

# MODERN METHODS OF CONSTRUCTION

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INTRODUCING THE MMC DEFINITION FRAMEWORK

# WHAT IS THE MMC DEFINITION FRAMEWORK?

The MMC definition framework is a new seven category definition framework that enables a full and future-proofed range of 'Modern Methods of Construction' 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 is tasked with improving stakeholder education and understanding of MMC with particular reference to enabling better access to mortgage finance, insurance and assurance. Particular thanks go to the Working Group members, Buildoffsite, Homes England, NHBC and RICS who all provided input to this definition framework.

# BUILDING TYPOLOGIES & MATERIAL GENRES

Before the categories can be examined and applied it is important to define the type of building and the material genre. The material genre is only applied to structural categories 1-4a.

## BUILDING TYPOLOGY

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- > Houses
- > Low rise apartments (<5 storeys)
- > Mid rise apartments (6-9 storeys)
- > High rise apartments 10 storeys and above

## MATERIAL GENRE

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- > Mass engineered timber (MET)
- > Timber framed (TF)
- > Light gauge steel framed (LGS)
- > Hot rolled fabricated steel (HRS)
- > Hot rolled / light gauge steel combination (SC)
- > Concrete & cement derived (C)
- > Timber framed / concrete combination (TFC)

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# 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 'workface factories' are included in Category 7).



CATEGORY  
DEFINITION



1  
Pre-manufacturing  
(3D primary structural  
systems)



2  
Pre-manufacturing  
(2D primary structural  
systems)



3  
Pre-manufacturing  
components (non-systemised  
primary structure)



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4  
Additive manufacturing  
(structural and non-structural)



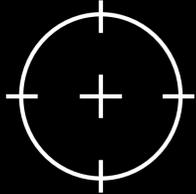
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Pre-manufacturing  
(non structural assemblies  
& sub-assemblies)



6  
Traditional building product  
led site labour reduction /  
productivity improvements



7  
Site process led site labour  
reduction / productivity /  
assurance improvements

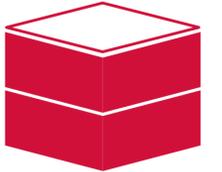


PMV ANALYSIS

# Category 1

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## Pre-manufacturing (3D primary structural systems)

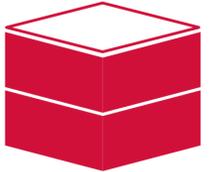


A systemised approach based on volumetric construction involving the production of three-dimensional units in controlled factory conditions prior to final installation. Volumetric units can be brought to final site in a variety of forms ranging from a basic structure only to one with all internal and external finishes and services installed, all ready for installation.

The system includes structural performance. Full volumetric units in apartment buildings can include apartment space and common area space. Mini volumetric structural units can include bathroom pods and the like which are structurally stacked and loaded.

# Category 1

## Pre-manufacturing (3D primary structural systems)



- a. Structural chassis only – not fitted out
- b. Structural chassis and internal fit out
- c. Structural chassis, fit out and external cladding / roofing complete
- d. Structural chassis and internal fit out  
–‘podded’ room assemblies – bathrooms / kitchens etc

Any of the above variants can be used in the following 3 configurations:

- i. Whole building systemised
- ii. Hybrid construction –  
part systemised, part traditional  
(ie traditional core / ground floor podium)
- iii. Hybrid construction –  
secondary structure to enhance system performance  
(ie build at height)



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# Category 2

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## Pre-manufacturing (2D primary structural systems)



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A systemised approach using flat panel units used for basic floor, wall and roof structures of varying materials which are produced in a factory environment and assembled at the final workface to produce a final three-dimensional structure. The most common approach is to use open panels, or frames, which consist of a skeletal structure only, with services, insulation, external cladding and internal finishing being installed on-site.

More complex panels – typically referred to as closed panels – involve more factory-based fabrication and include lining materials and insulation. These may also include services, windows, doors, internal wall finishes and external claddings. The system includes structural performance for primary walls and all floors (note – this excludes unitised or composite external walling systems that are not load bearing included in Category 5).

