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Mercury is a European contractor that builds and manages complex engineering projects that reimagine how people work and live in the built environment. Mercury believes that real innovation happens if you're willing to be brave. Its determination and sharp focus enable Mercury to deliver leading-edge construction solutions across a range of key sectors, taking its clients to new territories they never thought possible.

Mercury's purpose is to deliver its clients vision through leading-edge construction solutions, going beyond their duty which turns clients into partners and builds relationships that thrive across the

Author



Jason Toomey

following sectors: Enterprise Data Centres, Advanced Technology & Life Sciences, Hyperscale Data Centres, Fire Protection, Technical Support Services (TSS), Data Centre Facility Management, Healthcare & Building Services.

Mercury employs over 6,000 people, including sub-contractors, across over 15 locations in Europe and had an overall turnover of €1bn in 2020. Mercury employs the best people, invests heavily in training and education, and ensures that the highest standards of health, safety, and governance are applied throughout the organisation

Overview & Background to the Lean Initiative

Mercury has long been an advocate of Lean and has been implementing its principles into work practices for many years. Lean has always been something Mercury strives for: Mercury's default position is if there is an activity or a task that we're going to perform for our client, safely, we will always make it happen – better, faster, and smarter.

In recent years, the construction sector has started to see the benefits of modular construction and Mercury senior management made a strategic decision to embrace this new way of building all projects that we are involved in. Off-Site Assembly (OSA) is redefining our industry. Across the Group, Mercury's teams are

implementing OSA across all services, including: Electrical, Mechanical, CSA, Information Communication Technology (ICT), and Fire Protection.

Modular construction can be considered as a hybrid of manufacturing and construction, and in many ways lends itself to Lean Production, which permits significant improvements in terms of productivity, reduction in waste, schedule certainty, and improved quality. The latest challenge of Lean Production is its implementation in the modular building industry, where the full potential in terms of productivity is yet to be achieved.

Lean Initiative Undertaken – Lean Thinking, Tools, Techniques

This case study is centred on a large data centre project recently completed by Mercury. Several Lean tools and techniques were used to successfully complete the project.

Just In Time (JIT)

JIT is a technique developed by Taiichi Ohno and his fellow workers at Toyota. It was developed as a method of pulling work forward from one process to the next just in time. The goal of JIT is to reduce, and eventually eliminate, variations and waste from a process. On construction projects, this waste is normally waiting, storing inventory, and moving materials.

As the construction sector has tried to become more productive over the years, it has adapted the JIT technique to suit the needs of its sector. The application of JIT in construction differs greatly from the manufacturing industry because of the complexity and schedule uncertainty of large construction projects. With construction adopting the OSA module, JIT is now becoming an essential tool in

today's construction sector.

On this particular data centre project, JIT delivery was implemented for the fabrication and delivery of the cable containment modules. We were fabricating the modules in Mercury's off-site fabrication workshop in sequence of install on-site, and the project engineer was calling down the modules as the workforce opened up on-site. The project engineer used a digital pull plan on Mercury's project management tool to request the delivery of the modules he required.

When the request was made on the pull plan, the module would be delivered to site the next morning and installed the same day. The Last Planner® System (LPS) was in operation on the project, and this collaborative approach helped alleviate any trade-stacking in certain areas of the site. It also helped with the JIT process we had implemented.

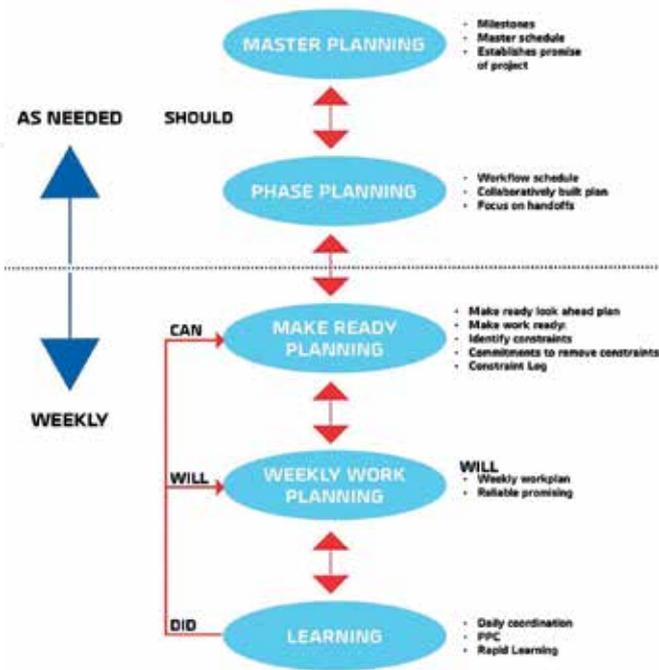


Figure 1. Last Planner System Outline

Gemba Walks

The term Gemba is a Japanese term which means actual place and that is exactly what it is: observing how a process really works, engaging with employees, and exploring opportunities for continuous improvement. It allows people of every level, from senior managers to key stakeholders, to walk the process, understand it, and improve it. Several Gemba walks took place over the duration of the project, and a particularly successful one was on the installation of cable containment modules. When the project launched and the first cable containment modules were delivered, the project manager decided to go on a Gemba walk with the electrical supervisors and one of the mechanical supervisors to observe the installation of the modules. By following the Gemba Walk seven steps, it helped in completing a successful Gemba walk and then improve the process.

