

Singapore BIM Journey



Cheng Tai Fatt

Deputy Managing Director

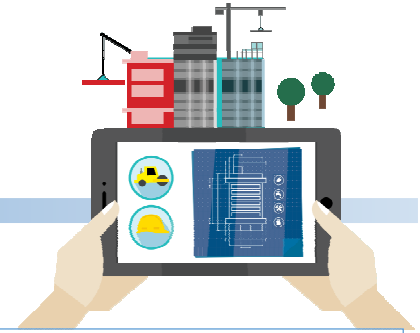
BCA Academy & Built Environment Research & Innovation Institute
Building and Construction Authority, Singapore

6th - 7th September 2017

We shape a **safe**, **high quality**, **sustainable** and **friendly** built environment.

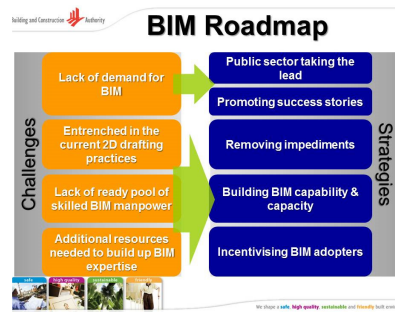


AGENDA



1. Background

- Construction Productivity Roadmap



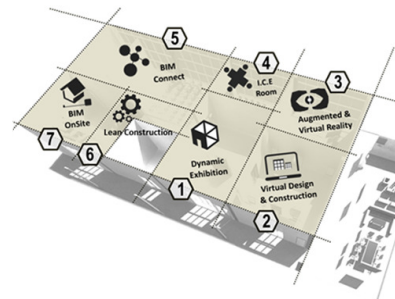
2. BIM Roadmap

- Challenges & Strategies



3. Research & Development

- BIM & VDC
- Integrated Digital Delivery (IDD)



4. Centre for Lean & Virtual Construction

- Experiential Learning Environment

BACKGROUND

**The
Economist**

Can we fix it?

The construction industry's productivity problem

And how governments can catalyse change

Print edition | Leaders

Aug 17th 2017

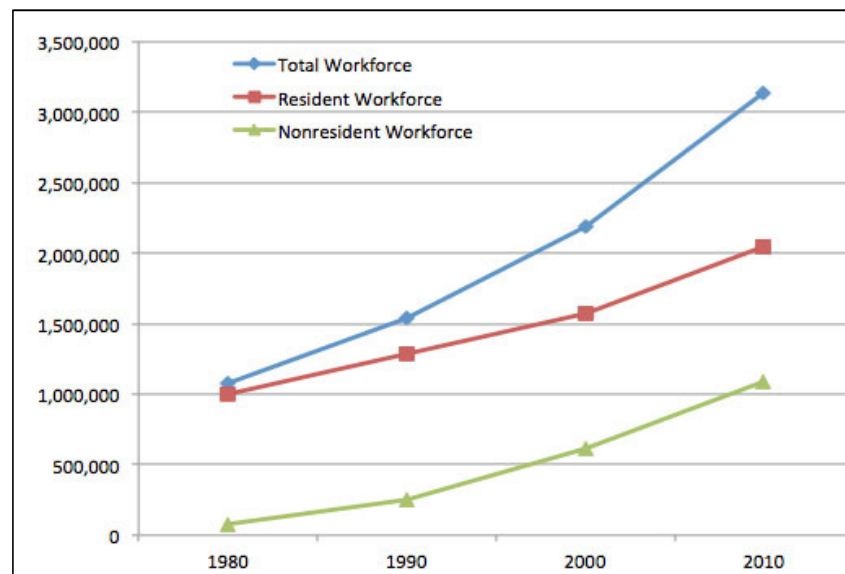
BACKGROUND



Economist.com

BACKGROUND

- Singapore's Total Resident and Non-Resident Workforce, 1980 – 2010



BACKGROUND



- **Construction Productivity Roadmap**
 - To achieve 2% - 3% annual value-added productivity growth from 2010 to 2020
 - 3 keys priorities:
 - Up-skill our workforce
 - Design for Manufacturing and Assembly
 - **Digital Engineering through BIM and VDC**

BIM ROADMAP

Challenges

Lack of demand for BIM

Entrenched in the current 2D drafting practices

Lack of ready pool of skilled BIM manpower

Additional resources needed to build up BIM expertise

Strategies

Public sector taking the lead

Incentivizing BIM adopters

Remove impediments

Build BIM capability & capacity

Promoting success stories

Public Sector Taking Lead

- Government Procurement Entities to stipulate use of BIM for new projects since 2012



Public Sector Taking Lead

July 2013

Architecture Submissions for all new building projects > 20,000 m²

July 2014

Engineering Submissions for all new building projects > 20,000 m²

July 2015

Architecture & Engineering Submissions for all new building projects > 5,000 m²

Oct 2016

Voluntary Submission in Native Format

Oct 2017

Mandatory Submission in Native Format

Incentivizing BIM Adopters

- Help companies defray part of BIM adoption costs (training, consultancy, hardware and software)
- Up to 70% subsidy
- Two schemes:
 - Firm Capability Scheme
 - Project Collaboration Scheme

Removing Impediments

• BIM Steering Committee

Objectives

- To provide strategic direction and guidance on the development of local BIM standards and supporting resources
- To oversee implementation of these standards and address any issue that may impede the adoption of BIM

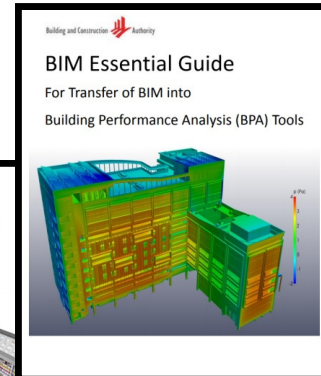
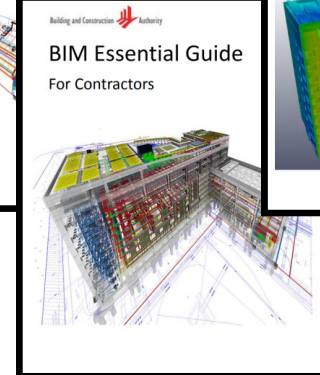
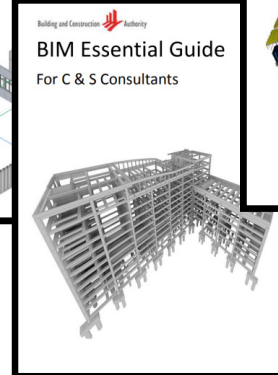
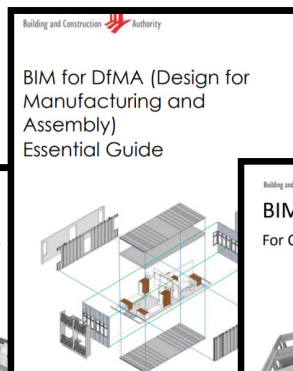
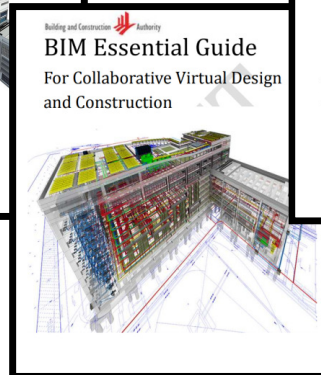
Areas of Focus

