



Construction Industry Transformation 建造業的轉型

DfMA & Other Trends 製造和裝配的產品設計 和其他趨勢

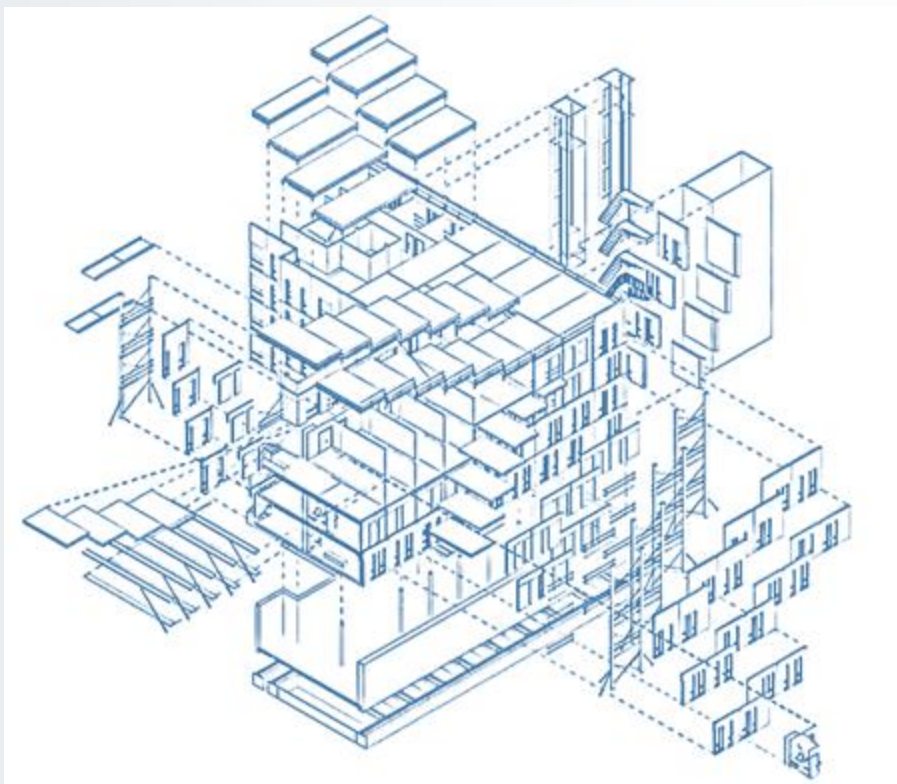
Ian Askew

DfMA Alliance x CITAC Webinar 9 Sept 2020



MiC / Volumetric 組裝合成建築法

Speed & Site Labour Demand
 速度和現場工人需求 ✓
 Logistics 物流 ✗



Kits-of-Parts 零件構造套件

Flexibility & Logistics
 靈活性和物流 ✓
 Complexity 複雜性 ✗

DfMA – Terminology 術語

DfMA – The Value Proposition

DfMA - 價值主張

Carrot

MiC 6% GFA Concession
MiC 6%的總樓面面積寬免

CITF for MiC modules,
plant and design
CITF用於MiC模塊，工廠和
設計

Technical scoring on
Government Tenders
政府招標的技術評分

**DfMA 6% GFA Incentive
for Kits-of-Parts?**
DfMA 對零件套件有6%總
樓面面積鼓勵？



MiC Mandate

**Buildability Design
Appraisal System
"DfMA Scoring System"?**

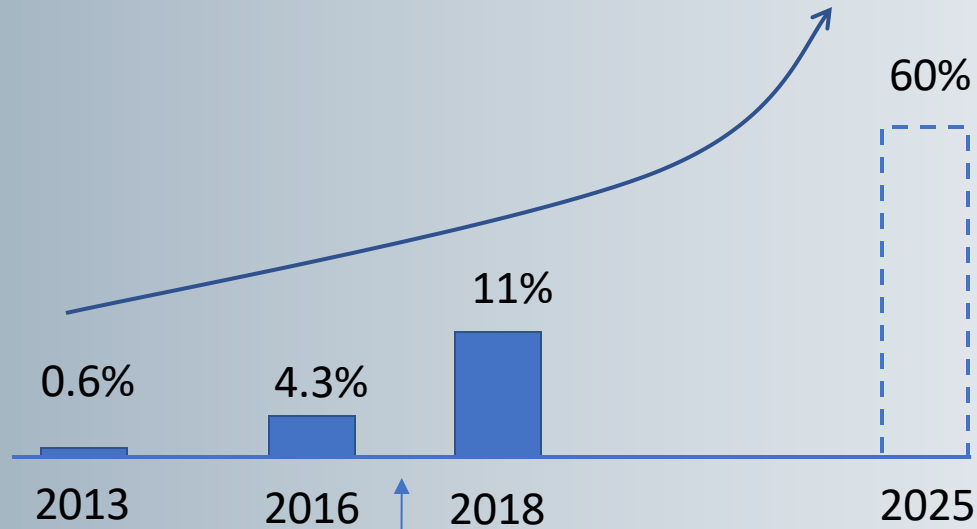
MiC的要求

可建造性設計評估制度
「DfMA計分制度」？

Stick

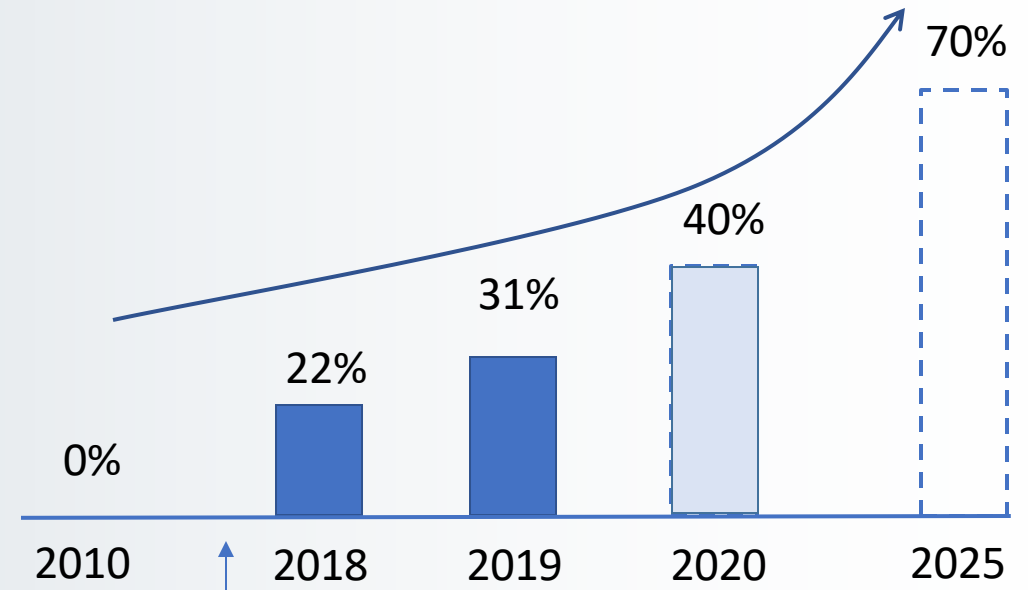
DfMA – Mandates and/or Incentives 要求/鼓勵

% of New Prefabricated Buildings in Mainland China
中國新建預製房屋的百分比



Introduction of Standard for Assessment of Prefabricated Buildings in 2017
引入2017年預製房屋評估標準

DfMA Adoption Rate in Singapore
新加坡的DfMA採用率



B-Score thresholds raised with "greater emphasis on DfMA" in 2017
2017年，提高了B-Score門檻，更加重視DfMA

Buildability Score – PRC & Singapore Industry Responses

可建設性得分-中國和新加坡行業的回應

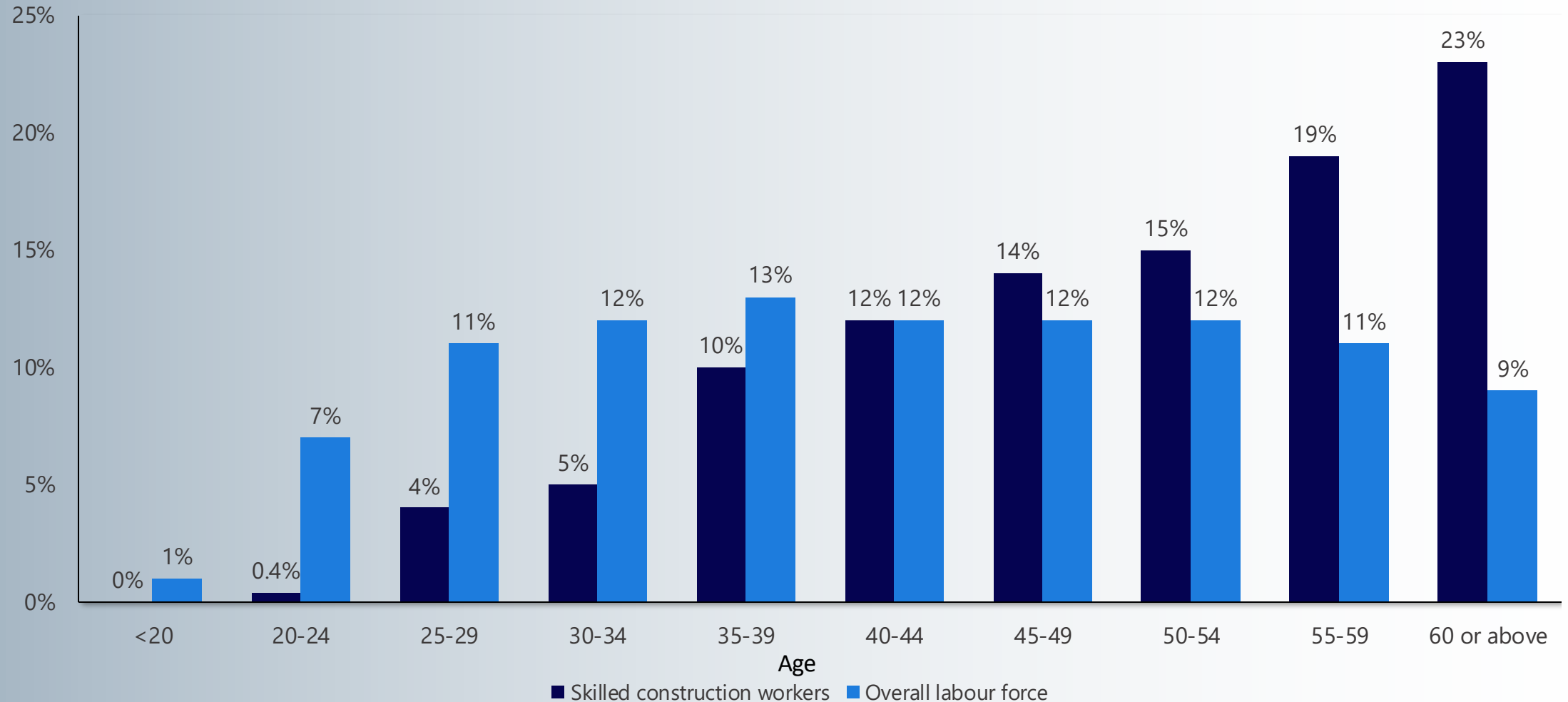


Traditional - 80 to 120 Site Labour Hours / m² GFA; 傳統方法 - 80至120個工時/總建築面積平方米
DfMA / Kits-of-Parts - 30 to 60 Site Labour Hours / m² GFA; DfMa - 30至60個工時/總建築面積平方米



DfMA – Project Value Proposition
DfMA – 項目價值主張

Age distribution of skilled construction workers vs overall labour force in 2017



Source: Construction Industry Council, Census and Statistics Department, KPMG Analysis

DfMA – Sustainable Industry
DfMA – 可持續產業

DfMA – Digitally Enabled DfMA – 數碼化

Centralised Control Centre 中央控制中心

OUR 4
NATIONWIDE
LOGISTICS
HUBS

DIGITAL
MODEL

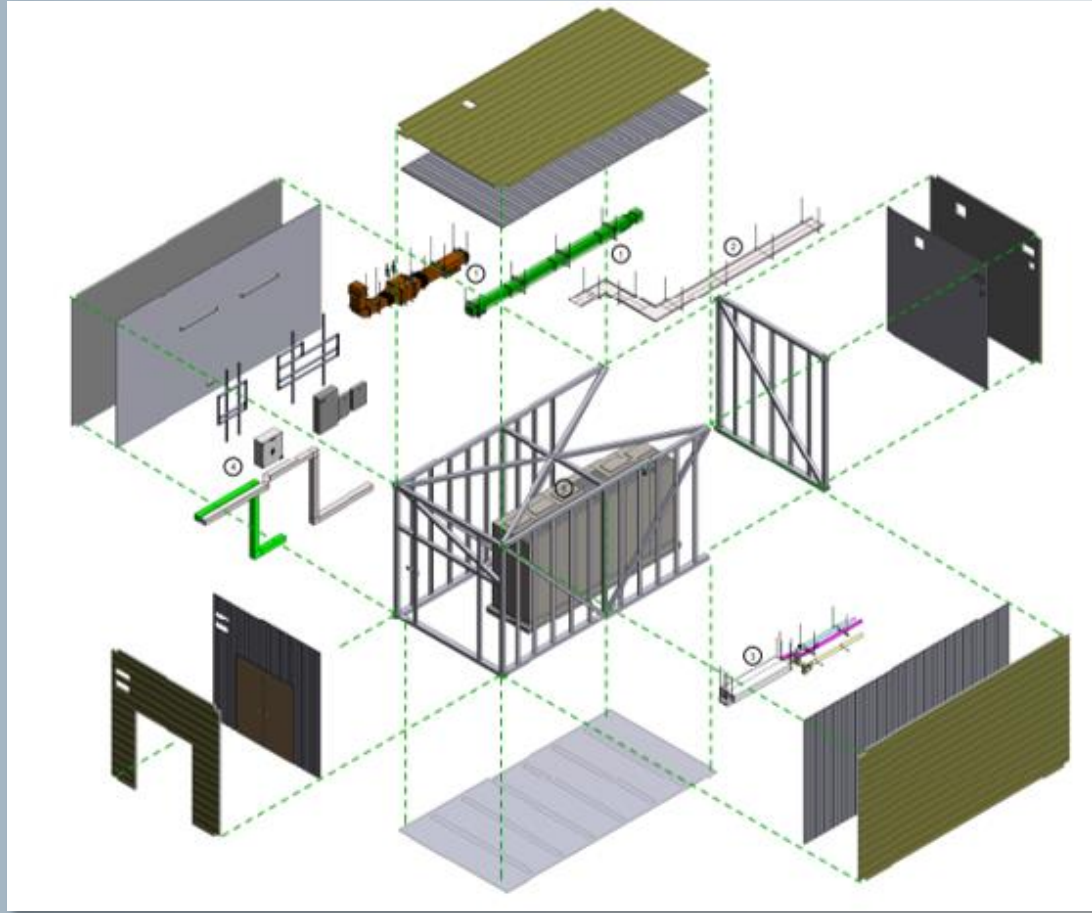


DELIVERY COORDINATED
THROUGH OUR CENTRALISED
CONTROL CENTRE

DESIGN
TEAM

CONSTRUCTION
SUPPORT
SITES





DfMA – Digitally Disassembled & Digital Insights
DfMA – 數碼分解和數碼見解

令工作變得輕鬆

不會增加工作量 (例如由手寫記錄變成電腦記錄)

不會令事情變得複雜

實質性投資回報

令數碼化成為工作一部份!

