

**COMPANY OVERVIEW**

**ARDMAC**  
Building Better

COMPANY WEBSITE  
www.ardmac.com

Ardmac is an international construction specialist delivering complex high-value workspaces and technical environments. Headquartered in Dublin, and with offices in Manchester, Craigavon, and Brussels, Ardmac employ over 300 people and provide specialist construction services to the commercial fit-out, life sciences, and

data centre sectors. Ardmac's vision is to be "the contractor of choice for clients, and the workplace of choice for great people". Ardmac's mission is "to consistently provide the ultimate solution for high value working environments through continuous investment in the best people, technology, and processes".

**AUTHOR**

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**OVERVIEW OF THE LEAN INITIATIVE**

The scope of the project where Ardmac commenced its Lean initiative was for its Client, MSD in Cork, covering 1,200 sq.m. and comprising the demolition of existing cleanroom ceilings, partitions, and services, plus refit of the existing envelope to form

new cleanroom systems including walk-on-ceilings, modular partitions, lights, terminal filter housings, floor finishes, doors with door automation, and fixtures and fittings. The Client requested that Ardmac follow a Lean approach.

**BACKGROUND TO THE LEAN INITIATIVE**

Ardmac's approach to Lean was born in response to Client demand and recurring issues at project level which were affecting performance and productivity levels. Tentative steps towards Lean were made following basic research and attendance at Lean conferences and workshops, including Lean Construction Ireland (LCi) events. The principles of Lean resonated with management, some of whom undertook further research and training, including Green Belt training. This coincided with our involvement in a project implementing the Last Planner® System (LPS). From there,

Lean practices and tools like LPS and 5S were piloted. The benefits were soon evident and triggered further expansion of Lean across various projects. Less than two years later, Lean is a key enabler to deliver Ardmac's business strategy.

Ardmac now utilise Lean across many sites in both the UK and Ireland. A key feature of this implementation has been the engagement of Lean practices by staff at all levels, which has led to a change in behaviours and the benefits of which are clearly evident across Ardmac.

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

This case describes the project planning practices prior to and following Lean implementation, an overview of LPS which used a pull-based approach to project scheduling, and the approach deployed by Ardmac.

*Traditional Project Planning Approach with Critical Path Method*

Before the adoption of LPS, Ardmac relied upon the Critical Path Method (CPM) to schedule projects. CPM scheduling seeks to identify crucial activities characterised by their impact on the project schedule. Ardmac found CPM to be very useful in enabling the development of high-level project schedules and managing high-risk activities on the critical path.

The main benefits of CPM include:

- Making dependencies visible between various project activities and clearly showing predecessors required to any given task.
- Assisting in the planning of large-scale projects and facilitating a systematic approach to project planning.
- Acting as a visual aid, which is a valuable tool when coordinating the various activities and assessing the impact of a delay and the impact of missed milestones.
- Enabling the project manager to optimise efficiencies by allocating resources appropriately and consequently

controlling the overall cost.

- Providing opportunities to respond to the negative impact of running over schedule by identifying the activities that are most critical.

The key limitations of CPM include:

- The potential for integration of activities is not highlighted.
- CPM does not seek to reduce the overall programme.
- A team ethos is not promoted.
- CPM is usually updated on a weekly basis and thus issues may not be identified in real time.
- Tracking the performance against schedule is not included in the system and the percentage of tasks being completed on time not tracked.
- Typical Percent Plan Complete (PPC), or task plan completion, is around 50%.

*MSD Project utilising the Last Planner® System for Project Scheduling and Management*

Ardmac was awarded the MSD project on the commitment of full participation in the Lean programme being deployed by the construction management team. Ardmac was aware that LPS was being implemented, however it did not have practical knowledge of the system.

Initial research showed that LPS:

- Is a scheduling control system for managing projects.

- Produces predictable workflow and rapid learning.
- Produces maximum value to the various stakeholders by eliminating waste caused by unpredictable workflow.
- Enables an accurate project delivery period and greater utilisation of project resources.
- Forms commitment among project participants (trades, design teams, crews, contractors) through a series of planned conversations.
- Key to LPS effectiveness is the buy-in from all stakeholders, and which is both demonstrable and measurable. This is the collaborative-based approach to project planning and execution.

