. Parallel work may be placed together, but dependencies must be explicit. Use arrows or physical alignment rather than relying on memory.

Forward validation

After reaching the phase start, walk the network forward. Test access, crew continuity, trade stacking, calendar logic, procurement, inspections, and the ability of each handoff to satisfy its customer. Backward planning discovers need; forward validation tests executability.

Compression

When the first-pass plan misses the milestone, do not simply shorten every duration. Explore smaller batches, parallel design or submittal releases, prefabrication, alternate sequence, increased capacity at bottlenecks, earlier decisions, and removal of wait states. Record the assumptions and risks.

FIELD ASSIGNMENT

Facilitate a 30-minute backward pull for a five-activity process. Photograph or export the plan, then run a forward validation and mark every changed assumption.

FACILITATOR QUESTIONS

- What is the downstream customer actually asking for?
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7. Handoffs, Durations, and Crew Logic

LEARNING OBJECTIVES

- Define reliable handoffs between trades.
- Use duration ranges and production assumptions intelligently.
- Test crew continuity and resource feasibility.

Handoff quality

A handoff is not “we are mostly done.” It is a transfer of a condition that enables another party to work safely and productively. Define the boundary, acceptance test, notice period, and responsible receiver.

Durations are promises under assumptions

Ask the trade to state crew size, work hours, quantity, production rate, access, and prerequisite assumptions behind a duration. When an assumption changes, the team can recalculate rather than argue about the original number.

Ranges and confidence

Early phase planning may use optimistic, most-likely, and conservative durations or a confidence statement. As make-ready progresses, uncertainty should narrow. Do not force false precision months ahead.

Crew flow

A sequence that works on paper may require the same crew in two places at once. Draw crew movement by zone, respect learning curves, and avoid fragmented mobilizations. Where possible, design repeatable trains of work.

Capacity and bottlenecks

Identify the operation that limits phase throughput. Protect that operation from starvation and blockage. Adding labor outside the bottleneck may only increase work-in-process.

FIELD ASSIGNMENT

For one critical activity, calculate duration from quantity, production rate, crew size, shift length, and expected efficiency. List the assumptions that must be protected.

FACILITATOR QUESTIONS

- What is the downstream customer actually asking for?
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8. Facilitation and Reliable Promising

LEARNING OBJECTIVES

- Use neutral facilitation to surface knowledge and conflict.
- Structure requests and promises clearly.
- Create psychological safety without lowering accountability.

Facilitator role

The facilitator protects the process, not a predetermined answer. They clarify language, balance airtime, expose missing stakeholders, test logic, and keep the group focused on the milestone. The facilitator should not silently build the plan for the trades.

Anatomy of a reliable promise

A sound promise includes a competent performer, clear request, shared Conditions of Satisfaction, due time, authority, resources, no known unaccepted constraints, and a sincere intention to perform. “We will try” is information, not a promise.

Negotiation is productive

A no, counteroffer, or conditional yes can protect the project. Teams should negotiate scope, sequence, support, or date before recording a commitment. Forced yeses become future variance.

Language that improves planning

Ask: What do you need before you can start? Who provides it? How will you know it is complete? What could prevent this? What are you willing to promise? When will you alert the team if the promise is at risk?

Behavioral rules

Attack the process, not the person. Bring bad news early. Do not punish accurate forecasts. Do not allow dominant personalities to erase trade expertise. Close every unresolved issue with an owner and due date.

FIELD ASSIGNMENT

Observe a coordination meeting. Record five examples of requests, promises, declarations, or breakdowns and rewrite weak statements into reliable commitments.

FACILITATOR QUESTIONS

- What is the downstream customer actually asking for?
- Which assumption is least certain?
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PART III — MAKING THE PLAN EXECUTABLE

9. Make-Ready Planning

LEARNING OBJECTIVES

- Screen future work for readiness.
- Maintain a workable backlog.
- Connect pull-plan activities to the lookahead horizon.

Should becomes can

The phase pull plan identifies what should happen. Make-ready planning tests whether upcoming work can happen by checking constraints before the commitment week. The horizon should be long enough to remove typical constraints, often three to eight weeks depending on procurement and decision cycles.