- BIM Manager Forum
- Technical Issues
- Promote Success Stories
- BIM Guides
- BIM Legal and Contractual Framework

Removing Impediments

- **BIM Essential Guides**

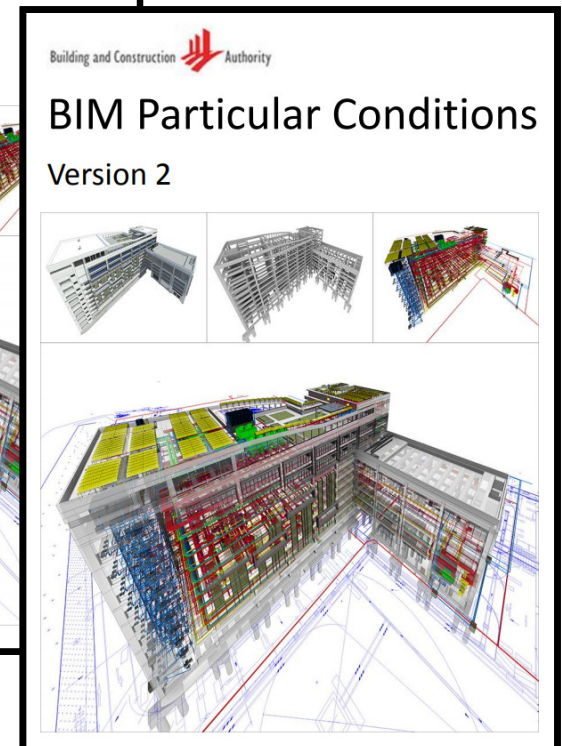
- The BIM Essential Guide Series provides references on good BIM practices in an illustrated, easy-to-read format, and are targeted at new BIM users in Singapore.



Removing Impediments

- **Singapore BIM Guides**

- A reference guide that outlines the roles and responsibilities of project members for using BIM.
- Used as a reference guide for the development of a BIM Execution Plan
- Consists of BIM Specifications and BIM Modelling and Collaboration Procedures.



Removing Impediments

- **CORENET BIM e-submission**

- BCA will accept voluntary BIM e-submissions in Native BIM format
 - Architectural plans – Oct 2016
 - C&S/MEP Engineering plans – Oct 2017



To develop BIM models to meet the new requirements of Building Information Model (BIM) submission.

Describe the requirements and guidelines on the creation of models with specific object types, associated properties and presentation format for regulatory BIM e-Submissions

Building BIM Capability & Capacity



Centre for Construction IT

Outreach Programmes

Chaperon/Handholding

Trainings

Standards

Building BIM Capability & Capacity

• International BIM Competitions

INTERNATIONAL BIM COMPETITION 2016
(Computational Design with BIM for DfMA)

About the Competition

- Open for registration till 28 August 2016
- Two submission dates on:
 - 1. 15th Sept - Intermediate Submission (Small Group)
 - 2. 15th Oct - Final Submission
- Notify interested participants on 20 September 2016
- Final Presentation for shortlisted participants on 23 September 2016
- Result Feedback on 26 September 2016
- Registered participants will be informed for sharing sessions arranged by ECA

Topic: Design of a Collaboration Platform with Computational Design and Building Information Modelling (BIM) towards Design for Manufacture and Assembly (DfMA)

Design Challenges

- To evaluate the concerns of sustainability (Resource efficiency, Environmental and Social Impact), constructability (Modularity, Prefabrication and Rapid Assembly) and productivity (Maximizing Value and Minimizing Waste).

Judging Criteria

Design for DfMA

- Overall planning, research, design and presentation.
- The ability to demonstrate multiple design options using computational BIM and other design tools to an optimum solution to meet sustainability, productivity, and DfMA considerations (Production, flexibility, modularity, maintainability, etc.)

Prized Delivery

- The ability to demonstrate the design can be constructed easily using standard and modular yet flexible components to the desired production setting, tool, cost and resources.
- Computational BIM considerations to be incorporated strategically at different stages
- Online training materials provided @ being.org

Rank	Cash Rewards (USD)	Plaque & Voucher
1st Prize	\$ 5000.00	1. One Plaque per group 2. One Certificate per member
2nd Prize	\$ 2000.00	
3rd Prize	\$ 1000.00	
Merit (one, two, etc.)	\$ 800.00	

Prize Categories

- 1. 1st Prize of Participation
- 2. 2nd Prize of Participation
- 3. 3rd Prize of Participation
- 4. Merit Prize of Participation

Official Contacts for registration

Country	Office Number
INDONESIA	6730 4320
USA	6730 4327
Malaysia	6730 4333
Maldives	6730 4409

Sponsored by ECA ACADEMY
ECA Academy of the Built Environment is the education and research arm of Engineering Australia (EA) member authority (ECA).

KEY DATES

- 6 APRIL - 31 MAY: Registration period
- 7 JULY: Briefing to participants
- 17 AUG - 20 AUG: Actual competition
- 18 SEPT: Final Presentation
- 14 OCT: Prize Presentation

REGISTRATION OPEN NOW!

Control points for registration: info@ecaacademy.org, www.eacademy.org, www.eacademy.org, www.eacademy.org

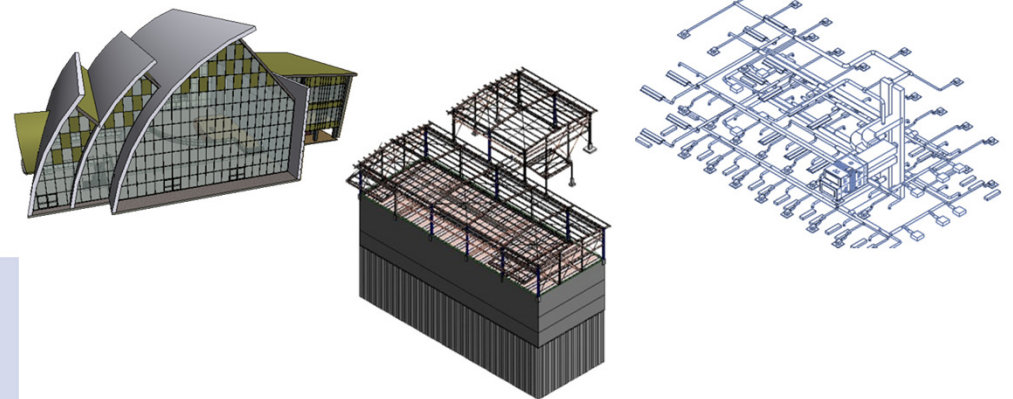
PRIZES

- 1ST PRIZE: \$5000 + Plaque
- 2ND PRIZE: \$2000 + Plaque
- 3RD PRIZE: \$1000 + Plaque
- MERIT PRIZE: 3x\$800 + Plaque
- ALL: Certificate of Participation

