

# Offsite Construction for Highways – Regional Delivery Partnership

## Focus on Lean Construction

18<sup>th</sup> October 2021

Brett Blake  
Associate Director




LC International

Building Business Improvement



# Application of Lean Construction in 'Construction to Production'

 <p>DFMA Overlay to the RIBA Plan of Work</p>	<p><b>5</b></p> <p><b>Manufacturing and Construction</b></p>
<p><b>Stage Outcome</b> at the end of the stage</p>	<p>Manufacturing, construction and Commissioning completed.</p> <p>There is no design work in Stage 5 other than responding to Site Queries</p>
<p><b>Core DFMA Tasks</b></p>	<p>Update the <b>Construction Strategy</b>, including a logistics plan, considering lifting, handling and transportation for each component and sub-assembly</p> <p>Monitor quality of offsite manufacturing</p> <p>Consider <b>Commissioning</b>, optimising the use of factory acceptance testing</p>
<p><b>Suggested Digital Tasks for DFMA</b></p>	<p>Use tools and technologies to train site operatives and access digital information including setting out, method statements or product manuals</p> <p>Use digital technologies to track manufacturing, packing, logistics and delivery process</p> <p>Use digital tools to compare actual against planned progress on site and to inspect <b>Construction Quality</b></p>

## DFMA in construction

Applied to the construction sector, DFMA is about finding ways to rationalise the design process, improve the selection of materials, and optimise the planning and logistics of building. In particular, it exploits opportunities to design built assets using a limited variety of repeated, previously standardised, components, sub-assemblies or assemblies that can be fabricated, manufactured off-site, transported to site safely, and assembled there safely, quickly and straightforwardly.

These components or assemblies can be for just a single project or, usually with mass customisation, many different projects.

## What are the benefits?

The reason why we should want to design for offsite manufacture are very similar to the reasons why car manufacturers prefer to design first cars for production in a factory rather than assembling them on buyers' drives.

Design for manufacture makes components simpler to make, design for assembly makes products easier to assemble. The DFMA process combines the functionality of numerous parts into fewer components to achieve the same or improved functionality.

## Factory benefits

According to a 2016 [Building Research](#) report, on-site conditions can be 50% less safe than factory conditions. Construction in a shed does not achieve a safe environment on its own, but manufacturing practices can – especially with more use of industry standards and ensuring that there is competition in pricing.

On-site labour is more than twice as expensive as factory-based labour, productivity in a factory reaches 50% compared to just 40% on-site, and waste is almost entirely eliminated in a factory setting. On top of that, production is more easily optimised and inspected in a factory. Overall, therefore, built quality is improved, outcomes are more certain and costs are minimised.

## On-site benefits

Of course, very few buildings can be completed in a factory the way a car can, and so they are always partly made on-site. However, because the on-site assembly has been planned, optimised and simplified, less on-site labour is needed and there are fewer preliminary costs and overheads.

Compared to business-as-usual construction, each designed with a DFMA mindset should:

- happen more quickly
- need:
  - less material
  - less labour
  - less associated management and paperwork
  - less rework
- result in:
  - less waste
  - fewer defects
  - safer work sites

As well as reducing risks, the aggregate cost savings associated with these benefits can be significant. Note, however, that to achieve these benefits, the interfaces between on-site and off-site elements have to be managed effectively.

## Environmental sustainability benefits

The process also leads to solutions that, regardless of the predominant material used, can be inherently more environmentally sustainable than traditional construction in a variety of ways:

- **Less waste:** Manufacture in a factory setting means better planning, better production control, fewer errors and, therefore, more efficient use of material and less material waste.
- **Lower transportation costs, better air quality, less noise pollution:** Since only what is needed for the building is transported to site, offsite manufacture minimises embedded transport carbon costs both in getting components, sub-assemblies and pre-assemblies to site and in removing waste from the site. It also limits negative impacts on air quality and noise pollution for the same reasons.
- **Less on-site energy and water use:** The speed and ease of assembly minimises on-site energy and water consumption, with resulting environmental benefits.
- **Less material:** Better, earlier design resolution leads to less material redundancy in, for example, unnecessarily large casting voids. More widely applied across whole programmes of work, this has the potential to significantly reduce material use.
- **Better energy performance in use:** The accuracy and quality of components, sub-assemblies and pre-assemblies and their ease of assembly on site minimises the risk of poor workmanship, helping to close the performance gap between design intent and as-built in use. For example, the use of offsite gut cross-sections (GLT) can lead to outstanding airtightness, which reduces operational energy loads, with huge carbon savings over the asset's whole life.
- **Encourages circular economy:** Some components, sub-assemblies and pre-assemblies can be more easily reused, helping with both the project's whole-life carbon cost progress and efforts to activate the circular economy.

