Last Planner™

Collaborative production planning
Collaborative programme coordination

The **Last Planner System** (LPS) enables programme and production planning decisions to be made collaboratively at the lowest possible level in a whole range of one-off production settings — software development, ship building, yacht fit-out, one-off manufacture and construction. By promoting conversations between trade foremen and site management at appropriate levels of detail before issues become critical, LPS is creating significant improvements in programme predictability, productivity, profit, safety and feelings of wellbeing among project staff.

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Last Planner:
a system for collaboratively managing the network of relationships and conversations required for programme coordination, production planning and project delivery.

A major source of uncertainty, frustration and waste in projects is waiting — waiting for access, materials, plant, waiting for the previous trade to complete work. When a team is late delivering, follow-on teams are prevented from starting when they planned to and work ceases to *flow*. This is why it is impossible for any centralized function or system to manage a project by planning.

The Last Planner System (LPS) makes project programmes more predictable and increases the chances that work will flow and projects will be completed on time. Conceived by Lean Construction Institute staff to help manage complex design and construction projects, Last Planner is now used elsewhere too — new product development, one-off manufacturing (including shipbuilding) and software development.

Recognising that personal relations and peer pressure are key to managing the network of production relationships and commitments required to deliver quality projects on-time, LPS creates conversations at the right level and at the right time to build trust between key project performers — the *last planners* [e.g. trade foremen on site, design team leaders] and overall project managers so as to increase the chances that work flows.

Last Planner is a simple system to administer using Post-it® notes, paper, pencil and a photocopier. On larger projects MS Excel® or a similar spreadsheet can help. Last Planner can work alongside current project management software.

> "The Last Planner System [enables] our site supervisors to **plan their workload on a weekly basis** and assess their team's performance on a daily basis [and] to make an accurate prediction of the labour required on a weekly/daily basis. **This plan is based on facts, not a site manager's wish list**... Once supervisors understand ... Last Planner, and are confident in using the documentation, it can reduce the frequency of senior management visits to site. The foremen are capable of handling situations as they arise as their decisions are based on facts that are documented weekly."
>
> ***Nick Wain, MD, Image Decorations Ltd***

In Last Planner, it is the *last planners* who work together to plan production week by week and ensure that work is made ready before it is planned to do it. They use continual improvement to improve both planning and production. Last planners and project management produce the overall project programme collaboratively so that they understand the overall process before they begin work.

LPS has four main elements:

Programming Workshop — collaboratively creating and agreeing the production sequence (and compressing it if required)

MakeReady — Making tasks ready so that they can be done when we want to do them.

Production Planning — collaboratively agreeing production tasks for the next day or week

Continual Improvement — learning about and improving the project, planning and production processes

Production planning

During the project there is a regular production planning meeting (PPM) involving all the *last planners* – design team leaders and/or trade supervisors on site. It generally lasts less than an hour. In very tight projects shorter daily work planning may be necessary, but generally the PPM is weekly. The purpose of the PPM meeting is to plan the work that will be done in the next period bearing in mind the work that is being done now and in the knowledge of the work that is made-ready to be done.

Each last planner/team leader proposes a production programme for her or his team. In the PPM team leaders explore any inter-dependencies between their proposals — conflicts of space, resources, access, equipment for example. As team leaders get used to the discipline of Last Planner they will do a lot of negotiating immediately prior to the meeting. Even then, nothing is finally agreed until everything is agreeable within the context of the PPM. One cause of late delivery at this stage is team leaders who over-commit. It is in every team member's interest to prevent this happening.

***Benefits** of PPM in the context of Last Planner:*
- *(re)commits people to the intention of the project and the current client concerns*
- *discipline – clearer expectations both ways*
- *re-establishes why the next PPM is important*
- *suppliers prepare their work better*
- *supplier teams know what is expected of them in terms of quality*
- *a forum for investigating issues of reliability before it is too late*
- *a pull signal for doing work along the value stream*
- *relationship building with supplier team leaders*
- *keeps project on a plan consistent with what can really be done.*

| Production plan | | | | | | | Week commencing | | | | | | | | | | |

Figure 1: Production Plan form used by trade foremen on site or design team leaders to prepare for PPM.

