National Highways' MMC Strategy - MMC(h)

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AGENDA

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Industrialised Construction

Manjit Rana

national highways

Industrialised Construction August 2024

Manjit Rana

Industrialised construction is about setting the right environment to allow innovation to happen at speed and be tested on projects (ICE, 2022)

national highways

Industrialised Construction and Productivity in Context – the Opportunity

Figure 1: Productivity has changed little in the construction industry in the past 50 years

Output per hour worked and multi-factor productivity, construction industry and market sector, UK, 1970 to 2020

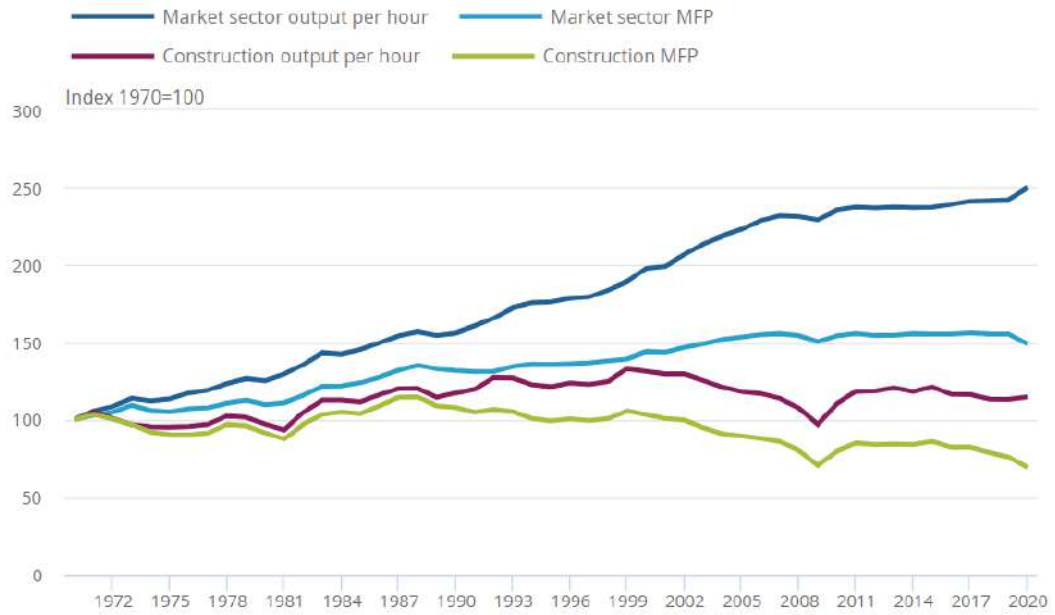
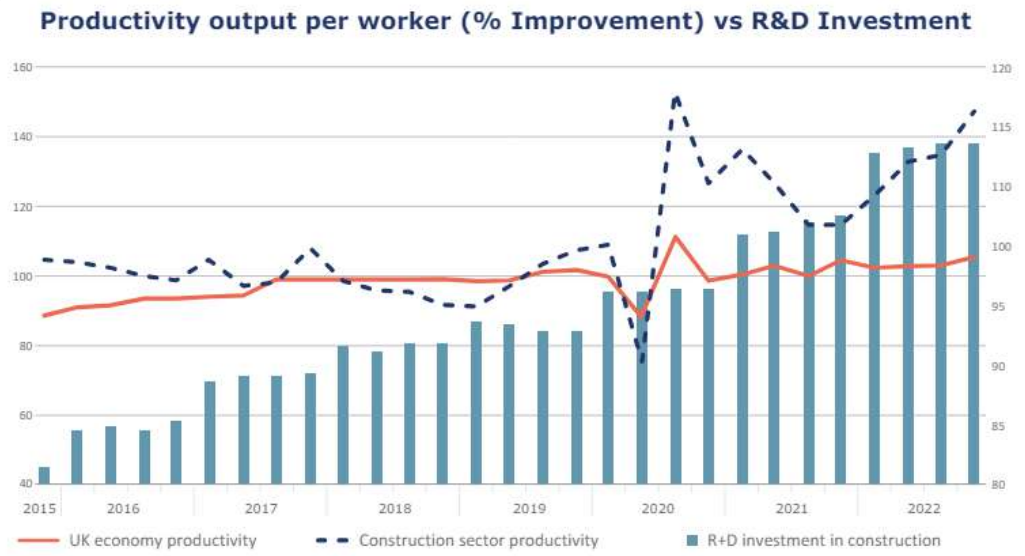