Organized by ECA ACADEMY
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• BIM Shoot-Outs

- BIM modelling proficiency
- Accuracy, Presentation, Speed
- Create models within 2 hours
- 3 disciplines – Architectural, Structural & MEP



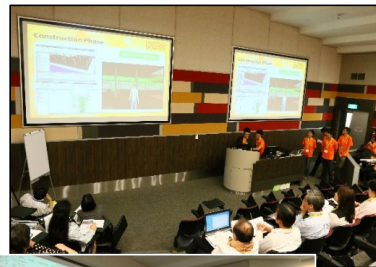
Different Themes



Building BIM Capability & Capacity

International BIM Competitions

Sharing by Industry & BIM Leaders



Final Judging Presentations



Prize Presentations



BIM Shoot-Outs

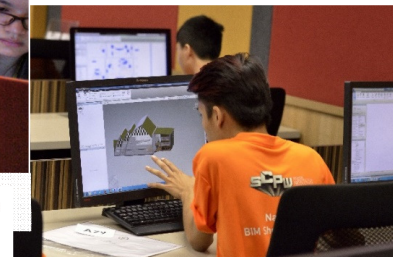
Pre-event Training



Prize Presentations

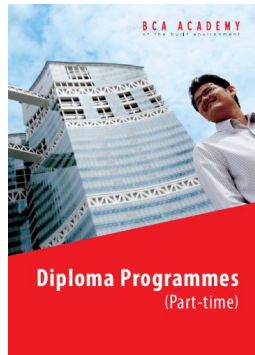


Participants in action



Building BIM Capability & Capacity

BIM Programmes



- BCA Academy
 - Certification Courses
 - Short Courses
 - Part-time Specialist Diploma programmes
 - Executive programmes
 - Seminars/Conferences

Equipping Existing Professionals



BCA ACADEMY

- BIM/VDC contents part of curriculum in Institutes of Higher Learning (IHLs) courses and programmes

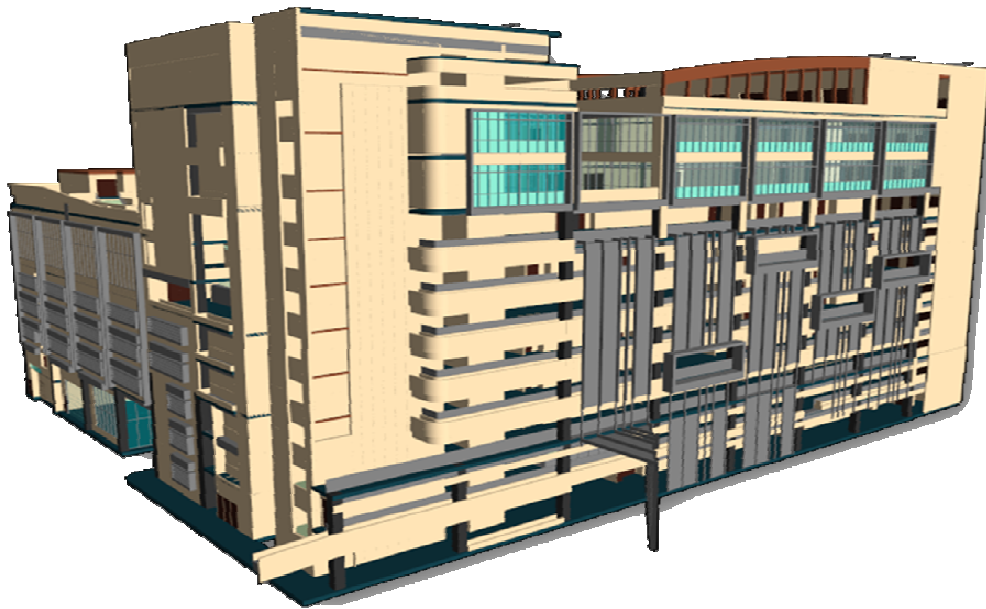
Equipping Future Built Environment Professionals



For more information, visit our website at <http://www.bcaa.edu.sg>

Building BIM Capability and Capacity

B C A A C A D E M Y



- ✓ Certification Course on BIM Modelling (Architecture Track)
- ✓ Certification Course on BIM Modelling (MEP Track)
- ✓ Certification Course on BIM Modelling (Structural Track)
- ✓ BIM Planning (Building Developers and Facility Managers)
- ✓ Certification Course on BIM for MEP Coordination
- ✓ BIM Quantity Take-Off
- ✓ BIM Scheduling and Process Management
- ✓ Certification Course on BIM Management
- ✓ Specialist Diploma in Building Information Modelling
- ✓ Specialist Diploma in Design for Manufacturing & Assembly (DfMA)
- ✓ Specialist Diploma in Lean Construction
- ✓ Specialist Diploma in Virtual Design & Construction (VDC)

Promoting Success Stories

Publications

UNISON CONSTRUCTION GROWS WITH MEHC
GEAR UP FOR THE SINGAPORE CONSTRUCTION PRODUCTIVITY WEEK 2012!
BIM: A LOOK AT THE VERMONT@CAIRNHILL

build smart

Building and Construction Authority

How close a safe, high quality, sustainable and socially built environment.

BIM SPOTLIGHT: SINGAPORE SPORTS HUB [1 of 20]

BUILDING INFORMATION MODELLING

BIM LEADERS IN ARCHITECTURE

Hear from three firms in Singapore who are using the emerging technology to design, collaborate and build smart

ONG&ONG Pte Ltd
 Tai Lee Siang, Group Managing Director, and Daniels Chandra, BIM Director

ONG&ONG stepped into BIM for one of its pilot projects at King Chong Rd. The 2007 Design Relevance project involved the use of BIM. It was a big challenge as many in the team were inexperienced BIM practitioners. However, the firm eventually improved productivity for architecture, civil and structural engineering and MEP engineering by averages of 10%, 15% and 20%, respectively. All the teams in the project were connected via the same IT network to facilitate BIM collaboration and data exchange. ONG&ONG currently has 15 ongoing BIM projects.

We hear your Building Information Modelling (BIM) implementation can be challenging, but BIM technology has also numerous advantages. Three local architecture firms share with their experiences of transferring into BIM and how they have benefited from the technology.

For these companies, BIM is not just a technology to produce 3D models, high quality visualisations. The value of BIM really lies in its ability to generate critical information for early decision. With the knowledge, these architecture firms have been empowered to become master builders as they use the data to facilitate collaboration, smarter construction and integrated work processes.