Consider people and culture, not just the technology.

Make peoples life easier

Nothing additional to do (if a task is added at least one task must be taken away)

Must not add complexity

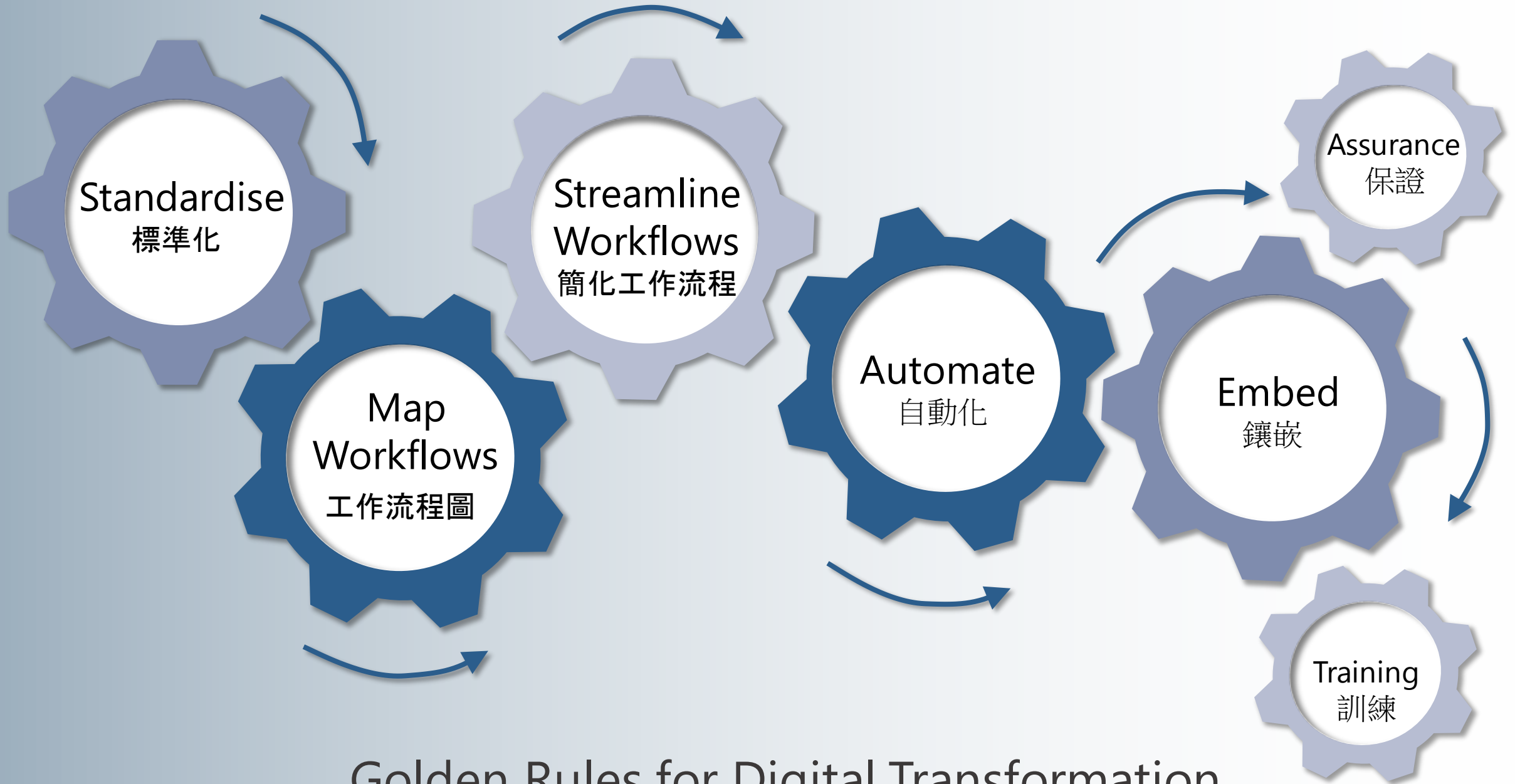
Realistic likelihood of return on investment

Don't make digital the enemy !



Golden Rules for Digital Transformation

數碼化轉型的黃金法則

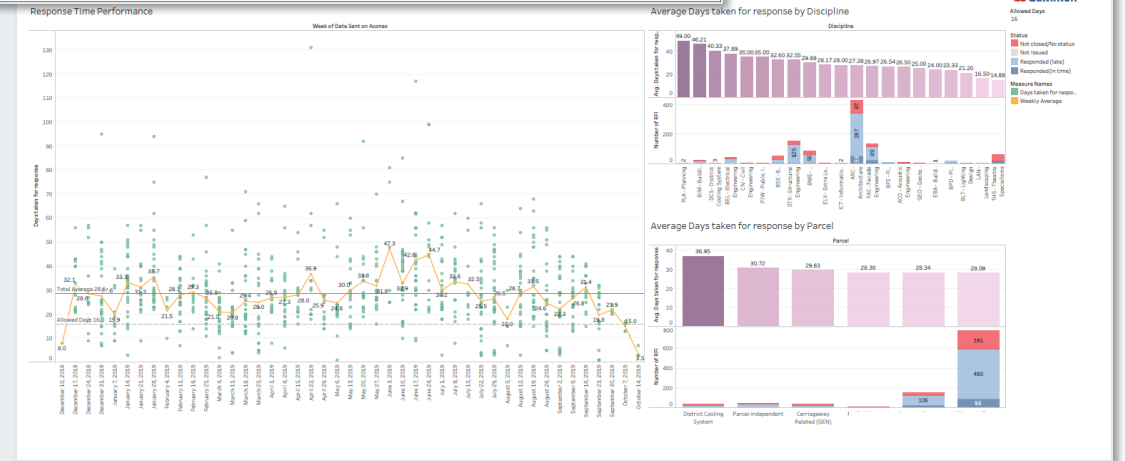
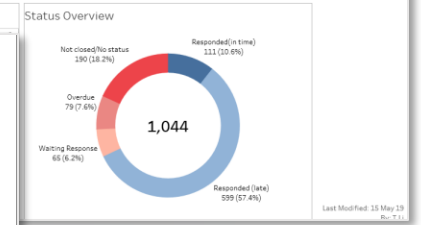
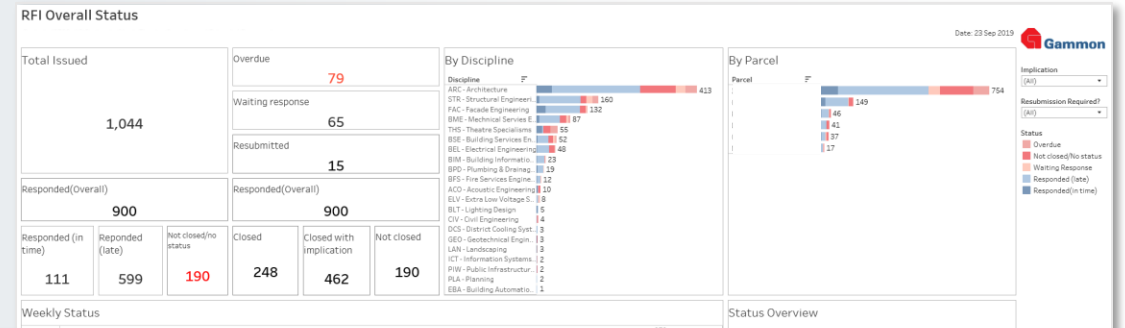


Golden Rules for Digital Transformation 數碼化轉型的黃金法則

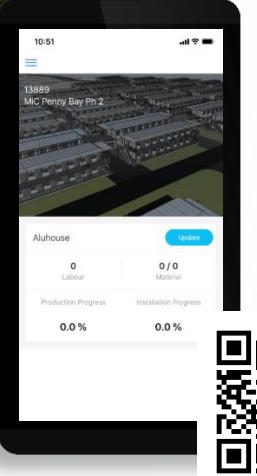
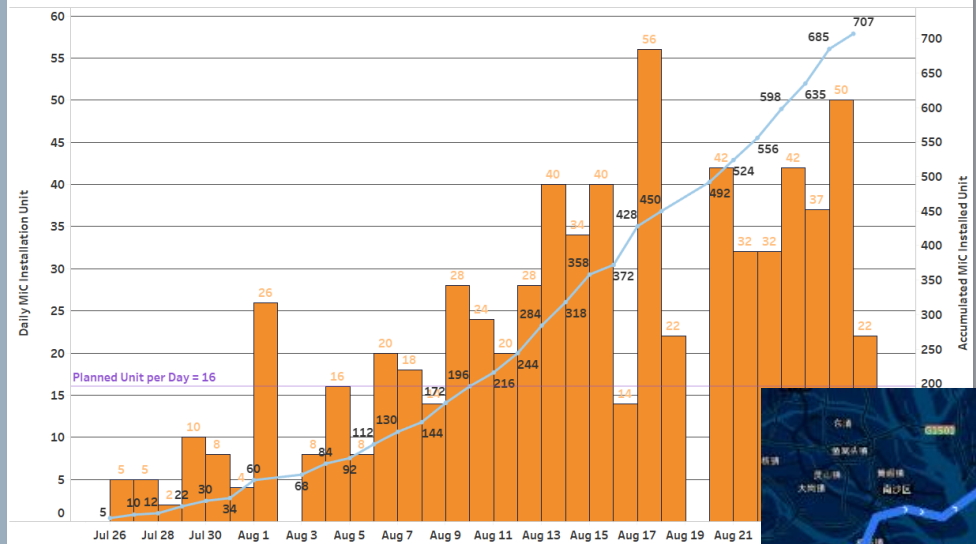


DfMA Essentials – Design Management / Freeze

DfMA的基礎-設計管理/保留



DailyBar Chart



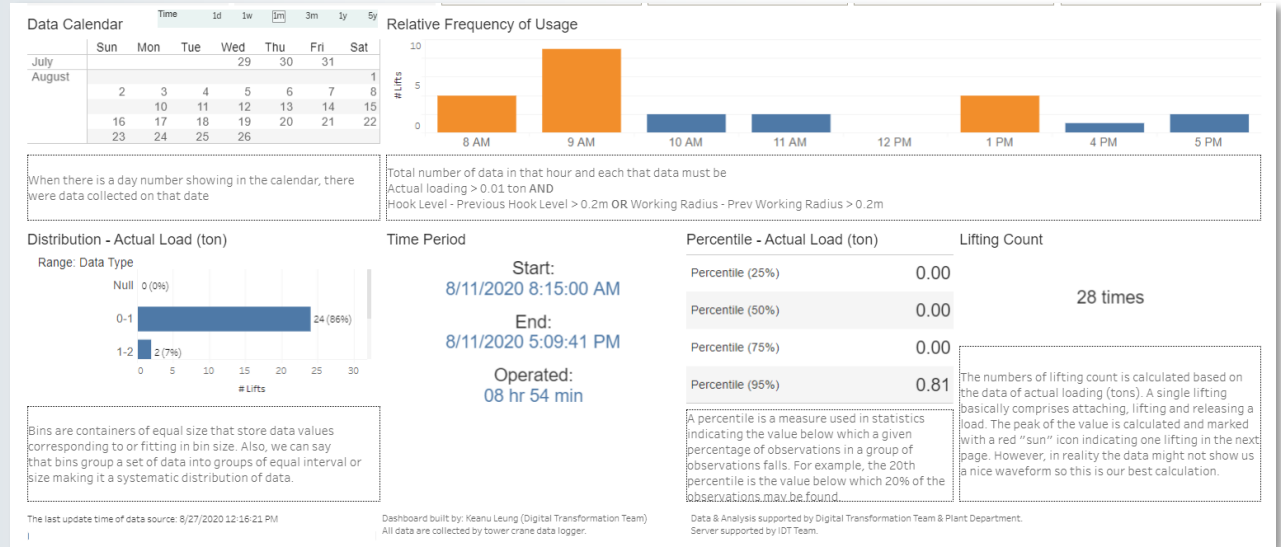
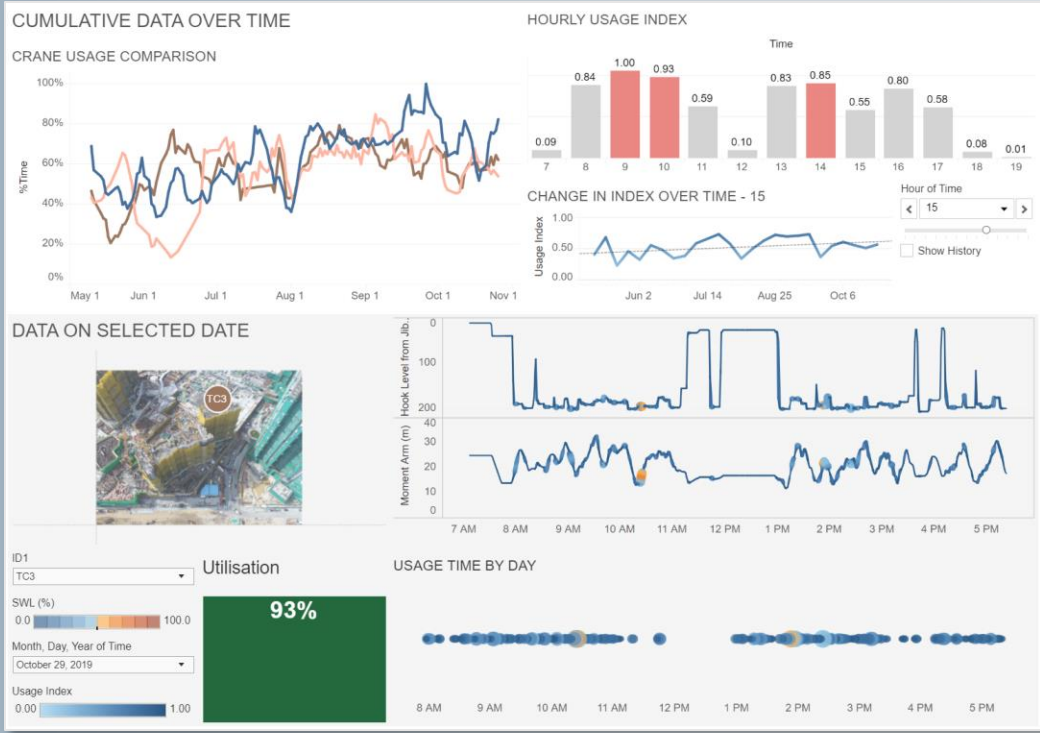
BLK01-201