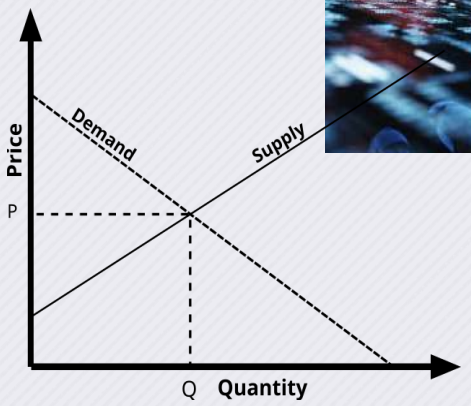
Figure 2: Construction Leadership Council (CLC)
Creating a productive environment for UK Construction



ICE State of the Nation

How? Setting the Right Environment

Components of Industrialised Construction



Recent Developments

Advanced Automation: The advent of advanced sensors, GPS technology, and machine learning facilitated the development of more autonomous construction equipment capable of performing tasks with minimal human intervention.

3D Printing Revolution: The introduction of 3D printing technology has revolutionized construction, enabling the creation of entire structures using additive manufacturing techniques.

AI and Machine Learning Integration: Artificial intelligence and machine learning have been integrated into construction robots, enabling them to make autonomous decisions, optimize routes, and improve operational efficiency.

Increased Safety Measures: Robotics in construction has significantly enhanced safety by handling hazardous tasks and minimizing risks to human workers.

Client enablers

- Productivity app
- Rapid Engineering model
- Product Catalogue
- Category Strategies
- Demand planning
- Standardising design
- Innovation Team
- IP clauses
- Carbon registers

- Pre-Manufactued Value
- IC working group
- MMC Toolkit

Benefits: Repetitive, faster, standardised, unaffected by adverse weather, reduced labour, less waste, new talent, quality control, safety, scalable, Leveraging cost, routes to net zero

national highways

Industrialised Construction

Seven category definition framework

Category 1	Category 2	Category 3	Category 4	Category 5	Category 6	Category 7
Pre-Manufacturing 3D primary structural systems	Pre-Manufacturing 2D primary structural systems	Pre-manufactured Components	Additive Manufacturing (Structural and Non-Structural)	Pre-manufacturing assembly	Traditional building product site led labour reduction / productivity improvements	Site led process labour reduction productivity and assurance improvements
 MS4 Standardised Gantry	 2 Bridge Span Components	 Pre-fab Slot Drain	 Slipform Concrete Barrier	 Underground Utilities	 V Ditch Bucket	 Drone Surveys
Complete modular 3D units Factory produced and transported to site for final installation.	2D units produced in factory conditions. When assembled create complete structures / assets	Standardised and mass engineered components that can be assembled and connected together (Pre-cast)	Components formed to a specific digital design / mould including remote or site-based printing of parts	Non-structural items and components bought together that when assembled make an asset	Building products manufactured for easy on-site assembly. Error proof designed tools / components	Site led process improvements using innovative-oriented solutions
Offsite Industrial / Automated Manufacturing				Onsite Construction		

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1 - Barriers/challenges in MMC(h) adoption

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MMC(h) Framework

John Armitage

Technical Director

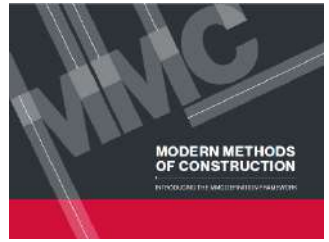
RAMBOLL

MMC definition framework

3D boxes	2D panels and frames	Structural components	3D printing	Pods, panels and components	Smarter materials	Better processes

