

BIM for Infrastructure GeoSmart Asia 2015

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- ❑ What is Infrastructure?
- ❑ Ongoing Singapore Infrastructure Projects
- ❑ BIM for Public Infrastructure
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- ❑ BIM Authoring Tools
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What is Infrastructure?

Infrastructure is defined as: **basic physical and organizational structure needed for the operation of a society or country.**

Hard Infrastructure:

- Roads & Bridges
- MRT Tunnels
- Airport and Seaport
- Water Supply
- Sewers
- Irrigation
- Flood Control
- Electrical Grids
- Telecommunications
- Civil Defense/Military
- Underground Caverns

Soft Infrastructure:

- Hospitals
- Schools
- Community Centres
- Library
- Parks
- Museums
- Fire & Rescue
- Police
- Government Offices
- Postal
- Stadiums/Sports Hall

Infrastructure represents 60% of Singapore construction industry!



Construction contracts for the built environment sector is expected to reach between **\$29 billion to \$36 billion in 2015** given a sustained pipeline of public sector projects.

2014 total construction demand of \$37.7 billion, representing public and private construction contracts.

Public infrastructure for 2015 include:

- Sengkang General Hospitals,
- Tampines Town Hub
- Thomson-East Coast MRT Line
- Changi Airport Terminal 4
- DTSS Phase 2
- Singapore Power Cables

Contracts Awarded (Excl. Reclamation) by Sector & Type of Work

Billion Dollars (SGD)

	2010	2011	2012	2013	2014 (Preliminary)	2015 (Fore cast)
Both Sectors	27.56	35.49	30.76	35.80	37.73	29.0 - 36.0
Building Work	24.54	28.75	25.95	28.86	27.52	19.4 - 23.4
<i>Residential</i>	11.49	15.30	11.85	15.96	10.90	6.6 - 7.9
<i>Commercial</i>	3.24	4.21	2.99	3.73	3.80	2.0 - 2.5
<i>Industrial</i>	4.79	6.22	6.42	5.49	5.63	5.1 - 6.3
<i>Institutional & Others</i>	5.03	3.02	4.70	3.68	7.18	5.7 - 6.8
Civil Engineering Work	3.02	6.74	4.81	6.94	10.22	9.7 - 12.7
Public Sector	8.55	15.28	9.52	14.89	19.74	18.0 - 21.0
Building Work	6.36	9.15	7.40	9.37	10.94	10.5 - 12.7
<i>Residential</i>	2.81	6.23	3.33	6.38	4.99	3.4 - 3.8
<i>Commercial</i>	0.18	0.05	0.10	0.06	0.13	0.1 - 0.1
<i>Industrial</i>	1.07	0.48	0.31	0.31	0.63	2.1 - 2.8
<i>Institutional & Others</i>	2.30	2.38	3.66	2.62	5.20	4.9 - 5.9
Civil Engineering Work	2.19	6.13	2.12	5.51	8.80	7.5 - 8.3
Private Sector	19.02	20.21	21.24	20.92	17.99	11.0 - 15.0
Building Work	18.18	19.60	18.55	19.49	16.57	8.9 - 10.7
<i>Residential</i>	8.68	9.07	8.51	9.58	5.91	3.2 - 4.0
<i>Commercial</i>	3.06	4.16	2.89	3.66	3.67	1.9 - 2.3
<i>Industrial</i>	3.72	5.74	6.11	5.18	5.01	3.1 - 3.5
<i>Institutional & Others</i>	2.73	0.64	1.04	1.06	1.99	0.8 - 0.9
Civil Engineering Work	0.83	0.61	2.69	1.43	1.42	2.2 - 4.4

Source : Building and Construction Authority, Singapore, as at 8 January 2015



----- Ongoing

Changi Airport Group (CAG) Terminal 4

**Awarded to BECA and S\$985m (£475m) contract to Takenaka Corporation*

Public Utility Board (PUB) Deep Tunnel Sewerage System Phase 2

**Awarded to Black and Veatch and AECOM*

Singapore Power (SP) Underground Transmission Cable Tunnels

**Awarded to Mottmac, GeoConsult*

Port of Singapore Authority (PSA) Pasir Panjang Phase 3 & 4 and Tuas Megaport

**Awarded to Daelim Industrial for S\$875m*

Land Transport Authority (LTA) Thomson East Coast Line (TEL) Circle Line 6 and North South Expressway (NSE)

**Awarded to Arup, Mottmac, Parsons Brinckerhoff, AECOM*



Infrastructure is important:

- a) 2X lifespan compared to building projects
- b) Capital outlay (investment) is 3x-4x
- c) Considered as essential facilities, must not fail; suspended or halted
- d) Operation and Maintenance (O&M) is about 70% of lifespan cost.





