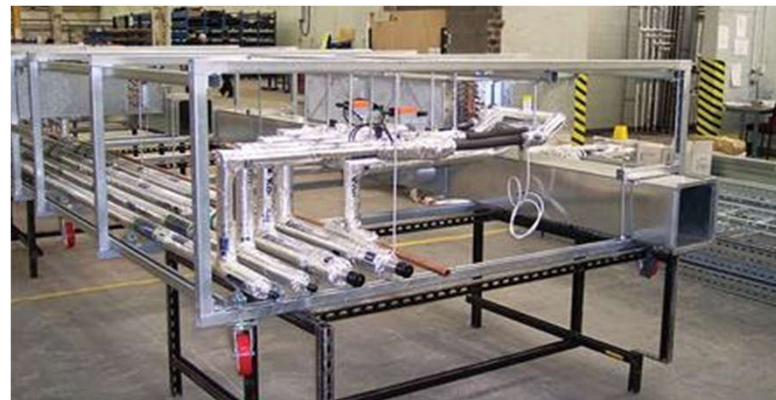
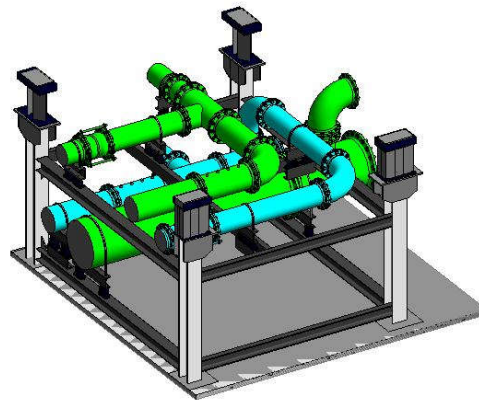
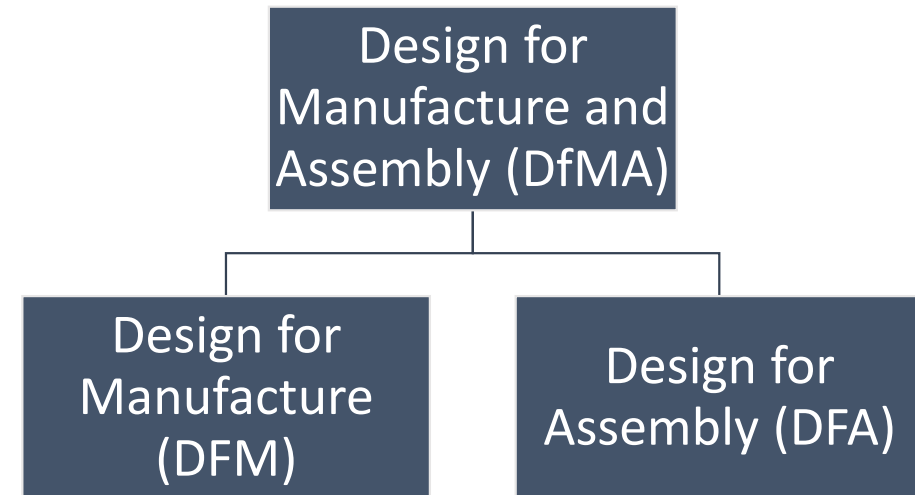


Wider Adoption of DfMA in MEP Works

- DfMA
- DfMA for Construction
- DfMA for MEP
- DfMA for Hong Kong



Design for manufacture and assembly (DfMA)

- A set of principles for enabling a design process that facilitates the optimization of all **manufacture & assembly** functions and contributes to the minimization of cost & delivery time and the maximization of quality & customer satisfaction
- Originate from production industries
- A potential approach for the construction industry to enhance productivity & quality

DfMA process



Design for Assembly (DFA)

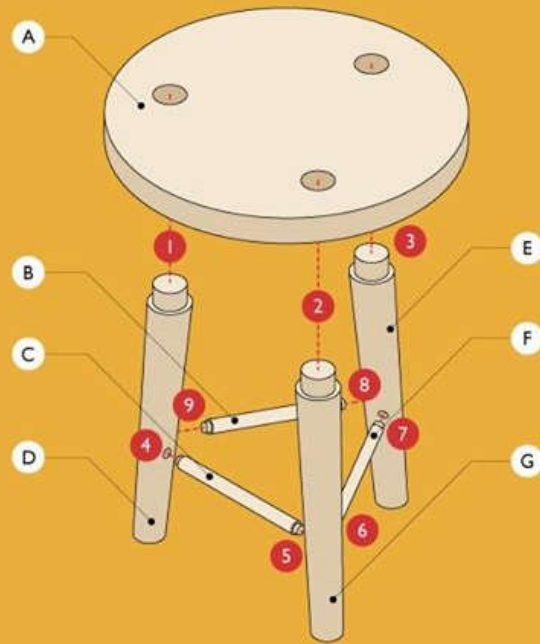
- Minimize the number of parts
- Optimize for assembly