As you will discover, BIM implementation is as much about investing in people and processes as it is about technology. Full support from the senior management of the company is crucial to move the implementation forward. The selection of a core BIM team with members who are eager to learn and who have a positive mindset to build internal BIM capability is another set ingredient in the recipe for BIM success.



Q How has BIM helped in enhancing the architectural aspects of your projects?
A BIM has helped us in various ways. At the earlier stages of the design process, BIM allows us to...

Q What are the initial challenges faced when adopting BIM and how did ONG&ONG overcome them?
A The implementation of BIM was our first challenge...

BIM LEADERS IN PROPERTY DEVELOPMENT

Hear from two developers that have adopted BIM successfully, and their plans for the way forward

City Developments Limited and Wing Tai Property Management Pte Ltd are household names in the real estate industry. But how do they fare when it comes to adopting Building Information Modelling to improve their productivity?

Mr Lawrence Leong, Manager in the Projects Division of City Developments Limited, and Ms Quee Chay Hoon, General Manager of Projects in Wing Tai Management, walk us through their company's BIM implementation process, registering the benefits, challenges, and the future of BIM.



Q How has BIM helped in enhancing the developer aspects of your projects?
A BIM helped us to deliver better products in an efficient and effective manner, especially since it allows us to be strategic with our resource and time management. It is a powerful tool that has helped us to raise the construction productivity for our projects.

Q Could you share with us some of the critical factors that led to your company's success in BIM implementation?
A We developed BIM expertise by getting our project team members to adopt BIM, specifying BIM in our tender specifications, and building capability and capacity to improve construction productivity.

Q What are some of the initial challenges faced by City Developments Limited when adopting BIM, and how did your company overcome them?
A As with any new technology, there is a learning curve and the entire project team must be willing to venture and learn. Our challenge was to influence our partners - such as consultants and builders - to help everyone work towards a harmonisation of BIM standards.

Q The full support from external stakeholders and their procurement of the hardware and software needed to implement BIM was a critical success factor as well. We also worked hard at convincing our service providers that BIM is the way to go for productivity and time and cost savings.
A Our eventual aim is to be able to adopt BIM as a necessary requirement in our main contracts.

TECHNOLOGY

BIM LEADERS IN STRUCTURAL ENGINEERING

Hear from two companies in Singapore that are leading the way in harnessing BIM technology

Bata Smart speaks to two local engineering companies on how they have successfully implemented Building Information Modelling (BIM), and on how the technology has benefited their work processes and productivity.



ACCOM is a Public Sector Panels of Consultants (PSPC) Panel 1 firm for both Civil and Structural (C&S) and Mechanical and Electrical (M&E) services. In its worldwide offices, ACCOM has a considerable number of staff trained and experienced in using BIM technology.

Q How has BIM helped in enhancing the engineering aspects of your projects?
A Our multi-disciplinary engineering team is now able to work on a single 3D model. This enables structural interface issues to be identified and...

Q What are the initial challenges faced when adopting BIM, and how did your company overcome them?
A The first hurdle was the lack of knowledge for both engineers and drafters in using BIM software. We recruited an experienced BIM manager to look into the training and hardware and software requirements.

Due to the lack of resources, BIM implementation was carried out in phases. In the initial stage, staff attended courses conducted externally. Now, with a BIM manager on board and a structured training programme in place, we conduct in-house project-based training. We built up a BIM team and expanded on our BIM skills in phases from one project to another. The BCA BIM fund also helped finance our BIM adoption costs.



Q How has BIM helped in enhancing the developer aspects of your projects?
A Our designers are able to better visualise the interior and exterior views of a building to minimise design error, mitigate ductability and ensure safety of construction.

Without a doubt, there is also improved coordination across different disciplines in a single model, which helps to resolve clashes between design elements at an early stage. Early co-ordination and clashes resolution remove the need for much abortive work on the part of contractors.

All these lead to savings in time, where plans, elevations and section drawings can be generated easily, and where there is speedier delivery of drawings.

Q What are the initial challenges faced by Wing Tai Property Management when adopting BIM, and how did your company overcome them?
A We needed a common collaboration platform, a common set of procedures to model library parameters, and a standard contract to document ownership and responsibility of BIM modelling and the various stages of the construction life cycle.

We are trying to work out these challenges through training and developing in-house BIM expertise. We are holding BIM training across the fields of architecture, structural, MEP and consultancy.



Q Could you share with us some of the critical factors that led to your company's success in BIM implementation?
A We have a dedicated project manager to monitor BIM implementation timelines. The manager also chairs the fortnightly BIM implementation meeting, during the meeting, we monitor the progress of current BIM projects, and resolve issues and queries. The support of the management and BCA is also crucial for a smooth BIM journey.

Moving ahead, we are looking to establish in-house capabilities to manage and implement all future BIM initiatives, as well as groom our pool of regular consultants and contractors to be competent in BIM.

Promoting Success Stories

BIM Conference and Government BIM Symposium

- Platform to learn from overseas & local exemplary projects in terms of business case, processes transformation & technology adoption