## Optimising the benefits

To reap the full benefits, components, sub-assemblies and pre-assemblies designed off-site should be standardised to the greatest possible extent, preferably in a way that complies with nationally or internationally agreed universal standards (see [Chapter 6, What will the near future look like?](#))

Standardised components, sub-assemblies and pre-assemblies are preferred on the assumption that they are tried, tested and therefore known to work, and because they avoid inventing the wheel, saving time and design fees, and reducing search and risk.

Standardisation also enables market competition (see [Standardisation?](#) on page 53), which is a critical requirement in most procurement processes.

## Measuring the benefits

A primary measure of the success of DFMA is the project's pre-manufactured value (see [What is pre-manufactured value?](#) on page 15), which expresses the amount of money spent off-site as a percentage of the total project budget. Although not true in all cases, a higher percentage can lead to a more efficient – and therefore better value – project.

Used judiciously in combination with other tools (for example, the Value Toolkit – see [Value Toolkit](#) on page 23), the measure is a useful way of forming project ambitions and monitoring progress.

The Construction Industry Research and Information Association (CIRIA) recently published a research-based methodology for quantifying the benefits of offsite construction in industrial buildings. It can be used by clients and construction management teams to assess the value and benefits achieved on projects.

The Overlay organises the core tasks that the profession needs to do differently through the process of briefing, designing, constructing and operating building projects if we are to effectively accelerate the uptake of Offsite, in line with current industry thinking and client requirements.

Implementing Offsite and MMC methodologies within the highways sector brings its own set of challenges. With this in mind, we will explore how a lean construction philosophy can minimize waste of materials, time, and effort in order to generate the maximum possible amount of value through the supply chain.

# Providing accelerated performance improvement across...

## Delivery

Building programme certainty and driving betterment.

## Costs

Reducing costs, eliminating waste and securing contingencies.

## Productivity

Accelerating performance and building resilience.

## Quality

Raising product and service quality and getting more right-first-time.

## Safety

Reducing risk and improving process safety.

## Skills

Building lasting capability and developing high performing teams.

## Sustainability

Driving sustainability goals, reducing carbon and delivering social value.



# Solutions that Span End to End - Engaging Early to Deliver Excellence



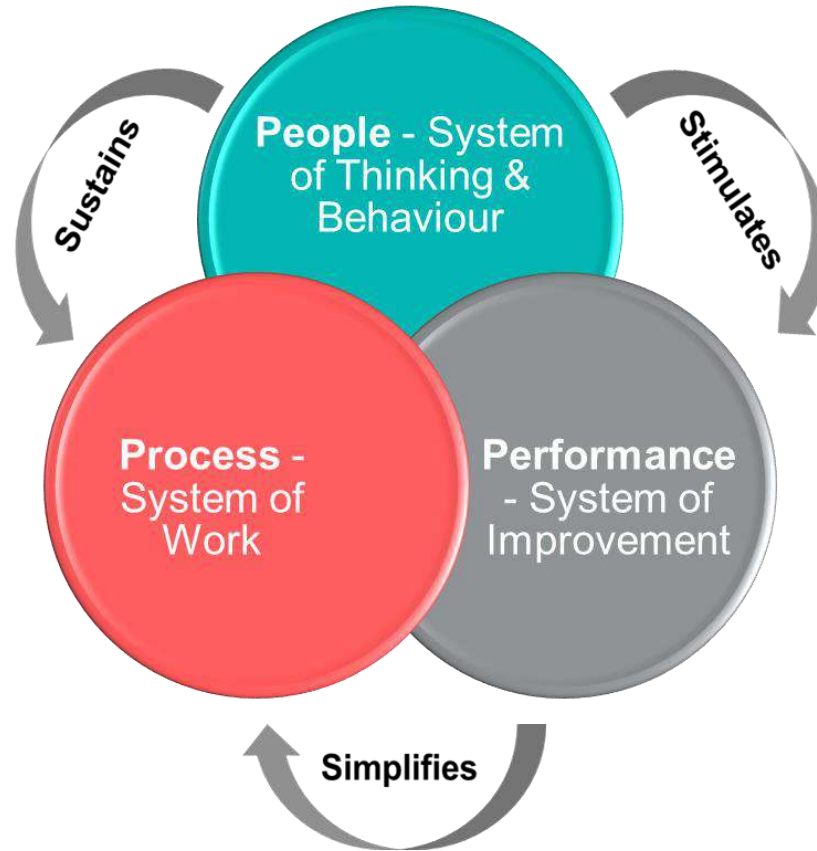
# Strategic Imperative:

## Understanding of your requirements

1. Facility capacity analysis and end to end process optimisation analysis from tender through to install, commissioning and handover.
2. Identify the primary improvement opportunities across this end to end process, that enable the seamless flow of materials, products, people and information.
3. Build the business cases based on data and deploy these to maximum effect.
4. Eliminate waste, delay and frustrations to boost productivity and build in quality.
5. Establish a robust production system to provide total transparency across the process, with the right KPIs to drive timely decision making and inspire continual improvements.
6. Grow capability to lead, manage and work in a Lean Manufacturing Environment.



# Locking in an Optimised, Scalable & Sustained Solution:



The way the workplace is structured, organised and oriented to satisfy customer requirements at the best value “how the work works”



The way issues and opportunities are surfaced & then resolved and the way in which appropriate metrics drive the right improvement behaviour at the right level and pace



The way in which leaders at all levels lead, engage and coach their people to maintain and improve against standards

# Delivering Sustainable Growth...

Delivering Sustainable **Growth** through...

## Value Creation

- 🌐 Flawless delivery
- 🌐 Faster, more reliable service
- 🌐 Speed to market on new products and services
- 🌐 Products and services aligned to needs
- 🌐 Enabling profitable growth for the customer
- 🌐 *Delighting the consumer!*

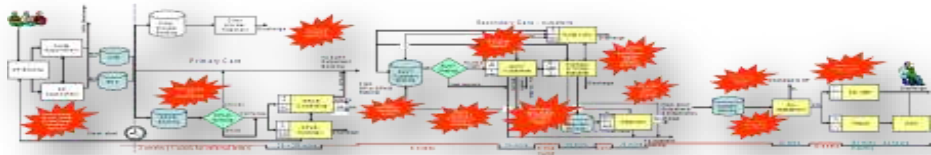
Delivering **Sustainable** Growth through...

## Waste Elimination

- 🌐 Removal of all blockages, delays and errors
- 🌐 Removal of all unnecessary activities
- 🌐 Ensuring that every necessary activity is performed right first time every time
- 🌐 Ensuring that every necessary activity is performed when it is needed
- 🌐 *Delivering more output with less resource or much more with the same!*

# Value Stream Analysis exposes Step Change Improvements that boost delivery capability

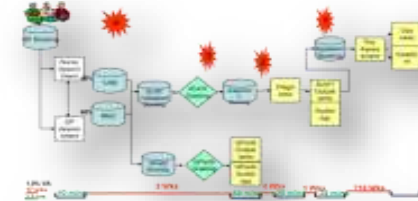
## Clearly define the Current State Process



End to end process analysis to expose and eliminate potential issues, delays across information and material flows, enables **lead-time compression** and **resource optimisation**

