

CONSTRUCTION PRODUCTIVITY ROADMAP

In support of the Economic Strategies Committee's (ESC) recommendation to raise productivity for sustained economic growth. MND/BCA, in consultation with the industry and the International Panel of Experts, have formulated a holistic **Construction Productivity Roadmap** to transform the construction industry and raise its productivity. The Roadmap aims to realise the ***vision of a highly integrated and technologically advanced construction sector led by progressive firms and supported by a skilled and competent workforce in 2020***, through a 4-pronged approach as follows:-

- a. Regulating the demand and supply of low cost, lower skilled foreign workforce through foreign worker levy and MYE system;
- b. Enhancing the quality of the construction workforce;
- c. Imposing regulatory requirements and minimum standards to drive widespread adoption of labour-saving technology; and
- d. Offering financial incentives to encourage manpower development, technology adoption and capability building.

Multi-pronged	Associated Initiatives
<p><u>Prong 1:-</u> Regulating the demand and supply of low cost, lower skilled foreign workforce through foreign worker levy and MYE system</p>	<ul style="list-style-type: none"> • <u>Reducing Man-Year-Entitlement (MYE).</u> To progressively cut the MYE to regulate supply of low cost foreign workers. In this regard, MOM has announced cumulative MYE cut of 40% by July 2013. • <u>Imposing Higher Levy.</u> To moderate the demand for low cost foreign workers, MOM has announced 6-monthly levy increases till July 2013.
<p><u>Prong 2:-</u> Enhancing the quality of the construction workforce</p>	<ul style="list-style-type: none"> • <u>Enhancing Construction Registration of Tradesmen (CoreTrade) Scheme.</u> BCA will expand the key construction trades recognised under the CoreTrade scheme from current 7 to 17 trades in 1H2011. [See Appendix 1 on CoreTrade] • <u>Introducing New Tiered-levy Framework.</u> From July 2011, unskilled workers will be phased out for the construction sector. A new tiered-levy

	<p>framework will be introduced to distinguish the “Higher Skilled” foreign workers from the “Basic Skilled” workers. The “Higher Skilled” workers, who are either CoreTrade-registered or possess minimum 4 years construction experience with relevant supervisory qualifications, will enjoy lower levy than the “Basic Skilled” workers who possess only BCA’s Skill Evaluation Certification (Knowledge) [SEC(K)]. The levy differential between the “Higher Skilled” workers and “Basic Skilled” workers will be progressively raised to encourage the employers to upgrade and retain the more experienced and higher skilled workers. [See Appendix 2 on SEC(K)]</p> <ul style="list-style-type: none"> • To facilitate the upgrading of workforce at all levels, the Workforce Training and Upgrading (WTU) scheme under the Construction Productivity & Capability Fund (CPCF) co-funds the cost of training courses and skills assessments. The supported training courses apply to PMETs, supervisory personnel, foremen as well as tradesmen. [See Appendix 3 on WTU]
<p>Prong 3:- Imposing regulatory requirements and setting minimum standards to drive widespread adoption of labour-saving technology</p>	<ul style="list-style-type: none"> • <u>Enhancing Buildability Framework.</u> BCA is enhancing the buildability framework to <i>require architects and engineers to adopt “easier-to-construct” building designs.</i> A new Constructability component will also be introduced to <i>require contractors to adopt more labour efficient construction methods and technology.</i> These changes will take effect in 2H2011. [See Appendix 4 on Buildability] • <u>Driving Adoption of Building Information Modelling (BIM).</u> BCA has worked out a 5-year BIM Adoption Roadmap to implement BIM across the sector. BIM, a 3D modelling tool, enables all parties in the construction value chain to visualise the design better, detect design problems early, enhance planning and coordination, and reduce reworks for projects. This integrated

	<p>approach can result in time and cost savings for the entire project. BCA will be mandating BIM e-submission of architectural, structural and M&E plans for building works for regulatory approval by 2015. The public sector will also take the lead in driving BIM adoption and work towards specifying this as a requirement in new building projects from next year. [See Appendix 5 on BIM]</p>
<p><u>Prong 4:-</u> Providing financial incentives to encourage manpower development, technology adoption and capability building</p>	<ul style="list-style-type: none"> • Enhancing the Construction Productivity & Capability Fund (CPCF). To help firms cope with the upcoming manpower policy changes, BCA is enhancing the CPCF to (a) extend the funding support to cover more industry stakeholders, (b) expand the scope of funding, and (c) raise the funding support levels to give a stronger push for firms to make the swift switch to technology in place of labour. [See Annex B for details of the enhancements to the CPCF]

