CONSTRUCTION INDUSTRY COUNCIL
建造業議會

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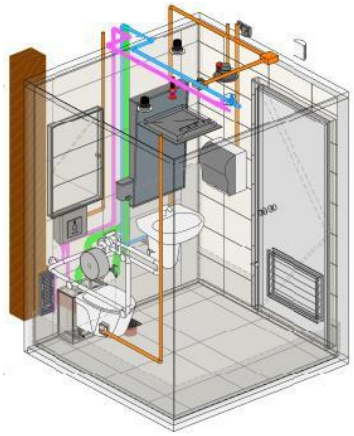
Wider Adoption of DfMA in MEP Works

DfMA MiMEP Tradeshow 2021



Project Timeline (CIC Consultancy Study)

01 **Inception Report (6 Jul 2020) (By 2nd Week)**

02 **Interim Report (27 Nov 2020) (By 5th Month)**

03 **Draft DfMA Guidebook on MEP Works (26 Feb 2021) (By 8th Month)**

04 **Draft Final Report (26 Mar 2021) (By 9th Month)**

05 **DfMA Guidebook on MEP Works (28 May 2021) (By 11th Month)**

06 **Final Report and Executive Summary (21 June 2021) (By 12th Month)**

In-depth Interviews

Questionnaire Survey & Webinar (15 Oct 2020)

Review Comments

May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun

2020 Qtr 3 | 2020 Qtr 4 | 2021 Qtr 1 | 2021 Qtr 2

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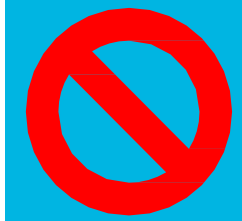
From Inception Report to Interim Report

Identified and agreed via in-depth interviews with stakeholders

BENEFITS

- Simplify Processes
- Shorter Construction Time
- Increase Reliability
- Reduce Costs
- Scale of Economy
- Health & Safety
- Reduce On-site Works
- Improve Quality
- Reduce On-site Labour
- Reduce Environmental Impact



BARRIERS

- Lack of Standardization
- Regulatory Hurdles
- No Procurement Model
- Lack of Demand
- Upfront Cost
- Culture against Change
- Lack of Expertise
- Fragmentation of the Industry
- Lack of Cross-Supply Chain Collaboration
- Unseen Benefits

STRATEGIES

- Raise **Awareness**
- Create **Demand**
- Enhance **Supply Chain**
- Build Up **Skills**

Inception Report

Review scope of local and international best practices for DfMA MEP; Government policies & regulations etc.; Strategies to remove barriers

In-depth interviews with stakeholders

Webinar Forum (with UK Expert Speakers) to explain and promote **(~800 Audiences)**; Survey Questionnaire **(133 Respondents)**

Interim Report

1. Practice Review
- Extent of DfMA for MEP
- Drivers and constraints
- Outcome

2. Hong Kong ecosystem
- Identify opportunities and benefits
- Identify barriers

3. Drive DfMA MEP in Hong Kong
- Propose initial strategies and measures

List of stakeholders

1. Hong Kong
- Architectural Services Department
- Gammon Construction Limited
- Hip Hing Construction
- Hong Kong Airport Authority
- HKFEMC
- Hong Kong Institute of Architects
- Hong Kong Institute of Surveyors
- Hong Kong Institution of Engineers
- Hong Kong Science and Technology Parks Corporation
- Hospital Authority
- Housing Authority
- MTR Corporation
- Paul Y. Engineering Group Limited
- Sun Hung Kai Properties Limited
- The Association of Construction Quantity Surveyors Limited
- The University of Hong Kong

2. United Kingdom
- Laing O'Rourke
- Prism Offsite Manufacturing

3. Singapore
- Building and Construction Authority
- Dragages
- Specialists Trade Alliance of Singapore
- Trans Equatorial Engineering, Singapore

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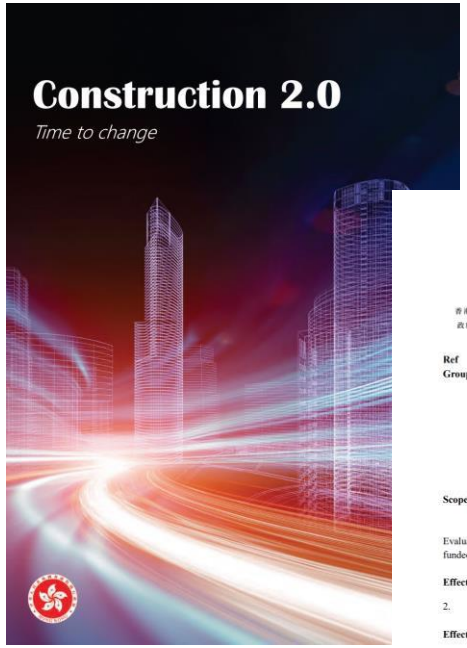
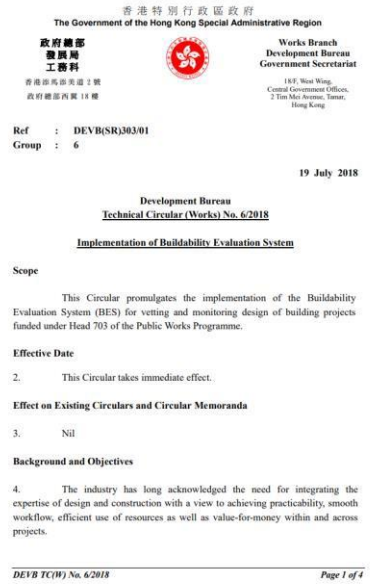
Re-industrialization for Offsite Manufacturing

- Construction 2.0 (2018)
- Development Bureau's Technical Circular (Works) No. 6/2018 – **Buildability Evaluation System**
  - Enhance Construction Productivity and Project Cost Management to Achieve Value for Money
  - Adoption of "3S Principle"
  - Promote mechanization and prefabrication
- Development Bureau's Technical Circular (Works) No. 2/2020 – **Modular Integrated Construction (MiC)**
  - Mandatory and Voluntary MiC Adoptions for New Building Works with Total Construction Floor Area (CFA) larger than 300m2





香港特別行政區政府
The Government of the Hong Kong Special Administrative Region

政府總部
發展局
工務科

Works Branch
Development Bureau
Government Secretariat

18/F, West Wing,
Central Government Offices,
2 Tim Mei Avenue, Tamar,
Hong Kong

Ref : DEVB(SR)303/01
Group : 6

19 July 2018

Development Bureau
Technical Circular (Works) No. 6/2018

Implementation of Buildability Evaluation System

Scope

This Circular promulgates the implementation of the Buildability Evaluation System (BES) for vetting and monitoring design of building projects funded under Head 703 of the Public Works Programme.

Effective Date

2. This Circular takes immediate effect.

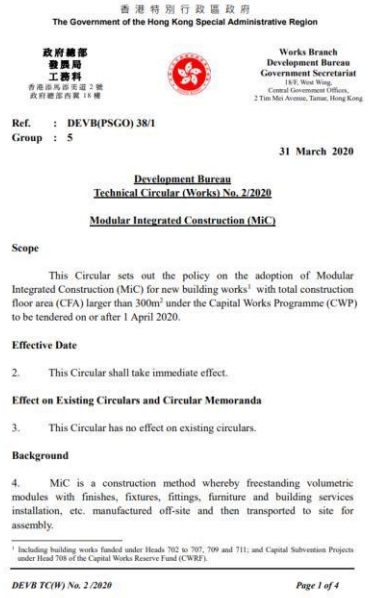
Effect on Existing Circulars and Circular Memoranda

3. Nil

Background and Objectives

4. The industry has long acknowledged the need for integrating the expertise of design and construction with a view to achieving practicability, smooth workflow, efficient use of resources as well as value-for-money within and across projects.

DEVB TC(W) No. 6/2018 *Page 1 of 4*



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2 Tim Mei Avenue, Tamar, Hong Kong

Ref. : DEVB(PSGO) 38/1
Group : 5

31 March 2020

Development Bureau
Technical Circular (Works) No. 2/2020

Modular Integrated Construction (MiC)

Scope

This Circular sets out the policy on the adoption of Modular Integrated Construction (MiC) for new building works[1] with total construction floor area (CFA) larger than 300m² under the Capital Works Programme (CWP) to be tendered on or after 1 April 2020.

Effective Date

2. This Circular shall take immediate effect.

Effect on Existing Circulars and Circular Memoranda

3. This Circular has no effect on existing circulars.

Background

4. MiC is a construction method whereby freestanding volumetric modules with finishes, fixtures, fittings, furniture and building services installation, etc. manufactured off-site and then transported to site for assembly.

[1] Including building works funded under Heads 702 to 707, 709 and 711; and Capital Subvention Projects under Head 708 of the Capital Works Reserve Fund (CWRF).

DEVB TC(W) No. 2 /2020 *Page 1 of 4*

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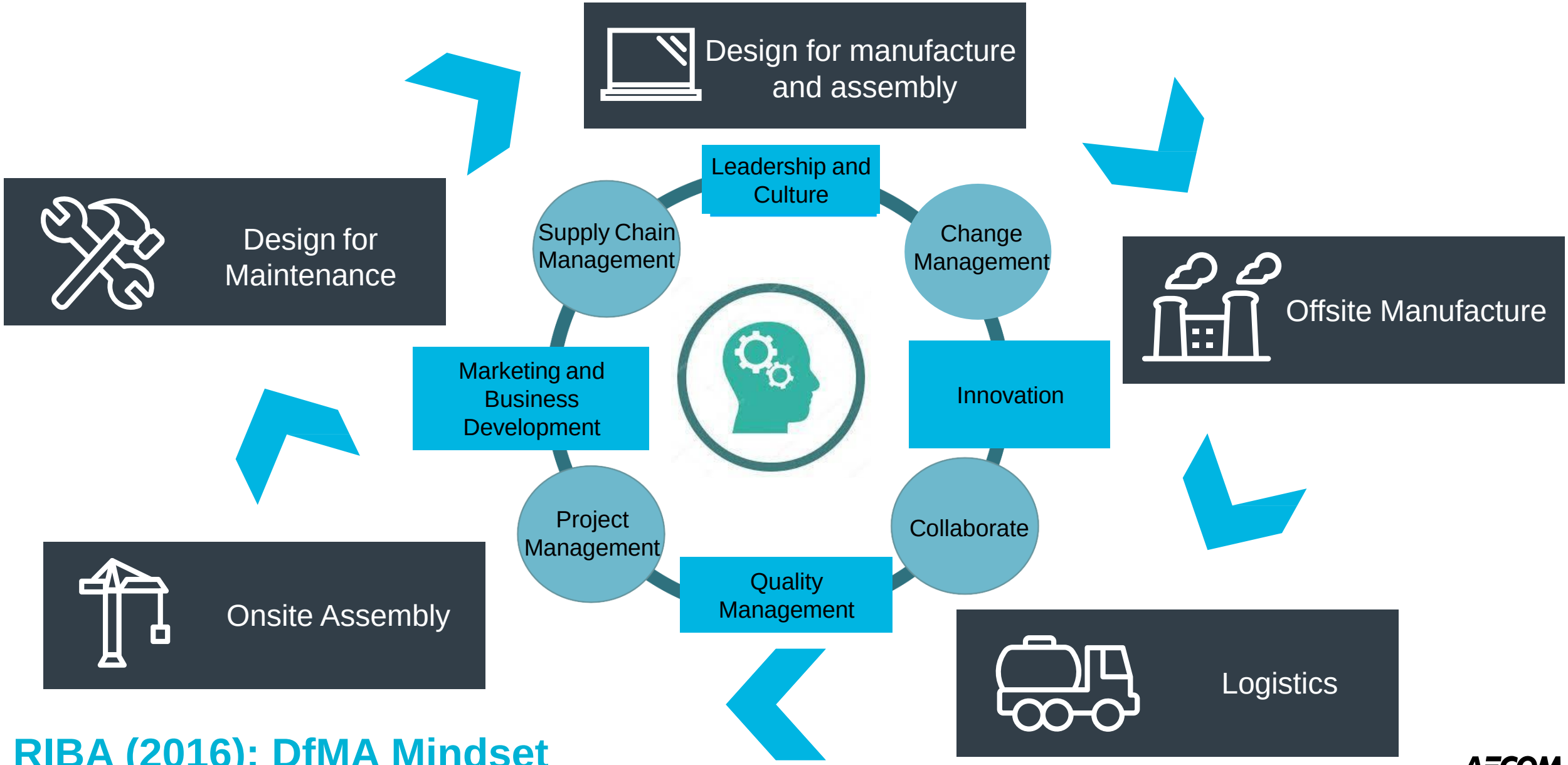
Duo Championship: MiC (Product Deliverable) + DMA (Process Management)



