

# CIC

## Designing for Manufacture and Assembly

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October 2020

# RIBA Plan of Work 2013



RIBA Plan of Work 2013

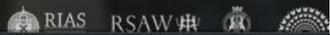
First developed in 1963, the RIBA Plan of Work is the for the building design and construction process. The includes this online resource enabling professionals to build download a plan of work. It is intuitive to use with on-scre

View the Plan of Work

About the Plan of Work

Plan of Work Toolbox

The RIBA Plan of Work 2013 is endorsed by the following organisations



	0	1	2	3	4	5	6	7
	Strategic Definition	Preparation and Brief	Concept Design	Developed Design	Technical Design	Construction	Handover and Close Out	In Use
<b>Core Objectives</b>	Identify client's Business Case and Strategic Brief and other core project requirements.	Develop Project Objectives, including Quality Objectives and Project Outcomes, Sustainability Aspirations, Project Budget, other parameters or constraints and develop Initial Project Brief. Undertake Feasibility Studies and review of Site Information.	Prepare Concept Design, including outline proposals for structural design, building services systems, outline specifications and preliminary Cost Information along with relevant Project Strategies in accordance with Design Programme. Agree alterations to Brief and issue Final Project Brief.	Prepare Developed Design, including coordinated and updated proposals for structural design, building services systems, outline specifications, Cost Information and Project Strategies in accordance with Design Programme.	Prepare Technical Design in accordance with Design Responsibility Matrix and Project Strategies to include all architectural, structural and building services information, specialist subcontractor design and specifications, in accordance with Design Programme.	Offsite manufacturing and onsite Construction in accordance with Construction Programme and resolution of Design Queries from site as they arise.	Handover of building and conclusion of Building Contract.	Undertake In Use services in accordance with Schedule of Services.
<b>Procurement</b> "variable task bar"	Initial considerations for assembling the project team.	Prepare Project Roles Table and Contractual Tree and continue assembling the project team.	The procurement strategy does not fundamentally alter the progression of the design or the level of detail prepared at a given stage. However, Information Exchanges will vary depending on the selected procurement route and Building Contract. A bespoke RIBA Plan of Work 2013 will set out the specific tendering and procurement activities that will occur at each stage in relation to the chosen procurement route.		The procurement route may dictate the Project Programme and may result in certain stages overlapping or being undertaken concurrently. A bespoke RIBA Plan of Work 2013 will clarify the stage overlaps. The Project Programme will set out the specific stage dates and detailed programme durations.		Administration of Building Contract, including regular site inspections and review of progress.	Conclude administration of Building Contract.
<b>Programme</b> "variable task bar"	Finalise Project Programme.	Review Project Programme.	Review Project Programme.		Review Project Programme.			
<b>(Town) Planning</b> "variable task bar"	Pre-application discussions.	Pre-application discussions.	Planning applications are typically made using the Stage 3 output. A bespoke RIBA Plan of Work 2013 will identify when the planning application is to be made.					
<b>Suggested Key Report Tasks</b>	Review Feedback from previous projects.	Prepare Handover Strategy or Risk Assessments. Agree Schedule of Services, Design Responsibility Matrix and Information Exchange and prepare Project Execution Plan including Technology and Communication Strategies and consideration of Common Standards to be used.	Prepare Sustainability Strategy, Maintenance and Operational Strategy and review Handover Strategy and Risk Assessments.	Review and update Sustainability, Maintenance and Operational Strategies and Risk Assessments.	Review and update Sustainability, Maintenance and Operational Strategies and Risk Assessments.	Review and update Sustainability Strategy and implement Handover Strategy, including agreement of information required for commissioning, training, handover, asset management, future monitoring and maintenance and ongoing completion of As-constructed Information.	Carry out activities listed in Handover Strategy including Feedback to use during the future life of the building or on future projects.	Conclude activities listed in Handover Strategy including Post-occupancy Evaluation, review of Project Performance, Project Outcome and Research and Development aspects.
<b>Sustainability Checkpoints</b>	Sustainability Checkpoint – 0	Sustainability Checkpoint – 1	Sustainability Checkpoint – 2	Sustainability Checkpoint – 3	Sustainability Checkpoint – 4	Sustainability Checkpoint – 5	Sustainability Checkpoint – 6	Sustainability Checkpoint – 7
<b>Information Exchanges</b> (at stage completion)	Strategic Brief.	Initial Project Brief.	Concept Design including outline structural and building services design, associated Project Strategies, proposals, Cost Information and Final Project Brief.	Developed Design, including the coordinated architectural, structural and building services design and updated Cost Information.	Completed Technical Design of the project.	As-constructed Information.	Updated As-constructed Information.	As-constructed Information updated in response to ongoing client Feedback and maintenance or operational developments.
<b>UK Government Information Exchanges</b>	Not required.	Required.	Required.	Required.	Not required.	Not required.	Required.	As required.

\*variable task bar = a ongoing overlap project or a one-off specific RIBA Plan of Work 2013. See www.ribaplanofwork.com for more details and for a complete list of options.



## RIBA Plan of Work 2013 Overview



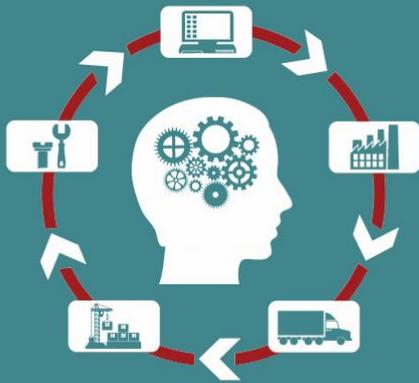
www.ribaplanofwork.com

www.ribaplanofwork.com

# DfMA overlay to RIBA Plan of Work

RIBA 

RIBA Plan of Work 2013  
**Designing for Manufacture  
and Assembly**



[www.offsiteschool.com/DfMA](http://www.offsiteschool.com/DfMA)

## Different Levels of Pre-Assembly

1. Component manufacture
2. Sub-assembly
3. Non-volumetric preassembly
4. Volumetric preassembly
5. Modular buildings

# RIBA Plan of Work 2020



## RIBA Plan of Work 2020

### Stage Boundaries:

Stages 0-4 will generally be undertaken one after the other.

Stages 4 and 5 will overlap in the Project Programme for most projects.

Stage 5 commences when the contractor takes possession of the site and finishes at **Practical Completion**.

Stage 6 starts with the handover of the building to the client immediately after **Practical Completion** and finishes at the end of the **Defects Liability Period**.

Stage 7 starts concurrently with Stage 6 and lasts for the life of the building.

### Planning Note:

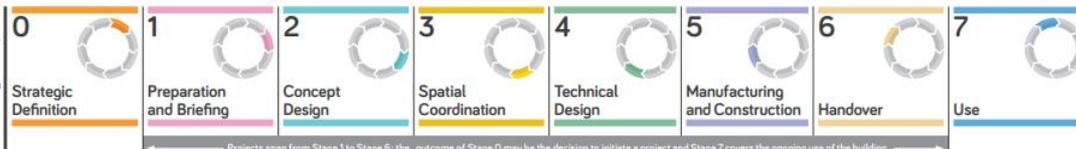
Planning Applications are generally submitted at the end of Stage 3 and should only be submitted earlier when the threshold of information required has been met. If a Planning Application is made during Stage 3, a mid-stage gateway should be determined and it should be clear to the project team which tasks and deliverables will be required. See Overview guidance.

