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CONSTRUCTION ITM LAUNCH AT SCPW, 24 OCTOBER 2017

MEDIA FACTSHEETS

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About BCA

The Building and Construction Authority (BCA) of Singapore champions the development of an excellent built environment for Singapore. BCA's mission is to shape a safe, high quality, sustainable and friendly built environment, as these are four key elements where BCA has significant influence. In doing so, it aims to differentiate Singapore's built environment from those of other cities and contribute to a better quality of life for everyone in Singapore. Hence, its vision is to have "a future-ready built environment for Singapore". Together with its education arm, the BCA Academy, BCA works closely with its industry partners to develop skills and expertise that help shape a future-ready built environment for Singapore. For more information, visit www.bca.gov.sg.

Annex A

OVERVIEW OF CONSTRUCTION ITM

The Construction Industry Transformation Map (ITM) was developed in close partnership with the industry, trade associations and chambers (TACs), institutes of higher learning (IHLs), unions and government through extensive consultation and fruitful discussions. (see **Figure 1**).

Figure 1: Examples of stakeholders involved in the Construction ITM development

Trends and Opportunities

2. There are key trends that we can develop to transform the sector:

a) **Green building** design, sustainable operations and maintenance will become increasingly important and is an area of strength to be built in the sector to meet both domestic needs and global demand. Many of our consultants have started exporting their expertise in green building design for the tropics, especially in developments which have adopted BCA's Green Mark assessment.

b) **Design for Manufacturing and Assembly (DfMA)** moves traditional onsite work offsite into controlled factory environment and designs upfront for ease of

manufacturing and assembly to improve quality and productivity. A controlled environment allows greater automation, leading to higher productivity and quality, while creating new and better jobs in the factory. The onsite installation process becomes more efficient and leads to a cleaner, quieter and safer site with better working conditions.

c) **Integrated Digital Delivery (IDD),** enabled by Building Information Modelling (BIM), fully integrates processes and stakeholders along the value chain through advanced info-communications technology (ICT) and smart technologies. Please refer to **Annex C** for more details on IDD.

3. Together, these will help us to realise a future-ready built environment with smart, green and high quality buildings.

Transforming the Industry

4. The vision for the Construction ITM is:

> ***An advanced and integrated sector*** with widespread adoption of leading technologies, led by ***progressive and collaborative firms*** well-poised to capture business opportunities, and supported by a skilled and competent workforce offering ***good jobs for Singaporeans***.

5. To achieve this vision, the key strategies are to: (i) increase adoption of DfMA and IDD, (ii) build progressive and collaborative firms, and (iii) support workforce needs and aspirations.

Increasing DfMA Adoption

6. One of our key approaches to achieve our desired vision is the adoption of DfMA technologies. We aim to achieve 40% DfMA adoption in construction projects by 2020. A robust DfMA eco-system will make DfMA technologies price competitive and enable widespread adoption. To achieve this, the strategies are to:

a) Generate lead demand to build-up experience and create economies of scale. Given the strong public sector demand, Government Procurement Entitles (GPEs) will continue to scale up adoption of DfMA technologies through the Productivity Gateway Framework (PGF). For the private sector, the Government will continue to roll out Government Land Sales (GLS) with appropriate DfMA conditions. The

Government will also provide funding support for private sector projects that adopt DfMA technology voluntarily.

b) Build supply capacity and capabilities. Up to ten Integrated Construction and Prefabrication Hubs (ICPHs) will be rolled out by 2020, depending on the need of the industry. Currently, there are three ICPHs in operation and two under construction.

7. BCA is partnering the industry, including key technical agencies and industry practitioners, to develop a series of guidebooks on DfMA technologies. These guidebooks provide simple and practical tips as well as good practices for the various DfMA technologies. The first guidebook in the series is the Prefabricated Prefinished Volumetric Construction (PPVC) guidebook. More details may be found in **Annex B**.