THE STATUTES OF THE REPUBLIC OF SINGAPORE

BUILDING CONTROL ACT

(CHAPTER 29)

(Original Enactment: Act 9 of 1989)

REVISED EDITION 1999

(30th December 1999)

Prepared and Published by

THE LAW REVISION COMMISSION
UNDER THE AUTHORITY OF
THE REVISED EDITION OF THE LAWS ACT (CHAPTER 275)

Informal Consolidation – version in force from 28/10/2013

“plans”, in relation to any building works —

(a) includes drawings, details, diagrams, digital representations generated from **building information modelling**, structural details and calculations showing or relating to the building works; and

[Act 22 of 2012 wef 01/12/2012]

(b) if prepared in electronic form, includes the medium in which the plans of building works have been stored;

[18/2003 wef 01/01/2004]



Building and Construction Authority
We shape a safe, high quality, sustainable and friendly built environment.

Our Ref: APPBCA-2015-07
 10 Apr 2015

See Distribution

Dear Sir/Madam

DEADLINES FOR PROJECTS REQUIRING MANDATORY BIM (BUILDING INFORMATION MODELLING) E-SUBMISSION FOR REGULATORY APPROVAL

Objective

This circular is to inform the industry of upcoming deadlines for projects requiring mandatory BIM e-submission for regulatory approvals by the relevant authorities.

Background

2 The use of BIM has been identified as a key driver under the construction productivity roadmap to improve the level of integration and collaboration across the various disciplines in the construction value chain. To kick-start BIM adoption early, CORENET started to accept architectural and engineering BIM e-submissions since January 2010 and April 2011 respectively.

3 Subsequently, we announced on 3 Jul 2012 the phased introduction of mandatory BIM e-Submission for certain types of projects.


Deadlines for projects requiring mandatory BIM e-submission for regulatory approval

4 Mandatory BIM e-submission has been introduced in phases since 2013, where architectural or engineering plans are required to be submitted in the BIM format for regulatory approval based on the following BIM e-submission guidelines.

	Gross Floor Area of New Developments		
	More than 20,000 m ²	More than 5,000 m ²	Less than or equal to 5,000m ²
Architecture	Require BIM e-submission if the first application for Planning Permission is made on or after 1 Jul 2013.	Require BIM e-submission if the first application for Planning Permission is made on or after 1 Jul 2015.	BIM e-submission is optional.
M&E Engineering	Require BIM e-submission if the first application for Planning Permission is made on or after 1 Jul 2014.		
C&S Engineering			

5 New developments include:

- New building and infrastructure projects; and
- A&A projects involving reconstruction or addition of any new building or infrastructure.

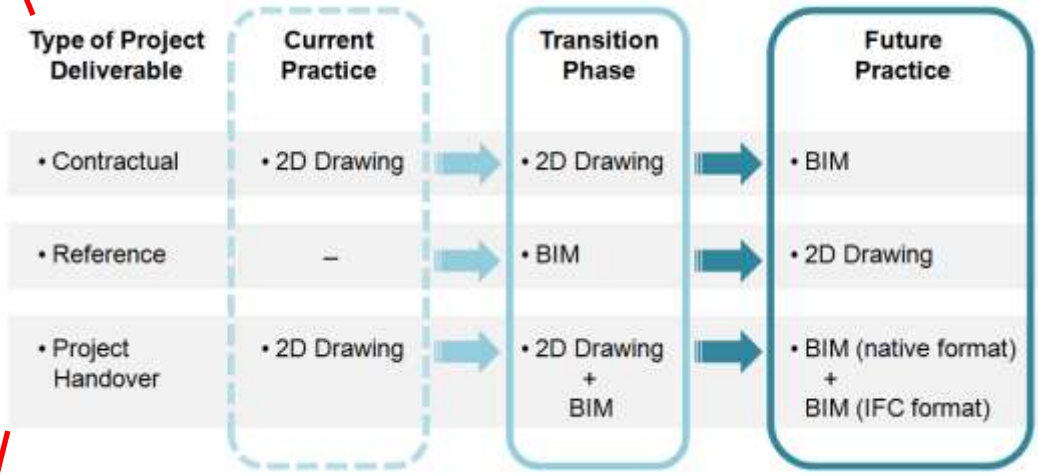
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 Tel: 1800 242222 Fax: (65) 6334 4237 Email: bca_enquiry@bca.gov.sg
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An MCD Statutory Board

2. Are engineering plans of civil engineering works (e.g. rail projects, road works, cable tunnels) subjected to mandatory BIM e-submission requirements?