### Procurement:

The RIBA Plan of Work is procurement neutral. See Overview guidance for a detailed description of how each stage might be adjusted to accommodate the requirements of the Procurement Strategy.

- ES Employer's Requirements
- CS Contractor's Proposals

The RIBA Plan of Work organises the process of briefing, designing, delivering, maintaining, operating and using a building into eight stages. It is a framework for all disciplines on construction projects and should be used solely as guidance for the preparation of detailed professional services and building contracts.

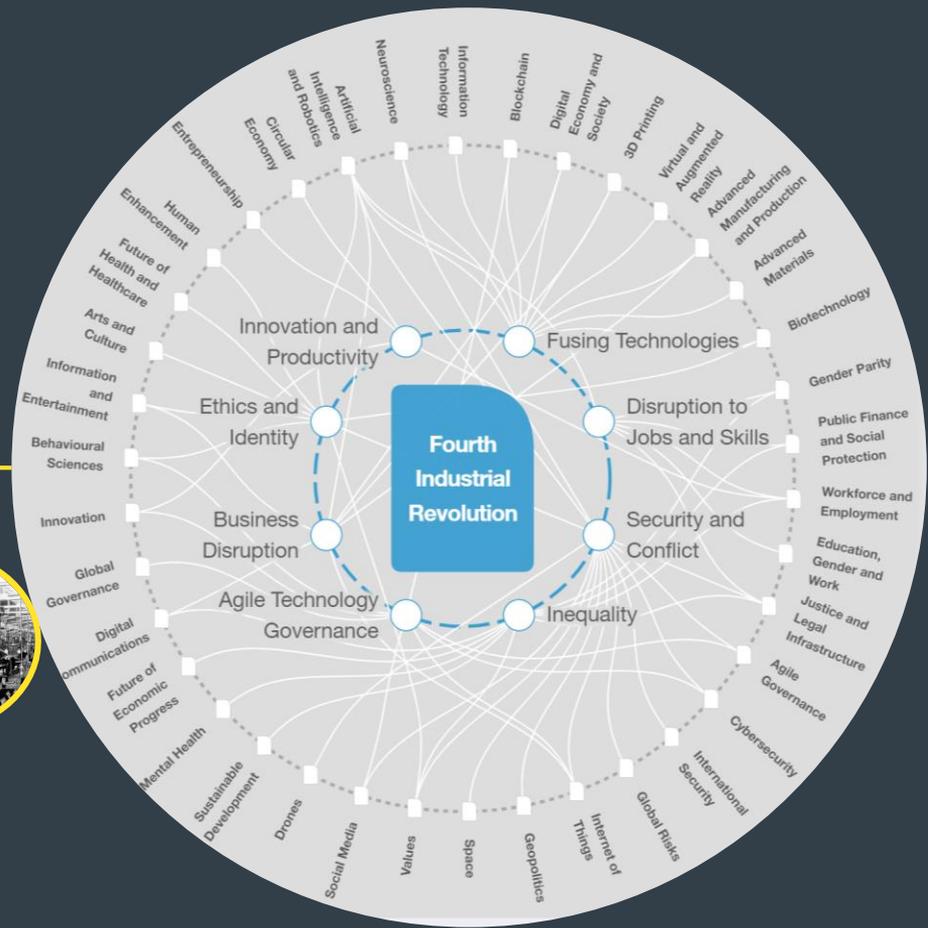


Stage Outcome	0 Strategic Definition	1 Preparation and Briefing	2 Concept Design	3 Spatial Coordination	4 Technical Design	5 Manufacturing and Construction	6 Handover	7 Use
<b>Stage Outcome</b> at the end of the stage	The best means of achieving the <b>Client Requirements</b> confirmed  <small>If the outcome determines that a building is the best means of achieving the <b>Client Requirements</b>, the client proceeds to Stage 1</small>	<b>Project Brief</b> approved by the client and confirmed that it can be accommodated on the site	<b>Architectural Concept</b> approved by the client and aligned to the <b>Project Brief</b>  <small>The brief remains "live" during Stage 2 and is developed in response to the <b>Architectural Concept</b></small>	Architectural and engineering information <b>Spatially Coordinated</b>	All design information required to manufacture and construct the project completed  <small>Stage 4 will overlap with Stage 5 on most projects</small>	Manufacturing, construction and <b>Commissioning</b> completed  <small>There is no design work in Stage 5 other than responding to <b>Site Queries</b></small>	Building handed over, <b>Aftercare</b> initiated and <b>Building Contract</b> concluded	Building used, operated and maintained efficiently  <small>Stage 7 starts concurrently with Stage 6 and lasts for the life of the building</small>
<b>Core Tasks</b> during the stage	Prepare <b>Client Requirements</b> Develop <b>Business Case</b> for feasible options including review of <b>Project Risks</b> and <b>Project Budget</b> Ratify option that best delivers <b>Client Requirements</b> Review <b>Feedback</b> from previous projects Undertake <b>Site Appraisals</b>	Prepare <b>Project Brief</b> including <b>Project Outcomes</b> and <b>Sustainability Outcomes</b> , <b>Quality Aspirations</b> and <b>Spatial Requirements</b> Undertake <b>Feasibility Studies</b> Agree <b>Project Budget</b> Source <b>Site Information</b> including <b>Site Surveys</b> Prepare <b>Project Programme</b> Prepare <b>Project Execution Plan</b>	Prepare <b>Architectural Concept</b> incorporating <b>Strategic Engineering</b> requirements and aligned to <b>Cost Plan</b> , <b>Project Strategies</b> and <b>Outline Specification</b> Agree <b>Project Brief Derogations</b> Undertake <b>Design Reviews</b> with client and <b>Project Stakeholders</b> Prepare stage <b>Design Programme</b>	Undertake <b>Design Studies</b> , <b>Engineering Analysis</b> and <b>Cost Exercises</b> to test <b>Architectural Concept</b> resulting in <b>Spatially Coordinated</b> design aligned to updated <b>Cost Plan</b> , <b>Project Strategies</b> and <b>Outline Specification</b> Initiate <b>Change Control Procedures</b> Prepare stage <b>Design Programme</b>	Develop architectural and engineering technical design Prepare and coordinate design team <b>Building Systems Information</b> Prepare and integrate specialist subcontractor <b>Building Systems Information</b> Prepare stage <b>Design Programme</b>  <small>Specialist subcontractor designs are prepared and reviewed during Stage 4</small>	Finalise <b>Site Logistics</b> , <b>Manufacture Building Systems</b> and construct building Monitor progress against <b>Construction Programme</b> Inspect <b>Construction Quality</b> Resolve <b>Site Queries</b> as required Undertake <b>Commissioning</b> of building Prepare <b>Building Manual</b>  <small>Building handover tasks bridge Stages 5 and 6 as set out in the <b>Plan for Use Strategy</b></small>	Hand over building in line with <b>Plan for Use Strategy</b> Undertake review of <b>Project Performance</b> Undertake seasonal <b>Commissioning</b> Complete initial <b>Aftercare</b> tasks including light touch <b>Post Occupancy Evaluation</b>	Implement <b>Facilities Management</b> and <b>Asset Management</b> Undertake <b>Post Occupancy Evaluation</b> of building performance in use Verify <b>Project Outcomes</b> including <b>Sustainability Outcomes</b>  <small>Adaptation of a building (at the end of its useful life) triggers a new Stage 0</small>
<b>Core Statutory Processes</b> during the stage:	Strategic appraisal of <b>Planning</b> considerations	Source pre-application <b>Planning Advice</b> Initiate collation of health and safety <b>Pre-construction Information</b>	Obtain pre-application <b>Planning Advice</b> Agree route to <b>Building Regulations</b> compliance Option: submit outline <b>Planning Application</b>	Review design against <b>Building Regulations</b> Prepare and submit <b>Planning Application</b>  <small>See <b>Planning Note</b> for guidance on submitting a <b>Planning Application</b> earlier than at end of Stage 3</small>	Submit <b>Building Regulations Application</b> Discharge pre-commencement <b>Planning Conditions</b> Prepare <b>Construction Phase Plan</b> Submit form F10 to HSE if applicable	Carry out <b>Construction Phase Plan</b> Comply with <b>Planning Conditions</b> related to construction	Comply with <b>Planning Conditions</b> as required	Comply with <b>Planning Conditions</b> as required
<b>Procurement Route</b>	Design & Build 1 Stage	Design & Build 2 Stage	Management Contract	Construction Management	Contractor-led			
<b>Information Exchanges</b> at the end of the stage	Client Requirements Business Case	Project Brief Feasibility Studies Site Information Project Budget Project Programme Procurement Strategy Responsibility Matrix Information Requirements	Project Brief Derogations Signed off Stage Report Project Strategies Final Specifications Outline Specification Cost Plan	Signed off Stage Report Project Strategies Updated Outline Specification Updated Cost Plan Planning Application	Manufacturing Information Construction Information Final Specifications Residual Project Strategies Building Regulations Application	Building Manual including Health and Safety File and Fire Safety Information  Practical Completion certificate including Defects List  Asset Information  <small>If Verified Construction Information is required, verification tasks must be defined</small>	Feedback on Project Performance Final Certificate Feedback from light touch Post Occupancy Evaluation	Feedback from Post Occupancy Evaluation Updated Building Manual including Health and Safety File and Fire Safety Information as necessary