MakeReady: Design								
project			week					
Phase			prepared by					
area			date prepared				© www.rubiconassociates.com 2004	
					Constraint			
ref	task description	m start date	responsible party	Information	Pre-req	Resource	can do	notes

Figure 2: MakeReady form for guiding and documenting the process of making tasks ready

The PPM alone will not realise these benefits week-in week-out. Trade foremen can only reasonably commit their teams to deliver a particular piece of work if the work **can** be done. Just because a task is on the project programme doesn't mean it can be done — there may be inadequate design information, pre-requisite tasks incomplete, resources or materials not available. LPS has a systematic *MakeReady* process to ensure that when work is programmed for production it CAN be done.

MakeReady

There is no point in putting a task into production if an essential pre-requisite is incomplete. The MakeReady process systematically checks that everything is in place for each of the tasks in the LookAhead window. A daily activity, it continues throughout the project.

Benefits of the MakeReady process:
- *ensures tasks are ready for production when required*
- *safer working — planning involves hazard analysis and method statements*
- *less waste — greater certainly of time, materials and equipment*
- *improved logistics reduces opportunity for damaged to materials prior to installation.*

Together PPM and MakeReady go a long way to improve the way the work works in a project. They are even more effective within the framework of an agreed, collaboratively produced project programme.

Traditionally programmes are prepared by professional planners and project managers — *first planners*. To do this they make many assumptions — and build slack into the programme to compensate for these uncertainties. First planners may consult members of the delivery team if the packages have been let, but delivery team members will not easily give up buffer when they are uncertain about who they will be working with and what the project involves. At the end of the day the first planner programme is generally imposed on the project. Projects are then managed in terms of what the programme says *should* happen. It often requires work to be done that cannot be completed at the time set in the programme. This causes delay that is difficult to recover, even with critical path methods.

Collaborative programming

LPS is a programme coordination and production control system designed to ensure the achievement of *agreed* goals. Those goals are set in a collaborative programming process so that all the main suppliers and specialist contractors are engaged right from the start in developing and signing up to the master programme and to the programme for each phase.

When all major players meet early in the process it's possible to discuss critical interdependencies, test assumptions and agree on good practice.

Figure 3: programming the production of detail design drawings for a factory in an architect's office

Systematic risk analysis is integral to collaborative programming so that float is included where it will best protect programme integrity and predictability.

Figure 4: Review of construction sequence in foreground while others continue to create the programme for a student housing scheme.

Benefits of collaborative programming:
- *introduces the suppliers to each other*
- *starts with client/end user values and creates a value stream to deliver them*
- *suppliers look at and talk about details much sooner;*
- *sorts out sequencing issues that would be difficult to change later;*
- *enables team to test options to improve work flow*
- *if necessary, subsequent re-programming is easier*
- *clarify criteria for release of work to others sooner*
- *reduces need for progress chasing*
- *builds the team*
- *prepares team members to be in action together*
- *includes an informed risk analysis*
- *suppliers have confidence in programme dates*
- *promotes two way accountability and responsibility*
- *allows the collection of other issues for discussion later or in other arenas.*

Programme compression

With an agreed programme it is possible to explore ways to compress the programme if this is desired or required. With a supply team that have worked together on a number of similar projects previously, one UK client has recently taken 6 weeks out of a 19-week programme using this approach. This clearly has enormous benefits for the client — their building is earning significantly earlier. It also has benefits for the main contractor and their suppliers — they are more competitive — reducing

the programme itself reduces cost — and they all stand to make a larger margin.

Figure 5: intense concentration and discussion during a programme compression workshop

Another client has used collaborative programming and compression principles to rescue a 70-week programme that was running about six weeks late after 30 weeks. From the time of that workshop, involving all the major suppliers on the project, Last Planner was used to help keep the project on the new agreed track.

