Cast

PMV Technical Manual

PRE-MANUFACTURED VALUE – CAST TECHNICAL MANUAL

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1. Introduction

Pre-Manufactured Value, known as **PMV**, was first set out in *The Farmer Review*[1] in 2016 as a metric to measure the proportion of manufactured components within an overall construction project cost. The metric, expressed as a percentage, is intended to identify how far projects are implementing innovative construction techniques that result in reduced site labour and preliminaries intensity.

This can be achieved through a combination of off-site, near site and on-site manufacturing techniques as well as through materials innovation and site based process improvement and technology use. The reason for measuring PMV is to act as a simple proxy for multiple other outcomes that are often more difficult to visualise or measure.

PMV has subsequently been recognised in the *UK Construction Sector Deal's*[2] *2018 Implementation Plan*, as one of the primary measures for improvement across the construction industry.

This PMV metric is applicable across all construction types. However, in this document PMV solely relates to the residential sector, for house typologies and low, medium and high rise apartments.

The metric was established as a hard, measurable and often physically visible parameter to be used by the industry to chart progress in a journey towards modernisation. A higher PMV signifies a different process has been adopted compared to traditional construction rebalancing the relative proportions of labour, plant and manufactured materials.

Construction projects that increase their PMV should be demonstrating improvements in the following:

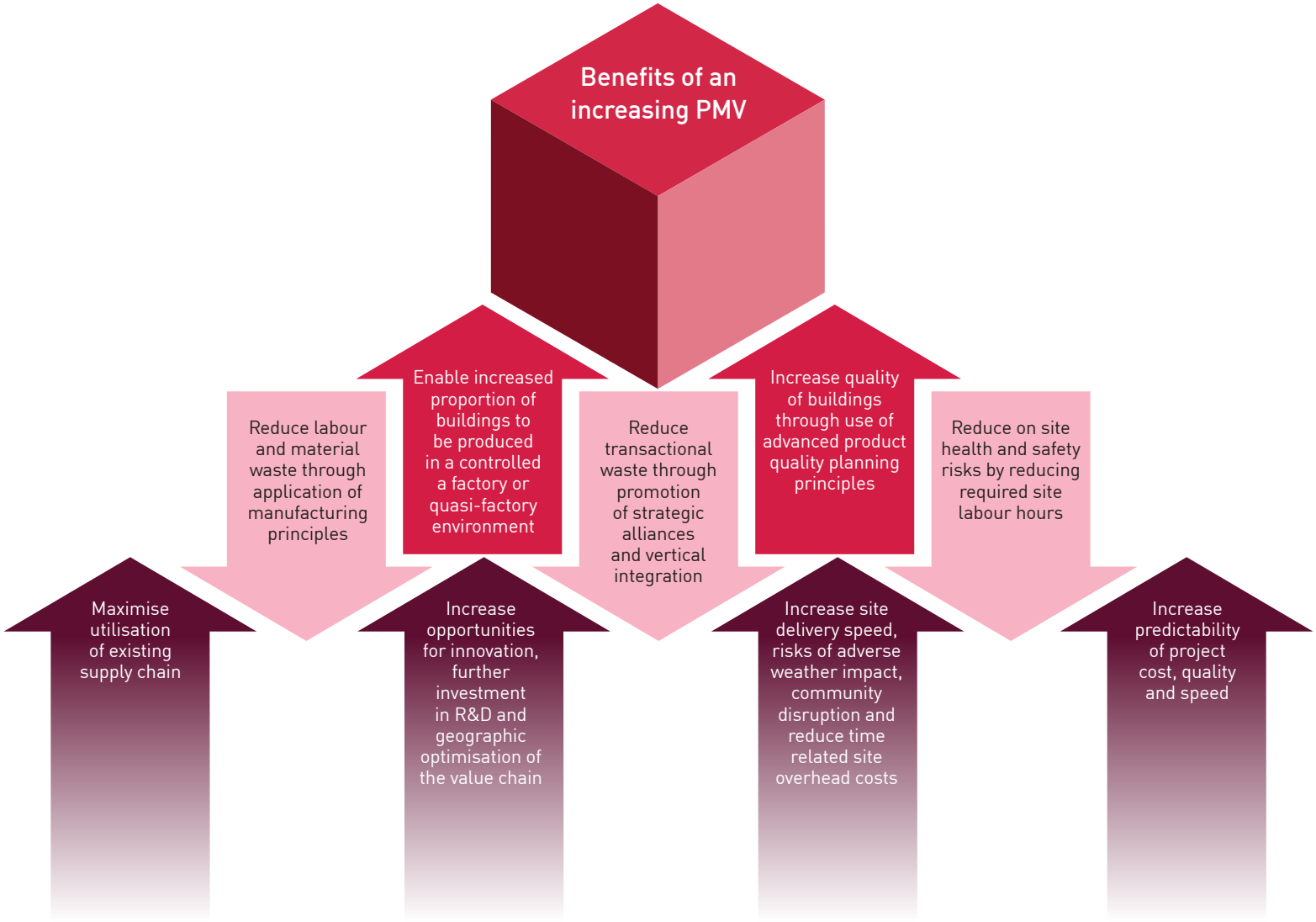
- **Predictability of outcome**
- **Productivity improvement and waste reduction** (labour, plant and materials) and related embodied carbon
- **Quality & performance** (including operational carbon)
- **On site delivery speed and site overheads**
- **Transactional costs**
- **Community disruption**
- **Site health and safety risk**

