

Increasing Pre-Manufactured Value Through Modern Methods of Construction: The UK Journey So Far

International Conference on MiC
Construction Innovation Expo
Hong Kong

31 January 2023



Cast 

Global Construction – The Drivers For Change

Market Conditions



Material Market



Labour Market



Housing & Infrastructure

ESG & Sustainability



Embodied Carbon



Waste



Government Regulation

Client Drivers



Quality



Programme



Cost

The UK Has Been On A 6 Year Journey Of Policy & Funding Interventions To Attempt To Modernise Construction

2016

- The Farmer Review of the UK Construction Labour Model

2017

- Modernise or Die: The Farmer Review of the UK Construction Labour Model
- Autumn Budget 2017: Philip Hammond commits £44bn to housebuilding

2018

- Industrial Strategy
- Off-site manufacture for construction: Building for change
- Independent Review of Build Out

2019

- Japan's biggest house builder enters UK market with £90m deal
- Government backs like Homes with £30m loan deal
- Modern Methods of Construction (MMC)
- WE WILL USE NEW TECHNOLOGIES TO HALVE THE ENERGY USE OF NEW BUILDINGS BY 2038
- Transforming UK construction: demonstrator projects

2020

- Jenrick unveils huge £12 billion boost for affordable homes
- Affordable Homes Programme 2021 to 2026
- Climate change: UK government to commit to 2050 target
- Household emissions in 1990, 2017 and 2050
- PLANNING FOR THE FUTURE

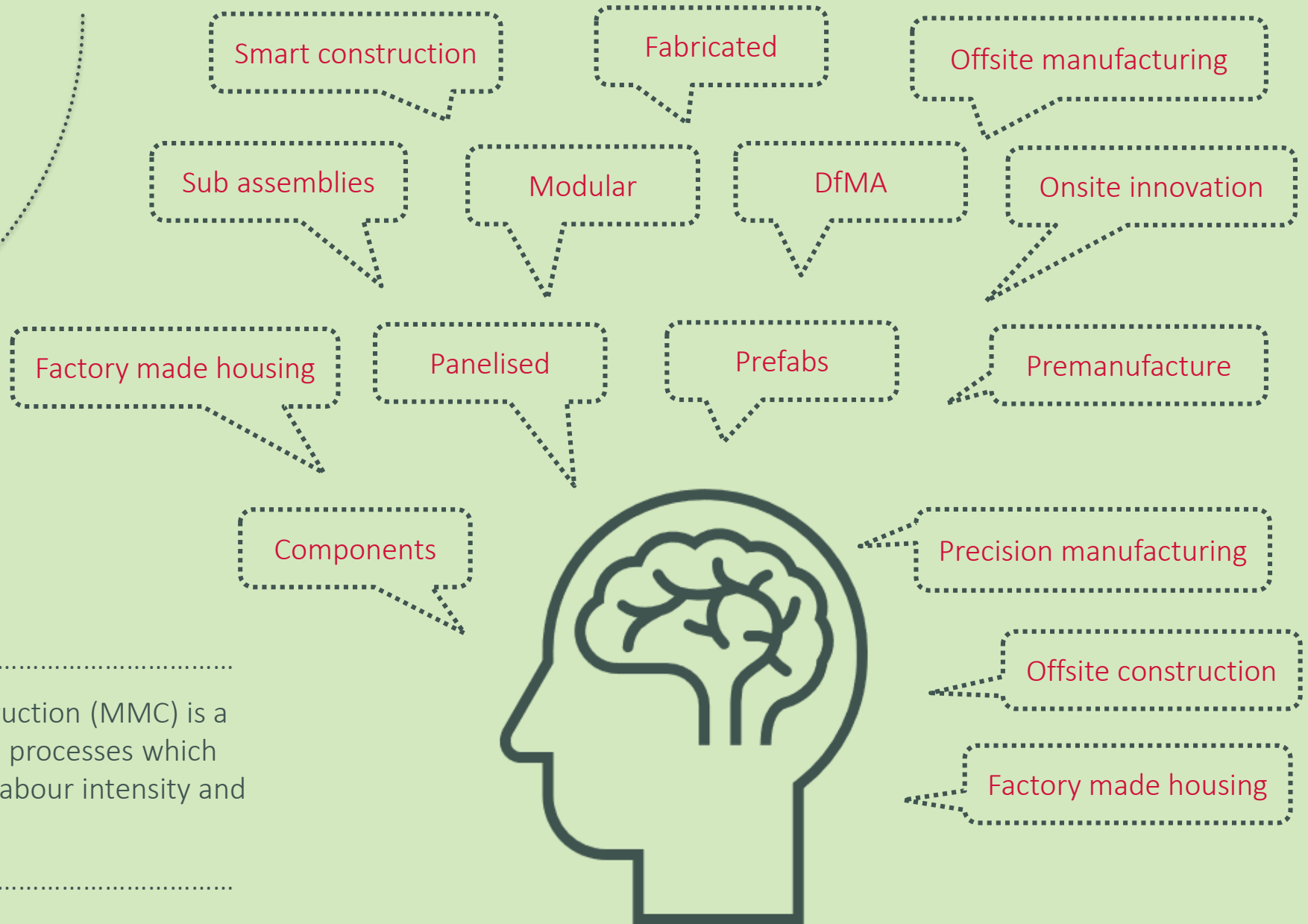
2022

- RIBA RESPONDS TO THE CCC'S REPORT ON UK HOUSING AND CLIMATE CHANGE

An Important Intervention Was To Define Modernisation & Link To Measurable Outcomes



We Needed A Start Point To Align Language



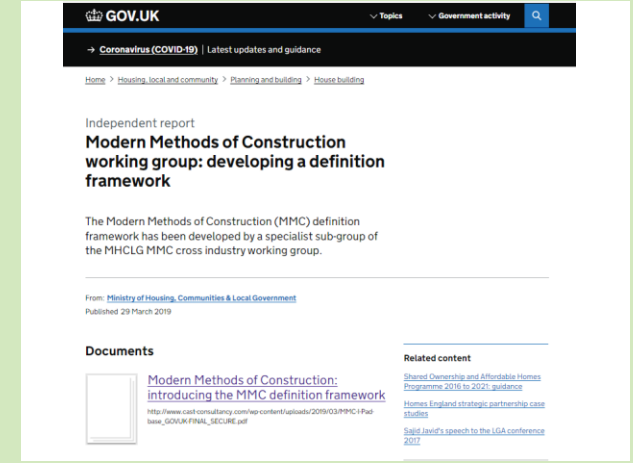
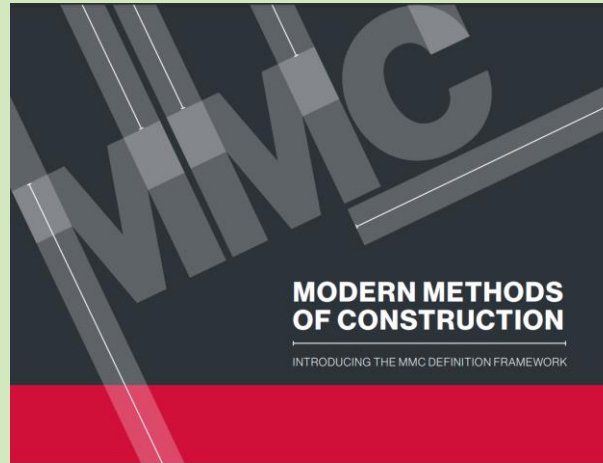
Modern Methods of Construction (MMC) is a **generic** term to embrace all processes which reduce the level of on-site labour intensity and delivery risk.

MMC Categorisation

The UK has now formally defined MMC – This Creates A Data Architecture Opportunity

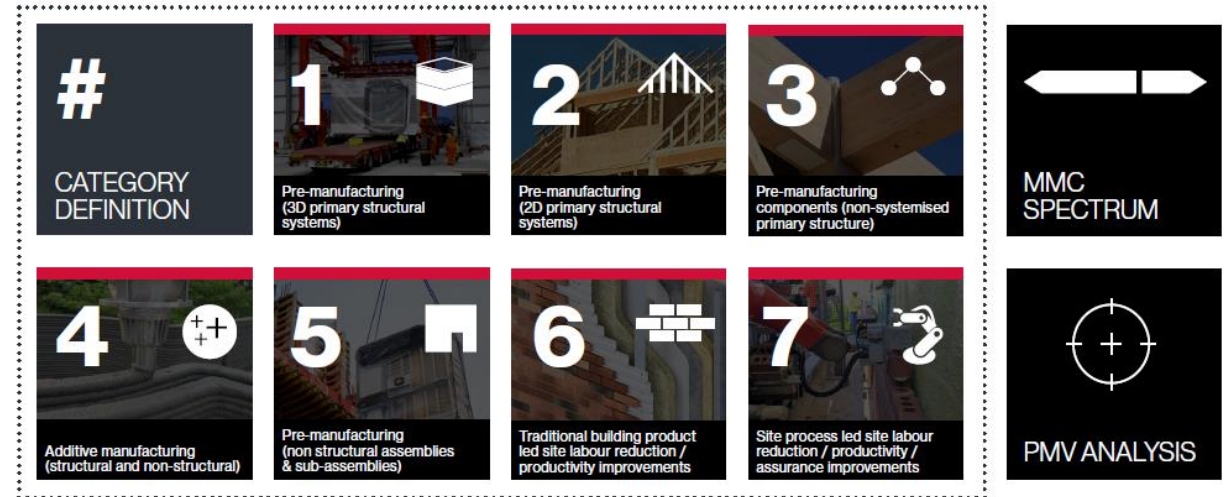
The MMC Definition Framework is a seven category definition framework that enables a full and future-proofed range of MMC used in homebuilding to be better understood with regularised terminology. The definition framework spans all types of pre-manufacturing, site based materials and process innovation.