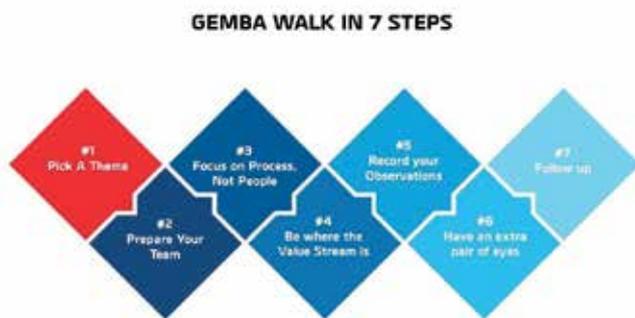


Figure 2. Gemba Walk 7-Step Model

1. Pick a theme

The project manager had a precise process that involved walking to see if there was any productivity gain to be made in the process. He wasn't observing the entire process of the modules being delivered to site and installed, rather he was only walking the process from when the modules were lifted into place and connected to the previous containment module.

2. Prepare your team

The supervisors informed their crews that a Gemba walk would be taking place, and they reassured them that it was the process they were observing and not the operatives. The ultimate goal was to develop a better process through continuous improvement and make life easier for all involved in the process. By informing their crews, the supervisors hoped the operatives would feel that they were part of the initiative and be more willing to collaborate.

3. Focus on process, not people

This step can be hard for some managers. When a manager observes someone not performing to the standard they expect, they often find it very hard not to say something to that person, but this in fact goes completely against the principle of the Gemba walk as you are only there to observe, understand, and improve the process, not evaluate an operative's performance. The project manager on this particular walk reminded the project supervisors of this fact before they began the walk.

4. Be where the value stream is

This Gemba walk was on a very precise process, so the value stream was small but could still be made very efficient.

5. Record your observations – don't make suggestions during the walk

Again, this is not an easy step for some managers to follow. They must not fall into the trap of trying to fix an issue on the walk or offering a solution to a problem they witness. The best approach is to take notes and analyse them later. These notes can be used as part of a problem-solving technique such as PDCA or DMAIC. The project manager and supervisors talked to the operatives and asked them how they felt the process could be improved, and did so without telling them how they themselves would improve the process. The operatives seemed to appreciate this and were happy that their point of view was being listened to.

6. An extra pair of eyes

The mechanical supervisor that was on the walk was the extra set of eyes. He was less familiar with the cable containment installation process than his electrical counterparts, but he had a fresh point of view. He was asking different questions to everyone else on the walk.

7. Follow up

It is essential that you share any findings from the Gemba walk, significant or not, with everyone involved in the process, and especially the operatives in the field. If you do not share the findings, they may feel like you were accessing their performance and not observing the process.

After analysing the data they had collected from the Gemba walk, the team learned that there was a significant amount of motion waste in the process. When the containment modules were lifted into place, often at a high level, they were joined together with small nuts, bolts, and washers. They observed people shuffling through their toolboxes that were full of tools that they didn't require for the task they were carrying out, looking for these materials. In one case, an operative couldn't find the bolts required and so they had to walk to the central site stores which was a 20-minute round trip. As a solution, the mechanical supervisor suggested using mobile toolboxes on wheels similar to the wheelie suitcase that we all use today. A new process

was put in place where all installation crews were supplied with a mobile toolbox complete with only the required tools. Each toolbox was filled at the start of the week with the materials needed and sorted into separate compartments. This is a very good example of 5S being implemented. The operatives were happy with the new process as it made their job easier. They were supplied with the new toolboxes and thus didn't have to carry their own heavy toolboxes around with them all day. They also didn't have to walk to the central site store to collect materials.

Lean Initiative Improvements & Impact

As stated above, OSA is becoming an increasingly essential part of construction today. On most Mercury projects, we are seeing Lean initiatives and improvements based around OSA. Advanced manufacturing firms routinely achieve productivity rates of 80%, whereas productivity rates can drop as low as 20% for on-site construction workers.

At the end of Q1 of 2021, Mercury was producing 27 module types, using 51 different suppliers, on 27 projects across Europe. By the end of Q2, Mercury was producing 34 module types – an increase of 26% from Q1 – and 27 projects were implementing OSA – an increase of 17% from Q1.