Readiness screening

Screen design information, prerequisite work, materials, labor, equipment, access, permits and inspections, safety plan, quality criteria, weather exposure, temporary services, and owner decisions. Add project-specific categories.

Workable backlog

Maintain a reserve of fully ready tasks that support project priorities. Workable backlog is not random filler. It provides controlled alternatives when a committed task is disrupted without pulling crews into unready work.

Make-ready meeting

Review activities by planned start, identify new constraints, verify owners and due dates, escalate overdue items, and decide whether an activity remains viable. Do not allow “no update” to stand when the due date is approaching.

Definition of ready

Create an agreed checklist by activity type. Concrete placement may require approved mix, form and rebar inspection, embeds, pump, access, weather plan, testing, finishing crew, curing materials, lighting, washout, and contingency.

FIELD ASSIGNMENT

Build a six-week lookahead for one phase. Screen every activity and classify it as ready, constrained, or uncertain.

FACILITATOR QUESTIONS

- What is the downstream customer actually asking for?
 - Which assumption is least certain?
 - Whose knowledge is missing from this conversation?
-

- What would make this activity unready?
- How will we know the handoff is complete?

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10. Constraint Management

LEARNING OBJECTIVES

- Write constraints as actionable gaps.
- Assign one owner and due date.
- Measure constraint aging and removal reliability.

Constraint statement

Write what is missing, which activity it blocks, who owns removal, the required-by date, and the next action. “Design issue” is weak. “Approved sleeve layout for Area B mechanical room required by August 12 to release deck embeds; owner: MEP coordinator” is actionable.

One accountable owner

Many people may help, but each constraint needs one accountable owner. Ownership does not mean blame; it means responsibility for driving closure and communicating status.

Due date versus activity start

The constraint due date must include the time needed to act on the information. An approved submittal due the morning installation starts is already late if fabrication or delivery is required.

Escalation

Define escalation thresholds before a crisis. Escalate based on risk to flow, not hierarchy or emotion. A red constraint should trigger a decision, alternative, or recovery action.

Metrics

Useful measures include open constraints, overdue constraints, average age, percent removed by promise date, source category, and recurrence. Metrics should drive learning, not administrative theater. Removing roadblocks early — well before the impact date — is the foundational discipline that makes reliable promising possible.

FIELD ASSIGNMENT

Create a constraint log with ten sample constraints. Rewrite every vague item until an unfamiliar team member could understand the blocked work and next action.

FACILITATOR QUESTIONS

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11. Weekly Work Planning and Daily Huddles

LEARNING OBJECTIVES

- Convert ready work into specific weekly promises.
- Run concise daily commitment conversations.
- Protect crews from unready assignments.

Quality assignments

A weekly assignment should be sound, sequenced, sized, and defined. It must identify trade, location, quantity or finish state, planned day, and acceptance criteria. Only ready work belongs in the committed plan.

Capacity check

Compare planned workload with available labor, equipment, supervision, and working hours. Account for onboarding, holidays, inspections, lifts, shared cranes, and expected disruptions. Promise below theoretical maximum when variability is high.

Daily huddle

Review yesterday: done or not done. Review today: commitments, handoffs, safety, logistics, and constraints. Review tomorrow: threats requiring action now. Keep the huddle at the plan, use visual controls, and send detailed problem-solving to a breakout group.

Early warning

Require a performer to declare when a promise becomes at risk, not only after failure. Early warning lets the team renegotiate sequence, provide support, or protect downstream crews.

Plan hygiene

Update completion status consistently. Do not move unfinished cards to make the board look green. Record partial completion separately and evaluate the original promise honestly.

FIELD ASSIGNMENT

Write a Weekly Work Plan containing at least twelve assignments with clear day, location, performer, completion criteria, and readiness status.

FACILITATOR QUESTIONS

- What is the downstream customer actually asking for?
- Which assumption is least certain?
- Whose knowledge is missing from this conversation?
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12. PPC, Variance, and Learning

LEARNING OBJECTIVES

- Calculate Percent Plan Complete correctly.
- Classify reasons for noncompletion without blame.
- Use root-cause learning to improve the system.