This definition framework is an output of the MHCLG Joint Industry Working Group on MMC which was chaired by Cast and tasked with improving stakeholder education and understanding of MMC with particular reference to enabling better access to mortgage finance, insurance and assurance.







Category **DEFINITIONS**

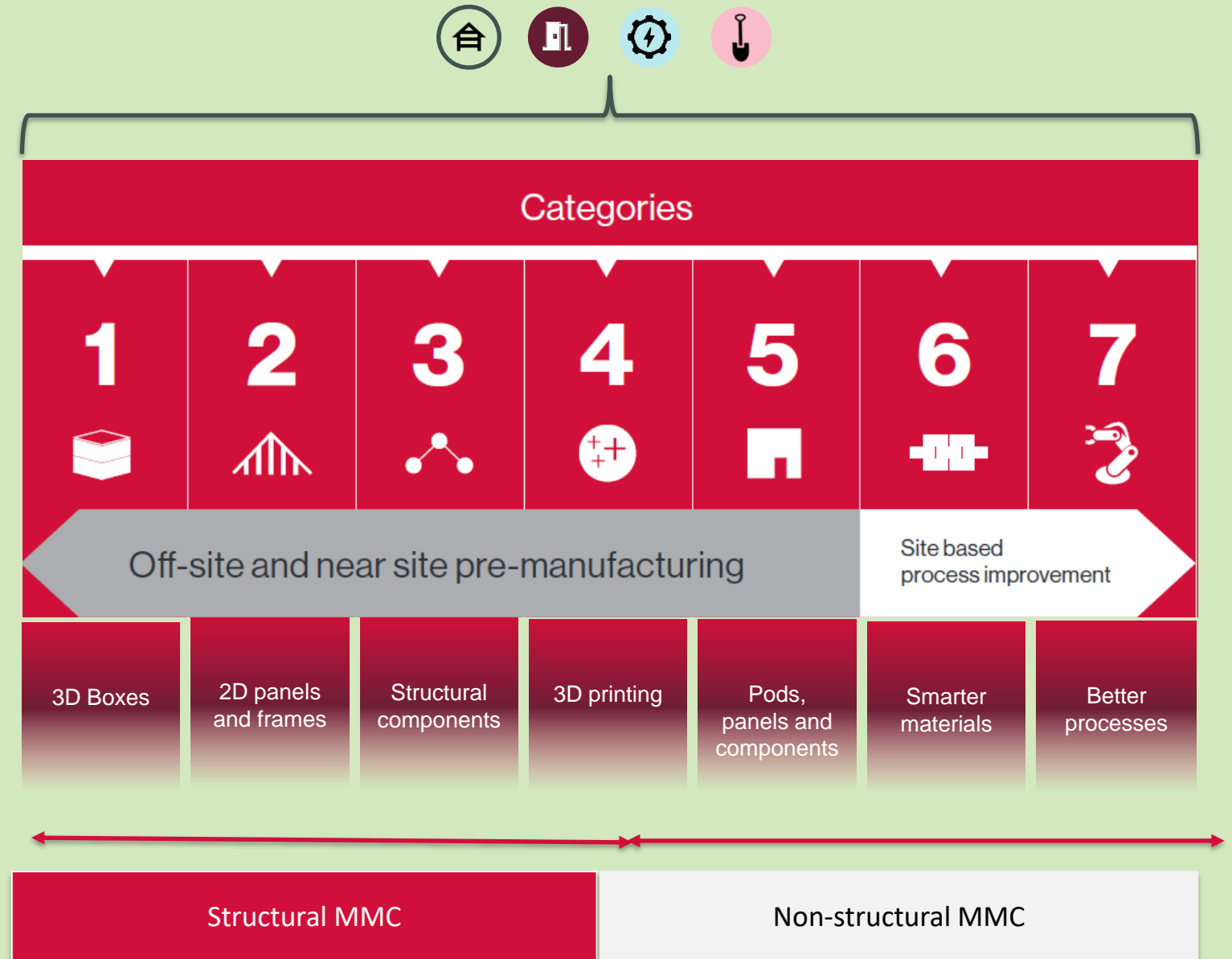
The term 'pre-manufacturing' encompasses processes executed away from final workforce, including in remote factories, near site or on-site 'pop up' factories. The pass test is the application of a manufactured led fabrication or consolidation process in controlled conditions prior to final assembly / install. On-site 'workforce factories' are included in Category 7).



The MMC Framework

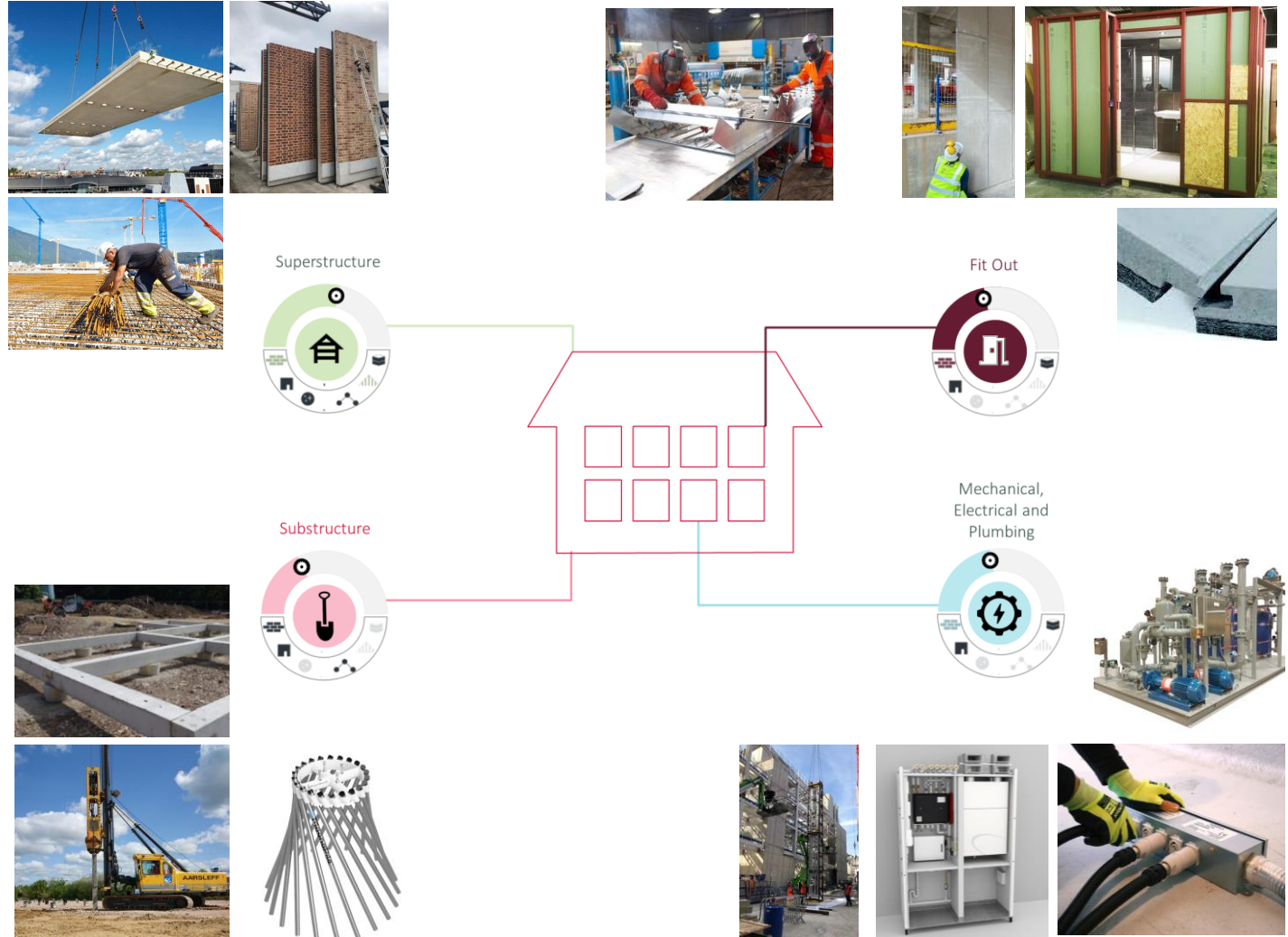
Building element

-  Substructure
-  Superstructure
-  Fit Out
-  MEP



Targeted MMC across all building elements

1. Precast Slab
2. Precast Façade
3. Stairmaster frame
4. Specwall
5. Bathroom Pod
6. Screed Board
7. Skidded Plant
8. Plug and Play Cabling
9. 3D utility Cupboard
10. Vertical MEP stack
11. Rapidroot foundation
12. Precast Pile
13. Precast Ring Beam
14. Bamtec Reinforcement



DECISION MAKING TIMEFRAMES



To unlock the potential of MMC you require **1. Standardisation**, **2.Repetition** and **3. Stacking** across the building.