To steer the industry towards raising productivity, BCA has established the **Construction Productivity Centre (CPC)** and the **Centre of Construction IT (CCIT)** to step up industry outreach efforts. The CPC and CCIT aim to educate and raise the industry's awareness and ownership on productivity improvements and manpower development. It adopts a customer-centric account management approach in chaperoning firms in their productivity journey and in administering CPCF incentives to encourage technology adoption, manpower development and capability building by firms.

Some of the key initiatives of the CPC includes:-

- Showcasing best practices and successful stories in productivity improvements through a **bi-monthly publication** called "BuildSmart" for industry players;
- **Recognizing industry productivity leaders through awards** to create a culture of productivity excellence; and
- **Establishing Benchmark indicators** for productivity improvements to create greater ownership in productivity improvement across the sector.

In April 2011, BCA is organising the **inaugural Singapore Construction Productivity Week**, to further heighten industry awareness of latest initiatives and best practices geared towards productivity improvements. The Week serves as a learning platform for the construction industry to gain valuable insights on best practices, new technologies and skills that have a positive

impact on raising productivity at the individual, firm and industry level. The Week will have the following key events:

- The **Skilled Builder Competition**, with four categories of trades (system formwork installation, drywall installation, telescopic handler operation, simulated crane operation) for skilled tradesmen to compete over two days (from 25 to 26 April 2011)
- The **Building Information Modelling (BIM) Competition**, which is targeted at professionals and students, to use BIM software to put together a building design (25 to 26 April 2011).
- The **Build Smart Conference**, a two-day conference at Singapore Expo on construction productivity (27 to 28 April 2011)
- **BuildTech Asia 2011 Exhibition**, a three-day trade exhibition at the Singapore Expo focusing on innovative technologies and products to improve construction productivity (27 to 29 April 2011)
- **Build Smart Site Tours** of innovative projects and construction technologies (29 April 2011).

MND/BCA will continue to review and evaluate the effectiveness of the measures under the Construction Productivity Roadmap to steer the industry towards improving productivity and raising capability.

Construction Registration of Tradesmen (CoreTrade)

The **Construction Registration of Tradesmen**, or CoreTrade in short, is a workers registration scheme administered by the Building and Construction Authority (BCA), for skilled and experienced construction personnel in key construction trades.

2. *Objectives of CoreTrade*. The CoreTrade scheme was introduced to facilitate the sector in building up a core group of competent and experienced tradesmen and trade foremen in key construction trades to anchor and lead the construction workforce, and thereby raise construction quality and productivity levels.

3. CoreTrade provides a platform to retain the better and more experienced workers by providing a clearer career progression path and giving them due recognition through a registration system. It allows one to move from a general worker, to a registered Construction Tradesman¹ specializing in specific trades and eventually become a registered Construction Trade Foremen². Workers who are eligible for registration include skilled locals as well as skilled and experienced foreign workers who have been working in the construction industry in Singapore. The registration of CoreTrade personnel commenced in December 2008.

4. Under the Building Control (Amendment) Act 2007, licensed Class 1 General Builders are required to deploy a minimum number of registered CoreTrade personnel in their projects of value S\$20 million and more. This applies to new building works, addition and alteration works and civil engineering works.

5. There are currently 7 construction trades recognised for registration under CoreTrade (see Table 1). Since 1 April 2010, skills assessment has been made mandatory for tradesmen and foremen who wish to be registered as CoreTrade personnel. With MOM's implementation of the tiered levy framework from Jul 2011, construction work permit holders who are CoreTrade registered will also be able to qualify for higher skilled levy tier. To facilitate the upgrading of workers into the higher skilled levy tier as well as the building up of a skilled and experienced pool of workers, number of trades under CoreTrade will be increased from the current 7 to 17 by mid 2011, covering a total of 48 skills qualifications (See Tables 1 and 2).

¹ Construction Tradesman is a worker who is skilled and engaged in a particular trade.

