

DIGITAL TRANSFORMATION FOR FUTURE CONSTRUCTION

Ar WILLIAM LAU T Y

Outline :

- 1) Introduction**
- 2) SG's BIM Road Map**
- 3) BIM-VDC**
- 4) IDD**

Ar WILLIAM LAU T Y

1) *INTRODUCTION*

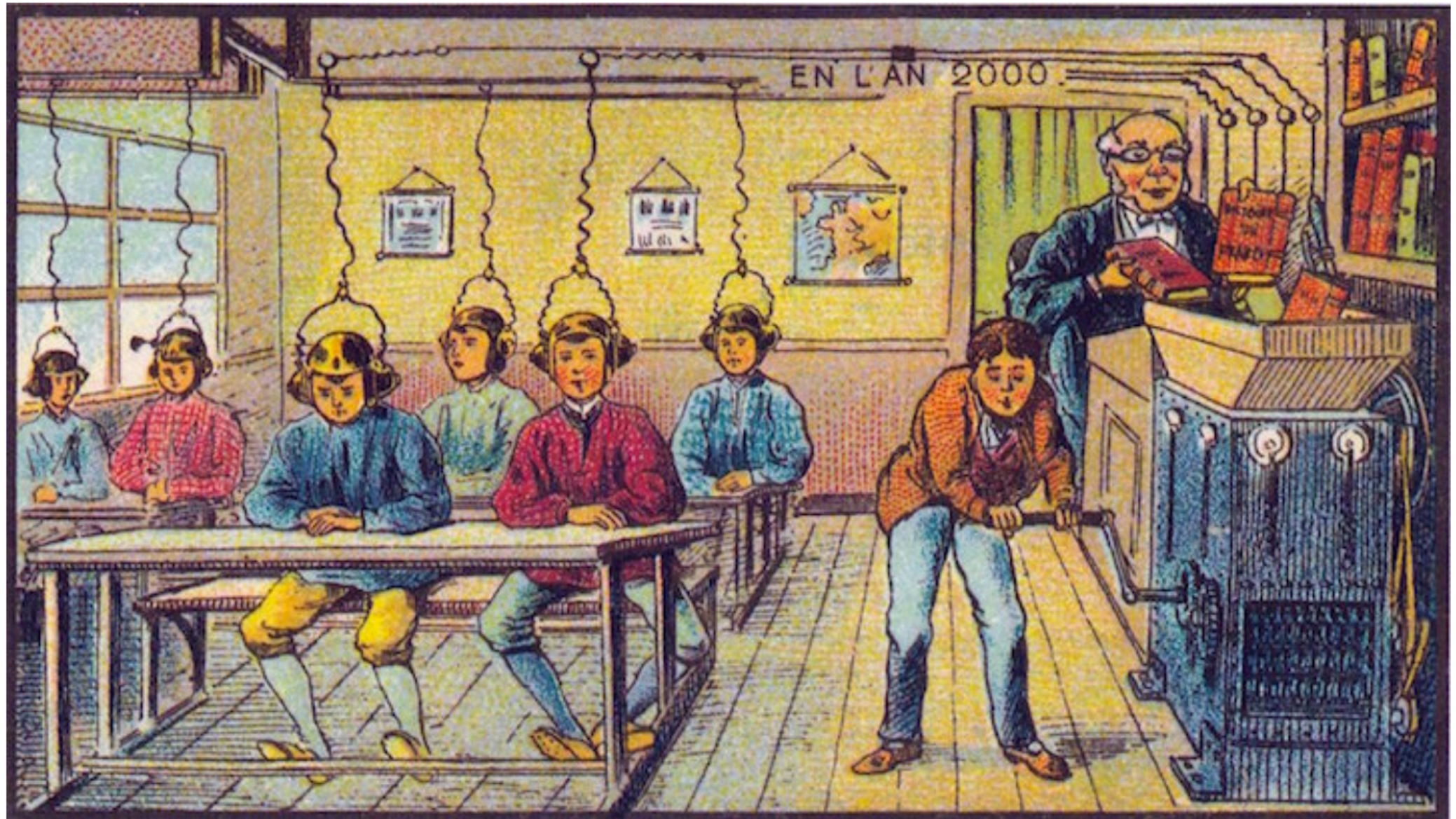
En L'An 2000 – (literally, In the Year 2000)

At the turn of the previous century, a group of French artists were asked to imagine the year 2000 by illustrating what kinds of scientific and everyday design inventions progress might bring the world 100 years into the future.

The result is a series of charmingly retrofuturistic illustrations. First produced for Paris' World Exhibition in 1900, they were printed as cigar box inserts, then as postcards between 1899 and 1910. But sadly they were never distributed

Science-fiction writer Isaac Asimov discovered a set in the 1980s, publishing them in his 1986 work of nonfiction *Futuredays: A Nineteenth Century Vision of the Year 2000*.