RIBA (2016): DfMA Mindset

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Enablers for Offsite Migration

(New Process for Old Wine)

PPVC Modules (Bare Shell)

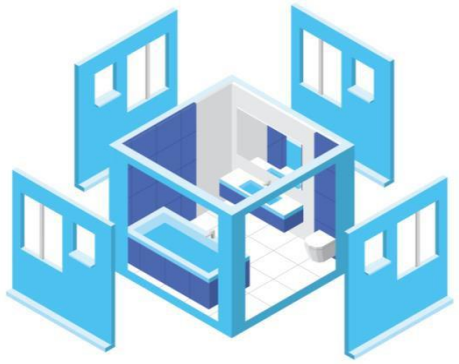
MiC Modules (Fully Integrated)

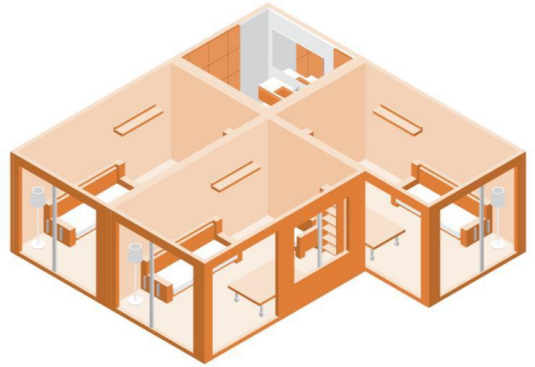
1. Bathroom

Innovative Enablers

- BIM as CAD/CAM for Construction Industry
- Sensing Technologies
- Artificial Intelligence (AI)
- Robotics and Other Automation and Mechanization
- Digital Logistic Management
- Digital Construction Management
- Internet of Things (IOT)
- DfMA Design and Procurement Management

2. Accommodation Room





Source of Images: Internet

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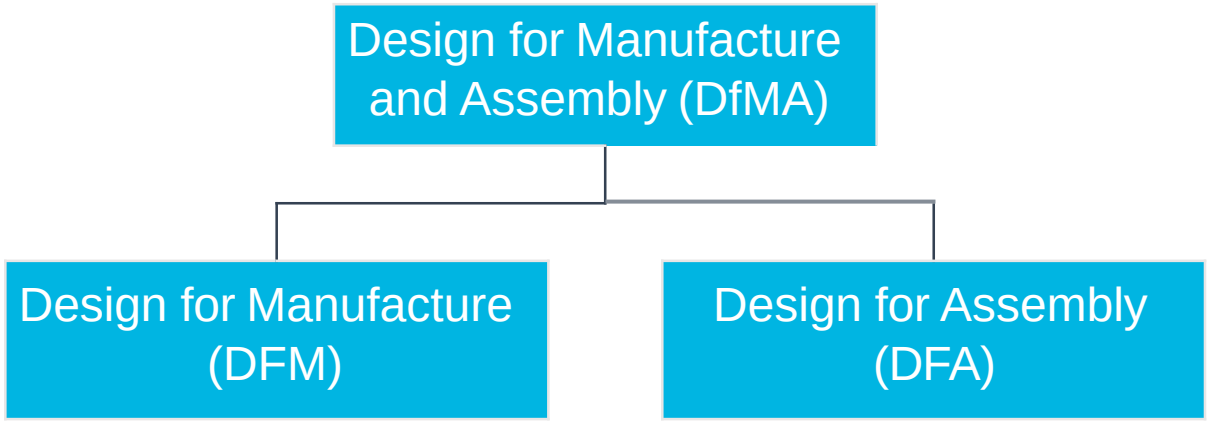
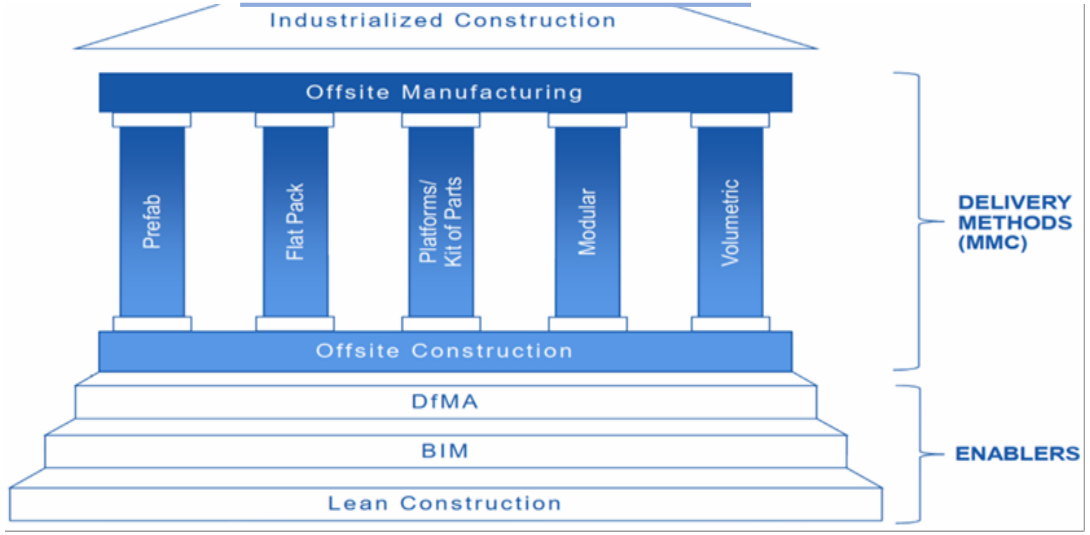
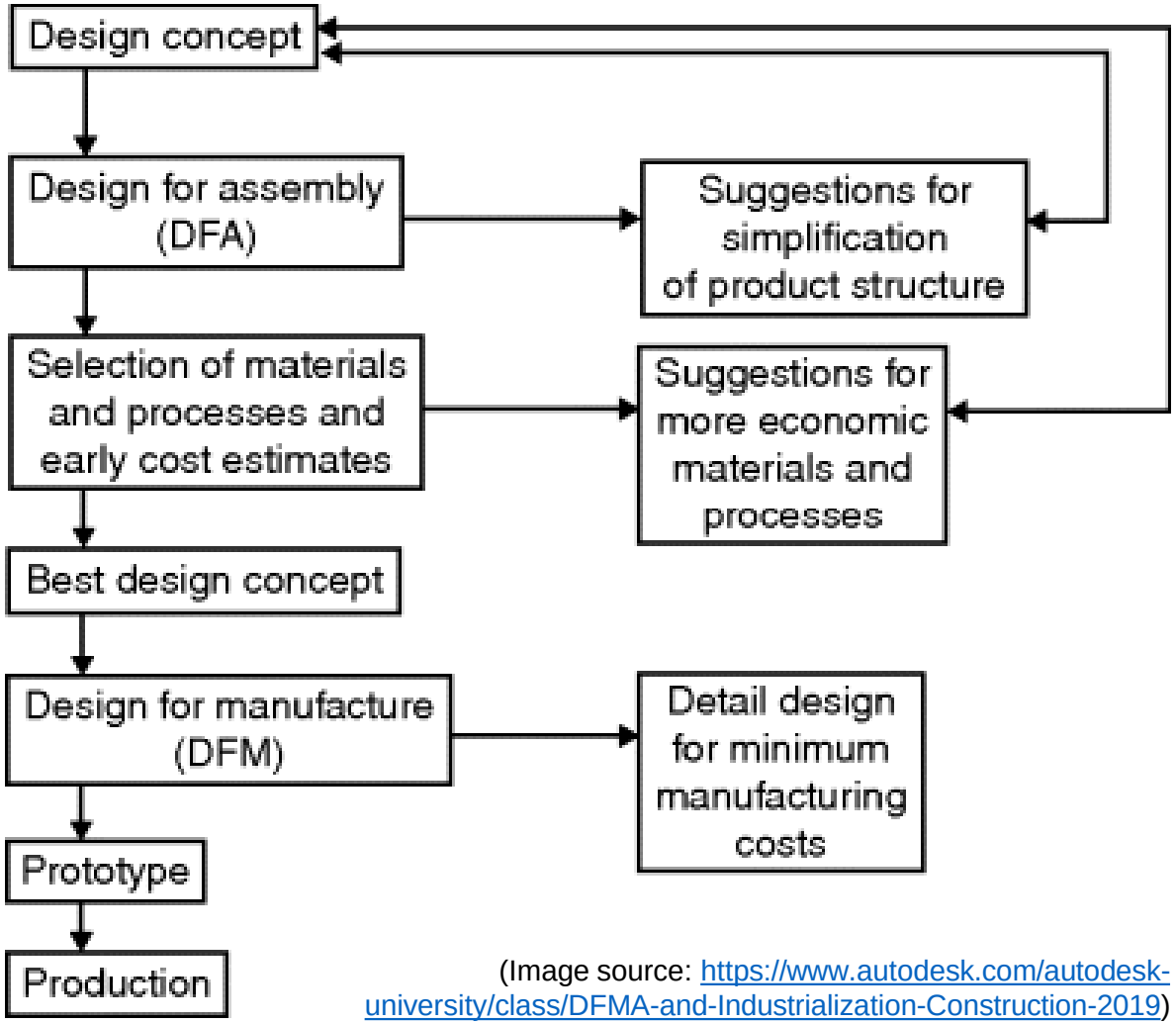
Basic Concepts of DfMA



DfMA and Industrialized Construction (IC)





(Image source: https://www.autodesk.com/autodesk-university/class/DFMA-and-Industrialization-Construction-2019)

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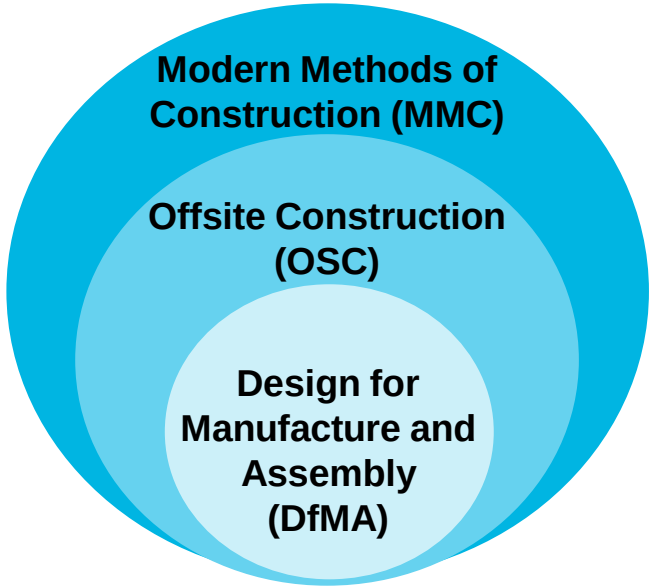
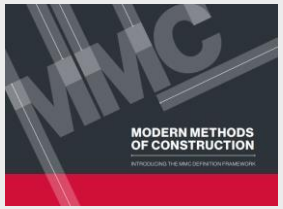
DfMA in Construction