ELEMENT	NAME	LEVEL	QR CODE	LINK	Status
3F001	EWS-1 Tower Curtain Wall	3F	STAMP-ELEMENT-13828-C	https://stamp.gammonconstruction.com/pack	04 Delivery of Glass
3F002	EWS-1 Tower Curtain Wall	3F	STAMP-ELEMENT-13828-C	https://stamp.gammonconstruction.com/pack	04 Delivery of Glass
3F003	EWS-1 Tower Curtain Wall	3F	STAMP-ELEMENT-13828-C	https://stamp.gammonconstruction.com/pack	04 Delivery of Glass
3F004	EWS-1 Tower Curtain Wall	3F	STAMP-ELEMENT-13828-C	https://stamp.gammonconstruction.com/pack	04 Delivery of Glass
3F005	EWS-1 Tower Curtain Wall	3F	STAMP-ELEMENT-13828-C	https://stamp.gammonconstruction.com/pack	04 Delivery of Glass
3F006	EWS-1 Tower Curtain Wall	3F	STAMP-ELEMENT-13828-C	https://stamp.gammonconstruction.com/pack	04 Delivery of Glass
3F007	EWS-1 Tower Curtain Wall	3F	STAMP-ELEMENT-13828-C	https://stamp.gammonconstruction.com/pack	04 Delivery of Glass
3F008	EWS-1 Tower Curtain Wall	3F	STAMP-ELEMENT-13828-C	https://stamp.gammonconstruction.com/pack	04 Delivery of Glass
3F009	EWS-1 Tower Curtain Wall	3F	STAMP-ELEMENT-13828-C	https://stamp.gammonconstruction.com/pack	04 Delivery of Glass

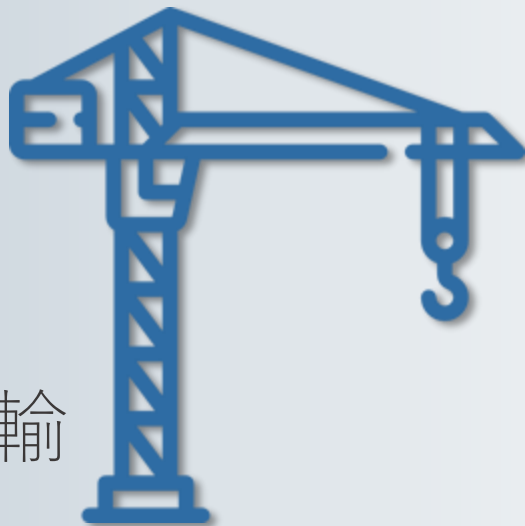
DfMA Essentials – Logistics & Tracking

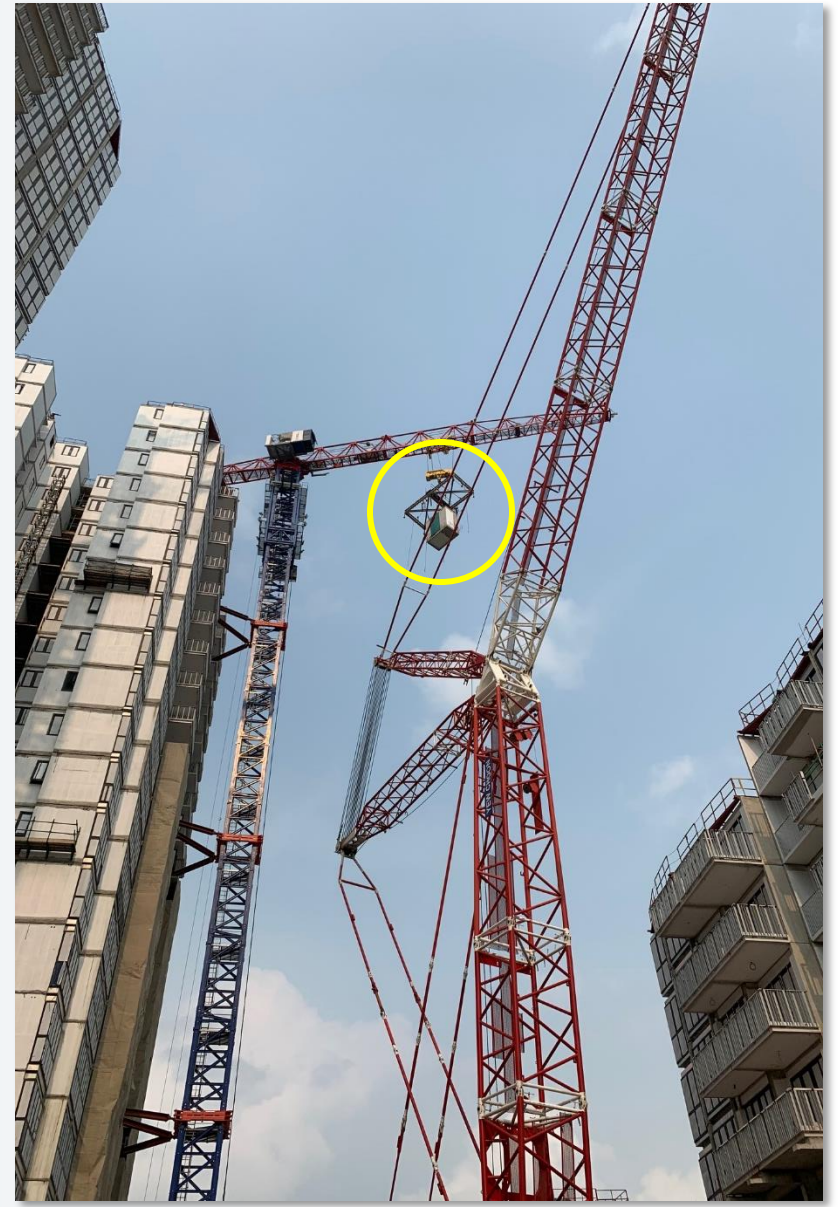
DfMA的基礎-物流與追蹤



DfMA Essentials – Vertical Transport

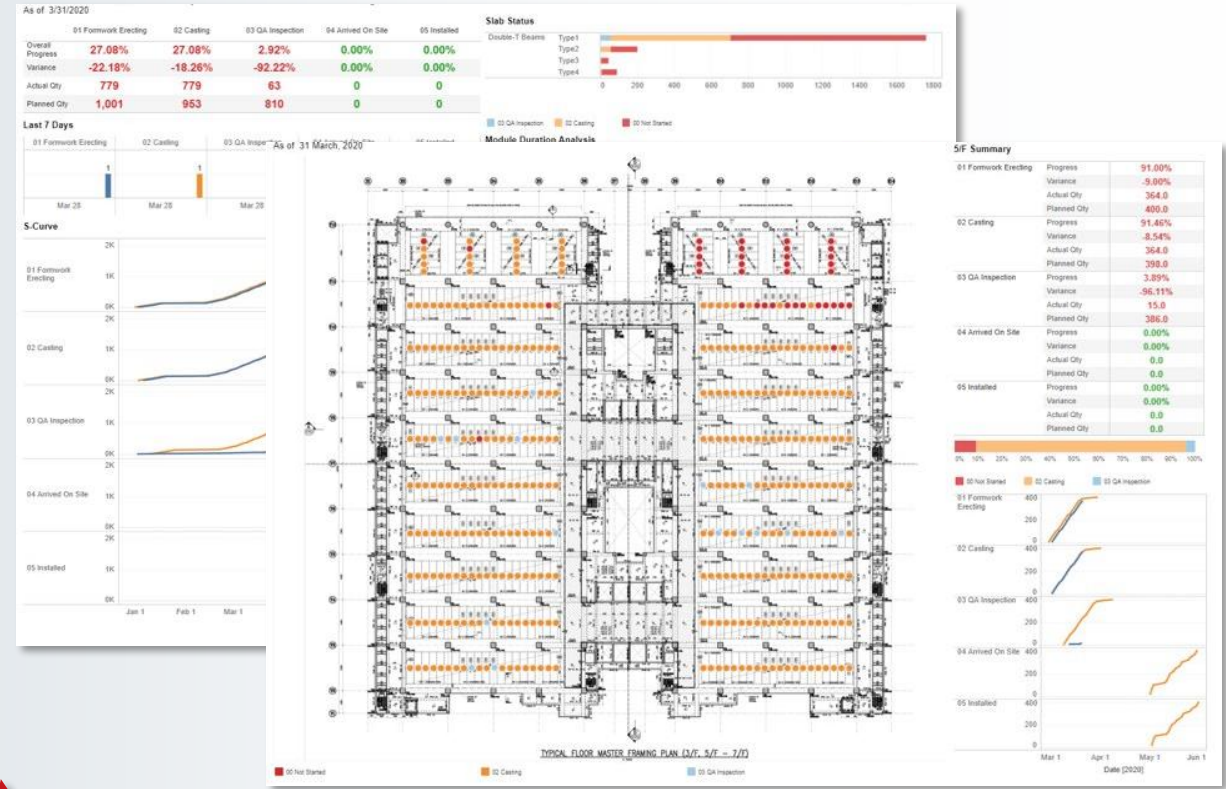
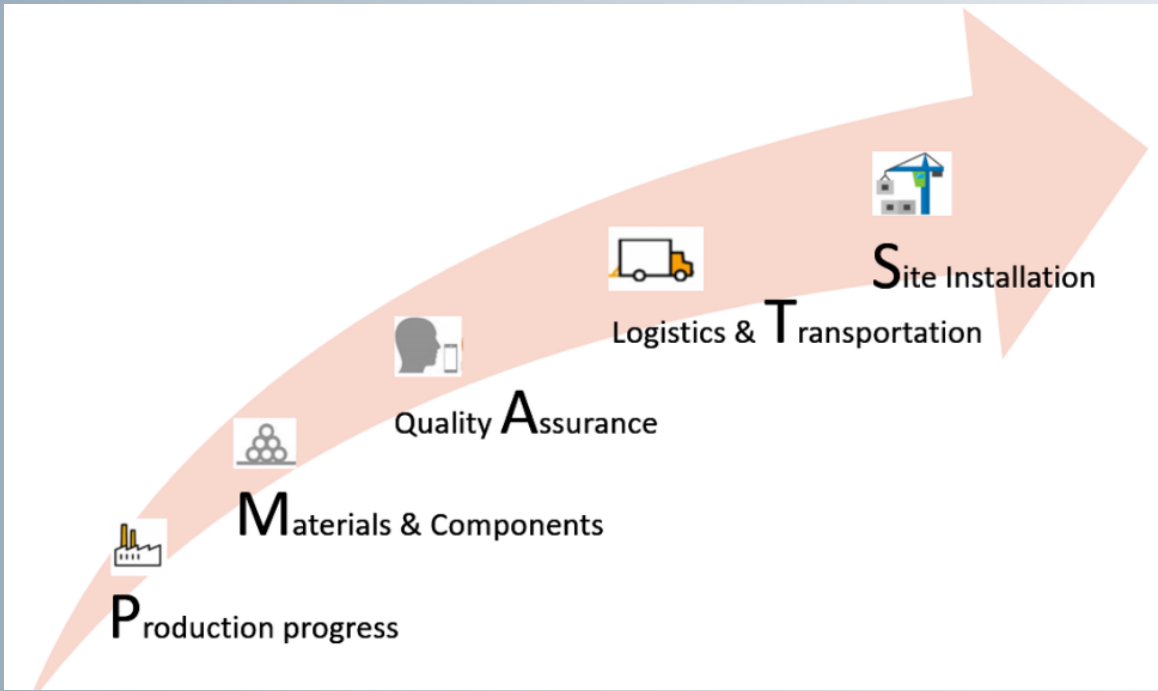
DfMA的基礎-垂直運輸



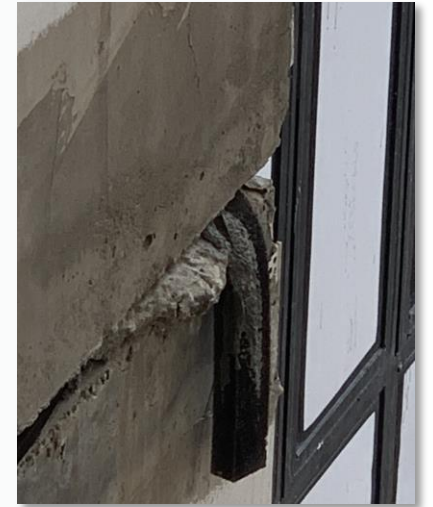
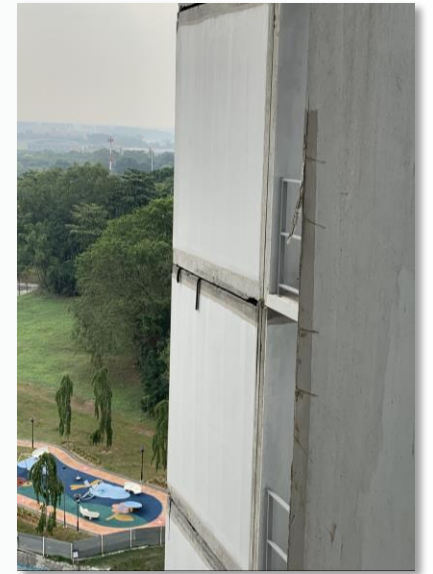


DfMA Essentials – Vertical Transport

DfMA的基礎-垂直運輸



DfMA Essentials –
 Quality Management (End-to-End)
 DfMA的基礎-質量管理 (點到點)