You can further optimise the opportunity of MMC by scaling this up taking it from the **building** to across the whole **project** and further still across a whole **portfolio** or **framework**

Category 1



Pre-manufacturing
(3D primary structural systems)



Product Options

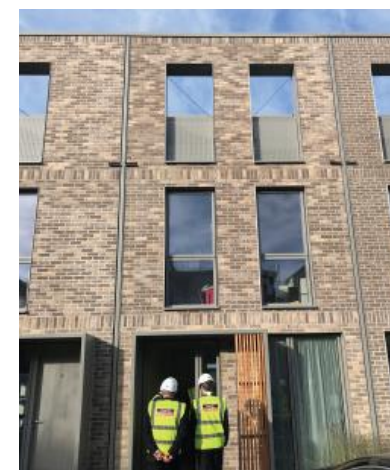
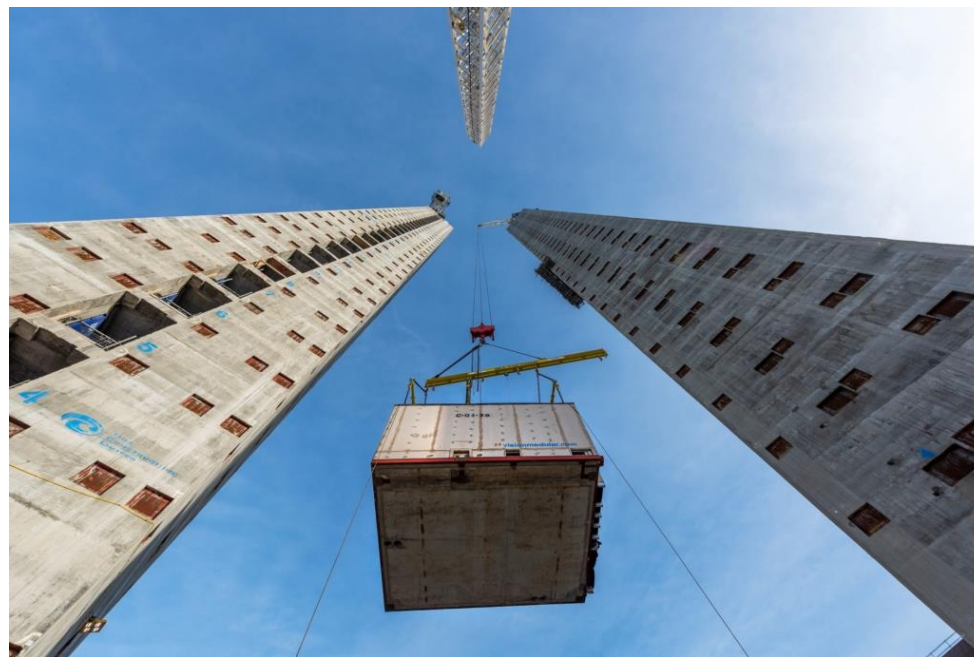
1a : Structural chassis only – not fitted out

1b : Structural chassis fitted out

1c : Structural chassis fitted out with cladding

i: Whole building systemised

ii: Hybrid traditional core with volumetric modules



Category 2



Pre-manufacturing
(2D primary structural
Systems)



2a. Basic framing
only including walls,
floors, stairs & roof

2b. Enhanced consolidation
Insulation > internal linings > external board > membranes

2c. Further enhanced
consolidation– insulation,
linings, external cladding,
roofing, doors, windows



Category 3



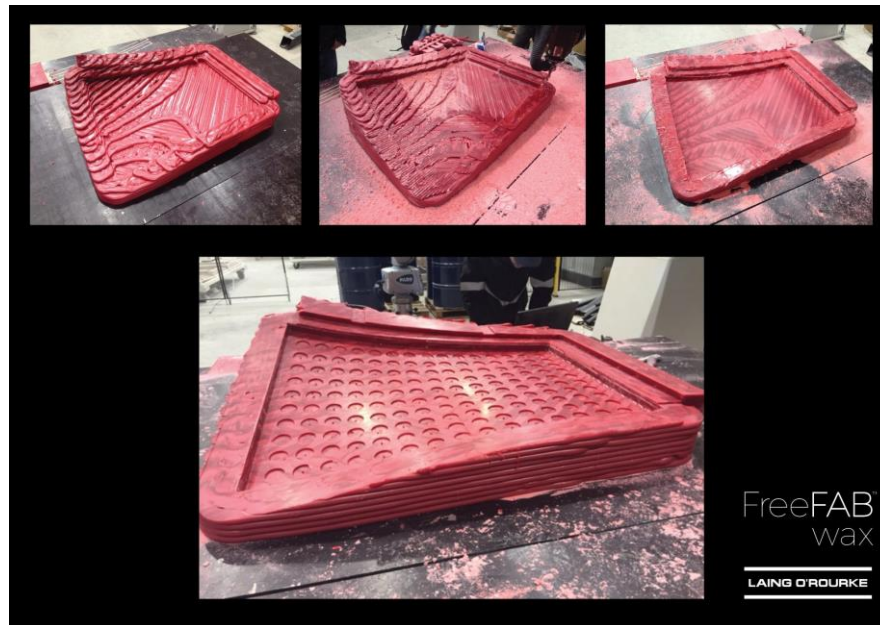
Pre-manufacturing components
(non-systemised
primary structure)



Category 4



Additive Manufacturing / 3D
Printing



Category 5



Pre-manufacturing
(non-structural assemblies & sub-assemblies)



Category 6

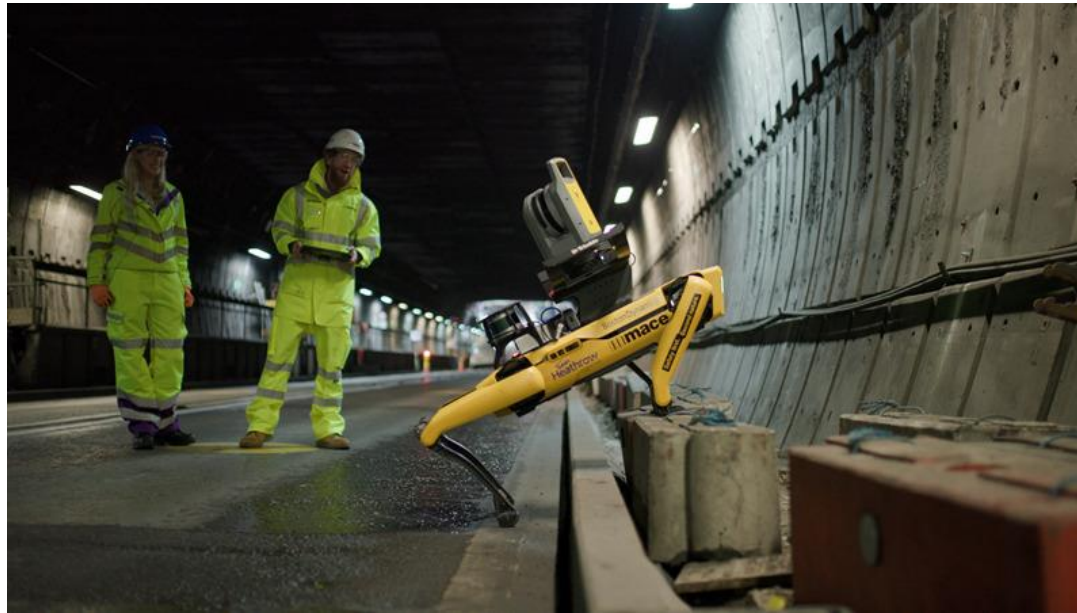
Traditional building product
led site labour reduction
productivity
improvements



Category 7

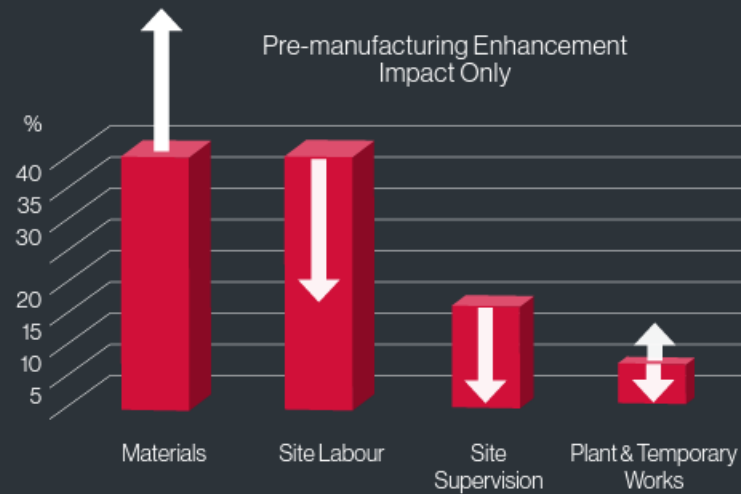


Site process led labour reduction /
productivity / assurance
improvements



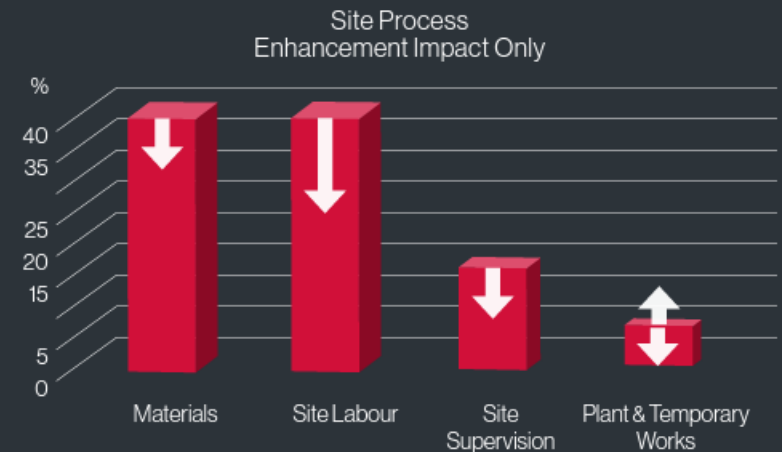
Linking The Framework To PMV

CATEGORIES 1-5 PRE-MANUFACTURING LED APPROACHES



- General shift of site labour to controlled manufacturing processes
- Speed reduces site preliminaries including supervision
- Possible upward pressure on logistics / craneage

