

Case Study Title: Maximisation of Pre-Manufactured Value (PMV) in delivery of complex projects

Company Overview | ARDMAC | ardmac.com

Ardmac is an international construction company delivering complex high value workspaces and technical environments. We have been providing high quality spaces to fast moving and evolving markets for over 40 years and are a leading provider of cleanrooms, data centres, electric vehicle battery facilities, fit out and modular solutions. At Ardmac, we believe in setting new standards for the industry and driving innovation to deliver safety first and excellence as standard

across our projects.

In our commitment to this approach, Cental Engineering, who have a long track record in the delivery of modular solutions in the Utilities sector, have joined the Ardmac Group which provides us with the ability to provide this service where appropriate for existing clients in the Life Sciences and Data Centre sectors.

Author



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Lean Initiative Undertaken – Lean Thinking, Tools, Techniques

Over the last number of years, we have recognised a real need for change within the construction industry. There are several reasons for this shift in mindset:

- **The impact of Covid-19:**

The Covid-19 pandemic had a profound impact on the construction industry, triggering a series of challenges and changes. During the initial stages of the pandemic, construction sites around the world were shut down or faced significant disruptions, leading to project delays and financial strain on many companies. Safety protocols, social distancing measures, and supply chain disruptions further complicated operations, causing construction costs to rise. To adapt, companies accelerated the adoption of digital technologies and remote work solutions. The pandemic has underscored the importance of flexibility, contingency planning, and innovation within the construction sector.

- **Labour and material shortages globally:**

In recent times, the construction industry has faced an acute challenge due to a widespread shortage of both labour and materials. The shortage of skilled labour has been a significant bottleneck, exacerbated by factors such as aging workforces and a decline in vocational training programs.

This scarcity of qualified workers has led to project delays and increased labour costs. Simultaneously, the global supply chain disruptions and increased demand for construction materials have caused unprecedented price hikes and delays in material deliveries. As a result, construction firms have had to adapt by finding innovative solutions, such as increasing automation and exploring alternative materials, to navigate these turbulent waters to meet their project deadlines and

budgets.

- **A growing demand from clients for MMC (Modern Methods of Construction):**

The construction industry is currently experiencing a remarkable surge in demand for modern methods of construction (MMC). This paradigm shift is driven by several factors, including the need for faster project completion, cost efficiency, and sustainability. MMC encompasses innovative techniques such as prefabrication, modular construction, and 3D printing, which significantly accelerate construction processes, reduce waste, and enhance precision in building structures. Moreover, as urbanisation continues to rise, there is a growing emphasis on sustainable building practices, with MMC offering the advantage of reduced environmental impact through reduced resource consumption and enhanced energy efficiency.

As the industry continues to adapt to these evolving demands, it is clear that MMC is not just a trend, but a fundamental transformation shaping the future of construction.

Within this setting, it is important to understand how we define MMC and PMV (pre-manufactures value) within this delivery model.

- **MMC - Modern Methods of Construction:**

Contemporary innovations in construction, including new technologies (digital tools, techniques, materials), offsite manufacture and use of efficient processes to deliver productive, sustainable, and better outcomes. Misunderstood by some as a re-badge for offsite solutions, MMC extends far beyond volumetric, modular, or offsite

manufacturing (OSM). It encapsulates broader themes of transformation that influence and impact where, how, why, and with whom we design and deliver built assets. MMC should be seen as a vehicle for more efficient project delivery rather than a specific technical solution.

PMV - Pre-Manufactured Value:

Measures the amount of offsite construction involved in a project. Traditional construction typically has low PMV, whereas those incorporating MMC have high PMV.

In relation to this case study our requirement was to maximise our PMV. One of the main benefits of this approach was to reduce onsite labour hours, minimising our interfaces with adjacent trades in a congested environment, and having a positive effect on our safety and quality performance.



Figure 1: Traditional Delivery versus Off Site Manufacturing

The main enablers to MMC are Lean Design Processes and Digital Construction.

Lean thinking helps identify ways to reduce defects and errors, leading to higher product and service quality. Streamlined processes and reduced waste result in increased productivity, as employees can work more effectively and efficiently.

Lean techniques, like value stream mapping and pull systems, reduce lead times, allowing companies to respond more quickly to customer

demands. Eliminating waste and improving efficiency can significantly reduce operating costs, which can boost profitability.