Different offsite techniques:

Level	Category
1	Component manufacture & subassembly
2	Non-volumetric preassembly
3	Volumetric preassembly
4	Modular systems or buildings
5	Hybrid system

Modern Methods of Construction: Introducing the MMC Definition Framework (2019)



The MMC Definition Framework helps evaluate the different ways of increasing the 'Pre-Manufactured Value' (PMV):

Category 1 – Pre-Manufacturing - 3D primary structural systems

Category 2 – Pre-Manufacturing - 2D primary structural systems

Category 3 – Pre-Manufacturing - Non systemised structural components

Category 4 – Pre-Manufacturing - Additive Manufacturing

Category 5 – Pre-Manufacturing – Non-structural assemblies and sub-assemblies, including MEP items such as utility cupboards, risers, plant room as well as pre-formed wiring looms and mechanical engineering components

Category 6 – Traditional building product led site labour reduction/ productivity improvements

Category 7 – Site process led labour reduction/ productivity improvements

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The Building Service Research & Information Association (BSRIA), UK

Offsite Construction Spectrum

Modular Buildings

- Student accommodation
- Hotels
- Services stations
- Food & retail outlets
- Commercial offices
- Prisons
- Domestic housing
- Workshops/process areas
- Laboratories

Preassembled Units/ Modules

- Total integrated services
- Air handling & boiler plantrooms
- Bathroom & toilets
- Lifts
- Generators
- Electrical switchgear
- Uninterruptible Power Supply (UPS)
- Data & telecommunications
- Water tank rooms

Prefab plant room

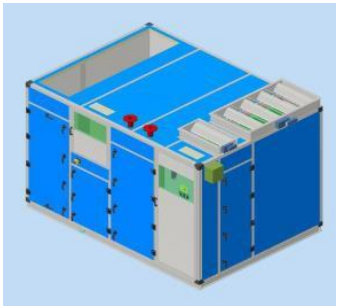
Prefabricated Horizontal & Vertical Distribution

- Sprinklers
- Cable management
- Chilled and hot water pipework
- Ductwork
- Plumbing and sanitary pipework
- Rainwater pipework
- Data & telecommunications
- Multi service distribution
- Modular wiring system

Prefab horizontal module or vertical riser

Terminal Unit Assembly

- Fan coil units
- Air handling units
- VAV boxes
- Radiators
- Sanitary fittings
- Distribution boards
- Floor boxes
- Light fittings



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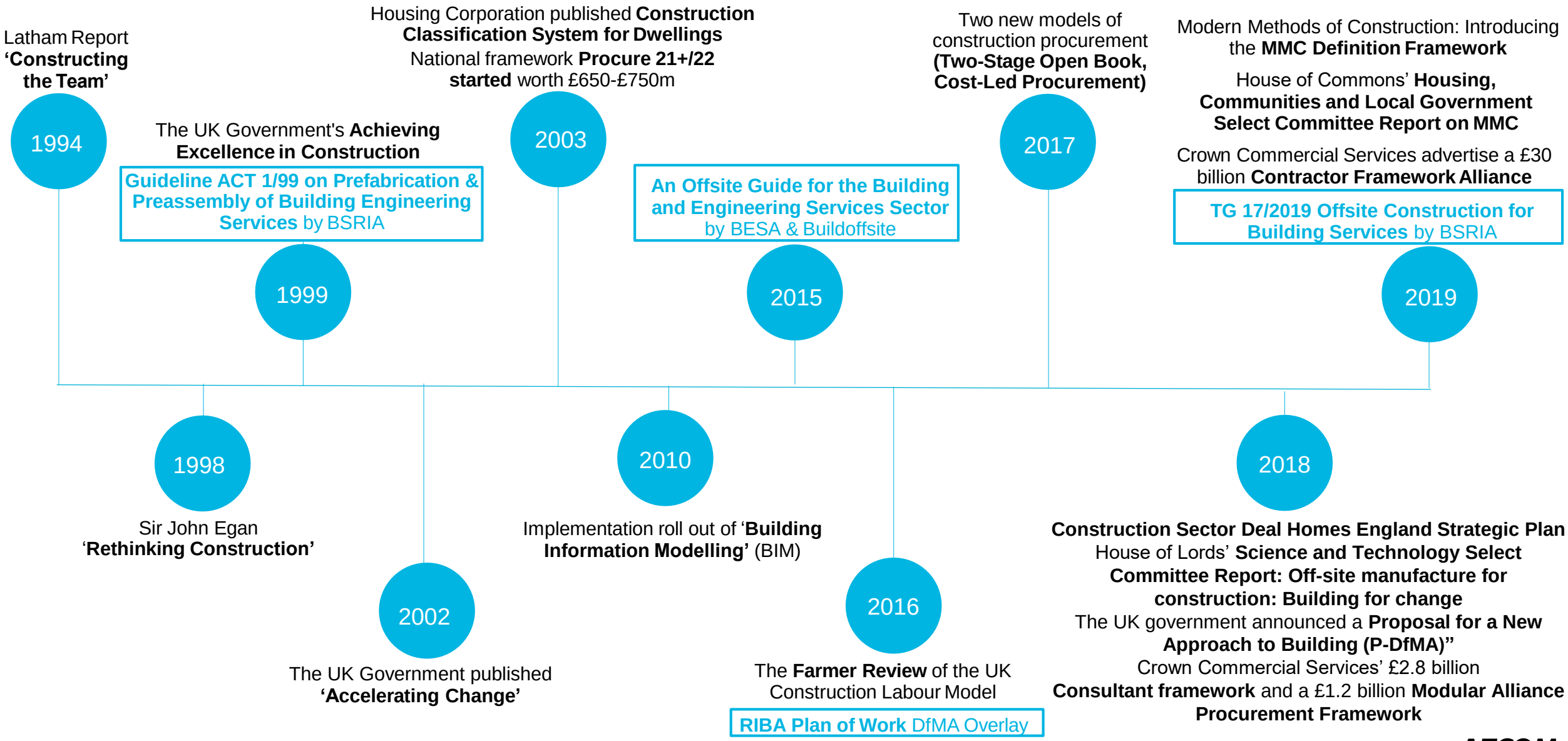
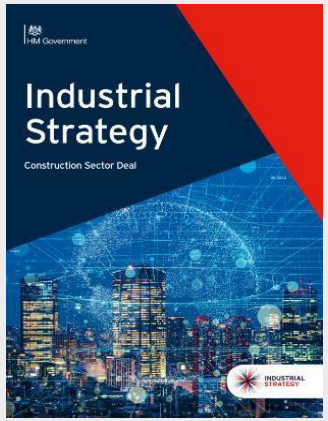
Background and History – United Kingdom



Construction Industry Strategy for the United Kingdom

Construction Sector Deal (2018)

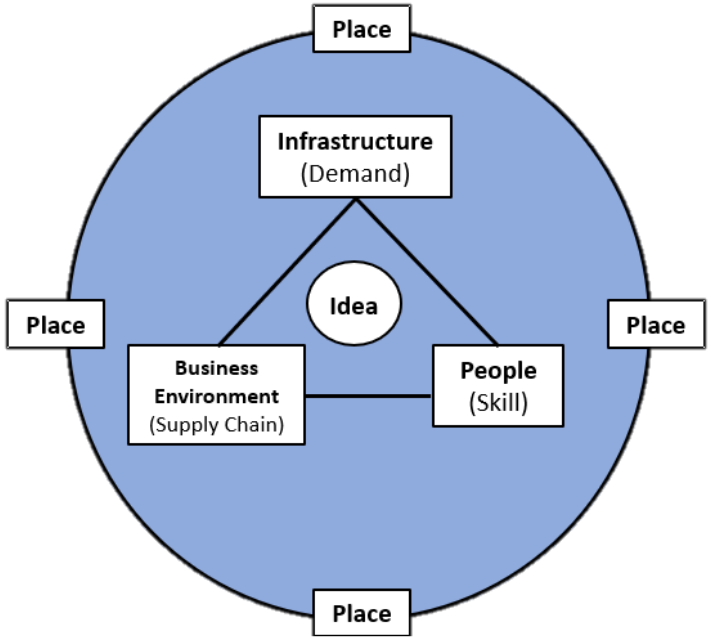


Three focuses for better productivity and performance:

- **Digital Techniques**
- **Offsite Manufacturing Techniques**
- **Whole Life Asset Performance**

Five foundations of the Industry Strategy :

1. **Idea** – investment to innovate and accelerating in the development of digital and manufacturing-based approaches
2. **People** – reforming industry recruitment and training
3. **Infrastructure** – National Infrastructure and Construction Pipeline to support the government's ambition
4. **Business environment** – developing a better procurement and sustainable business model
5. **Places** – working across the sector to strengthen the supply chain and skills base across the UK and extend to overseas



Relationship between the five foundations

MiC Projects in the United Kingdom

101 George Street, Croydon (Residential) (44-Storey, 135m(H))

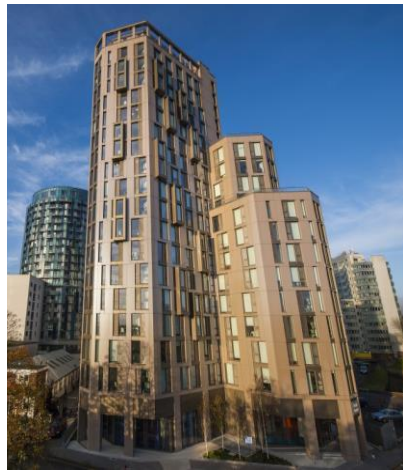
11 Mapleton Crescent, Wandsworth (Residential) (23 Storeys, 89.2m(H))

Apex House, Wembley (Residential) (23 Storeys, 75.3m(H))

Two-Fifty One, London (Residential-commercial) (43 Storeys, 134.05m(H))

The Madison, London (Residential-commercial) (53 Storeys, 184m(H))

Felda House, Wembley (Student accommodation) (19 Storeys, 55m(H))



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DfMA MEP Projects in the United Kingdom

The Madison
(High-rise Residential)
(55 Storeys)

Prefabricated Modules, including:

- 482 nos. bathroom pods
- MEP Panels, comprising of Heat Interface Units (HIU), insulated water supply pipework, drainage pipework, MCB board and socket outlets

Quadram Institute
(Healthcare Facility)
(4 Storeys)

217 Nos. Prefabricated Modules, including:

- 36 Nos. AHU valve arrangements
- 164 Nos. Horizontal Pipework and Electrical Containment Modules
- 6 Nos. Ductwork Risers (with Platforms, 4 floors in height)
- 4 Nos. Pipework Risers (Ditto)
- 3 Nos. Electrical Risers (Ditto)
- 4 Nos. Plantroom Pump Skids

Crossrail Underground Train Station
(Infrastructure)

Prefabricated Modules, including:

- Vertical riser modules
- Horizontal modules

Two-Fifty One
(High-rise Residential-Commercial)
(41 Storeys)

Prefabricated Modules, including:

- 13 Nos. Horizontal Modules
- 11 Nos. Vertical Riser Modules
- 11 Nos. Prefabricated Plantroom Skids
- 499 Nos. Bathroom Pods