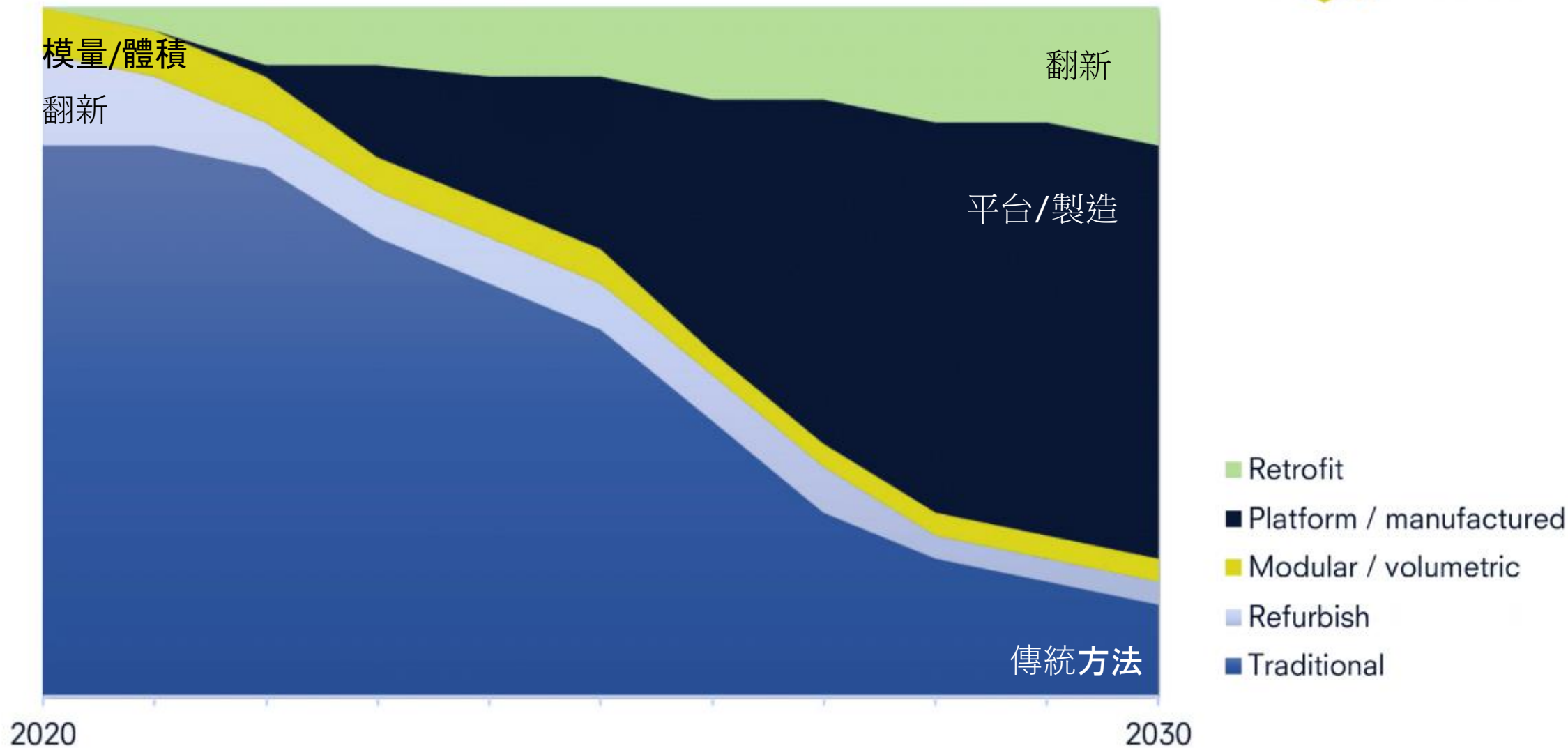
DfMA Essentials – Factory Quality Management

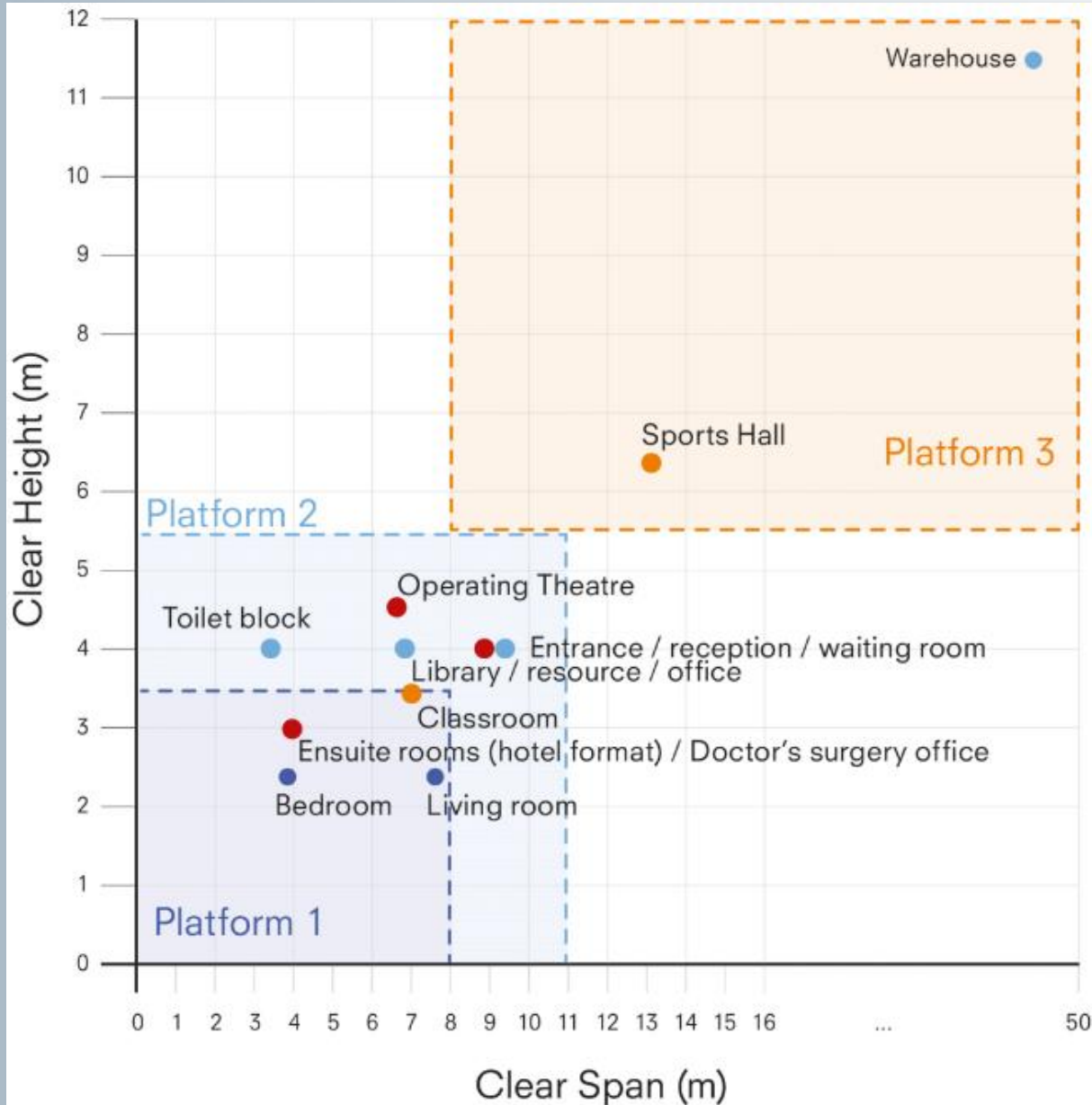
DfMA的基礎-工廠質量管理





p-DfMA – Platforms

DfMA- 平台

UK Government's 10 year vision 英國政府10年願景





-  Residential
-  Offices
-  Health
-  School

 Infrastructure and Projects Authority

 Ministry of Justice

 Infrastructure and Projects Authority

 Department for Education

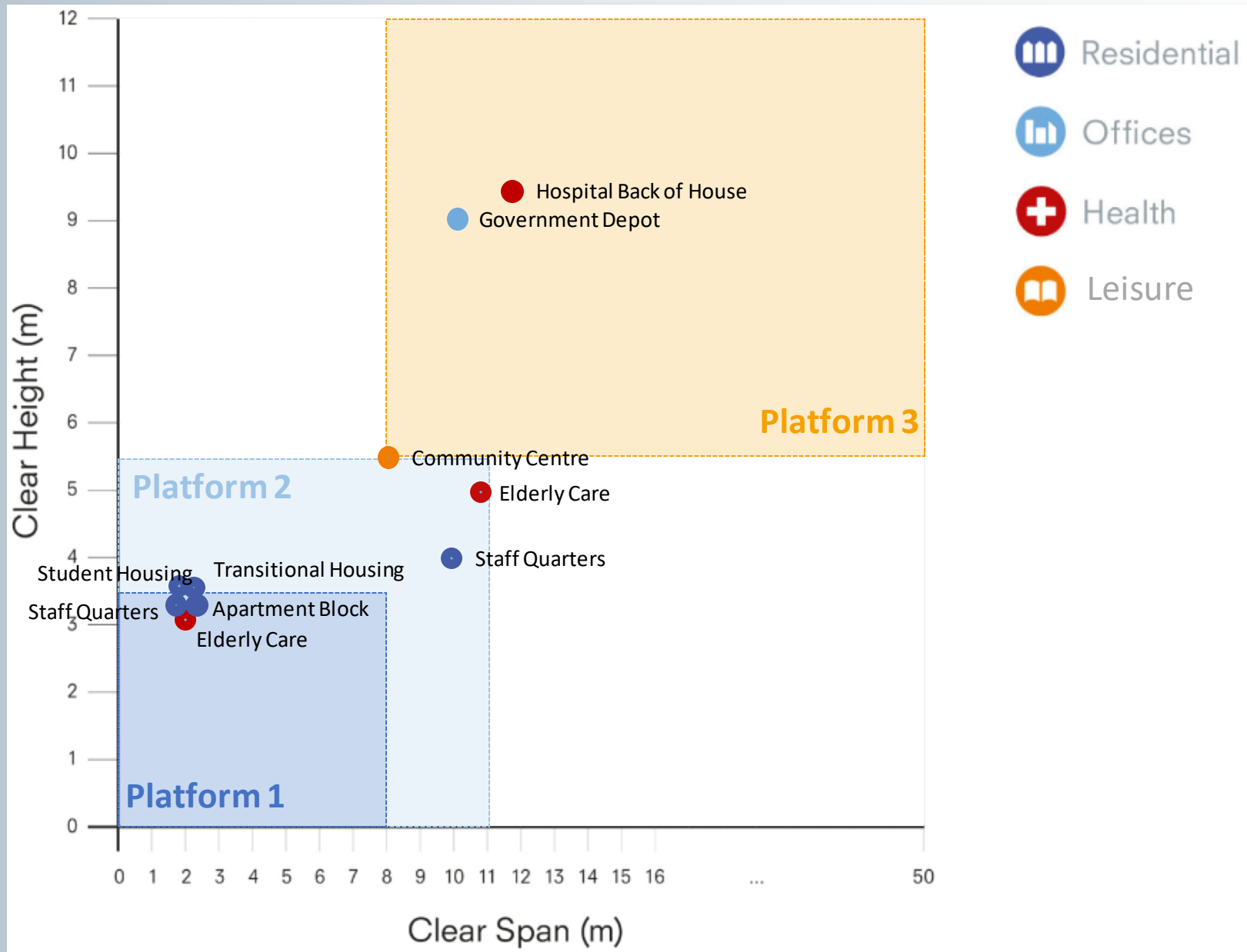
Our proposal: a Platform approach to Design for Manufacture and Assembly (P-DfMA)

 Department of Health

 Ministry of Defence

 Department for Transport

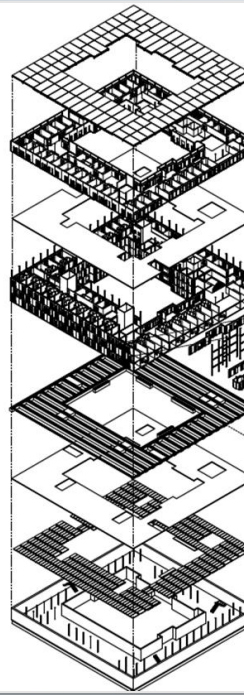
Platforms 平台 (p-DfMA)



Platforms 平台 (p-DfMA)

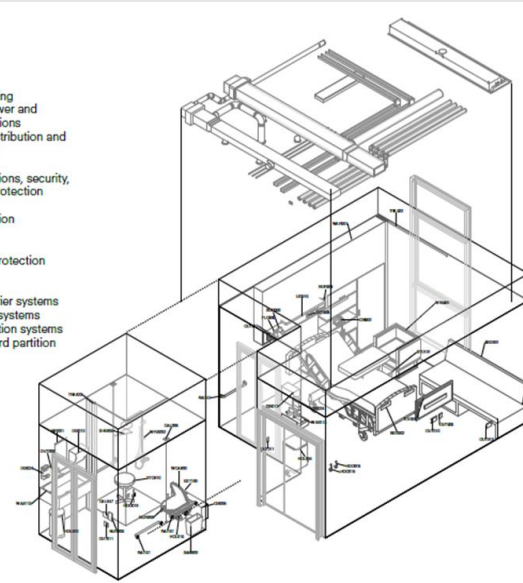
Uniclass at 'Facility' level...

Ac -	Activities	Co	Complexes
Ac_25_30	Scientific & laboratory activities	Co_35	Medical, health, welfare and sanitary complexes
Ac_25_90	Worship activities	Co_35_10	Medical complexes
Ac_35	Medical, health, welfare & sanitary activities	Co_35_10_37	Hospital complexes
Ac_35_10	Medical activities	En -	Entities
Ac_35_10_08	Birthing	En_35	Medical, health, welfare & sanitary entities
Ac_35_10_10	Burns treating	En_35_10	Medical entities
Ac_35_10_15	Consulting	En_35_10_10	Medical buildings
Ac_35_10_31	First aiding	SL -	Spaces / locations
Ac_35_10_36	Hearing testing	SL_35	Medical, health, welfare and sanitary spaces
Ac_35_10_39	Hydrotherapy	SL_35_10	Medical spaces
Ac_35_10_42	Intensive caring		
Ac_35_10_43	Isolation caring		
Ac_35_10_51	Medical scanning		
Ac_35_10_53	Midwifery		
Ac_35_10_57	Nursing		
Ac_35_10_58	Occupational therapy		
Ac_35_10_59	Operating		
Ac_35_10_64	Pharmaceutical dispensing		
Ac_35_10_65	Phototherapy	EF -	Elements / functions
Ac_35_10_66	Physiotherapy	Ss -	Systems
Ac_35_10_70	Radiography	Pr -	Products
Ac_35_10_71	Radiotherapy		
Ac_35_10_74	Rehabilitating		
Ac_35_10_76	Screening		
Ac_35_50	Welfare activities		
Ac_35_50_21	Day care		
Ac_35_50_42	Infant caring		
Ac_35_60	Food management activities		
Ac_35_60_16	Cooking		
Ac_35_60_30	Food preparation		
Ac_35_60_31	Food serving		