Promoting Success Stories

- **BIM Awards (Project Category)**



- **BIM Awards (Organisation Category)**



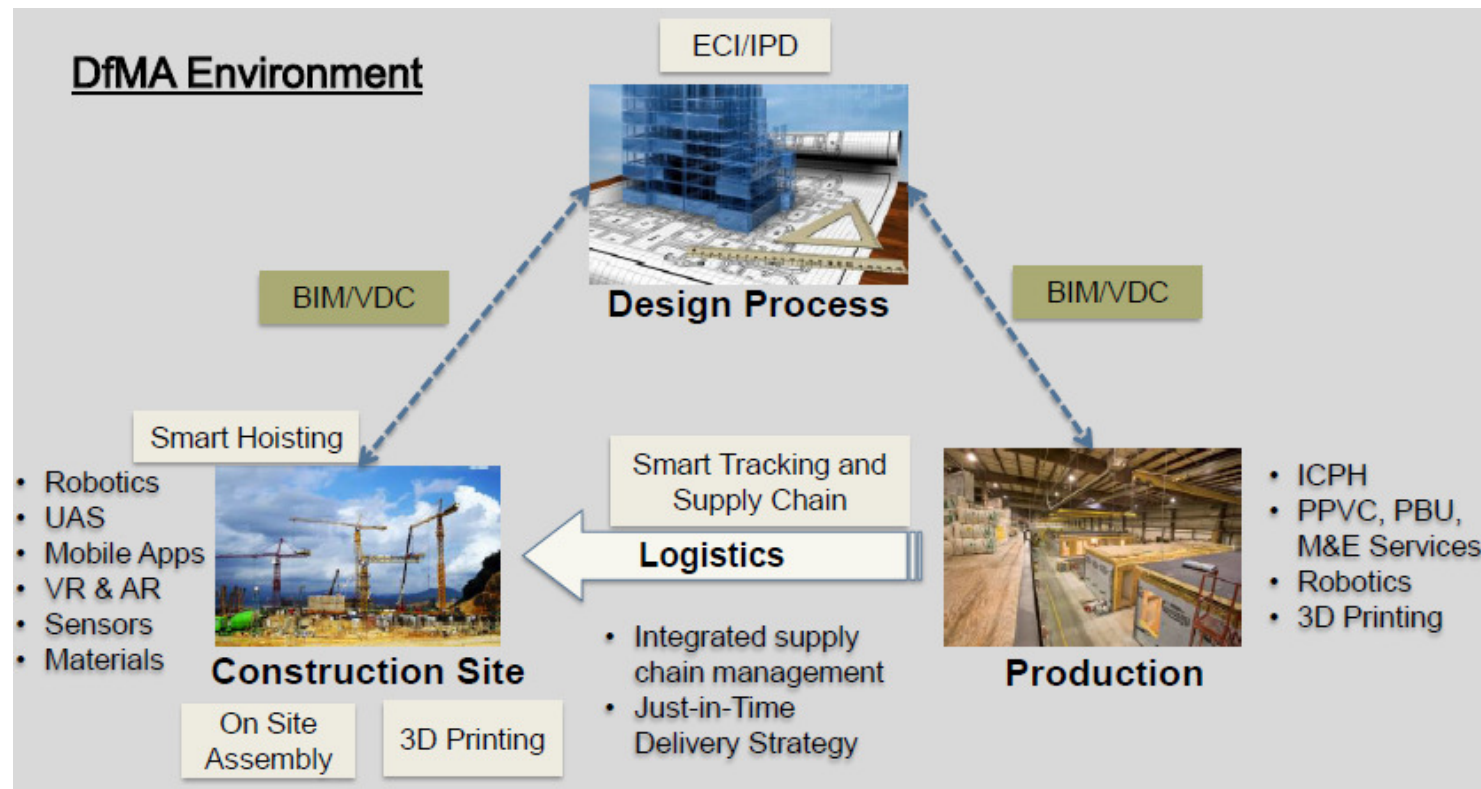
RESEARCH & DEVELOPMENT

- BIM/VDC part of BCA's Construction Productivity R&D Roadmap
- Work with BIM Centres of Excellence at universities
- Areas of focus:
 - Lean Principles in Design & Construction
 - Prefab & DfMA
 - Underground Works
 - Information and Communication Technologies (ICT)
- Construction Productivity R&D Roadmap
- Integrated Digital Delivery (IDD)

Construction Productivity R&D Roadmap

Construction of the Future – Smart Construction

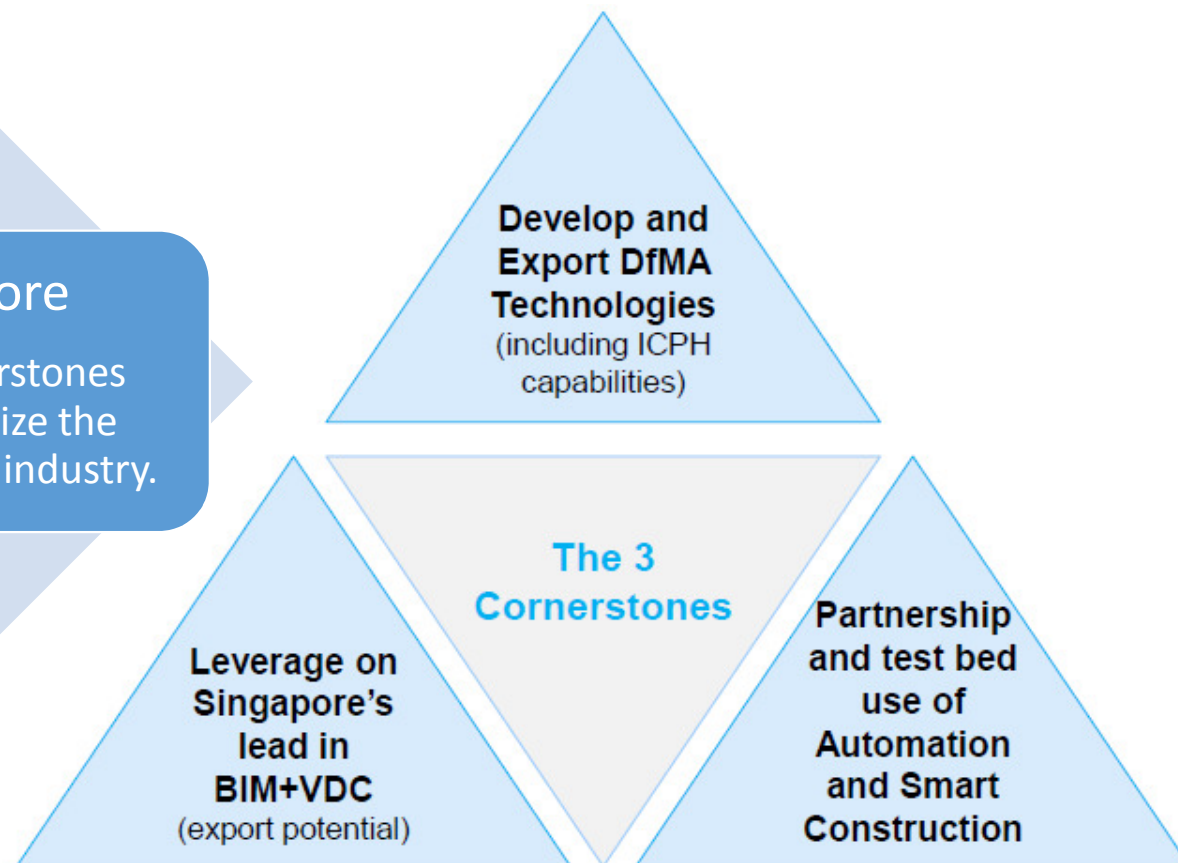
- Going forward, there is a need to drive industry productivity due to changes in business climate and increased competition. This will involve analyzing how current R&D efforts may transform and contribute to the construction process of the future.