² Construction Foreman is a worker who takes charge of and co-ordinates a group of tradesmen in a particular trade

Table 1a: Existing CoreTrade Trades and Associated Skills Qualifications

S/N	Construction Trades	Skills Qualifications
1	Construction Plant Operation	1 SEC(K), SEC, CSC or BBC in Tower Crane (Saddle Jib) Operations
		2 SEC(K), SEC, CSC or BBC in Tower Crane (Luffing Jib) Operations
		3 SEC(K), SEC, CSC or BBC in Mobile Crane Operations
		4 SEC(K), SEC, CSC or BBC in Crawler Crane Operations
		5 SEC(K), SEC, CSC or BBC in Hydraulic Excavator Operations
		6 SEC(K), SEC, CSC or BBC in Telescopic Handler Operations
		7 SEC(K), SEC or BBC in Bulldozer Operations
		8 SEC(K), SEC or BBC in Track Shovel Operations
		9 SEC(K), SEC or BBC in Excavator Loader Operations
		10 SEC(K), SEC or BBC in Bored Piling Operations
		11 SEC(K), SEC or BBC in Driven Piling Operations
		12 SEC(K), SEC or BBC in Jack-In Piling Operations
		13 <u>SEC(K), SEC or BBC in Bored Micro-Piling Operation</u>
		14 <u>SEC(K) or BBC in Jet Grout Piling Operation</u>
		15 <u>SEC(K), SEC or BBC Underground Pipe-Jacking</u>
		16 <u>SEC(K) or BBC in Tunnel Boring Machine (Earth Pressure Method)</u>
		17 <u>SEC(K) or BBC in Tunnel Boring Machine (Slurry Method)</u>
		18 <u>SEC(K), SEC or BBC in Asphalt Concrete Paving</u>
		19 <u>SEC(K) or BBC in Crawler Drill Operation</u>
2	Electrical Work	20 SEC(K), SEC or BBC in Electrical Wiring Installation
3	Plumbing and Piping Work	21 SEC(K), SEC or BBC in Plumbing and Pipefitting
		22 SEC(K), SEC or BBC in Pipe Fitting ³
		23 SEC(K), SEC or BBC in Gas Pipefitting ⁴
4	Reinforced Concrete Work	24 SEC(K), SEC or BBC in Timber Formwork
		25 SEC(K), SEC or BBC in Metal Formwork

³ SEC(K), SEC or BBC in Pipe Fitting is recognised under 2 Construction Trades, namely *Plumbing & Piping Work* and *Structural Steel Work*.

⁴ SEC(K), SEC or BBC in Gas Pipefitting is recognised under existing Construction Trade on *Plumbing & Piping Work* as well as the Additional Construction Trade on *Gas Pipefitting Works* (see Table 2 below)

S/N	Construction Trades	Skills Qualifications
		26 SEC(K), SEC or BBC in Steel Reinforcement Work
		27 <u>SEC(K), SEC or BBC in Precast Concrete Component Erection</u>
		28 <u>SEC(K) or BBC in System Formwork Installation</u>
		29 <u>SEC(K) or BBC in Precast Kerb and Drain Laying</u>
		30 <u>SEC(K) or BBC in Aluminium Formwork</u>
5	Structural Steel Work	31 SEC(K), SEC or BBC in Structural Steel Fitting
		32 SEC(K), SEC or BBC in Welding
		SEC(K), SEC or BBC in Pipe Fitting ³
6	Tiling and Stone Laying Work	33 SEC(K), SEC or BBC in Tiling
		34 <u>SEC(K) or BBC in Timber Flooring</u>
7	Waterproofing Works	35 SEC or BBC in Waterproofing

Note: Skills Qualifications underlined are additional relevant skills qualifications for existing CoreTrade Trades.

Table 2: Additional CoreTrade Trades and Associated Skills Qualifications

S/N	Additional Trades	Skills Qualifications
1	Cladding and Curtain Wall Installation	1 SEC(K), SEC or BBC in Cladding Installation
		2 SEC(K), SEC or BBC in Curtain Wall Installation
2	Glazing	3 SEC(K), SEC or BBC in Glazing
3	Drywall Installation	4 SEC(K), SEC or BBC in Interior Drywall Installation
4	Suspended Ceiling Installation	5 SEC(K), SEC or BBC in Suspended Ceiling Installation (Acoustical)
		6 SEC(K), SEC or BBC in Suspended Ceiling Installation (Fibrous Plaster)
5	Doors and Windows Installation	7 SEC(K), SEC or BBC in Doors and Windows Installation (Timber)
		8 SEC(K), SEC or BBC in Doors and Windows Installation (Aluminium)
6	Joinery Works	9 SEC(K), SEC or BBC in Joinery
7	Air-Conditioning Ducting Installation	10 SEC(K), SEC or BBC in Ducting Installation for Air-Conditioning and Ventilation
		11 SEC(K), SEC or BBC in Thermal Insulation
8	Fire Protection Works	12 SEC(K), SEC or BBC in Fire Sprinkler Installation
9	Gas Pipefitting Works	SEC(K), SEC or BBC in Gas Pipefitting ⁴
10	Lift Installation	13 SEC(K), SEC or BBC in Lift Installation