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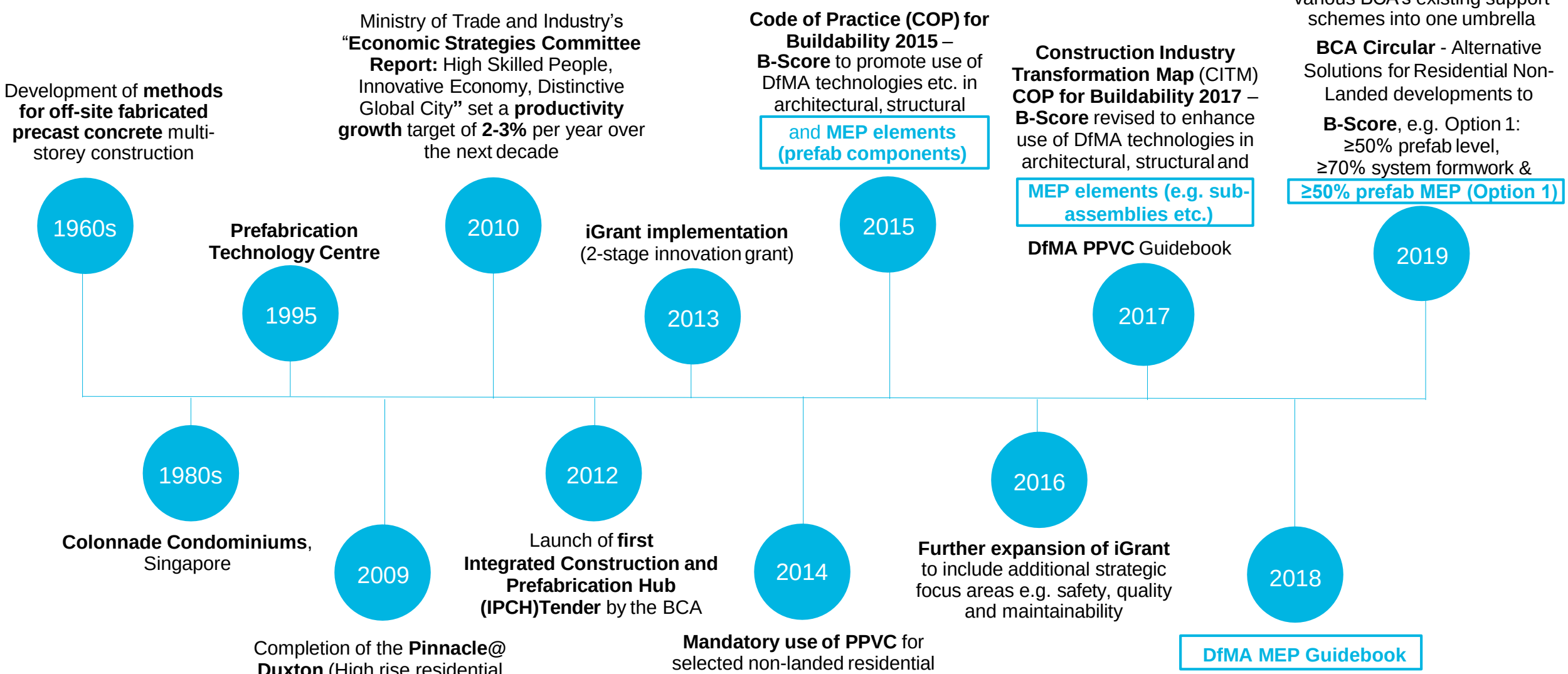
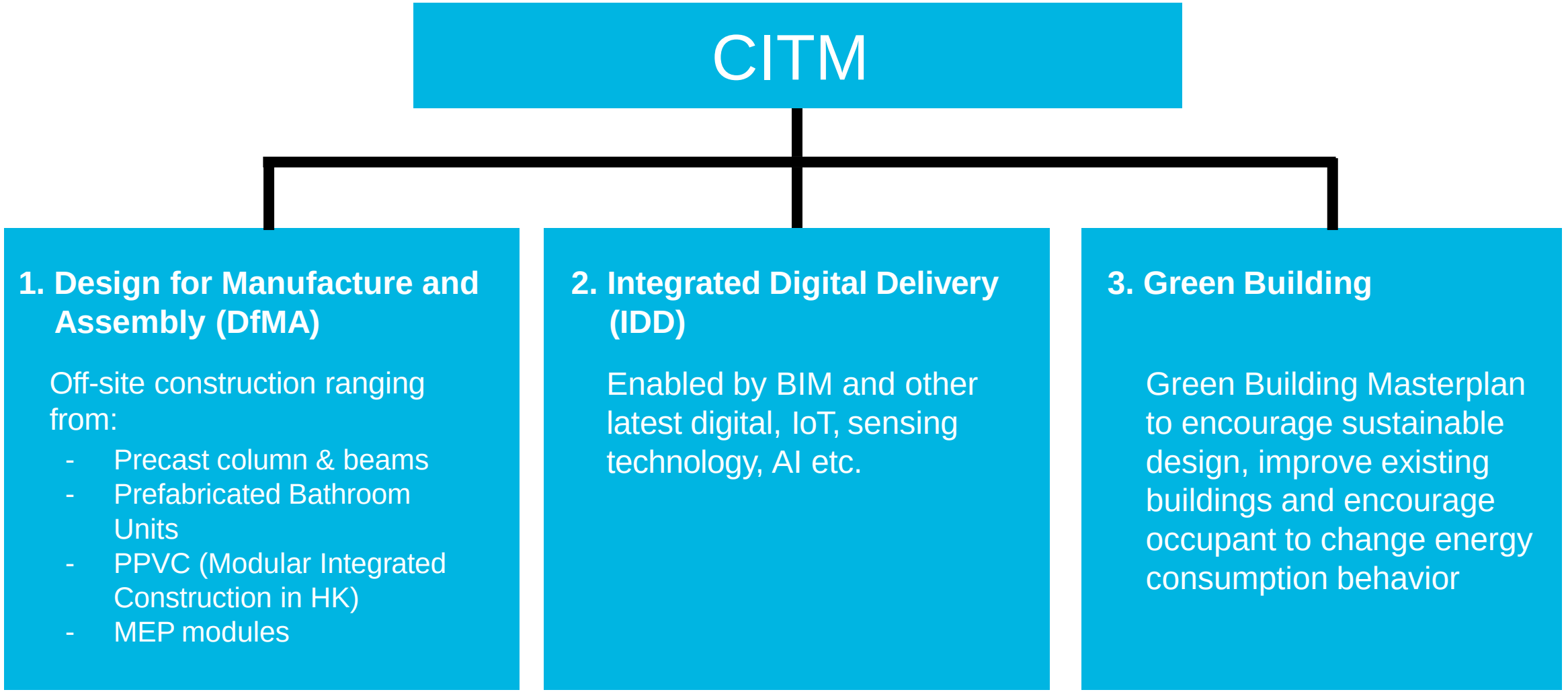
Background and History – Singapore



Construction Industry Strategy for Singapore

Pillars for the Construction Industry Transformation Map (CITM)



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Ecosystem for Supporting Singapore's CITM

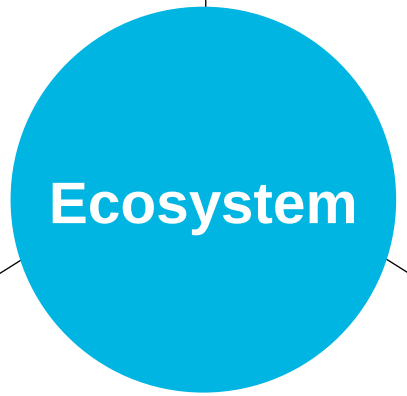
1. Generate Lead Demand

Public Sector

- Productivity Gateway Framework for government procurement
- Code of Practice for Buildability
- Public Sector Construction Productivity Fund (PSCPF)*

Private Sector

- Rollout of Government Land Sales with appropriate DfMA conditions
- Code of Practice for Buildability



2. Build Up Supply Chain

Land, Accreditation Schemes, Multi-Agency Approval Platform and Funding

- Integrated Construction and Prefabrication Hubs (ICPHs)
- PPVC Manufacture Accreditation Scheme (MAS) under Singapore Concrete Institute and Structure Steel Society of Singapore (SSSS)
- Prefabricated MEP Manufacturer Accreditation Scheme (STAS) with the Specialist Trade Alliance of Singapore (STAS)
- Building Innovation Panel (BIP) to expedite statutory evaluation and approval on using innovative technologies
- Productivity Innovation Project (PIP)*
- Investment Allowance Scheme (IAS)*
- Productivity Solutions Grant (PSG)

3. Develop Industry Capabilities

Guidebooks and Training

- Design for Manufacturing and Assembly (DfMA) Prefabricated Prefinished Volumetric Construction (2017)
- Design for Manufacturing and Assembly (DfMA) Prefabricated Mechanical, Electrical and Plumbing (MEP) Systems (2018)
- BCA Academy Courses, e.g.
  - Specialist Diploma in MEP Modularization (SDMM)
  - The Basics of Design for Manufacturing and Assembly (DfMA)

*For Details on BuildSG Transformation Funds, Please Visit https://www.bca.gov.sg/professionals/govasst/buildsg- transformation-fund-btf.html

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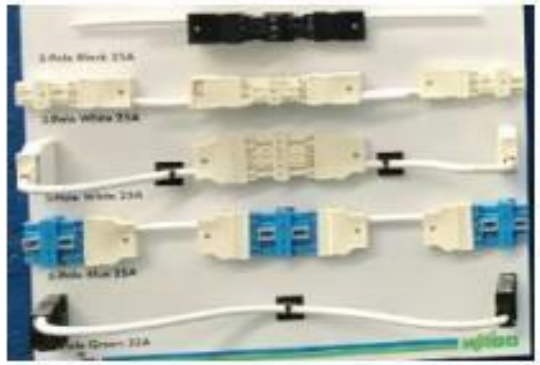
Singapore Buildability Framework

Prefab Components

Pre-insulated Plastic Piping



Sub-assemblies

Include MEP Services Only

Integrate With Architectural/ Structural Components

Prefab Horizontal Module With Ceiling Board

Integrated Assemblies MEP PPVC

Complete Assembly

Prefab Plant Room

Manpower Savings (Trade Level)

30% Prefab Horizontal Services / Vertical Riser Modules 45% Prefab Vertical Riser Module With Catwalk 60% 70%

Photo Courtesy of the BCA Academy, Singapore

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Promotion of DfMA Technologies in Singapore

Legislation Framework to Enhance DfMA – Buildability Score for DfMA MEP, Code of Practice on Buildability

COP on Buildability 2015		COP on Buildability 2017		Alternative Solutions for Residential Non-Landed developments (2019)
System	**Points**	**System**	**Points**	Deemed Acceptable Solutions Option 1 ≥50% prefabrication level + ≥70% system formwork + **≥50% prefabricated MEP** Option 2 ≥65% prefabrication level + ≥70% system formwork Option 3 ≥60% PPVC adoption OR Open Option Any proposal which can achieve minimum 20% productivity improvement (from 2010's level)
Prefabricated pre-insulated duct (mandated)	4	Prefabricated pre-insulated duct (mandated)	1	
Flexible sprinkler dropper	2	Flexible sprinkler dropper	1	
Flexible water pipes	1	Flexible water pipes	1	
Common M&E brackets	2	Common M&E brackets	1	
		Prefab MEP modules integrated with work platform/catwalk	5	
		Prefab MEP modules e.g. pipes, cable trays, trunking etc.	4	
		Prefab MEP plant modules e.g. pump, compressor etc.	4	

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MiC Projects in the Singapore

Clement Canopy Condominium at
Clementi Ave 1 (40 Storeys)