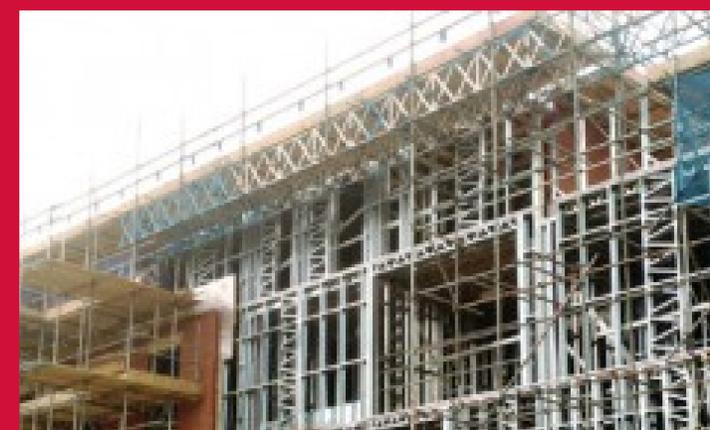
# Category 2

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## Pre-manufacturing (2D primary structural systems)



- a. Basic framing only including walls, floors, stairs & roof
- b. Enhanced consolidation – insulation, internal linings etc
- c. Further enhanced consolidation – insulation, linings, external cladding, roofing, doors, windows



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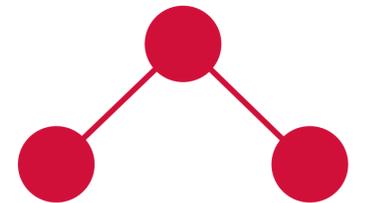
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# Category 3

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Pre-manufacturing components  
(non-systemised primary structure)



Use of pre-manufactured structural members made of framed or mass engineered timber, cold rolled or hot rooled steel or pre-cast concrete. Members to include load bearing beams, columns, walls, core structures and slabs that are not substantially in-situ workface constructed and are not part of a systemised design.

This category, although focused on superstructure elements, would also include sub-structure elements such as pre-fabricated ring beams, pile caps, driven piles and screw piles.

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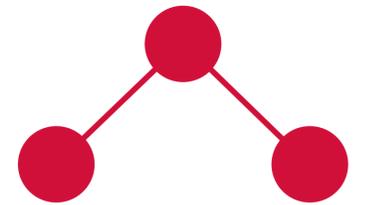
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# Category 3

Pre-manufacturing components  
(non-systemised primary structure)



- a. Driven / screw piling
- b. Pre-fabricated pile caps / ring beams
- c. Columns / shear walls / beams
- d. Floor slabs
- e. Integrated columns, beams and floor slabs
- f. Staircases
- g. Pre-assembled roof structure – trusses / spandrels



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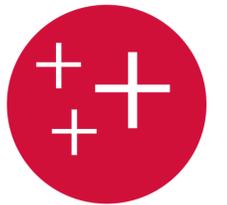
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# Category 4

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Additive manufacturing  
(structural and non-structural)



The remote, site based or final workface based printing of parts of buildings through various materials based on digital design and manufacturing techniques.

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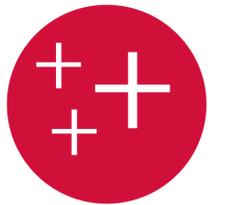
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# Category 4

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Additive manufacturing  
(structural and non-structural)



- a. Substantive structural forms / components
- b. Non structural components



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# Category 5

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## Pre-manufacturing (Non structural assemblies and sub-assemblies)



A series of different pre-manufacturing approaches that includes unitised non-structural walling systems, roofing finish cassettes or assemblies (where not part of a wider structural building system), non-load bearing mini-volumetric units (sometimes referred to as 'pods') used for the highly serviced and more repeatable areas such as kitchens and bathrooms, utility cupboards, risers, plant rooms as well as pre-formed wiring looms, mechanical engineering composites, would fall into this category.

Conventional masonry site constructed schemes utilising conventional building products such as windows and door-sets – which might otherwise be part of the fabrication process in the other pre-manufacturing categories – should not be included as sub-assemblies or components in this category unless there is a further level of consolidation from traditional configurations. Also excludes any structural base elements that composite assemblies are fixed to and which are to be included in Cats 1-4. Any structure in this category is purely to support the sub-assembly in transit / install phase.