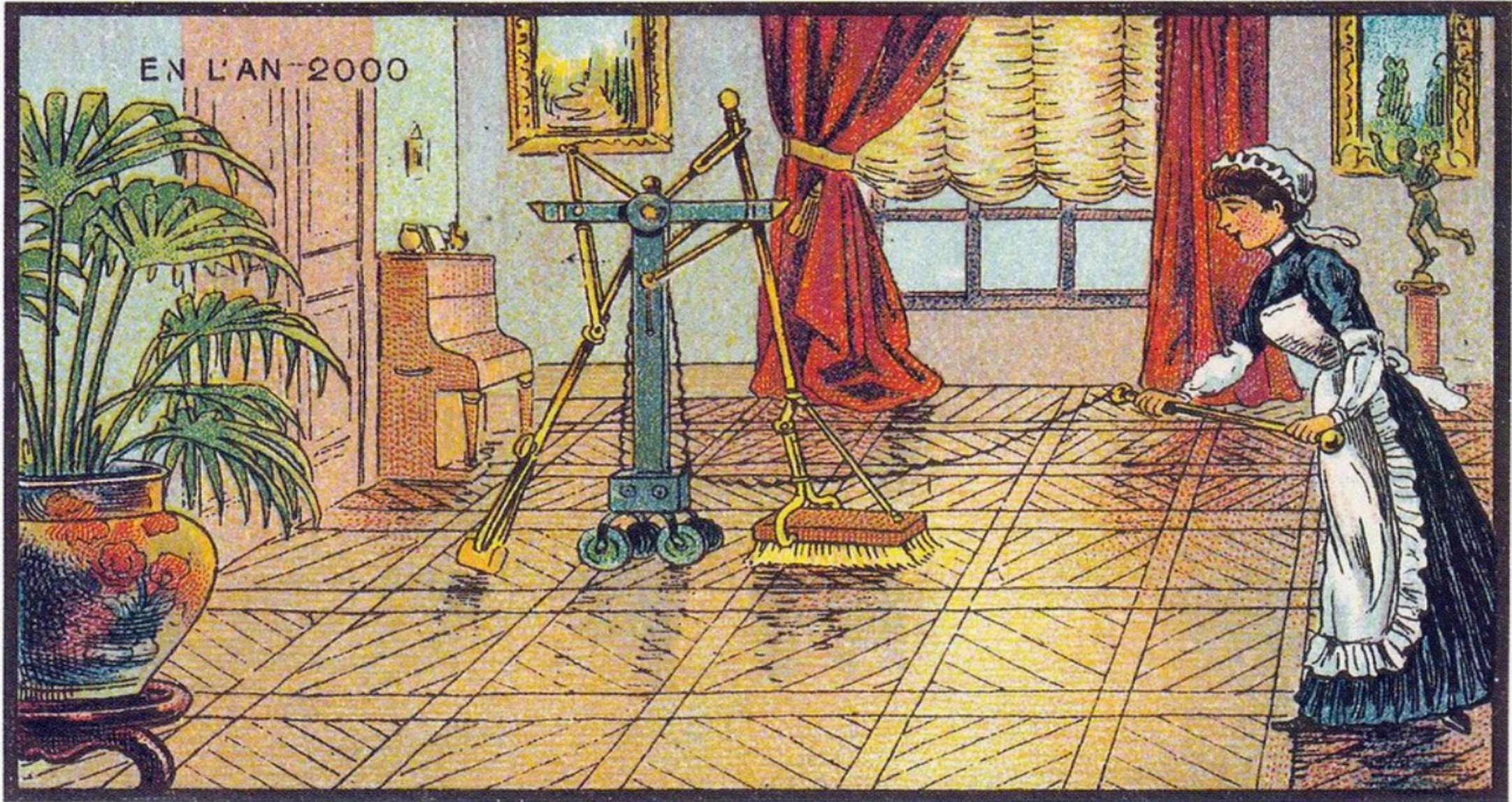
EDUCATION



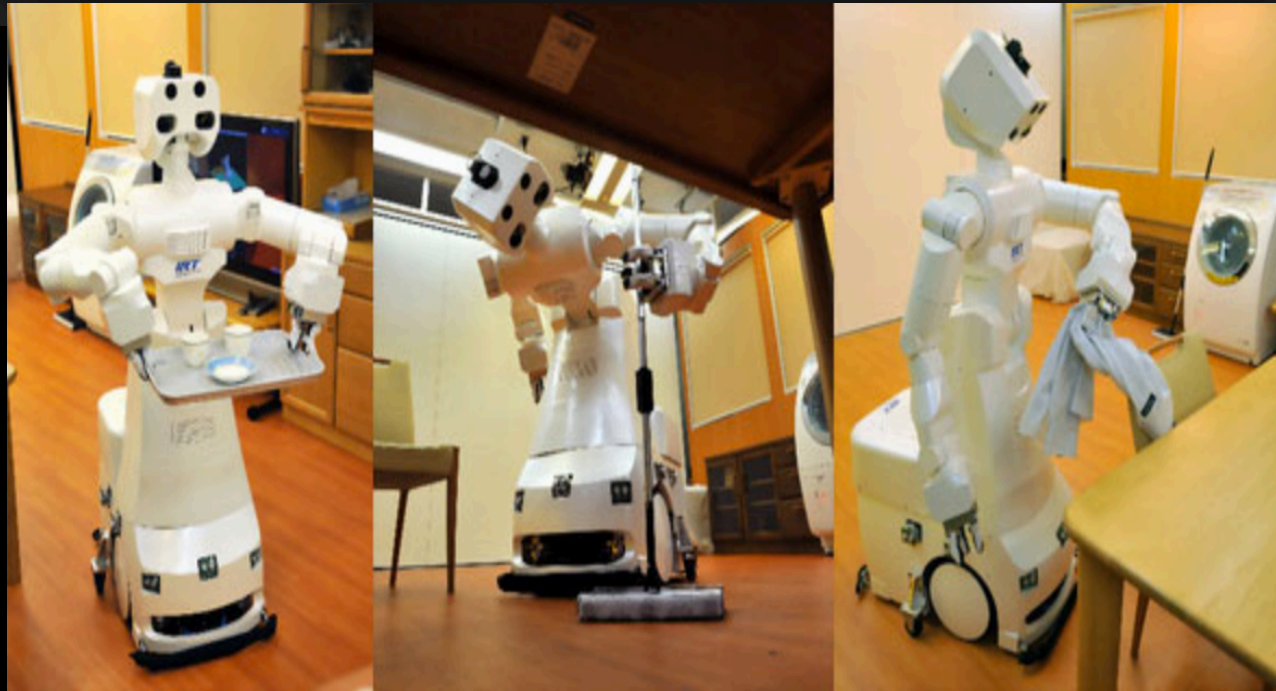
EDUCATION



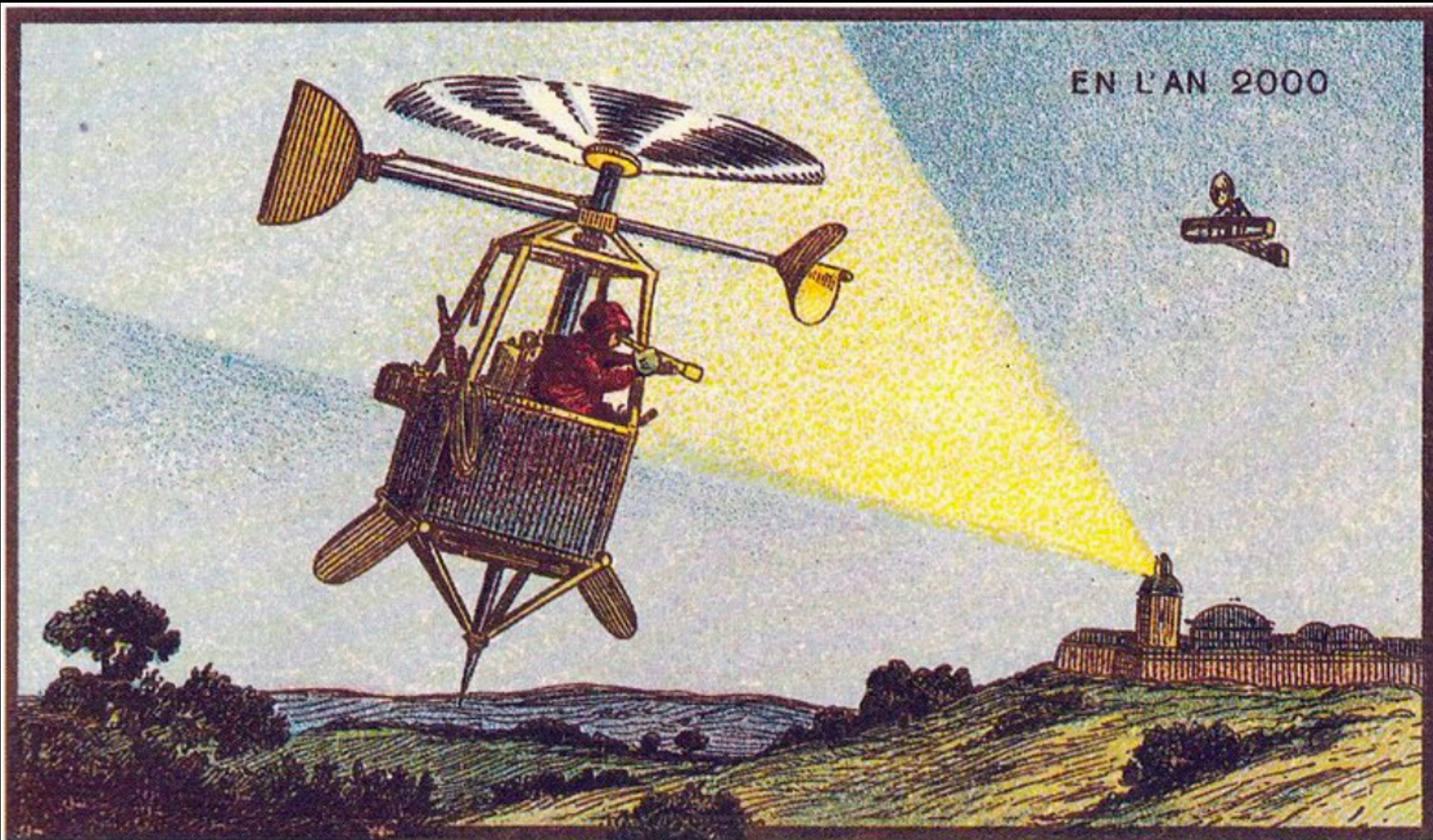
ELECTRICAL CLEANING APPLIANCE



ELECTRICAL CLEANING APPLIANCE



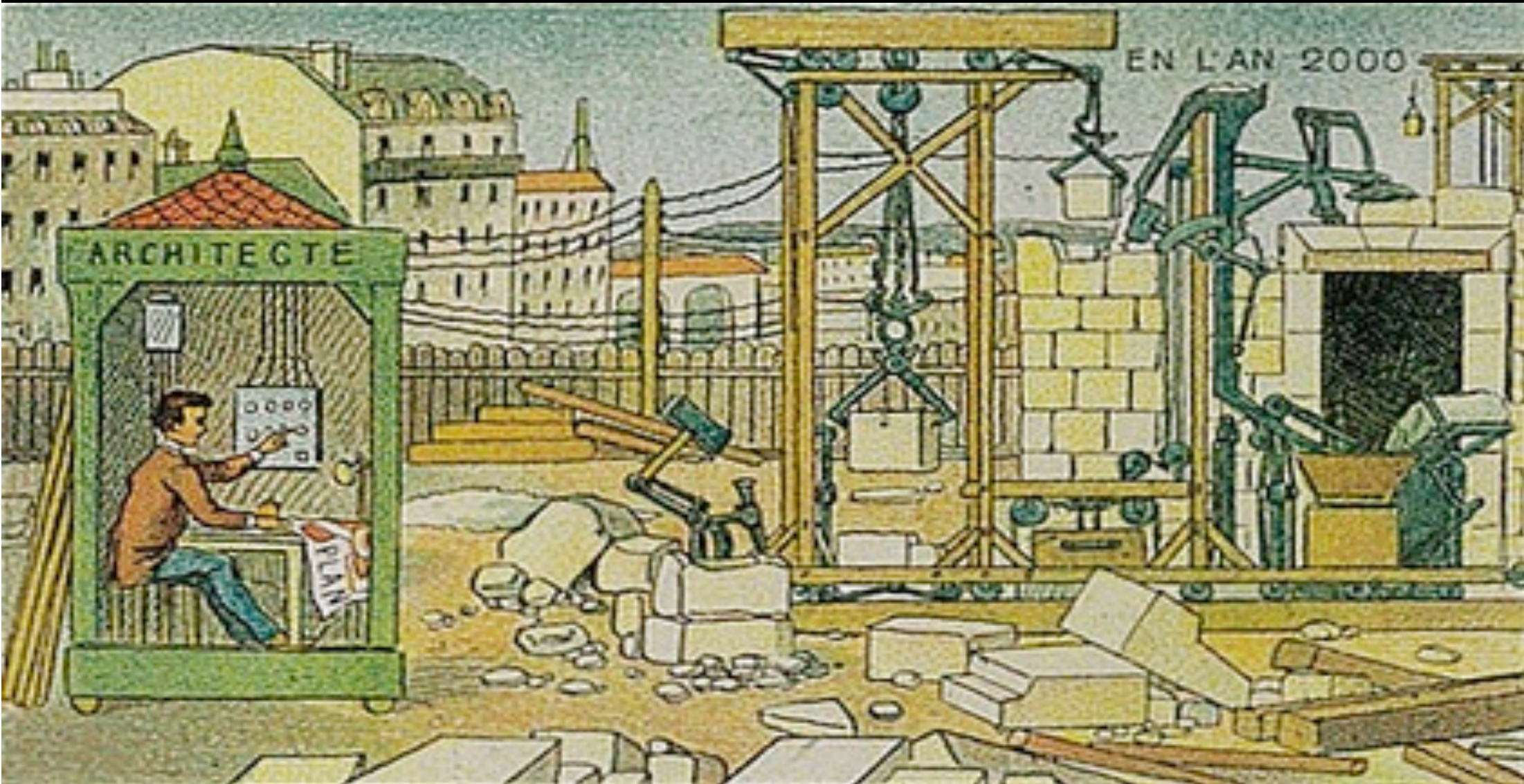
FLYING MACHINES



Pilotless Electric Flying Taxis - Singapore



CONSTRUCTION SITE



Vision of Construction Site 100 years from 1900 – into year 2000

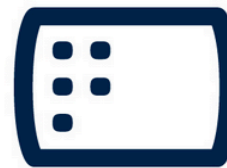
Industry
1.0

Industry
2.0

Industry
3.0

Industry
4.0

DIGITALISATION



1784

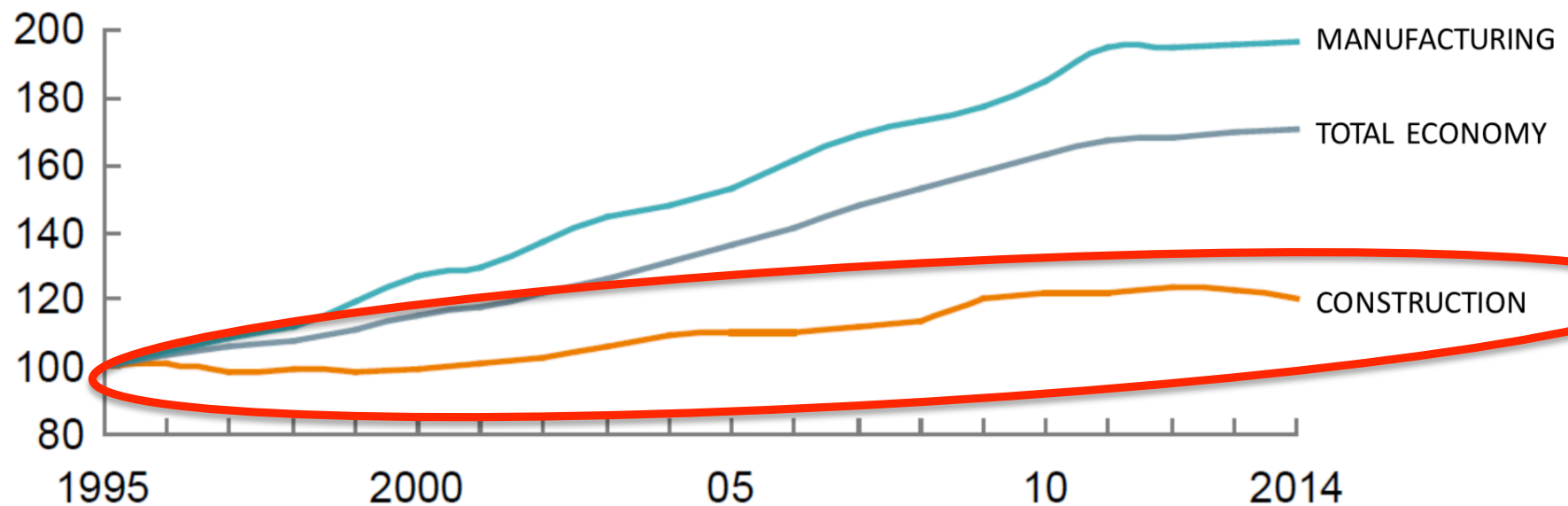
1870

1969

Today

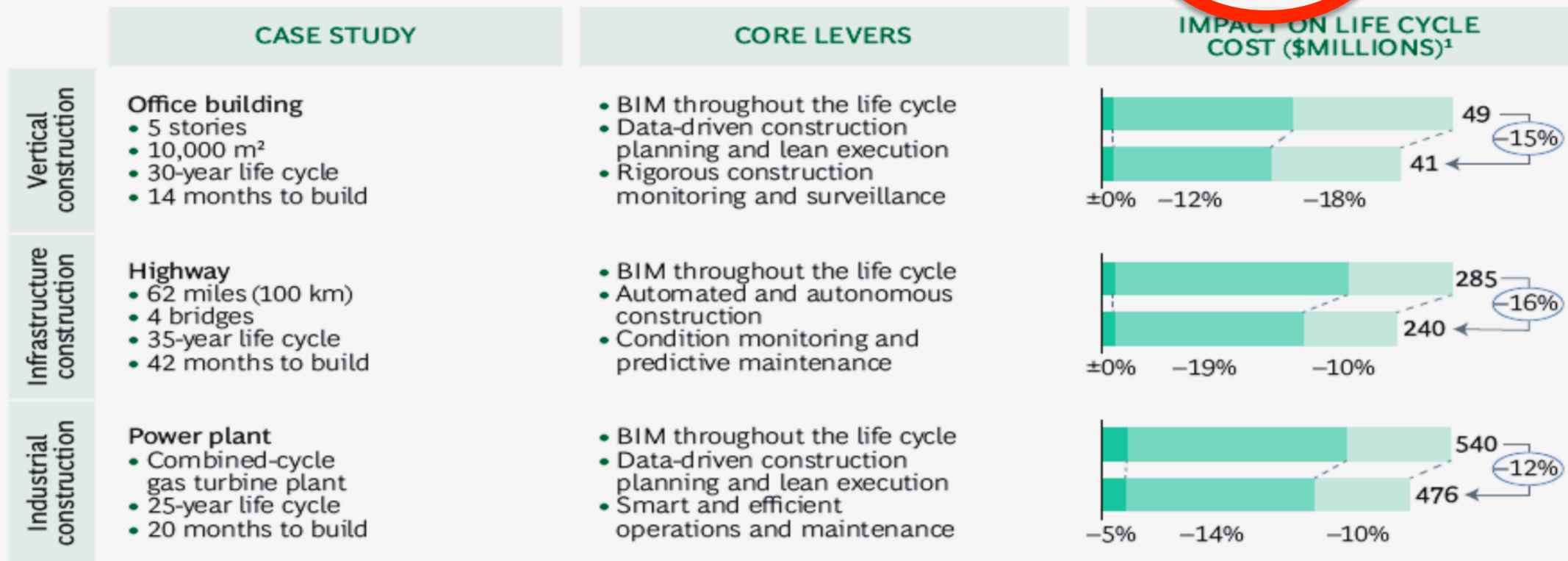
Global Productivity Growth Trends

**Real gross value added per hour worked
by persons engaged, 2005 \$**
Index: 100 = 1995



Source: OECD; WIOD; GGCD-10, World Bank; BEA; BLS; national statistical agencies of Turkey, Malaysia, and Singapore; Rosstat; McKinsey Global Institute analysis

Digital Transformation could reduce > \$1T / year



\$0.7 trillion to \$1.2 trillion (13% to 21%)
Total E&C cost reduction potential in 2025

+

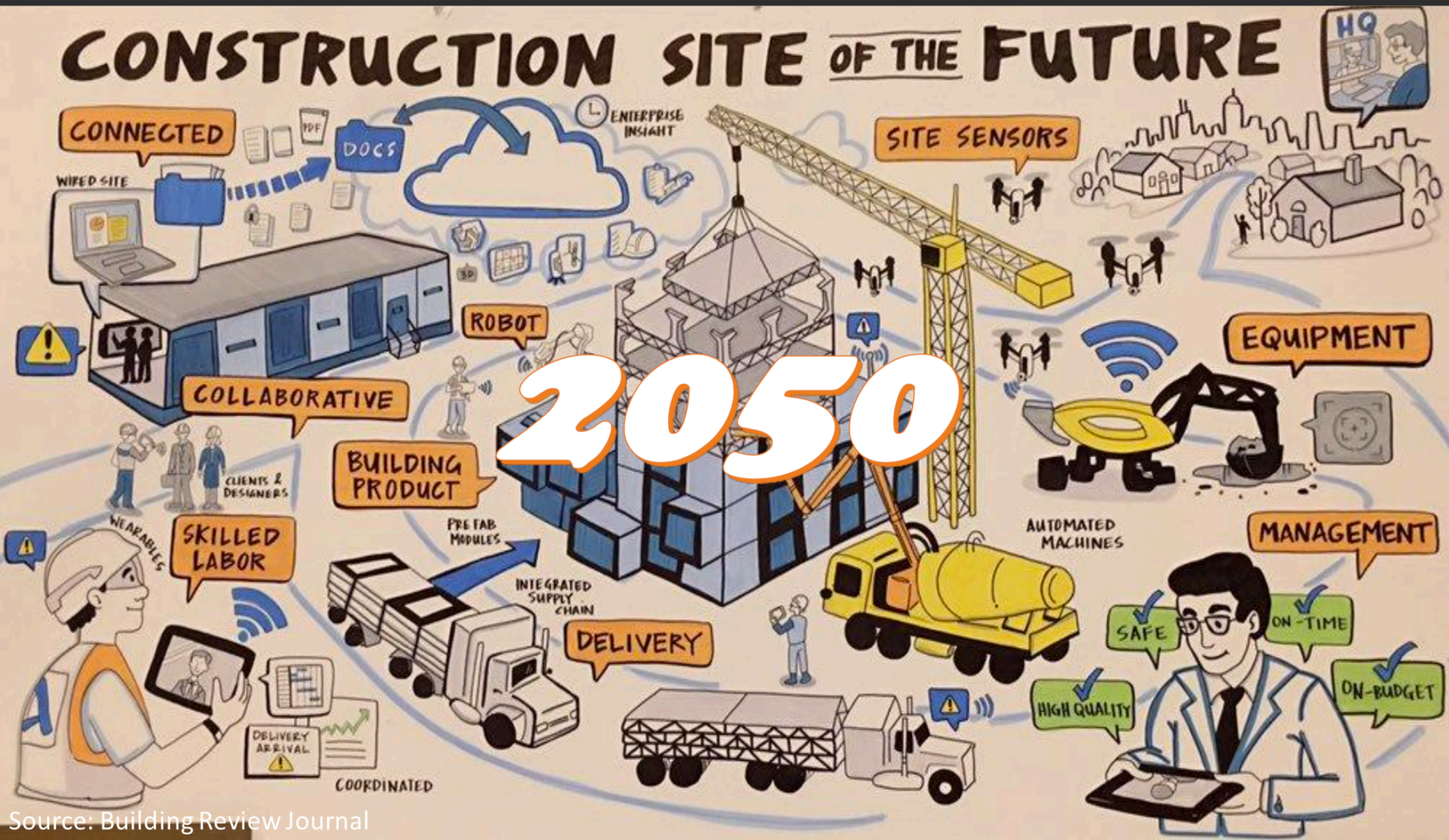
\$0.3 trillion to \$0.5 trillion (10% to 17%)
Additional savings on operations in 2025

■ Design and engineering
 ■ Construction
 ■ Operations

Sources: IHS; BCG analysis.