Increasing IDD Adoption

8. The next key approach is to drive IDD adoption. IDD adoption will be raised through a two-pronged approach:

a) Progressively Building up IDD Capabilities. BCA has mandated the adoption of Building Information Modelling (BIM) for key projects[1] as BIM is a necessary pre-cursor for the wider adoption of IDD. BCA has also developed the Singapore Virtual Design and Construction (VDC) Guide to build capability on collaborating using BIM. Please refer to **Annex D** for more details. The BCA Academy will also review its BIM/VDC training programmes to include IDD scope.

b) Drive Adoption of IDD. Under the next phase, BCA will continue to develop standards for IDD to ensure interoperability and encourage adoption of shared platforms and IDD solutions in both public and private sector projects. The Centre for Lean & Virtual Construction (CLVC) will provide an incubating environment, especially for smaller firms which lack the capacity to develop their own in-house systems and processes, to test bed IDD solutions.

9. These key strategies for IDD and wider digitalisation across the sector will be further developed within a comprehensive IDD Plan.

[1] Since 2015, BCA has required Architectural and Engineering submissions in BIM for new projects > 5,000 m^2.

Build Progressive and Collaborative Firms

10. As part of industry transformation, it is important to support firms in capability building.

a) Review of Public Procurement Practices: To support a sustainable and collaborative sector, the Government is reviewing procurement frameworks and contracting practices.

i) Better Differentiation of 'Quality' and Greater Transparency. The Quality-Fee Selection Method (QFM) for consultants and the Price-Quality Method (PQM) for contractors are being reviewed. The objective is to encourage sustainable bidding behaviour and larger investments in technology and innovation to improve productivity, uplift quality and enhance collaboration among firms. In particular, higher weightage will be placed on non-price components and the differentiation of the 'Quality' score between tenderers will be made clearer. Greater transparency of the 'Quality' component of public sector projects will also be made available to encourage firms to improve performance through healthy competition.

ii) Facilitate Greater Collaboration among Firms. Beyond Early Contractor Involvement (ECI)[2], Collaborative Contracting[3] further enhances integration by promoting mutual trust and collaboration in executing projects that could result in less changes and claims.

Supporting Workforce Needs and Aspirations

11. To drive the transformation of the built environment sector, the quality of the workforce needs to be strengthened, especially for the key professions of engineering and architecture.

a) Attract more Singaporeans into the sector: The growth of IDD, DfMA and Green Buildings will create new and good jobs that will be attractive to the younger and more IT-savvy Singaporeans. These jobs will involve higher skills, which come with more competitive salaries and a better working environment. Firms will also need to strengthen HR practices, and the overall image of the sector will need to be improved through sustained rebranding. BCA will continue to partner industry firms to

[2] The Early Contractor Involvement (ECI) procurement method is an approach where contractors are engaged early to provide construction inputs during the design stage to facilitate the integration of the overall design and construction processes.

[3] A working committee has been set up to review the adoption of collaborative contracting.

offer scholarship and sponsorship programmes, which have succeeded in attracting a new wave of young Singaporean built environment professionals.

b) Build Key Competencies: Industry transformation has to be driven by a strong core of PMETs who are well equipped with core engineering skills as well as the requisite skills in IDD, DfMA and Green Buildings. By 2025, the target is to train 20,000 personnel in IDD, 35,000 in DfMA and 25,000 in green buildings. To achieve this, a Built Environment SkillsFuture Tripartite (BEST) taskforce[4] has been set up. The taskforce will look at providing more structured internships, and lead in training more new graduates in response to industry feedback to help graduates become fully job ready. The work of the taskforce is currently ongoing and detailed recommendations will be made subsequently.

Government Support for Industry Transformation

12. The Construction Productivity and Capability Fund (CPCF) will continue to play a key role to support firms to adopt technology, build capabilities and upgrade their workforce. BCA is currently reviewing the support provided through the CPCF to align them with the ITM strategies.

APPENDIX

BACKGROUND OF INDUSTRY TRANSFORMATION MAPS (ITM)

INTEGRATED ROADMAPS TO DRIVE INDUSTRY TRANSFORMATION

Broader sector-focused strategies to sustain growth & competitiveness of our economy & industries

To achieve maximum synergies in our industry transformation over the next few years, the Government announced the S$4.5b Industry Transformation Programme at Budget 2016. The programme will integrate different restructuring efforts, taking a targeted and industry-focused approach to address issues and deepen partnerships between Government, firms, industries, trade associations and chambers.