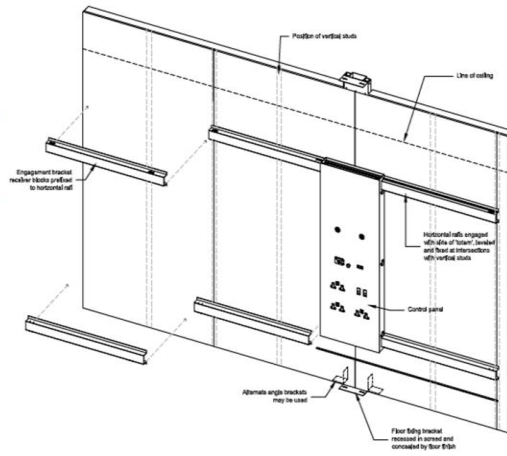
...at 'Room' level

Ac -	Activities	EF 65_40	Ventilation
Ac_35	Medical, health, welfare and sanitary activities	EF_65_80	Air conditioning
Ac_35_10	Medical activities	EF_70	Electrical power and lighting functions
Ac_35_10_57	Nursing	EF_70_30	Electricity distribution and transmission
Ac_35_60_31	Food serving	EF_70_80	Lighting
Ac_45_10_79	Sleeping	EF_75	Communications, security, safety and protection functions
Ac_35_80	Sanitary activities	EF_75_10	Communication
Ac_35_80_07	Bathing	EF_75_30	Signalling
Ac_35_80_80	Showering	EF_75_40	Security
		EF_75_50	Safety and protection
SL -	Spaces / locations		
SL_35	Medical, health, welfare and sanitary spaces	Ss -	Systems
SL_35_10	Medical treatment spaces	Ss_25	Wall and barrier systems
SL_35_10_53	Wards	Ss_25_10	Framed wall systems
SL_35_10_96	Medical buildings	Ss_25_10_30	Framed partition systems
SL_45_10_09	Bedrooms	Ss_25_10_30_35	Gypsum board partition systems
EF -	Elements / functions		
EF_25	Wall and barrier elements	Pr -	Products
EF_25_10	Walls		
EF_25_30	Doors and windows		
EF_30_20	Floors		
EF_55	Piped supply functions		
EF_55_05	Gas extraction and treatment		
EF_55_20	Gas supply		
EF_55_70	Water supply		
EF_60	Heating, cooling and refrigeration functions		
EF_60_40	Space heating and cooling		
EF_65	Ventilation and air conditioning functions		



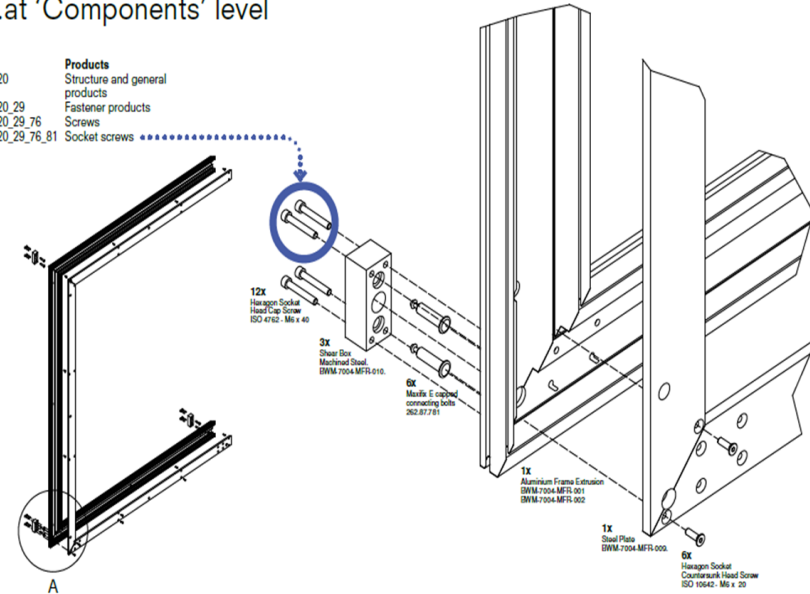
...at 'Fixtures + fittings' level

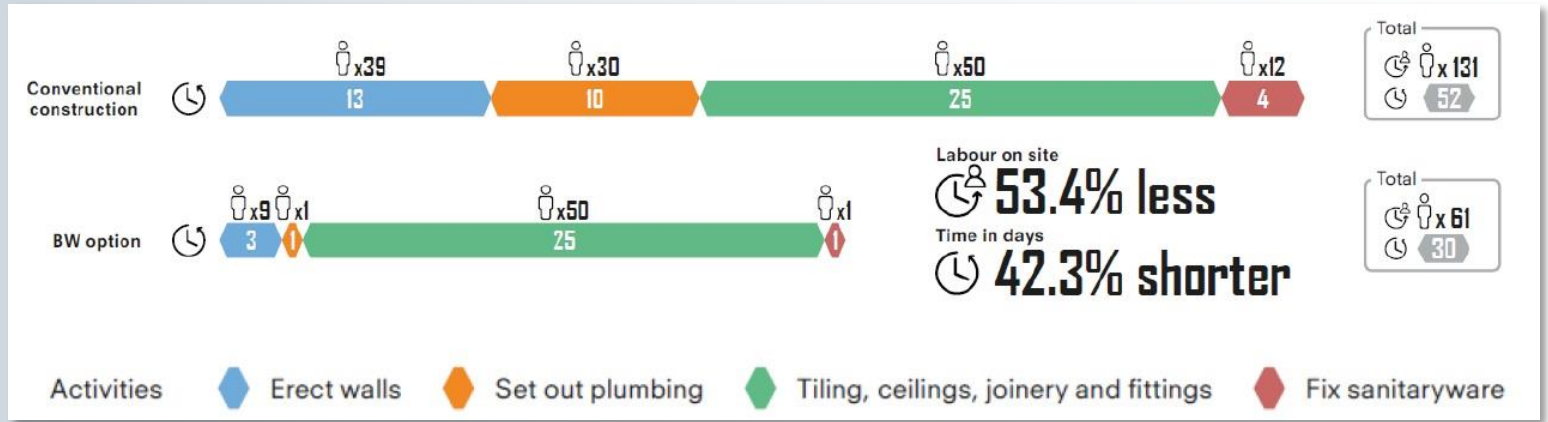
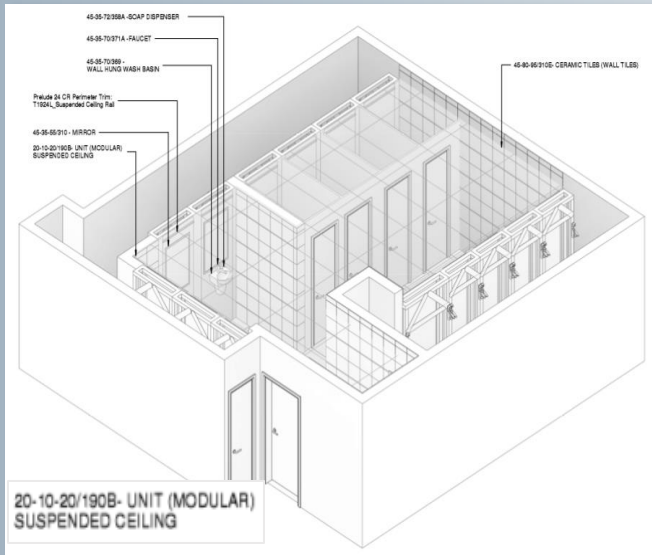
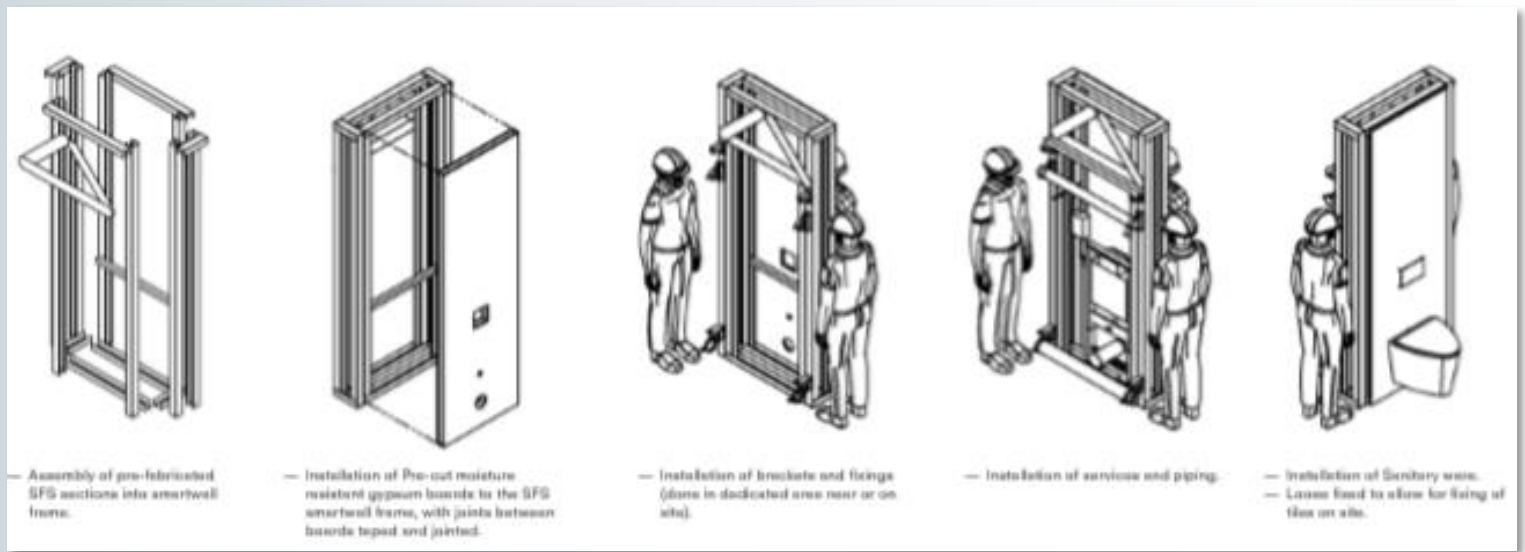
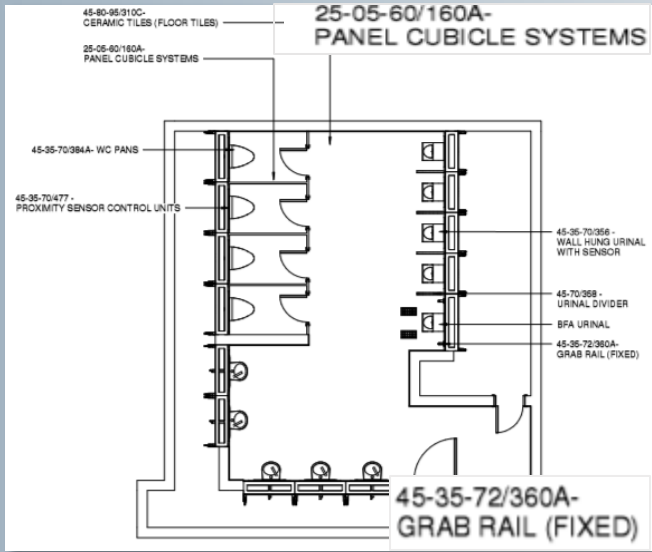
Ss -	Systems	Se_70_80	prefabricated wiring
Ss_25_25	Wall lining systems	Se_70_80_33	Lighting systems
Ss_25_25_45	Lining and casing systems		General space lighting systems
Ss_25_25_46_25	Duct and wall panel lining systems	Se_70_80_33_33	General lighting systems with prefabricated wiring
Ss_25_25_46_90	Timber board wall lining systems	Se_75	Communications, security, safety, control and protection systems
Se_40_50	Medical, health and welfare FF&E systems	Se_75_10	Communications systems
Se_40_50_50	Medical and health FF&E systems	Se_75_10_21	Data distribution and telecommunications systems
Se_40_50_50_37	Hospital ward FF&E systems	Se_75_10_21_21	Data distribution systems
Se_55_20_51	Medical gas supply systems	Se_75_10_21_21_21	Telecommunications systems
Se_55_20_51_03	Medical anaesthetic gas scavenging systems	Se_75_50	Communication, safety and protection systems
Se_55_20_51_27	Medical entonox supply systems	Se_75_50_11	Call and alarm systems
Se_55_20_51_36	Medical helium/ oxygen mixture supply systems	Se_75_50_11_57	Nurse call systems
Se_55_20_51_56	Medical nitrous oxide supply systems		
Se_55_20_51_57	Medical nitrous oxide/ oxygen mixture supply systems		
Se_55_20_51_58	Medical oxygen supply systems		
Se_70	Electrical systems		
Se_70_30_80	Small power systems		
Se_70_30_80_45	Low-voltage small power systems with		



...at 'Components' level

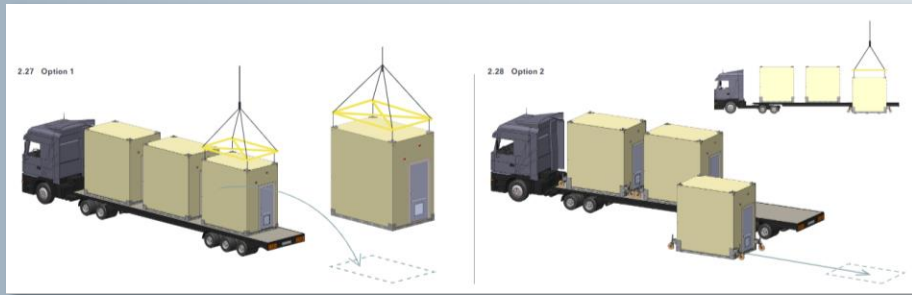
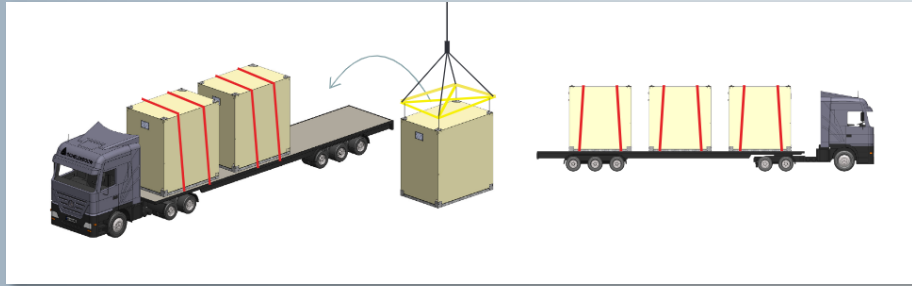
Pr -	Products
Pr_20	Structure and general products
Pr_20_29	Fastener products
Pr_20_29_76	Screws
Pr_20_29_76_81	Socket screws



