

**COMPANY OVERVIEW**



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PM Group is an international project delivery company operating across Europe, the USA and Asia. We have a 45-year track record in project management, process design, facility design and construction management for leading multinational companies. We are world leaders in the Pharmaceutical, Food, Mission Critical, Medtech, Advanced Manufacturing and Energy sectors. Our reputation is

built on great people with a flexible “can-do” attitude who consistently deliver successful projects safely for our clients. We pride ourselves on our technical expertise and work closely with our clients to develop innovative solutions for complex projects. We have over 2600 highly skilled employees worldwide. While headquartered in Ireland, we have offices based in 17 countries worldwide.

**OVERVIEW & BACKGROUND TO THE LEAN INITIATIVE**

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This case study details the Last Planner® System (LPS) processes applied to the fast track delivery of the construction of a biopharmaceutical facility in Dublin, Ireland. LPS was adopted to help implement lean practices and enable high level project-wide coordination. The owner was converting an existing facility in Swords, North County, Dublin to a high-tech biopharmaceutical manufacturing facility. PM Group was retained by the owner to partake in the design and construction management of the Biotech Project. The author is a project engineer employed by PM Group, and is coordinating the implementation of LPS on the Biotech Project.

Construction and turnover is scheduled to be completed by July 2020 and, to support delivery of this ambitious fast track timeframe, detailed design had to be completed by July 2019. In order to achieve this schedule on time, systems turnover began when the project was about 35% construction complete. Conventionally, system turnover usually begins somewhere between 55-65% construction complete. This earlier

turnover start drives a much greater overlap between construction and detailed design phases, which forces greater emphasis on coordination in the field.

The project comprises 5 buildings with 11 manufacturing suites and a high level of GMP finishes and fit-out on a constrained site in a suburban setting.

Biotech Buildings

1. Bulk Drug Substance Building (BDS)
2. Warehouse
3. CUB
4. QC & MS&T Labs
5. Offices & Other



Figure 1. Site Layout Plan

**LEAN INITIATIVE UNDERTAKEN – LEAN THINKING, TOOLS, TECHNIQUES**

This case study focuses on the construction of the Bulk Manufacturing Building (BDS). Interfaces can range from physical connection boundaries between building components to contractual work package scopes. Interface management is a key project delivery risk. There are numerous common and constantly changing interfaces between 15 trade contractors. By limiting and clearly defining interfaces, communicative action can take place which will resolve a lot of the issues in construction. Updating IT application to interface management, and

using it extensively, can reduce project CAPEX costs by 2% and delivery duration. Instead of the traditional approach of contractors and EPCM firms relying on 14-30-90 day schedules, and placing heavy emphasis on them by pressurising crews to meet deadlines, LPS addresses these issues by recognising interfaces and tackles them by engaging all stakeholders to the level of contractor foremen and supervisors to create a micro-schedule. These micro-schedules look one week and six weeks ahead, breaking down



activities daily and weekly. Inherently, now the people in the field are actively driving the schedule, and they are making an honest commitment to deliver within the team. This changes the traditional culture and enables the foremen to think in a Lean way.

Creating a “people first” collaborative environment is key to achieving high levels of construction progress. LPS promotes a non-blame culture. LPS meetings take place once a week to discuss the next week’s work plan and constraints. These meetings are chaired by the BDS LPS lead and attended by the BDS Construction Manager and other members of the BDS Construction Management (CM) team. In addition, they are attended by at least one design project manager and designated contractor representatives, typically a CM or supervisor. The weekly lookahead is broken down and focused on process zones and rooms. The Weekly Work Plan (WWP) is the output from the weekly LPS meeting and includes:

- i. Work breakdown by Process Zone and Room.
- ii. Colour coding of responsible organization/contractor.
- iii. Resources planned.
- iv. Percent Planned Complete (PPC).

Each week when the plan for the next week’s lookahead is discussed, the team highlights constraints that are to be removed. Constraints vary and include lack of materials, labour, predecessor works, design, field clashes, weather, etc. These items are then logged and dated. The team will then identify a person who will answer or resolve the constraint. For example, to install a process pipe run, the contractor may need a bracket redesigned. They will flag this in the meeting, and a designer at the meeting will undertake to resolve the constraint; promising a date for the redesign to be done. This approach differs from the traditional means of going through a request for information (RFI) process, and improves on it. LPS enables the constraint to be identified to the team and made clear to the party responsible to remove the constraint. In this case, the designer on the spot now knows where the bracket is and that it is on the critical path. Eliminating the interface of an RFI and getting a designer who normally wouldn’t interact with a foreman to be aware of the construction process, helps ensure the workflow will be completed on time. Separate streams of meetings are also arranged to resolve constraints such as design delivery, clashes, and sequencing. These are taken “off-line” for resolution by the key parties outside of the LPS meeting.

In addition to identifying future potential constraints, those constraints that have arisen previously are recorded and analysed, and trends are identified so that measures can be put into place to reduce risk of recurrence. Figure 2 illustrates a sample of some of the constraints that have arisen on this BDS Project.