Rationale for ITMs

2. Externally, we face challenging economic conditions, rising competition, and disruption from technological advances. Domestically, land and manpower constraints grow more pressing. The Government will continue its support at the enterprise and worker level. However, we need to look more intensively into industry-centred strategy in a more systematic and co-ordinated way.

3. The integrated approach is necessary as:

[4] The BEST taskforce is co-led by BCA, Construction Industry Joint Committee (CIJC), IHLs and setup under the Future Economy Council Built Environment Cluster.

a) Increasingly complex challenges will require cross-cutting solutions from multiple agencies and stakeholders working together.

b) We need to develop strategies that can upgrade a significant proportion of the industry, to move the productivity and innovation needle.

c) We need industry itself, both the corporates and unions/workers, to take ownership of the transformation effort and sustain it

23 Industries, 6 Clusters

4. Under the programme, there will be Industry Transformation Maps (ITMs) developed for 23 industries under 6 clusters (refer to **Table 1** for the list of clusters and industries). Together, they cover over 80% of our GDP.

5. The Future Economy Council (FEC) will take overall responsibility for the implementation of the ITMs. To do so, there are 6 sub-committees under the FEC[5]. Each of the sub-committees will oversee a group of ITMs within the same broad cluster of industries.

6. For tight coordination and accountability within the Government, one Government agency will assume overall responsibility for each ITM, and coordinate among agencies and with the tripartite partners. Similarly, at the cluster level, there will be one Government agency taking the lead.

7. Each ITM will be tailored to the needs of the industry. In developing these ITMs, the Government will examine deeply the industry landscape, the future trends and needs to set out a suite of initiatives to systematically raise productivity, develop skills, drive innovation, and promote internationalisation, so as to catalyse transformation and achieve the stated vision of each industry. These will be refined over time to ensure relevancy.

Integrated Approach to develop skills, innovation and productivity

8. Each ITM will consist of a growth and competitiveness plan, supported by four pillars:

- Productivity. Strategies to support companies especially our Small and Medium Enterprises (SMEs) to move to higher value-added (VA) activities and raise operational efficiency

- Jobs & Skills. Investing in our people, to equip them with deep skills to support the shift to greater value creation

- Innovation. Strategies to leverage R&D to develop new products and services

- Trade and Internationalisation. Supporting companies in expanding to overseas markets

9. The ITMs will also address the Government's role as facilitator and enabler of industry upgrading, for example, by creating a regulatory environment conducive to innovative business models, or setting national standards to promote technology adoption.

ITMs supported by strong partnerships

[5] The 6 cluster subcommittees are Manufacturing, Built Environment, Trade & Connectivity, Essential Domestic Services, Modern Services, and Lifestyle.

10. Industry transformation requires deep partnerships between large and small companies, public research institutions, education and training providers, as well as Trade Associations and Chambers (TACs), unions, individuals and the government. Each will bring an important perspective. Hence the ITM will involve everyone working together to address the salient issues in the medium to longer term for our sectors.

11. The ITMs will be progressively rolled out by the end of FY2017. The Construction ITM is the 11th ITM to be launched.

Table 1: List of ITM Clusters and Industries

S/N	Cluster	Sector	Lead Agency
1	Manufacturing	Energy & Chemicals	EDB
2		Precision Engineering	EDB
3		Marine & Offshore	EDB
4		Aerospace	EDB
5		Electronics	EDB
6	**Built Environment[6]**	**Construction**	**BCA**
7		Real Estate	CEA
8		Environmental Services	NEA
9		Security	MHA
10	Trade & Connectivity	Logistics	EDB
11		Air Transport	CAAS
12		Sea Transport	MPA
13		Land Transport	LTA
14		Wholesale Trade	IES
15	Essential Domestic Services	Healthcare	MOH
16		Education	MOE
17	Modern Services	Professional Services	EDB
18		ICT and Media	MCI
19		Financial Services	MAS
20	Lifestyle	Food Services	SPRING
21		Retail	SPRING
22		Hotels	STB
23		Food Manufacturing	SPRING

[6] While the Landscape sector comes under the Built Environment Cluster, it is not officially one of the sectors developing an ITM. Instead, NParks is developing an Industry Manpower Plan (IMP) for the sector.