Lean thinking is customer centric. By delivering better quality and value, it leads to higher customer satisfaction and loyalty. Lean thinking involves employees in the continuous improvement process, leading to a more engaged and empowered workforce. This encourages flexibility and adaptability in response to changing market conditions and customer needs.

Lean Design Process:

- Concise brief definition/ user requirement specification (URS).
- Accuracy and timely availability of design information is vital to project success.
- Stage Gate approach to design development.
- Strict Change Control essential.
- Standardised & repeatable design solutions.
- Component led design.
- Design phase pull-planning/ CPM.
- Focus on what design information adds value – value stream mapping.
- Improving process flow.

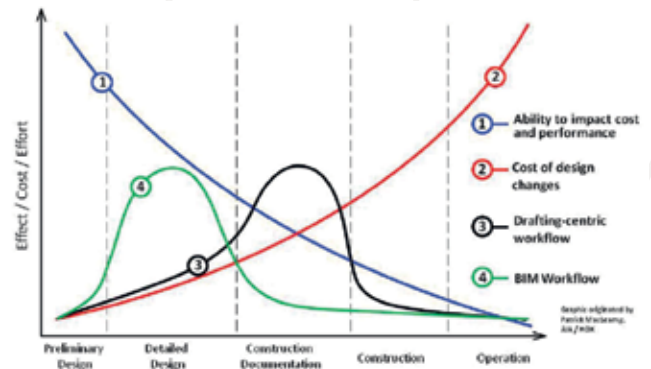


Figure 3: Effect/ Cost/ Effort for project lifecycle

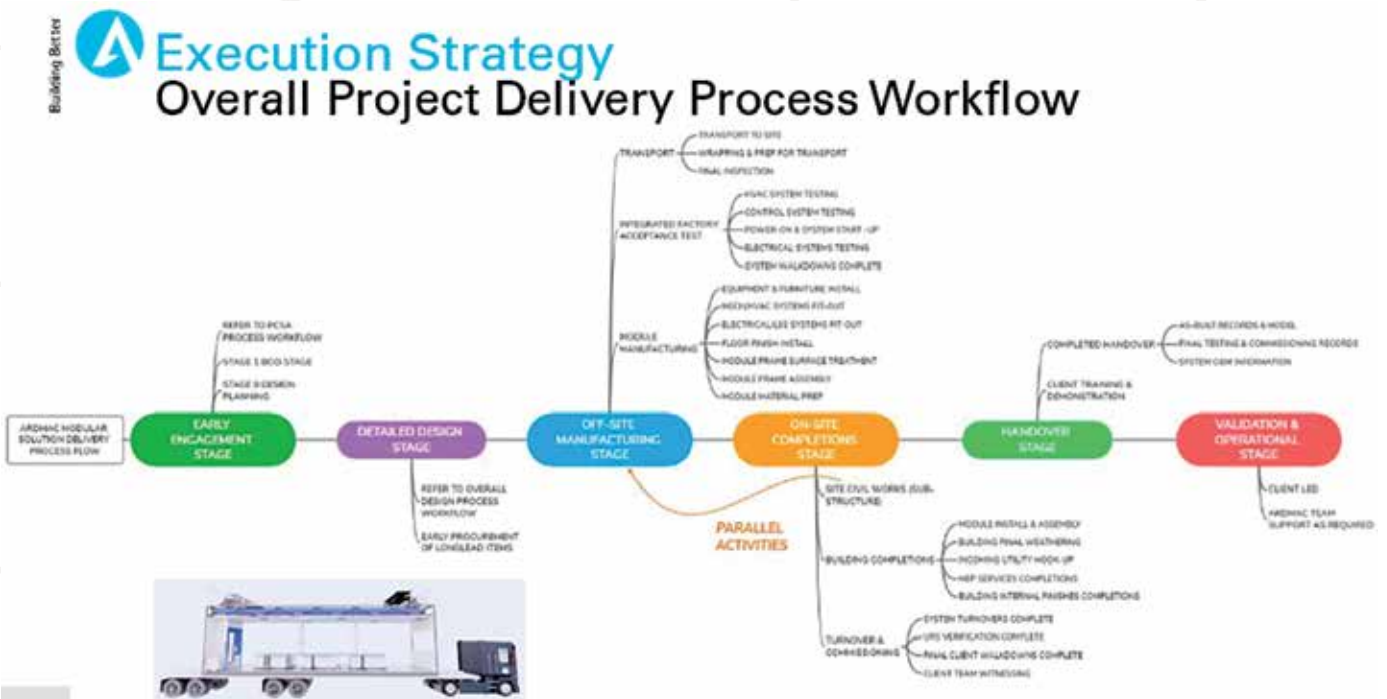


Figure 2: Execution Strategy: Overall project delivery process workflow

Digital Construction

Ardmac work “Smart”, meaning we deploy innovative technology throughout the business to empower our people, drive performance and delight our customers. We place the customer at the centre and apply lean construction principles and technology to everything we do. Our ultimate goal is to maximise value for our customers, and we