CATEGORIES 6-7 SITE PROCESS LED APPROACHES



- Low wastage reduces total manufactured material content
- Productivity improvements on-site reduces labour requirements
- Better planning & digital augmentation reduces supervisory needs
- Possible use of autonomous equipment and robotics could increase plant
- Can be used in conjunction with Categories 1-5 pre-manufacturing

What is PMV?



Pre-Manufacturing:

The inclusive term for all processes encompassed by construction materials, component, sub-assembly manufacture, consolidation and pre-assembly prior to final movement and installation at the construction workforce. This, for the avoidance of doubt, can include offsite, near site and on-site temporary factory led processes.

THE PMV FORMULA IS A SIMPLE EQUATION

$$\text{PMV \%} = \frac{\text{Pre-manufactured value (£)}}{\text{Gross Construction Cost (£)}} \times 100$$

The equation is presented with a red 3D cube icon above the numerator and a black circular icon with three interlocking rings below the denominator.

Defining Pre Manufactured Value and the PMV Cycle

$$\frac{\text{Pre-Manufactured Value (PMV) (£)}}{\text{Gross Construction Cost (£)}} \times 100$$

The PMV formula is a simple equation, it translates the **Pre-Manufactured Value** of a project into a percentage of the overall **Gross Construction Cost**.

The more processes carried out within a factory setting prior to delivery to the final workforce, the higher the pre-manufactured material cost becomes.

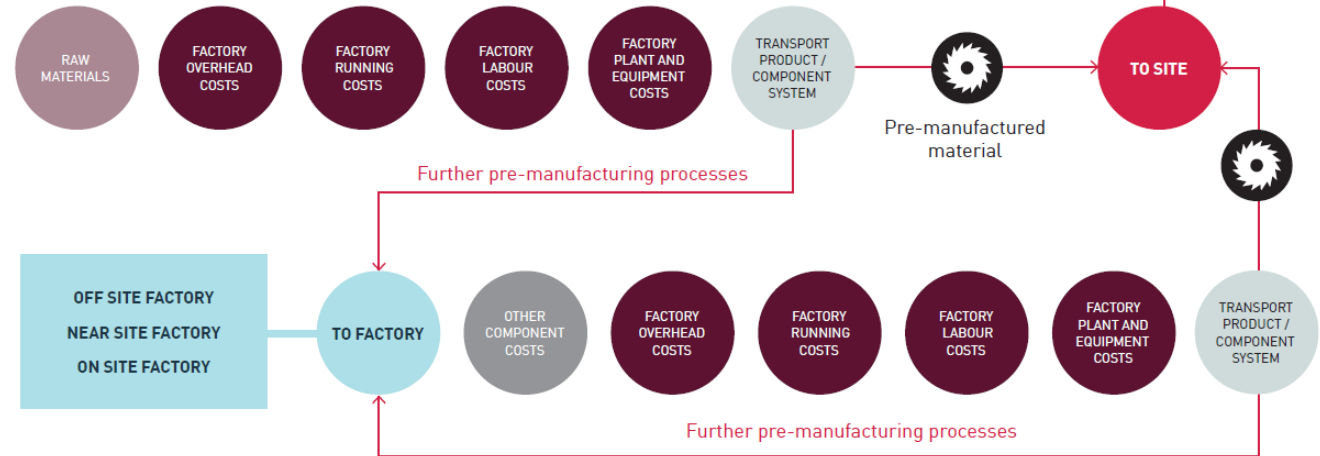
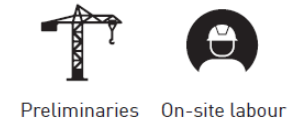
The PMV score is a **proxy metric** for project deliverables. Targeting the optimised score during the design stages will help achieve deliver against project outcome performances.



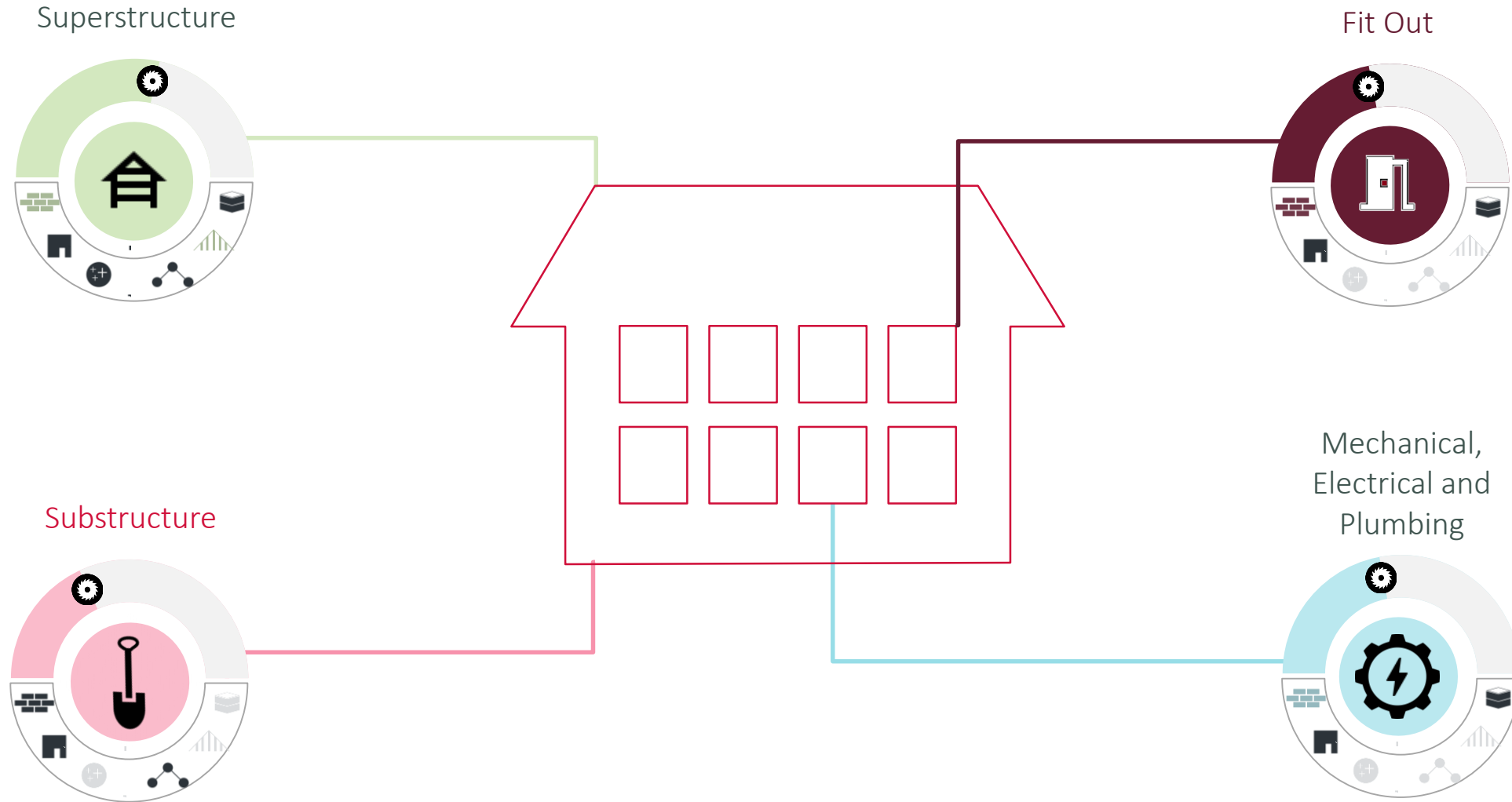
The factory setting can be:

- off-site e.g. in another factory facility;
- near site e.g. a pop up factory; or
- even on-site within a controlled consolidation centre.

Specifying a higher PMV measure will ensure that a higher proportion of project building materials, components and consolidated assemblies or modules are assembled within a controlled environment and encourage the optimisation of labour, plant and management on site.