Annex B

LAUNCH OF PREFABRICATED PREFINISHED VOLUMETRIC CONSTRUCTION (PPVC) GUIDEBOOK

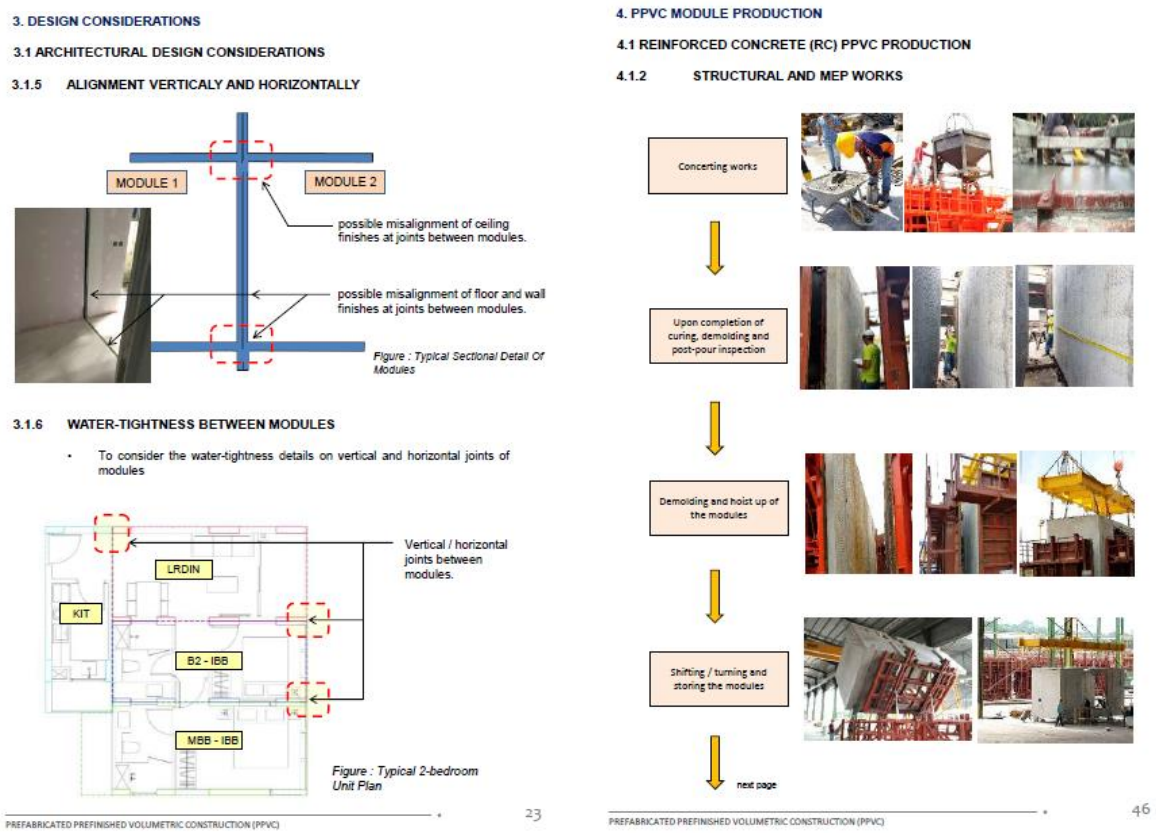
The Prefabricated Prefinished Volumetric Construction (PPVC) guidebook is the first instalment of a series of guidebooks on DfMA technologies. It was developed through a collaborative effort involving BCA, key technical agencies and industry practitioners.

2. This guide provides simple and practical tips to practitioners on how PPVC is designed, fabricated, inspected, delivered and installed to achieve its functional requirements and workmanship standards. Good practices such as upfront planning and design to incorporate PPVC adoption are also covered. Practitioners are encouraged to use this guide to innovate and improve further on PPVC design, fabrication and installation.