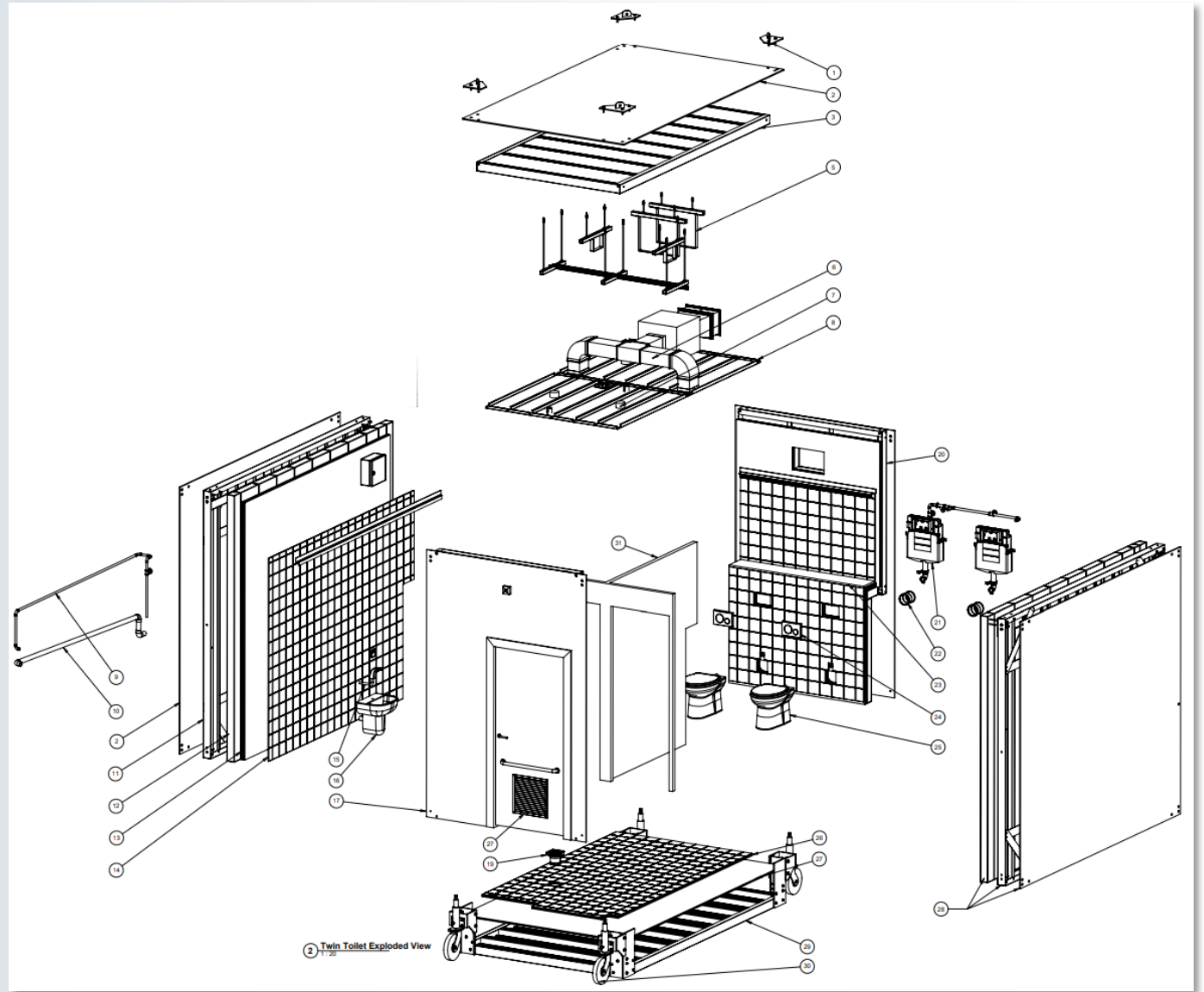


p-DfMA Systemised Workflow 系統化的工作流程

Logistics Simulations 模擬物流

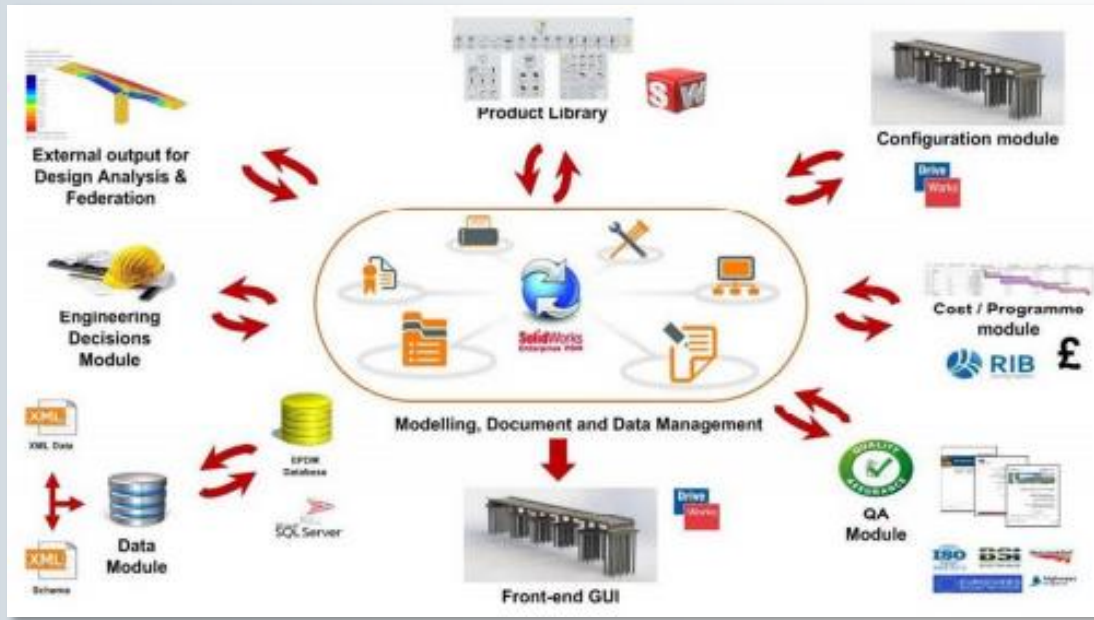


Installation Simulations 模擬安裝



p-DfMA Systemised Workflow 系統化的工作流程

HS2 modular bridge installed over M42 in two days



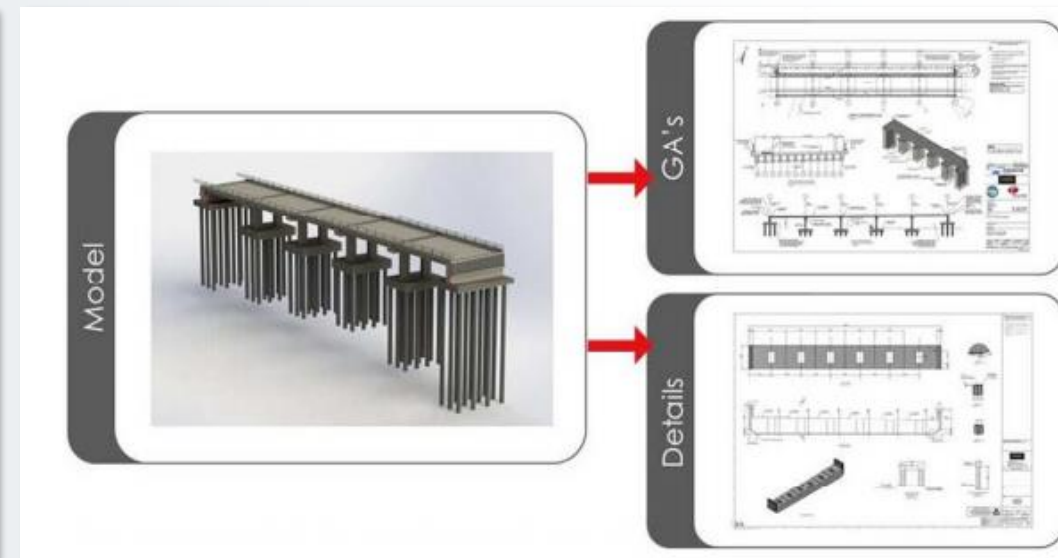
Kits-of-Parts /
p-DfMA



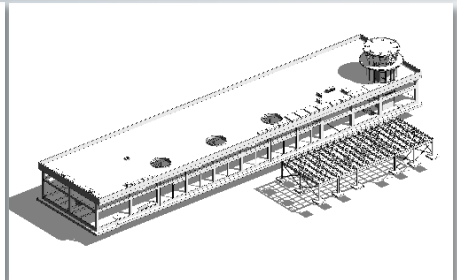
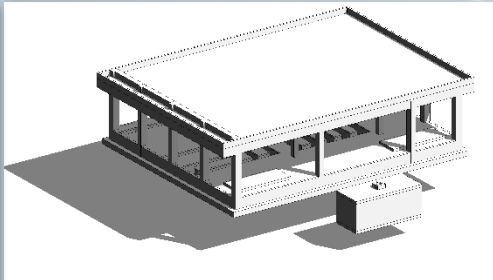
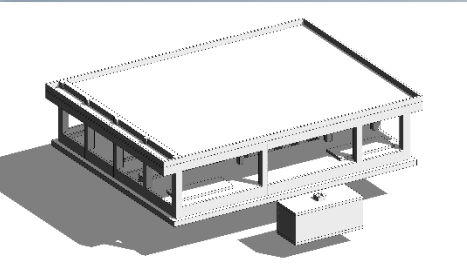
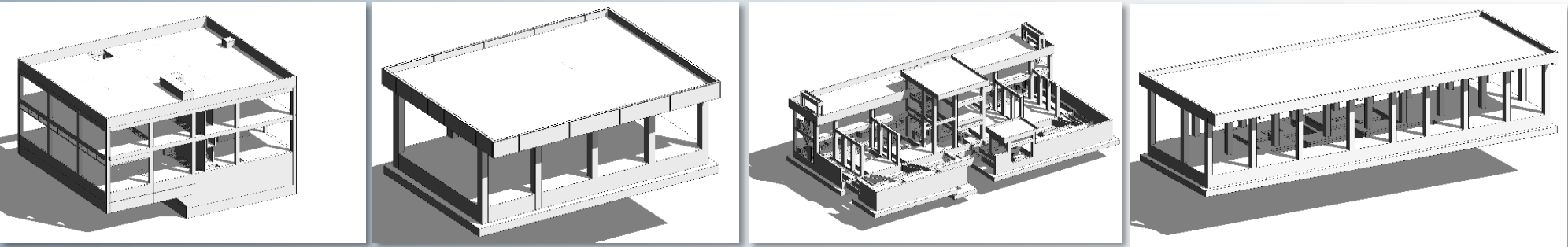
Envelope of obstacle to be
crossed 跨越障礙



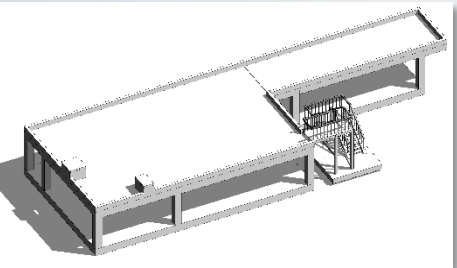
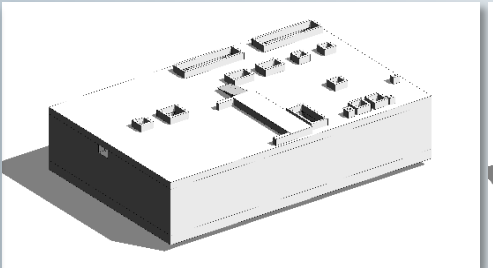
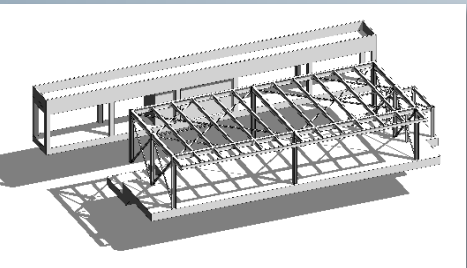
Abutments selected from
range of options 從選項中
選擇的基台



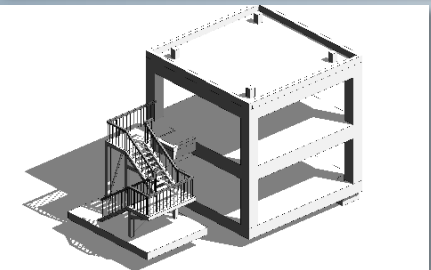
Automatic generation of production information
自動生成生產信息



AIRPORT AUTHORITY BUILDINGS 機場管理局大樓



GOVERNMENT BUILDINGS - SELECTED 政府大樓



Platforms 平台 ≠ Software 軟件...

its a mindset that drives standardisation & systemisation of delivery
這是推動交付標準化和系統化的一種心態

p-DfMA – Platform Thinking 平台思維

DfMA – Manufacturing Hubs & Supply Chain Management

DfMA – 製造中心和供應鏈管理

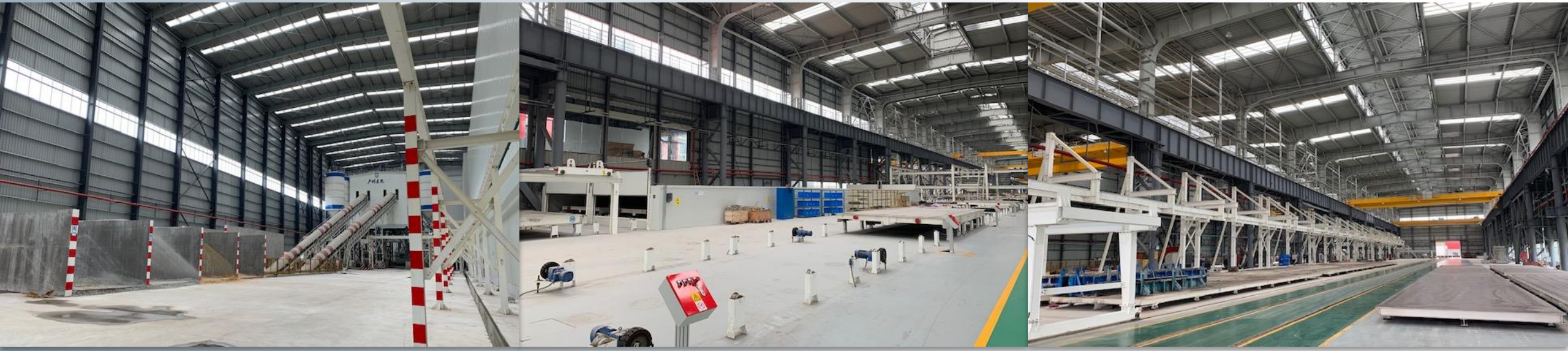
Target 目標	Supportive Policy 支持政策
Pearl River Delta Cities 珠江三角洲城市:	
<p>By the end of 2020, new construction will reach above 15%, government investment projects will reach above 50%</p> <p>到2020年底，新建工程將達到15%以上，政府投資項目將達到50%以上</p>	<ol style="list-style-type: none"> 1. Prioritized land usage plan 優先使用土地計劃 2. Instant refund of VAT 即時退還增值稅
<p>By the end of 2025, new construction area ratio will reach above 35%, government investment projects will reach above 70%</p> <p>到2025年底，新建築面積比例將達到35%以上，政府投資項目將達到70%以上</p>	<ol style="list-style-type: none"> 3. Capital subsidy 資本補助 4. Financial support 資金支持