1.1 Purpose of PMV

The use of the *Pre-Manufactured Value (PMV)* proxy measure enables construction project teams to adapt design, supply chain, logistics and site based construction and assembly choices to deliver improvements against all of the criteria above.

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 factory environment either off, near or on site, and encourage the optimisation of labour, plant and management on site. The use of this approach is also not prescriptive of the manner in which PMV is increased, it is effectively left to project teams to identify the optimum solution across the full range of MMC approaches.

Clients and project managers, can use the PMV metric as part of early stage client brief parameters to set the challenge for the design and construction team to respond to as they see fit.



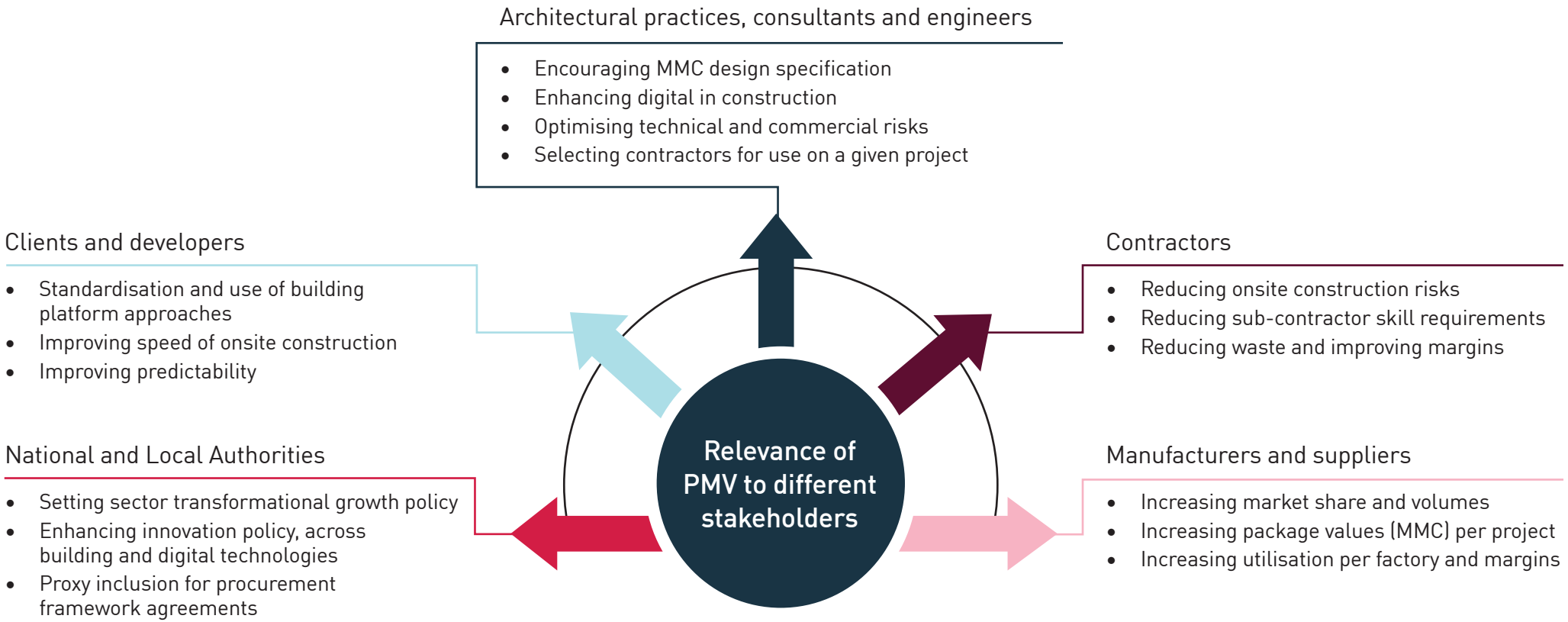
1.1 Purpose of PMV (continued)

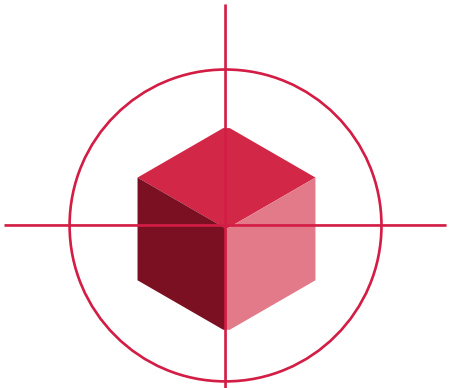
Policy makers, both at national and regional level can use the PMV metric to create positive change for the construction industry and society in line with broader policy objectives.