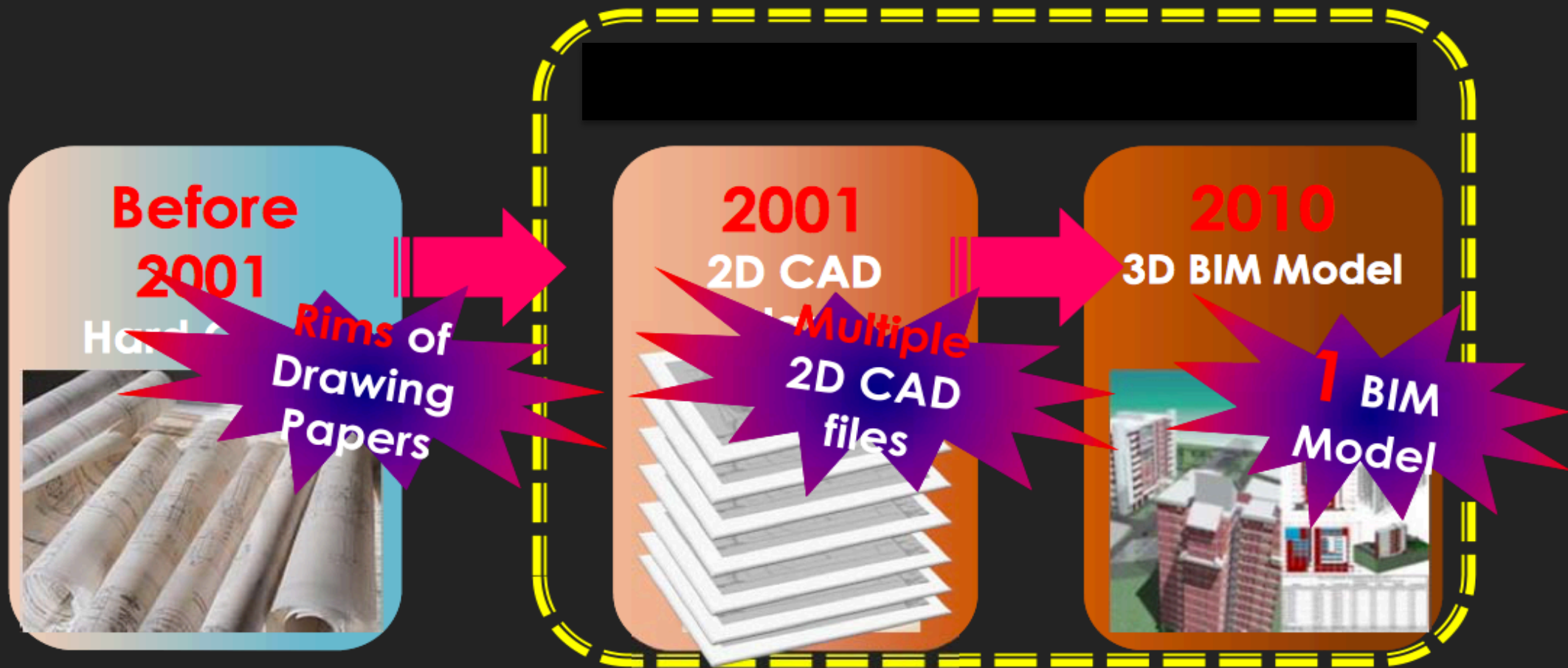
¹Life cycle cost is shown as the inflation-adjusted net present value. The cost of equipment (for instance, gas turbines in the power plant) and of non-building-related operations (for example, fuel for the gas turbines) is excluded.

CONSTRUCTION SITE OF THE FUTURE



Source: Building Review Journal

ICT IN SG's BUILT ENVIRONMENT



2) SG's BIM ROAD MAP

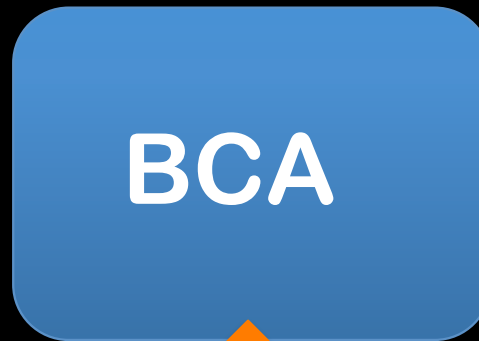
TARGET



Singapore Construction
Industry to Use BIM
Widely by 2015

1ST BIM ROAD MAP- 2010

SG BIM IMPLEMENTATION STRATEGY



BIM STEERING COMMITTEE

1ST BIM ROAD MAP- 2010

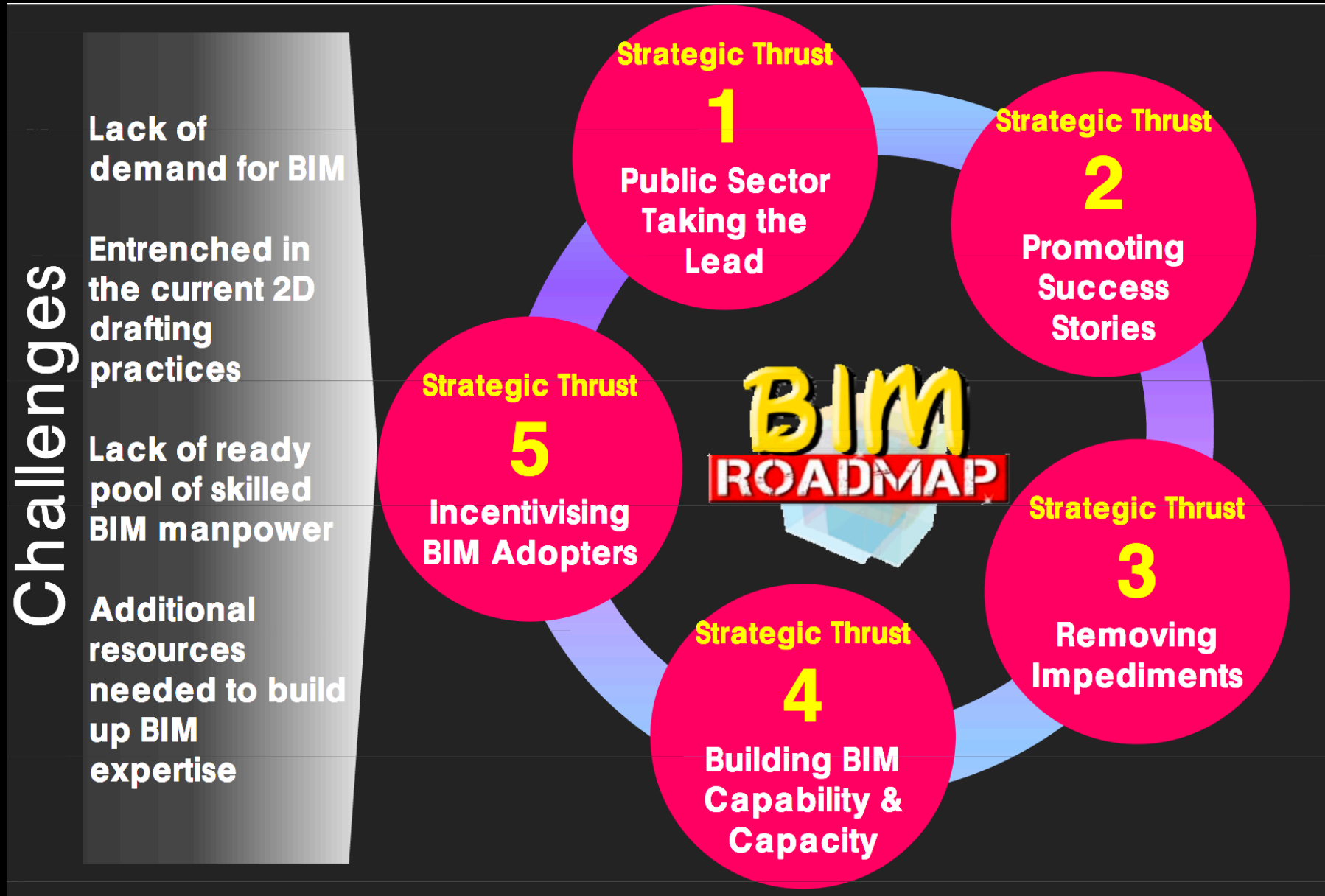
Objectives

- To lead the development of BIM standards and supporting resources to facilitate the collaborative use of BIM;*
- To advise on areas that would enable effective implementation of BIM at company, project and industry levels.*