PPC

Percent Plan Complete equals the number of weekly assignments completed as promised divided by the total number of assignments promised, multiplied by 100. An assignment is complete only when the agreed Conditions of Satisfaction are met by the promised time.

What PPC means

PPC measures planning reliability, not total project progress, trade productivity, or individual worth. A rising PPC can indicate better commitments, but a perfect number created by easy promises or retroactive editing is meaningless.

Complementary metrics (current practice)

PPC is a lagging measure of the commitment plan; it says nothing about whether the lookahead is doing its job. Mature teams pair it with leading indicators of make-ready quality. Tasks Anticipated (TA) measures how much of the work executed was actually foreseen on the lookahead weeks earlier. Tasks Made Ready (TMR) measures the share of planned work whose constraints were removed on time, so it could be committed. High TA and TMR generally predict shorter, steadier durations, whereas a high PPC built on a thin, poorly anticipated plan is fragile.

Takt-based teams extend this further with flow KPIs: Perfect Handoff Percentage (how often planned trade-to-trade handoffs land on time, target roughly 80%+), a Remaining Buffer Ratio (whether enough schedule buffer survives to absorb delay), and Roadblock Removal lead time (how many days before impact constraints are cleared — higher is better). As a rule of thumb, aim for PPC above 80% in a CPM-based Last Planner System and toward 100% in a mature takt system, where production has already been leveled. Read the metrics as a set: they diagnose the health of the planning system, not the worth of any crew.

Reasons for variance

Use a consistent category set such as prerequisite work, design or information, material, labor, equipment, weather, inspection, safety, access or logistics, owner decision, overcommitment, and unforeseen condition. Preserve a short factual narrative.

Root cause

Repeated categories require deeper analysis. Use five whys, fishbone, A3, or direct observation. Correct the system that created the breakdown rather than demanding more effort from the crew.

Learning loop

Review trend, top reasons, recurring locations, and high-impact failures. Select one or two countermeasures, assign owners, and test whether reliability improves. Too many action items produce no learning. Keep PPC a learning tool, never a performance weapon.

FIELD ASSIGNMENT

Calculate PPC for a sample week of 24 promises with 18 completed (75 percent). Then select three failures and perform a five-whys analysis on one recurring cause.

FACILITATOR QUESTIONS

- What is the downstream customer actually asking for?
- Which assumption is least certain?
- Whose knowledge is missing from this conversation?
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PART IV — FIELD APPLICATIONS

13. Concrete and Structural Work

LEARNING OBJECTIVES

- Apply pull planning to excavation, foundations, vertical structure, and slabs.
- Integrate inspection, testing, delivery, finishing, and curing constraints.
- Use production zones and pour cycles to stabilize flow.

Pull from the pour or turnover milestone

Start with an accepted condition: foundation ready for steel, slab ready for layout, elevated deck released for follow-on trades, or structure topped out. Work backward through curing or strength release, finishing, placement, pre-pour inspection, embeds, reinforcing, formwork, layout, excavation, and subgrade.

Pre-pour Conditions of Satisfaction

Define approved drawings and RFIs; survey and elevation checks; stable access; forms, shores, reinforcing, embeds, sleeves, joints, vapor barrier, and edge conditions; inspection acceptance; approved mix and placement method; pump and backup; batch-plant coordination; testing agency; lighting; washout; finishing plan; curing materials; protection; weather thresholds; and emergency contacts.

Standards interface

Project specifications govern. Common references may include ACI CODE-318 for structural concrete, ACI SPEC-301 for construction specifications, ACI PRC-308 curing guidance with ACI SPEC-308.1 for external curing and the project curing requirements, ASTM C94/C94M for ready-mixed concrete, applicable ASTM sampling and testing standards, and OSHA construction requirements. Verify current editions — for example ACI CODE-318-25, ACI SPEC-308.1-23, and ACI PRC-308-26 — and confirm contract applicability.

Cycle planning

For repetitive decks, define zones and a repeatable cycle for layout, forms, embeds, reinforcing, inspection, placement, stripping, reshoring, and trade release. Balance crews to the takt or target cycle rather than maximizing one operation at the expense of the system.

Weather and contingency

Create decision points for hot weather, cold weather, wind, rain, lightning, access, and batch delays. Identify alternate pour size, admixture or mix approval path, protection, backup equipment, and stop criteria before the event.