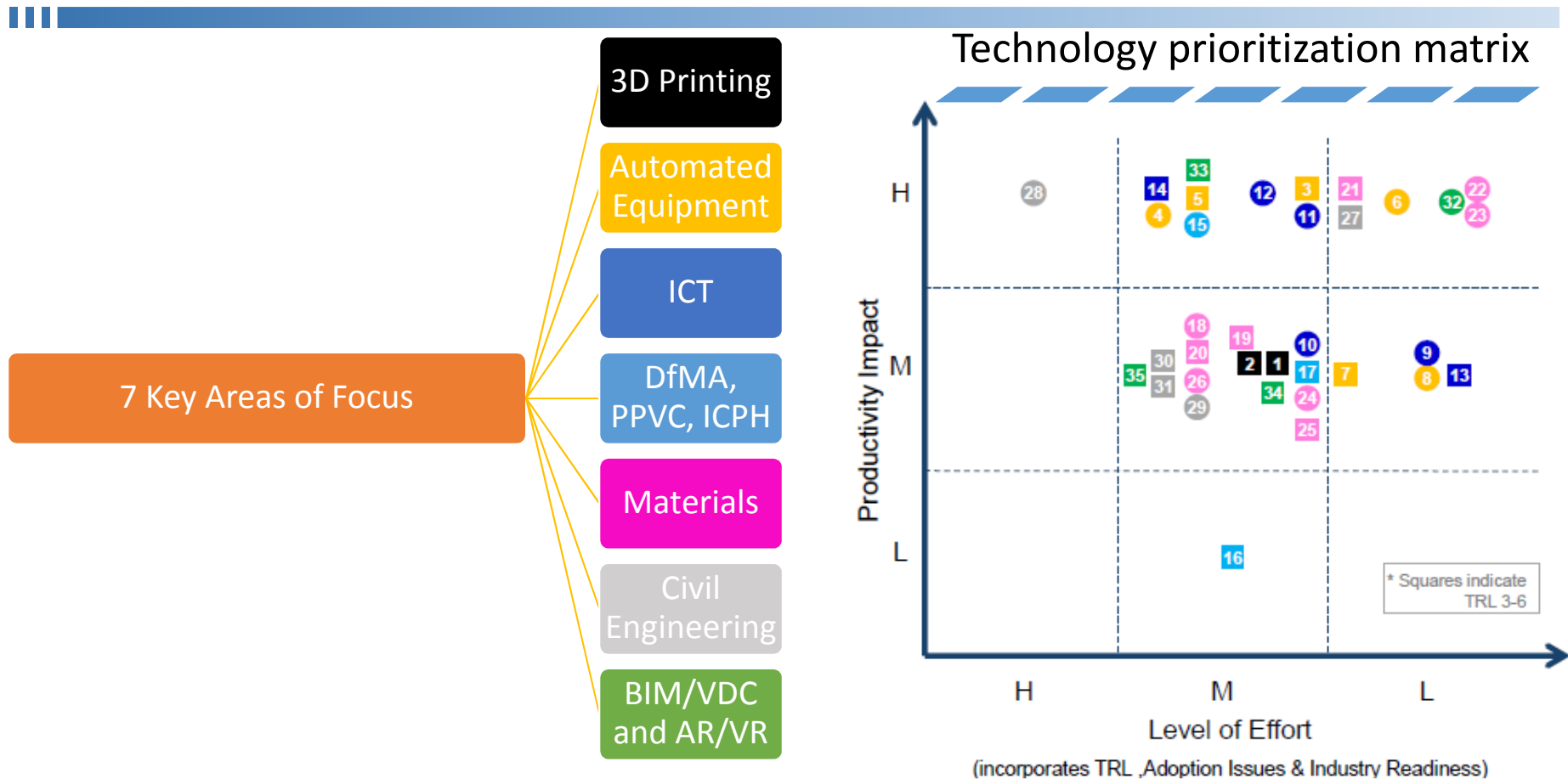
Construction Productivity R&D Roadmap

Strategic Imperatives for Singapore

- From a R&D perspective, these 3 cornerstones will be necessary to lever up and globalize the capabilities of Singapore's construction industry.



Construction Productivity R&D Roadmap



Integrated Digital Delivery

Build Twice

First Virtual

Then Real

Resolving construction issues virtually through collaboration



BIM/VDC



Integrated Digital Delivery

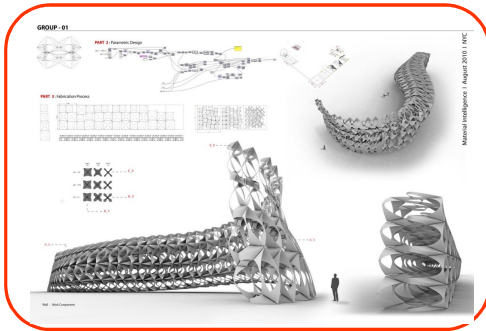
NEW

Delivering VDC resolutions with digital solutions for fabrication, construction site and logistics

Digital Engineering

Integrated Digital Delivery

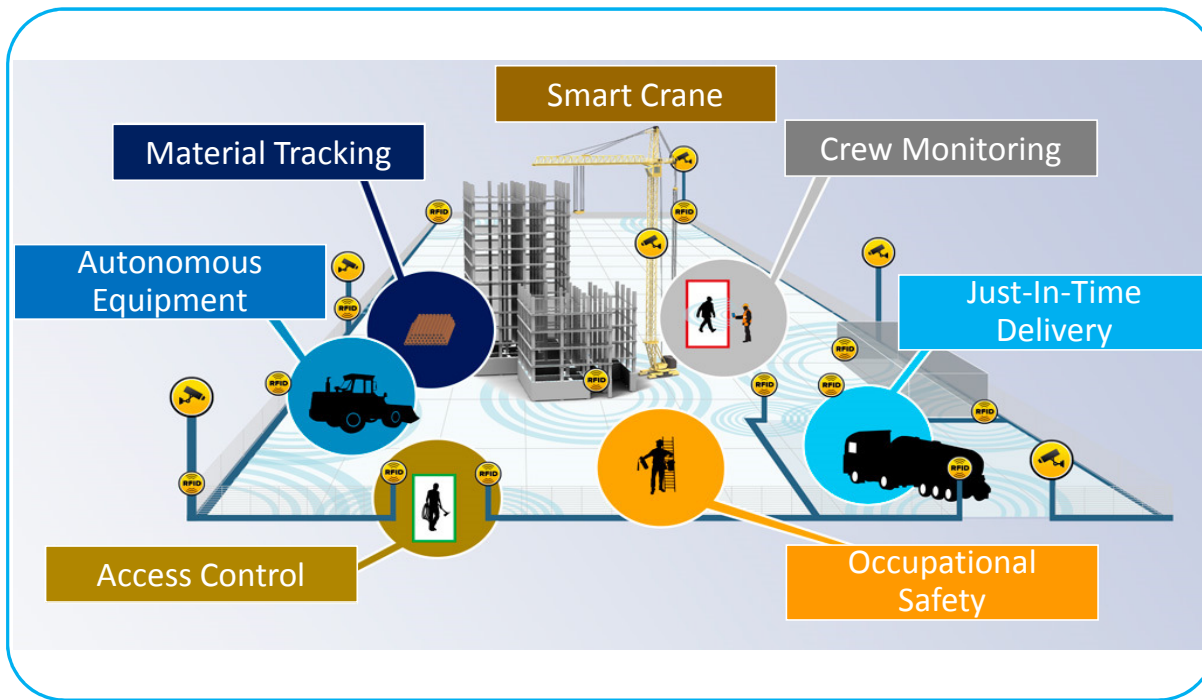
Computational Approach



Digital Fabrication



Digital Construction Site



Digital Commissioning



Integrated Digital Delivery



Joint Programme/Collaboration with other agencies



**Develop a IDD
Roadmap**

**Source for
funding**

**Kick Start
Pilots**

**Involve ICT solution
providers/startups to develop
solutions to match problem
statements from industry**

Target:
Generate problem statements &
develop digital solutions for
Fabrication, Construction Site &
Logistics