3. The PPVC guidebook will available for downloading from 28 Oct 2017 at: https://www.bca.gov.sg/Professionals/Technology/others/PPVC_Guidebook.pdf

4. The upcoming guidebooks in the series are:

- Structural Steel Guidebook
- Advanced Precast Guidebook
- Mechanical, Electrical, and Plumbing (MEP) Guidebook
- Mass Engineered Timber (MET) Guidebook



Pages from the PPVC Guidebook

Annex C

INTEGRATED DIGITAL DELIVERY (IDD)

Building and construction projects often involve many different parties - Developers (who conceive and finance projects); Consultants (who produce plans); Builders (who do the actual construction); Sub-Contractors and Tradesmen (e.g. electricians, plumbers); Suppliers; Facility Managers. They are typically separate firms – some large but mostly small and medium enterprises (SMEs).

2. Integrated Digital Delivery (IDD) aims to connect various industry parties involved in building and construction projects through digital information. Such shared information, created through Building Information Modelling (BIM), will allow the integration of the entire project delivery process from design, fabrication (in factories), assembly on-site to operations and maintenance of buildings.

3. This approach minimises mistakes, delays and rework, better coordinates the production and delivery of factory-produced building parts (including entire modules like PPVC), speeds up construction, reduces noise and disamenities to neighbours around the construction site, and provide useful information about the building for future maintenance or retrofitting.

4. IDD involves four main components – Digital Design, Digital Manufacturing and Fabrication, Digital Construction, and Digital Asset Delivery and Management. These components also complement the DfMA process. Examples of industry applications of the four components are shown in the following Figures.

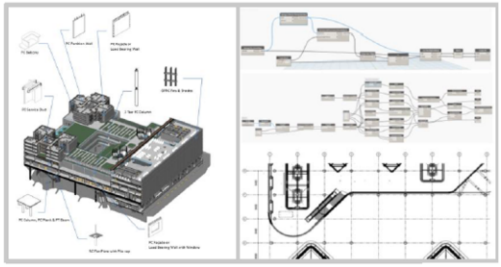
Examples of IDD in the industry

Digital Design

Examples of Digital Design

WOHA (Kampung Admiralty)

- *Using BIM to improve constructability and potential for prefabricated systems*
- *Using visual scripting to automate certain mundane tasks (e.g. sheet creation)*