Eliminate  
Combine  
Re-arrange  
Simplify  
Standardize  
Automate

## Agree the Streamlined Desired State Process

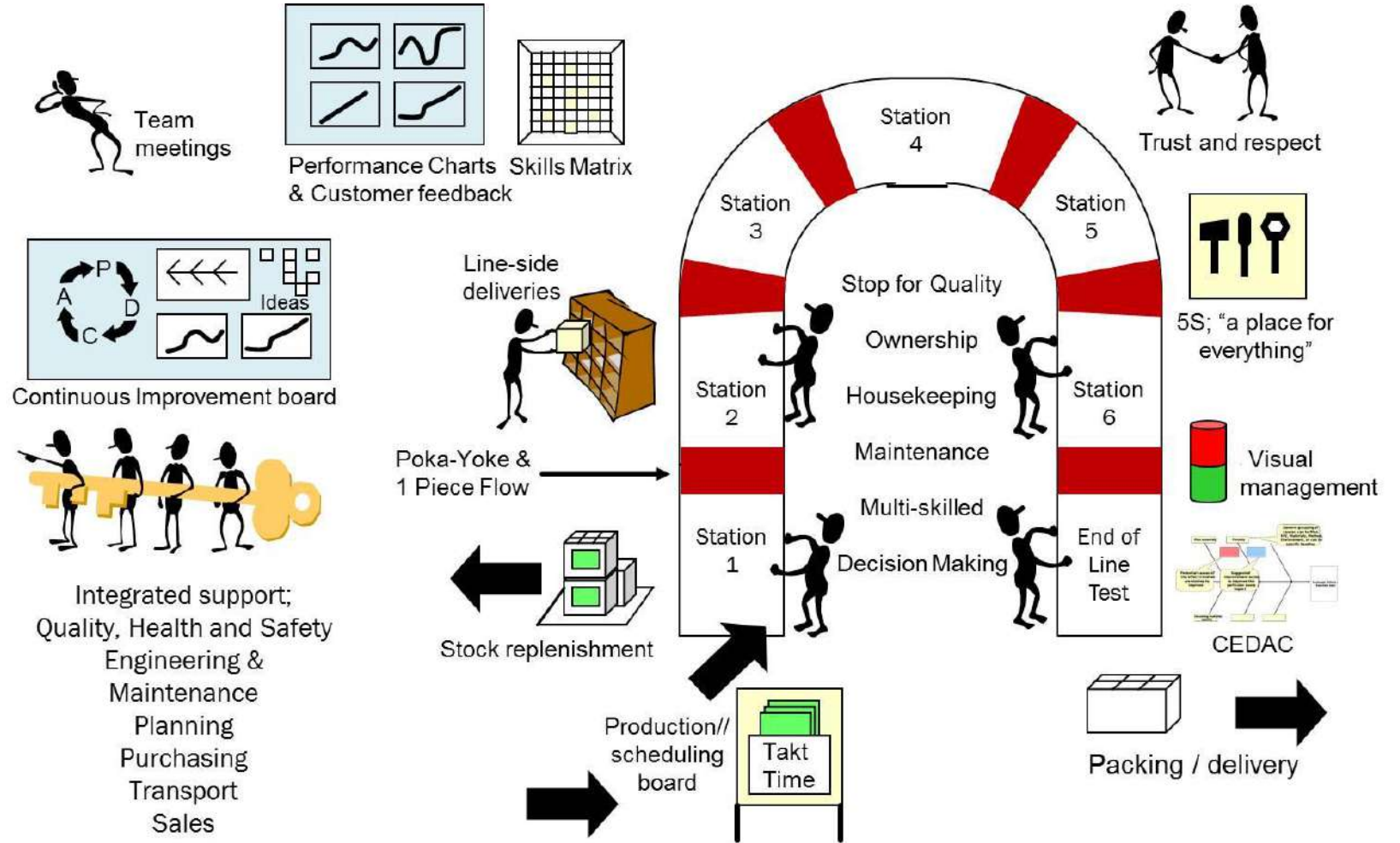
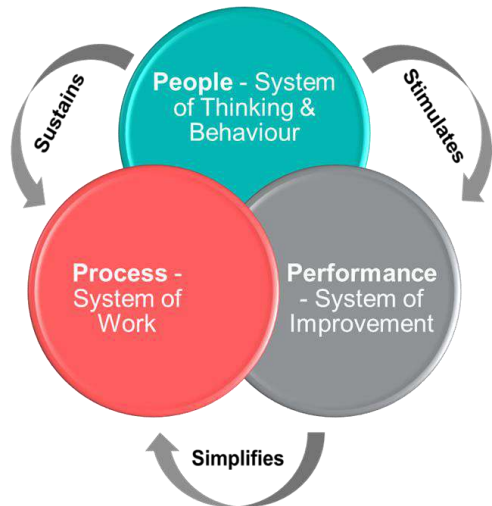