For a third client collaborative programming showed an airport upgrade project could be delivered in 16 weeks instead of the 20 or 21 weeks that *first planners* thought it would take. In a subsequent workshop they have managed to get that down to 14 weeks.

> "Results show a **30% improvement in the rebuilding times for runways** since Last Planner was introduced, and predictability is greatly improved."
>
> *Gerry Chick, Supply Chain Development Manager, BAA*
>
> "LPS is **an effective set of tools for leveraging the shared knowledge of all members of the project team**. Without LPS a project manager is guessing at what can be accomplished versus knowing how the job will get done."
>
> *Tom Richert, Programme Mgr, Linbeck Construction*

Securing reliable promises

A contract is a very formal promise to the client to deliver the project by a certain date in a specified condition. Within the project it is helpful to think about the production plan as a record of promises made to the wider project team.

The agreed programme defines when tasks should be done and acts as a request to the supplier to do that task. The *last planners* only promise once they have clarified the *conditions of satisfaction* and are clear that the task *can* be done — i.e. they have the materials labour, information, etc. to do the work.

Once the task is complete the *last planner* responsible *declares delivery* so that site management or the team

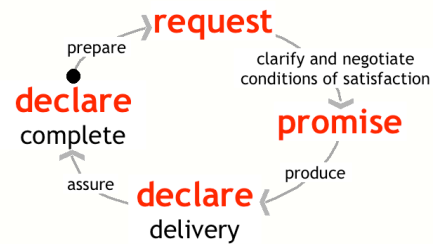responsible for the next task can assure themselves that it is complete to an appropriate standard.

Figure 6: the promise cycle

The discipline of managing promises improves the way operatives engage in the project. They become members of a team intent on fulfilling the overall promise to the client. They cite the effect of peer pressure from the public managing promises meetings and demonstrate initiative in keeping their promises and adjusting to the changing performance of others so that the overall project is a success.

Collaborative programming, MakeReady and negotiation in and around the PPM all help trade foremen promise reliably. Continual Improvement — the fourth key element of LPS — can further increase promise reliability and the predictability of production plans.

Continual improvement

Our task is not to fix the blame for the past, but to fix the course for the future. John F Kennedy

All these elements together contribute to predictable work-flow. It is only by adding continual improvement processes that we systematically learn how to work more effectively together, to make the work programme ever more predictable. They also contribute to the quality of the finished product as the process significantly reduces hurry and wait and smooths work flows.
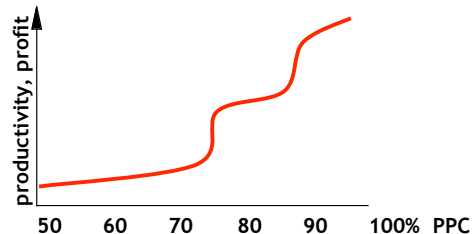

Figure 7: productivity, profits increase with PPC

Within Last Planner there is a measure of predictability of work delivery — **PPC** — the **P**ercentage of **P**romises **C**ompleted on time. At the PPM each team leader promises to complete one or more activities by a given day of the next week. Used to improve production predictability, PPC measures the proportion of promises made that are delivered *on time*. LCI research shows that where Last Planner isn't used, PPC is typically 30% overall — only 1 in 3 of the tasks promised for tomorrow will be delivered by the end of the day! Studies in both the US and the UK show that there are step changes in productivity and margins with a PPC around 75% and 90%.

Part of the **continual improvement** of PPC scores and programme predictability is a study of the reasons why tasks promised in the production plan are delivered late. Recording reasons in a Pareto chart (Fig. 8) shows where attention is most likely to yield the most results.

Using tools like *5 Why* and *cause-effect diagrams* helps a team understand how to improve the clarity of information and ensure there are enough operatives.