BIM STEERING COMMITTEE



1ST BIM ROAD MAP- 2010

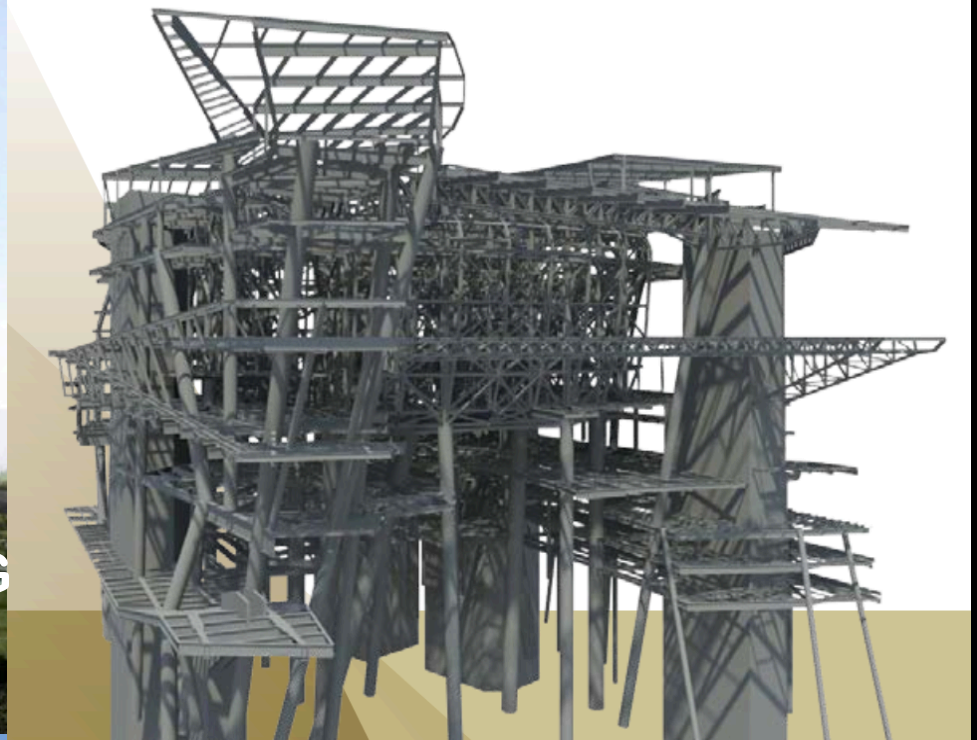


PROJECTS USING BIM

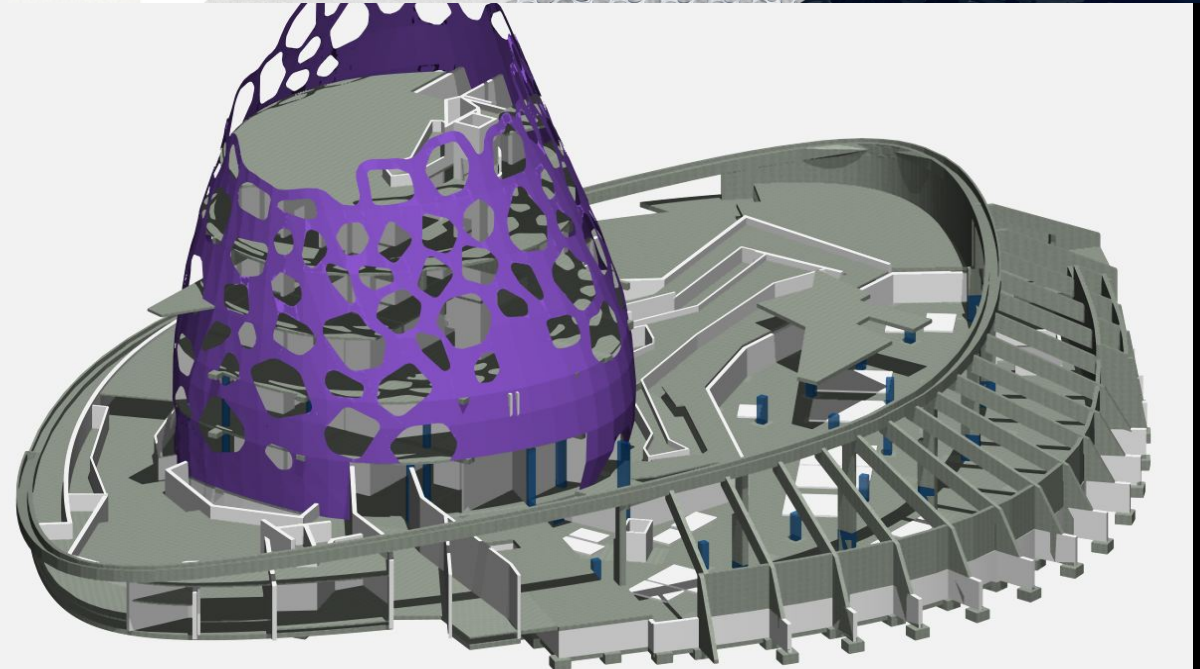
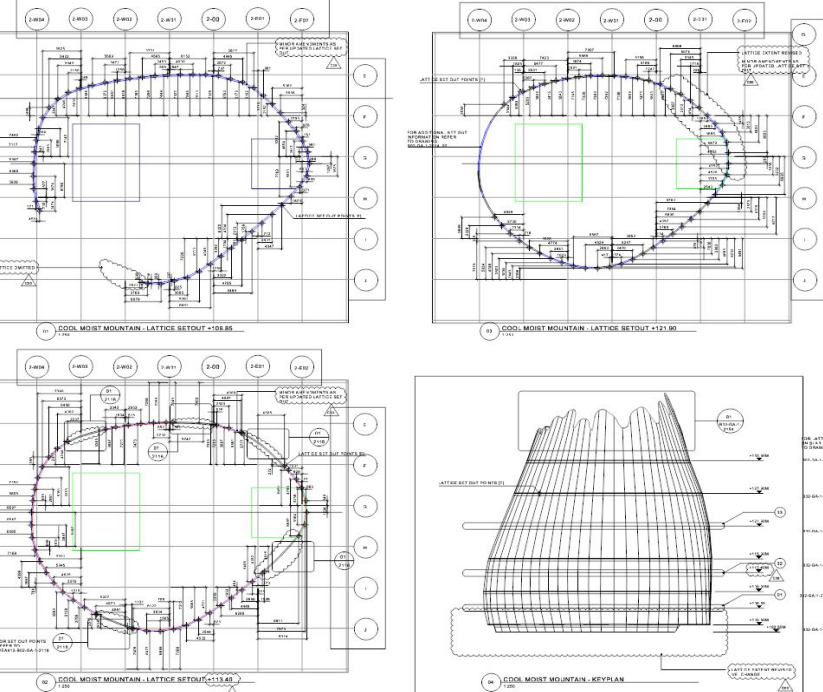
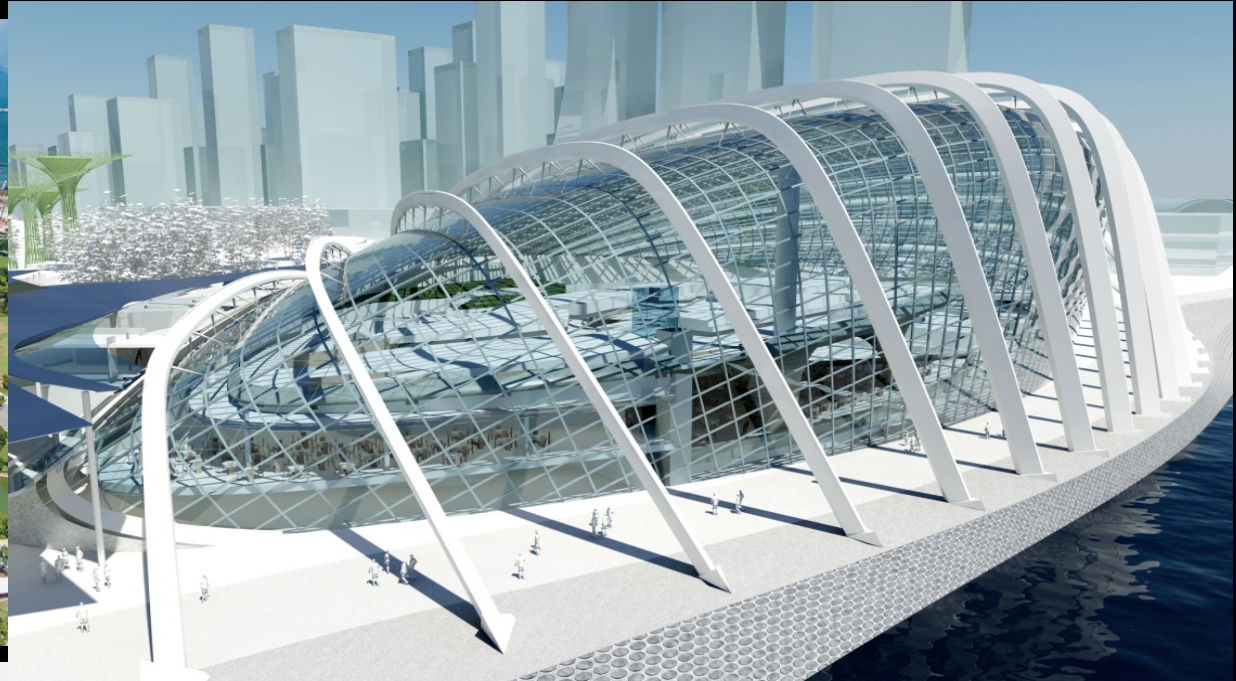


***MARINA BAY –
ARTS & SCIENCE
MUSEUM***

PROJECTS USING BIM



PROJECTS USING BIM



PROJECTS USING BIM

SG SPORTS HUB



BIM GUIDES

BIM GUIDE VER 1.0

BIM GUIDE VER 2.0

ESSENTIAL GUIDES

BIM Essential Guide for Adoption in Organization

BIM Essential Guide for Execution Plan

BIM Essential Guide for Architectural Consultants

BIM Essential Guide for Collaborative Virtual Design and Construction

BIM for DfMA (Design for Manufacturing and Assembly)
Essential Guide

BIM Essential Guide for C & S Consultants

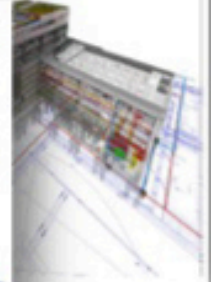
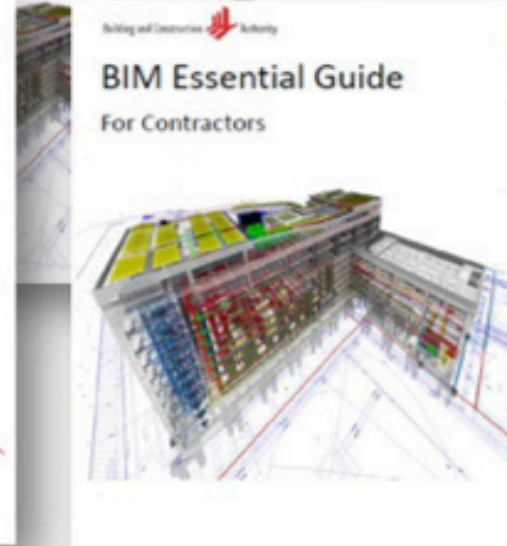
BIM Essential Guide for MEP Consultants

BIM Essential Guide for Contractors

BIM Essential Guide for Building Performance Analysis

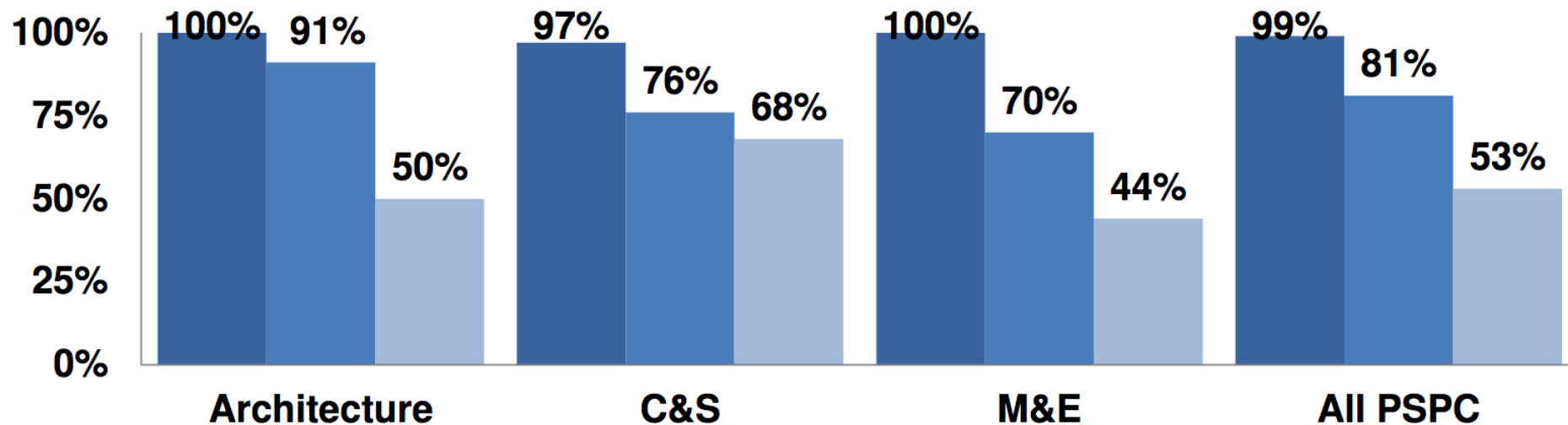
BIM Essential Guide for Land Surveyors

- Develop practical Essential BIM Guides
- Address technical issues



BIM ADOPTION LANDSCAPE

Public Sector Panel of Consultants



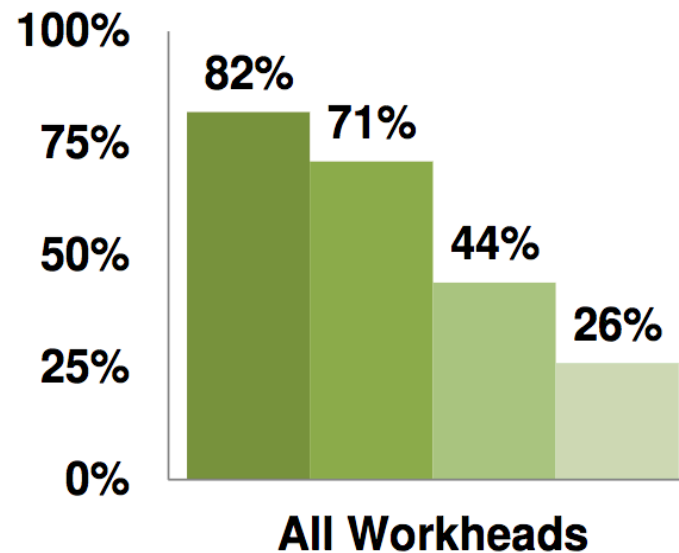
	No of firms who adopted BIM (total no of firms in red)			
Panels	Architectural	C&S	M&E	Total
1	38 / 38	34 / 35	23 / 23	95 / 96
2	23 / 25	21 / 28	7 / 10	51 / 63
3	19 / 37	12 / 18	9 / 20	40 / 75

Notes:

- Figures updated as of 8 Oct 2014
- Tendering limits of the above panels range from \$14 million (Panel 3) to \$90 million (Panel 1)
- From July 2015, consultants' regulatory submissions in the BIM format is mandatory for new projects > 5,000m²

BIM ADOPTION LANDSCAPE

Grade A1 – B2 Contractors

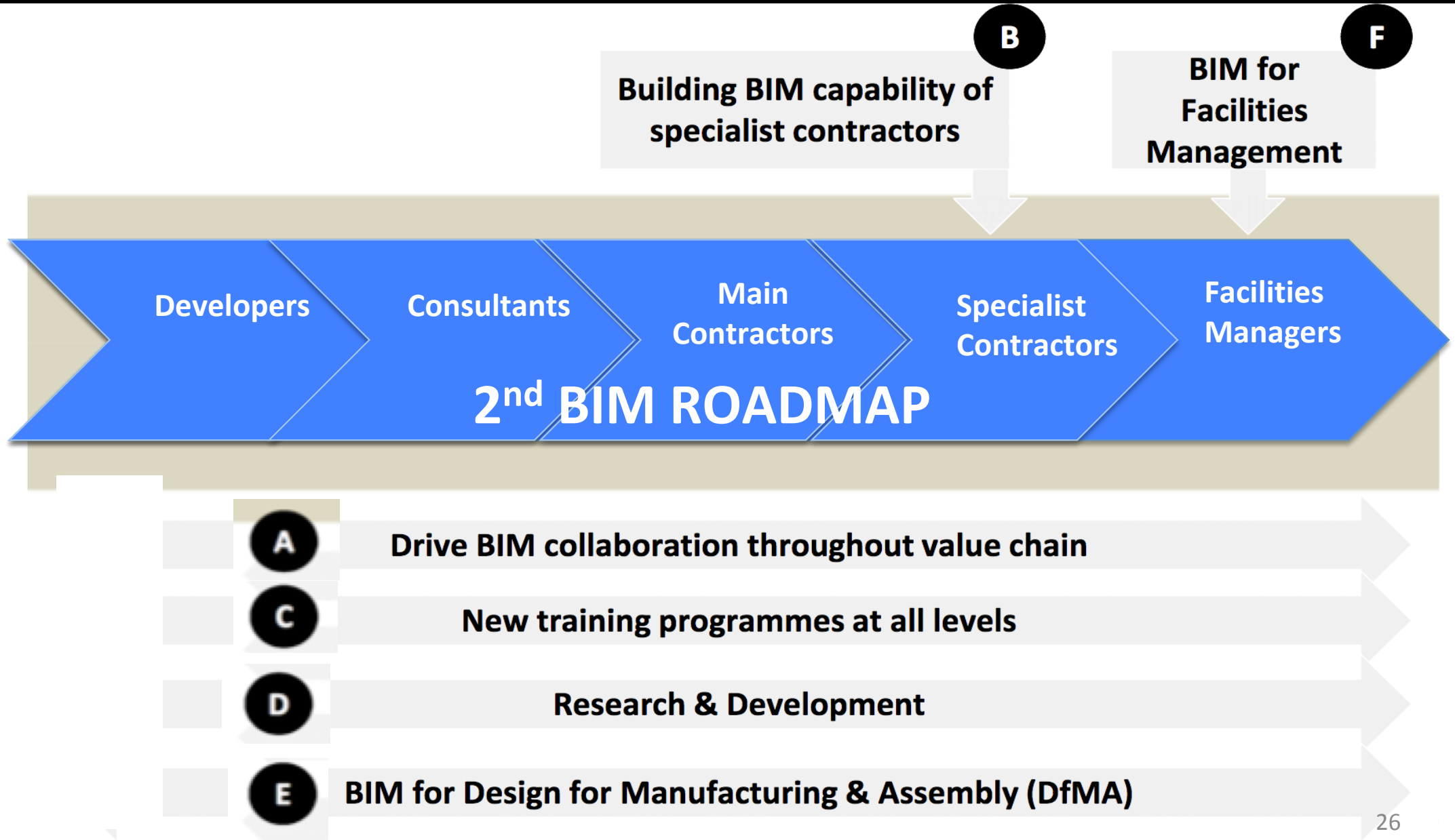


	No of firms who adopted BIM (total no of firms in red)
Grades	All Workheads
A1	73 / 89
A2	41 / 58
B1	57 / 130
B2	41 / 159

Notes:

- Figures updated as of 8 Oct 2014
- Tendering limits of the above grades range from \$14 million (B2 contractors) to unlimited (A1 contractors)

2ND BIM ROAD MAP- 2014



FOCUS OF 2ND BIM ROAD MAP

- Process Transformation
- BIM Research & Development
- BIM for Contractor
- BIM for Facilities Asset Mgt



Process Transformation

- Project Delivery Process Study
- BIM Tool for Construction Productivity

SOURCE : FR BCA SG

VDC – Build Twice – First Virtual Then Real

PROMOTION OF BIM BEST PRACTICES

Code of Practice for Building Information Modelling (BIM)