Woodlands Nursing Home
(9 Storeys)

NTU North Hill Hostel
(13 Storeys)

Crowne Plaza Hotel Extension
(10 Storeys)

Brownstone Executive Condominium at
Canberra Drive (10 & 12 Storeys)

Wisteria at Yishun Avenue 4 –
Commercial and Condominium Development
(12 Storeys)

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DfMA MEP Projects in Singapore

- Case studies for prefabricated MEP systems

Global Switch Data Centre
(5 Data Floors)

a. Construction period: Dec 2016 to Nov 2018
b. GFA: ~ 25,000 m^2
c. 337 prefab modules for:
   - Horizontal ceiling svcs
   - Roof cooling tower
   - Riser
   - Plant room
   - External MEP svcs with catwalk

SMU Tahir Foundation Connexion (Phase 1)
(5 Storeys)

a. Construction period: Jul 2018 to Oct 2019
b. GFA: ~ 8,600 m^2
c. Prefab modules for:
   - Horizontal ceiling svcs (L3 – L5)
   - Risers (L2 – L5)
   - Plant room

Rivervale Community Centre
(5 Storeys)

a. Construction period: Sep 2018 to Sep 2020
b. GFA: 5,726 m^2
c. Prefab modules for:
   - 10 nos. horizontal corridor ceiling svcs
   - Riser
   - Pump skids

JTC Woodlands North Coast
(9 Storeys)

a. Construction period: Aug 2018 to Apr 2020
b. GFA: 43,900 m^2
c. Total 272 prefab modules for:
   - 272 nos. horizontal modules for electrical, ELV and air-con duct

CapitaSpring
(51 Storeys, 280m(H))

a. Construction period: Dec 2017 to Nov 2020
b. GFA: 93,350 m^2
c. 522 prefab modules for:
   - Horizontal corridor ceiling svcs
   - AHU
   - FCU
   - Prefabricated toilet sub-assemblies

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Background and History – Hong Kong

HSBC Main Building

1980s

16-Storey **public housing blocks** constructed with **precast concrete panels**

1960s

Prefabricated Terminal Building Roof, Hong Kong International Airport

Launch of **BEAM** for New and Existing Offices

1996

Joint Practice Note (JPN) No. 1 Green and Innovative Buildings

2001

JPN No.2 Second Package of Incentives to promote Green and Innovative Buildings

2002

Launch of revised HK-BEAM for new and existing building developments

Completion of a **32-storey residential project in Fu Tei, Tuen Mun**, featuring 9 standardised precast elements, e.g. bathroom units and kitchens etc.

2004

DEVB Technical Circular No. 5/2009; Environmental Bureau Circular No. 2/2009 **Green Government Buildings**

2009

BEAM Plus Version 1.2

2012

“3S Principle” (Standardization, Simplification, Single Integrated Elements)

2013

HK$1 Billion CITF Construction 2.0

DEVB Technical Circular TC(W) No. 6/2018 **Buildability Evaluation System (BES)**

2018

BEAM Plus 2.0

JPNs No.1 & No.2 updated to promote MiC adoption

APP-161 GFA exemptions for MiC Adoption by BD

Guidelines/ circular letters by BD, FSD, WSD, EMSD, TD & CIC

2019

DEVB TC(W) No. 2/2020 **Adoption of MiC for new building works** with CFA>300m^2

DEVB TC(W) No. 6/2020 **Guidelines** for design review and **implementation of BES**

2-Storey MiC Mock-up by the **Housing Authority**

Reference materials on statutory requirements and logistics and transport by **CIC**

2020

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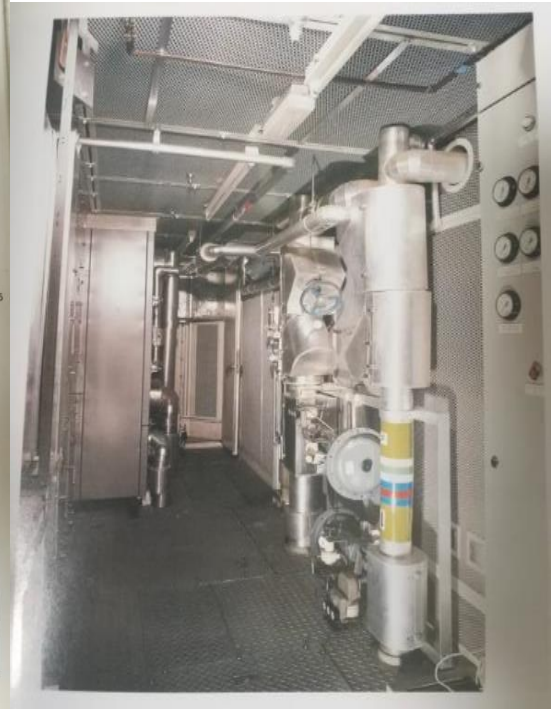
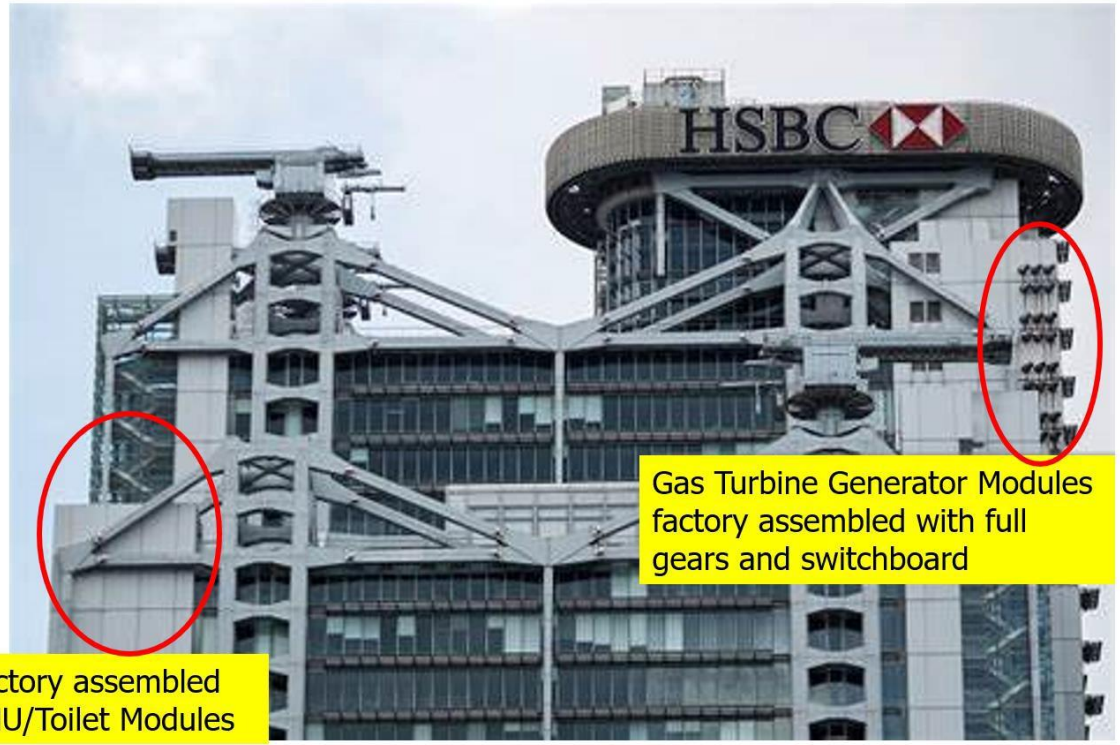
DfMA MEP in Hong Kong during the 1980s

AHU Module Stacking in HSBC





DfMA MEP Elements in HSBC

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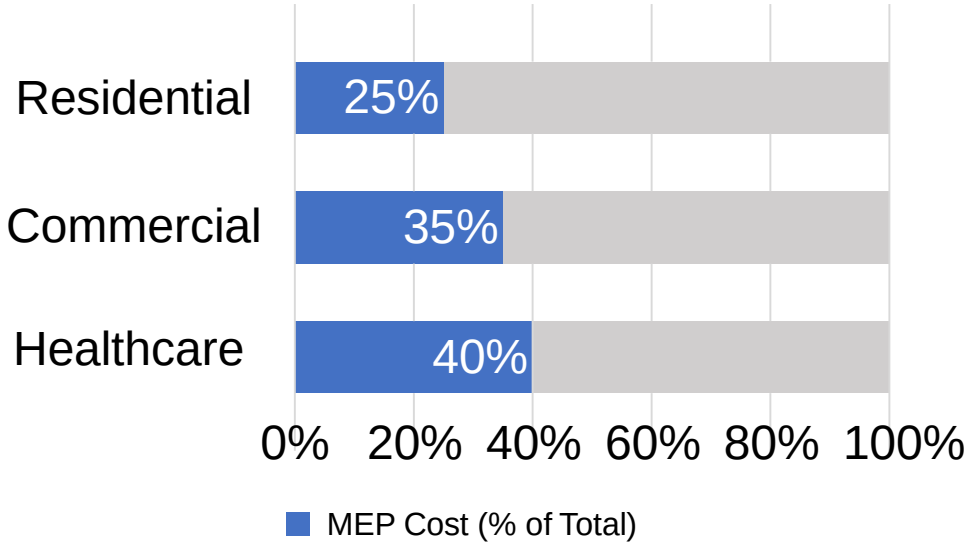
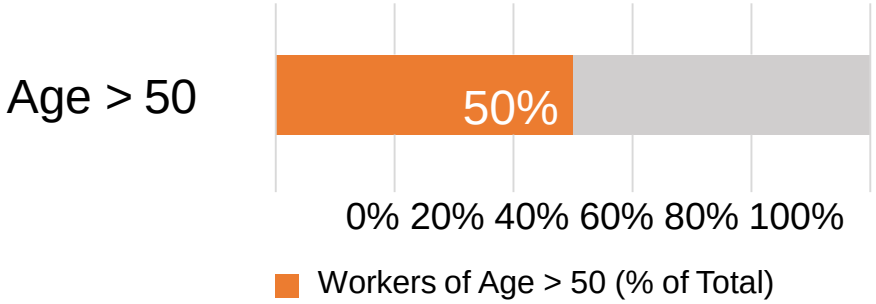
MEP Cost, Labor Forces and Time Saving