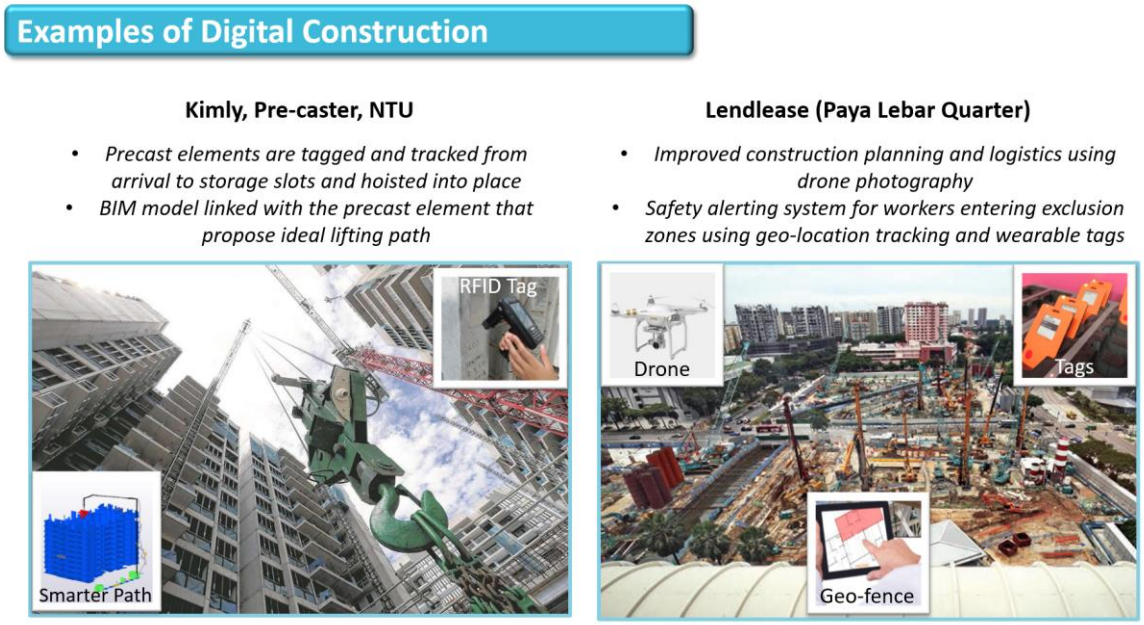


- *WOHA use intelligent objects to perform semi-automated building code checking*
- *They also used the BIM model to analyse the performance of the building through Computational Fluid Analysis (CFD) approach*
- *And using computational BIM approach, they could automate the generation of 2D sheet drawing directly from the BIM model*

Digital Manufacturing and Fabrication

- *Greyform develop the fabrication model which is a further development from design intent model from consultant.*
- *Using this fabrication model, could send the information directly to the machinery for production.*
- *It is a highly automated process using Enterprise Resource Planning (ERP) system that control the process from planning to production, all the way to storing and delivery.*

Digital Construction



- *In this project Kimly and NTU use RFID tag to track their precast elements from arrival at the site, to being placed in specific storage slots, to being hoisted into place.*
- *As the precast elements travel, both the site inventory and the construction progress are automatically recorded in the site's BIM (Building Information Modelling) model – a digital, info-rich 3D model*
- *A computer model calculates the ideal lifting path for each precast element. With real-time GPS tracking, the crane operator can see how closely the load's actual path matches the suggested one.*

Digital Asset Delivery and Management

- *In this project, CCDC use defect management solution to track and monitor construction defect.*
- *With this solution, CCDC could accurately monitor project activities with regards to defect rectification through its consolidated report*
- *With the solution data analytics capability, CCDC could evaluate the performance of their supplier and sub-contractors*

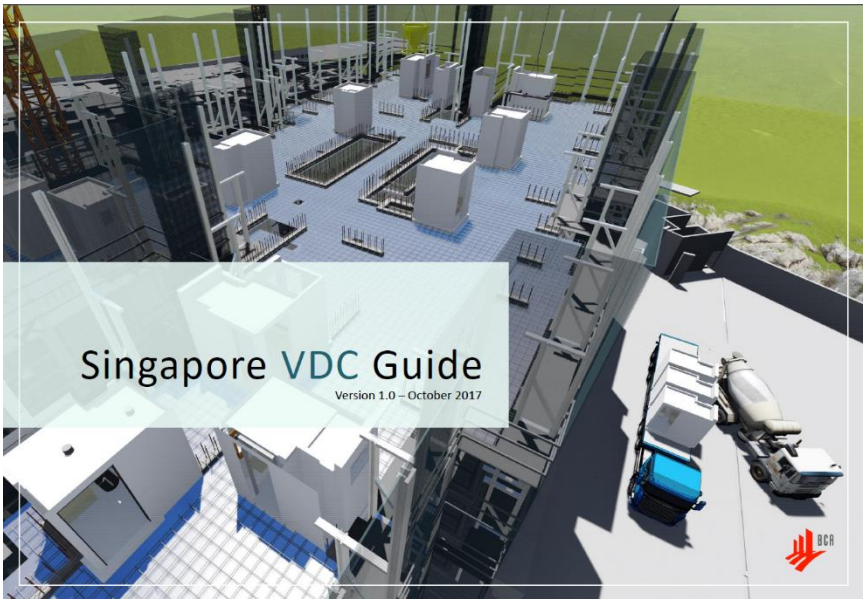
Annex D

LAUNCH OF SINGAPORE VIRTUAL DESIGN AND CONSTRUCTION (VDC) GUIDE

The Singapore Virtual Design and Construction (VDC) Guide comprehensive set of VDC implementation guidelines for projects in Singapore. This guide also highlights key activities where the VDC is found to be most impactful and beneficial. The areas covered in the guide include specifying requirements for design model to contractors for further development and the framework for intensive collaboration period where a project team can resolve conflict speedily. The Singapore VDC Guide allows more practitioners to acquire the necessary knowledge to implement VDC in their projects.