Objective: To establish a **common standard** in the creation of 3D models for communication and information sharing

- File Naming
- Family Naming
- View Naming
- Colour Conventions
- Documentation
- Core Information

Code of Practice for BIM e-Submission

Part 1: General Requirements

Part 2:
Archi

Part 3:
C&S

Part 4:
MEP

Agency Specific Requirements

Code of Practice for BIM Tender & Construction

Invite BIM Award Winners

Code of Practice for BIM FM & As-Built

BIM-FM Workgroup

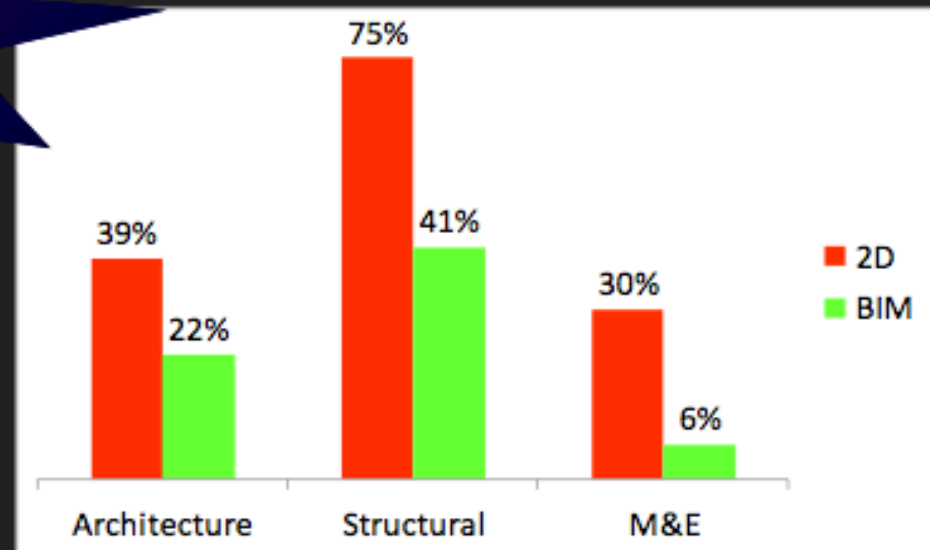
BIM ADOPTION STATUS

PRODUCTIVITY GAIN – CASE 1

Project Collaboration Scheme

Request for Information (RFI)

Reduced
52%



- ✓ Improved Presentation/ Visualisation
- ✓ Faster Documentation
- ✓ Reduced Errors in Construction Documents

SAFRA CLUBHOUSE

SOURCE : EP BCA SG

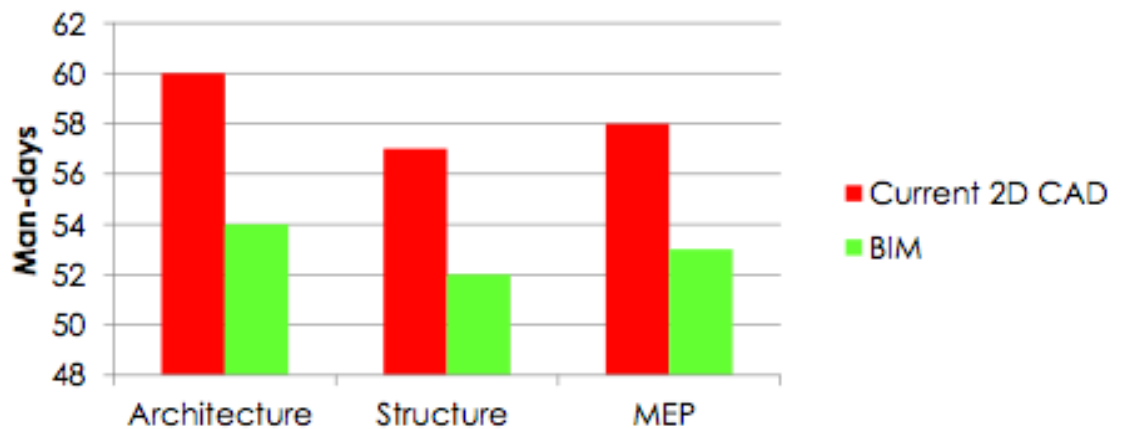
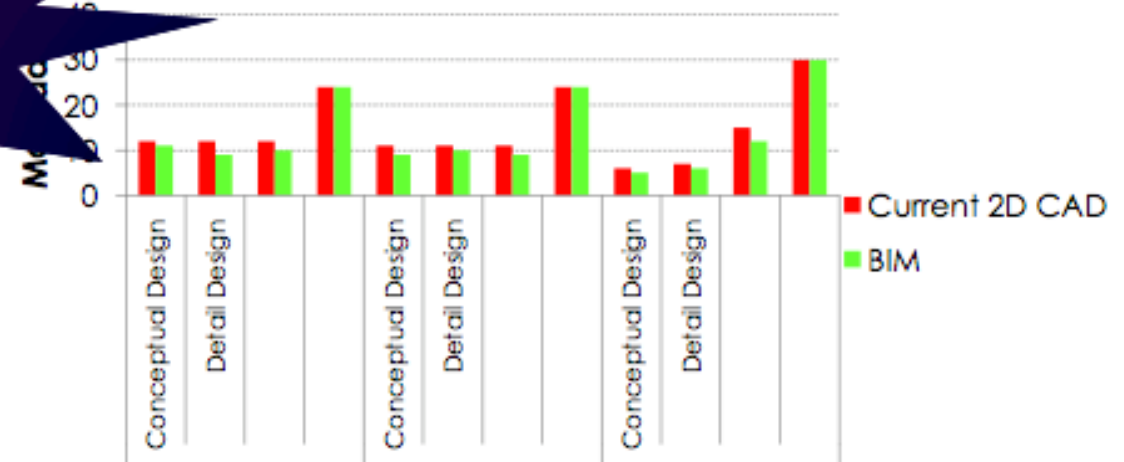


BIM ADOPTION STATUS

PRODUCTIVITY GAIN – CASE 2

Project Collaboration Schedule

9-10%
Saved



ANIMAL BREEDING FACILITY

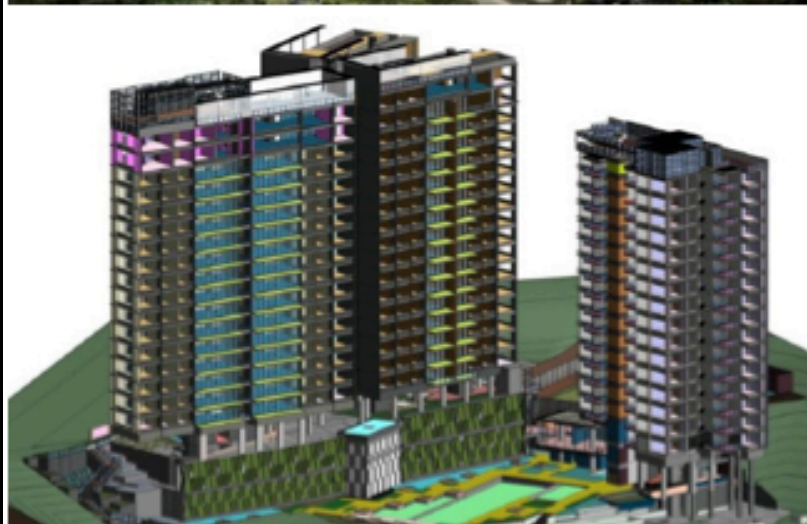
SOURCE: EPBCA SC



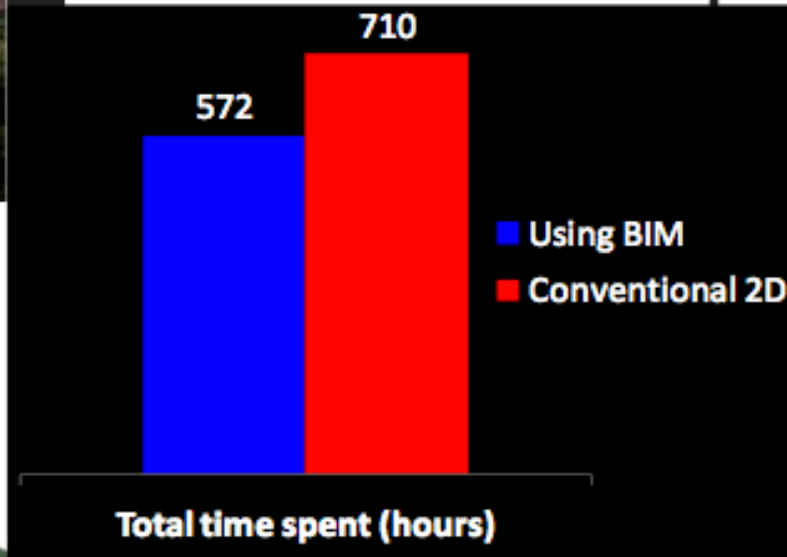
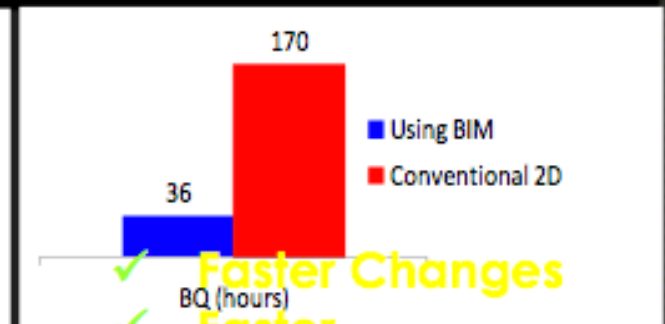
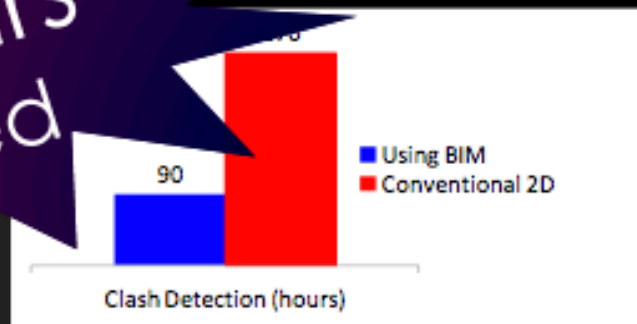
BIM ADOPTION STATUS

PRODUCTIVITY GAIN – CASE 3

Firm Level Scheme



138 Hrs saved



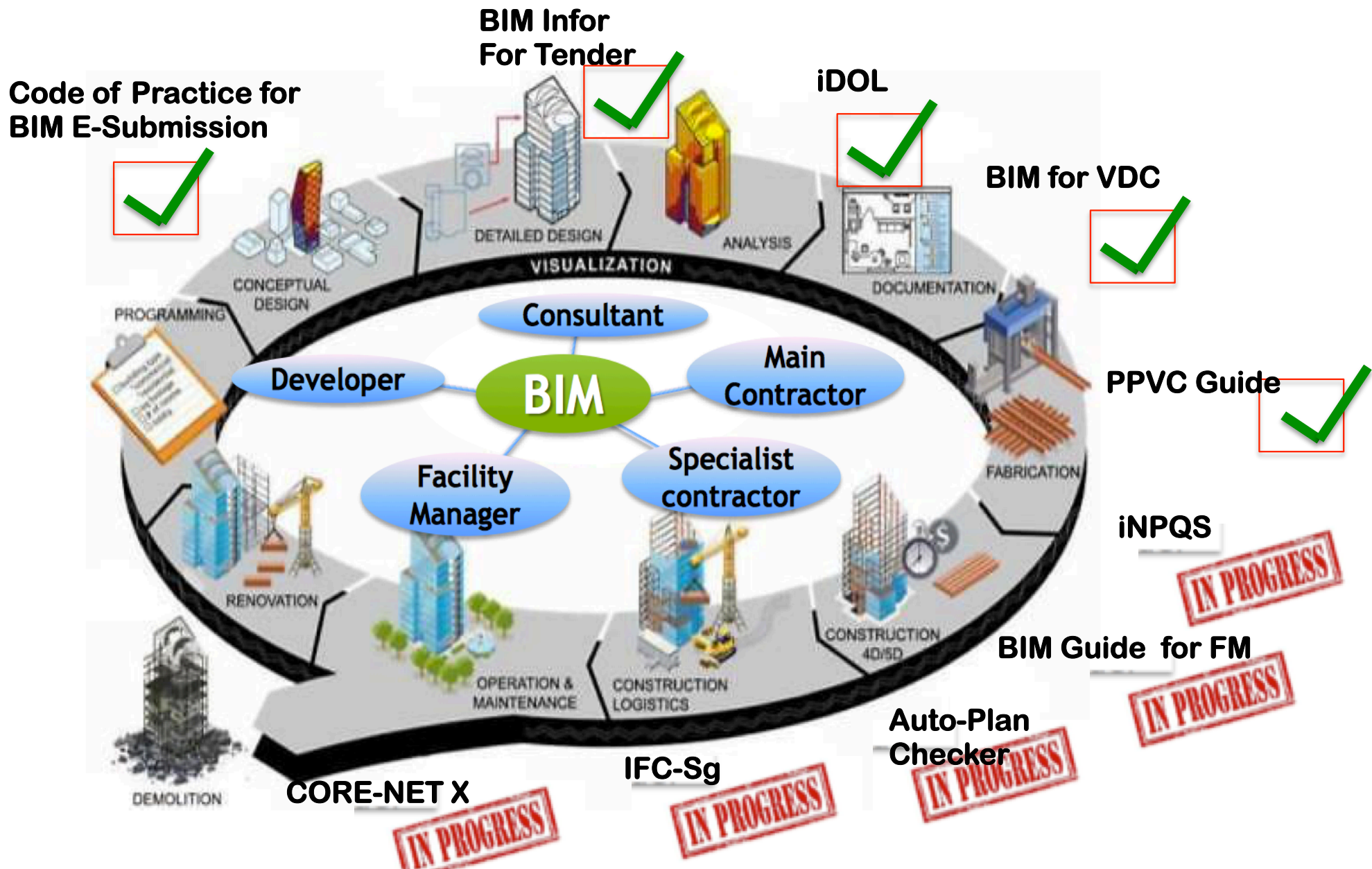
- ✓ Faster Changes
- ✓ Faster
- ✓ Documentation
- ✓ Higher Accuracy & Fewer Site Coordination Problems
- ✓ Improved Visualisation
- ✓ Clash Detection
- ✓ Positive Impact on Winning Tenders