Quality at the handoff

Do not release the slab merely because concrete is hard. Confirm strength or time criteria, curing and protection, flatness or elevation data when required, repairs, edge safety, housekeeping, access, and documentation needed by the downstream customer.

FIELD ASSIGNMENT

Create a backward pull plan for a 20,000-square-foot slab-on-grade pour divided into four placement zones. Include inspections, batch delivery, finishing, curing, sawcutting, testing, weather decisions, and downstream release.

FACILITATOR QUESTIONS

- What is the downstream customer actually asking for?
- Which assumption is least certain?
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14. MEP, Interiors, and Commissioning

LEARNING OBJECTIVES

- Plan information and installation handoffs across dense systems.
- Use area readiness and closure criteria.
- Pull commissioning requirements into installation planning.

Overhead coordination

Pull from ceiling close or system-ready milestones. Work backward through inspections, testing, insulation, controls, labeling, branch connections, mains, supports, layout, coordination approval, sleeves and embeds, procurement, and access.

Zone release

Define when an area is available, what temporary services exist, maximum trade loading, access route, material staging, and completion standard. Visual zone maps reduce arguments about “the floor being ready.”

Close-in packages

Create Conditions of Satisfaction for wall close, shaft close, ceiling close, equipment startup, and room turnover. Include photos, test records, firestopping, access panels, labels, punch thresholds, and authority approvals.

Commissioning starts early

Functional performance depends on design intent, submittals, controls sequences, startup, testing and balancing (TAB), training, documentation, and issue resolution. Pull these deliverables into procurement and installation rather than treating commissioning as a final-month event.

Information pull

Design teams can use the same method. Start with the date a construction decision is required and work backward through review, coordination, modeling, engineering, owner input, and criteria. Release information in batches aligned with construction need.

FIELD ASSIGNMENT

Write a phase milestone for ceiling closure on one floor and develop Conditions of Satisfaction from every affected discipline.

FACILITATOR QUESTIONS

- What is the downstream customer actually asking for?
- Which assumption is least certain?
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15. Safety, Quality, Logistics, and Weather

LEARNING OBJECTIVES

- Integrate production planning with hazard prevention.
- Make quality controls prerequisites rather than afterthoughts.
- Plan site logistics and weather decisions as production conditions.

Safety through planning

Production promises must not bypass hazard controls. Integrate competent-person needs, permits, engineered plans, fall protection, excavation protection, electrical controls, lifts, cranes, hot work, confined spaces, public protection, and job briefings into readiness screening. OSHA emphasizes communication and coordination among employers during planning and scheduling.

Pre-task planning connection

The pull plan defines upcoming work and handoffs. Pre-task planning translates that work into crew-level steps, hazards, controls, and stop-work conditions. Feedback from the crew may require the production plan to change.

Quality at the source

Identify hold points, witness points, mockups, first-work inspections, testing, tolerances, sample approvals, documentation, and responsible acceptance authority. A failed inspection is not merely a quality event; it is a flow interruption.

Logistics as shared capacity

Cranes, hoists, gates, laydown, temporary power, access roads, pumps, loading docks, and waste routes are production resources. Plan reservation and handoff rules. Resolve conflicts in advance rather than by whoever arrives first.

Weather decision matrix

For weather-sensitive work, define forecast source, review times, thresholds, decision authority, lead time, protection plan, alternate work, and communication chain. Avoid making a high-cost go/no-go call with undefined criteria at dawn.

FIELD ASSIGNMENT

Add safety, quality, logistics, and weather columns to a six-week lookahead. Identify at least one production activity whose planned sequence should change because of risk.

FACILITATOR QUESTIONS

- What is the downstream customer actually asking for?
- Which assumption is least certain?
- Whose knowledge is missing from this conversation?
- What would make this activity unready?
- How will we know the handoff is complete?

KNOWLEDGE CHECK

1. State the main purpose of the chapter in one sentence.
2. Identify one common field failure this practice prevents.
3. Name the evidence that would show the practice is working.

16. Digital and Hybrid Pull Planning

LEARNING OBJECTIVES

- Select tools based on planning behavior, not novelty.
- Preserve collaboration and ownership in digital environments.
- Maintain one current source of truth.