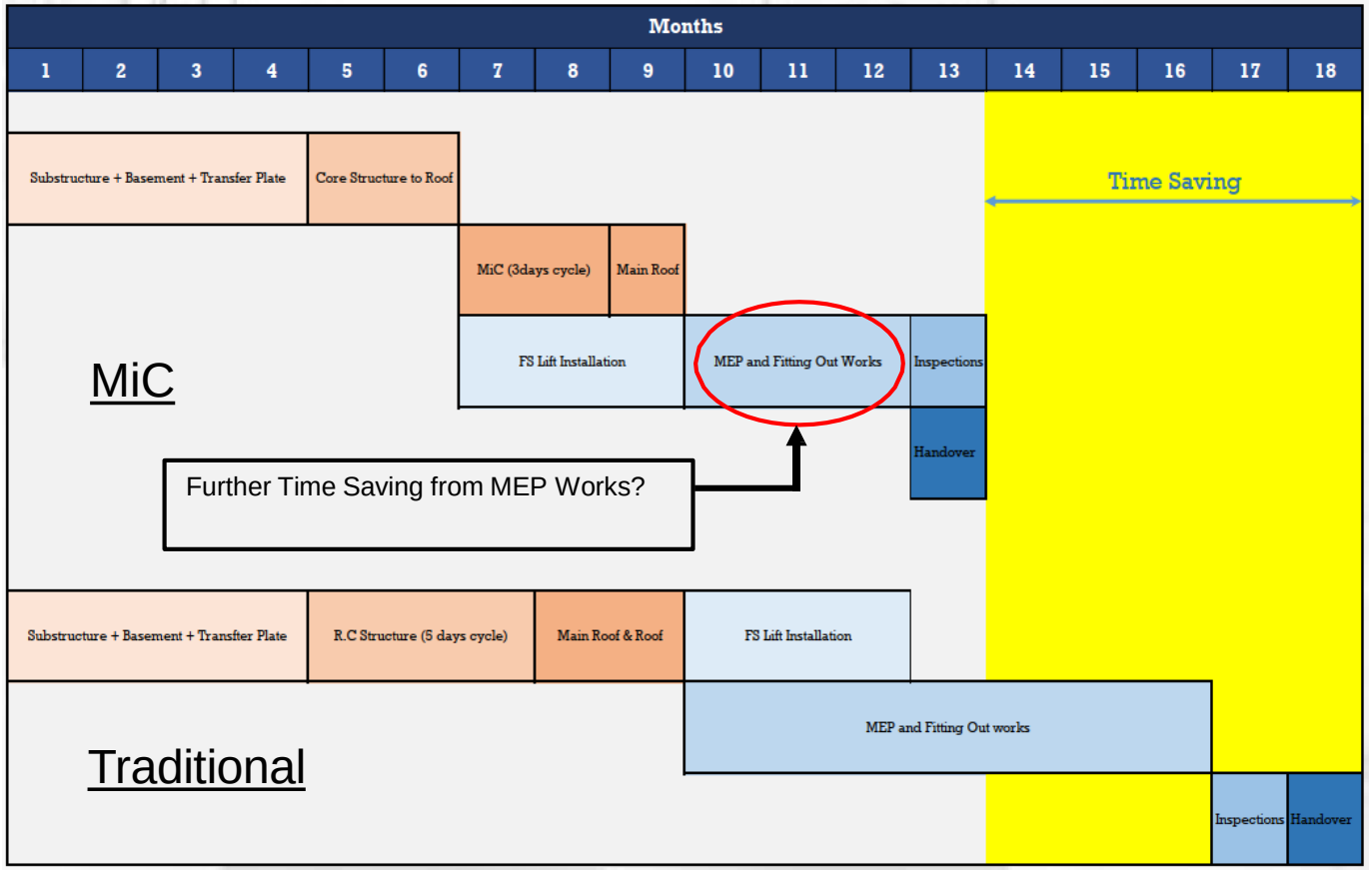
MEP Cost in Construction Projects



Age of Workers (MEP)



Time Saving (Project Overall)



Source: Presentation: MiC Journey & Adoption for InnoCell by HKSTP in 2019

Note: Total No. of Registered Workers of MEP Trades: **67637** (as of May 2020)

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MiC Projects in Hong Kong

Disciplined Services Quarters for the Fire Services Department at Pak Shing Kok, Tseung Kwan O (16-17 Storeys)

Elderly's Home at Jat Min Chuen in Sha Tin (10 Storeys)

InnoCell at Hong Kong Science Park (15 Storeys, 59.2m(H))

Residential Care Homes for the Elderly ("RCHE") in Kwun Tung North (8 Storeys)

Temporary Quarantine Facilities at Penny's Bay

Student Residence at Wong Chuk Hang Site for the University of Hong Kong (17 Storeys)

Transitional Homes at Nam Cheong Street in Sham Shui Po (4 Storeys)

Transitional Homes at Yen Chow Street in Sham Shui Po (4 Storeys)

Transitional Homes at Yip Shing Street in Kwai Chung (4 Storeys)

MiC Negative Pressure Isolation Ward (Prototype) at Zero Carbon Park, Kowloon Bay

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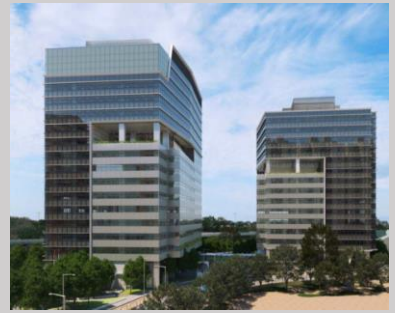
DfMA MEP Projects in Hong Kong

- Trunking risers in Electrical/ ELV Riser Room by 50%

Disciplined Services Quarters for the Fire Services Department at Pak Shing Kok, Tseung Kwan O (16-17 Storeys)

- 20 Nos. multiple-trade modules, completed with ductwork, VAV box and trunkings

Transport Department's Vehicle Examination Centre at Sai Tso Wan Road, Tsing Yi (3-Storey Inspection Hall + 7-Storey Office)



- 21 Nos. pipe modules completed with pipework, valve and pipe accessories
- 20 Nos. cooling tower modules

West Kowloon Government Offices in Yau Ma Tei, Kowloon (15-18 Storeys)

- 7 Nos. pipe riser modules completed with pipework, valve and pipe accessories

HKSH Eastern Medical Centre (12 Storeys)

- 2 x 4.5km service maintenance tunnel, comprising of fire service and drainage piping

TMCLK Link J3728

- Ductile iron pipe header, branch and tee-off pipework and completed with fittings, valves and accessories
- Modular counter flow type cooling tower – upper deck and lower deck assembly

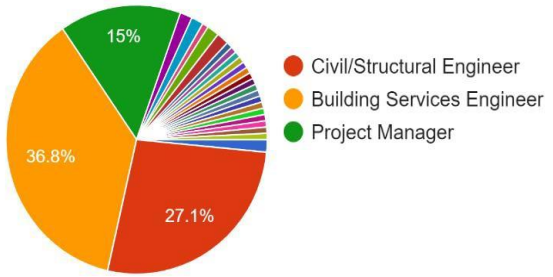
I-Square (31 Storeys)

Respondents' Profile

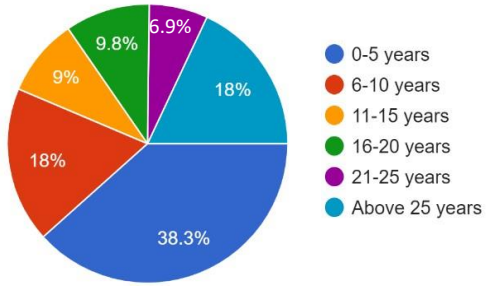
- Total **133** respondents
- Type of company/ organization
  - Government: 15.8%
  - Developer: 9%
  - MEP Consultant: 14.3%
  - Main Contractor & Sub-contractor: 36.8%
- Role in the company/ organization
  - Building Services Engineer: 36.8%
  - Project Manager: 15%
- Years of working experience in the industry
  - >10 years: 43.7%
  - **>20 years: 24.9%**
- Attendance of DfMA-related training/seminar
  - Yes: 45.9%
  - **No: 54.1%**
- Participation of building projects with DfMA adoption
  - Yes: 24.1%
  - **No: 75.9%**
- Generally **agree** with the **potential use** of sub-assemblies and integrated assemblies

Type of company/ organization

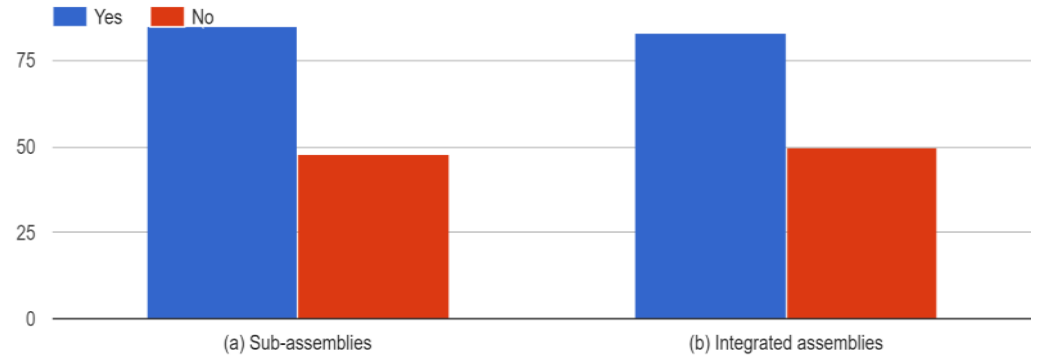
Role in company/ organization



Years of working experience



Potential use



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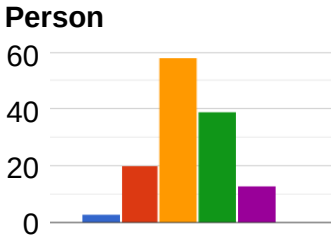
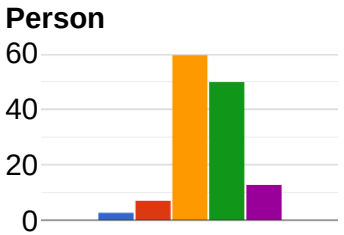
Respondents' Views on Benefits

Legends
- Irrelevant
- Not Important
- Moderate
- Important
- Very important

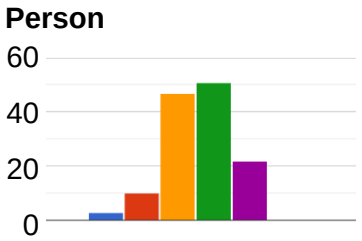
1 Reduce Overall Costs



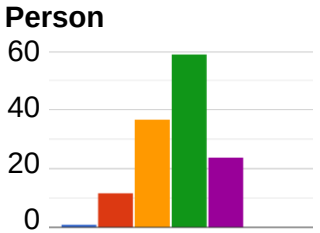
2 Scale of Economy by Standardization



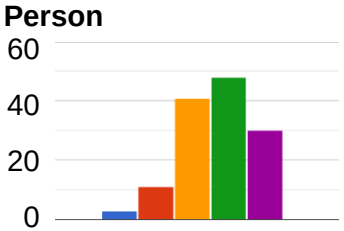
3 Positive Impact on Health & Safety



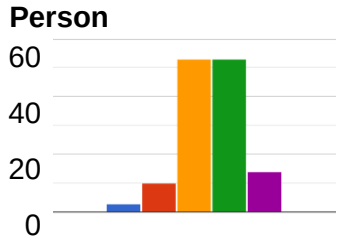
4 Reduce On-site Works & Impacts



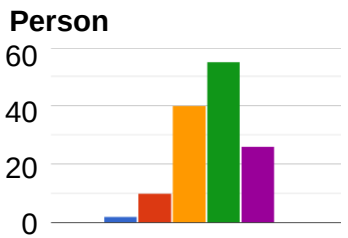
5 Improve Workmanship & Quality



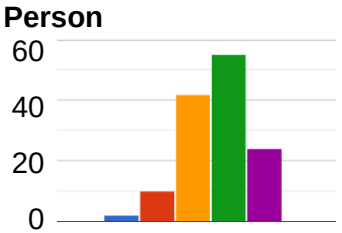
6 Simplify Manufacturing & Assembly Processes



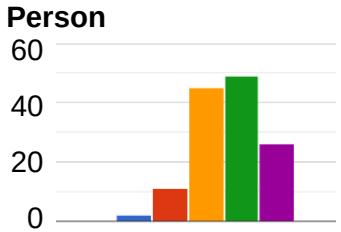
7 Shorter Construction Time



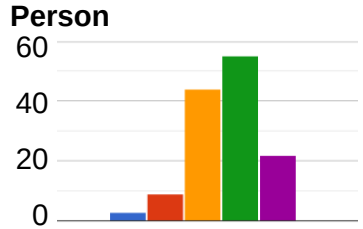
8 Increase Reliability & Efficiency



9 Reduce On-site Labour & Skills



10 Reduce Waste & Environmental Impact



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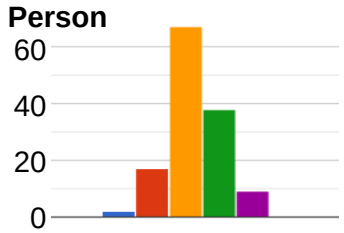
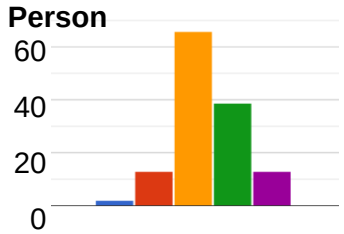
Respondents' Views on Barriers