Ardmac's LPS includes:

- Master Schedule.
- Pull Planning Process.
- 6-Week Look Ahead & Constraints Log.
- Weekly Work Planning (WWP).

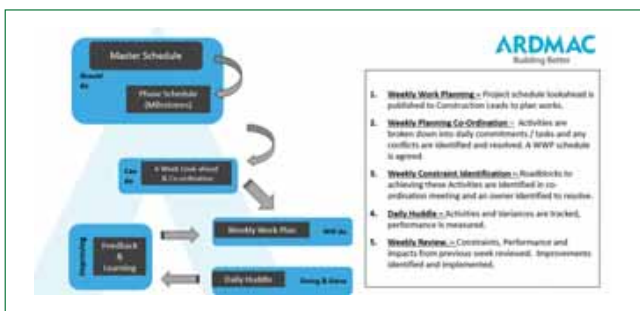


Figure 1. Ardmac's LPS Continuous Improvement Model

#### Opportunity for Comparison of CPM and LPS

The project also presented an unusual opportunity to compare the performance and productivity levels of this project against a previous project undertaken at the same facility which was similar in nature and size and completed only 12 months earlier. Issues on the previous project were reviewed and analysed with a focus on identifying areas for potential improvement. Areas for targeting improvement included:

- Safety.
- Quality.
- Schedule.
- Labour Productivity.

#### How Ardmac Implemented LPS on the Project

Ardmac acknowledged the lack of in-house experience at that time to ensure effective engagement in the project's Lean programme – no personnel had previous practical experience of Lean tools and principles on such a project. To maximise the benefits of this process and to help ensure a successful project outcome, a series of Lean training workshops were introduced and coordinated by (the late) Kevin Hallahan from DPS Group. Kevin introduced Ardmac to the world of LPS, adopting a comprehensive and pragmatic approach whilst being highly engaging with his passion and enthusiasm for the system. Kevin's approach ensured full participation from project contractors in the system. Each contractor and their personnel soon learned how LPS worked via a combination of classroom-based training and practical experience.

The critical factors for the successful implementation of LPS include:

1. Top management commitment to LPS:

- Implementation.
  - Training.
  - Reviews & Results.
  - Weekly Reports.
2. Do it for the gains not for lip service.
  3. Roll-out LPS training (LPS tools).
  4. 100% collaboration and engagement between all stakeholders.
  5. Build close relationships with subcontractors and suppliers.
  6. Real time reporting using PPC performance (a measure of schedule performance) and reasons for variance.
  7. Root Cause Analysis.



Figure 2. Daily Huddle Meeting & Daily Whiteboard

#### Key Roles within LPS

There are four key roles within LPS, with accompanying responsibilities, to ensure the process is successful at all levels:

1. Dedicated Last Planner:
  - Run Daily Huddles.
  - Collate WWPs.
  - Facilitate the Weekly Coordination Meeting.
  - Track Constraint Log.
  - Monitor and Report KPIs (PPC & variance drivers).
  - Champions Implementation Plan.
2. Scheduler:
  - Supports Pull Planning Sessions.
  - Generates Phase Plans.
  - Tracks project progress – Pull Plan Vs Actual Daily Progress.
3. Trade Foremen/Discipline Lead:
  - Attend daily huddle & Weekly Coordination Meeting.
  - Provide WWPs by noon on Wednesdays with defined Task, Owner, and Duration.
4. Client/Sponsor:
  - Commitment to support LPS.
  - Open door to removal of constraints.
  - Continuous Improvement (removal of reoccurring issues).