Structural **Non-Structural**

Ministry for Housing Communities and Local Government (MHCLG) 2019



MMC(h) framework – structural categories

Category 1

Pre-manufacturing 3D primary structural systems

Complete modular 3D units, factory produced and transported to final location

MS4 standard gantries

Whole structures built offline

Category 2

2D primary structural systems

Full structural components, forming complete structures when assembled

Arches, culverts, precast portal frames

Category 3

Pre-manufactured components

Mass engineered components connected together

Precast components to form bridge systems

Permanent formwork

Category 4

Additive manufacturing (structural and non-structural)

Standard designs, moulds and site base printing

3D printing

Slipforming

MMC(h) framework – non-structural categories

Category 5

Pre-manufacturing assembly

Non-structural components, when assembled making an asset

Gantry cabinets

Pre-formed utilities

Category 6

Traditional building product site led labour reduction / productivity improvements

Building products manufactured for easy onsite assembly

Cladding units (non-structural)

V-ditch buckets

Category 7

Site led process improvements suing innovative-oriented solutions

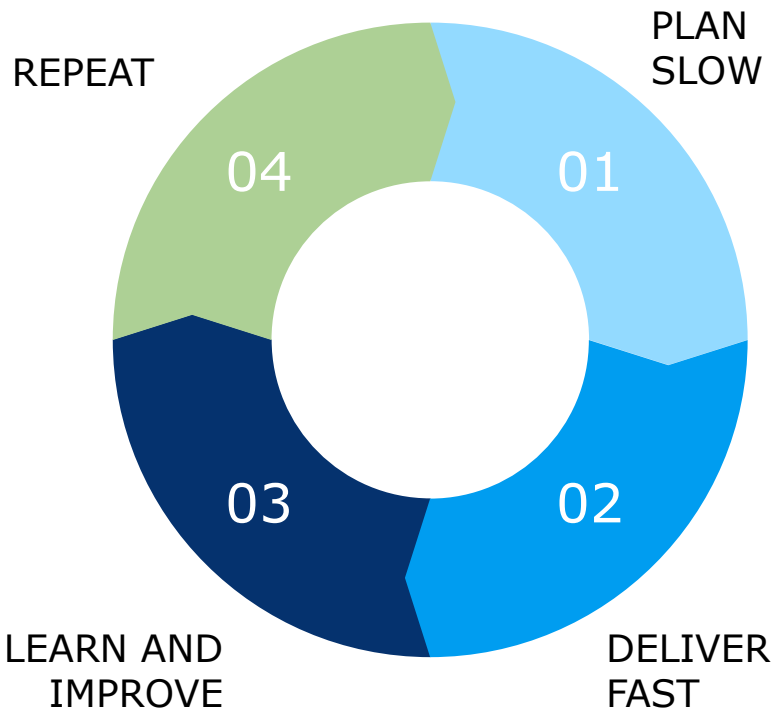
Drones

Robotics

Autonomous plant

Implications of Industrialised Construction

- Benefits of Industrialised Construction
- Reduced access requirements
- Less constrained worksites
- Reduced number of operatives on site
  - Improved Safety
  - Labour constraints from skills availability
- Improved programme and increased certainty
  - Moving work off the critical path
- Reduced cost and increased certainty
- Constructability at the heart of design



- Implications of Industrialised Construction for Design
  - Earlier collaboration and integration
  - Integration of products into design process
  - Learning and feedback improved

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2 - Benefits in MMC(h) adoption

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MMC(h) sharing our approach to adoption.