The construction supply chain can also use PMV as part of business strategy planning and target setting to chart progress in how suppliers, specialists and main contractors are all innovating in product or process development to achieve the outcomes set out in 1.0 above.

There is increased industry focus on moving to outcome and value based procurement as advocated in the *2020 Construction Playbook* and ongoing public sector procurement reforms.

However, it is necessary to understand the inputs that will create these improved value outputs and PMV is a strong indicator of how you will achieve better outcomes across social, economic and environmental parameters.





TARGETING PMV THROUGH THE CONSTRUCTION PROJECT

Policy makers

Strategic policy makers use PMV with stakeholders in written policy papers and documents, formulating strategies using the different levels of PMV % to drive wider outcomes.

Lead Designer/ Architects

Architects interrogate specifications and consider alternative techniques in order to achieve the projects target PMV. A focus on PMV through design stages promotes Design for Manufacture & Assembly (DfMA) thinking including standardised design and inclusion of modern methods of construction (MMC) from the earliest design stages. An architect can use the PMV Estimator to determine a design/ product strategy.

Quantity Surveyors

A Quantity Surveyor combines the target PMV score with the development budget and scope to advise on design and construction techniques, report on construction costs and advise on alternative procurement opportunities. PMV encourages early engagement with suppliers to ensure the PMV score is achieved which in turn will provide an opportunity for greater certainty on out turn cost.

Structural Engineers

Adopting the PMV metric provides Structural Engineers with direction on alternative MMC options on both substructure and superstructure. The standardisation of design has the opportunity to rationalise structural design with improved tolerances and increased certainty.

Procurement Leads

Procurement leads, in particular within housebuilding, use PMV % to create bundled procurement requirements to enable the aggregated procurement volume to be enhanced, enabling increased volume of specified materials.

Programmers

Programmers and schedulers can use the target PMV % score to help benchmark the construction programme. They would further look to ratify the target programme set by the target PMV and identify opportunities where PMV can be improved on future work. They can also evaluate logistics and preliminaries strategies that define the site set-up and organisation that is optimised for the target PMV.

Acquisitions/ Development Managers

Incorporating a higher PMV metric will improve development appraisal certainty and delivery speed and cashflow, assisting the viability process and providing the acquisition manager with an improved construction programme and greater certainty of construction cost. Development managers will inherit the target PMV as a measure for designers and contractors to build to.

Project Managers

Project managers use the target PMV initial project briefs to design & construction teams to deliver assumptions in development appraisals and client expectations on wider outcomes. They then track actual delivery against the metric through the design stages to ensure targets are being met and encourage where falling short.

MEP Consultants

MEP consultants use the projects target PMV score from an early design stage to advise on systems/construction techniques which could help to achieve the target including the opportunities to pre-manufacture complex assemblies or installations.

Contractor Project Leads

Main contractor project leads use the PMV metric to help set the resource requirements for the development with those projects achieving higher PMV capable of delivering over a quicker period with less onsite supervision and other time related overheads.

Buyers

Main contractor buyers use the target PMV% to request subcontractors and material manufacturers to optimise supply chains and reduce transactional layers and waste.

Logistics Managers

Logistic managers in conjunction with programmers use PMV scores to help set the logistic strategy taking into consideration delivery and installation of pre-manufactured content but also to identify opportunities to improve the PMV on future project through efficiencies and improved delivery including management supervision, temporary works and site organisational strategies.

Site Managers

The contractor's site managers in conjunction with their commercial team will monitor and report the true on-site labour costs and preliminaries costs to confirm the projects out turn PMV against the target PMV.

Component and system suppliers

Use PMV to model and bring together products efficiently. They promote systems and products which provide high PMV scores.

2. What is Pre-Manufactured Value (PMV)?

2.1 Glossary of terms and definition of 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 workface. This, for the avoidance of doubt, can include offsite, near site and on-site temporary factory led processes.