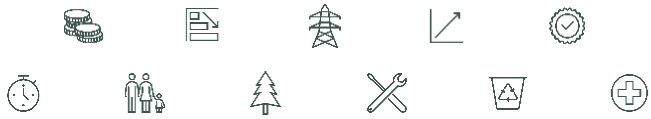


Incremental MMC Deployment Across Building Elements

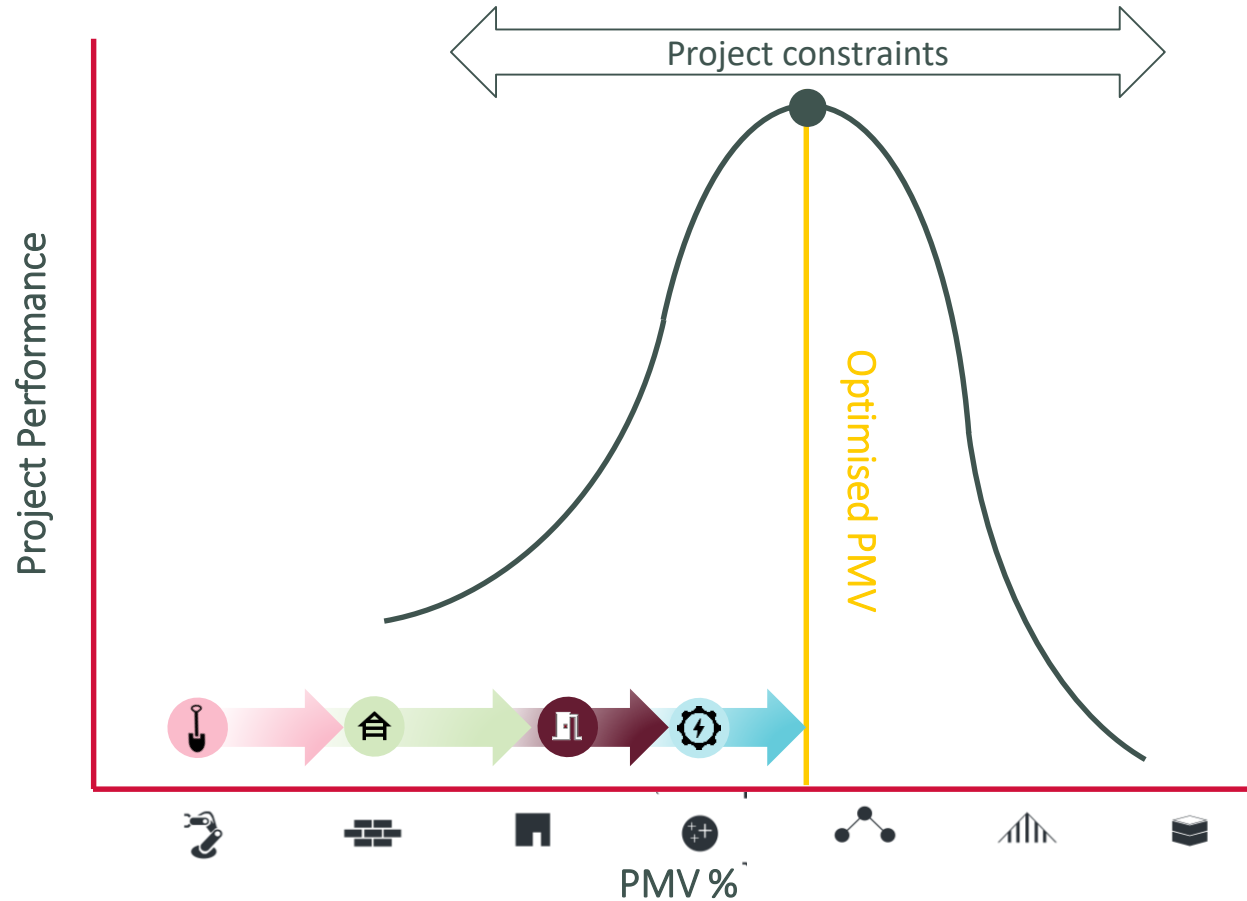


Optimising Not Maximising PMV to drive better outcomes

Project Deliverables



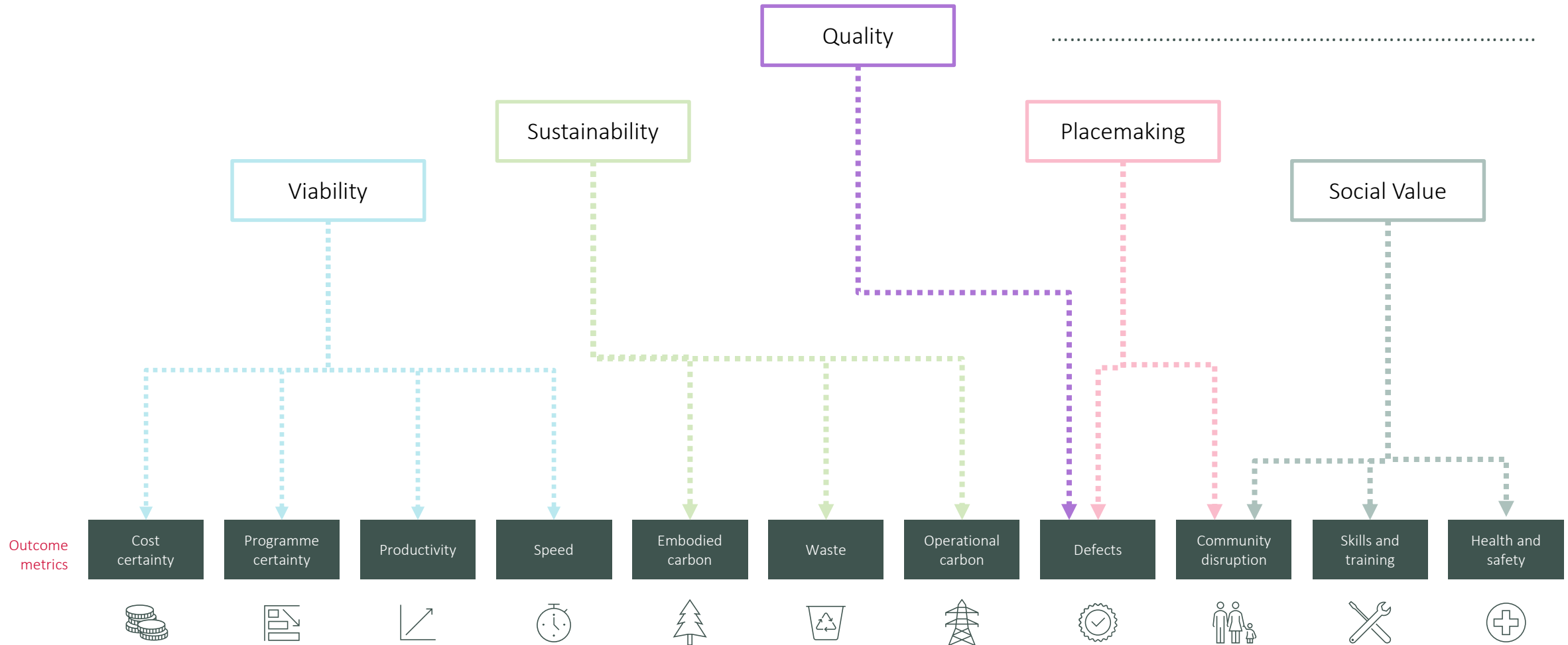
Selecting the appropriate MCC categories against all building in the context of the project ensures an optimised PMV score for the project is achieved