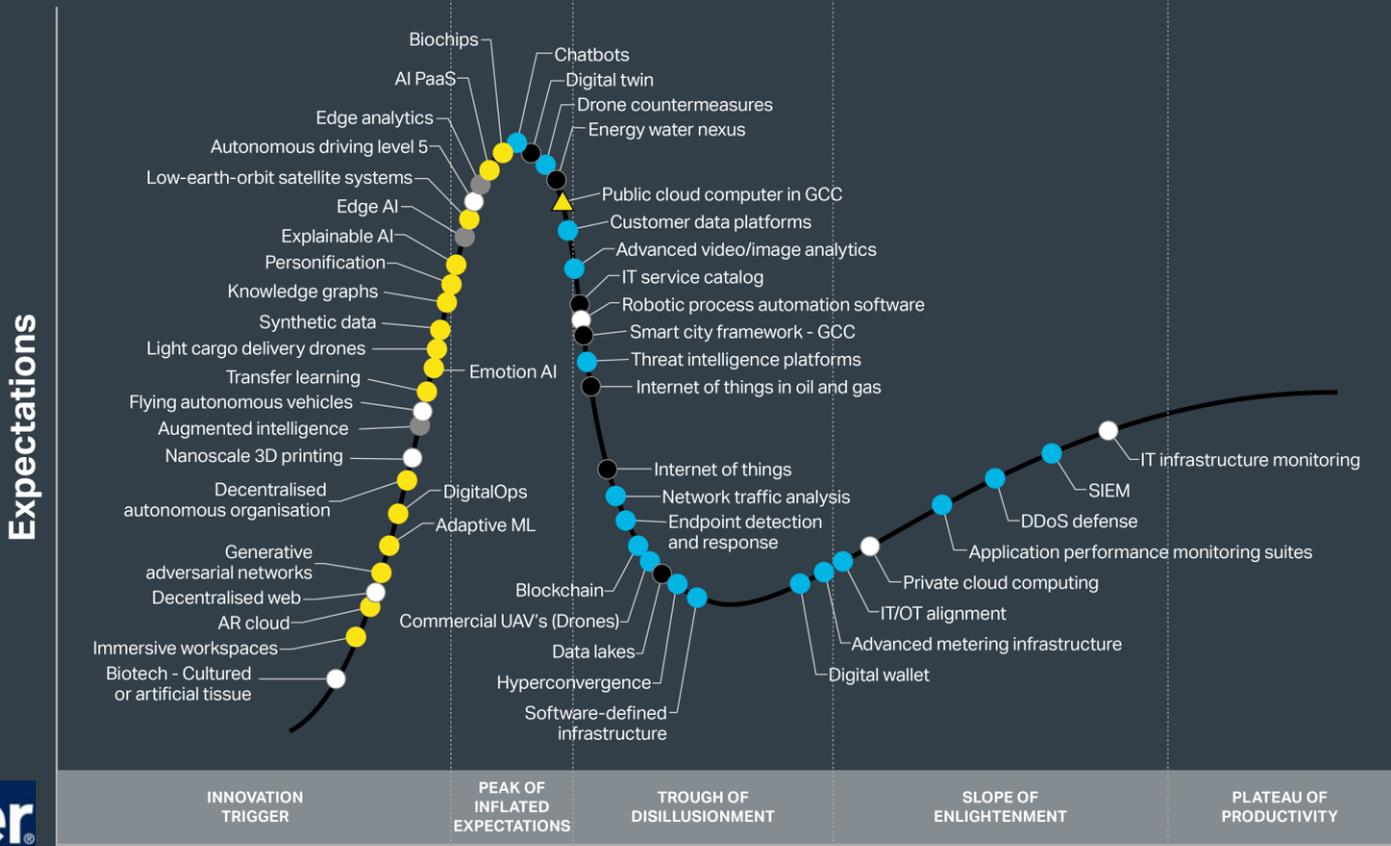
## RIBA Plan of Work 2020 Overview



# Paradigm shifts



# Hype cycle: timing is everything

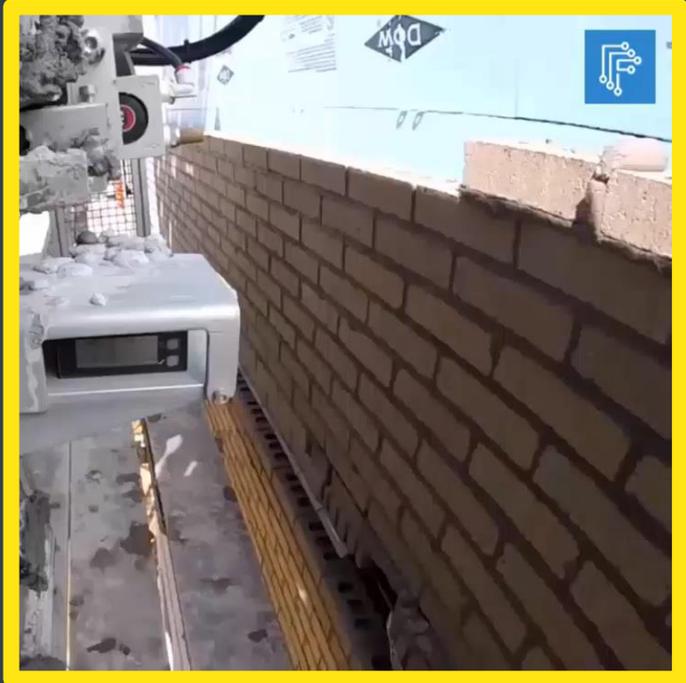


# Changing industry

Oxford Martin Programme  
on the Impacts of Future  
Technology

<u>Occupation</u>	<u>Probability</u>	<u>Occupation</u>	<u>Probability</u>
Mechanical Engineers	<b>0.011</b>	Construction & Related Workers	<b>0.71</b>
Architectural & Engineering Managers	<b>0.017</b>	Carpenters	<b>0.72</b>
Architects	<b>0.018</b>	Glaziers	<b>0.73</b>
Civil Engineers	<b>0.019</b>	Tile & Marble Setters	<b>0.75</b>
Interior Designers	<b>0.022</b>	Painters	<b>0.75</b>
Lawyers	<b>0.035</b>	Civil Engineering Technicians	<b>0.75</b>
Landscape Architects	<b>0.045</b>	Drywall and Ceiling Installers	<b>0.79</b>
Construction Managers	<b>0.071</b>	Floor layers	<b>0.79</b>
Electrical Engineers	<b>0.1</b>	Brick masons	<b>0.82</b>
Electricians	<b>0.15</b>	Labourers	<b>0.88</b>
Construction Trades Supervisors	<b>0.17</b>	Terrazzo workers	<b>0.88</b>
Engineering Technicians	<b>0.24</b>	Roofers	<b>0.9</b>
Plumbers & Pipefitters	<b>0.35</b>	Crane and tower operators	<b>0.9</b>
Surveyors	<b>0.38</b>	Electrical Installers (inc lifts)	<b>0.91</b>
Mechanical Engineering Technicians	<b>0.38</b>	Model makers	<b>0.93</b>
Architect and Civil Draftsmen	<b>0.52</b>	Accountants	<b>0.94</b>
Tapers	<b>0.62</b>	Surveying and mapping technicians	<b>0.96</b>
Construction & Building Inspectors	<b>0.63</b>	Estate agents	<b>0.97</b>
Mechanical Insulation Workers	<b>0.64</b>	Insurance underwriters	<b>0.99</b>
Mechanical Draftsmen	<b>0.68</b>		

# New ways of making

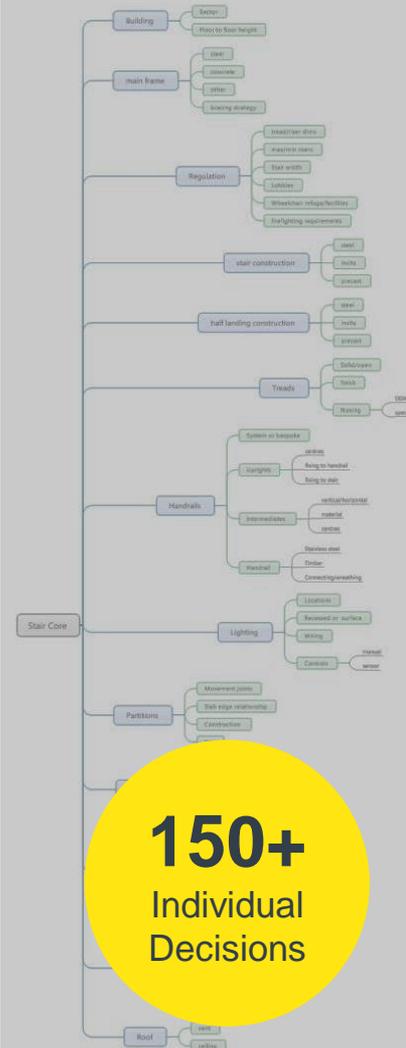


Increasing complexity

**DECISIONS**  
**KNOWLEDGE**  
**PROJECTS**  
**2D TO 3D**  
**PROCUREMENT**  
**SUPPLIERS**  
**CLIMATE CHANGE**  
**SOCIAL VALUE**



# Digital libraries: transforming decision making



**150+**  
Individual  
Decisions

# Future workflow



LOBBY

C O N F I G U R E  
Y O U R C O R E

# Degrees of DfMA

# Projects and products



Innovative Timber Homes. Made on Skye.

**Product**



**Project**



# Scope of DfMA



DFMA Possibilities however different innovations required including faster system production