Legends
- Irrelevant
- Not Important
- Moderate
- Important
- Very important



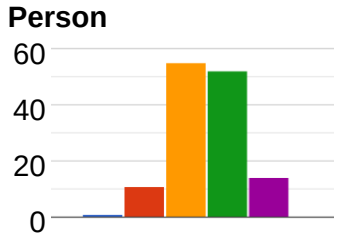
1

Lack of Demand



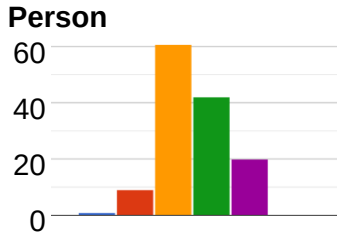
2

No Suitable Procurement Model for DfMA



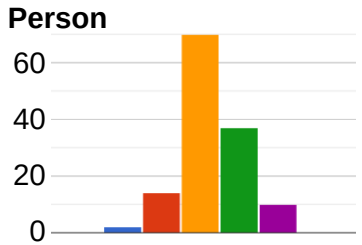
3

Upfront Cost for Adoption



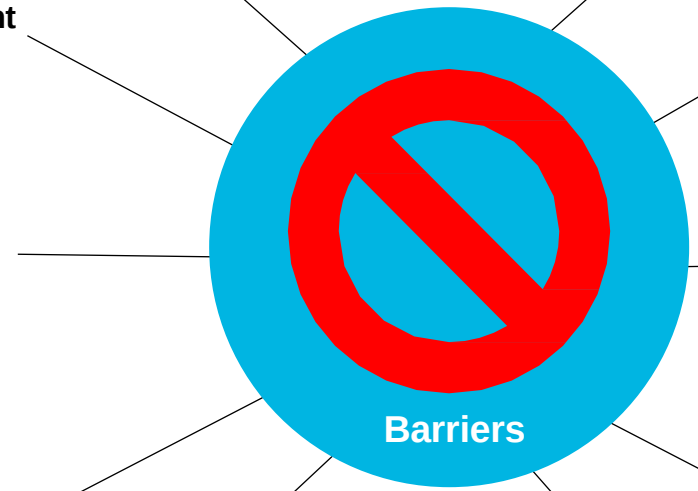
4

Industry Inertia/ Culture against Change



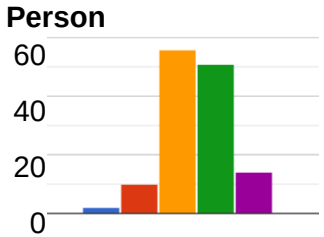
5

Unseen Benefits



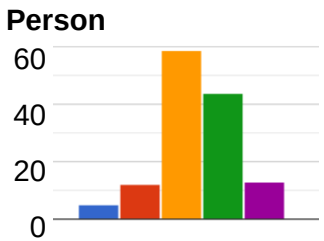
6

Lack of Standardization



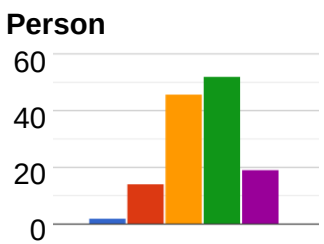
7

Regulatory Hurdles



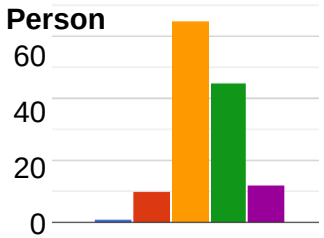
8

Lack of Expertise & Training



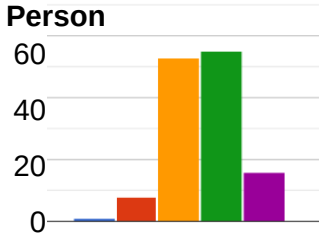
9

Fragmentation of the Industry



10

Lack of Cross-supply Chain Collaboration



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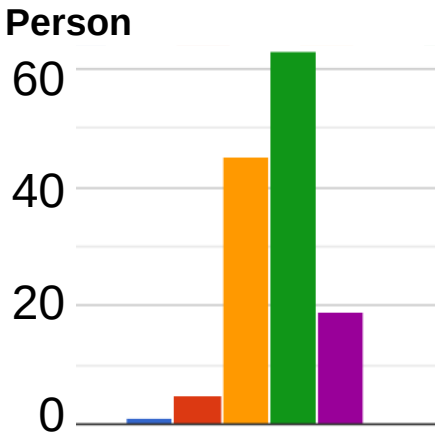
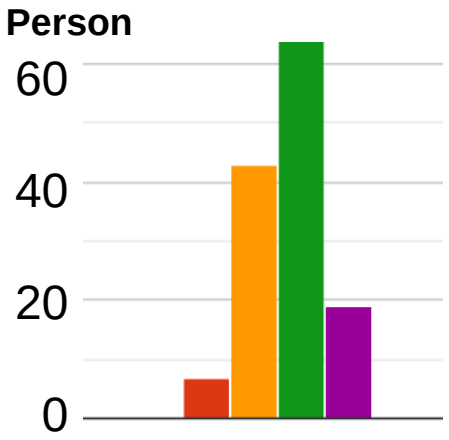
Respondents' Views on Strategies

Legends
- Irrelevant
- Not Important
- Moderate
- Important
- Very important



1

Raise Awareness by Education and Information

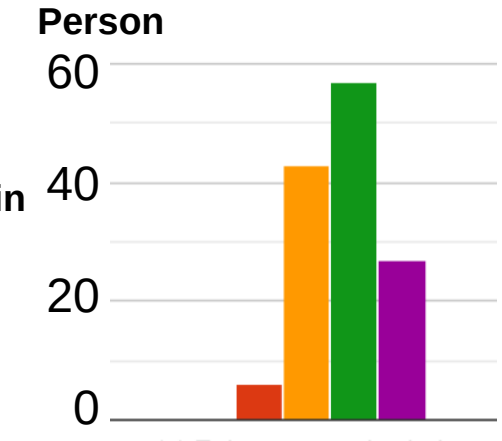


2

Engage Stakeholders to Create the Demand

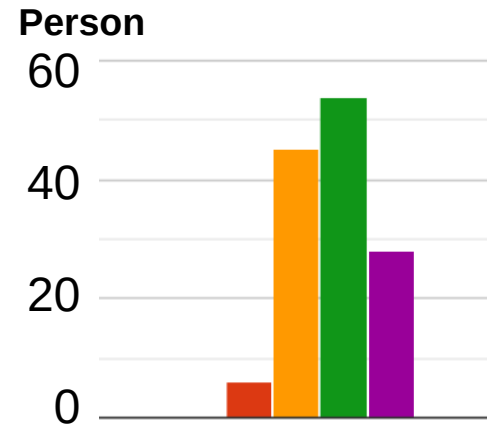
3

Enhance Supply Chain Collaboration/ Ecosystem



4

Build Up Local Capability and Skills



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Initiatives for Implementing the Strategies

Initiatives for Implementing the Strategies

1. **Top management** to understand the benefits and transform their organizations
2. Judge project outcome with **new KPIs**
3. Launch **pilot project** to show benefits and form database for quantification
4. Establish **framework** for the new KPIs

1. Define **a road map** for buildability & productivity
2. Progressive **development** for wide MEP **spectrum**
3. **In short term**, adoption of **MEP equipment**-based integration in plantrooms
4. **In mid and long term**, adoption of services **sub-assemblies** and integration with **architecture**
5. Establish a **reference document** on standard, methodology and the required level of details
6. Establish **BIM templates** and **BIM object libraries**

1. Establish **new quality standards** for MEP elements, e.g. multi-service supports
2. Establish **wider standardization** for economy of scale
3. **Harmonize** the manufacturing standards for more choice
4. **Bridge the HK standards** and share practices with regional practitioners

1. Review the regulatory mechanism for **works executed across borders**
2. Establish a robust and efficient regulatory mechanism

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Initiatives for Implementing the Strategies

2.5 New contract arrangement

1. Review current **procurement, approval and payment practices** for offsite construction elements
2. Establish **standards** of guideline for **procuring offsite construction** to enable early contractor input
3. Review the **standards of measurement** for any adjustment required
4. Review the **procurement options** to enable Early Contractor Involvement

2.6 New project management approach

1. **Review** current project management practice
2. Establish standards of guideline for **management of offsite construction**
3. **Share information** and experience
4. Launch **pilot project and R&D study** to refine the approach

2.7 New government incentives

1. Review feasibility for local **offsite manufacturing hub**
2. Review **CITF** funding support
3. Review environmental benefits using **BEAM Plus**

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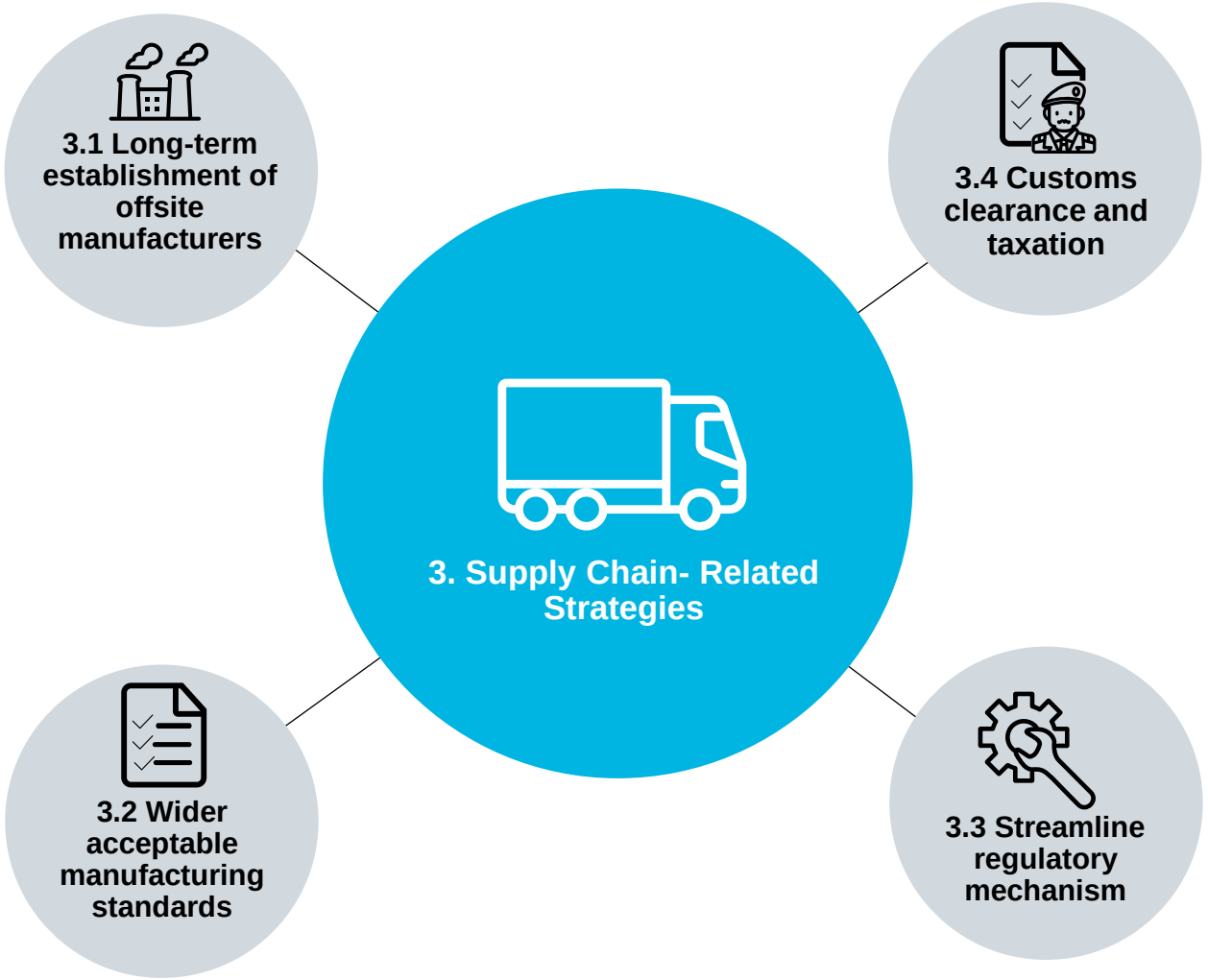
Initiatives for Implementing the Strategies