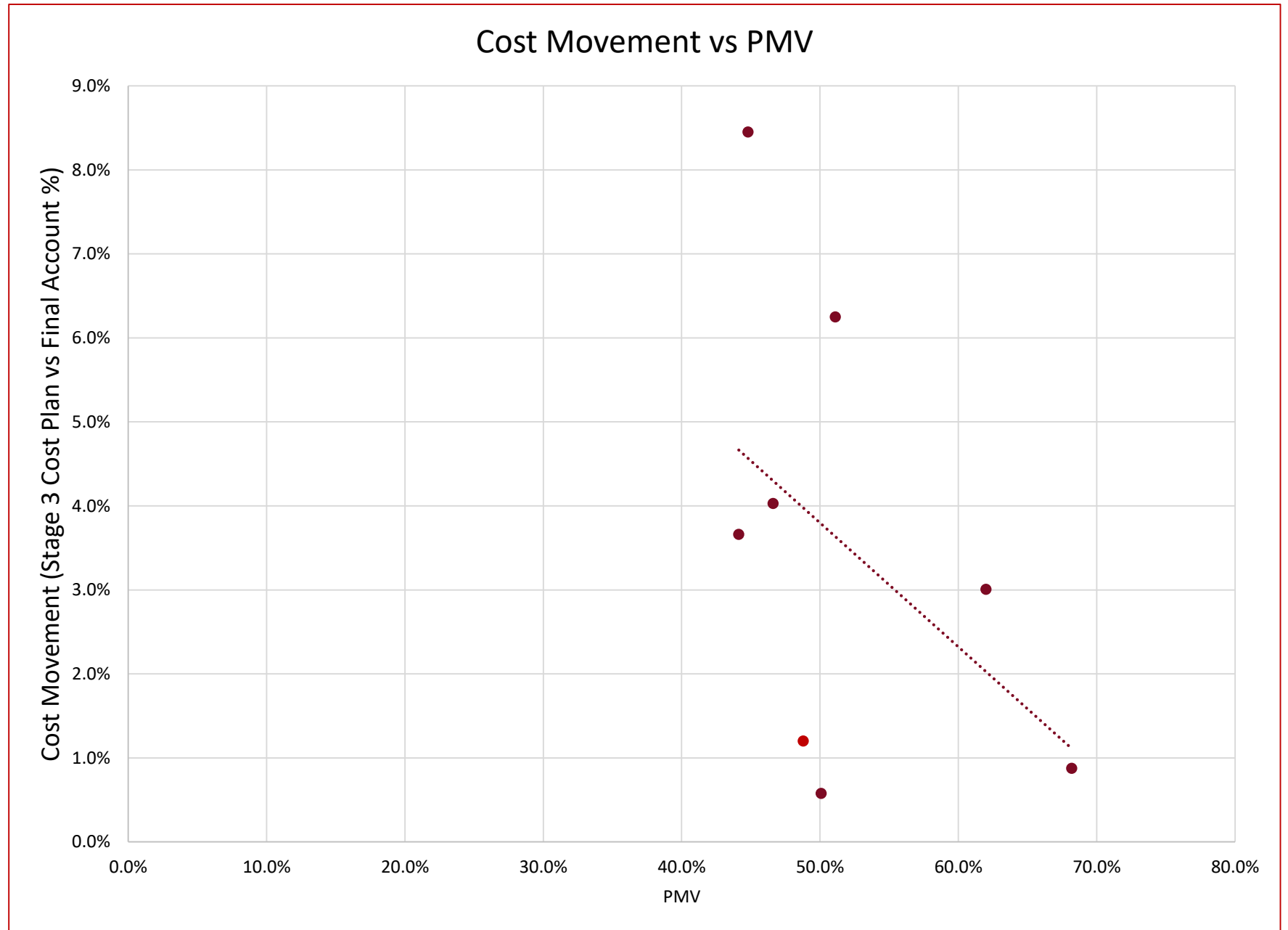
A Data Led Strategy - Linking PMV To Outcomes

Project Deliverables

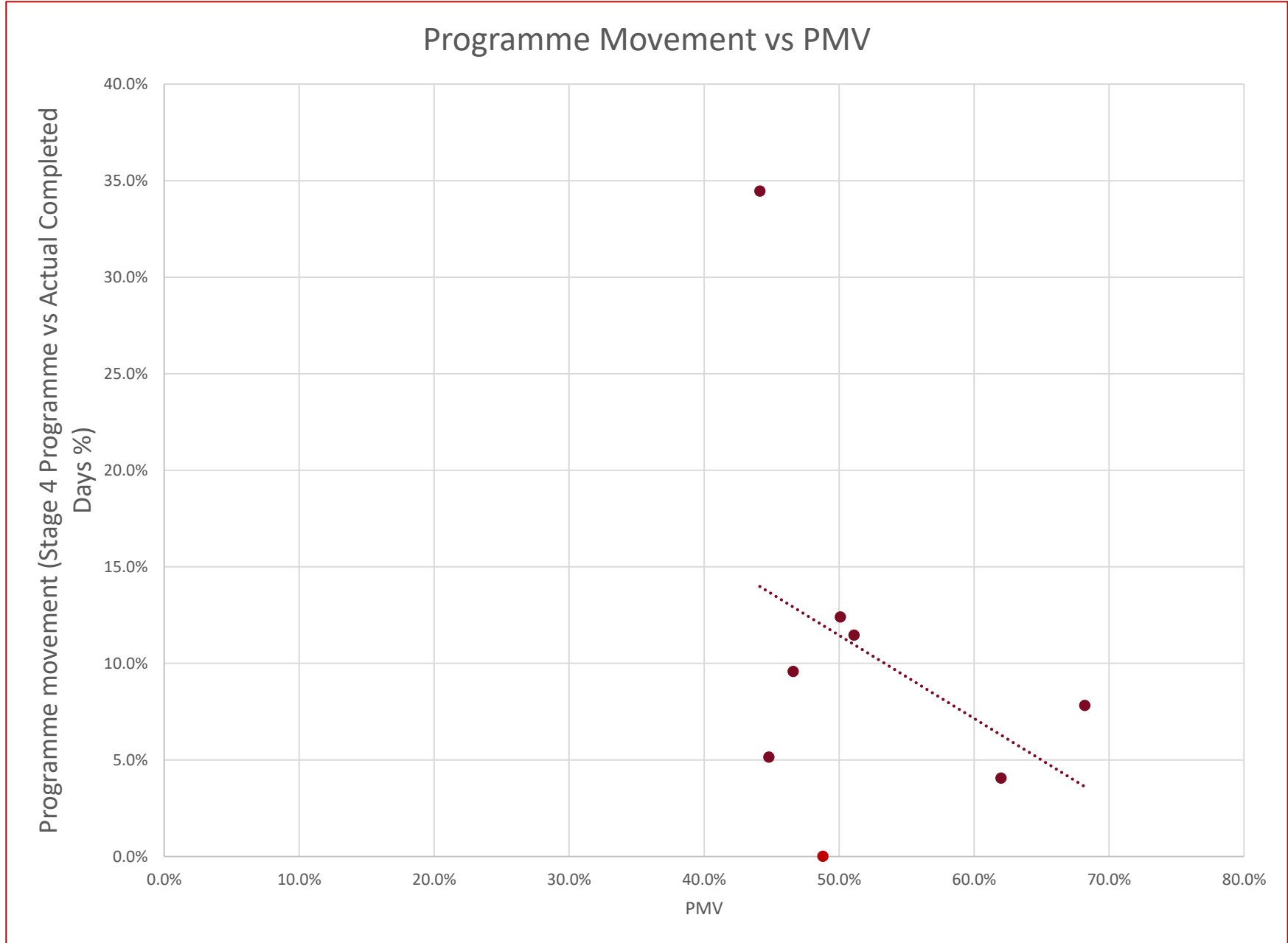
Capturing data against project outcomes can provide greater insight against the success of a development and help identify the opportunities for improvement