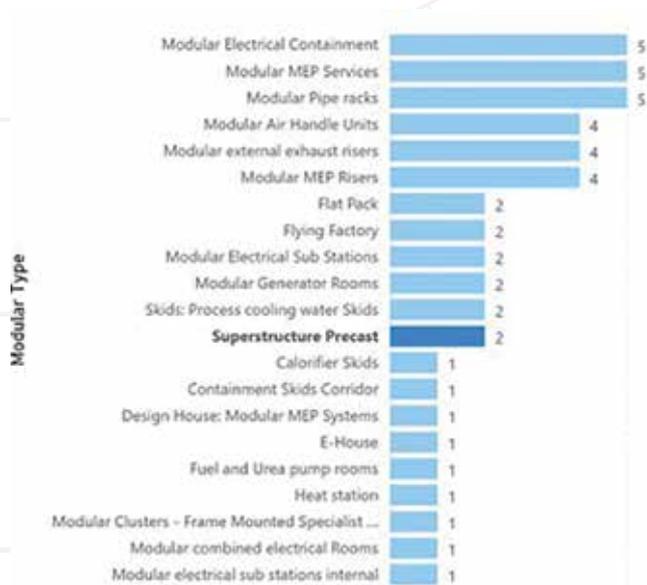


Figure 3. Module Types

Some of the main measurable improvements Mercury has seen with the implementation of OSA include:

- Reduction of on-site labour, which has had a direct impact on lowering Health & Safety risk, welfare costs, and motion and waiting wastes.
- Improved Quality – Manufacturing modules in a controlled environment has resulted in a substantial reduction in defects and rework.
- Productivity has improved by standardising work. Having a more comfortable and consistent working environment has also contributed to productivity gains.

Summary

Performing Gemba walks on a regular basis on this project offered some significant advantages such as:

- Improving processes by identifying the problems, no matter how small and taking actions for achieving continuous improvement much faster.
- It helped build a stable relationship with those who carry out the on-site activities and the management.
- Processes were standardised accurately.
- It encouraged collaboration within the project team.

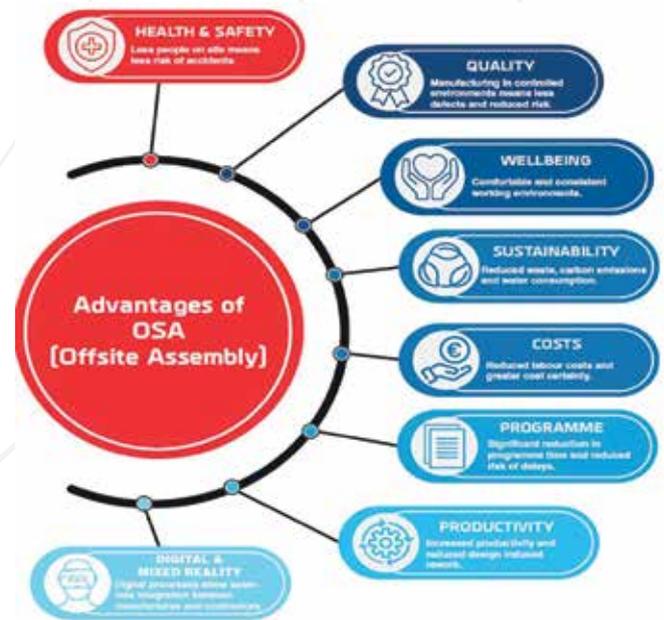


Figure 4. Advantages of Off-Site Assembly (OSA)

Some of the Lean tools Mercury has introduced in its own OSA facility, and encouraged its supply chain partners to adapt, are:

- Value Stream Mapping – VSM highlights the module cycle-time and wait-time between the production functions. With this Lean tool, Mercury's OSA facilities have been able to identify waste within and between their processes. They are able to visually demonstrate the current state of their production line and then map out the future state, which highlights the opportunities for improvement.
- Kanban – This is a visual production system in which a supply of parts is delivered to the production line as-needed, thus increasing efficiency. This Lean tool works by making sure that operatives have what they need, where they need it, and when they need it.
- 5S – This is one of the first Lean tools Mercury encourages its OSA supply chain partners to implement. The 5S system is designed to improve efficiency through a systematic approach to organisation and cleanliness in the workplace. The system includes five fundamental guidelines that help improve workplace efficiency: Sort, Set, Shine, Standardise, and Sustain. Implementation of this method “cleans up” and organises the workplace, basically in its existing configuration.

5S makes workplaces more efficient and effective by:

- Removing unneeded items from each work area (Sort).
- Customising each unique work area to maximise efficiency (Set).
- Cleaning each work area after every shift to help find and eliminate issues before they become major problems (Shine).
- Documenting improvements so they can be more easily applied in other work areas (Standardise).
- Making 5S a way of life to enable continuous improvement (Sustain).



Figure 5. Mercury Module Placement