

COMPANY OVERVIEW



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DPS Group is a Global Engineering and Project Management Company, serving industries around the World for 42 years, with industry experts in key locations in Europe, the Middle East, Asia, and the USA, bringing world-class resources and the latest innovative technologies to every project. DPS delivers Full Service Engineering with a ‘client-first’ mentality and personal

touch across a range of disciplines: Project and Programme Management, Procurement, Design, Construction Management, Health & Safety Management, Commissioning, Qualification, and Start-up. DPS employ more than 1,300 people worldwide, which includes 230 in its Cork operations where this case study is based.

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OVERVIEW OF THE LEAN INITIATIVE

The Client in this case study is a major multinational company in the Biopharma space. Due to the tight schedule and the necessity to integrate and align all elements of Engineering, Procurement, Construction Management, and Validation (EPCM&V) on the case study project, it was decided to use Last Planner® System (LPS) across the entire delivery process. DPS Group has executed over 10 million project hours in construction using LPS; however, the use of LPS in design,

construction, and commissioning would be a novel undertaking in integrated construction delivery as case studies on its use across all elements of EPCM&V are scarce.

BACKGROUND TO THE LEAN INITIATIVE

Due to market pressures to develop trial batches of a new product, an existing production building required decommissioning, dismantling, and the reconstruction of a new biologics facility. This constituted ‘the project’. The Client had instructed that the tight 32-week schedule from commencement of construction to Installation Qualification/Operational Qualification (IQ/OQ) completion be further compressed to 24 weeks. This aggressive fast-track schedule requirement would necessitate the implementation of a delivery process that would offer improved integration of the design, procurement, construction, and commissioning phases of the project.

Allied to this demanding schedule requirement was the extremely restricted size and nature of the construction site as it was located within a live production plant. Given these constraints, it was apparent that traditional project delivery approaches would not accomplish the goals of the project. The departments of Design, Procurement, Construction, and Commissioning/Validation would have to effectively and efficiently collaborate to ensure seamless integration of work handovers both within and between each discipline and department. Allied to this was the necessity to have the Client very closely involved and accessible to ensure a rapid decision-making process was in place.

LEAN INITIATIVE UNDERTAKEN – LEAN THINKING, TOOLS, TECHNIQUES

Both the Client and DPS Group had used LPS together on a recent project – but only on the construction phase. Both parties were very pleased with its success as it had contributed towards producing a smooth and predictable workflow; it had revealed constraints impeding the commencement of tasks; it created an atmosphere and a basis for improvement; while it also contributed towards building accountability, judgment, and confidence within the team. The intention on this project was to use LPS across design, construction, and commissioning; ensuring that all inter-discipline handoffs were agreed, committed to the weekly work plans (WWP), and then monitored daily.

As a key concept in Lean Construction is the provision of reliable workflow to the teams to reduce uncertainty in the delivery process, LPS is a major waste reduction and waste elimination technique that addresses this, and the principles underlying LPS can be summarised as follows:

- Plan in greater detail as you get closer to doing the work.
- Produce plans collaboratively with those who will do the work.
- Reveal and remove constraints on planned tasks as a team.

- Make and secure reliable promises.
- Learn from breakdowns.

Research suggests that a more complete introduction of LPS on construction projects could bring about a change in mindset and ultimately assist overcome the cultural barriers to the new approaches to efficiency and production in construction. Such mindset change is possible as LPS is a critical tool for enabling the delivery of better performance over time, and the consequential actions that logically develop are in fact the identification of what is valuable to the next-customers. The highlighting of next-customer awareness was identified as being a critical objective on this case study project as traditionally departments within the EPCM&V model would have tended to work as siloed entities, resulting in numerous non-value-added (NVA) work occurring in the handover between departments, mostly due to an absence of collaboration between the parties. While the end goal or milestone is likely to be a valued item to the end user, various interim goals are of value to other internal customers in the delivery process. The very act of identifying predecessors and constraints to the start or finish of an activity in LPS defines

value to the owner of that activity – that person is a ‘customer’ of the trade or organisation performing the predecessor activity. The introduction of LPS on a project promotes cross-trade collaboration deep inside and this was exactly the type of behaviour and interaction that was required to ensure that an environment existed where EPCM&V could cooperate and engage to ensure that best efforts at realising the aggressive fast-track schedule could be achieved.