Design for Manufacture (DFM)

- Best process
- Best materials
- Tolerances
- Optimize process

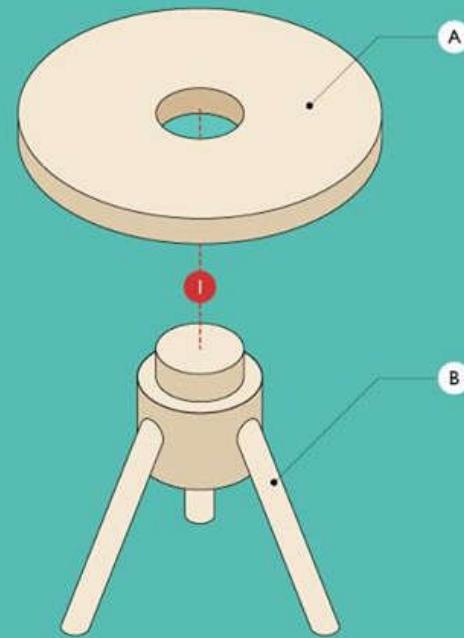
CONVENTIONAL DESIGN



● 7 Parts

● 9 Assembly Steps

DESIGN FOR MANUFACTURING AND ASSEMBLY (DFMA)



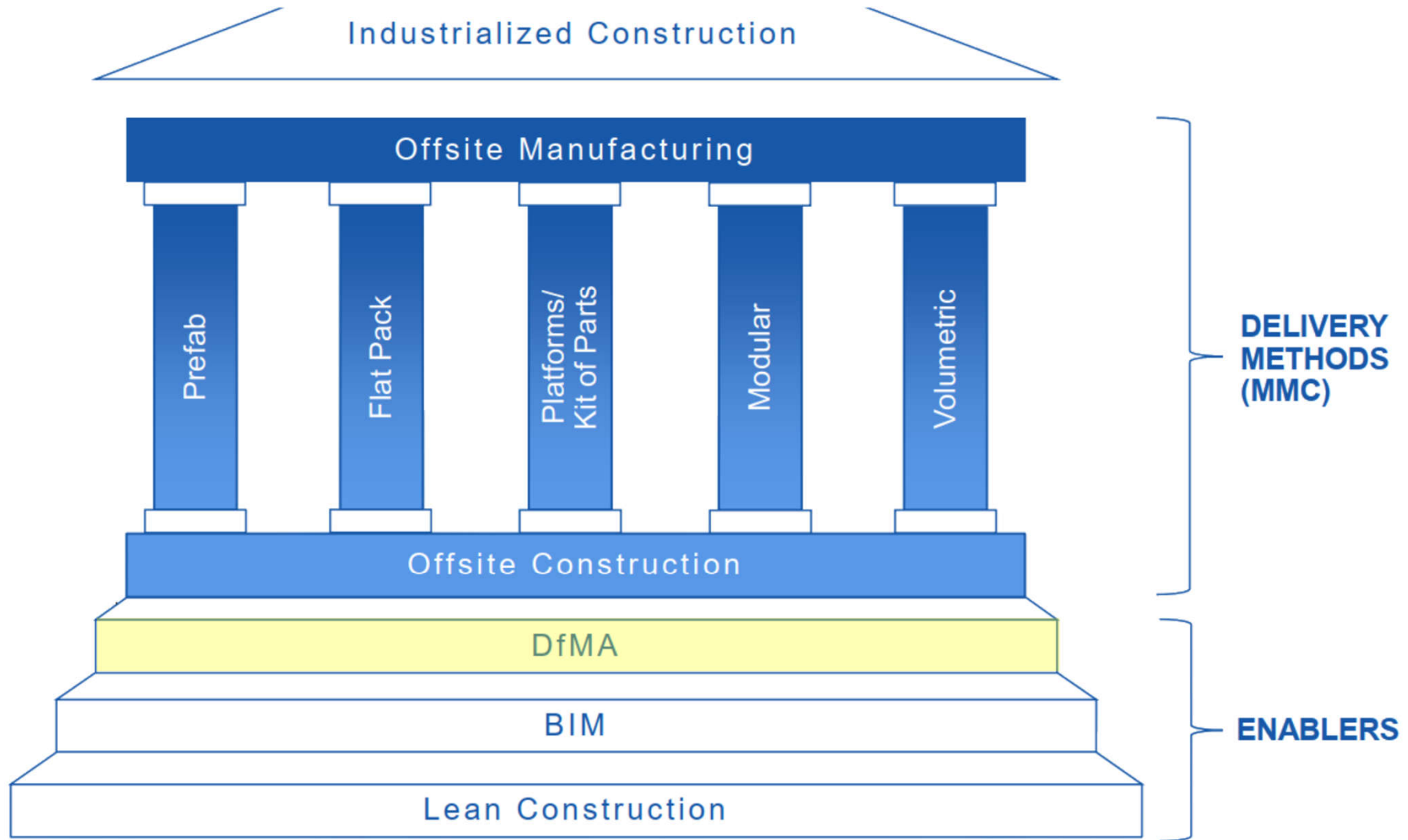
● 2 Parts

● 1 Assembly Step

DfMA for Construction

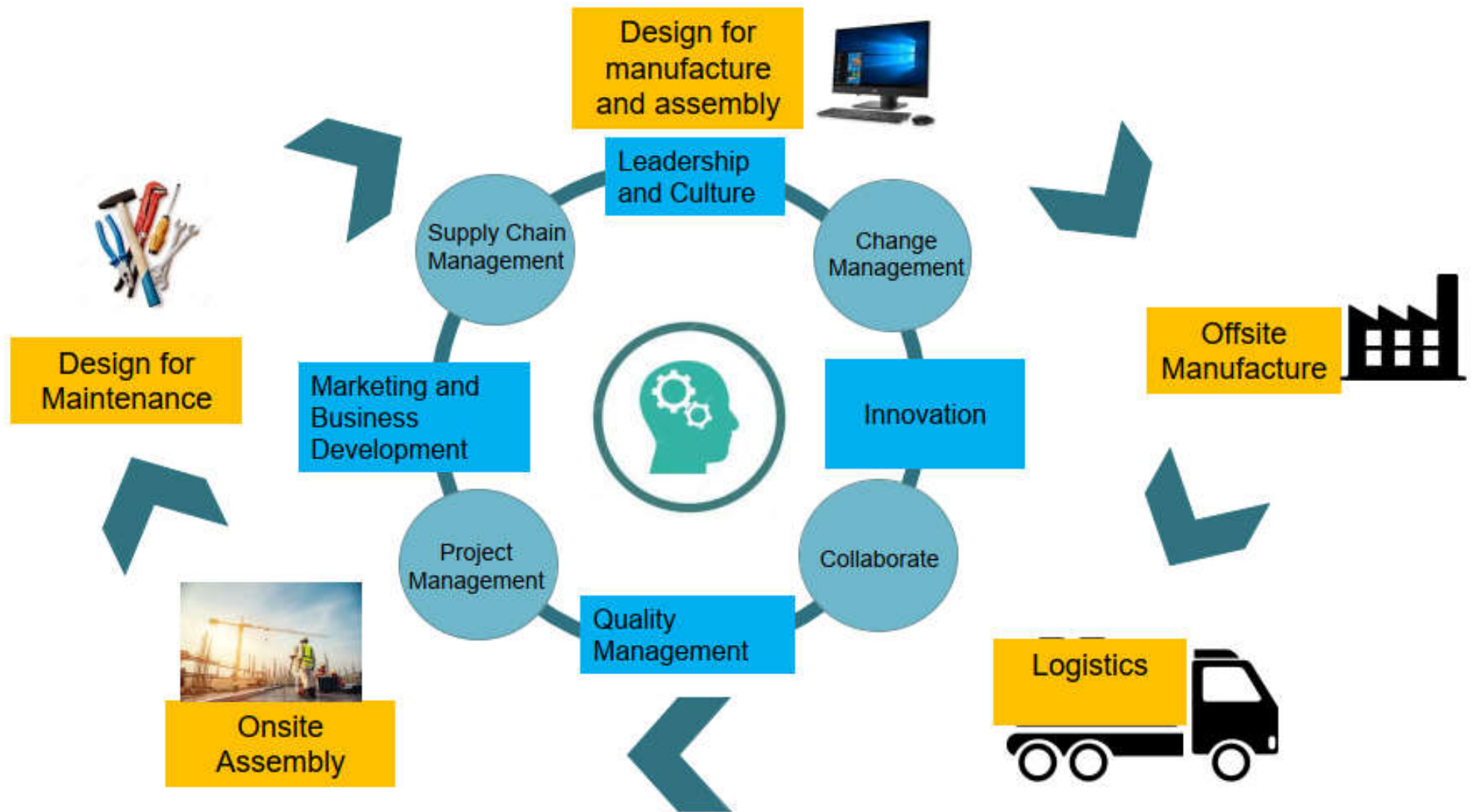
- (a) Holistic & systematic design with DfMA principles
- (b) Work with virtual design & construction (VDC) to assess the efficiency of manufacturing & assembly
- (c) Philosophy to support prefabrication & modular construction technologies
- Facilitated by **building information modelling (BIM)** & **lean construction** to enable **industrialized construction (IC)**

DfMA & Industrialized Construction



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

DfMA mindset for construction industry



(Adapted from: RIBA, 2016. *RIBA Plan of Work 2013: Designing for Manufacture and Assembly*, RIBA Publishing, Newcastle upon Tyne, UK.