BCA's Skills Certification System

Objective of Skills Certification. The Skills Certification system was implemented by the Building and Construction Authority (BCA). It is a mandatory requirement that all foreign workers who enter the Singapore construction workforce must be skill certified to ensure they possess the adequate skill level and skill sets in the various key construction trades

2. Skills Test Requirements. BCA has implemented the Skills Certification System in the source countries since 1995 to facilitate the recruitment of foreign construction workers through skills testing and certification for the Singapore construction industry. The tests are carried out by BCA officers in source countries. Currently, there are 25 overseas testing centres (OTCs) in various source countries, including PRC, India, Bangladesh, Thailand and Myanmar.

3. Under the Skills Certification system, the foreign workers are tested on the specific trade knowledge and hand skills required for the individual trades. These foreign workers have to pass both written and practical test components to be awarded BCA's Skills Evaluation Certificate (Knowledge). The written test component requires the worker to know essential trade knowledge such as the materials, tools and equipment used in the trade, work sequence, good practices to be adopted and safety requirements. For the practical test component, the worker has to demonstrate his practical craft-skills competency to meet quality standards for the trade in the timely completion of a practical test project modelled based on the expected skills set of a skilled tradesman. A wide range of practical test projects has been implemented for the trade tests.

4. The skills test requirements are continually reviewed and the test standards raised progressively to improve quality, productivity and safety. This is to ensure the relevance of skill sets and that the workers are trained and certified according to existing project requirements, quality standards and good site practices.

Workforce Training and Upgrading (WTU) Scheme

The Workforce Training and Upgrading (WTU) scheme is one of the 6 financial incentive schemes supported by the \$250 million Construction Productivity and Capability Fund (CPCF) to help firms raise its construction productivity and to build capability.

2. The WTU Scheme seeks to facilitate the upgrading of workforce at all levels. Currently, the WTU **co-funds up to 80% of the cost of skills upgrading and assessment of suitable personnel**. This includes defraying the training and assessment fees for CoreTrade registration, as well as other suitable productivity-related course fees for construction personnel, including PMETs employed by the consultants and builders. Please refer to Appendix 1 for the list of skills qualifications under CoreTrade and Tables 1 & 2 of this Appendix for the list of productivity-related training courses.

Table 1: List of Higher Training Qualifications currently funded by WTU

	Higher Training Qualifications
1	Certificate in Interior Finishing Coordination
2	Certificate in Pavement Construction and Maintenance
3	Certificate in Precast Concrete Construction Supervision
4	Certificate in Waterproofing Supervision
5	Certificate in Building Measurement
6	Certificate in Geotechnical Instrumentation for Supervisors
7	Certificate in Levelling and Setting Out
8	Certificate Course for Structural Steel Supervisors
9	NBQ in Project Supervision
10	Higher NBQ in Project Supervision
11	Advanced NBQ in Project Supervision
12	NBQ in Supervision and Coordination of M&E Works
13	Higher NBQ in Supervision and Coordination of M&E Works
14	Advanced NBQ in Supervision and Coordination of M&E Works
15	NBQ in Operation & Maintenance
16	Higher NBQ in Operation & Maintenance
17	Advanced NBQ in Operation & Maintenance

Table 2: List of Additional Courses to be funded by WTU

Type of Courses	
Specialist Diplomas (PMETs)	1. <u>Building Information Modelling (BIM)</u>
Certificate courses (PMETs)	2. Project Management for Professionals in the Building and Construction Industry <i>(in collaboration with SPM)</i> 3. <u>Construction Productivity Management</u> <i>(in collaboration with SCAL)</i> 4. <u>Design of Precast Concrete structures for Engineers</u> 5. Workshop on Site Management of Precast Concrete Construction
Certificate courses (Tradesmen / Foremen)	6. Builders Cert in Plumbing and Pipefitting 7. SEC(K) in Precast Concrete Components Erection 8. SEC(K) in Structural Steel Fitting 9. SEC(K) in Interior Drywall Installation 10. <u>System Formwork Training</u> 11. <u>Mechanical Elevated Work Platform</u>
Trade Diplomas (Foremen / Supervisors)	12. Structural Steel Supervision 13. Reinforced Concrete Supervision 14. Plumbing Technology 15. Electrical Technology 16. Waterproofing

Note: Courses underlined are new courses that will be introduced in 2011.