Michael Schenk

Head of Research & Innovation

Balfour Beatty

Balfour Beatty

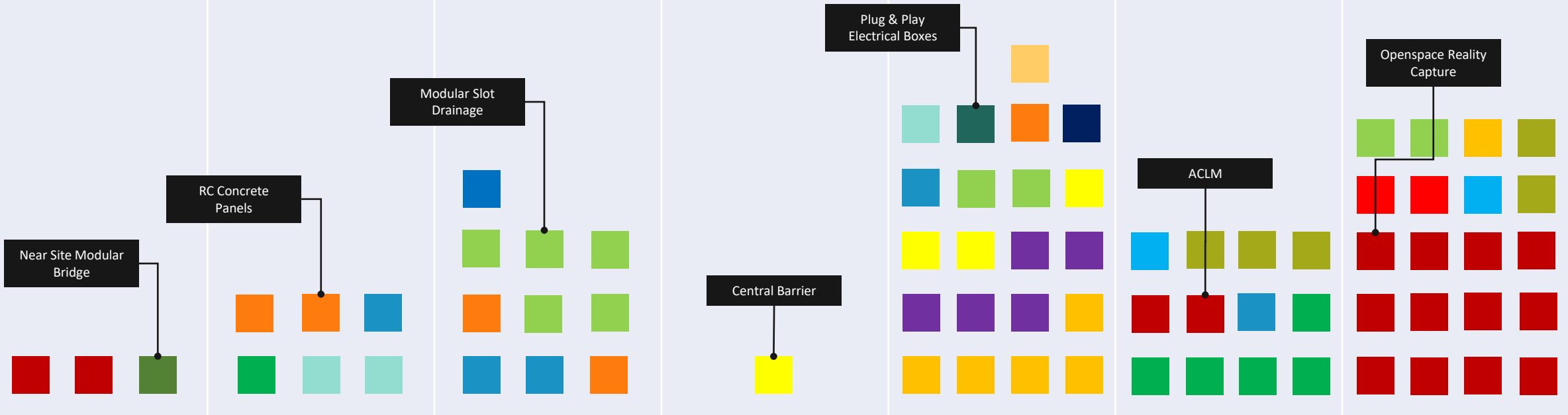
MMC(h) sharing our approach to adoption.

Michael Schenk

Balfour Beatty

WBS	P-Overhead	Site Clearance	Fencing	Road Restraint	Drainage	Earth Works	Pavements	Kerbs & Footways	Traffic Signs	Road Lighting	Electrical Work	Motorway Comms	Piling & Retaining	Structural Concrete	Structural Steel	Commissioned Structures	Landscape & Ecology
L1	0100	0200	0300	0400	0500	0600	0700	1100	1200	1300	1400	1500	1600	1700	1800	2500	3000
L2	8	4	3	6	7	19	8	9	5	4	5	8	12	6	9	2	9
W/S Act.	16	2	6	4	9	6	2	1	1	5	1	1	5	5	3	1	5

C1	C2	C3	C4	C5	C6	C7
3D Modular Construction	2D Components	Pre-fabricated Components	3D Printed / Extruded Components	Pre-manufactured Components	Equipment / Material / Product Innovation	Construction Process Innovation



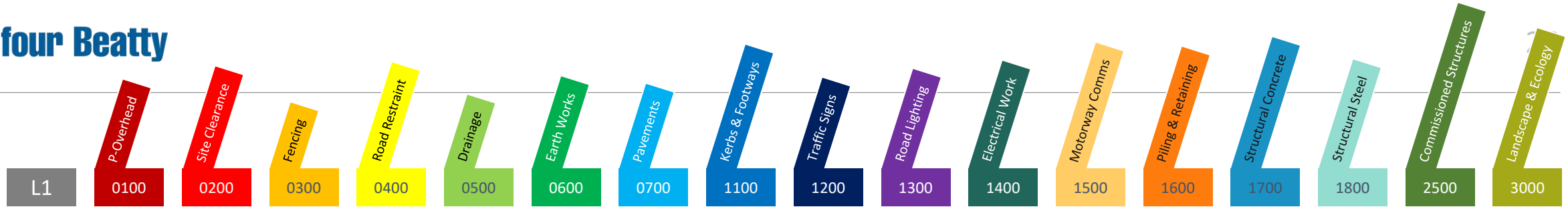
4%	8%	14%	1%	28%	16%	27%

Balfour Beatty

L1	P-Overhead 0100	Site Clearance 0200	Fencing 0300	Road Restraint 0400	Drainage 0500	Earth Works 0600	Pavements 0700	Kerbs & Footways 1100	Traffic Signs 1200	Road Lighting 1300	Electrical Work 1400	Motorway Comms 1500	Piling & Retaining 1600	Structural Concrete 1700	Structural Steel 1800	Commissioned Structures 2500	Landscape & Ecology 3000

	C1	C2	C3	C4	C5	C6	C7
	3D Mod Construction	2D Components	Pre-fabricated Components	3D Printed / Extruded Components	Pre-manufactured Components	Equipment / Material / Product Innovation	Construction Process Innovation
						ACLM	
	Near Site Modular Bridge				Plug & Play Electrical Boxes		Openspace Reality Capture
				Central Barrier			
	RC Concrete Panels		Modular Slot Drainage				