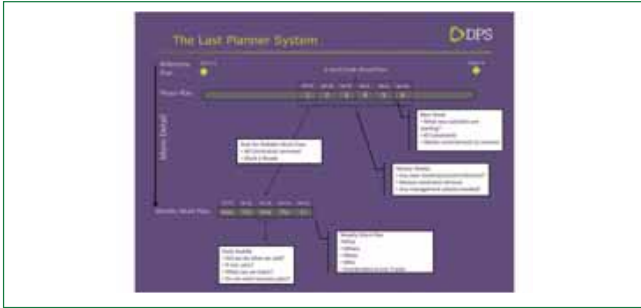


Figure 1. The Last Planner® System @ DPS

As LPS had already been used in construction with this Client it was decided to embed two members of the construction team within the engineering disciplines to coordinate the running of the morning huddles and to bring across the concepts and principles of LPS to the designers. Going forward, this was also going to be beneficial as the construction management team would contribute to the constructability of the design and would also gain a head start on the site construction works arising from the prior knowledge of the specific design. Introductory training on LPS and Pull Planning was carried out with all team members across engineering and procurement. More specific and focused training was conducted with team leaders and supervisors as these were the persons who were going to drive and sustain the momentum around LPS implementation. An open-plan big room environment was created where engineering and procurement were co-located, and at that early stage it was also determined that the core validation and commissioning expertise would be supported by members of the engineering team who had been involved in the design of the project from the outset. The Client’s Project Manager was also co-located in this big room environment. The common thread that would bind this collaboration, integration, and communication together was LPS and its various functions.

An important aspect of the LPS implementation was the success of the integrated Pull Planning sessions involving team members from across the EPCM&V functions, while also having Client attendance and interaction. This led to a greater level of common understanding across the teams and encouraged behaviours that broke down the existing siloed practices thus enabling greater collaboration, especially when identifying constraints and obstacles along the schedule workflow. The next-customer clarification of its Conditions of Satisfaction (CoS) by the EPCM&V teams, plus the Client-ensured minimisation of wasteful design iterations, enabled better alignment of handoffs between all parties when next-customer expectations were made explicit.

The Lean Construction Institute states that “CoS are the criteria that the team uses to make decisions, develop a common language for collaboration, define expected behaviours, drive team culture, and work together to achieve positive outcomes. Well-designed CoS ensure that all participants are fully engaged with their labour, talents, and experience. With CoS, everybody wins”.

Client support and involvement in the Pull Planning sessions and in the constraint removal process was critical to

maintaining the flow of information between engineering and vendors during the procurement process. All aspects of the LPS functions were supported by the Client, including participation in the Pull Planning sessions, the constraint process, the development of the WWP, the morning huddles, and during the learning review of the previous week’s progress reports.

To assist in the implementation of the coordinated workflow and the inclusion of the desired next-customer awareness, commissioning and validation (the customer of construction) organised the end of its WWP meeting to overlap and run into the start of the construction WWP meeting. This was to ensure that any information transfer or requests were immediate and not at risk of misinterpretation. Similarly, construction (the customer of design) scheduled its WWP meeting to run into the start of the design team WWP meeting. The DPS Senior Project Manager and the Client Project Manager attended all planning sessions to visibly support and offer commitment to the process.

Progress was communicated to the Last Planners at the weekly coordination meeting and the focus was on emphasising the positive aspects of project planning while also noting the focus points that could be improved going forward. Such learning, development, and refinement of the process on a week-to-week basis was a crucial aspect of LPS on the project. Tasks completed as planned, tasks missed, and tasks completed early are recorded and presented back to the Last Planners. A summary of the volume of work undertaken on the week (total tasks planned) is shown and the top three categories of variance (reasons for non-completion) is discussed amongst the team with countermeasures suggested to eliminate or minimise reoccurrence of such negative impacts. A week-to-week trend of percent plan (promise) complete (PPC) is an important KPI of LPS and is an indicator of the team’s planning performance.

C&Q produced their own weekly PPC report. A Variance Trend Analysis illustrates the categories of missed tasks that were impacting on the completion of work when measured against the original planned tasks on the WWP. This was trended over a five-week period and as this is a visual presentation one could see how the ‘Client-driven changes/delays’ that impacted WW-30 were brought under control, as was the issue around ‘qualified staff availability’ which impacted WW-29, WW-31, and WW-32. Engineering/Design suite teams each produced their own WWP and weekly PPC reports. For weekly and monthly governance meetings, Design, C&Q, and Construction PPC were collated into a single report. If there was any major abnormality to discuss, the specific report could be shown and the countermeasure to the issue could be agreed. By presenting a combined report, the major issues that were impacting the project could be easily identified.



Figure 2. LPS Overview

‘Pre-requisite work by others’ was having a major negative impact in WW-31. When this received focus its impact was reduced for WW-32, and almost eliminated in WW-33.