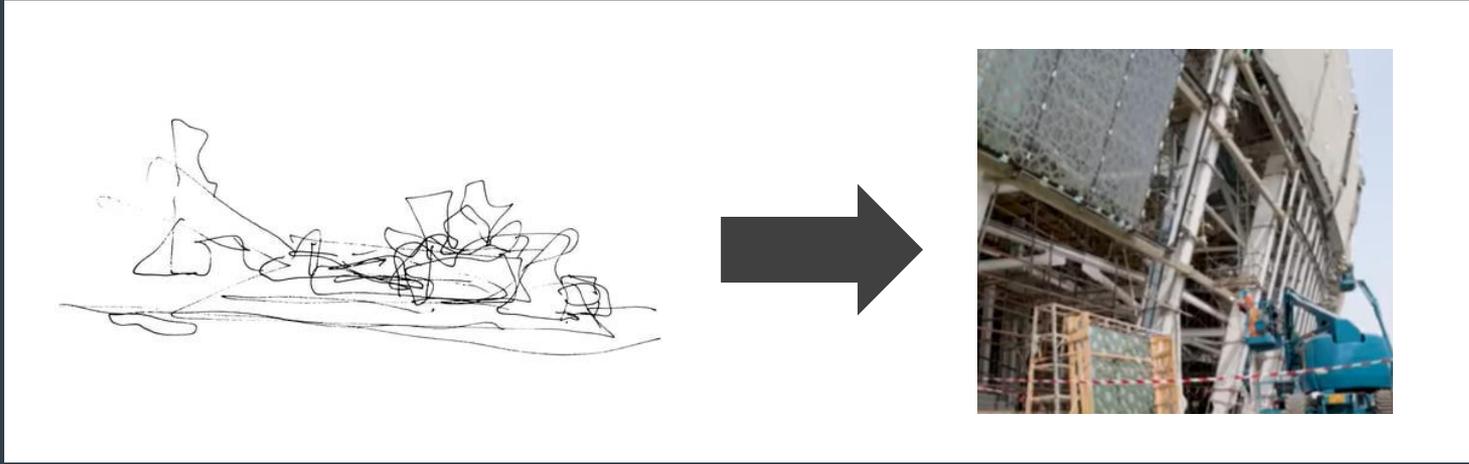


Reduced industrialized components opportunity



Reduced volumetric opportunity

# Design stages



2



Concept Design

3



Spatial Coordination

4



Technical Design

Quick wins



£7BN

# Optimising traditional



# Lights out manufacturing



# Volumetric Maturity

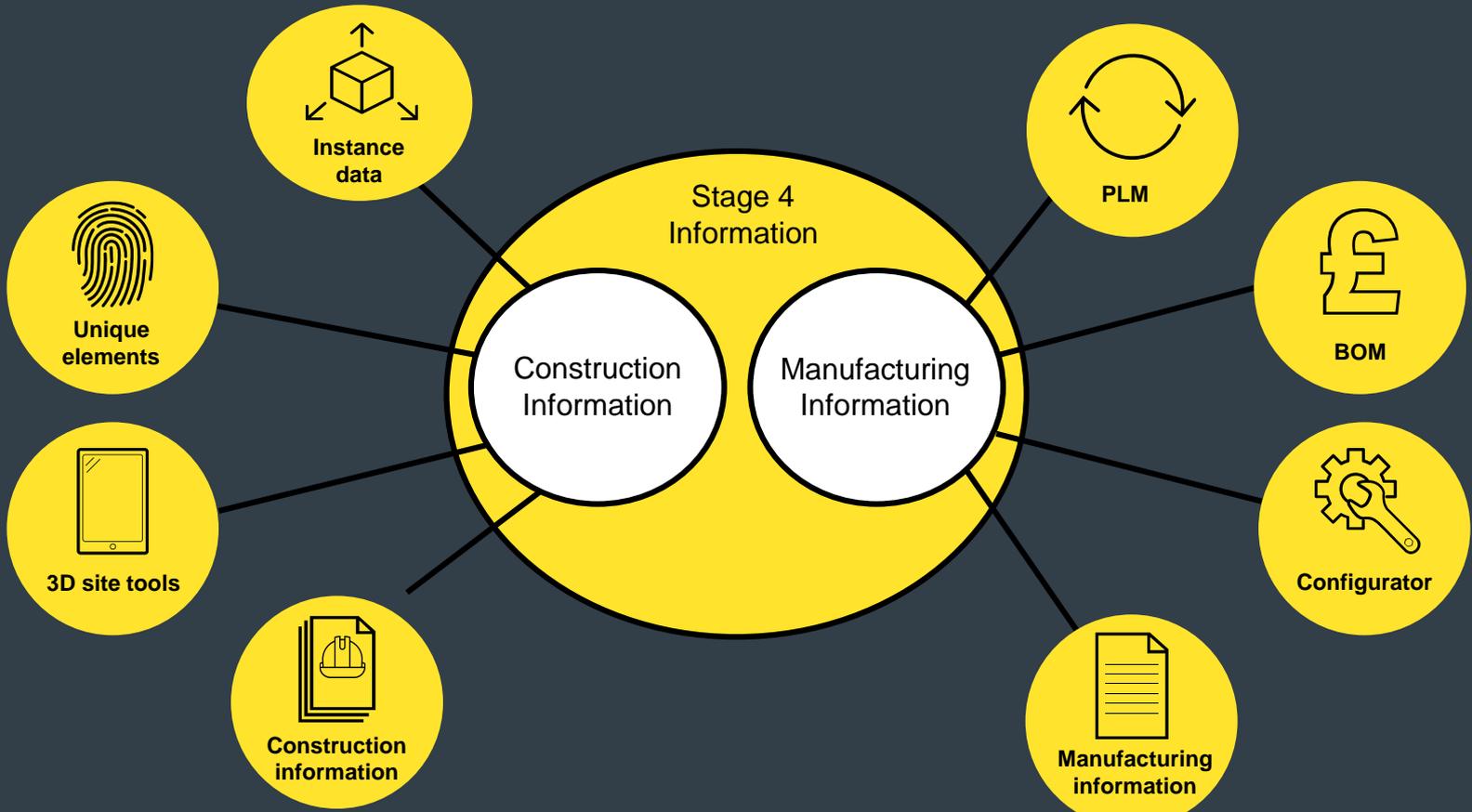


# Appropriate lessons



# DfMA: Future Trends

# Convergence of manufacturing and