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# Category 5

## Pre-manufacturing (Non structural assemblies and sub-assemblies)

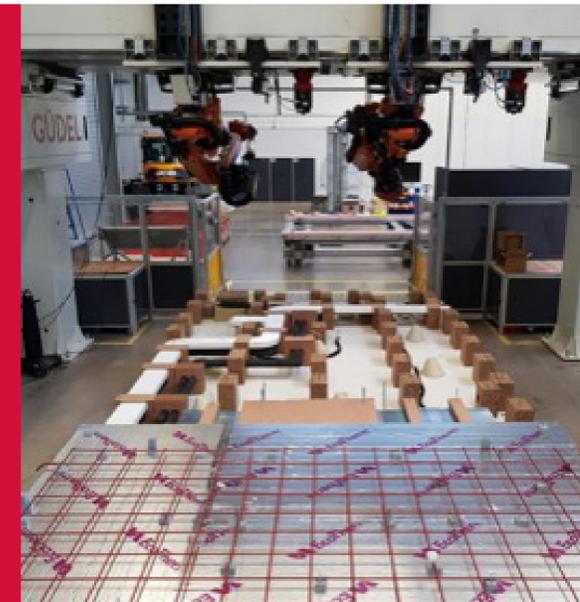
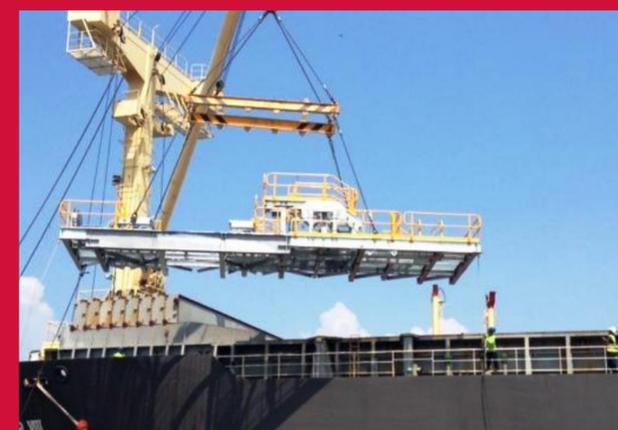


### Volumetric podded assemblies

- a. Whole bathroom assemblies (including enclosing structure)
- b. Kitchen assemblies  
(including enclosing / supporting structure)
- c. Bathroom / kitchen combined assemblies  
(including enclosing / supporting structure)
- d. In unit M&E central equipment assemblies  
(utility cupboards etc)

### Panelised / linear assemblies

- e. Façade assemblies (non structural) including glazing,  
solid cladding, metalwork
- f. Roof assemblies / cassettes – pre-finished roof sections  
(including structure to support own weight)
- g. In unit M&E distribution assemblies
- h. Infrastructure M&E assemblies – vertical risers / main distribution
- i. Infrastructure M&E assemblies – central plant & equipment
- j. Floor cassettes with horizontal services / finishes added
- k. Partition cassettes – with horizontal & vertical services / finishes added
- l. Doorsets (pre-hung, finished with ironmongery)



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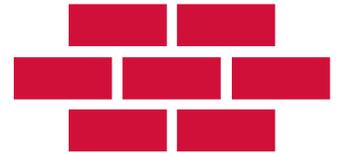
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# Category 6

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Traditional building product led site labour reduction / productivity improvements



Includes traditional single building products manufactured in large format, pre-cut configurations or with easy jointing features to reduce extent of site labour required to install.

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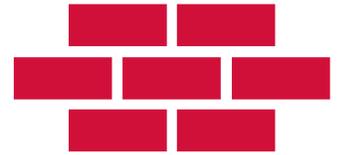
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# Category 6

Traditional building product led site labour reduction / productivity improvements



- a. Large format walling products – external walls
- b. Large format walling products – internal walls
- c. Large format roofing finishes
- d. Pre-sized and cut to measure traditional materials – component level systemisation
- e. Easy site install / jointing / interfacing features – brick slips, modular wiring, flexible pipework



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# Category 7

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Site process led site labour reduction / productivity / assurance improvements



This category is intended to encompass approaches utilising innovative site based construction techniques that harness site process improvements falling outside the five main pre-manufacturing categories 1-5 or materials innovation in Category 6. This category would also include factory standard workface encapsulation measures, lean construction techniques, physical and digital worker augmentation, workface robotics, exoskeletons and other wearables, drones, verification tools and adoption of new technology led plant and machinery.