believe that technology and innovation have the power to drastically change the face of the construction sector in the coming years. A 2018 study found that reworks on-site account for up to 34% of total project costs. See Figure 3.

Lean Initiative Improvements & Impact

Based on the use of our lean processes throughout the design phase, we were able to progress the PMV value from an initial 50% value at tender stage to 77% at Issue For Construction (IFC) stage through team collaboration and incorporation of modularised and standard components throughout the building.

By planning the works in an agreed sequence with predecessors and hand offs clearly understood, as well as all constraints being removed in advance, we have seen a significant reduction in rework and therefore a reduction of waste. As a result, we have been able to reduce our quality target to one punch list item per €25k at client walk down.

Target PMV Assessment Progression

Discipline	Original Tender Layout & Spec.	Updated Layout / Original Spec.	Updated Layout / Updated Spec.	IFC Design
Structural Scope	100%	100%	100%	100%
Architectural Scope	52%	57%	61.5%	70%
Lab Equipment/Furniture	17%	17%	73%	73%
Mechanical/HVAC Scope	28%	28%	50%	68%
Electrical Scope	53%	53%	77%	72%
Overall Target PMV %	50%	51%	72%	77%

Table 1: Target PMV Assessment Progression

We have witnessed schedule functionality improve in two key ways. End dates that have been committed to are being achieved with little or no works to complete, post practical completion. We are also seeing a shift in labour resource, moving earlier into the programme, and ramping down towards the end as opposed to ramping up reactively and having a more congested completion to the project. We have found that the effort required to close out a project in the final weeks has become a lot more controlled and less stressful, leaving more time to access standard of finish, safety control and ultimately deliver projects to our clients with maximum value.

As our leading guiding principle, safety is our first consideration wherever we operate. Our projects are seeing less task change at site level which means increased control, risk reduction and improved safety audit scores.

With improvements in safety, quality, schedule, and labour, we have seen improvements commercially, allowing us to cost risk in a different manner. Our supply chain is more competitive also, as they have worked with us on projects utilising Last Planner System (LPS) bringing less risk to their own output.

Summary and Lessons Learned

We are currently in challenging times and within the BioPharma sector, which is one of the areas where our modular approach has been applied, there are several pressures and critical factors involved in facility design as follows:

product development) and expansion with investment in facilities being pushed further along the product life cycle.

- **Increased Diversification:**
Companies moving away from single-product specialisation with multiple product types in development simultaneously.
- **Need for Greater Flexibility:**
Adaptive facilities that can expand and contract with rapid R&D development or changes in business strategy.
- **Need for Reduced Timelines:**
Speed of delivery including regulatory approval allows for clinical stage companies to rapidly progress towards commercialisation.
- **Need for Innovative Facility Design:**
A need for multi-modal and agile facilities that can meet the technical challenges facing gene and cell therapies.
- **Need for Improved ROI:**
Companies taking a more cautious approach to NPD (new

- **Alignment with Sustainability Goals:**
Global companies keenly aware of the need to ensure development plans align with Sustainability Goals.

From a lessons learned perspective, to achieve our goal, there are several key success factors:

1. Standardised components- design ready.
2. Collective Project Team Buy-in from inception to operation.
3. Design Completion- fully approved design prior to commencing manufacturing.
4. Robust Change Control Process- potential impact of change on a project is magnified in the context of OSM.
5. Project Suitability- optimised solution.
6. Delivering on MMC benefits- building confidence in the approach.
7. Innovative mindset- open to change.

Our objective was to support and increase lean engagement and understanding based on our experience. We recognise that our experiences in recent years have been instrumental in us achieving a higher level of engagement across our organisation.

We continue to be a driver of lean within the construction industry and will continue to communicate the efficiencies and successes lean bring to our business, clients, and peers. Lean construction principles

deserve recognition as an innovative way of improving productivity on site, and our teams are proud to be ambassadors for innovation and change.