Balfour Beatty



	C1	C2	C3	C4	C5	C6	C7
	3D Mod Construction	**2D Components**	**Pre-fabricated Components**	**3D Printed / Extruded Components**	**Pre-manufactured Components**	**Equipment / Material / Product Innovation**	**Construction Process Innovation**
5 Industry Leading						Full Automation	
4 Raising the Bar	Smart Raft					Remote Control	
3 Platform for Excellence						3D Machine Control	
2 Doing the Basics Well							
1 Doing the Basics					Steel VRS	Earthwork Blade	

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3 - What can supply chain do to help overcome barriers?

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How is the industry contributing

Jordan Flint

Managing Director of Design and Engineering

KIER

How is the industry contributing

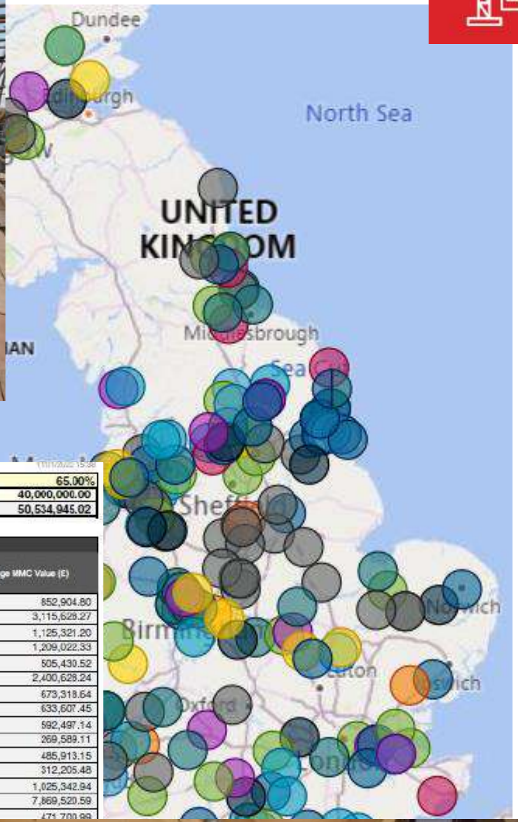
Industry and company working groups

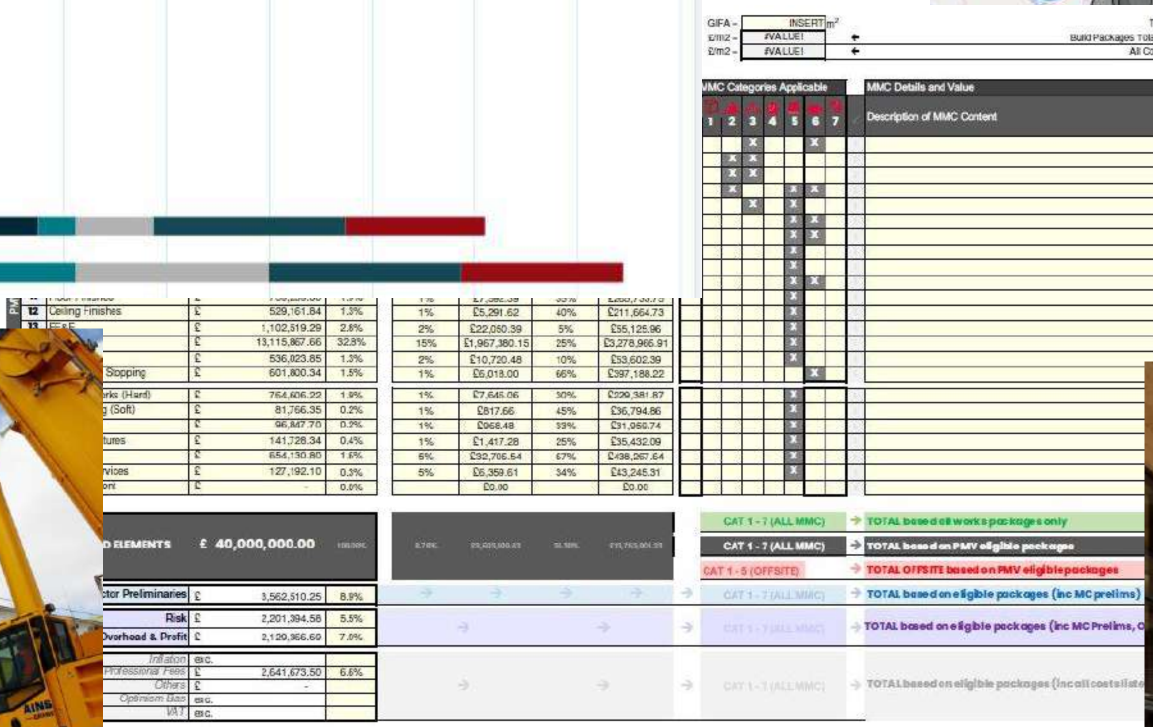
Investment in time and expertise into National Highways and company Industrialised construction working groups.