VERMONT CONDOMINIUM



SOURCE: EP, BCA, SC

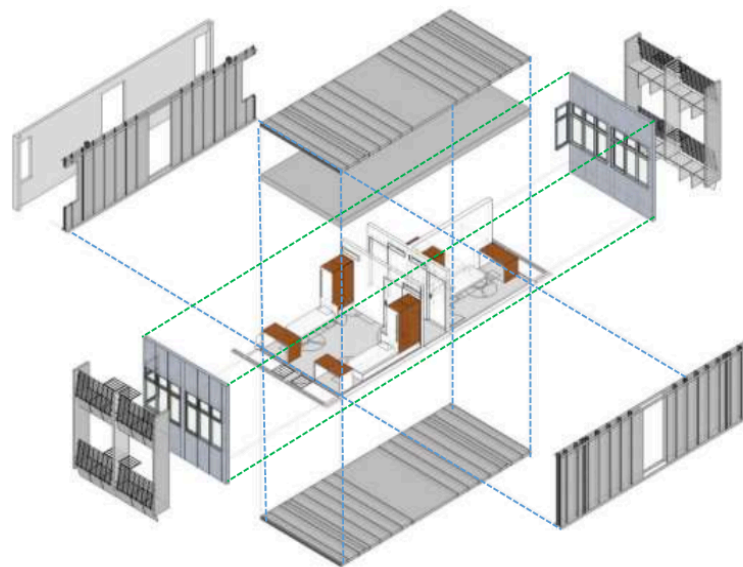
BIM TO VDC – ADD ONS



BIM FOR DfMA - DESIGN & MANUFACTURING & ASSEMBLY

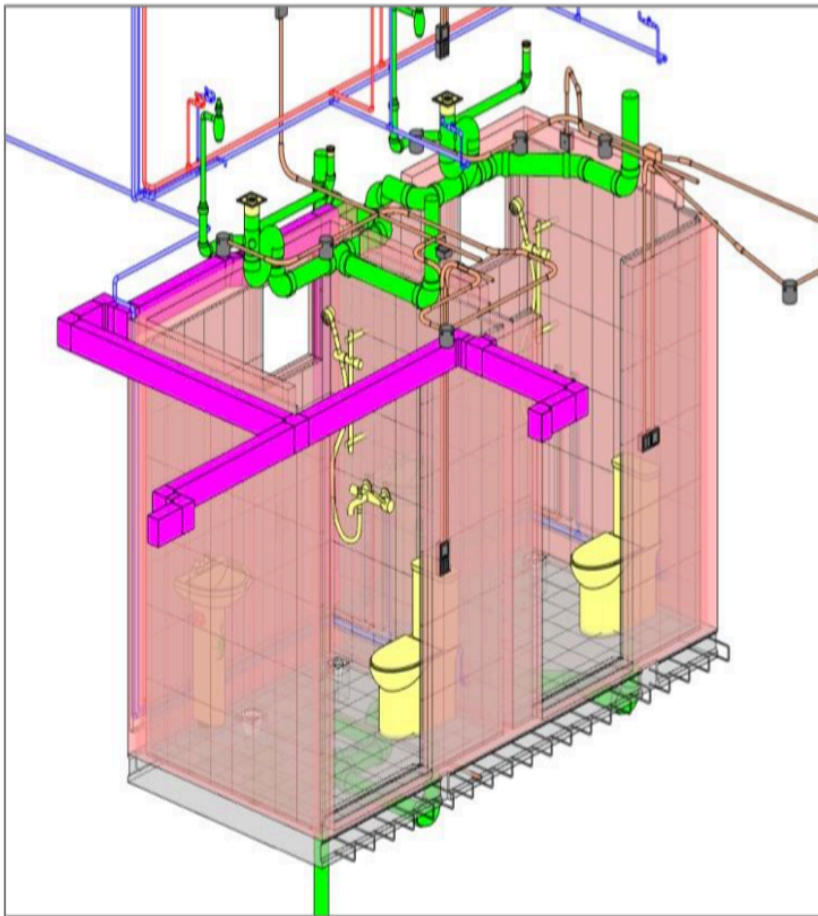
Building and Construction Authority

BIM for DfMA (Design for Manufacturing and Assembly) Essential Guide



BIM FOR DfMA - DESIGN & MANUFACTURING & ASSEMBLY

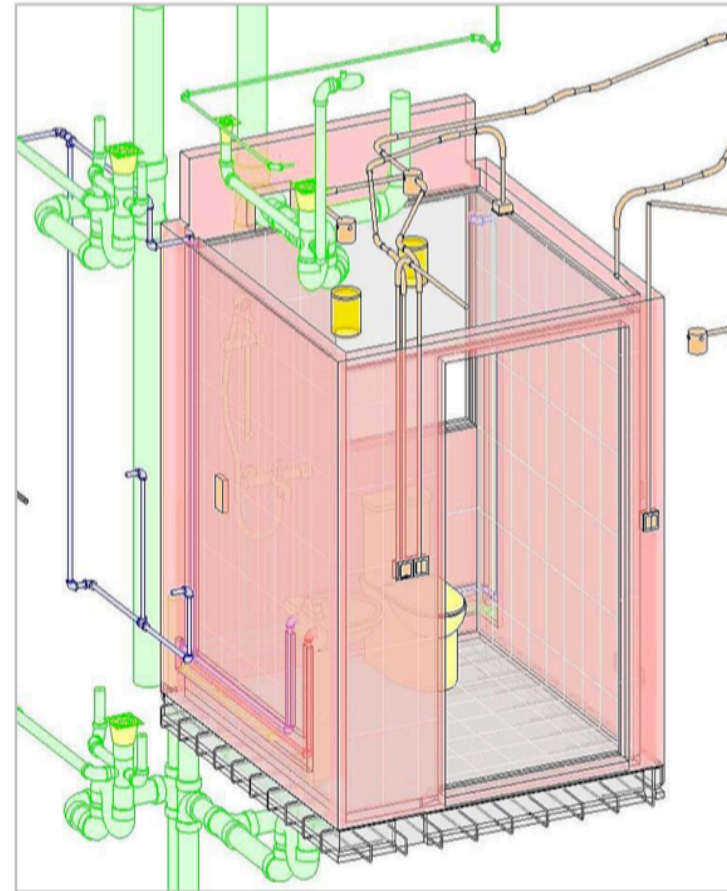
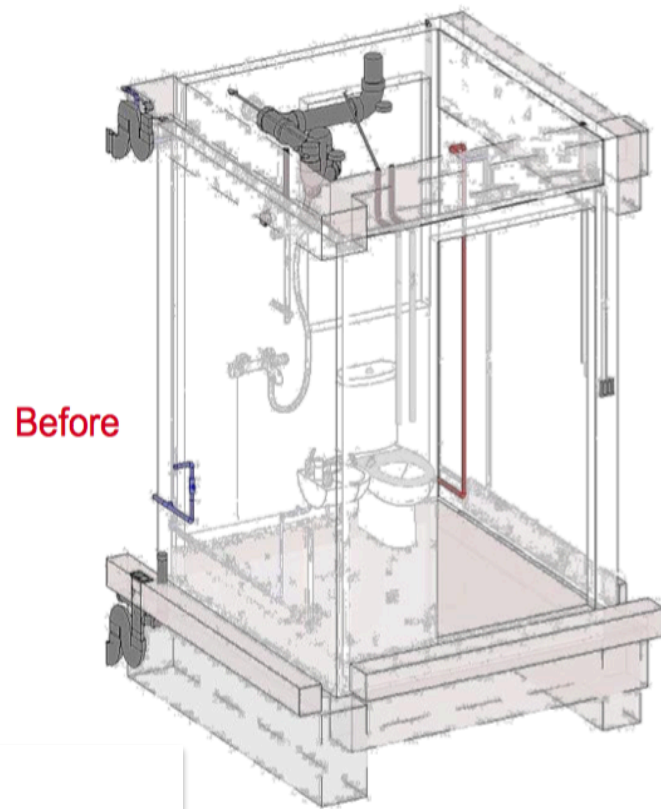
PBU – Digital Model to Coordination and Installation



SOURCE : FR BCA SG

BIM FOR DfMA - DESIGN & MANUFACTURING & ASSEMBLY

Coordination Works (PBU Design)



SOURCE : FR BCA SG

BIM FOR DfMA - DESIGN & MANUFACTURING & ASSEMBLY

OFF SITE ASSEMBLY



BIM FOR DfMA - DESIGN & MANUFACTURING & ASSEMBLY



BIM FOR DfMA - DESIGN & MANUFACTURING & ASSEMBLY



**NTU –
STUDENT
HOUSING –
NORTH HILL**

BIM FOR DfMA - DESIGN & MANUFACTURING & ASSEMBLY



**COMPLETED
IN 2016**

40-STY – FULLY PPVC RESIDENTIAL APARTMENT



40-STY – FULLY PPVC RESIDENTIAL APARTMENT

CLEMENTI CANOPY

***WORLD RECORD
FOR TALLEST
FULLY PPVC
CONSTRUCTION***



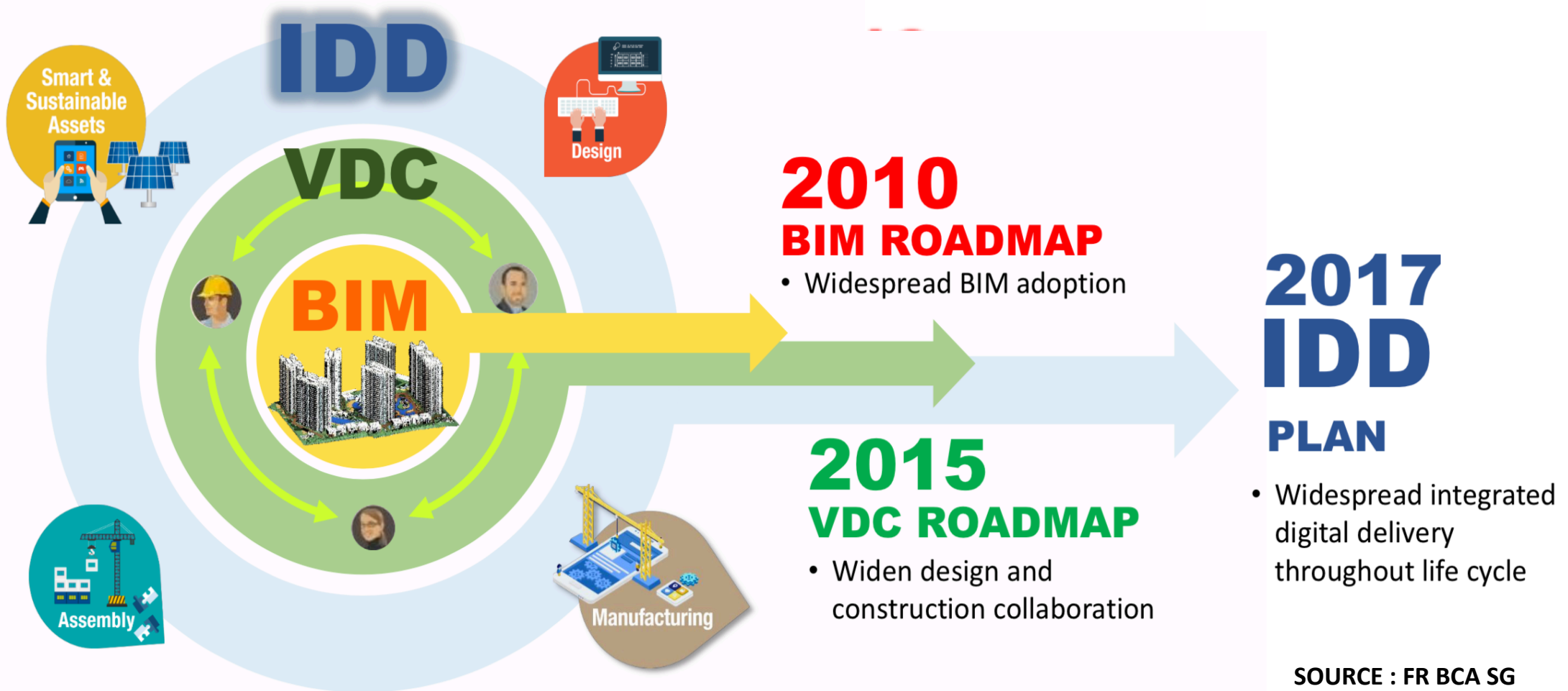
MASS ENGINEERED TIMBER – NTU SPORTS HALL



MASS ENGINEERED TIMBER – NTU SPORTS HALL

***1st Large Scale Building in MET in ASIA
72m Roof – 7X Timber Arches
Column free, 9,800m², 1,000 seating***

4) *IDD – INTEGRATED DIGITAL DELIVERY*



IDD aims:

Outcomes

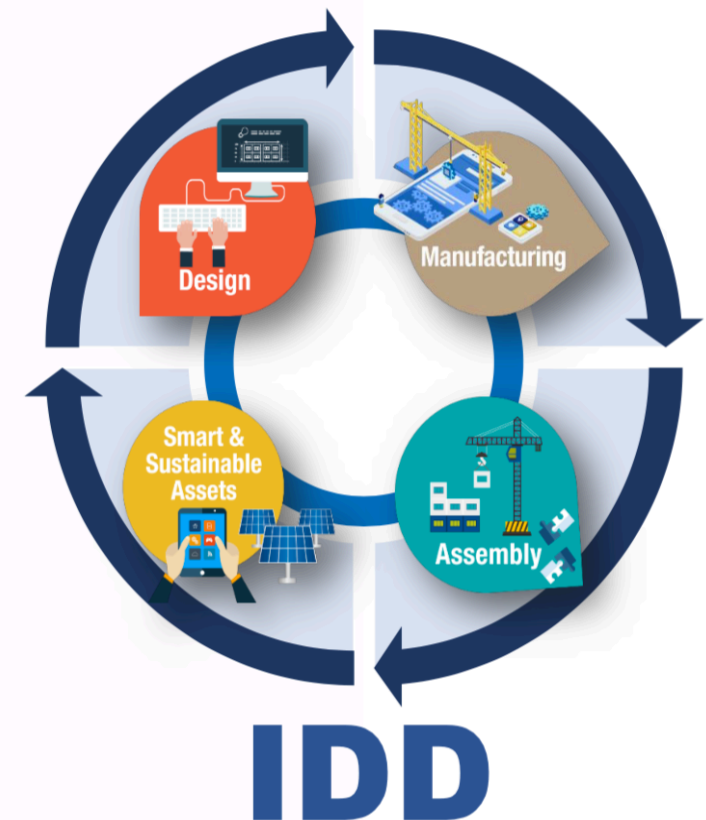
To achieve **timely, cost effective, productive** and **high quality** project delivery - design, manufacturing, fabrication, construction and asset delivery