'Client driven changes/delays' had the largest negative impact in WW -32 and this was greatly reduced in WW-33. 'Client documentation signoff delays', which impacted WW-30 and were addressed, arose again with a major negative influence in WW-33. This re-occurrence, so soon after it had been initially identified and considered resolved, warranted investigation and a separate meeting to address the issue was convened. A 5 Why analysis and scientific problem-solving technique in the form of an A3 problem report was undertaken, and the root cause was identified as Client resources being diverted from the planned task to prepare for an upcoming external audit within the facility. The Client worked around the issue and the construction project was sufficiently supported to enable it stay on schedule. The use

of the functions of LPS, namely the commitment of planned tasks to the WWP and the prompt generation of the PPC report, allied to the trending of PPC over time, had resulted in the identification of issues that could impact negatively on the schedule. This allowed countermeasures to be implemented promptly, thus avoiding delay to the project. The data recorded from the huddles and the daily marking-up of the WWP, and which was communicated through the weekly reports, was further collated into a Pareto analysis of all the variances. This ensured that the entire team was using data-based decision-making project management, thus completing the connection between the social interaction-based weekly production and the traditional critical path schedule-based management process.

LEAN INITIATIVE IMPROVEMENTS & IMPACT

The major difference from the traditional planning process, and from the previous experience of DPS Group and the Client using LPS, was the inter-departmental participation and collaboration in the Pull Planning and WWP sessions. Engineering and Procurement produced their own joint WWPs and Pull Plans, Construction produced their own plans, and so did Commissioning. While LPS enabled cross-trade collaboration within each department, its crucial contribution to the case study project was the facilitation of the interaction and collaboration between EPCM&V and focussing all parties' attentions on the project's overall goals.

All functions of LPS were used on the project, and this is what contributed the greatest benefits to the project. Its creators declare that LPS is a system of interconnected parts and that omission of any part curtails the system's ability to accomplish its functions. The full integration of the teams from Engineering/Design, Procurement, Construction, and Commissioning phases was enabled by the visualisation of each department's position and role on the overall project milestone schedule. The separation of the different phases of the schedule and associated Pull Plans allowed each department to focus on its own goals whilst also actively progressing and coordinating their tasks towards the overall project completion date. The weekly and monthly governance meetings, where the LPS data was reviewed at management level, was key to steering the project on course. The Last Planners held their daily huddles and weekly LPS coordination meetings at site level ensuring that the connection from high-level milestones to the daily production planning was complete. The extremely tight schedule was achieved with some areas being completed and handed over ahead of the target date. This was despite the Client's independent risk analyst calculating the probability of achieving this schedule as being 10%.



Figure 3. The DPS Team Doing LPS

Despite the very aggressive schedule, extremely tight site footprint, restrictive working space, and 24-hour work days totalling 144,600 hours worked on site, there were zero lost

time incidents or accidents. Both DPS Group and Client Safety Officers attribute great credit to LPS for the achievement of this key project goal and mention the increased understanding by the supervisors and trade foremen of their own and others daily work tasks, leading to a greater coordination and spreading of work across the work zones, lessening congestion, and leading to improved and safer working conditions.

The Construction Manager insisted on accurate resource numbers being entered in the WWPs, which were then filtered per area which highlighted if any work zone was overloaded with multiple trades. This practice assisted trades in ensuring availability of a clear area in which to carry out their work and avoided unnecessary reorganisation and firefighting. As a major issue in construction delivery is trades waiting to commence their own work or waiting for other trades to finish, it was satisfying to receive the following quotes from the contractors on the project confirming the coordination benefits of LPS:

- The Electrical Contractor said that "We were able to meet deadlines and in turn, not hold up any other trades in carrying out their own work and achieving their own goals".
- The Civils Contractor said that "Last Planner had a big part to play in this project as all contractors had a large volume of work within a tight work area".
- The Specialist Clean Room Contractor said that "Last Planner reinforced the team element of the project with all trades being aware of other trades requirements".

A major problem in any construction project close-out is the management of punch-lists and their timely close-out. While the punch-lists were managed through a separate dashboard, the walk-downs and approaching deadlines were coordinated through the WWP and the daily huddles. This proactive approach of addressing punch items as work was progressing was, in the eyes of the Construction Manager, responsible for the reduction of punch items by approximately 30% when compared with previous projects of a similar nature. By focussing on the punch-list items from an early stage through the WWP, an atmosphere was created where quality at every stage of the production process became engrained in the trades executing the work. In conjunction with the 5S workplace implementation which focussed on organised and tidy workplaces, it was possible to close-up walls and ceiling spaces at the earliest possible time as rework had been minimised by this increased quality focus. No time allowance was therefore required for rework which resulted in satisfied contractors and which in turn led to improved employee satisfaction as the project neared completion.