construction



# Mass-customisation / mass-configuration

## **DESIGN FOR FLEXIBILITY**

Millions of design options to allow design diversity in our built environment.

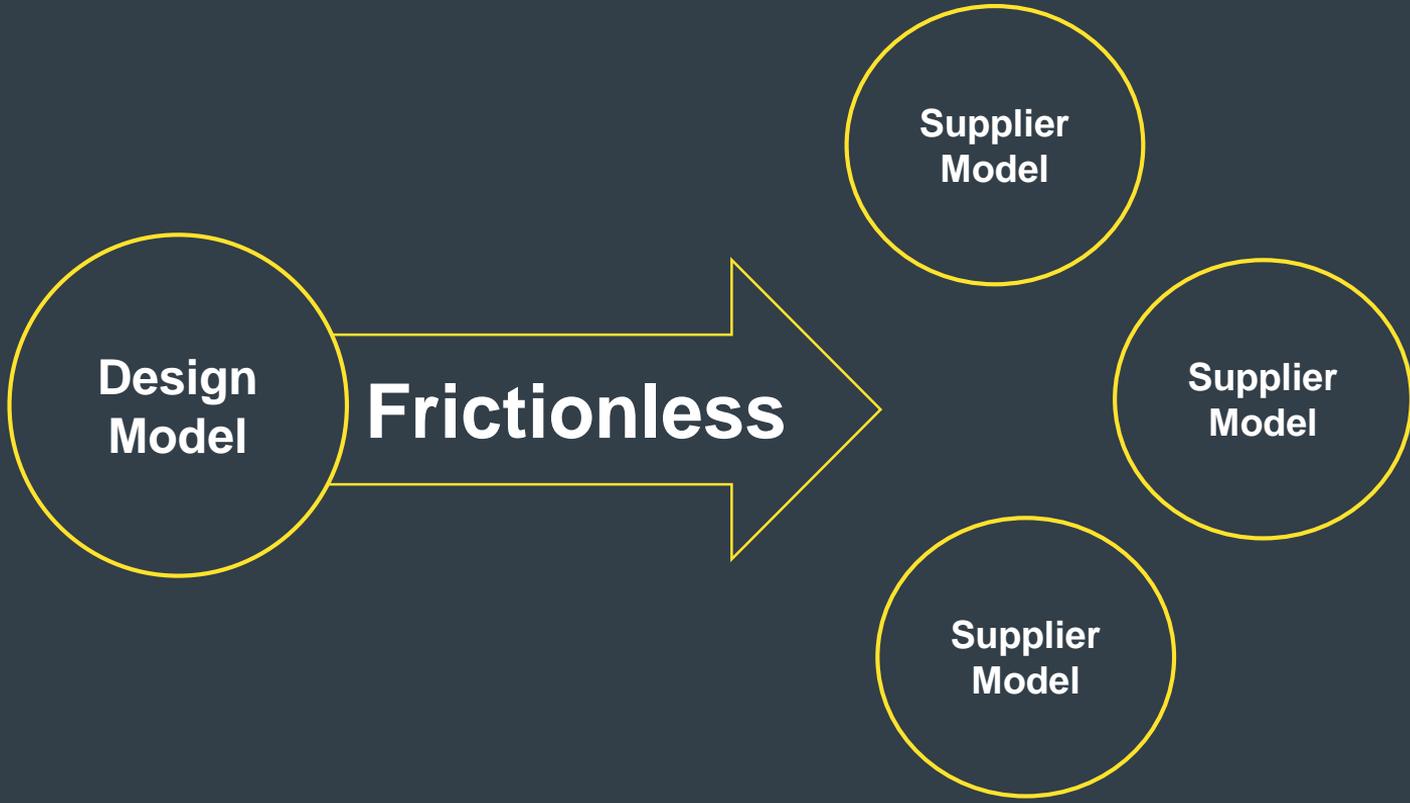
## **DESIGN FOR AUTOMATION**

Automation downstream into production, engineering, documentation and manufacturing.

## **DESIGN FOR USABILITY**

To remove barriers to entry for designers, manufacturers, asset managers and contractors.