Align strategy - share best practice - Collaborate

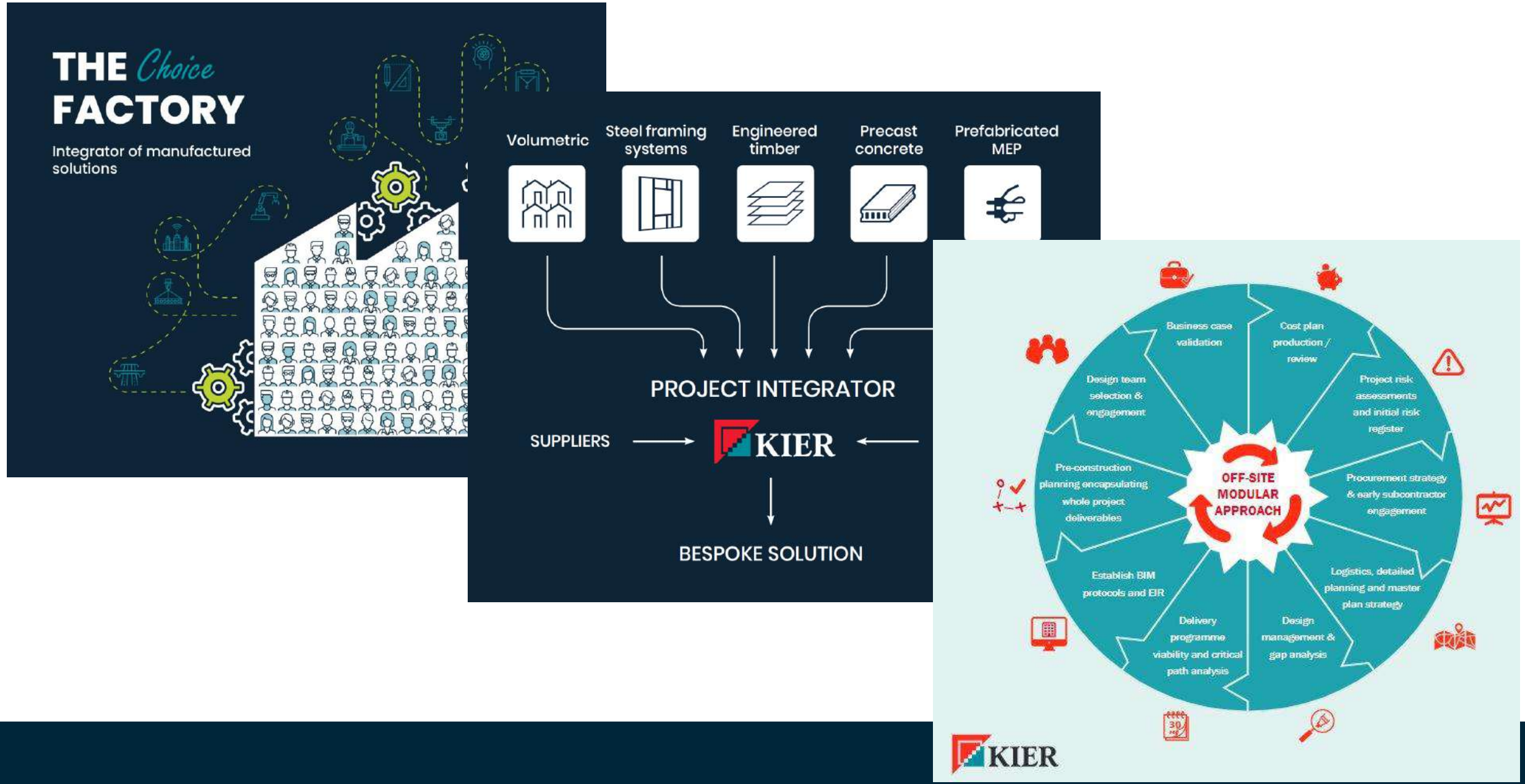
	Item	Timing	Lead
0	Introductions	10 mins	All
1	Health, Safety & Wellbeing moment : MMC moment – sharing and building case studies	10 min	Victoria Burnham
2	Workshop 3 objectives and actions arising from the last meeting	10 min	Manjit /Gavin
3	MMC Maturity Plan for assessment Ladder – what does our journey look like?	15 mins	Manjit
4	MC Toolkit: progress on trial of the toolkit and feedback on: (a) the guidance note (b) the toolkit and its application (c) how can we operationalise the toolkit?	30 Mins	Michael / All
5	Good / Bad and The Ugly prioritisation	25 mins	Manjit
6	LUNCH	35 mins	
7	Learning from others: The NHS MMC assessment model – what can we adopt in highways?	30 mins	Scott T
8	MMC and Digital: NH Rapid Engineering Model – what is it and how is it used?	20 mins	Lorraine Butler
9	AOB	10 mins	