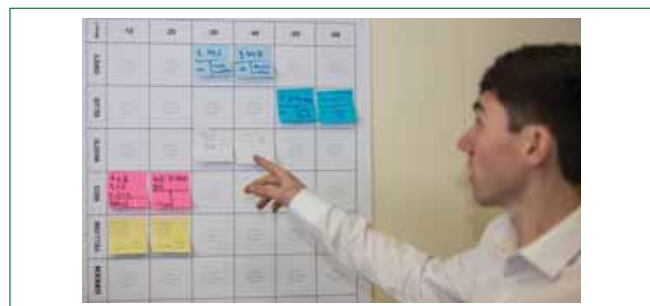


Figure 3. Pull Planning

#### Key Learnings from the LPS Approach

Training on LPS – As Lean is a relatively new approach for the Irish Construction sector it required a leap of faith by Ardmac under the guidance of an experienced facilitator, namely Kevin Hallahan, who proved to be invaluable to the transition process. Kevin outlined the advantages of LPS over CPM and gave Ardmac the tools to demonstrate this at a practical level. The mounting evidence of these advantages helped break down fears of change and new systems, and enabled Ardmac be responsible for the implementation of its own Lean programme.

**Collaborative Approach** – The project required a collaborative approach to creating a master schedule and the Pull Plans. This involved bringing all primary sub-contractors together, defining duration of tasks, and agreeing predecessors and handovers. This process created a great team approach to the project and in turn opened avenues for constraints and barriers to be removed by mutual agreement within the project team. Each week, a six-week look-ahead was issued along with a constraints log and a WWP.

**Root Cause Analysis** – One of the key learnings Ardmac found from using LPS was that by applying 5 Why root cause analysis, along with variance analysis, its management and site leads got an increased understanding of where the root cause of repetitive problems initiated and realised that some of these issues had been inherent for years without being resolved. For example, Ardmac had a period during a summer where it was missing completion of planned tasks due to unavailability of qualified and skilled labour.

The reason historically would have been explained as someone was not on site to do the task and they moved on to get the task closed-out. By using LPS and 5 Whys they found that there was a trend around when schools were closed and the weather was better, and that most of the days off were ad hoc. In order to mitigate this, Ardmac put in place a stronger holiday planner which is project-based so that it is clearly visible and so that

constraints of this nature can be mitigated in advance.

As a result of understanding the root cause of issues, there was a significant increase in control of the site and it enabled greater project flow with a substantial reduction in communication by phone and email, thus leaving the team with more time available to plan the works accurately, check the works, and act on any improvements required.



**Figure 4. Collaborative Planning**

#### *Lessons Learned*

On completion of the project, Ardmac conducted a lessons learned review on the approach that had been adopted, and found significant and consistent positive feedback from all personnel on the project, from construction management, sub-contractors, safety, quality, to deliveries. There was substantial improvement in safety audits, schedule improvement, reduction in labour usage, and reduction in defects.

Overall, LPS was a huge success, and so much so that there was an instant buy-in from senior management within Ardmac and a direct strategy was put in place to develop the use of LPS so that it would be adopted on all Ardmac projects across all sectors.

## **LEAN INITIATIVE IMPROVEMENTS & IMPACT**

The key benefits arising from using LPS on this project include:

- Safety – Zero first aids or near misses.
- Defects per €50k – Reduced from 9 defects at Client walk-down to 3.4.
- Labour Ratio Actual:Budget – Reduced labour to budget ratio (approximate 10% reduction).
- Margin Actual:Budget – Margin improvement on project last planner.
- Unplanned Stoppages per €50k – Unplanned stoppages on project with last planner were less than two per €50k works complete.
- Team Ethos – Increased engagement and throughput on following projects.

#### *Last Planner System: Next Steps*

After the success of the MSD project, Ardmac's leadership team identified Lean Construction as a strategic function of the business and directed the roll-out of LPS on all projects across the business as the primary focus area of its Lean deployment. This has proven to be very successful and provided significant benefits across various functional facets of projects, including site management, safety, quality, commercial, and schedule.

Some benefits to date include:

- Safety – Projects are seeing less task change at the workplace

which means increased control, risk reduction, and improved safety audit scores.