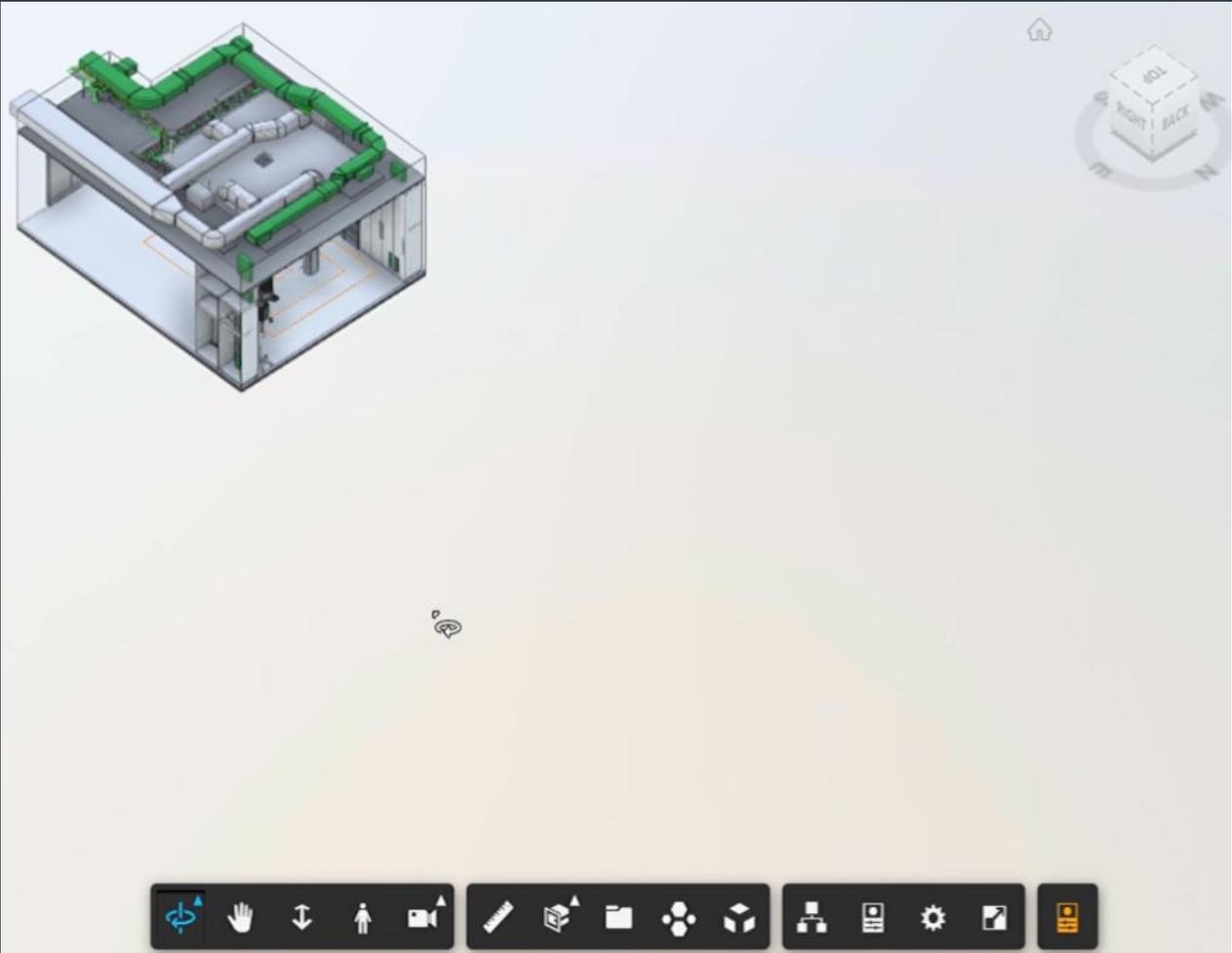
# Supplier resilience / procurement



# Configurators

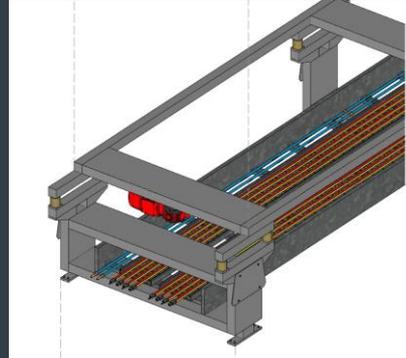
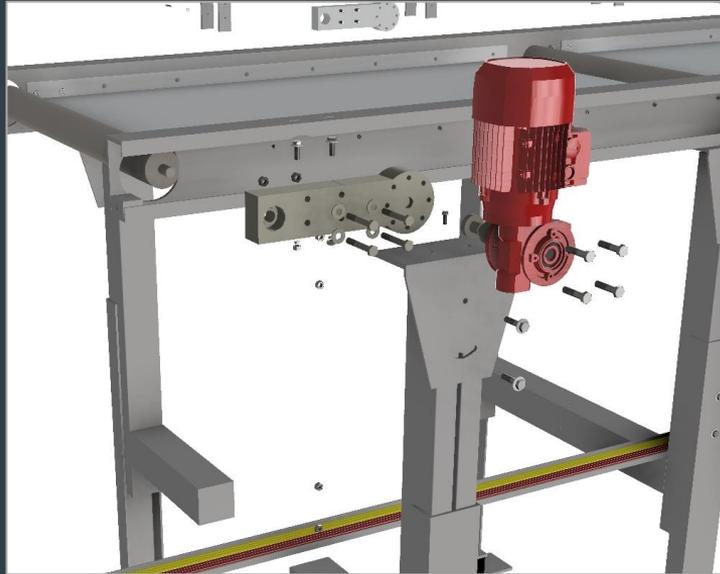