Enhanced Buildability Framework to Improve Site Productivity

Since 2001, BCA's mandatory buildability framework has encouraged more labour efficient building designs and is one of the key contributing factors towards improving productivity on site. To give productivity a further boost, BCA is enhancing the buildability framework to require designers to deliver more buildable designs upstream, and builders to adopt more labour-efficient construction methods / technologies downstream through the following ways.

2. **Requiring more buildable design upstream.** The existing Buildable Design Score will be tightened by *dis-incentivising designs which need labour-intensive construction processes such as brick walls and walls with plastering finishes, while at the same time, encouraging designers to adopt labour-saving and standardized designs.* Buildable features such as the use of off-form external finished walls, prefabricated bathrooms and industry-wide standardised floor heights with standardised precast staircases would be recognised with more points. The enhanced buildable design scoring system would thus bring about wider use of buildable and easy-to-build construction that would help to reduce dependence on labour.

3. **Requiring more labour-efficient construction methods – New Constructability Score.** While the Buildable Design Score focuses on the use of buildable designs during the upstream design process, the introduction of a new Constructability Score would impact on the construction methods used during the downstream construction phase. Through the Constructability Score, the builders' contribution to raising site productivity can be increased by getting them to *move away from traditionally labour-intensive construction methods and switching to more labour-efficient construction processes.*

4. The Constructability Score would assess the builders' choice on their usage of labour efficient systems and processes under the structural, architectural, mechanical, electrical and plumbing scope of construction works. For example, under the structural component, the use of traditional timber formwork and external scaffolding would be given much lower points to disincentivise their use. Comparatively, a builder who adopts the use of system formwork and climbing scaffolding, which would reduce the manpower usage on site, would be awarded with more points. Besides labour efficient construction methods, the adoption of good site practices, such as good project and site management is also critical to improving site productivity. Thus, the Constructability Score framework also awards points for Good Industry Practices such as use of BIM and trade productivity monitoring on site to achieve higher productivity.

5. **Scope and Timeline for Enhanced Buildability Framework.** *For a start, the constructability score requirement will apply to projects with GFA more than 5,000m².* Builders will be required to submit the Constructability Score when they apply for the permit to commence work, or within 3 months after the permit has been issued (6 months for Design and Build projects) in the event that they require more time to plan for the type of construction methods / technologies to be adopted in the project.

6. BCA will **launch the enhanced buildability framework by 1H 2011.** The new requirements will **take effect by 2H 2011.**

Building Information Modelling

Building Information Modelling (BIM) is a new three-dimensional modelling technology and an integrated process that allows the building professionals of various disciplines to explore the building project digitally, before it is built. BIM facilitates better teamwork among the professionals, helping to reduce unnecessary reworks when the project is being constructed.

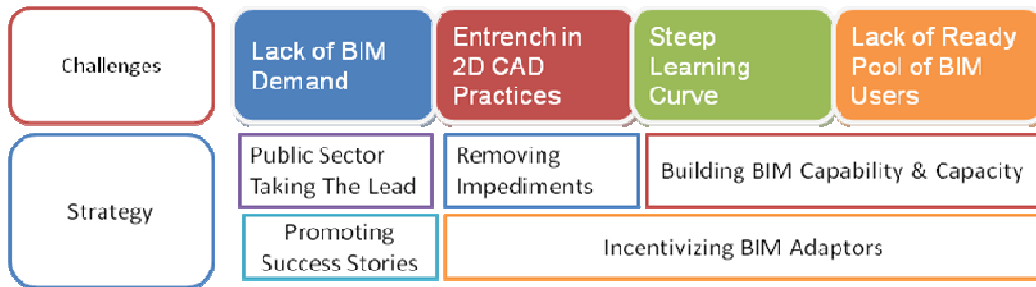
2. 3D versus 2D. Traditionally, in a two-dimensional drawing, each building professional prepares their own plans. Due to the limitations of a two-dimensional drawing, certain design clashes (e.g., pipes running into the air-con ventilation tubes) would appear only during construction. With BIM, a three-dimensional model of a project and drawings can be shared among these professionals. This allows the professionals – architects, engineers and contractors – to analyse and resolve potential design clashes before construction begins. BIM will facilitate better teamwork among the professionals, helping to reduce unnecessary reworks when the project is being constructed.