Technological Solutions

by developing and adopting **BIM/VDC** and other **digital solutions** to convey **relevant, accurate, and timely digital information**

Collaboration (people + platform)

through **collaborative working approaches & integrated platforms.**



SOURCE : FR BCA SG

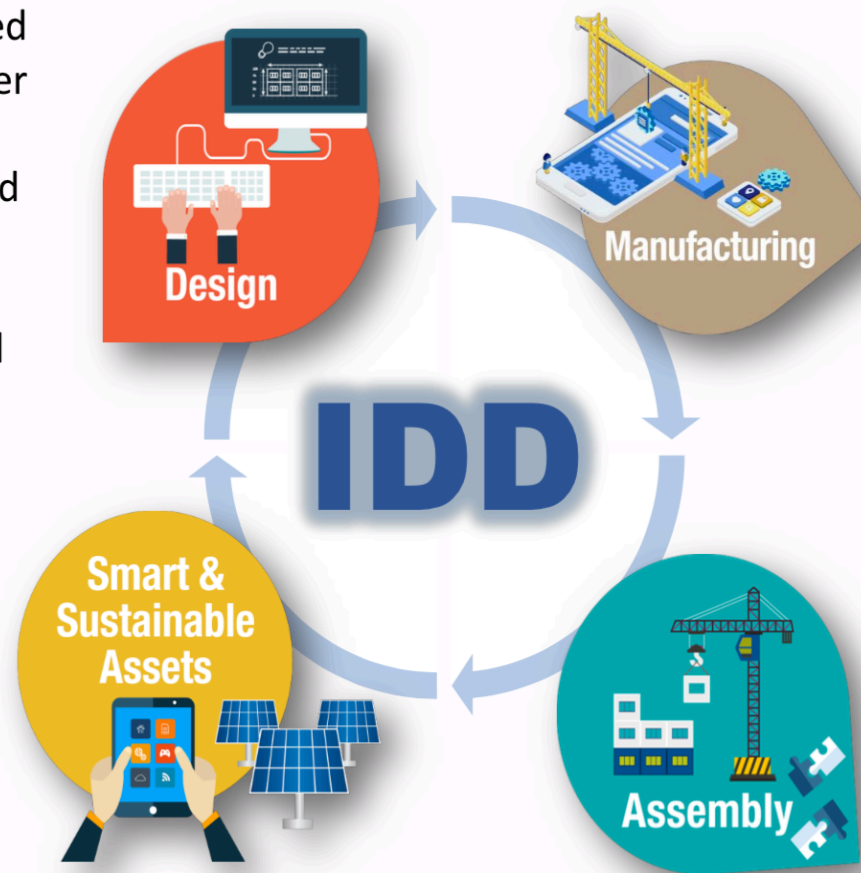
Scope of IDD

Digital Design

Collaborative and coordinated design via BIM/VDC and other computational tools to achieve design objectives and ease and optimize downstream manufacturing, fabrication, construction and maintenance.

Digital Asset Delivery & Management

Verification and handing over of the asset for operations and maintenance through effective use of digital tools.



Digital Manufacturing and Fabrication

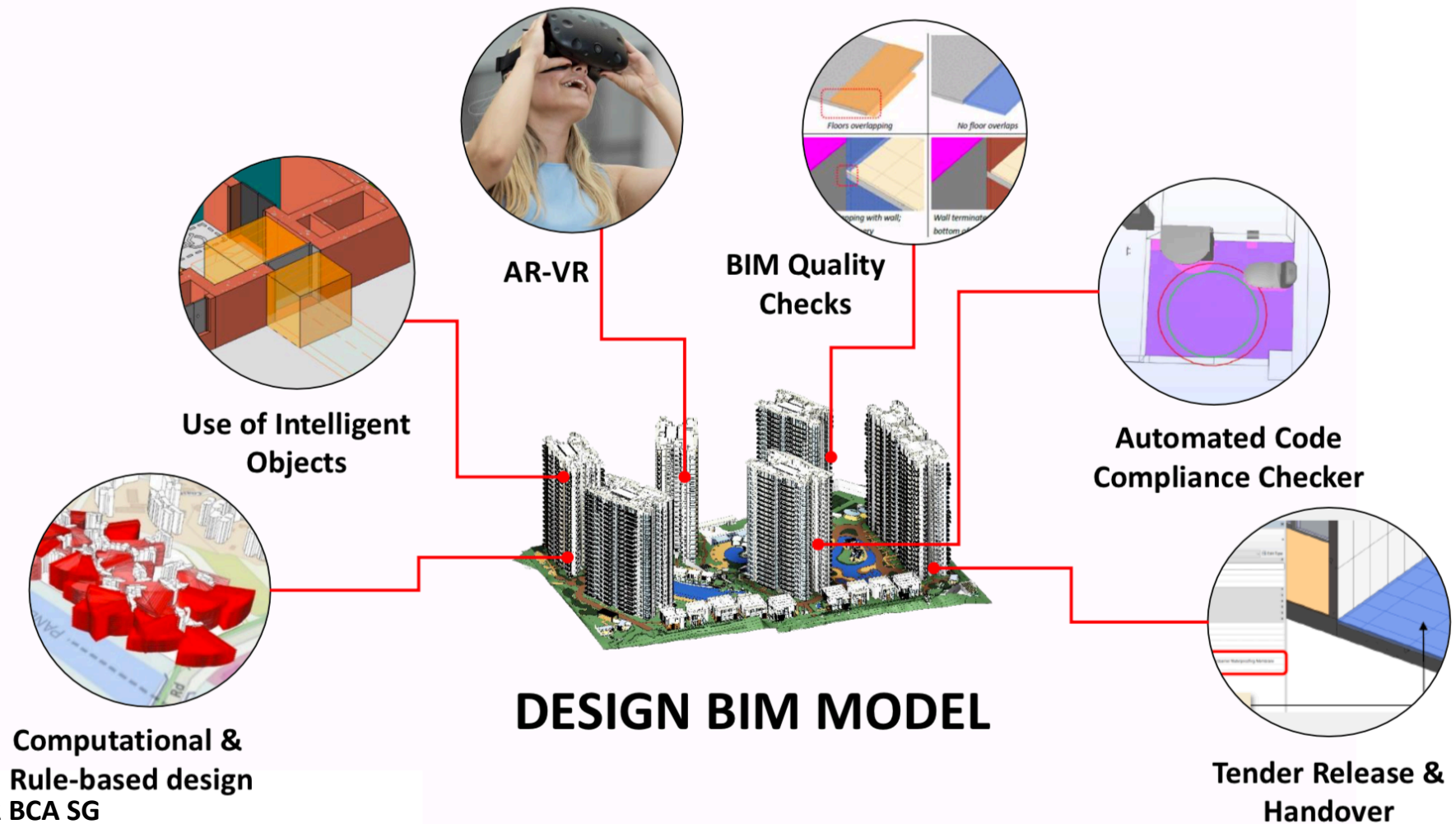
Integration of BIM/VDC design to off-site production, fabrication and component management through automation, robotics optimization.

Digital Construction

Integration of BIM/VDC design and off-site manufacturing/fabrication to delivery and installation on-site through use of real-time ICT solutions, as part of project management and Lean construction

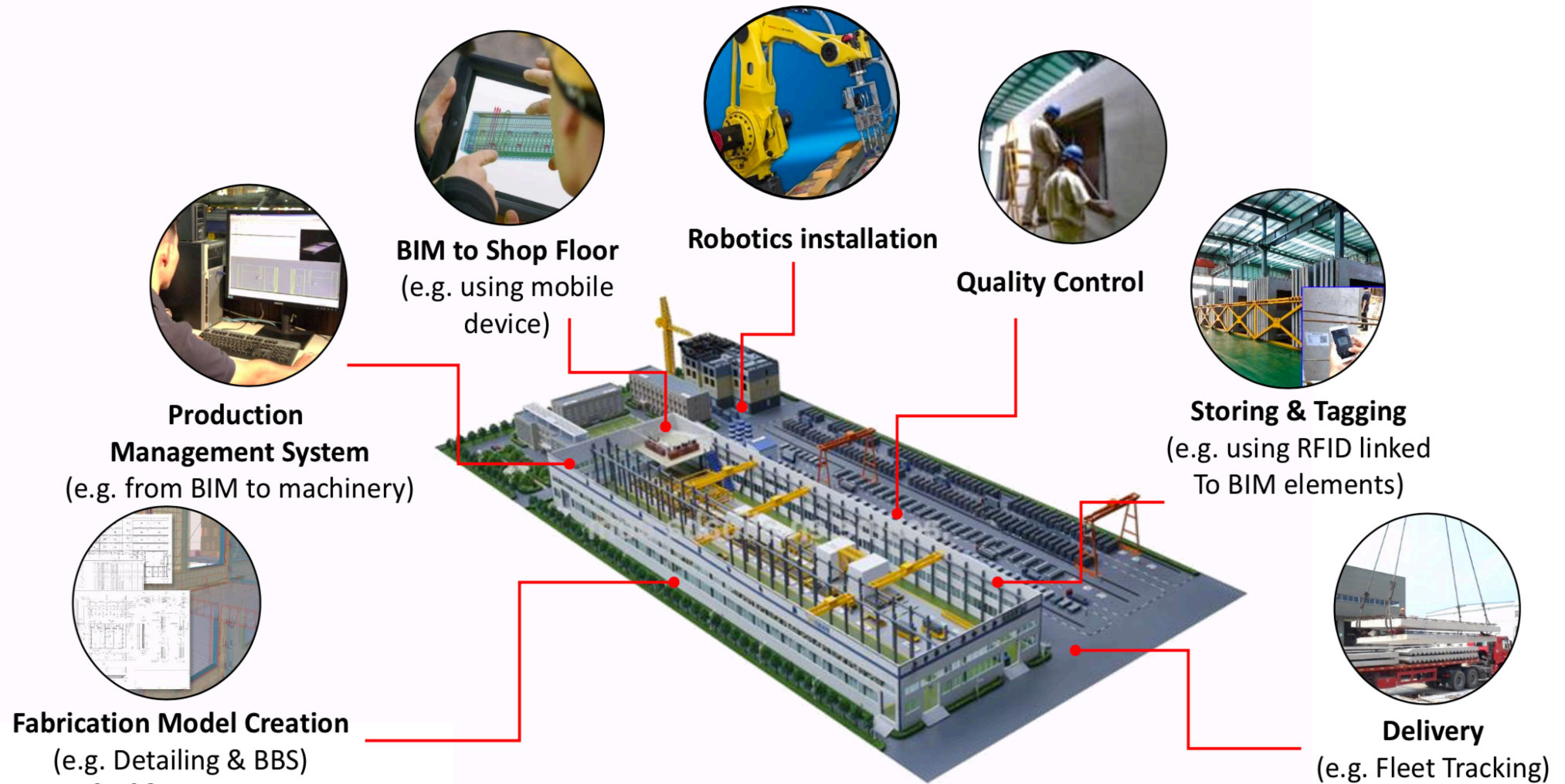
SOURCE : FR BCA SG

Digital Design - components



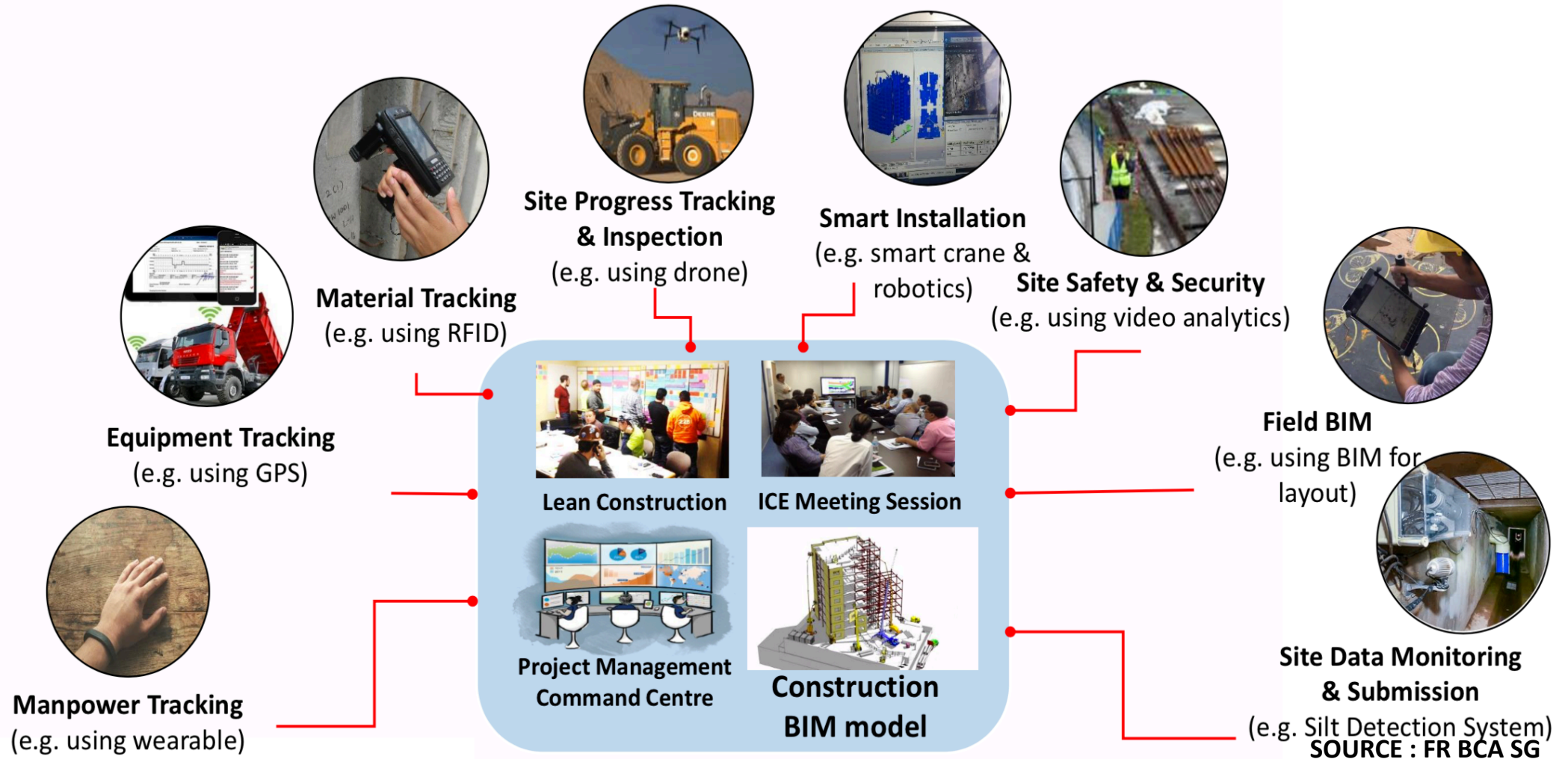
SOURCE : FR BCA SG

Digital Manufacturing and Fabrication components



SOURCE : FR BCA SG

Digital Construction - components



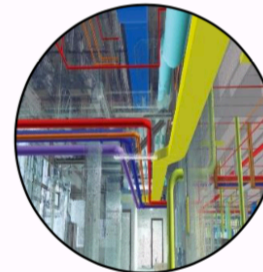
Digital Asset Delivery & Management - components



Defect Management System
(e.g. using cloud-based mobile system)



BIM Handover Quality Check
(e.g. check data correctness)



BIM As-built Verification
(e.g. using 3D scanner)



Asset Monitoring
(e.g. using video analytics to detect leakage)



Quality Assessment System
(e.g. using robot for building inspection)



Asset Management
(e.g. using BIM data for maintenance)

SOURCE : FR BCA SG

Challenges



DIGITAL DESIGN

- Design BIM model is often not developed to tender stage
- Regulatory agencies are still building BIM processing capabilities



DIGITAL MANUFACTURING & FABRICATION

- Design and construction BIM not directly linked to manufacturing, fabrication and logistics planning and execution
- Opportunities for further automation, use of robotics and 3D printing



DIGITAL CONSTRUCTION

- BIM is not fully utilized during construction beyond 3D
- Documentation still very paper-based
- Real-time information not captured and used effectively to guide coordination, execution, and validation



DIGITAL ASSET DELIVERY AND MANAGEMENT

- Building owners still learning how to link BIM to FM
- Lack of capability and infrastructure to support FM operations digitally.