Physical strengths

A wall supports movement, visibility, embodied participation, and fast group editing. Physical cards can make ownership obvious and reduce the temptation for one scheduler to control the plan.

Digital strengths

Digital systems support remote participation, version history, filtering, analytics, integration, and persistent access. They are valuable when the project is distributed or the board must connect to constraints and weekly plans. A common hybrid pattern is to run strategic pull sessions on sticky notes, then transfer the plan into a digital platform for lookaheads, weekly work plans, PPC tracking, and cross-trade visibility.

Hybrid risk

A hybrid session can create two classes of participant. Use a dedicated remote facilitator, shared camera views, a clear speaking protocol, and a single editable system. Do not maintain an unofficial wall and a separate digital “official” plan.

Data structure

At minimum capture activity ID, phase, location, trade, description, predecessor, successor, duration, crew, planned finish, constraint status, owner, completion criteria, and source milestone. Avoid collecting fields nobody maintains.

Automation and AI

Automation may flag missing predecessors, impossible crew overlaps, aging constraints, or trend patterns. AI may help summarize variance narratives or propose questions. It must not invent commitments, approve unsafe sequences, or replace the responsible last planner. Human review and traceability are essential.

FIELD ASSIGNMENT

Compare a physical, digital, and hybrid setup for your project. Score participation, access, audit trail, integration, speed, and risk of facilitator domination.

FACILITATOR QUESTIONS

- What is the downstream customer actually asking for?
- Which assumption is least certain?
- Whose knowledge is missing from this conversation?
- What would make this activity unready?

- How will we know the handoff is complete?

KNOWLEDGE CHECK

1. State the main purpose of the chapter in one sentence.
2. Identify one common field failure this practice prevents.
3. Name the evidence that would show the practice is working.

PART V — DEPLOYMENT AND MASTERY

17. Leadership, Contracts, and Culture

LEARNING OBJECTIVES

- Create leadership behaviors that support reliable planning.
- Align commercial practices with collaboration.
- Respond to failure without destroying transparency.

Leaders create the climate

Teams reveal problems early only when leaders treat early warning as useful information. Punishing bad news produces late surprises. Accountability should focus on promise quality, communication, learning, and corrective action.

Trade partner onboarding

Explain why the system exists, the role of the last planner, meeting expectations, card standards, readiness rules, and metrics before the first pull. Include participation requirements in project onboarding and planning exhibits where appropriate.

Contract and schedule interface

Pull plans do not automatically replace the contractual baseline schedule. Define how phase plans, lookaheads, updates, notices, and recovery plans connect to contract requirements. The scheduler should translate between systems without stripping away trade commitments.

Commercial incentives

Local optimization thrives when payment, buyout, procurement, and change management reward individual activity rather than whole-project flow. Leadership should remove administrative barriers that prevent timely decisions and material release.

Recovery planning

When the milestone is threatened, re-pull the remaining work with the responsible trades. Protect safety and quality, identify the true bottleneck, test alternatives, document assumptions, and communicate impacts. A recovery bar chart created in isolation is rarely credible.

FIELD ASSIGNMENT

Write five project leadership behaviors that will be rewarded and five behaviors that will be challenged during pull planning implementation.

FACILITATOR QUESTIONS

- What is the downstream customer actually asking for?
- Which assumption is least certain?
- Whose knowledge is missing from this conversation?

- What would make this activity unready?
- How will we know the handoff is complete?

KNOWLEDGE CHECK

1. State the main purpose of the chapter in one sentence.
2. Identify one common field failure this practice prevents.
3. Name the evidence that would show the practice is working.

18. Implementation Roadmap and Capstone

LEARNING OBJECTIVES

- Deploy pull planning in controlled stages.
- Measure process adoption and outcome improvement.
- Demonstrate mastery through a complete phase plan.

Start with a real phase

Choose a phase important enough to matter but bounded enough to learn. Assign an executive sponsor, project champion, facilitator, and scheduler partner. Establish baseline reliability and pain points.

Thirty days

Train the core team, define planning cadence, select the phase, prepare milestone and participants, run the first pull, establish a constraint log, and schedule make-ready and weekly meetings.