Reason	ocurrence
Unclear information	✗✗✗✗✗✗✗✗✗✗✗
Too few operative(s)	✗✗✗✗✗✗✗✗✗
No promise to deliver	✗✗✗✗✗✗✗
Client/Design change	✗✗✗✗✗✗
Overated capacity	✗✗✗✗✗✗
Late request	✗✗✗✗✗
Unclear requirement/CoS	✗✗✗✗
Prerequisite work	✗✗✗
Failure to request	✗✗
COS not made clear	✗✗
Rework	✗✗
Other	✗✗
Absent operative(s)	✗
Unplanned work	✗
No customer	
No performer	
No due date	

Figure 8: example of a reasons Pareto chart

We do it already

Many project managers do some or all of these things to a degree already. Last Planner is a formal and rigorous discipline. It consists of a system of inter-related elements and it is only when *the full set* is systematically implemented by the whole project team over time that the major benefits will be appreciated. Greatest benefit is likely when an integrated team use Last Planner consistently over a number of projects.

Signals that you don't yet do it already include:
- work pushed into production by the programme
- project dominated by fire-fighting
- sub-contractors with no sense of ownership of the programme
- work being done out of sequence
- operatives with no sense of what work there is for them the day after tomorrow.
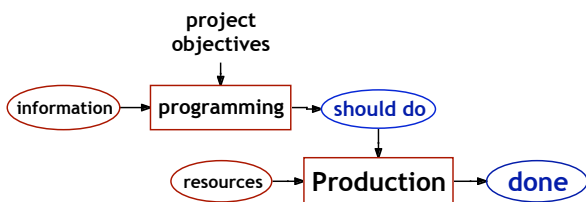
Push *vs* pull

Figure 9: traditional *push* approach to production

The traditional planning system is a push system — it pushes work into production based on pre-determined start and completion dates, without regard to whether the work is ready to be done or not — or the readiness of the producers. If this system worked, there would be a high coincidence between **should do** and **done**.

This traditional *push* approach leads to non-senses such as ceiling contractors installing ceilings before the M&E contractor has finished working above them. The M&E contractor often removes (and damages) all or part so the ceiling contractor has to return to make good the ceiling at extra cost. Good money for the ceiling contractor. Bad for the client and everyone else on site, as it increases costs and slows work down.

In software engineering it can lead one programmer to make assumptions about what another is or will do, resulting in rework; in design, one designer will make an educated guess about what will be required and proceed

on that basis — sometimes they'll be spot on, but more often, they'll have to do a load of rework too. When building luxury yachts installing fitted furniture in the wrong sequence can lead to problems for the plumbing, electrical or mechanical teams.

LPS changes the way the programme is arrived at and adds a critical step designed to ensure that only work that **can** be done is scheduled for production.

> "MT Højgaard - the largest construction company in Denmark - has applied the Last Planner System on more than 25 building projects during the last two years. No matter what the size or type of project, **the Last Planner System improves the building process and hence the overall result — reduction in costs, projects that are on or ahead of schedule**, and **a shorter [defects] list**. The most significant improvement is the **lower accident frequency and severity**. "
>
> *Mikkel Thomassen, Project Manager, MT Højgaard*

Safety and personnel

*Last Planner benefits don't stop at programme predictability, profit and productivity. On like for like project comparisons 45% **fewer accidents** and **60-70% less sickness absence** on Last Planner managed construction sites according to Danish research.*

Image Decorations Ltd, a Sheffield based decorating company, found that using LPS improved the managerial skills of their foremen on site and led to a freeing up of senior management time. MD Nick Wain told a *Construction Productivity Network* meeting:

> Yes – Last Planner has worked for our company. The team works towards common goals, and team members have joint ownership in planning and delivering the project. There has to be mutual trust, open communication and a desire to have all members of the team win.