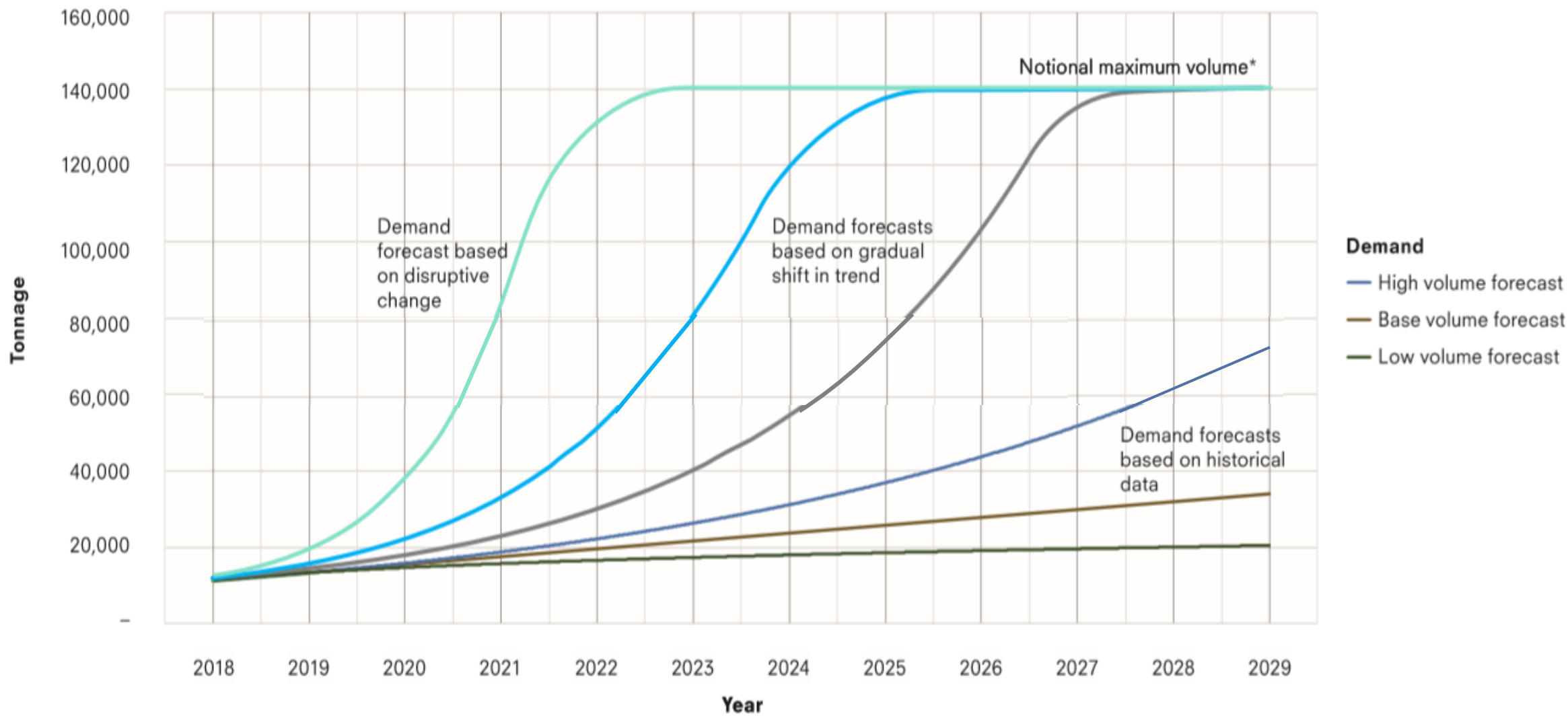
Market Developments – Greater Bay Area 市場發展—大灣區



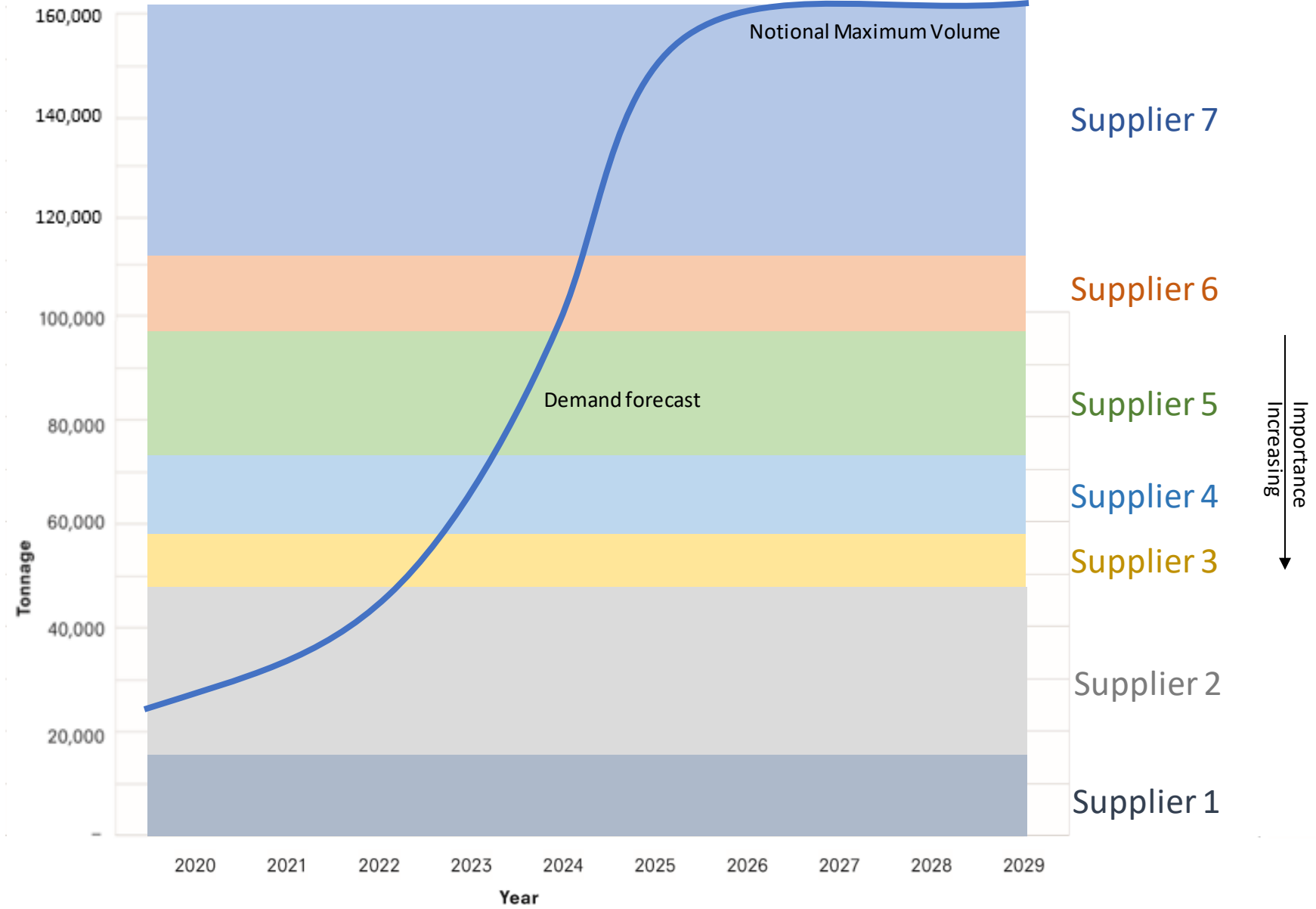
Market Developments – Greater Bay Area 市場發展—大灣區



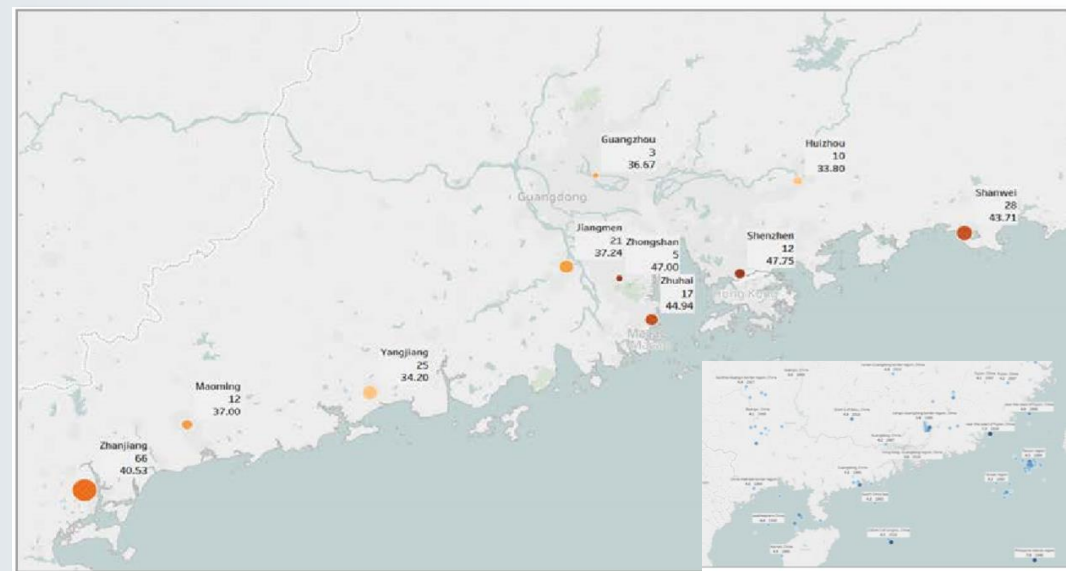
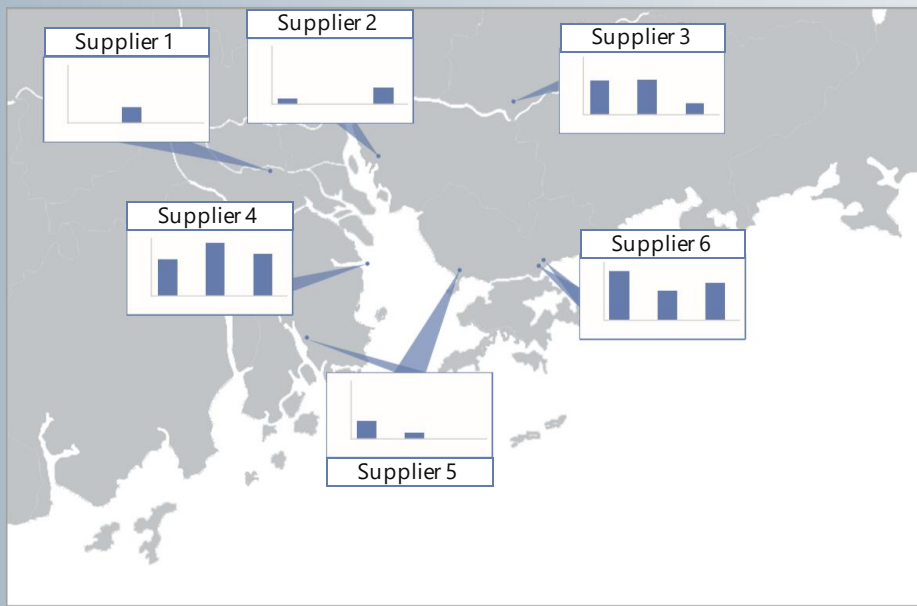
Market Developments – Greater Bay Area 市場發展—大灣區



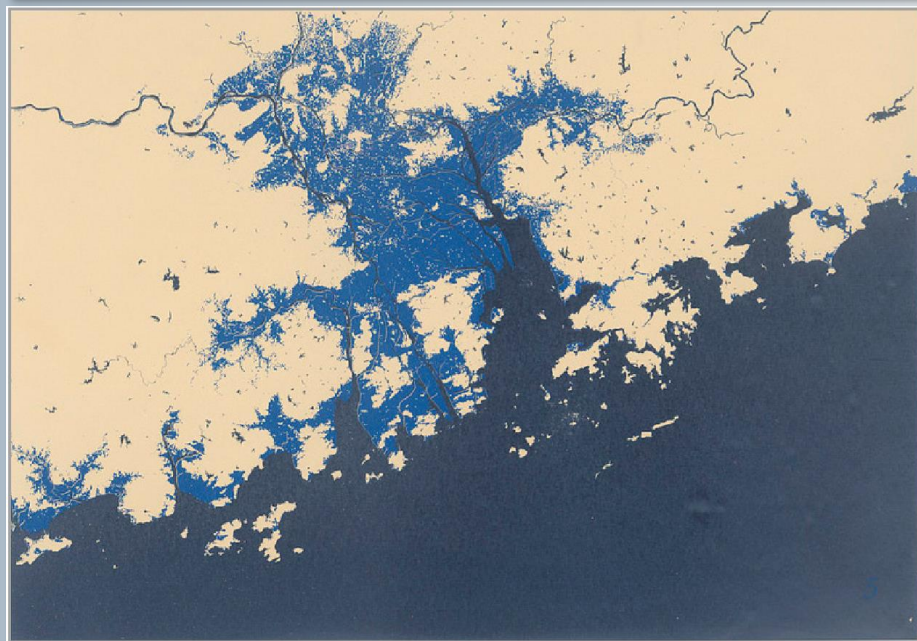
Supply Chain Capacity 供應鏈能力



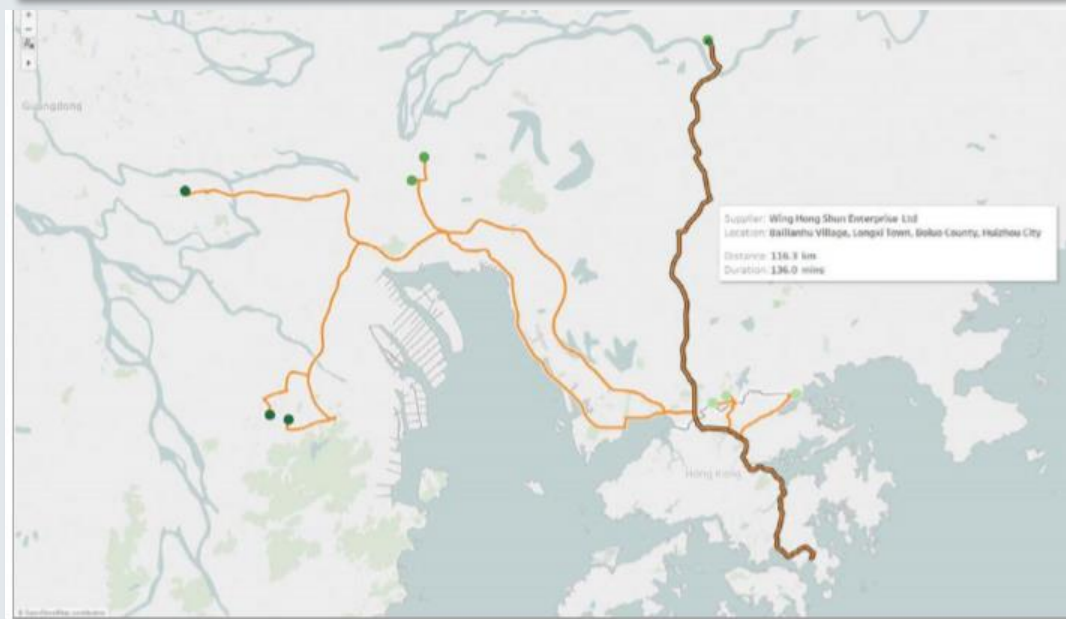
Supply Chain Capacity 供應鏈能力



Major typhoon occurrences in cities close to Hong Kong



Areas close to Hong Kong with increased probability of flooding



Mapping out optimised routes from the construction site to all available suppliers, with relevant details for comparison