Sixty days

Measure participation, ready-work percentage, constraint removal, PPC, variance categories, and meeting effectiveness. Coach weak promise language, improve card quality, and connect the pull plan to field zone controls.

Ninety days

Complete at least three learning cycles, compare performance with baseline, standardize useful practices, retire unnecessary administration, and decide where to expand. Publish lessons, not victory theater.

Capstone

The learner prepares and facilitates a full pull-planning package for a real or simulated phase, including charter, milestone and CoS, backward network, forward validation, constraints, six-week lookahead, Weekly Work Plan, huddle board, PPC report, variance analysis, and improvement A3.

FIELD ASSIGNMENT

Complete the capstone package in the workbook and present it to a panel of field leaders and trade partners.

FACILITATOR QUESTIONS

- What is the downstream customer actually asking for?
- Which assumption is least certain?
- Whose knowledge is missing from this conversation?
- What would make this activity unready?
- How will we know the handoff is complete?

KNOWLEDGE CHECK

1. State the main purpose of the chapter in one sentence.

2. Identify one common field failure this practice prevents.
3. Name the evidence that would show the practice is working.

WORKBOOK AND FIELD TEMPLATES

Recreate these templates at the scale appropriate to the project. Keep visual systems simple enough that field leaders can update them without a specialist.

Template 1 — Pull-Planning Session Charter

Field	Project Entry
Phase / milestone	
Purpose and boundaries	
Required date	
Facilitator	
Participants and authority	
Pework and source documents	
Calendar and shift assumptions	
Decision rules	
Outputs	
Follow-up cadence	

Template 2 — Milestone and Conditions of Satisfaction

Field	Project Entry
Milestone statement	
Downstream customer	
Acceptance authority	
Required date and time	
Condition	
Verification method	
Responsible provider	
Required notice	
Evidence / record	

Template 3 — Activity Card Standard

Field	Project Entry
Activity ID	

Field	Project Entry
Trade / responsible last planner	
Action + object	
Location / batch	
Duration	
Crew / capacity assumption	
Predecessor handoff	
Successor customer	
Completion criteria	
Known constraints	

Template 4 — Constraint Log

Field	Project Entry
Constraint ID	
Blocked activity	
Specific missing condition	
Category	
Owner	
Date identified	
Required-by date	
Next action	
Status	
Escalation / resolution	

Template 5 — Six-Week Lookahead

Field	Project Entry
Week	
Activity	
Location	
Trade	
Planned start	
Readiness status	

Field	Project Entry
Constraint IDs	
Safety / quality hold points	
Material status	
Decision	

Template 6 — Weekly Work Plan

Field	Project Entry
Day	
Trade	
Activity and location	
Quantity / finish state	
Crew	
Completion criteria	
Ready?	
Promise accepted by	
Actual result	

Template 7 — Daily Huddle Board

Field	Project Entry
Yesterday — done / not done	
Today commitments	
Handoffs	
Safety and logistics	
At-risk promises	
Tomorrow threats	
Owner / next action	

Template 8 — PPC and Variance

Field	Project Entry
Week	
Promises	

Field	Project Entry
Completed as promised	
PPC	
Variance category	
Narrative	
Root cause	
Countermeasure	
Owner	
Check date	

Template 9 — Concrete Pre-Pour Readiness

Field	Project Entry
Drawing / RFI approval	
Survey / layout	
Subgrade / base	
Forms / edge	
Reinforcement	
Embeds / sleeves	
Inspection	
Mix and quantity	
Pump / access	
Testing	
Finishing	
Curing / protection	
Weather	
Lighting	
Washout	
Contingency	

Template 10 — Weather Decision Matrix

Field	Project Entry
Work type	

Field	Project Entry
Hazard / weather variable	
Forecast source	
Threshold	
Decision time	
Decision authority	
Protection	
Alternate work	
Communication	

Template 11 — Session Health Check

Field	Project Entry
Last planners present	
Milestone clear	
Backward pull used	
Cards specific	
Handoffs defined	
Constraints captured	
Forward validation complete	
Owners and dates assigned	
Plan connected to lookahead	
Participants rate value	

Template 12 — A3 Improvement Report

Field	Project Entry
Background	
Current condition	
Target condition	
Root cause	
Countermeasures	
Implementation owner and dates	
Measures	

Field	Project Entry
Follow-up learning	

Concrete Pull-Planning Case Study: Warehouse Slab

Scenario

A contractor must place a 20,000-square-foot warehouse slab in four 5,000-square-foot zones. The turnover milestone requires each zone to be available for rack layout with curing and protection complete, sawcuts accepted, test reports logged, repairs identified, and access controlled. The team has one laser screed, one pump, a finishing crew that can support one zone per shift, and uncertain afternoon thunderstorms.