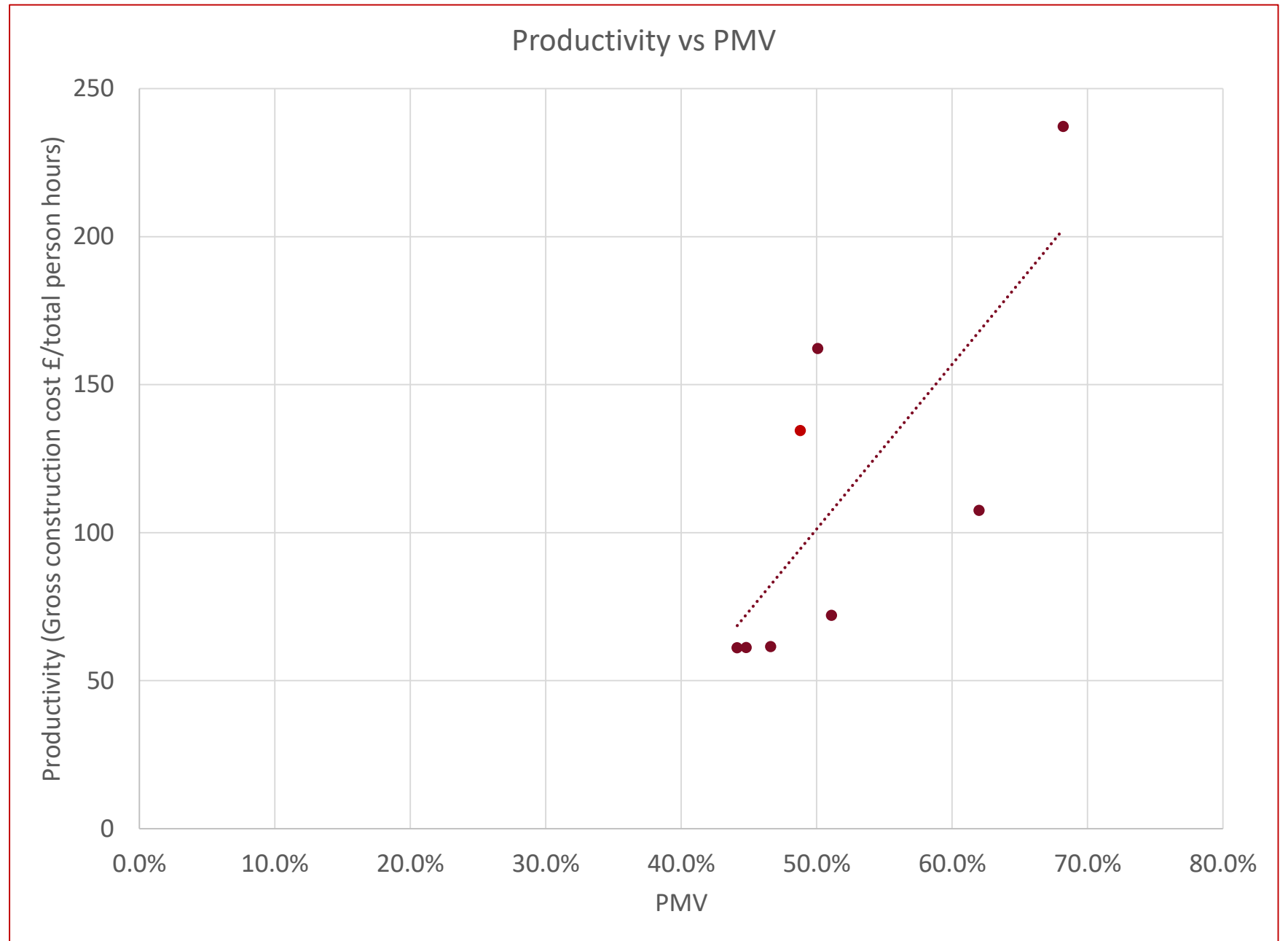
PMV Outcomes



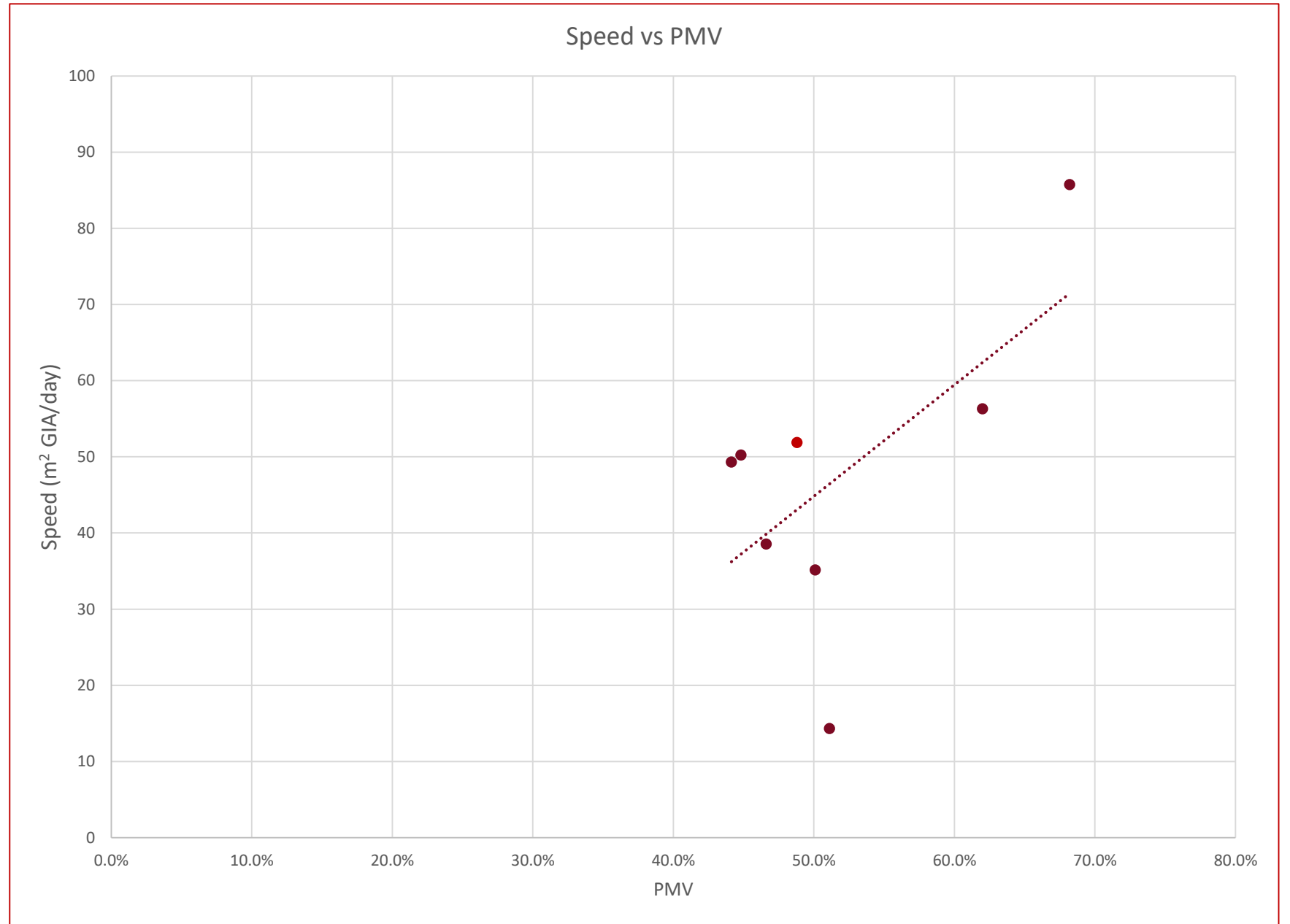
PMV Outcomes



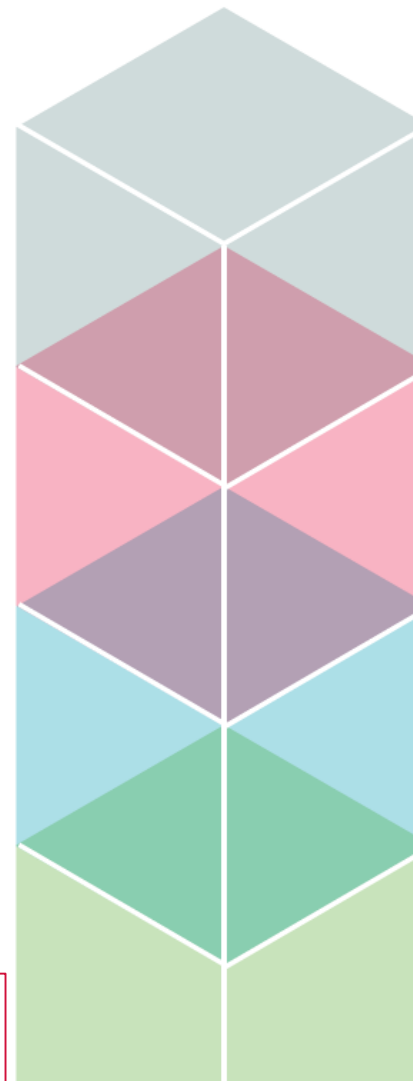
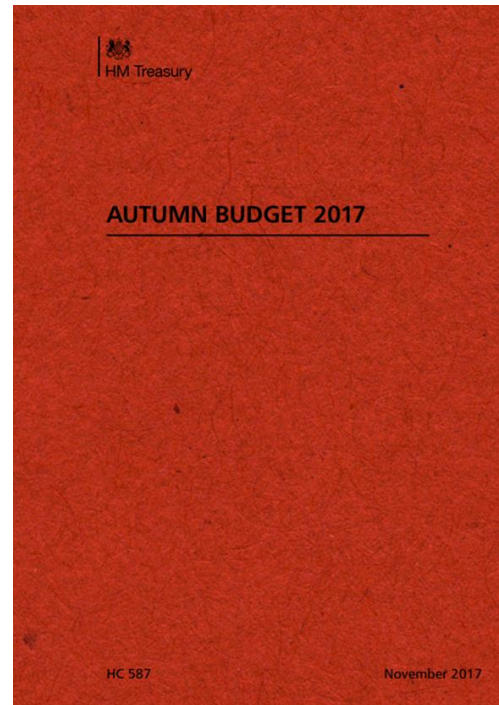
PMV Outcomes



PMV Outcomes



UK Government Infrastructure Project Metrics



Productivity	
Economic Output	Unit – £/hour
Innovation	
Pre-manufactured value (PMV)	Unit – %age
Contract spend with start-ups, SMEs, voluntary, community and social enterprises, mutuals	Unit – Number, £ (value), %age of total
Levelling Up	
Apprenticeship opportunities	Unit – Number
Direct employment	Unit – %age and total no. FTEs
Local employment	Unit – %age
Net Zero Carbon	
GHG emissions on a whole life basis	Unit – tCO ₂ e/unit

4.52 Construction – The government is taking a series of steps to improve the cost effectiveness, productivity and timeliness of infrastructure delivery. The government will use its purchasing power to drive adoption of modern methods of construction, such as offsite manufacturing. Building on progress made to date, the Department for Transport, the Department of Health, the Department for Education, the Ministry of Justice, and the Ministry of Defence will adopt a presumption in favour of offsite construction by 2019 across suitable capital programmes, where it represents best value for money.