**Examples of digital
solutions:**



IoT/Sensors



Drones/Robots



Video Analytics



Data Analytics



Wearables
(e.g. Smart Helmet,
Wristband)

Integrated Digital Delivery

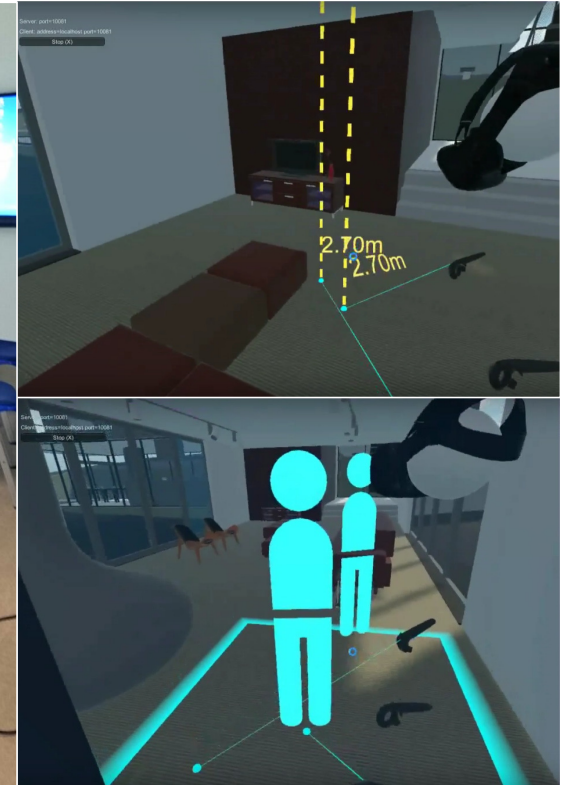
Example of Innovative Solution



- Local Start-Up
- 2 Co-Founders
- Funded by IMDA – SGInnovate
- Solution developed in **3 months** to meet local firms' requirements



Multiuser VR plug-in to BIM for Collaboration



Integrated Digital Delivery



R&D Projects - Collaboration

1

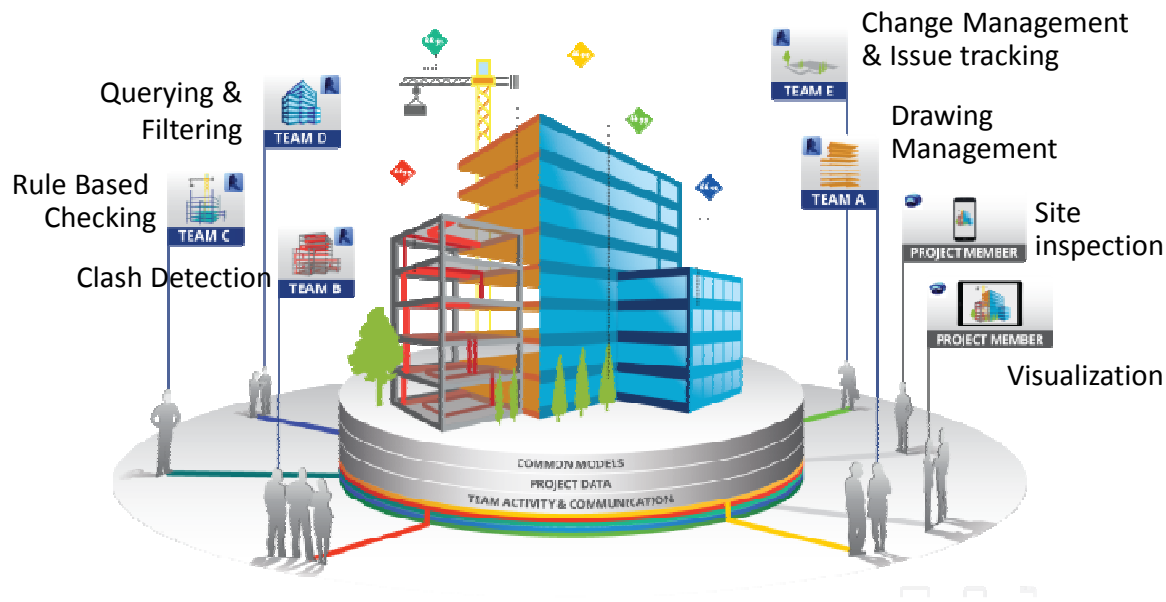
Development of Solutions for Model Server

Objective:

To provide a common data environment for collaboration and sharing of info amongst project team members

Expected Outcome:

A platform to test out the implementation of VDC projects and for subsequent benchmarking and measuring of KPIs of the VDC projects



Integrated Digital Delivery

R&D Projects - Computational Design & Construction

2

Development of Computational Solutions

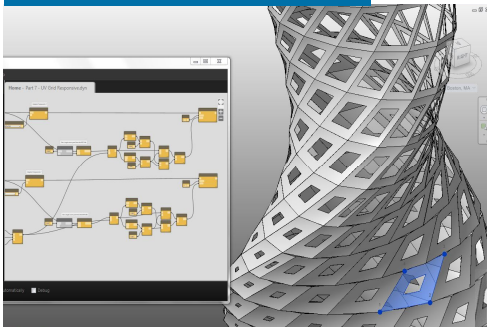
Objective:

To develop computational solutions to automate and optimise design and construction processes

Expected Outcome:

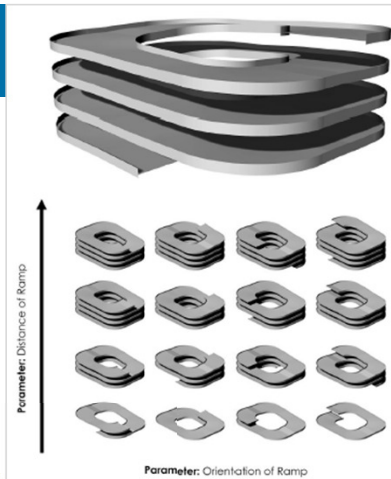
A suite of computational solutions to help consultants and contractors improve processes for better efficiency & productivity

Parametric Generation of Design Options



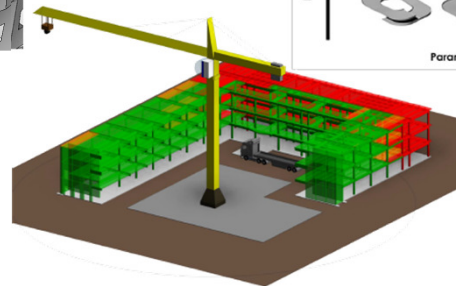
Rule-based Modelling

e.g. ramp design complying with regulatory requirements



Optimisation

e.g. crane location optimisation



Integrated Digital Delivery

R&D Projects - Integrated Construction

3

Development of Integrated Solutions for Fabrication, Site Management & Logistics

Objective:

To develop advanced digital technologies for construction

Expected Outcome:

An integrated platform to better manage construction processes & resources including fabrication, installation and hand-over for improved productivity, cost and time management

Drones
(e.g. for site inspection, monitoring)

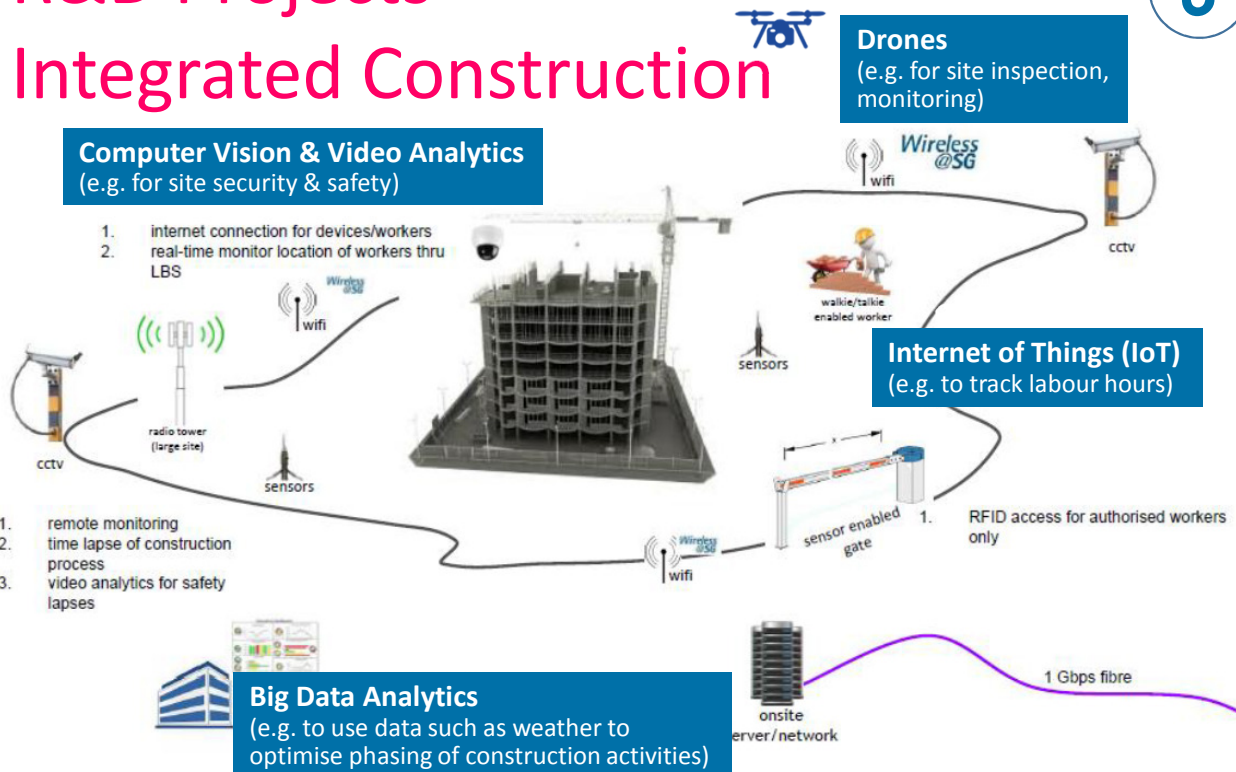
Internet of Things (IoT)
(e.g. to track labour hours)

Computer Vision & Video Analytics
(e.g. for site security & safety)

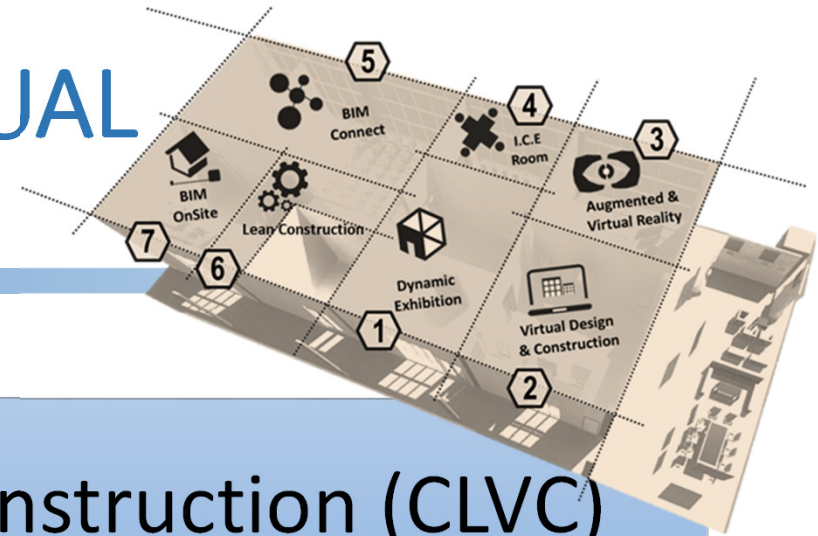
Big Data Analytics
(e.g. to use data such as weather to optimise phasing of construction activities)

1. internet connection for devices/workers
2. real-time monitor location of workers thru LBS

1. remote monitoring
2. time lapse of construction process
3. video analytics for safety lapses



CENTRE FOR LEAN & VIRTUAL CONSTRUCTION



Centre for Lean & Virtual Construction (CLVC)



Immersive & experiential learning hub for BIM, VDC and Lean Const.



“Build Twice: First Virtual Then Real”



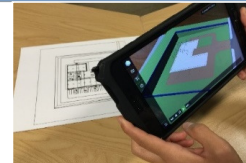
Big Room for VDC projects



Immersive 3D virtual env.



BIM-to-Field Technology



Augmented/ Virtual Reality (AR/VR)




Showcase cutting edge BIM technology

CENTRE FOR LEAN & VIRTUAL CONSTRUCTION

A **national lab** for industry to **experience and co-develop** VDC and IDD solutions

Targets

<p>Connect@CLVC (Sharing & Dialogue)</p>	<p>BIM/VDC Project Implementation</p>	<p>Projects</p>
	<p>BIM Award Winners</p>	<p>Firms</p>
<p>Innovation@CLVC (Jointly with other public sector agencies)</p>	<p>Involve ICT solution providers/startups to develop solutions to match problem statements from industry</p>	<p>Generate problem statements & develop digital solutions for Fabrication, Construction Site & Logistics</p>
<p>Experiential Learning@CLVC</p>	<p>VDC & IDD Solution Mapping</p> <p>CLVC 2.0: Enhance to include IDD exhibits</p> 	<p>Industry to experience VDC & IDD</p>



THANK YOU!

We shape a **safe**, **high quality**, **sustainable** and **friendly** built environment.