Backward Logic

Order from Milestone	Required Handoff	Primary Owner	Typical Constraint
1	Zone accepted for rack layout	Superintendent / QA	Curing duration, repair status, access
2	Sawcutting and joint work complete	Sawcut subcontractor	Timing, equipment, lighting
3	Curing and protection installed	Concrete foreman	Material, labor, wind, traffic
4	Placement and finishing accepted	Concrete foreman	Batch rate, pump, weather, finishing capacity
5	Pre-pour inspection accepted	GC / inspector	Rebar, embeds, vapor barrier, forms
6	Zone fully prepared	Concrete and trades	Subgrade, layout, sleeves, access
7	Approved plan and supply released	PM / supplier	Mix, quantity, trucking, testing agency

Production Design

The team elects to maintain one-zone flow rather than opening all four zones. Zone B preparation begins only after Zone A reaches a defined readiness checkpoint, limiting work-in-process. The supplier receives a delivery curve rather than a single total quantity. A weather decision is set for 2:00 p.m. the prior day and 3:30 a.m. on pour day. A backup line pump and alternate smaller placement boundary are identified.

Sample Constraints

Constraint	Owner	Required By	Countermeasure
Final rack embed locations	Owner / Designer	Five working days before Zone C pre-pour	Escalate decision; isolate optional embed strip
Testing agency technician	PM	72 hours before each pour	Standing reservation with written release time
Curing blankets for cold night	Concrete foreman	Day before pour	Inventory count and rental backup
Stormwater / washout	Superintendent	Before pump mobilization	Inspect lined washout and

Constraint	Owner	Required By	Countermeasure
capacity			backup bin
Access conflict with steel delivery	Logistics lead	Weekly plan	Time-window deliveries and flagger plan

Case-study lesson

The milestone is protected less by demanding faster finishing and more by designing reliable upstream information, inspection, logistics, supply, weather, and acceptance handoffs.

Mock Final Examination

1. What distinguishes pull planning from a push schedule?
2. Where does phase pull planning sit within the Last Planner System?
3. What is a Condition of Satisfaction?
4. Why should a pull plan be built backward and validated forward?
5. List six minimum fields for an activity card.
6. What makes a promise reliable?
7. What is the purpose of make-ready planning?
8. Define workable backlog.
9. Write a strong constraint statement for a missing shop drawing.
10. How should constraint due dates differ from activity start dates?
11. What belongs in a Weekly Work Plan?
12. What three time frames should a daily huddle address?
13. Calculate PPC when 17 of 22 promises are completed as promised.
14. Why is PPC not a productivity metric?
15. Name four useful variance categories.
16. How can smaller batches improve flow?
17. What concrete items should be included in pre-pour readiness?
18. How should safety planning connect to pull planning?
19. Name one risk and one benefit of digital pull planning.
20. What should a 90-day implementation review measure?