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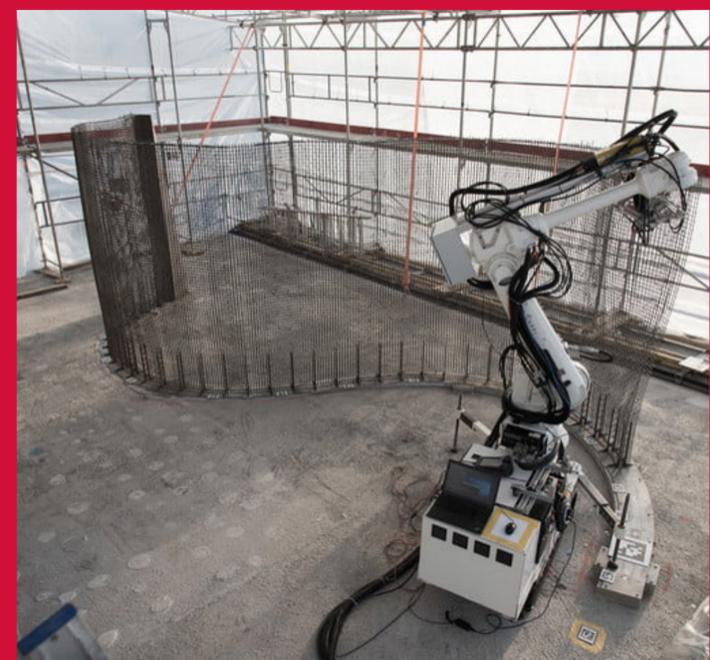
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# Category 7

Site process led site labour reduction / productivity / assurance improvements



- a. Site encapsulation measures – weatherproof and environmentally controlled enclosures
- b. Use of standardised or sacrificial temporary works – modular scaffold, tunnel form in-situ concrete, insulated concrete formwork
- c. Use of BIM connected lean delivery framework – digitally enabled workflow planning
- d. Site worker augmentation – visual (ie AR/VR )
- e. Site worker augmentation – physical (ie exoskeletons, assisted materials distribution etc)
- f. Site worker productivity planning tools (GPS, wearables etc)
- g. Site process robotics and drones (rebar, masonry, plastering, decorating, surveying etc)
- h. Autonomous plant and equipment and drones (driverless cranes, diggers etc)
- i. Digital site verification tools (photogrammetry, site worker video, LIDAR scanning etc)



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# MMC Spectrum

A range of approaches which spans off-site, near site and on-site pre-manufacturing, process improvements and technology applications

## Categories



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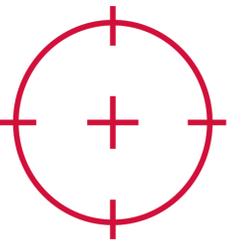
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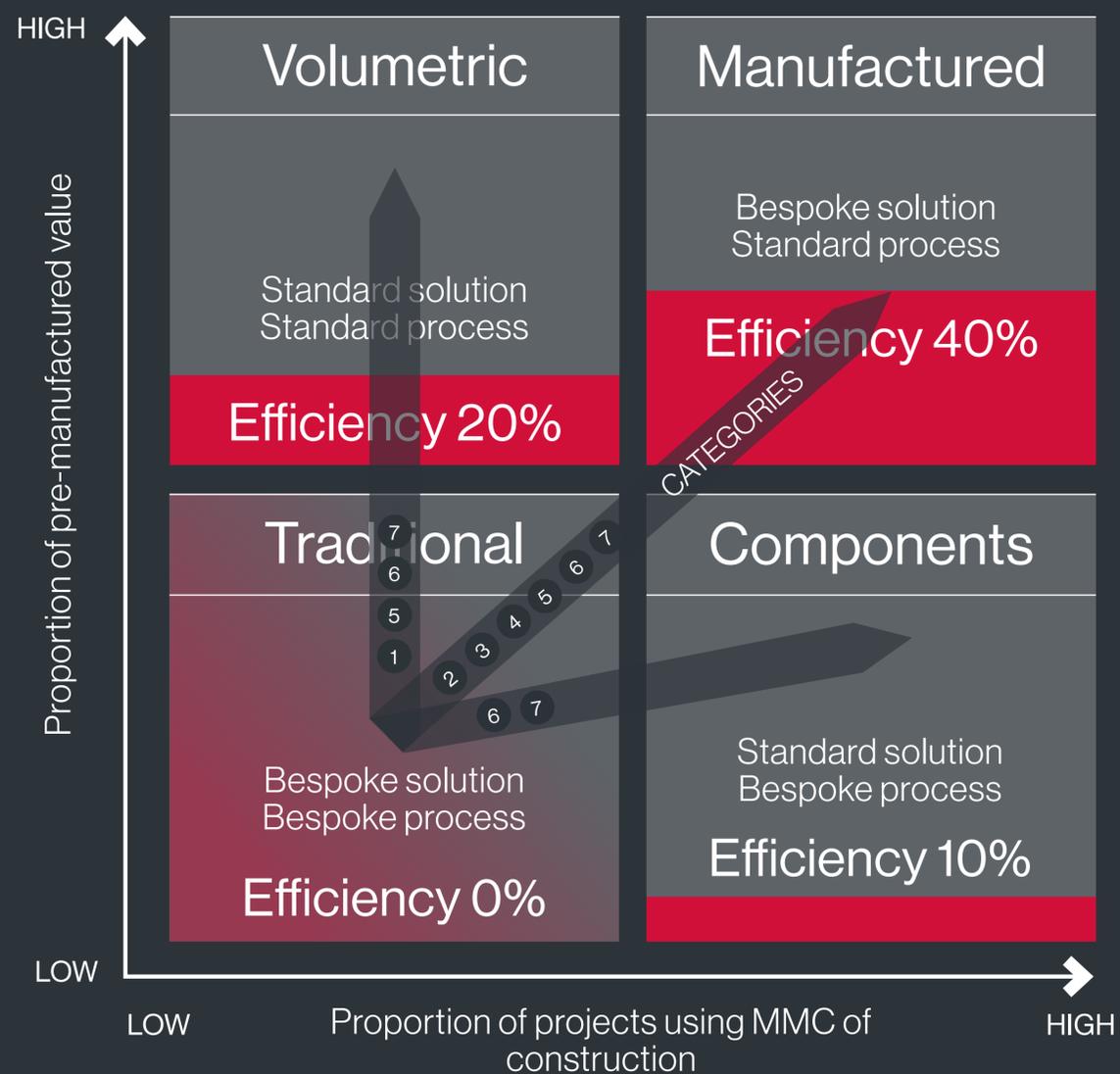
PMV  
ANALYSIS