DfMA for MEP

- DfMA & prefabrication to support offsite construction (OSC) of building services (MEP) elements
- Degree of DfMA adoption
 - Lower level: site assembly + standardization + some prefab elements
 - Higher level: highly standardized + prefab components/assemblies
 - Highest level: prefab components /assemblies + high modularization & integration + highest standardization

Major MEP elements suitable for prefabrication

Building services systems	Major elements
Mechanical ventilation & air conditioning	<ul style="list-style-type: none">- Air duct system- Water pipework & fitting- Refrigerant pipework & fitting- Air conditioning equipment (e.g. air handling unit)
Fire services	<ul style="list-style-type: none">- Water pipework & fitting- Pump sets & fittings
Plumbing & drainage	<ul style="list-style-type: none">- Water supply pipework & fitting- Drainage pipework & fitting- Pump sets & fittings- Bathroom & toilet sanitary fittings
Electrical services	<ul style="list-style-type: none">- Cable & busbar trunkings- Conduits & wiring- Power outlets & telecommunication- Electrical switchgear

(Ref: Hui S. C. M. & Or G. K. C., 2005. Study of prefabricated building services components for residential buildings in Hong Kong, In *Proceedings of the Hubei-Hong Kong Joint Symposium 2005*, 1-2 July 2005, Wuhan, China, pp. 88-97. <http://ibse.hk/cmhui/hubei2005.pdf>)

Prefabricated MEP systems

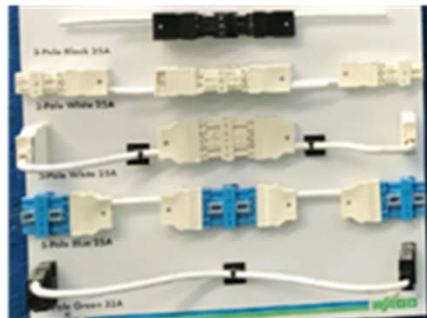
Components:
Incremental Improvement...

...Integrated Assemblies:
Game-Changing Improvement

Prefab Components



Pre-insulated plastic piping



Sub-assemblies

Include MEP services only

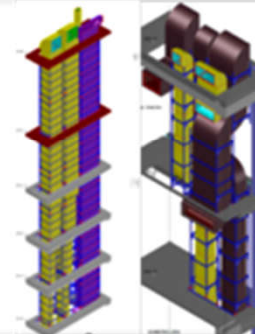


Prefab horizontal services / vertical riser modules

Integrate with architectural/ structural components



Prefab horizontal module with ceiling board



Prefab vertical riser module with catwalk

Integrated Assemblies MEP PPVC

Complete assembly



Prefab plant room

Manpower Savings (Trade Level)

30%

45%

60%

70%

(Image source: BCA, 2018. *Design for Manufacturing and Assembly (DfMA): Prefabricated Mechanical, Electrical and Plumbing (MEP) Systems*, Building and Construction Authority (BCA), Singapore.)

DfMA and levels of offsite

Level	Category	Definition
1	Component manufacture & subassembly	Items always made in a factory and never considered for on-site production
2	Non- volumetric preassembly	Pre-assembled units which do not enclose usable space (e.g. timber roof trusses, flat panel units, panelised systems)
3	Volumetric preassembly	Pre-assembled units which enclose usable space and are typically fully factory finished internally, but do not form the buildings structure (e.g. toilet and bathroom pods)
4	Modular systems or buildings	Pre-assembled volumetric units which also form the actual structure and fabric of the building (e.g. prison cell units or hotel/ motel rooms)
5	Hybrid system	Consists of a combination of any two or more volumetric or nonvolumetric systems (extensively used in commercial and residential buildings)

DfMA for Hong Kong

- Precast concrete & prefabrication for housing projects
- Construction 2.0 & key initiatives to enhance productivity & sustainable/green building (BEAM Plus)
- Prefab components & DfMA approach for infrastructure & building projects
- Promotion of modular integrated construction (MiC)
- Wider adoption of DfMA approach & thinking

Key challenges & initiatives in Hong Kong

Key challenges

- **Significant future construction volumes**
- **High costs**
- **Unsatisfactory site safety performance**
- **Declining productivity**
- **Lack of creativity and innovation**

Key initiatives

- Offsite construction (DfMA and MiC)
- Building Information Modelling
- Smart infrastructure
- Uplifting project governance and leadership
- Professional development
- Attracting and nurturing young talents
- Project Management Information Systems
- Digitalization of site management

DfMA development in Hong Kong & other places



Hong Kong & Greater Bay Area – factories & logistics



Strategies to drive DfMA adoption in Hong Kong