1. Long-term establishment of manufacturers by creating **long-term demand**
2. Progressively establish the criteria for **good manufacturing practice**
3. Explore opportunity for **MEP offsite manufacturing hub**



1. **Share the information and experience** for dealing with the customs clearance and the taxation system

1. Facilitate suppliers to have their **products accredited** by clients and statutory authorities
2. In long term, **harmonize** Chinese GB Standards and other International Standards against the local practices

1. Streamline the **regulatory control** for manufacturing across the borders and subsequent on-site **inspection**.

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Initiatives for Implementing the Strategies

1. Establish the roles to be undertaken by various members of a project team

4.1 Define new project team capabilities

4. Strategies to Build Up Local Capabilities and Skills

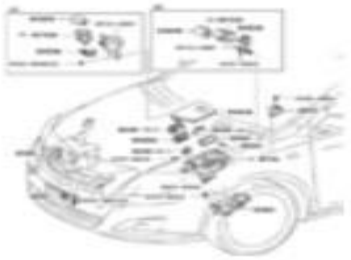
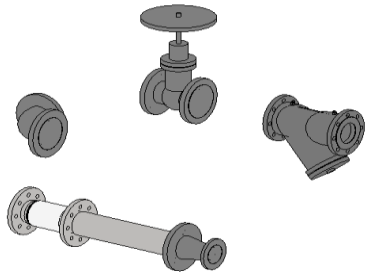
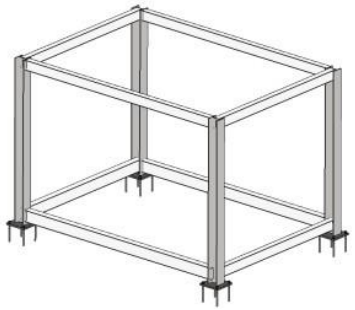
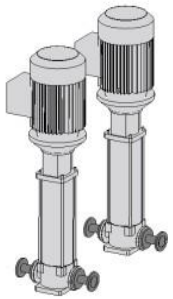
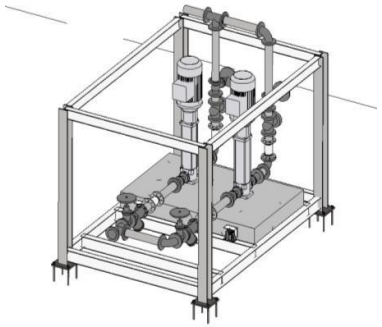
4.3 Training to build up skills and capabilities

1. Establish **learning modules** for leadership, planning, project management, offsite process, design, logistics, onsite process & maintenance
2. Establish **sufficient academic or on job training** for various learning modules
3. Support and organize various activities for **sharing knowledge** and **experience**
4. Sponsor and steer **long term research** on the required initiatives

1. Collaborate across the industry to **define skills gaps**
2. Define the **project management skills** to manage the interface between offsite and onsite, timing, sequencing and scheduling
3. **Gear up the skills in design** with the new digital tools
4. Develop the **marketing and business development skills**

4.2 Define and manage the skill gaps

DfMA-Driven Construction Industry

	Component	Platform (Core Component)	Product
P-DfMA (Bryden Wood, 2018)	 Engine block	 Chassis	 Car
P-DfMA for MEP	 Pipes and fittings	 Metal frame  Pumps	 Pump skid

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RIBA Plan of Work Designing for Manufacture and Assembly Overlay

HK Stages→	Stages	Inception, Feasibility and Brief Development		Concept Design	Detailed Design	Documentation and Tender	Construction	Handover/ Close out	Post-Handover Services
RIBA Stages →		Strategic Definition 0	Preparation and Brief 1	Concept Design 2	Developed Design 3	Technical Design 4	Construction 5	Handover and Close Out 6	In Use 7
Core Objectives		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 the **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 the **Design Programme**.	Prepare **Technical Design** in accordance with the **Design Responsibility Matrix** and **Project Strategies** to include all architectural, structural and building services information, specialist subcontractor design and specifications, in accordance with the **Design Programme**.	Offsite manufacturing and onsite **Construction** in accordance with the **Construction Programme** and resolution of **Design Queries** from site as they arise.	Handover of building and conclusion of the **Building Contract**.	Undertake **In Use** services in accordance with **Schedule of Services**.
DfMA Strategy		Consider opportunities for applying DfMA across portfolios or programmes of projects. Consider how DfMA might impact on the **Business Case** or **Strategic Brief**. Consider whole life issues in the **Strategic Brief** including options for reuse or repurposing and recycling of components at the end of the building's life. Consider **Research and Development** that might assist **Feasibility Studies** or the **Concept Design** including intellectual property issues.	Initiate DfMA thinking and incorporate client requirements into the **Initial Project Brief**. This should include high-level targets for the extent of DfMA adoption and time/ cost/waste savings against traditional benchmarks. Consider opportunities for 'repeatability', site/logistical constraints, **Research and Development** and early input required from specialist subcontractors. Consider best practice DfMA exemplars for comparable projects. Test the feasibility of high-level DfMA objectives included in the **Initial Project Brief** using the **Site Information** and **Feasibility Studies**.	Test initial **Concept Design** options against the DfMA aspirations set out in the **Initial Project Brief**. Identify opportunities for the greatest impact and initiate any **Research and Development** required to integrate DfMA into the **Concept Design**. Prepare the **Construction Strategy** considering high-level DfMA benefits including safety, productivity, quality and sustainability, considering topics such as eliminating scaffolding, wet or hot works, the delivery methodology and the suitability of proposed systems. Consider DfMA aspects in **Risk Assessments** and the **Health and Safety** and **Maintenance and Operational Strategies**. Ensure that the **Cost Information** takes account of the DfMA methodologies set out in the **Construction Strategy**.	Update the **Construction Strategy** taking into account DfMA opportunities appropriate to the **Developed Design** and coordination activities. Prepare a schedule of DfMA components and consider national (or other) standards appropriate for DfMA. Consider buildability, including how the erection sequence, fabrication or manufacturing techniques and tolerances impact on interfaces. Update **Cost Information** taking into account discussions with potential contractors, specialist subcontractors and suppliers. Update **Risk Assessments** and the **Health and Safety** and **Maintenance and Operational Strategies** taking into account DfMA considerations.	Develop the DfMA components more accurately considering the implications of the possible methods of manufacturing or fabrication. Develop the interfaces and specifications including structural, water/moisture/vapour penetration and acoustic issues. Update the **Construction Strategy** considering the lifting, handling and transportation strategy for each component and sub-assembly. Consider manufacturing and assembly risks in the updated **Risk Assessment** and **Health and Safety Strategy**. Develop a commissioning plan optimising the use of factory acceptance testing.	Update the **Construction Strategy**, including a logistics plan that ensures the right materials, plant and operatives are deployed in the right place at the right time. Commission the building progressively and capture **'As-Constructed' Information**. Consider how DfMA impacts the **Construction Programme**.	Consider how to capture commissioning and **'As-Constructed' information** in a manner that will assist the **In Use** stage including the potential disassembly of the building.	Consider any **Feedback** during the **In Use** stage necessary to inform future projects. Monitor the performance of standardised components including maintenance and replacement and provide **Feedback**. Monitor disassembly or potential reuse of materials during demolition at the end of the stage and provide **Feedback**.
Suggested BIM Tasks for DfMA		Analyse data from the existing building to identify key metrics for success. Gather cost and programme data from previous projects to set benchmarks. Consider establishing a BIM object library if components are going to be used across multiple projects.	Use BIM for the preparation of **Feasibility Studies** including data-rich 'placeholder' objects with limited geometry to assist in the preparation of **Cost Information.** Use BIM to test and optimise the **Initial Project Brief**. Include the Level of Development required at each stage when preparing the **Design Responsibility Matrix**. Consider the implications for professional services contracts and the **Design Responsibility Matrix** where a client is using their own BIM library, including intellectual property and professional indemnity insurance.	Develop the BIM model and components to the Level of Development set out in the **Design Responsibility Matrix**. Validate the model against the client's information requirements. Consider DfMA tolerances in the development of the BIM model.	Progress the BIM model and components to next Level of Development as set out in the **Design Responsibility Matrix**. Validate the model against the client's information requirements. Use digital technologies as part of coordination exercises.	Progress the BIM model and components to next Level of Development as set out in the **Design Responsibility Matrix**. Validate the model against the client's information requirements. Use 4D technologies to test and rehearse the sequencing set out in the **Construction Strategy**, including every aspect of manufacture, logistics and assembly before work starts on site.	Use BIM to train site operatives. Use digital technologies to track each step of the manufacturing, packing, logistics and delivery process. Consider recording the complete history and location of every component for **Feedback**, future use and learning. Link components to assembly manuals, method statements and quality records including identifying any aspects of the design which may be reused in the future.	Ensure any relevant documentation relating to DfMA components is linked to BIM components for **Feedback**, including lessons learned and potential repurposing.	Consider configuration management techniques to maintain an up-to-date record (BIM model) of the building.
Suggested Procurement Tasks for DfMA		**Feedback** – Ensure lessons learned from previous projects have been incorporated. Consider how DfMA impacts on the assembly of the project team including how the project team will achieve a collaborative approach and how innovation can be incentivised.	Consider how to emphasise the importance of DfMA in the **Initial Project Brief** when assembling the project team and developing the **Procurement Strategy**, including how to select design team members with DfMA experience. Ensure that any tender information encourages the behaviours required for effective collaboration and the experience needed to identify early DfMA opportunities.	Update the **Procurement Strategy** and hold discussions with contractors and specialist subcontractors relevant to the procurement route to test DfMA objectives set out in the **Concept Design** including the **Construction Strategy**. Consider the appropriateness of early contractor involvement (ECI).	Hold further discussions with contractors and specialist subcontractors relevant to the procurement route to test DfMA components and coordination exercises set out in the **Developed Design** including the updated **Construction Strategy**.		Capture **Feedback** including lessons learned from site installation to inform the **Procurement Strategy** of future projects.	Ensure that **'As-Constructed' Information** relating to DfMA elements has been delivered including **Feedback** on information to be incorporated into the client's in-house BIM object library. Provide **Feedback** on the capability and performance of specialist subcontractors who delivered DfMA aspects.	

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For each stage,
1. Core Objectives
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3. BIM Tasks for DfMA
4. Procurement Tasks for DfMA

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Thank you

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