# Pre-manufactured value (PMV)

## Analysis of projects using MMC and their proportion of pre-manufactured value (PMV)



There are multiple routes to increasing the PMV of a project. The PMV is measuring the proportion of a project made up of on-site labour, supervision, plant and temporary works. Increasing manufacturing and/or reducing site labour can both be applied to improve PMV.



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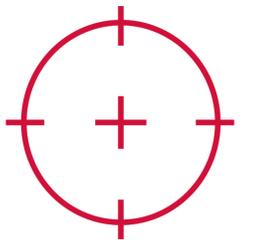
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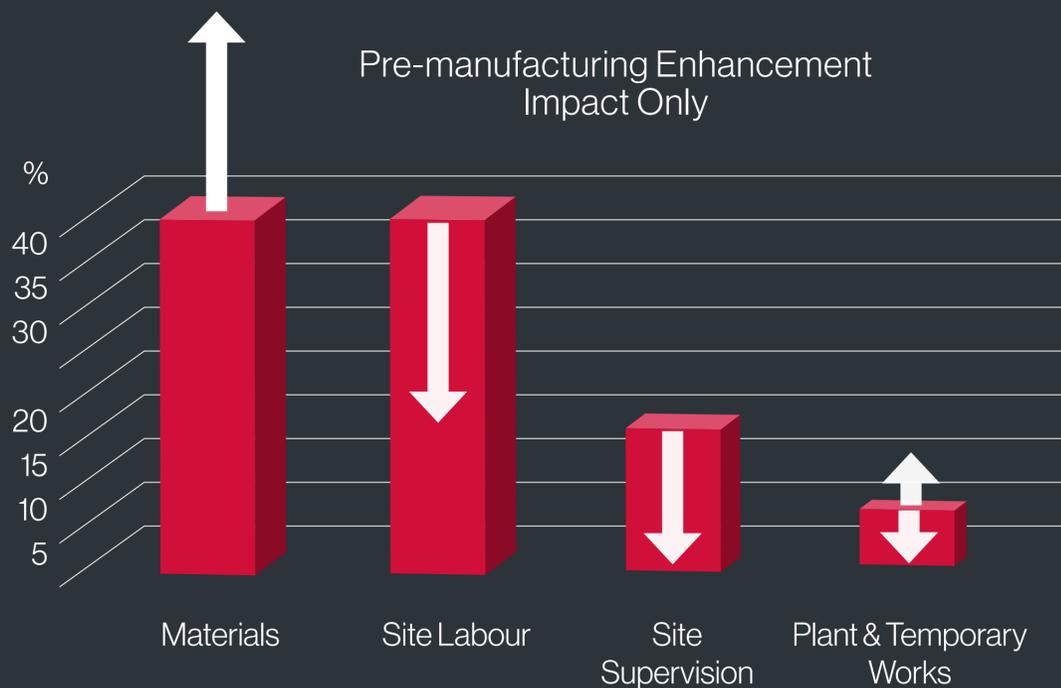
# Pre-manufactured value (PMV)

Analysis of projects using MMC and their proportion of pre-manufactured value (PMV)



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## 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