Mock Final — Answer Key

1. Pull planning starts from downstream need and collaboratively defines predecessor handoffs; push scheduling releases work mainly from planned dates.
2. It follows milestone planning and feeds make-ready, Weekly Work Planning, daily management, and learning.
3. An objective acceptance condition the downstream customer requires for a handoff or milestone.
4. Backward planning reveals need; forward validation tests sequence, resources, access, calendar, and executability.
5. Examples: trade, action, object, location, duration, crew assumption, predecessor, completion criteria.
6. Clear request and CoS, competent and authorized performer, resources, no known unaccepted constraints, due time, and sincere commitment.
7. To remove constraints so work that should happen can actually happen.
8. A prioritized set of fully ready alternative tasks.
9. Example: Approved Area B sleeve shop drawing required by August 12 to release deck embeds; owner: MEP coordinator; next action: designer review meeting August 8.
10. They must allow time for fabrication, mobilization, or action after the constraint is removed.
11. Only ready, specific, sized, sequenced assignments with performer, time, location, and completion criteria.
12. Yesterday, today, and tomorrow.
13. 77.3 percent.
14. It measures reliability of promises, not total installed production or worker performance.
15. Design / information, predecessor, material, labor, equipment, weather, inspection, access / logistics, owner decision.
16. They reduce waiting for full-batch completion, expose defects earlier, and reduce work-in-process.
17. Inspection, forms, rebar, embeds, access, mix, supply, pump, testing, finishing, curing, weather, lighting, washout, contingency.
18. Hazard controls and competent-person requirements must be readiness conditions; crew pre-task feedback may change sequence.
19. Benefit: persistence, analytics, and remote access. Risk: reduced engagement, or one-person control and data burden.
20. Participation, ready work, constraints, PPC, variance, meeting quality, milestone performance, safety and quality impacts, and adoption learning.

Glossary

Term	Definition
Activity card	A visual record of a planned task and its essential promise information.
Batch	A defined quantity or area transferred as a unit.
Condition of Satisfaction	The acceptance criteria required by the customer of a promise or handoff.
Constraint	A missing condition preventing an activity from being sound or ready.
Daily huddle	A short commitment-management conversation addressing recent completion, current work, and near-term threats.
Flow	Steady movement of value through a production system with minimal interruption and excess work-in-process.
Handoff	Transfer of completed work, information, space, or condition to a downstream customer.
Last planner	The person closest to the work with knowledge and authority to make a reliable commitment.
Lookahead	A near-term planning horizon used to make future work ready.
Make-ready	The process of screening and removing constraints from upcoming work.
Milestone	A required outcome or condition at a defined point in time.
Percent Plan Complete	Completed weekly promises divided by total weekly promises, multiplied by 100.
Pull planning	Collaborative planning from a required downstream outcome backward through necessary handoffs.
Reliable promise	A clear and accepted commitment made by a competent, authorized performer under understood conditions.
Should-Can-Will-Did-Learn	The connected conversations of milestone / phase planning, readiness, commitment, performance, and improvement.
Takt	Dividing work into equal zones and advancing trades through them on a fixed, repeating beat to stabilize flow.
Tasks Made Ready (TMR)	The share of planned work whose constraints were removed on time so it could be committed; a leading make-ready metric.
Variance	The reason a promise was not completed as agreed.
Weekly Work Plan	The set of ready assignments accepted as promises for the upcoming week.
Work-in-process	Started but unfinished work within the production system.
Workable backlog	Ready alternative work that supports project priorities.

References and Current Practice Basis

The following sources informed the best-practice framework used in this book. Readers should consult the current official publications and their project requirements.

- Lean Construction Institute. Last Planner System® topic guidance, including milestone planning, pull planning, make-ready planning, Weekly Work Planning, constraint management, daily huddles, PPC, and reasons for variance. Accessed July 2026.
- Lean Construction Institute. Reliable Promises topic guidance. Accessed July 2026.
- Lean Construction Institute. Last Planner System® for Design topic guidance. Accessed July 2026.
- Hamzeh, F. R., et al. Lookahead-planning metrics — Tasks Anticipated (TA), Tasks Made Ready (TMR), and Planned Work Ready (PWR). International Group for Lean Construction (IGLC) proceedings.
- Associated General Contractors of America. Lean Construction Education Program, Second Edition overview and learning objectives. Accessed July 2026.
- Occupational Safety and Health Administration. Recommended safety-management practices emphasizing communication and coordination among host employers and contractors, plus applicable 29 CFR Part 1926 requirements.
- American Concrete Institute. ACI PRC-308-26, Curing of Concrete—Guide; ACI SPEC-308.1-23, External Curing of Cast-in-Place Concrete—Specification; ACI CODE-318-25, Building Code Requirements for Structural Concrete; and applicable project structural concrete documents.
- ASTM International. ASTM C94/C94M, Standard Specification for Ready-Mixed Concrete, current project-specified edition, and applicable sampling / testing standards.

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