## Tactical Improvement Plan

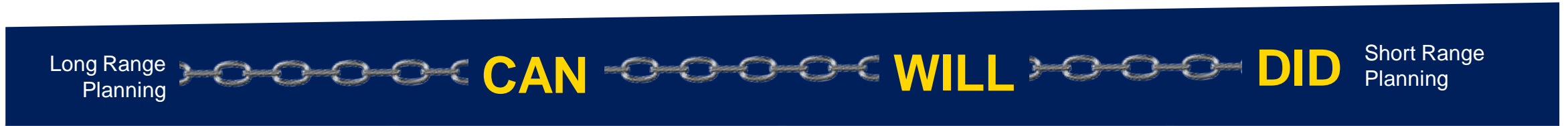




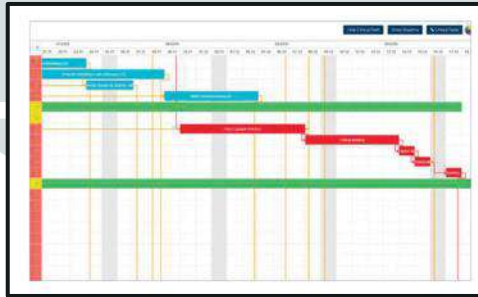
# Complete Lean Cell Design



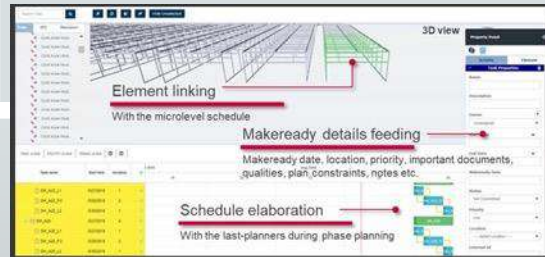
# Deploying the appropriate (best fit) solution for rigorous collaborative planning, co-ordination and control