# Intelligent libraries





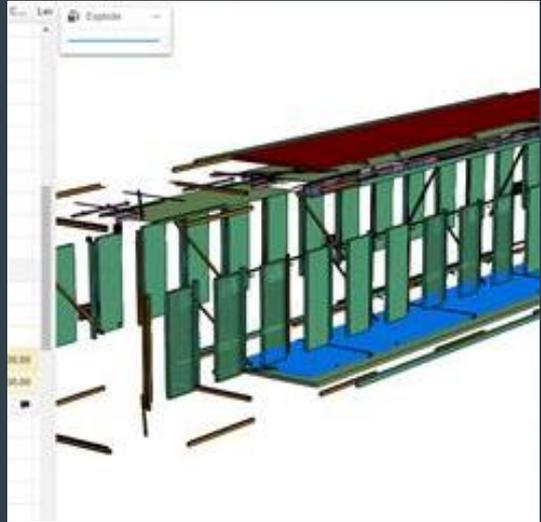
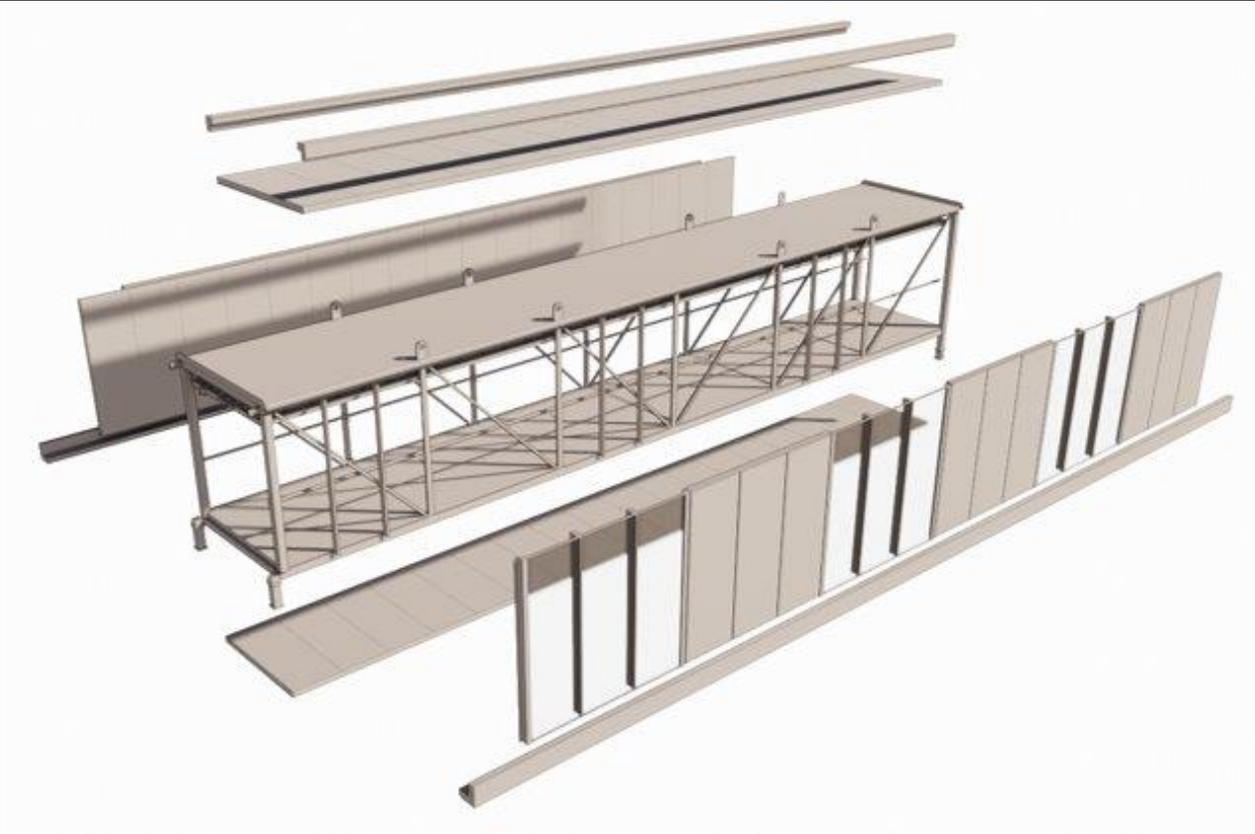
# Bills of materials / MEP connections



Conveyor Aluminium Sheet small	2
House Bearing - non-Drive Shaft Gear Side small	6
C channel Guide1	10
M6 Nut1	80
M6 x 25 MIR31	40
M6 Washer MIR11	40
guide connection brackets1	20
c channel mating plates1	20
M6 x 251	104
M6 Washers1	104
DIN EN ISO 4017 - M6 x 401 Hex-Head Bolt	40
ISO 7093 - 6 - 140 HV111 - Plain washers - Normal series - Product grade A	40
ISO 4032 - M6 - ISO1 - Hexagon nuts, style 1 - Product grades A and B	64
DIN EN ISO 4017 - M10 x 301	16
ISO 7091 - 10 - 100 HV1 - Plain washers - Normal series - Product grade C	16
ISO 4032 - M10 - ISO1 - Hexagon nuts, style 1 - Product grades A and B	16
M6 Nut MIR2	60
Conveyor drive shaft MIR	8
House Bearing - Drive Shaft Gear Side small MIR	8
Bearing UC204-020 MIR1	8
motor drive MIR	8
DIN EN ISO 4014 - M10 x 70 MIR - Hex-Head Bolt	32
ISO 7091 - 10 - 100 HV MIR - Plain washers - Normal series - Product grade C	32
ISO 4032 - M10 - ISO MIR - Hexagon nuts, style 1 - Product grades A and B	32
E-stop	6
c channel mating for e stop	6
Floor plate	5
Joining Legs top Y	10
ISO 4017 - M6 x 20 - Hexagon head screws	40
Current leg design	12
Current leg design MIR1	12
DIN EN ISO 4017 - M10 x 30 MIR1 - Hex-Head Bolt	24
ISO 7091 - 10 - 100 HV MIR2 Plain washers - Normal series - Product grade C	72
ISO 4032 - M10 - ISO MIR2 - Hexagon nuts, style 1 - Product grades A and B	72
DIN EN ISO 4014 - M10 x 45 MIR1 - Hex-Head Bolt	48
<b>TOTAL PARTS QTY.</b>	<b>2515</b>



# Stage 1 fabrication: weight / carbon



2.00	M2	Align Plat	Fixed Link	Cladding	1	0.00	0.34	
22.00	M2	Align Plat	Fixed Link	Cladding	8	22.00	2.69	
15.00	M2	Align Plat	Fixed Link	Cladding	7	15.00	2.36	
70.00	M	Align Plat	Fixed Link	Cladding	20	70.00	8.88	
10.00	M2	Align Plat	Fixed Link	Cladding	4	10.00	1.25	
6	E.R.			Fire Alarm	6			
2	E.R.	Align Plat	Fixed Link	Fire Alarm	2	0.00	0.00	
2	E.R.	Align Plat	Fixed Link	Fire Alarm	2	0.00	0.00	
2	E.R.	Align Plat	Fixed Link	Fire Alarm	2	0.00	0.00	
40.00	M2			Flooring	1		1,382.40	30.00
40.00	M2	Align Plat	Fixed Link	Flooring	1	40.00	4.52	1,382.62
52	E.R.			MEP	52			5.00
1	E.R.	Align Plat	Fixed Link	MEP	1	1.13	0.02	
1	E.R.	Align Plat	Fixed Link	MEP	1	1.13	0.02	