After the weekly meeting, the LPS plan is printed and posted on a wall in the LPS meeting room to be checked off daily by the contributing contractor foremen. The contractors will check “yes” or “no” based upon the activity having been completed, and, if not, the reason it

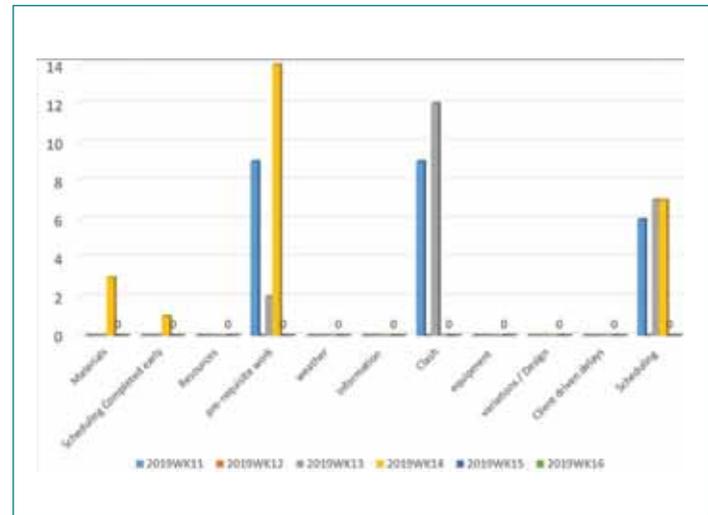


Figure 2. Extract from BDS Constraints Log

wasn’t completed.

The data collected from the contractors’ status update on the weekly LPS plan is used to create the PPC. The PPC metric is a measure of the activities actually completed within the weekly plans. The PPC is then displayed and this shows how well the weekly plans that are put together each week are working. PPC is linked with constraints and identifies what constraints are hindering construction progress. For instance, if the redesigned bracket did not come as promised, this will prevent the particular activity being completed and so reduce the PPC metric for the week. Over time, PPC data will compound and show what variances are slowing the progress down. In summary, the LPS process makes clear the effect of a break in the delivery chain by any member. This fosters a culture of delivery within the team over a short period of time.

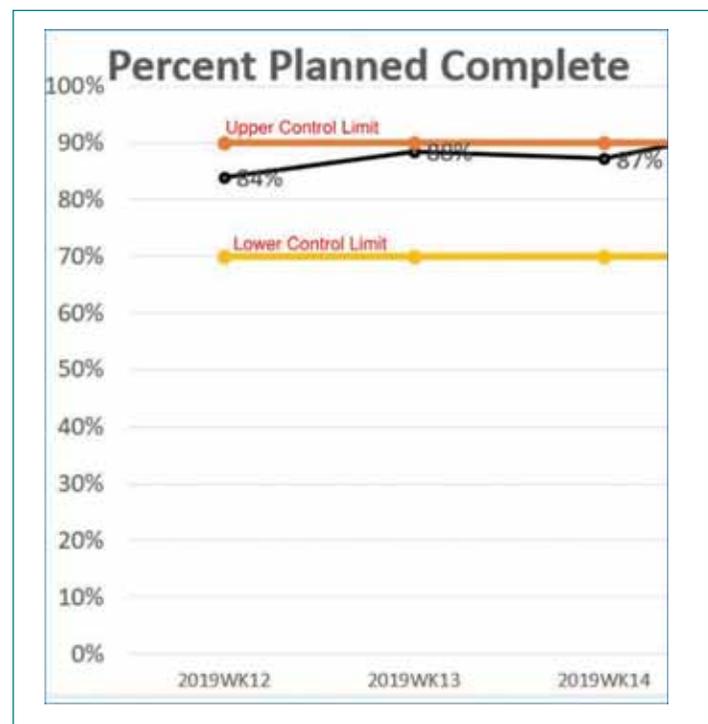


Figure 3. Percent Planned Complete (PPC) Curve

PPC is tracked weekly and measures how



well the team is performing tasks planned versus tasks completed. An extract from the BDS PPC curve is shown in Figure 3, with the yellow line representing the lower control limit and the orange the upper control target.

A key element of LPS is pull planning. By focusing on the end milestone and developing a six-week schedule, the constraints, the interfaces to be managed, and the activities to be completed to meet the milestone are clear to the team. For instance, issued for construction drawings (IFC) were constantly a constraint, and particularly in the earlier stage of the project given the significant overlap between design completion and construction. To overcome this, pull plans gave the design team clear visibility of priorities. For example, focusing early on freezing the architectural package for walls enabled the timely release and install of the associated mechanical and electrical services with minimal rework.

