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Established in 1977, Ardmac is an international construction specialist delivering complex and high-value workspaces and technical environments. Headquartered in Dublin, with offices in Manchester, Craigavon, Brussels, Cork, and Switzerland, Ardmac is supporting projects all over Ireland, the UK, Denmark, Belgium, the Netherlands, Switzerland, and have this year announced their expansion into Finland and Germany. Ardmac employs over 350 people and is a leading global provider of cleanrooms, data centres, fit-out and refurbishment, and modular solutions.

At Ardmac we work Smart, meaning we deploy innovative technology throughout our business to empower our people, drive performance, and delight our customers. We believe in setting new standards for our industry and driving innovation, we believe in tailoring solutions to our clients' evolving needs, and in working hard to harness our unrivalled knowledge to deliver safety first and excellence as standard across award-winning projects.

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Overview & Background to the Lean Initiative

In most construction projects, particularly those that are complex and large in nature, the scope is divided into multiple trade packages that are delivered by specialist organisations. It is only natural for each party to maximise their productivity by planning their use of resources in a streamlined manner. However, each package is not executed in isolation and often requires significant interaction with other parties. These interactions are known as hand-offs. Optimising each package independently often results in conflicts across trades, and results in waste. To maximise value for the customer, an overall project view should be taken and, if the hand-offs between trades can be managed well, flow can be achieved. However, this is a significant challenge. According to the Lean Construction Institute, the Last Planner® System (LPS) gives the last planners the tools and language to focus on flow by optimising the hand-offs between trades. This is achieved by improving the reliability of commitments made by participants.

Ardmac was an early adopter in 2014 of LPS, and we have observed significant benefits from its implementation. On a recent major project, Ardmac was engaged as a specialist contractor working as part of a group of trade partners. Ardmac implemented LPS internally, but the other trade partners and main contractor did not. This case study describes the challenges and benefits of adopting LPS on a project without the full participation of other stakeholders.

Lean Initiative Undertaken – Lean Thinking, Tools, Techniques

Buildings are becoming more complex in parallel to construction schedules becoming more condensed. Organisations operating within the construction sector are being challenged to deliver cheaper, faster, and better. It seems as if the sector is being forced to accelerate at an unprecedented pace and notwithstanding the ongoing resource challenges across the globe. Customer and client expectations haven't lessened and the challenge is how we as a sector adapt.

LPS is an excellent Lean Construction planning tool that Ardmac engaged with in 2014. It is easy to understand, is not overly expensive to implement, and it focuses on collaboration and cooperation. Scheduling is used as a tool on every large project. Anecdotally, the scheduling process leads to inaccurate time estimates on a regular basis, resulting in delays and lost time when work cannot be executed as planned. LPS has been proven to improve scheduling accuracy to >85% when implemented fully.

In the LCi Annual Book of Cases 2020, we described the success we have had using LPS. Significant investment has been made in

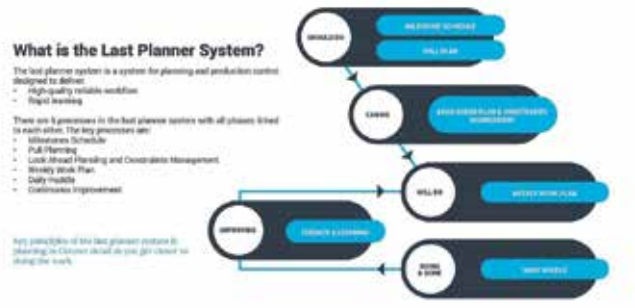

Figure 1. LPS System Description

employee training, software rollout, and the creation of an Ardmac LPS Workbook that people can use as a guide when using LPS on their projects. We use a combination of visual planning to supplement the LPS process, as outlined in Figure 1, and Figure 2 provides examples of LPS metrics and visual weekly work plans.