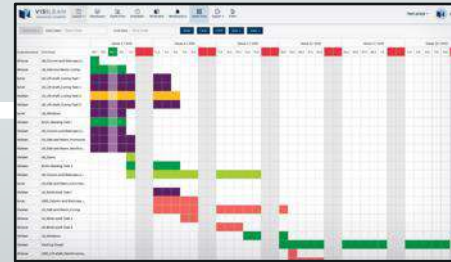
Master Schedule / Baseline Programme



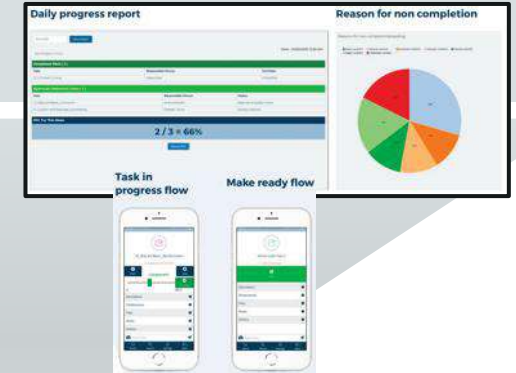
6 -12 Week Look Ahead



Detailed Weekly Work Plans



Daily Activity Briefing & Confirmation

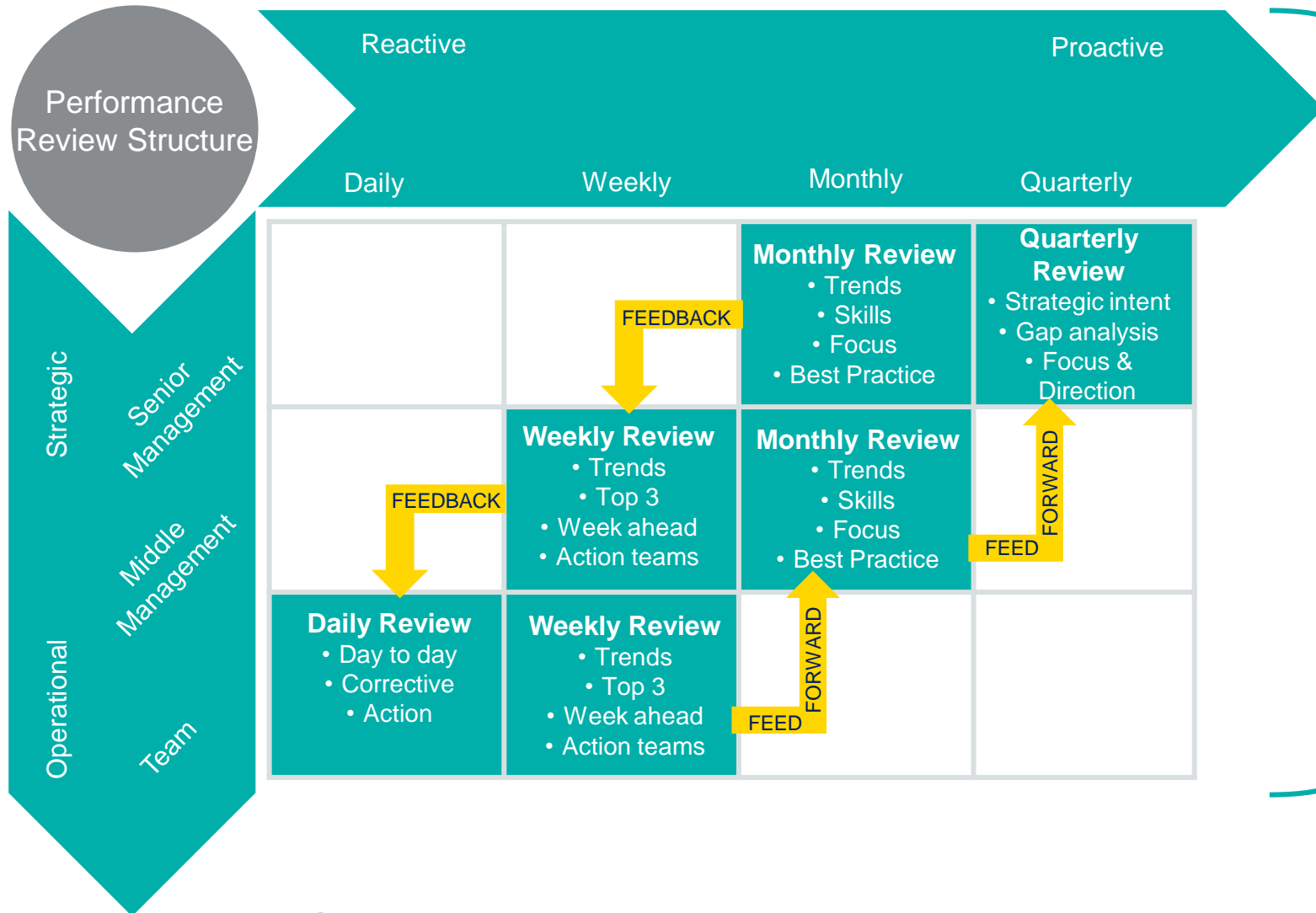


- ✓ Help teams exploit digital solutions
- ✓ Embed routines and behaviours
- ✓ Timely and informed decision making
- ✓ Improved certainty



- ✓ Streamlined Automated Reporting
- ✓ Improved Transparency and Control
- ✓ Real-time Activity Status
- ✓ Accommodates Remote Workers / Activity
- ✓ Collaborative Planning COVID Safe & Compliant

# Helping streamline & simplify review structures & reporting to align focus & drive behaviours



- ✓ Action
- ✓ Level
- ✓ Time
- ✓ Results

# An approach for Construction to Production

- ✓ Safe
- ✓ Optimised
- ✓ Repeatable
- ✓ Reliable
- ✓ Capable
- ✓ Scalable
- ✓ Controlled
- ✓ Sustainable



## Set-up & Streamline

### Key Deliverables:

- End to End Diagnostic
- Lean Process Design
- Established Production Controls
- Identify & Initiate Quick Wins
- Benefits Case
- Tactical Improvement Plan

## Deploy & Deliver

### Key Deliverables:

- Quick Wins Realised
- Lean Production Solutions Deployed
- Skills Control – Flexibility & Co-ordination System Deployed
- Visual Performance Management & Control
- Productivity and Capacity Gains

## Optimise & Scale

### Key Deliverables:

- Strategic Supply Chain Improvements
- Enhanced internal capability
- Reduced Cost Base
- End to End Process Transparency & Control
- Embedded Behaviours & Habitual Improvement Routines

- ✓ Improved safety
- ✓ Improved Certainty
- ✓ Reduced Site Time
- ✓ Improved Productivity
- ✓ Right First Time
- ✓ Reduced Costs

## Features

## Benefits

SYSTEMATIC END TO END PROCESS DIAGNOSTIC



Primary Improvement Opportunities clearly exposed and quantified to boost overall programme performance

INNOVATION AND DEVELOPMENT ROADMAP



Clear improvement roadmap aligning aspirations to digestible phases of improvement, inspiring the art of the possible

TACTICAL IMPLEMENTATION PLANS



Practical improvement plans driven at pace throughout the programme

FOCUSED STEP CHANGE IMPROVEMENT EXECUTION



Improved Cost, Quality, Delivery, Development, Reputation and Growth

ENHANCED COLLABORATIVE LOOKAHEAD PLANNING



Reduce risk and increase programme certainty, responding to issues faster and decisively with clear accountability, predictability and stability

ENHANCED CAPABILITY & CULTURAL ALIGNMENT



Enhanced skills and embedded behaviours to lock in improvements and deliver continual gains



# Does it make the boat go faster?



**Knowledge has little value unless you transfer what you learn into meaningful workplace actions and performance improvement**

**Everything you deploy must be geared to boost performance!**

# Providing accelerated performance improvement across...

## Delivery

Building programme certainty and driving betterment.