SOURCE : FR BCA SG

VDC ROADMAP

IDD PLAN

Building **capability**

Public sector taking the lead

Private sector efforts

Incentivizing **adoption**



Strengthening IDD Capabilities & Enterprise Development

Widening **adoption** through public and private sector clients

Nurturing **R&I** and **piloting new IDD solutions**

Developing **collaborative procurement approaches**

Identifying & encouraging adoption of **vertical applications**

Developing & promoting **collaborative platforms** and **common standards**

OBJECTIVE

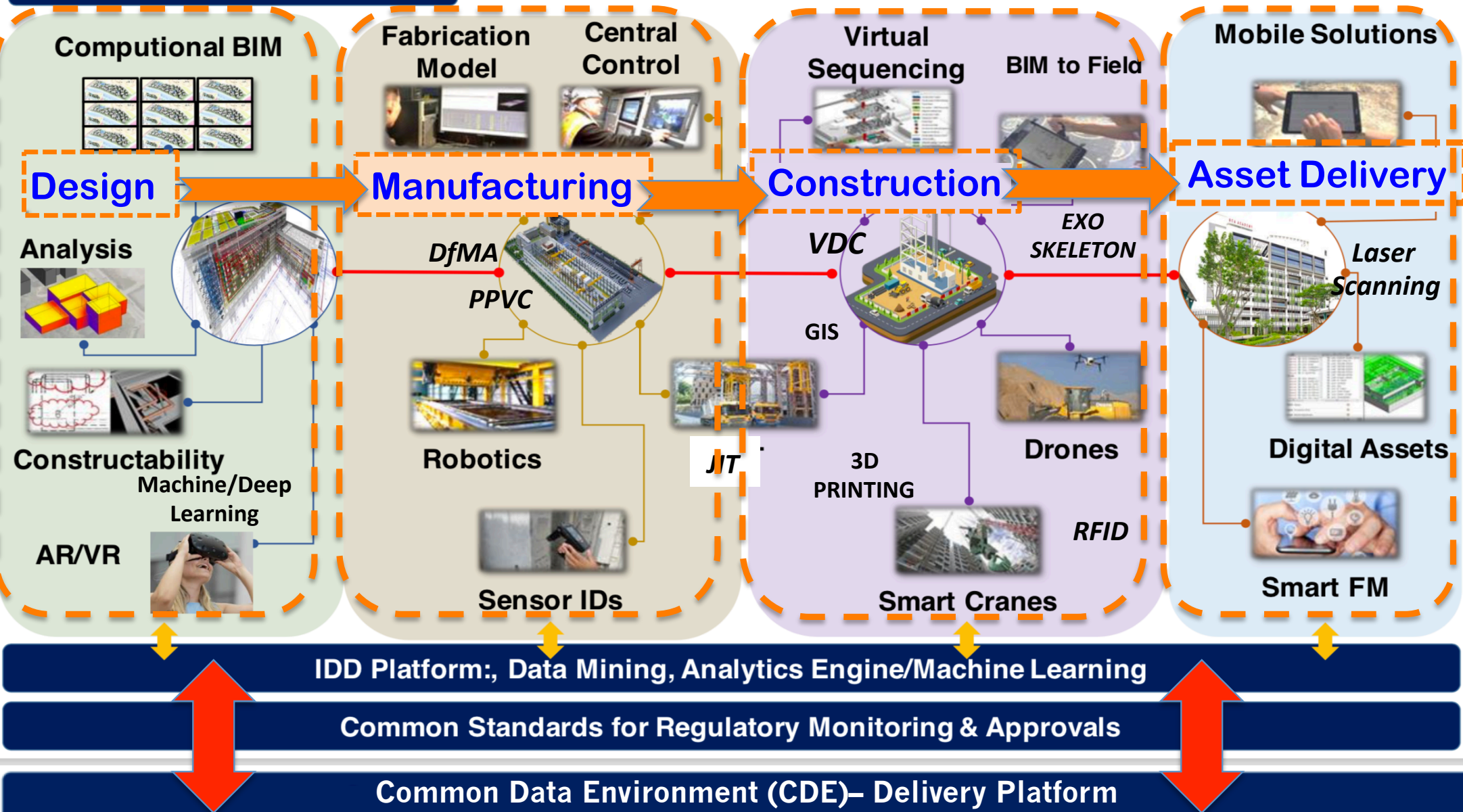
To implement IDD Plan in support of Construction ITM

TARGETS

- **40-60** demonstration **projects** involving **150-180 firms** that cover at least **40% of GFA** by 2020
- To contribute to the built environment overall productivity target of **25-35%** by 2025

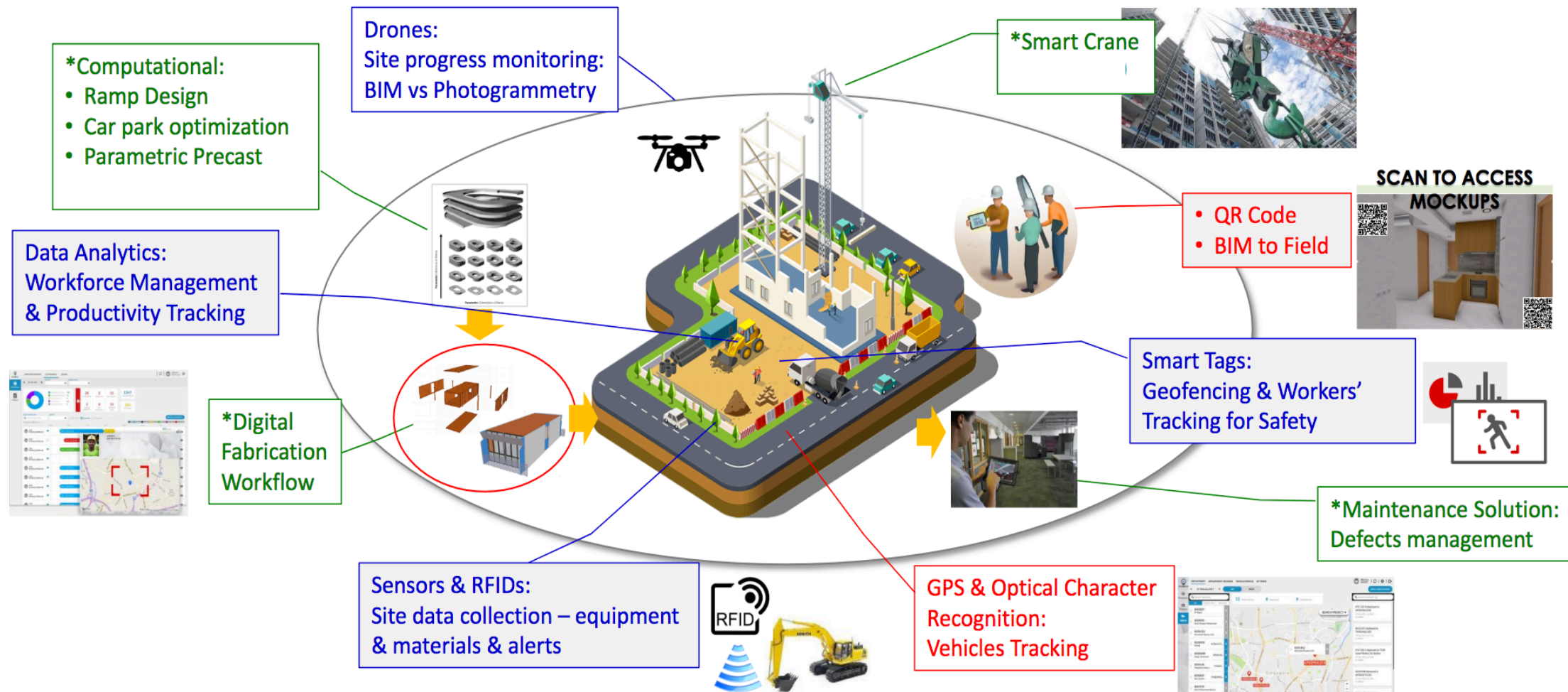
SOURCE : FR BCA SG

An IDD Scenario



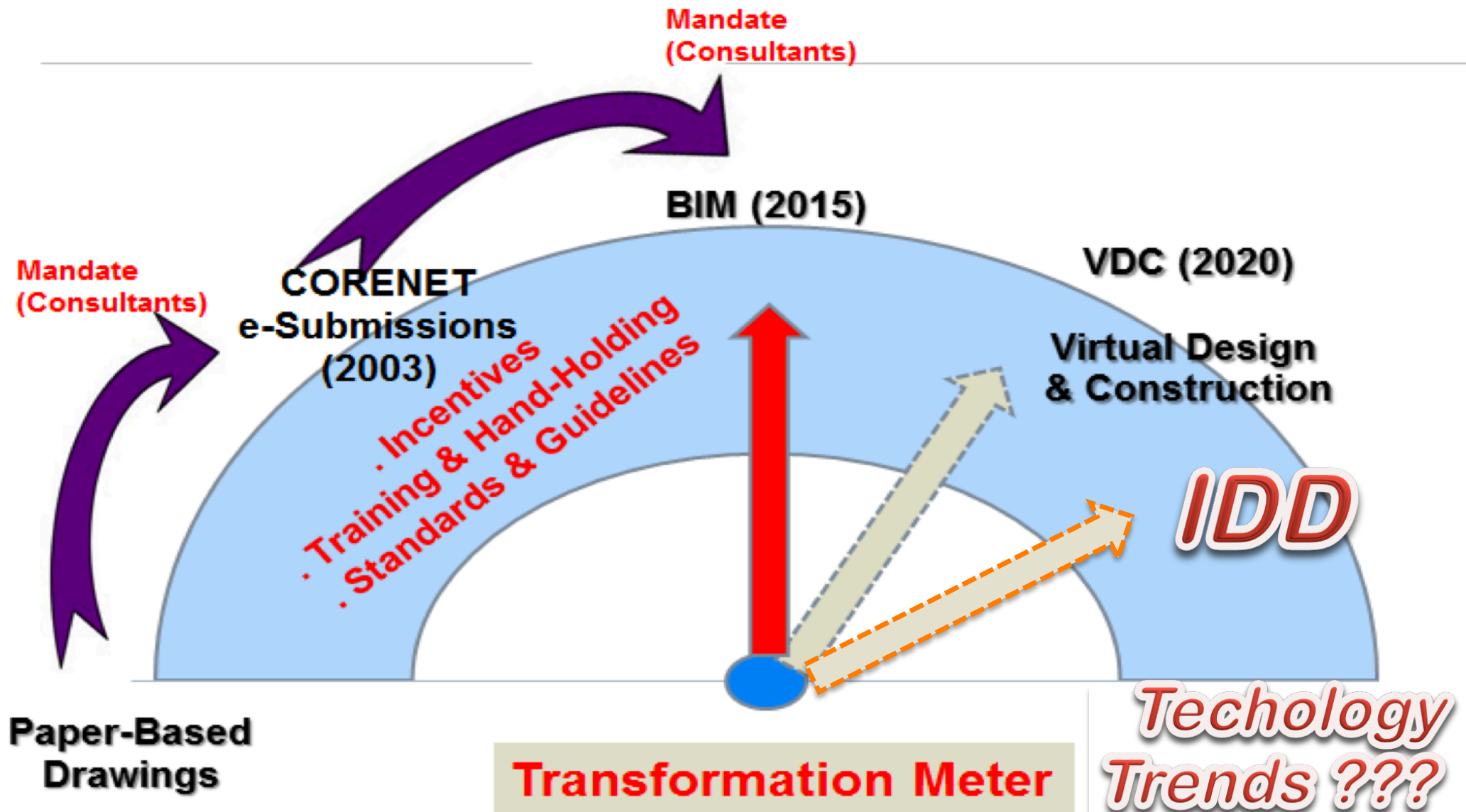
Integrated Digital Delivery

IDD – ON SITE APPLICATION



SOURCE : FR BCA SG

DIGITAL TRANSFORMATION ROADMAP



FUTURE TECHNOLOGY TRENDS & IMPACT

- ***IOT*** – (5G, Li-Fi, CD, Wear-ables , ARVR. ML,)
- ***GEO LOCATION*** (cross border collaboration,)
- ***SMART PLATFORMS*** .. (CDE, Block-Chain, Smart FM,..)

An aerial photograph of a city skyline, likely Singapore, featuring the Marina Bay Sands hotel and other skyscrapers. A network of glowing white lines connects various points across the sky, symbolizing smart infrastructure and connectivity. The text is overlaid on the upper left portion of the image.

***Smarter Design
Smarter Construction
Smarter Operation - - - -***

SMARTER CITIES

THANK YOU

william@wlarch.com.sg