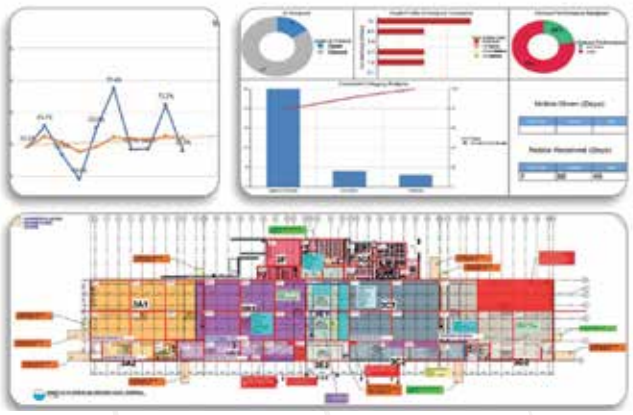

Figure 2. Examples of LPS Metrics and Visual Weekly Work Plans

This case study describes how one of our teams implemented LPS on a recent project when acting as a trade partner and with LPS not being adopted by the wider project team. The challenges faced by the team and the merits of using LPS in this situation are discussed. Regardless of the client, management team, trade partners or colleagues, we all have a part to play in the effective and efficient completion of our scope of work to ensure a project is handed over to the end user successfully. Nevertheless, sometimes the last gasp heroic type efforts to get a project to an end user can be forgotten when milestones and project dates are achieved. Scrambling to hit milestones can be an extremely rewarding feeling for a team, and can often improve morale; however, doing this for every milestone is not sustainable across the course of a major project. Construction projects are marathons not sprints, and they need to be treated as such.

The project in question was complex in nature and involved multiple organisations, some working in partnership and others working directly with the client. Initially, a high-level schedule was created that all parties agreed to and a sequence was agreed describing which levels, zones, and elements would be completed in order of priority.

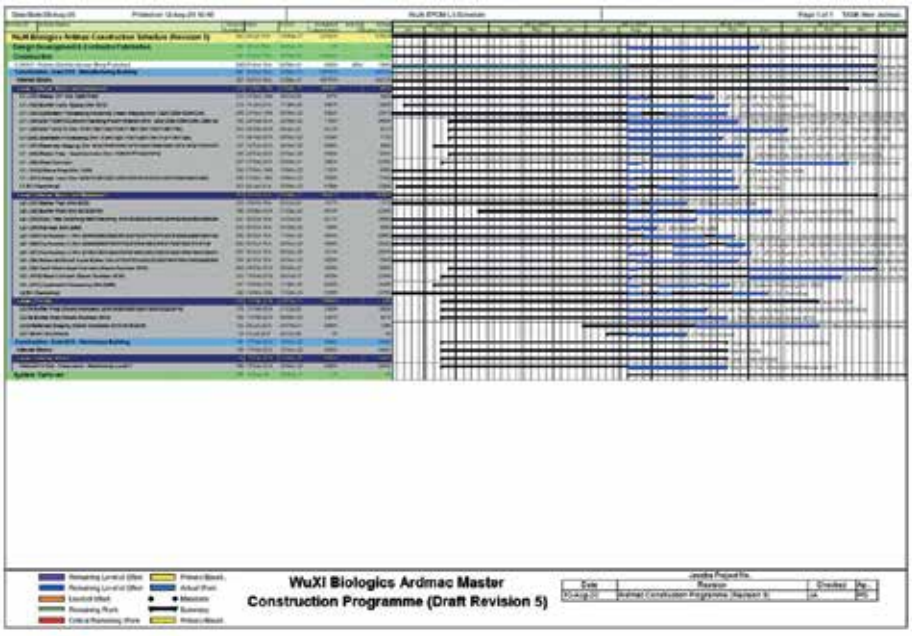

Figure 3. Initial Project Baseline Schedule

Unfortunately, the project coincided with a few macro-economic events that had a significant impact, the two most impactful being Brexit and the Covid pandemic. The challenges posed by these events was added to by design changes and supply chain issues experienced by multiple project stakeholders. Material and labour shortages became a challenge, and the project was completely stopped for 10 weeks due to the pandemic.