## Costs

Reducing costs, eliminating waste and securing contingencies.

## Productivity

Accelerating performance and building resilience.

## Quality

Raising product and service quality and getting more right-first-time.

## Safety

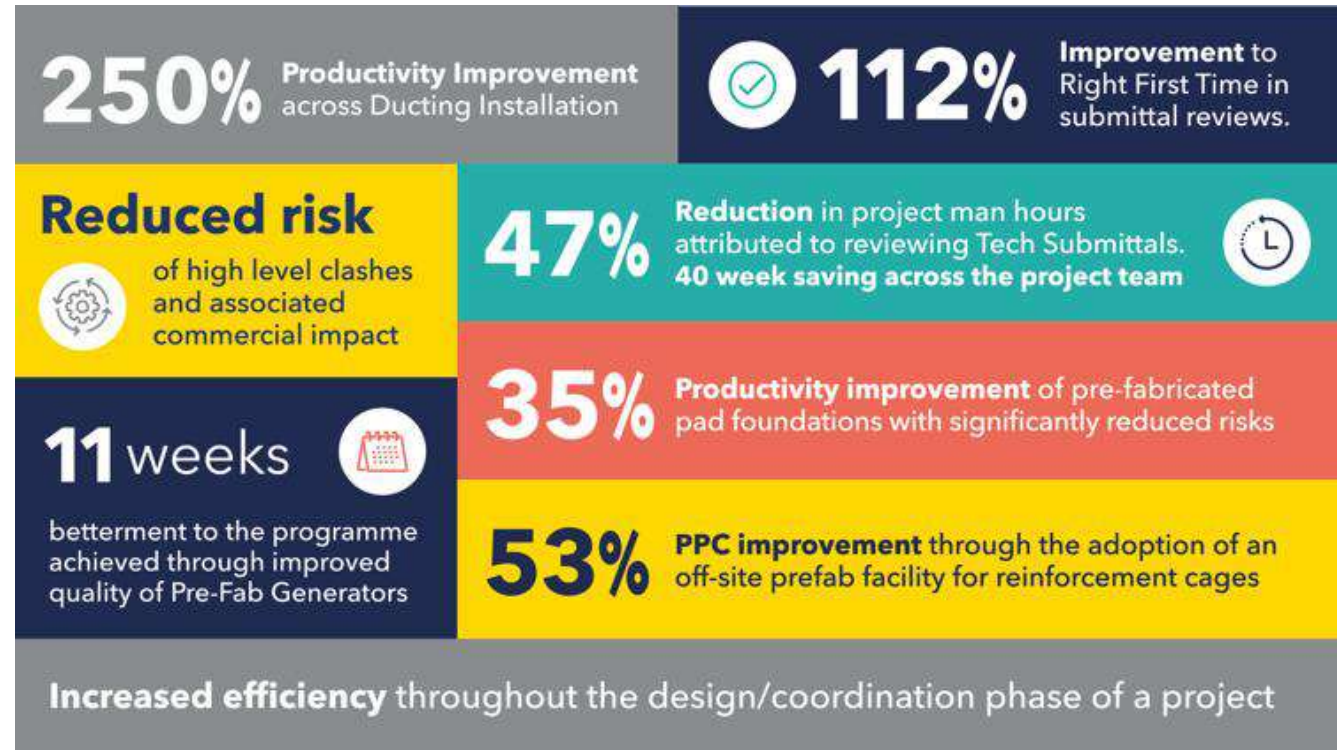
Reducing risk and improving process safety.

## Skills

Building lasting capability and developing high performing teams.

## Sustainability

Driving sustainability goals, reducing carbon and delivering social value.



We look forward to adding value in your organisation.

01608 664589  
contact@lcint.co.uk  
www.lcint.co.uk

Lean Construction International Ltd, 50 Stratford Road,  
Shipston-on-Stour CV36 4BA UK  
© Copyright LC International 2020. All rights reserved.

Connect with us