## MEP considerations



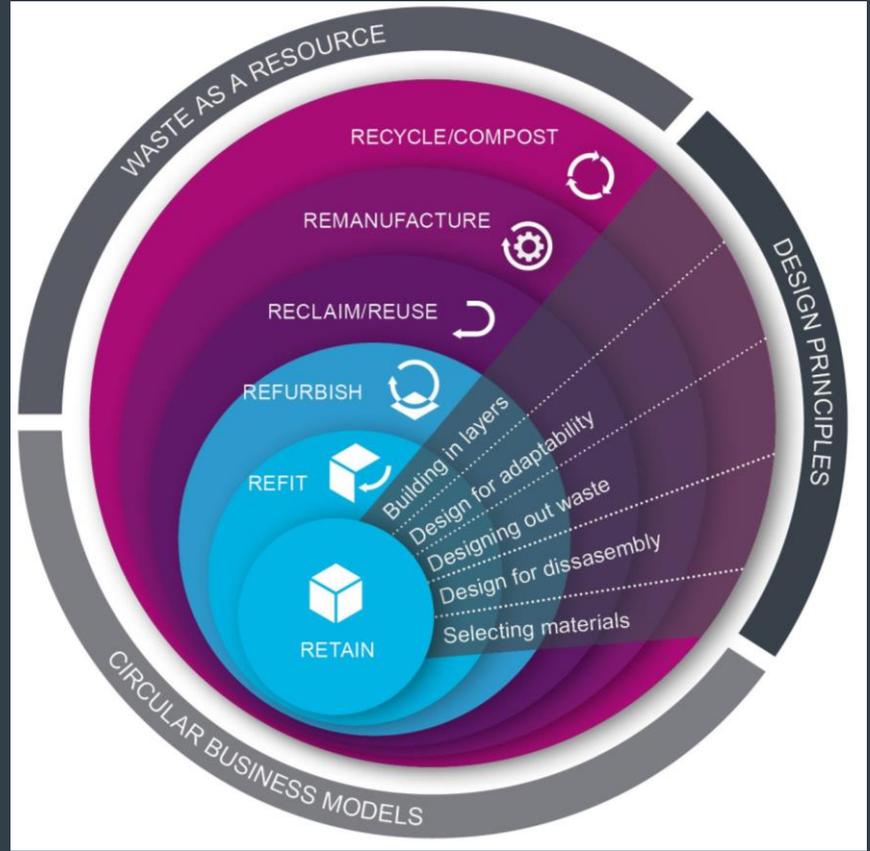
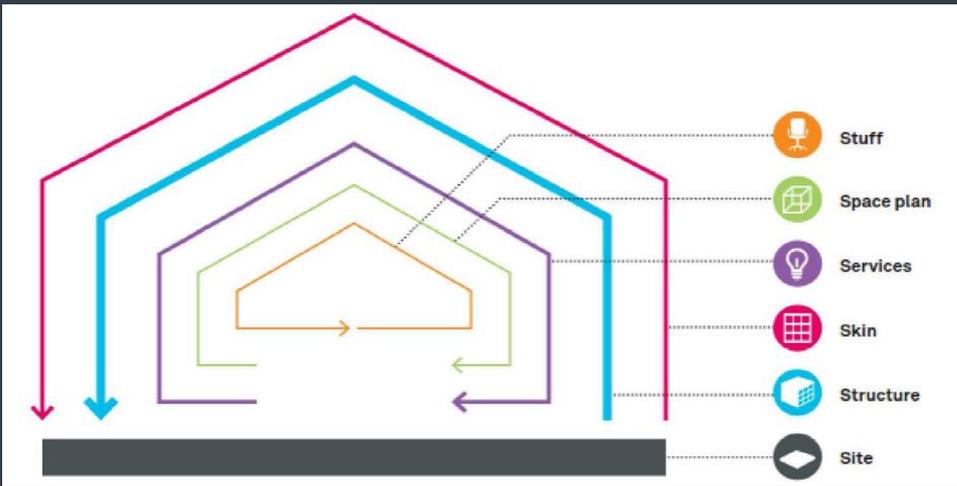
Spatial Allowances – risers and main horizontal services routes must allow for framing

Plantrooms need to consider pre-assembly – for example, pumpsets on skids

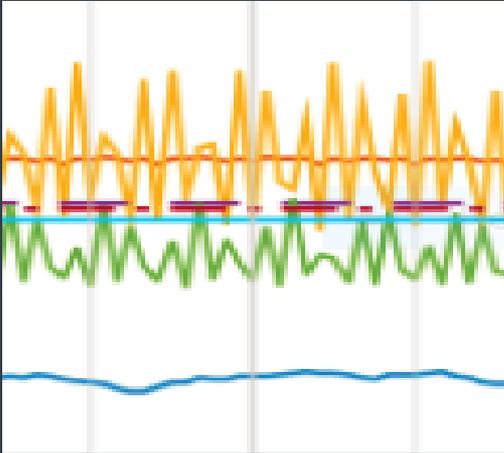
Early involvement of suppliers essential to ensure all DfMA options have been considered during the concept design

Logistics and craneage impact on approach

# Circular economy



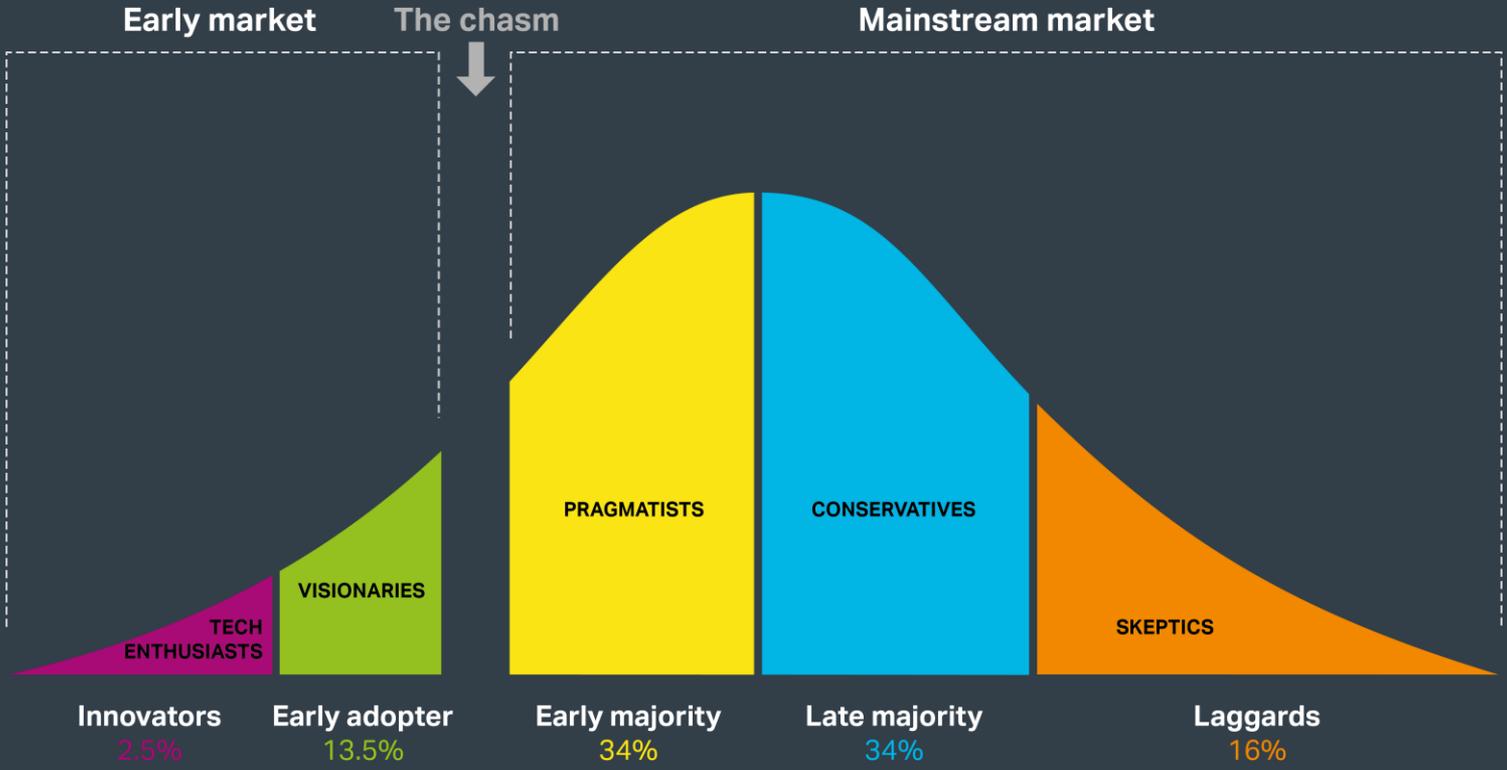
# CLOUD and IOT: free buildings!



Capital Costs **20:80** Operational Costs

Capital Costs **=24** Greater than Capital Cost

# Innovation curve: crossing the chasm



**AECOM** Imagine it.  
Delivered.