The result was a schedule that lacked certainty and impacts that were not possible to predict. Elements that were not impacted would be accelerated to compensate for those that were delayed. Consequently, frustrations mounted in the field with supervision becoming increasingly disillusioned by unrealistic requests from management as original milestone dates began slipping. The hand-over priority originally agreed at project commencement began to blur and resulted in different trades working to differing sequences to minimise schedule impact.

Due to the ongoing pressures of unreasonable timelines, we experienced negative attitudes and lack of engagement from our field supervision. As a result, this created a significant issue internally which needed to be reviewed, resolved, and actioned with immediate effect. Our management team were highly motivated, enthusiastic, and safety-conscious, and had previously delivered projects using LPS at a high level.

As part of our project execution plans, we focus heavily on utilising LPS to ensure the successful completion of our works. Despite the investment in training, as a team, we unfortunately fell short of the fundamental requirements of LPS. Dates we were working towards had exceptionally tight timelines and people did not have faith they could be achieved. The effectiveness of the planning process was lost in the depths of unreasonable timelines, which could not continue. We sought opportunity to eliminate parts of the process that were not adding value. There was no alternative and a better solution was badly needed because, if the trend continued, we were inevitably going to fail. As simple as it seems, we re-energised our focus on what had delivered success previously – tasks that are available and work we Can Do through our LPS process.

We stopped, assessed, and re-evaluated our situation and recognised the issues within – failed commitments, missed dates, the appetite for success had dropped. Following lengthy and sometimes intense discussions with our management team, a change in the LPS set-up was agreed. A key finding in our original LPS arrangements were meeting times and schedule review timings didn't support field execution needs. Internal changes with a focused effort on detailed look-aheads at a time that worked for the entire team enabled more meaningful constraint management and effective communication amongst the group. With this subtle change, we immediately encountered a change in mindset towards what we were striving to achieve.

Recognising the issues enabled a revised set-up to our LPS approach, thereby allowing the team to voice their thoughts and opinions through constructive planning meetings and daily

reviews and conversations. This in turn created a more positive outcome with optimum performance. Whilst these issues identified are fundamental requirements for effective team performance and management, we had lost sight of the basics through a continuous firefight of unreasonable delivery requests. Utilising our field management tool, Procore, to effectively manage and support our performance with RTI was hugely beneficial. It enabled the team, in a timely fashion, to identify potential issues or roadblocks that could then be communicated to the construction management team and our trade partners for review and action.

Lean Initiative Improvements & Impact

After several challenging months on the project, it became apparent that the programme was not achievable by continuing in the same fashion. We had to step back from the detail and re-look at the project. We started by agreeing a priority hand-over sequence. Whilst it may sound so simple and basic, it was fundamental to our success for the duration of the project. The project schedule and sequence had started out as logical and well-planned, but with issues such as design changes, the Covid pandemic, Brexit, and other significant challenges, the logic no longer made sense. It was not possible to tell which elements of scope would be impacted with delays, and even more difficult to understand what interlinked elements would suffer as a result. By taking a step back and almost starting again, we were able to clearly align our priorities internally. We then worked with the main contractor to validate the order of priority.

Once realigned, we brought the delivery team together and started to map out the works remaining in each area to complete the project, starting with the priority areas along with durations. We worked together to walk the zones and created a detailed list of constraints per area, and we used Procore to attach images to each constraint for increased effectiveness. This simple exercise generated some momentum internally, which in turn brought optimism and positivity that was lacking in the team when hand-over dates were consistently missed. This had a powerful impact. Once complete, we had a works to go list, a visual constraint list per area, and a commitment from our internal team to hit a set of target hand-over dates. The exercise was almost opposite to the pull planning format we are traditionally accustomed too. To create a robust plan, we had to build from a starting date rather than pull from a completion date. Constraint management became paramount to limit unproductive time. The closure dates of constraints were difficult to predict due to high levels of uncertainty, as mentioned above.