Nick listed the **benefits** to his company and its staff as:

- *It is a management tool that enables our site supervisors to plan their workload on a weekly basis and assess team performance on a daily basis.*
- *It enables us to make an accurate prediction of the labour required on a weekly/daily basis. This is based on facts, not a site agent's wish list.*
- *Site supervisors improve their management skills in running the site works, dealing with customers and managing site labour.*
- *It gives our site supervisors a better understanding of the planning that goes into a job in the office and has created a closer working relationship between directors, managers and on-site foremen.*
- *Once supervisors have understood the working of Last Planner and are confident in using the documentation, it can reduce the frequency of senior management visits to site.*
- *Supervisors learn to handle situations as they arise basing decisions on facts documented weekly.*
- *Progress through Last Planner is monitored daily against the requirements of the planned work. If targets are not being met it is easy to assess where the problem lies and address it.*
- *Subcontractors tend to work more closely with each other, recognising that they all responsible to*

succeeding trades for ensuring that they can carry out their works in line with the programme.

- *So long as expectations are in line with the agreed programme, subcontractors tend to ensure they achieve what they set themselves each week. A professional pride develops in not letting the team down. It can be embarrassing at the next meeting to admit failure to deliver on time.*
- *It can highlight poor performing subcontractors.*
- *The only companies that have to be concerned about using Last Planner are those that work with no regard to the programme.*
- *By putting more emphasis on management and the planning of work Last Planner can dramatically reduce site labour costs.*
- *Although it is not the reason to use Last Planner, it can provide evidence that you have acted within the terms of the contract in the event of a dispute.*

He also acknowledged a number of issues —as with any system there are some points that should be followed to increase the success rate:

- If Last Planner is not carried out in a systematic manner, it will fail. The documents have to completed in full and discussed weekly.

- Project managers must police the Last Planner System effectively. There is still a need for sanctions against badly performing companies.

- Last Planner will highlight teams that don't perform well. If project managers don't use the data to manage performance, Last Planner will be discredited and the benefits lost.

- Last Planner can show up poor project managers. This can trigger appropriate training and/or reassignment.

At the same meeting[1] Gerry Chick from BAA talked of the value of getting everyone round a table. He emphasised the importance of it being supplier driven and the recognition it gave to bad news. *Bad news*, he said, *provides good information. Bad news* early *is even better*. Last Planner enables bad news to surface quickly before it becomes a major issue. It can also provide signals of immanent bad news that may enable the team to head it off.

Much of construction management is described as *fire-fighting* — dealing with things that have gone wrong in effort to get back on track. Continuing that metaphor, the Last Planner System is an *integrated fire prevention system*. Collaborative programming anticipates problems and help the team develop countermeasures; MakeReady weeds problems out before they impact on production; collaborative production planning reduces potential problems still further and continual improvement helps the team learn how to avoid the problems that do emerge.

LPS is not for construction managers who thrive on fire-fighting, but, as the DTI research shows, most in construction would welcome an easier life and Last Planner is a good way to start creating that *with* them.

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[1] 17 September 2003 in London. For a copy of the full report of the meeting go to:
http://www.ciria.org/acatalog/copy_of_copy_of_17_September_2003_ _E3151_.html for other CPN Last Planner reports see:
http://www.ciria.org/acatalog/CPN_workshop_notes___2004.html

Lean Construction Institute UK

LCI-uk Ltd aims to be the primary UK body for the documentation, development and dissemination of global good practice in lean thinking applied to construction and construction related activities and to make it available to the widest possible audience in the UK.

LCI-uk offers:

- A biennial lean construction summit showcasing the latest applications from around the world
- Fora for practitioners to exchange ideas and learning
- Special interest groups/Communities of Practice to enable practitioners and academics to develop and learn together
- Academic/practitioner meetings
- Study tours to visit companies and projects with advanced applications of lean and last planner around the world
- Lean construction and Last Planner training workshops
- Collaborative identification of research topics and joint commissioning of research programmes
- In the longer term we want to be in a position to commission research on behalf of the industry or groups of industry stakeholders.

Founded on the same principles of collaboration and openness as our sister institutes in the US and Denmark, **LCI-uk Ltd** is onstituted as a not-for-profit, pan industry think tank.

LCI-uk is a membership organisation open to individuals and organisations; it aims to attract the widest possible membership from across the industry — clients, designers, contractors, sub-contractors, specialists and suppliers — and to represent the special interests of none.

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