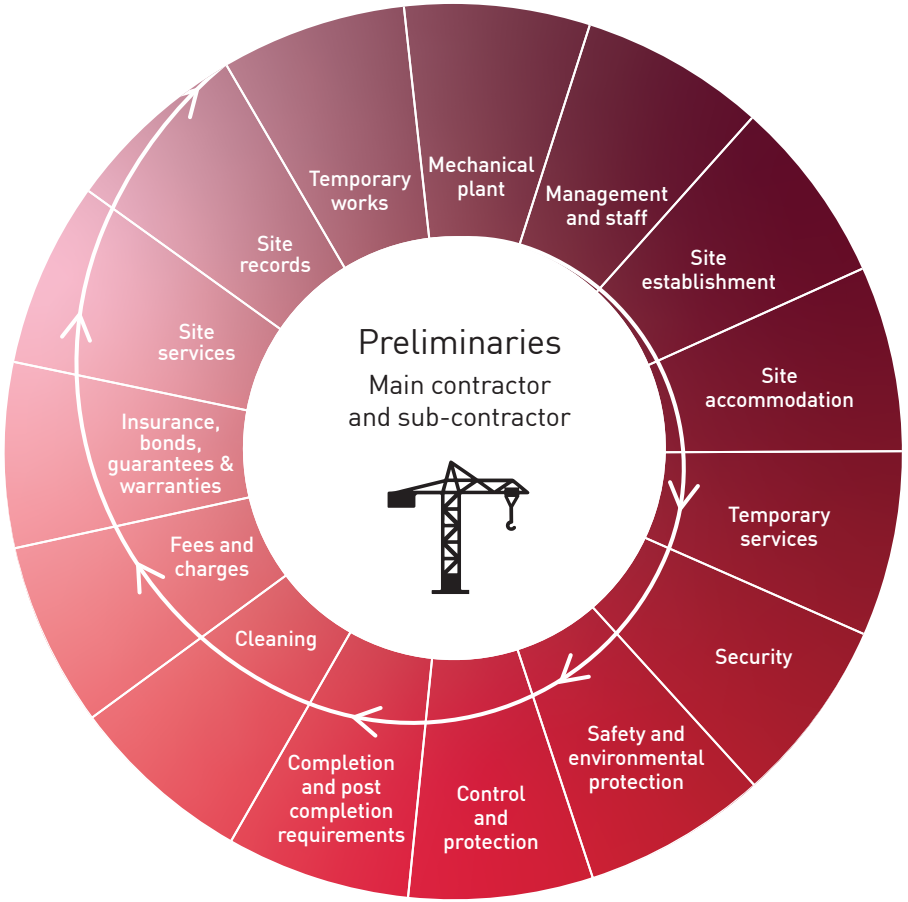
Pre-Manufactured Value (PMV %):
Pre-Manufactured Value (PMV %) is the financial proportion of a construction project's Gross Construction Cost derived through pre-manufacturing. Pre-manufacturing includes all costs incurred prior to the final installation at the construction workface, including all materials, the total labour applied in pre-manufacturing processes, fixed and variable manufacturing overheads and associated plant, logistics and transportation costs. Gross Construction Costs include all pre-manufactured costs, on site labour costs, all preliminaries costs, overhead, profit and risk.

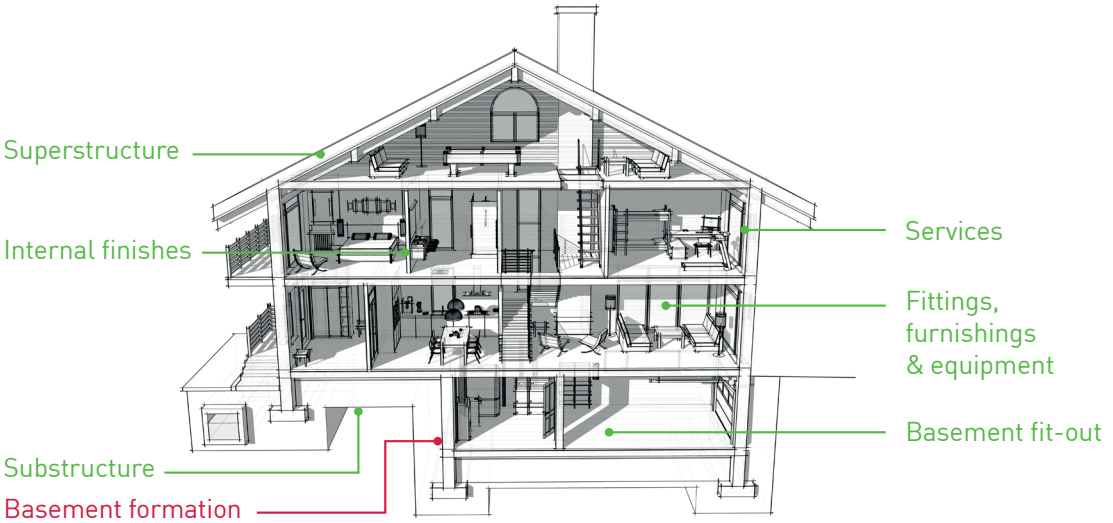
Gross Construction Cost:
The following are included in the calculation of a new build project's Gross Cost for the purposes of PMV calculation:

Pre-Manufactured Value: Gross Construction Cost[3]	
Inclusions ✓	Exclusions ✕
Substructure, NRM element 1 (excluding basements)	Basement construction works including fit out works to basements
Superstructure, NRM element 2	Facilitating works, NRM element 0
Internal finishes, NRM element 3	Work to Existing Buildings, NRM Level 7
Fittings, furnishings & equipment, NRM element 4	External works, NRM element 8
Services, NRM level 5	Project design / team fees, NRM level 11
Prefabricated buildings and building Units, NRM Level 6	Other development / project costs, NRM level 12
Preliminaries, NRM Level 9 (including main contractor and sub-contractor preliminaries)	Inflation allowances, NRM level 14 (if calculating current PMV)
Main contractor's overheads & profit, NRM Level 10	VAT, NRM Level 15
Risk, NRM Level 13	
Inflation allowances, NRM 14 (if calculating predicted outturn PMV)	

2.1 Glossary of terms and definition of PMV (continued)

Gross Construction Cost (continued):
The full preliminary costs of the project covering both main contractor and sub-contractor preliminaries is required. This would include all preliminary costs as detailed in NRM Level 9 and illustrated below.





- Other development / project cost
- VAT
- Project design / team fees
- Facilitating works
- External works
- Basement
- Overheads & profit (OH&P)
- Risk
- Prefabricated buildings and building units
- Preliminaries

Inclusion ✓ Exclusion ✗

2.2 PMV Formula

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 as illustrated opposite.

THE PMV FORMULA IS A SIMPLE EQUATION

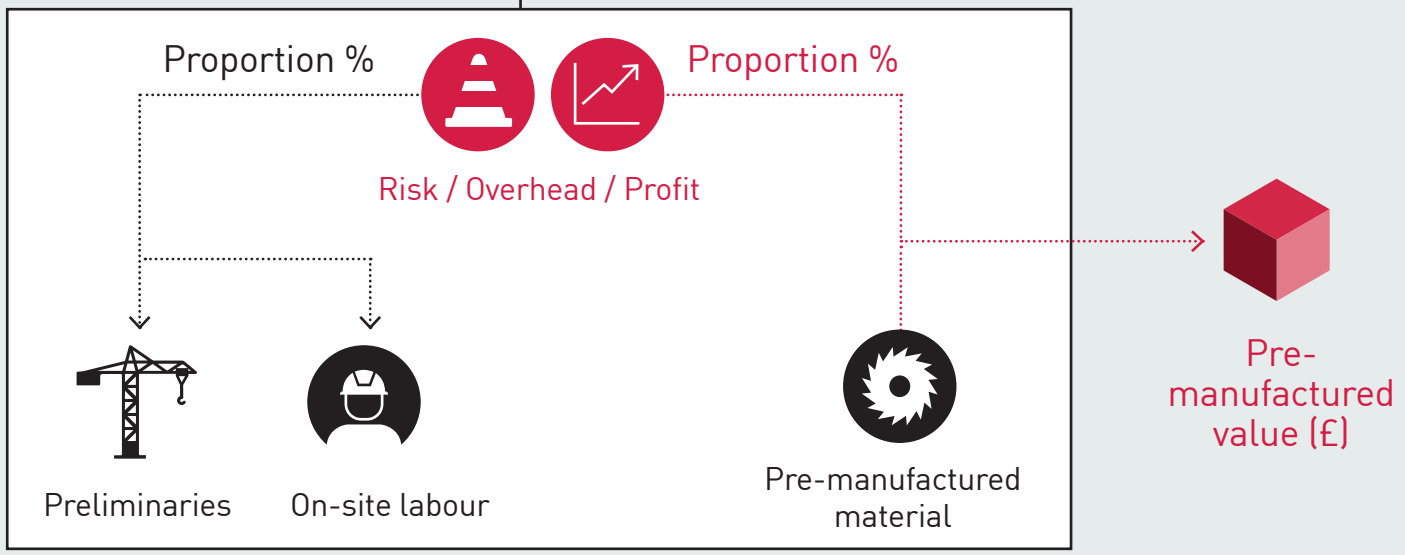
$$\text{PMV \%} = \frac{\text{Pre-manufactured value (£)}}{\text{Gross Construction Cost (£)}} \times 100$$

How do I calculate the PMV%?

To calculate the Pre-Manufactured Value it is important to first look at the component parts of the Gross Construction Cost. The following diagram illustrates the costs which are either included or excluded from Pre-Manufactured Value.

As shown the risk allowances and overhead and profit costs are combined and then shared against pre-manufactured material costs and other costs on a pro-rata basis. The project's preliminary costs (as defined in Section 2.1.1) and onsite-labour cost are excluded from pre-manufactured value. The remaining costs equate to the total pre-manufactured material of the project and once applied with the respective risk, overhead and profit allowances, becomes the Pre-Manufactured Value of the project.