“Just in case“ Supply Chain Disruption “以防萬一“供應鏈中斷



Typhoon Hato 23 August 2017

“Just in case” Supply Chain Disruption
“以防萬一”供應鏈中斷

DfMA – Skill Sets

DfMA - 技能

Traditional Design Considerations
傳統設計注意事項



Future of Design Considerations
設計考慮因素的未來



End-to-End Design Workflow
點到點設計流程



“Designers must learn to design in terms of 20ft shipping containers”

“設計師必須學會以20英尺高的運輸集裝箱進行設計”



DfMA – Industry Skill Set Gaps
DfMA – 行業技能缺口



Logistics
物流



Supply Chain Management
供應鏈管理



Factory Quality Management
工廠質量管理



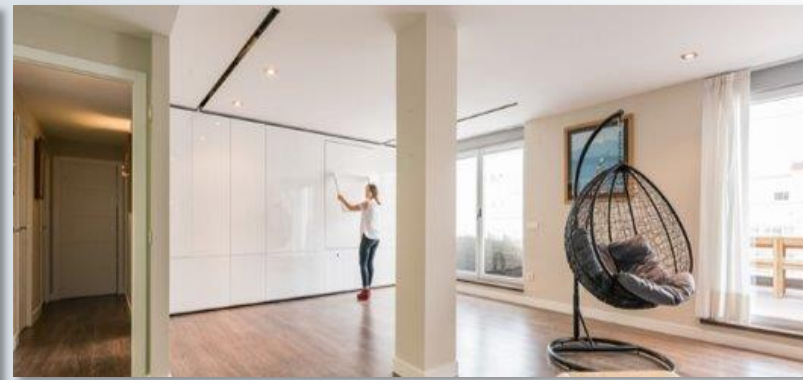
Digital Tools
數碼工具



DfMA – Industry Skill Set Gaps DfMA – 行業技能缺口

Industry Trends

行業趨勢



Customisation and Flexible Living Spaces 定制和靈活的生活空間



Cleaning Robot 清潔機器人



Concrete Distributor 混凝土分配機



Transportation Robots 運輸機器人



Floor Presser 地面按壓機

Site Robotics 地盤機器人

“Old sector gets new youthful look” “舊部門煥然一新”

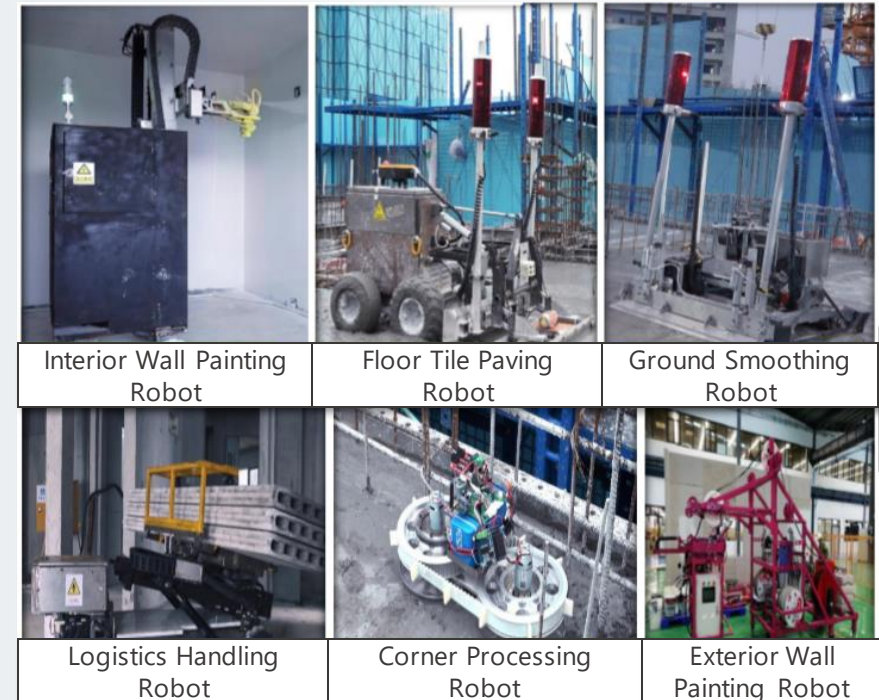
Developer 開發者	2018 construction (million sq. m) 2018年建設 (百萬平方米)	Latest projects 最新項目
Country Garden Holdings	77.3	Robotics
China Evergrande Group	52.4	Electric vehicles, Robotics, AI
China Vanke	40.2	AI
Greenland Holdings	35.7	AI, smart retailing

Sources: J.P. Morgan

SCMP

“..... 1 million houses completed in 1 year”

“..... 1年內完成了100萬套房屋”



Site Robotics 地盤機器人

Beijing, China <> Japan & Hainan

Remote Heavy Equipment Operation
遙控重型設備操作



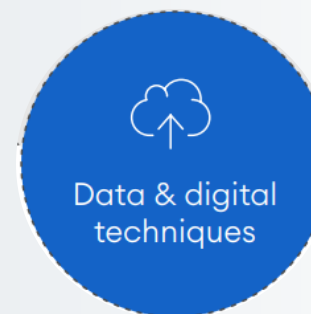
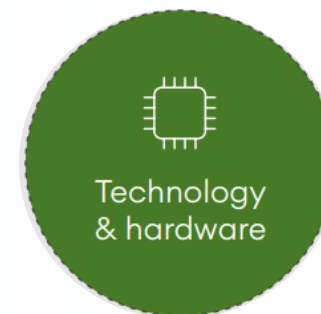
UK

Connected & Autonomous Plant Highways England Roadmap
互聯和自治工廠英格蘭路線圖



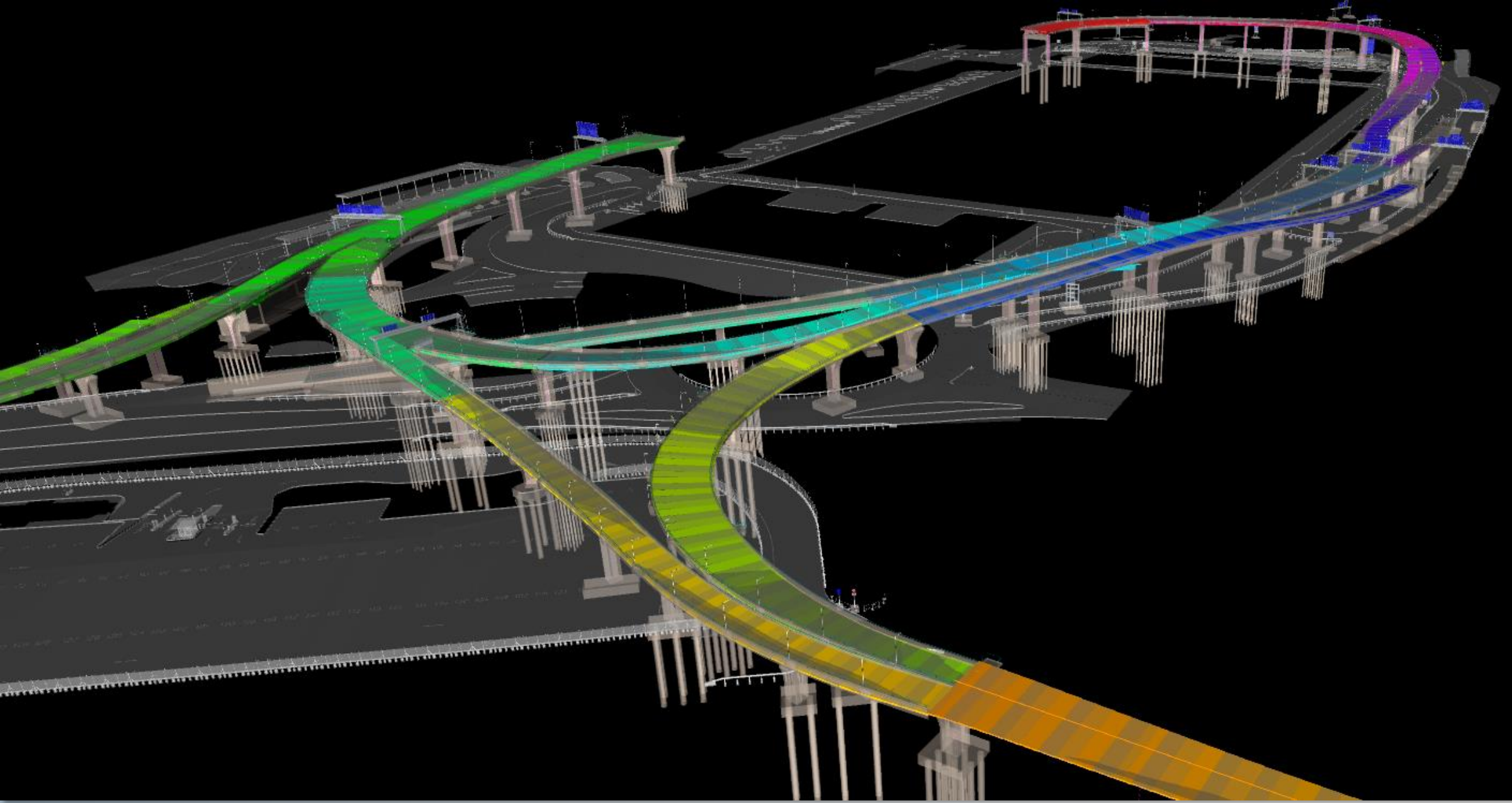
Legislation, finance, insurance
and industry training
立法，金融，保險和行業培訓

Connectivity, remote operation
and autonomous plant
連接性，遠程操作和自治工廠



Algorithms, telemetry, and
common data platforms
算法，遙測和通用數據平台

Remote to Autonomous Plant 遙控機械



Data Driven Design 數據驅動設計

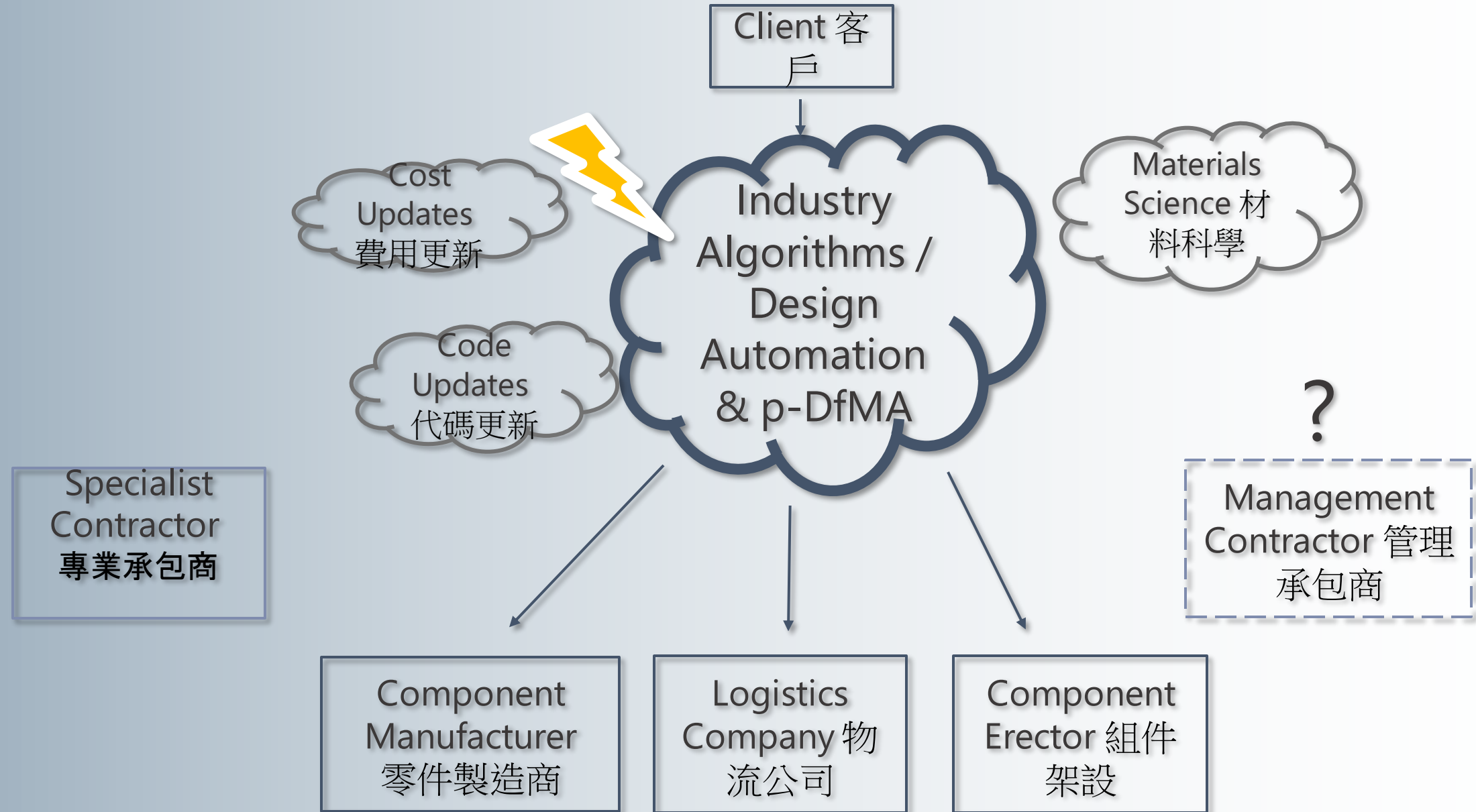


SiteVision™



Augmented Reality 擴增實境 - "The last 100m"

Industry Transformation (Disruption) ? 產業轉型 (顛覆) ?



There is no better time to be an Engineer!
現在就是成為工程師的最好時機！