3. Building professionals. The benefits of BIM to the various building professionals in the construction value-chain are listed in the table below:-

Building professionals	Benefits of BIM
Architects	<ul style="list-style-type: none"> • Create three-dimensional models (that help other professionals to visualise his design better) • Perform sustainability analysis, • Coordinate the work on the project with other professionals from various disciplines, - produce construction documents and drawings quickly, and design changes can be incorporated consistently
Structural engineers	<ul style="list-style-type: none"> • Perform structural analysis of the buildings in the project, and • Design and produce construction documents and drawings of the building structures quickly • Facilitate fabrication of elements with greater accuracy.
M&E engineers	<ul style="list-style-type: none"> • Design the mechanical & electrical systems with greater accuracy; and • Plan & optimise the distribution and routes of mechanical & electrical equipment within the building project.
Builders	<ul style="list-style-type: none"> • Plan the entire construction process and material delivery through the computer simulation; and • Determine, review and optimise the sequence of the building's construction.

4. Strategies in BIM Roadmap. BCA has set a target of getting 80% of the construction industry to use BIM widely by 2015. To increase the adoption of BIM in the sector, BCA has identified the following strategies:

- a) Removing impediments to ease transition from 2D to BIM;
- b) Incentivising early adopters;
- c) Creating the demand - Public Sector Taking The Lead;
- d) Building BIM capability and capacity; and
- e) Promoting Success Stories



- a) Removing impediments. To ease the transition from 2D drawings to 3D BIM, BCA has developed **BIM submission templates** to help the industry to adopt BIM while reducing the learning curve. Architectural and structural BIM submission templates were introduced in Jan and Nov 2010 respectively, with mechanical & electrical submission template to be introduced in Apr 2011. To facilitate information sharing and shared building objects, BCA is also working with BuildingSMART Singapore to **develop a design objects library** and project collaboration guidelines by early 2012.
- b) Incentivising BIM adopters. To encourage the industry to come on-board the BIM journey as early as possible, BCA rolled out the **BIM Fund** under the CPCF in Jun 2010. \$5.7 million has been set aside for BIM adoption, which covers costs on training, consultancy, software and hardware.
- c) Creating the demand - public sector taking the lead. Countries such as the United States, Finland and Norway have made BIM mandatory for public sector building projects. BCA is working with key agencies such as MOE, LTA and HDB on a number of **pilot projects** using BIM starting in 2011. To drive a much wider adoption of BIM, **mandatory regulatory submissions** using BIM would be progressively introduced for architectural submission (by 2013), structural and M&E submissions (by 2014) and eventually for plan submissions of all projects with more than 5000 m² by 2015.
- d) Building capability. To ensure that industry practitioners and new entrants are BIM-ready, BCA has engaged institutes of higher learning (IHLs) to **incorporate BIM as part of their curriculum**, of which Singapore Polytechnic and NUS's Architecture Department have started teaching BIM. For the graduating batch of students, BCA will be organising **intensive BIM training** to equip them with the necessary BIM skill sets

before they join the industry. To equip the current industry practitioners, BCA will also launch a ***Specialist Diploma programme for BIM Coordinators & Managers*** in Jul 2011.

- e) Promoting success stories. In Sept 2010, BCA established the ***Centre for Construction IT (CCIT)*** to take up the role of chaperoning the industry in their BIM journey. The CCIT will also launch a portal in 2011 on BIM and produce online materials covering case studies and best practices to educate the industry on BIM. In addition, CCIT works with buildingSMART Singapore and industry partners to organise BIM related workshops and seminars on a regular basis.

5. ***Mandatory BIM e-submission.*** BCA will work towards mandating BIM e-submission of architectural, structural as well as mechanical & electrical plans for building works for regulatory approval by 2015. In addition, the public sector will be taking the lead in driving BIM adoption and target to specify this as a requirement in new building projects from next year.