THE COMPONENT PARTS OF THE GROSS CONSTRUCTION COST



2.2 PMV Formula (continued)

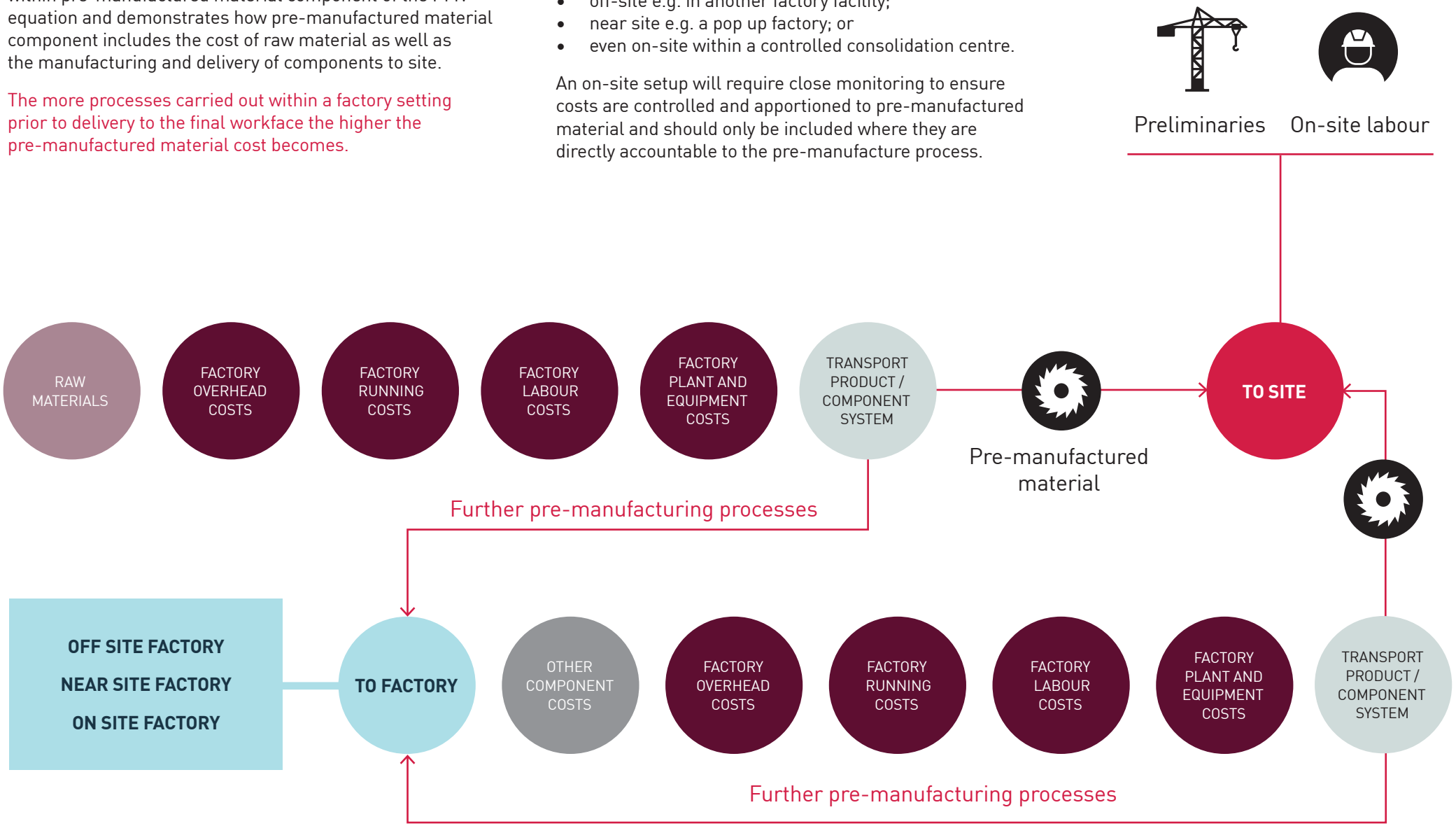
The following flow diagram demarcates the costs included within pre-manufactured material component of the PMV equation and demonstrates how pre-manufactured material component includes the cost of raw material as well as the manufacturing and delivery of components to site.

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

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.

An on-site setup will require close monitoring to ensure costs are controlled and apportioned to pre-manufactured material and should only be included where they are directly accountable to the pre-manufacture process.



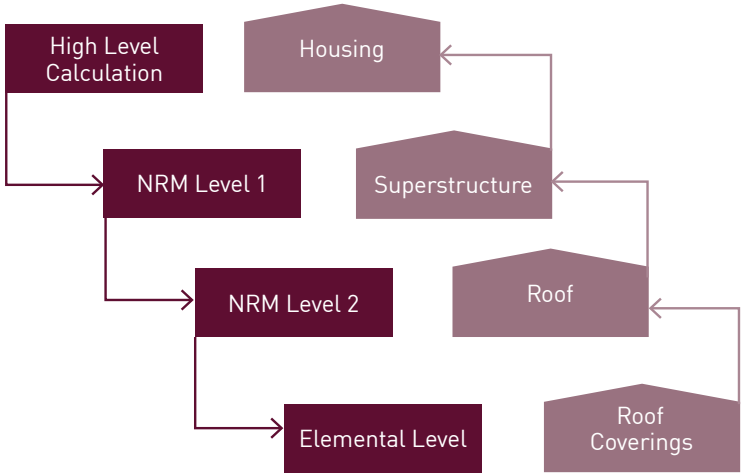
3. PMV Estimation Process and MMC Impacts

3.1 PMV Process

The PMV process requires continual assessment and updating during the design, procurement and construction stages. Consequently, the PMV assessment should become more accurate as the designs develop and construction techniques firmed up.