The project has its own dedicated LPS meetings which create a strong sense of team and partnership for all parties involved in the BDS Project. The scale of the BDS Project requires a large dedicated room to facilitate these meetings which is beneficial in adding value to the team. The room allows for the CM team to present not only the key project milestones, but also weekly project data, design constraints, quality information, etc., in a consistent group environment. Over time, the BDS LPS team has become familiar and responsive to each other's needs in the best overall interests of successful project delivery, namely the common goal of the team. Mechanical contractors learned where and what electrical contractors were struggling with or succeeding with and vice versa. By identifying these issues, plans have become more accurate and collaborative in nature. Dual projection screens allow for general layout drawings and aerial photos to be displayed enabling better

understanding of works discussed. Frequently team members walk up to the drawing or use a laser pointer to highlight the works or plans under discussion. The meeting is on site so team members are able to walk to see and address any potential challenges immediately after the meeting.”



Figure 4. LPS Weekly Meeting

## LEAN INITIATIVE IMPROVEMENTS & IMPACT

LPS was challenging to implement on the BDS Project due to the scale, fast track schedule, and the large number of contractors and interfaces in close quarters. In the beginning, it required a significant culture change for many team members used to more traditional approaches of construction delivery. Contractor supervisors are now also focused on schedule development, and the majority of planning decisions are made as a team. Initially, the CM team had to constantly work to overcome negative attitudes, traditional methods, and getting contractor management to buy into the system. However, the impact and improvements are very visible on site and from the data PPC averaged around 35-45% from weeks 1-20, and by week 35 forward PPC was averaging within the 70-90% range. This meant the team was making dates, milestones, and was working smartly. Constraints went from an average of 10 per week to approx. 5 per week – a near 50% reduction. This can be attributed to design being more substantially complete, but also to the construction team “thinking ahead” identifying problems and

collaboratively solving them in advance and achieving critical milestone dates.

The strengthened relationships developed from the LPS process, and founded on collaboration and integrity, have shown great benefits on schedule and project cost delivery. The BDS Project has seen similar benefits through increased collaboration and trust in coordination and action of plans. Contractors from different trades are interacting amongst themselves independent of the CM team's direction in terms of coordinating, completing, and handing over work areas. Frequently, an electrical contractor will raise constraints claiming they can't commence work due to mechanical works taking place adjacent or overhead. Now the mechanical contractor, due to LPS is enabled as a scheduler to point out where they could start work as another area might be free. On a fast-track project, traditional 'parade of trades' approach is not fast enough. Work needs to be constantly flowing, and LPS has given the team predictable workflow. Predictable workflow leads to



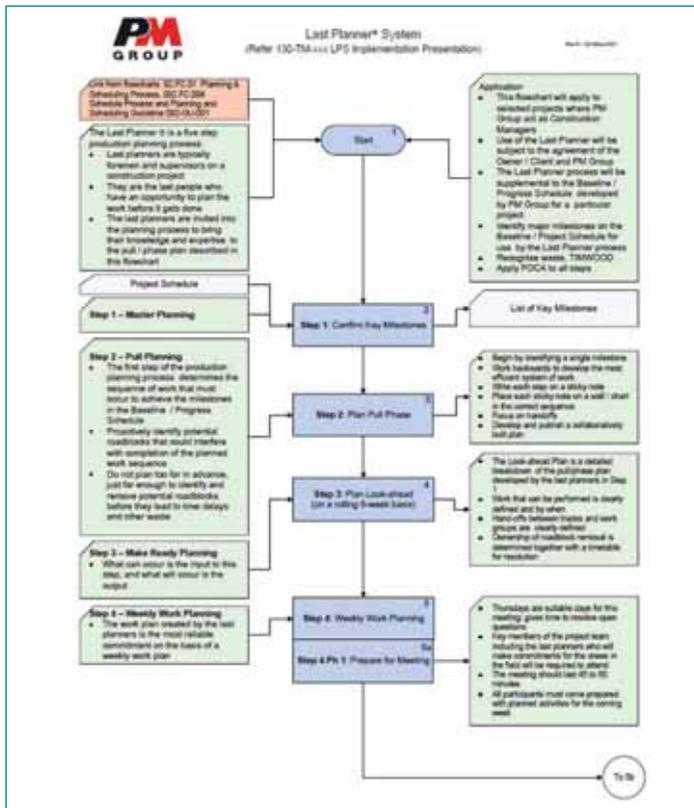


Figure 5. PM Group LPS Flowchart



higher productivity. The BDS team set a goal of snag free construction and this has been realised with a number of the first systems having been successfully walked down snag free. Credit can be given to the team for sequencing works from a top-down approach to allow for quality installs.

In conclusion, the intangible outcomes that LPS brings to the project team is where the real benefit lies for the BDS Project. The biggest challenges are developing and maintaining strong collaborative relationships and overcoming adversarial “turf battles” by dealing proactively with interfaces through working together effectively. A construction manager and management team can strive only so much to create a “team environment” with respective contractors, but complete commitment is needed at every level of the team to generate and achieve the highest level of safety, progress, and quality. It has been the experience on the project that the LPS approach as summarised in this case study assists greatly in achieving this outcome.