An important qualitative benefit of the integrated use of LPS was the improved vendor, sub-contractor, supplier, and broader supply chain engagement and collaboration which

resulted in almost all the project team being retained for the contract that ensued after this case study project.

The DPS Group Construction Manager had the following to say about the use of LPS:

“The Last Planner System implemented on the project had a positive impact in many ways. It enhanced acceptance of task ownership and improved leadership skills with our supervisors while in parallel creating a natural team ethos between contractors. It created a very proactive planning approach. Pharma projects can be challenging to close on-target deadlines and last planner provided all the information required to allow constraints to this goal to be mitigated. It also highlighted punch-list closeout requirements which had definite dates for closure. With improved punch-list closeout durations as well as the project being completed on time, this allowed us to see a positive impact commercially as we had no requirement for additional labour or prelims post-Project Completion. The enhanced coordination amongst trades brought greater safety and quality benefits, affording management more time to focus their efforts on value adding tasks as opposed to firefighting and resolving impending issues.”

The learning that DPS Group attained on this project has now become the standard procedure in its delivery model, and the lessons learned from integrating EPCM&V into such a challenging schedule has enabled the company to take a major leap forward in the scale of projects that it can now bid for.

The DPS Group Design Project Manager suggests the following:

“Last Planner in design assists greatly the understanding from design discipline to design discipline, identifying the constraints and highlighting the reasons why work is being scheduled in a specific way. Knowing who your customer is, drives a shared responsibility to deliver on design commitments at the time required.”

As Lean is ultimately defined as ‘value in the eyes of the customer’, it is fitting that the final comment on the integrated use of LPS across EPCM&V on the case study project should rest with the Client’s Project Manager:

“This client completed two similar sterile facility upgrade shutdowns this year, one with standard scheduling tools with another Engineering firm and another under Last Planner with DPS. There were significant improvements evident within the following areas:

- Schedule reliability & forecasting.
- Contractor ownership of their work streams and milestones.
- Issue resolution speed.
- Avoidance of issues around overcrowding in certain rooms

by entering number of personnel per area/task.

- Improvements in safety and coordination.

Last Planner is a useful tool to enforce discipline with other stakeholders onsite with regards to work planning (site maintenance/operations/facilities teams) and with other smaller project works that are occurring in the same workspaces.”

Postscript by Aiden O’Dwyer, Director Cork Operations DPS Group

“Kevin Hallahan was DPS Group Performance Manager in Cork Operations and was responsible for implementing LPS on this case study project. On the 30th of September 2017, Kevin lost his life as a volunteer with Dublin-Wicklow Mountain Rescue Team on a mountain rescue training exercise in North Wales. In the short space of time since his path crossed with the DPS Cork operation, initially doing Yellow Belt Training and then joining the Operation as Performance Manager, Kevin had such a positive influence on his work colleagues and on the day-to-day workings of projects he was involved in. His energy carried all those eager to join the Lean journey, but moreover Kevin influenced any reluctant team members to participate, by demonstrating the benefits of Lean and LPS in a way that only Kevin’s unique leadership and personable charisma could accomplish. Kevin’s legacy remains resolute, and the Cork Operation is driving forward with Lean initiatives. There are now 18 Green Belts in the office and a strong Lean ethic embedded within the Operation. There will be an annual review of the Lean initiatives undertaken and an award offered to the best submission in Kevin’s name. This annual award, as well as this case study, will maintain focus and due credit to Kevin’s legacy, who through his energy and leadership has started DPS Group Cork Operations on this Lean journey.”

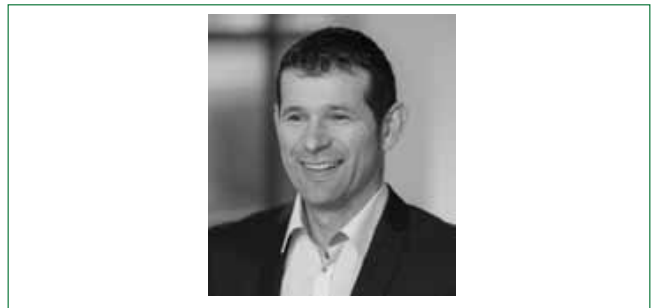


Figure 4. In Memoriam: Kevin Hallahan