MMC, PMV & Homes England funding

<https://www.gov.uk/guidance/capital-funding-guide/8-procurement-and-scheme-issues#mmc>

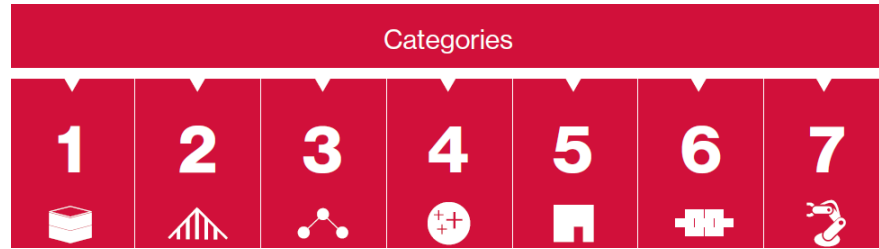
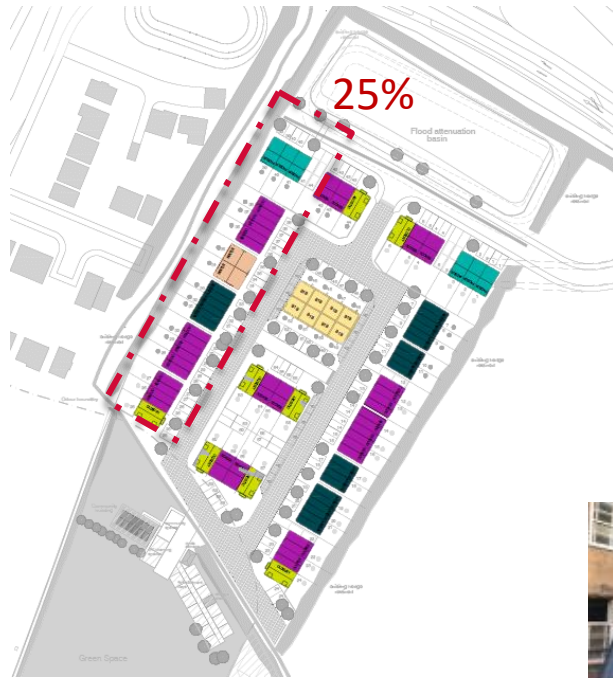
The screenshot shows the GOV.UK website interface. At the top, there are navigation links for 'Coronavirus (COVID-19)' and 'Brexit'. Below this is a breadcrumb trail: 'Home > Funding programmes'. The main heading is 'Capital Funding Guide'. A metadata table shows the document is from 'Homes England', published on '4 November 2016', and updated on '27 November 2020'. A search bar is present below the metadata. The breadcrumb trail continues to '9. Procurement and Scheme Issues'. The section title is '9. Procurement and Scheme Issues', followed by a brief description: 'This chapter sets out procurement and scheme delivery requirements, including the types of schemes eligible for grant funding.'

3.5.1 Where homes are being produced using MMC, all providers are required to assign them to one (or more) of the seven category definitions of MMC listed and summarised below. For funding through the AHP 2021 to 2026, this is regardless of whether funding is accessed through CME or through a Strategic Partnership. This information will be collected through Homes England's Investment Management System.

3.5.5 In the AHP 2021 to 2026, Strategic Partnerships must achieve at least 25% of homes delivered as MMC. The selected 25% of homes should use the above framework to categorise the MMC delivered on a project. Organisations can deliver the requirement using any of the categories in the framework. However, we expect organisations to use categories 1, 2 or with construction processes that achieve a pre-manufactured value (PMV) score of 55% or above.

PMV Worked Example

3.5.5 In the AHP 2021 to 2026, Strategic Partnerships must achieve at least 25% of homes delivered as MMC. The selected 25% of homes should use the above framework to categorise the MMC delivered on a project. Organisations can deliver the requirement using any of the categories in the framework. However, we expect organisations to use categories 1, 2 or with construction processes that achieve a pre-manufactured value (PMV) score of 55% or above.



PMV 55%+



Cat 2a



Cat 2b



Cat 2c



Building Market Awareness & Understanding

mmc.market

A partnership between  **KOPE** &  **Cast**

 **MMC Market**

[Register for free](#)



Explore & connect with the UK's MMC sector

Supported by  **BOPAS**
Buildoffsite Property Assurance Scheme

Thinking In Categories

mmc.market

Find Suppliers by MMC category



Volumetric Systems
Category 1



2D Structural Systems
Category 2



Non Systemised Structure
Category 3



3D Printed Systems
Category 4



Assemblies
Category 5



Product-Based improvements
Category 6




Site-Based Improvements
Category 7



Auto Calculation of PMV

<https://www.cast-consultancy.com/pmv/>

 Cast
Pre-Manufactured Value (PMV) Estimator

Home About PMV PMV Estimator

▼ Select Building Type
Houses

▼ Select Substructure Options

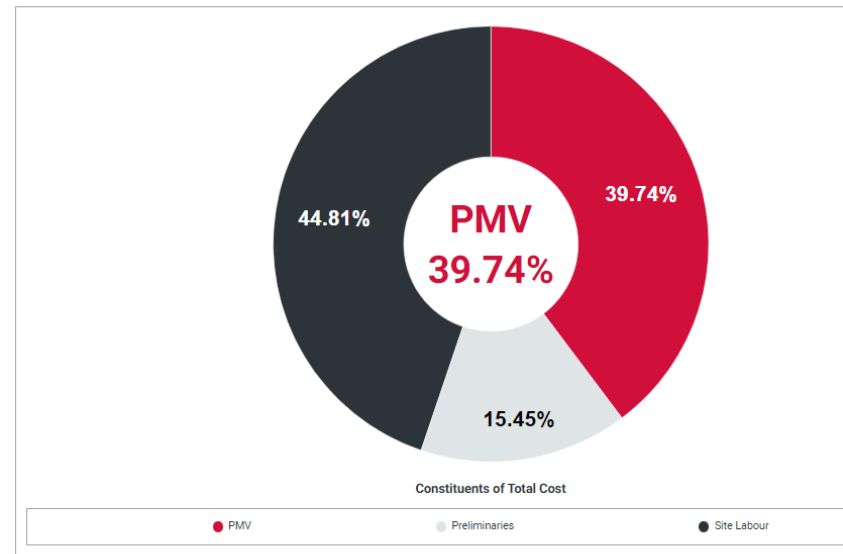
3a. driven / screw piling
 3b. pre-fabricated pile caps / ring beams

▼ Select Structural Options

1a. structural chassis only - not fitted out
 1b. structural chassis and internal fit out
 1c. structural chassis, fit out and external cladding / roofing complete
 1d. structural chassis and internal fit out - 'podded' room assemblies - bathrooms / kitchens etc

▼ Select Non-Structural Options

4b. non structural components



Auto Calculation of PMV



myPMV

PMV estimates calculated using Cast's online PMV tool myPMV.co.uk

Prelims	MMC	Other Cost
10%	£7,000,000	£4,000,000



2 Bed Terrace - Cat 2a

1 units
House
Affordable

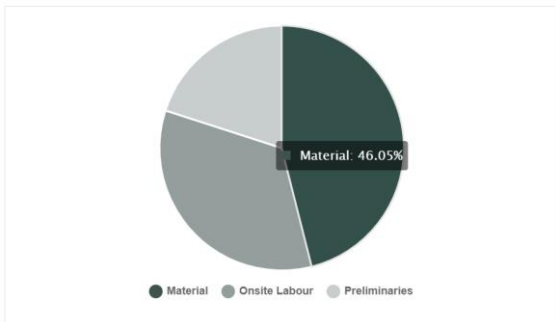
House Gross Internal Area / Net Internal Area
764 ft2

Total Gross Internal Area
764 ft2

Report Generated

Status
Complete

myPMV Score



PMV – 46.00%



Cat 2a	House GIA	House £/m2
£580,000	4945m2	£118

End of Terrace 2 Bed	Other Cost
71.04m2	£108,878

Additional cost £8,300 v
Additional Funding £10,000

	Type	Beds	Persons	Size
House	End of T (EoT)	2 Bed	4	71.04
House	Terrace (T)	2 Bed	4	71.04
House	End of T (EoT)	2 Bed	4	71.04
House	End of T (EoT)	3 Bed	4	85.32
House	Terrace (T)	3 Bed	4	85.32
House	End of T (EoT)	4 Bed	7	119.56
House	End of T (EoT)	2 Bed	3	71.04
House	Terrace (T)	2 Bed	3	71.04
House	End of T (EoT)	2 Bed	3	71.04
House	Semi D	2 Bed	3	71.04
House	Semi D	2 Bed	3	71.04
House	Semi D	3 Bed	4	85.32
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House	Terrace (T)	3 Bed	4	85.32
House	End of T (EoT)	3 Bed	4	85.32
House	End of T (EoT)	2 Bed	3	71.04
House	Terrace (T)	2 Bed	3	71.04
House	End of T (EoT)	2 Bed	3	71.04
House	Semi D	4 Bed	5	97.88
House	Semi D	4 Bed	5	97.88
House	End of T (EoT)	3 Bed	4	85.32
House	Terrace (T)	3 Bed	4	85.32
House	End of T (EoT)	3 Bed	4	85.32
House	End of T (EoT)	2 Bed	4	71.04
House	Terrace (T)	2 Bed	4	71.04
House	End of T (EoT)	2 Bed	4	71.04
House	End of T (EoT)	3 Bed	4	85.32
House	Terrace (T)	3 Bed	4	85.32
House	End of T (EoT)	4 Bed	7	119.56
House	End of T (EoT)	1 Bed	2	60.15
House	Terrace (T)	1 Bed	2	60.15
House	Terrace (T)	1 Bed	2	60.15
House	End of T (EoT)	1 Bed	2	60.15
House	End of T (EoT)	1 Bed	2	60.15
House	Terrace (T)	1 Bed	2	60.15
House	Terrace (T)	1 Bed	2	60.15
House	End of T (EoT)	1 Bed	2	60.15
House	End of T (EoT)	4 Bed	7	119.56
House	Terrace (T)	3 Bed	4	85.32
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THANK YOU FOR LISTENING