The diagram illustrates how PMV develops from a high level PMV calculation at an early design stage, through cost plan elements at NRM level 1 and level 2 before focusing on an elemental level.

The first High Level PMV estimate is carried out at an early design stage incorporating the above assumptions and high level estimation on sub-contractor OH&P, preliminaries and on site labour costs. An example of which is shown opposite.



The following worked examples demonstrates the initial step using a housing development as a basis:

ITEM	ASSUMPTION
Construction Type	Housing
Net Construction Cost	£2,500,000
Gross Construction Cost	£3,000,000
Risk	2%
Main contractor overhead and profit	4%
Main contractor preliminaries	13%
Modern methods of construction	None
Sub-contractor overhead and profit	15%
Sub-contractor preliminaries	10%

HOUSING					NET CONSTRUCTION COST		£2,500,000	
GROSS CONSTRUCTION COST (GCC)	RISK CONTINGENCY	MAIN CONTRACTOR (MC) OH&P	MC PRELIMINARY	SUB-CONTRACTOR (SC) (OH&P	SC PRELIMINARY	TOTAL ON SITE LABOUR COST	PRE-MANUFACTURED MATERIAL	PRE-MANUFACTURED VALUE
		MC	MC	SC	SC			
PMV %			13.01%		7.91%	39.35%		39.74%
£2,996,760	£58,760							
	£2,938,000	£113,000						
		£2,825,000	£325,000					
			£2,500,000	£326,087				
				£2,173,913	£197,628			
					£1,976,285	£983,202		
						£993,083	£993,083	£197,847
								£1,190,930
	RISK/OH&P (£)	£497,847						
	OTHER COSTS	£2,498,913						
		19.92%						
		RISK/OH&P (%)						

3.1 PMV Process (continued)

When a more detailed cost estimate is developed, PMV scores are then calculated against each element and accumulated to generate an overall PMV score. An example of an NRM level 1 output is shown opposite.

The PMV calculation becomes more refined through the design and procurement process, early input from the supply chain is key to ratify the cost allowances set against pre-manufactured material, onsite labour and preliminaries. It is important for contractors and subcontractor to further set up their construction process to capture on-site labour records and preliminary expenditure.

This will ensure the final PMV score for a project is accurately calculated upon completion.

Description	Gross Construction Cost*	Pre-Manufactured Value %**	% of GCC	PMV Score
Gross Construction Cost	£3,000,000.00			
Housing	£2,996,760	40%	100%	40%
Substructure	£317,657	25%	10%	3%
Superstructure	£1,432,451	33%	48%	16%
Internal finishes	£485,475	41%	16%	7%
Fittings, furnishings & equipment	£335,637	70%	11%	8%
Services	£425,540	49%	14%	7%
Total	£2,996,760	40%	100%	40%

* Inclusive of risk, OH&P and preliminaries costs

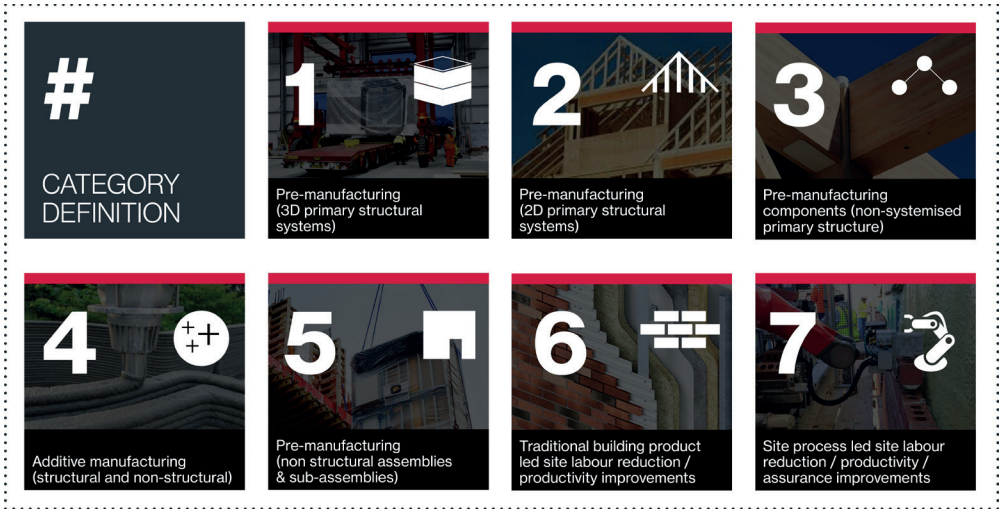
** Inclusive of risk and OH&P on a pro-rata basis

3.2 MMC combinations and impact on PMV scores

3.2.1 THE MODERN METHODS OF CONSTRUCTION (MMC) DEFINITION FRAMEWORK[4]

The *Modern MMC Definition Framework* is an output of the *MHCLG Joint Industry MMC Working Group in 2019*. The framework incorporates all types of pre-manufacturing approaches, as well as materials innovation and on site tools and digital process innovations that can reduce required site labour, supervision or site overhead costs.