Learning from others and process





Kier MMC Strategy



Mersey Gateway | precast concrete and preassembled reinforcement cages

Mersey Gateway is one of the largest infrastructure initiatives in the UK, and stands out as a landmark that is recognisable throughout the North West and beyond. It has been labelled as a 'bridge to prosperity', delivered on time, within budget, as well as exceeding client expectations.

The project involved the design and construction of a new six lane cable stayed toll bridge over the River Mersey, along with upgrades to 9km of the adjoining road network and associated junctions.

The choice of concrete as the primary structural material for a number of infrastructure elements enabled its success. Extensive use of precast, high-strength concrete, permitting rapid construction cycles, has resulted in low maintenance and durable structures that were built within a very ambitious programme.

By standardising the design of major structural components of the scheme (pylons, piers and deck), and using high strength precast concrete for the Freight Line Bridge, Clifton Road Bridge and the Bridgewater Junction, we maximised potential for the highest quality, safety, and streamlining of the construction programme.

As one of the largest infrastructure projects in
the numbers behind Me
Gateway are staggering.
scale and complexity of
engineering and constru
activity is phenomenal.
of the figures involved s
that delivering this proje
schedule and under buc
an incredible achieveme

Cllr Rob Polhill, Leader, Halton Borough Council

M6 Smart Motorways

Maximising efficiencies across a programme

Working in partnership with Highways England and other main contractors on our M6 Smart Motorways upgrade scheme, we are maximising the use of repeatable processes and solutions; increasing economies of scale in procurement to deliver efficiencies. Standard products are designed collaboratively once, then procured and delivered multiple times.

The challenge

Working safely and minimising disruption to road users are key priorities for the M6 Smart Motorways scheme. Works are carefully planned around key events, holidays and traffic management for neighbouring network schemes. Our project teams are required to work within narrow lanes with restrictive access and egress points, whilst maintaining live lanes of traffic for the 120,000 road users.

The solution

pre-assembly across all of our construction activities... We will adopt ever increasing levels of automation and offsite construction on road improvement schemes and smart motorways in our next five year road investment programme."

Jim O'Sullivan, Chief Executive, Highways England

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4 - What should designers do to help deliver MMC(h)?

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Q and A

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5 - What format suits you for future comms about MMC(h)?

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MMC(h) in practice

M6 Junction 10 bridge beam lift

MMC(h) in practice

M25 junction 10 upgrade works ramps up

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MMC(h) in practice

May 2024 - M25 Junction 10 Update - New roundabout bridge beam installation by drone x5 speed