2. The Singapore VDC Guide was produced under the leadership of the BIM Steering Committee. Significant contributions were also made from local and overseas experts in BIM and VDC, drawn largely from actual implemented projects in the local environment.

3. The Singapore VDC Guide will be available for download through CORENET in the coming weeks.



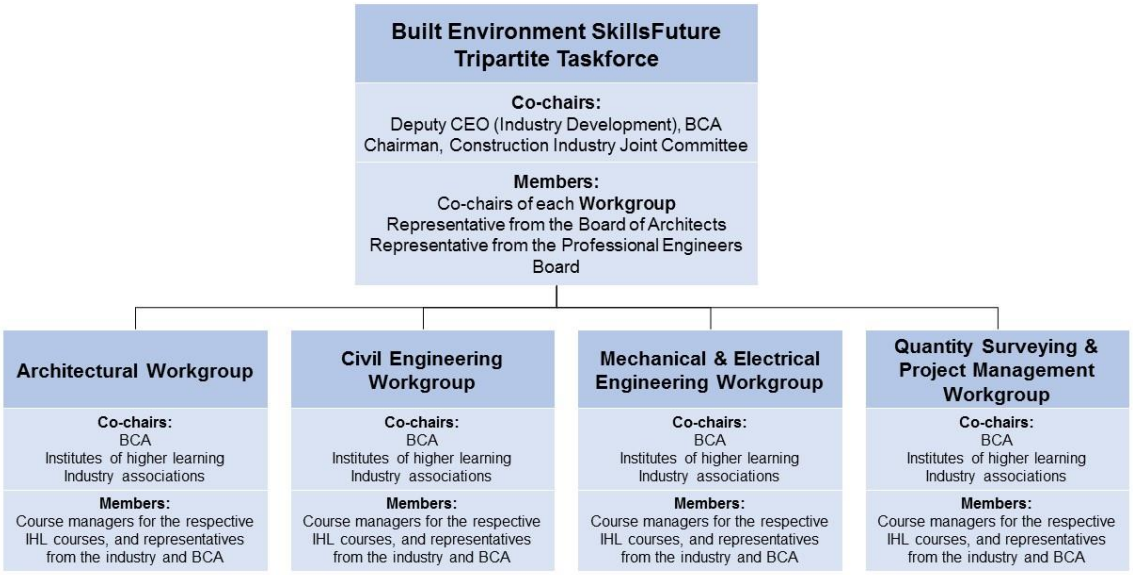
Cover page of Singapore VDC Guide

Annex E

FACTSHEET ON ON BEST TASKFORCE

The Built Environment SkillsFuture Tripartite Taskforce is a tripartite collaboration among BCA, institutes of higher learning and the industry partners.

BCA Deputy CEO (Industry Development) and the Construction Industry Joint Committee Chairman are co-chairing this Taskforce, which comprises four Workgroups represented by members of the industry and the academia from the various disciplines of the built environment – architecture, civil engineering, mechanical & electrical engineering, quantity surveying and project management.



The Taskforce will:

A. Develop comprehensive training pathway in industry transformation areas covering Pre-Employment Training (PET), internship and Continuing Education and Training (CET):

- Infuse Integrated Digital Delivery (IDD), Design for Manufacture and Assembly (DfMA), green buildings' in curriculum, with emphasis on inter-disciplinary collaborative projects:
  - ✓ Recommend mechanisms / frameworks to ensure adequate teaching resources, e.g. train the trainer and (or) industry to provide adjunct lecturers / mentors
  - ✓ Put in place a framework for regular updates to institutes of higher learning on developments in the sector

- Develop a capstone programme to prepare current graduating students for built environment careers (interim), which could be part of pre-internship training:

B. Enhance Industry/Institutes of Higher Learning (IHL) partnerships by

- Looking into collaboration models to:
  - ✓ Attract new entrants through scholarship / sponsorship and rebranding
  - ✓ Ensure graduates are ready to enter the sector workforce through PET (pre-employment training) and internship
  - ✓ Upgrading and retaining built environment personnel through CET (continuing education and training) and life-long learning