We then discussed the plan with the Construction Management team for their input, and we got their buy-in and support and were able to amend some dates based on insights they shared, and the result was an extremely ambitious plan to hand-over 26 areas in 12 weeks.

Figure 4. Area Hand-over Plan

We met daily to review progress on constraints, and we would then issue a report to the CMT project director upon his request. We reviewed internal resources, materials, tools and plant, and other trades in the area that had the potential to impact our works. The daily report would filter down from the Project Director and initially resulted in conflict – in particular across organisational boundaries. Highlighting constraints can seem like a negative finger-pointing exercise if people are not familiar with the LPS process. Initially, our team appeared negative rather than proactive, and it took several weeks for other stakeholders to see the benefits of using visual constraints management. By identifying the work that could not be completed, we were able to focus on the works that could be completed, until such time as constraint closure commitments were made. Resources were deployed to productive work that could be completed rather than abortive stop-start tasks that would be impacted by, for example, missing materials. If constraints related to priority tasks were closed, we became better at readjusting the plan to focus on urgent items. Whilst this is against the standard LPS mentality, given the volatility being experienced at the time, we felt an element of flexibility was crucial to success.

As part of our LPS approach, we target 80%+ percent plan complete (PPC) each week. The before and after graphs in Figures 5 and 6 demonstrate how our original PPC performance was not consistent and below our target. Figure 6 shows how, with the refocused approach to the Last Planner set-up on site, we increased the weekly average. It is clear that the team's performance significantly increased when the set-up supported the project needs and the system was utilised as an aid as opposed to a requirement.

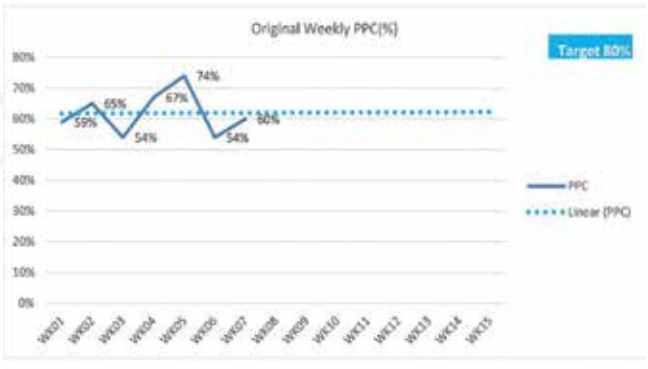

Figure 5. Original Weekly PPC Performance

Finally, Figure 6 shows that all 26 areas were completed 3 weeks after the original planned completion date. Rather than being negative,

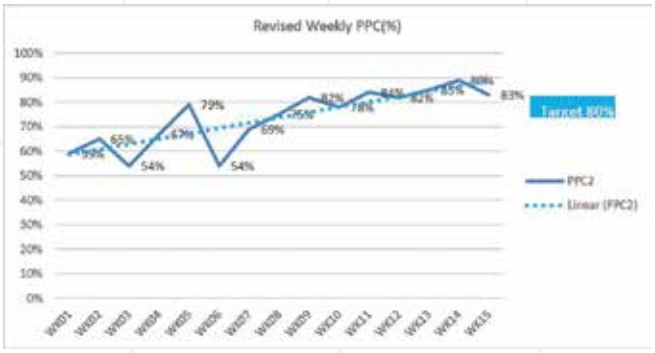

Figure 6. Final Weekly Team PPC Performance

this was an excellent achievement by the project team due to the high levels of uncertainty during that period. Whilst the project was challenging, the team learned that extreme circumstances can require specific solutions. In this case, rather than abandon the LPS process, the team adapted it slightly, reframed the challenge in a positive way, and engaged the entire delivery team to create a sense of togetherness and collaboration that is vital to the success of LPS.

Figure 7. Plan V Actual Area Hand-overs