- Quality – By planning the works in an agreed sequence with predecessors, and with hand-offs clearly understood as well as all constraints being removed in advance, there has been a significant reduction in rework and a reduction in the waste of making-do.
- Schedule – Improved schedule functionality in two forms. End dates that have been committed to are achieved with little or no works to complete post practical completion. On top of that they are finding that the stress and effort required to close-out the project in the last few weeks is reduced, thus leaving more time to assess standard of finish, safety control, and ultimately deliver projects to clients with maximum value.
- Commercial – Due to improvements in safety, quality, schedule, and labour, they have seen improvements commercially allowing them to cost risk in a different manner and more competitively due to their supply chain utilising LPS and seeing less risk to their own output.

To further support the benefits of LPS for Ardmac, results from a recent internal Lean survey highlighted that 100% of leadership and 87.5% of employees that use LPS found it of benefit. This survey was based on a number of sectors and regions across Ardmac. In comparing sectors, 96% of pharma found it of benefit, compared with 80% within fit-out and

67% within data centre sectors.

External recognition also came in mid-2018 when Ardmac was awarded the Irish Construction Industry award (ICIA) for the Innovation in Construction category for their Lean strategy which highlighted the MSD project as an exemplar case study.



**Figure 5. Ardmac's Jason Casey and Colm Casey presented with the Innovation in Construction Award at the Irish Construction Industry Awards 2018**

#### *LPS: Process-based Approach*

Ardmac began to utilise LPS across all new projects from January 2018. A process was set-up to report results to senior management bi-weekly. The purpose of this process is to monitor and review both PPC and variance trends across the business, thus aiding strategic direction for the company as a whole.

#### *Additional Lean Activity*

Ardmac's Lean culture is continuing to grow and there is an open attitude to develop the commitment to Lean project integration. Ardmac is looking at the implementation of other Lean tools, with localised trials being run on 6S, Waste Reduction Walks, and Value Stream Mapping. Over 20% of managers have received Yellow/Green Belt training, and further training programmes are now in place for the remainder of 2018.

#### *The Future of Lean at Ardmac*

The implementation of Lean Construction has demonstrated significant improvement for Ardmac, in particular with the deployment of LPS. Given this success, Leadership has identified Lean as a key enabler to achieve its business strategy. A Lean Strategy was developed including the following key elements: alignment of the business to the business goals, process-based approach to manage the business, data-based decision-making within all these processes, and training of personnel to support the processes to deliver the business goals. Ardmac is deploying a process-based approach to managing the business, with a focus on training and the implementation of key Lean systems. Lean thinking is expanding into all business processes, including

off-site elements. Business processes will also maximise the benefits from software solutions as part of Ardmac's continuous improvement initiative.

Employee feedback from the Lean Survey is also incorporated into the Lean Strategy, in particular, in the area of training requirements. Computer-based training is a key business system to share Lean knowledge across the business. Ardmac manage the progress of this strategy implementation monthly, with key senior leaders providing support to each of the business system owners who present on the status of the strategy. The ultimate aim is to create a culture where everyone will know, understand, and live the culture of continuous improvement to deliver Ardmac's brand promise of "Ardmac, Building Better" and support our vision as "the contractor of choice for clients and the workplace of choice for great people".

The use of digital construction techniques is becoming more prevalent across the industry. Ardmac maximise the use of modern construction methods such as BIM by overlaying a Lean approach, and has formed a Digital Construction Department, focusing on industry trends. The National BIM Council launched the "Digital Transition Roadmap" and developed an excellent guide for companies to follow. The use of Laser Scanning, Drones, and Virtual Reality are becoming more common and are certainly beneficial to construction organisations. The use of tablets and cloud-based collaboration platforms ensure all project personnel have access to current project information in real-time. Field management applications and software also allow for data capture in the field in digital format, thus drastically reducing paper waste and saving time. Trends show that utilising BIM to design elements for offsite manufacture will become more common in the future. Augmented reality, while still in developmental mode, will become business as usual for contractors on site. The ability to identify the location of services in 3D while in the field will greatly improve understanding of complex installations by site personnel. There is also a heavy focus on data analytics, allowing organisations to identify trends at a business level and react accordingly.



**Figure 6. Ardmac Win the Leadership in Lean Category at the Lean Business Ireland Awards 2018**