All MMC categories can support an increase in a PMV score, with the pre-manufactured led approaches of Categories 1-5 providing the greatest increase on pre-manufactured material and reduction in onsite labour and site supervision component of preliminaries. This is in contrast to the site process led approaches of Categories 6-7 which marginally reduce the total amount of material whilst reducing site labour and site supervision.

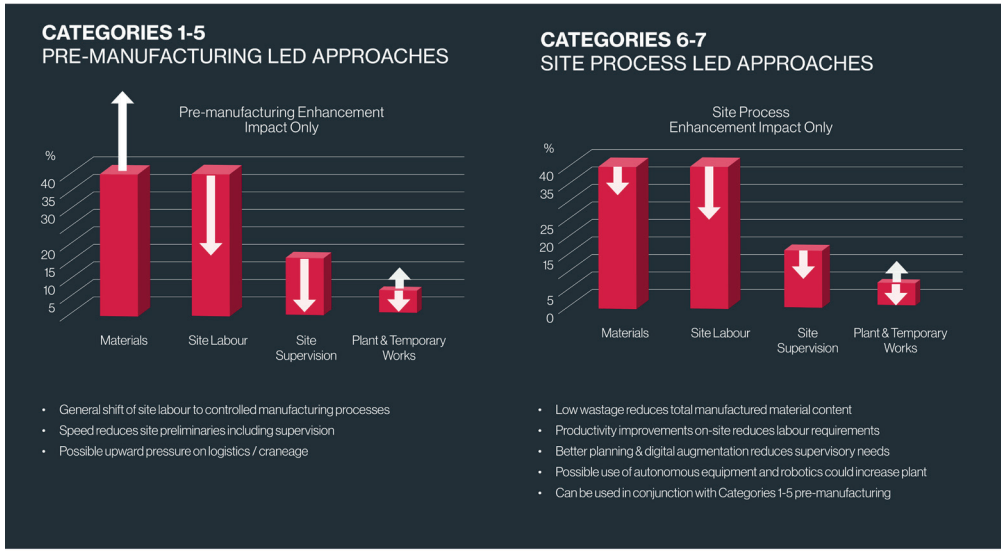


3.2.2 IMPACT ON PMV SCORES

Using any one or multiple combinations of the MMC categories improves a project's PMV score.

The *Cast PMV Estimator Online Tool*, available at www.cast-consultancy.com/pmv/, helps to demonstrate this with users able to carry out a PMV estimate against the following four residential building typologies:

1. Residential houses
2. Low rise apartments: 5 storeys or fewer
3. Mid rise apartments: 6 to 9 storey buildings
4. High rise apartments: 10 storeys or above



3.2 MMC combinations and impact on PMV scores (continued)

There are multiple combinations of MMC categories all of which will have varying impacts on PMV, on-site labour and preliminaires. The following table provides the outputs from the online tool demonstrating the transition from the baseline construction through to a target PMV score of 55% and 60% on all four typologies.

It is important to note that material selection can also have an impact on the PMV score, more expensive finishes will increase both the pre-manufactured material and gross construction cost of a PMV equation. It is therefore important to identify where material selection is impacting a PMV score to ensure PMV is benchmarked on comparable material and specification bands.

Target PMV score of
55% and 60%
on all four typologies

Typology	Housing			Low Rise			Mid Rise			High Rise		
PMV Target*	Baseline	55%	60%	Baseline	55%	60%	Baseline	55%	60%	Baseline	55%	60%
Pre-Manufactured Value*	39.74%	56.79%	60.04%	42.02%	55.27%	61.02%	44.39%	55.69%	60.04%	48.12%	55.92%	61.07%
Site Labour*	44.81%	29.96%	27.36%	41.00%	28.40%	24.40%	36.99%	26.39%	22.54%	31.00%	23.40%	19.95%
Preliminaries*	15.45%	13.25%	12.60%	16.98%	16.33%	14.58%	18.62%	17.92%	17.42%	20.88%	20.68%	18.98%
MMC Definition Framework: Category Combination		2C	2C	-	3E	2C	-	3F	3F	-	5C	2B
		5C	3B		3F	5C		5C	3G			5A
			5C		5A	5L		5H	5C			5D
			5L		5G			6E	5D			
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*Inclusive of risk and OH&P on a pro-rata basis

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