For civil engineering works, mandatory BIM e-submission requirements for engineering plans will apply if the structures are required to be submitted to BCA for approval and fall under the requirements in Paragraph 4.







(III) CIVIL BIM ELEMENTS

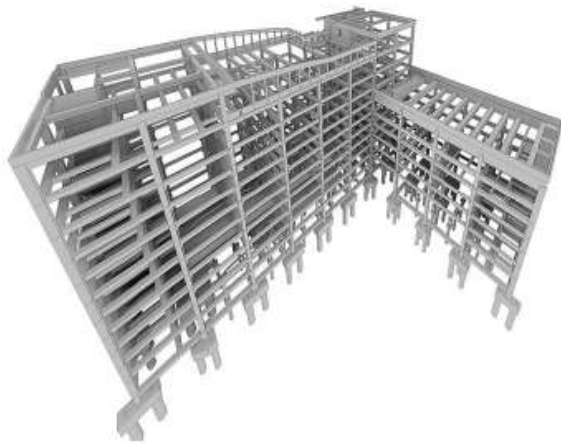
	Element
Digital Terrain Model (DTM) ※	3D surface based on topography that shows site conditions and building locations Include existing walkways, roads, curbs, ramps and parking lots etc
Geology Report △	Soil investigation report (A BIM Model is not required)
Utilities Model	All points of connection for existing and new utilities within site boundary
Rainwater & storm water pipe work	Includes outlets, surface channels, slot channels and manholes
Underground Public Utilities	For drainage only
Others	Drains, canals, crossings, retaining walls, and underground harvesting tanks
	Underground electrical supply cables and sewer lines, IDA (telecom) line and Gas Lines.

※ Data of Digital Elevation Model to be provided by registered surveyor

△ Data of Geology Report to be provided by geotechnical engineers



BIM Essential Guide For C & S Consultants



BIM e – Submission Guideline Structural

While BCA tries to highlight the major points of submission requirements, BCA cannot take into account all the special cases in other regulatory agencies as well as the changing technology. Updated versions will continue to be issued to address and incorporate on-going feedback in an open, collaborative process. All readers of this guide are encouraged to submit feedback to BCA.COPI@NET.

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safe

high quality

sustainable

friendly

BIM for Structural

SUB (Foundation + Civil)		ST (Superstructure)		CD (Civil Defence)	
Element Geometry	Attributes	Element Geometry	Attribute	Element Geometry	Attribute
Pile	Type/Mark	Column	Type/Mark	Household Shelters	Type/Mark
Pile Caps	Material	Beams	Material	Storey Shelters	Material
Isolated Footing	Mass & Density	Walls	Mass & Density	Public/Transit Shelters(MRT)	Mass & Density
Grade Beams	Thermal Coefficient	Floor/Slab	Thermal Coefficient	Shielding Walls	Thermal Coefficient
Retaining Walls		Staircase (Non-Typical)		RC Canopies	Rebars Schedule/%byVol
ERSS (Permanent)	Rebar Schedule/%byVol	Shafts and Pits	Rebars Schedule/%byVol		Bolt/Weld Connections
Grade Slab	Bolt/Weld Connections	Precast Elements	Bolt/Weld Connections		
Tunnels		Post Tension Elements			
Digital Terrain Model /Topography	Member Forces	Transfer Structures	Member Forces		Member Forces
Drainage Elements	Soil Bearing Capacity	Trusses	Construction Method		Construction Method
Sewer Elements	Boundary Conditions	Braces			
Water Supply Elements		Composite Elements			
Telecom Elements	Element Classification	PPVC	Element Classification		Element Classification
Gas Line Elements	Asset Tag Number	CLT	Asset Tag Number		Asset Tag Number
Power Line Elements		Holisting Elements			
Site Plan (Road, Ramps, & Lots)		Equipment Plinth/Pads			
		Specialty Works (Outline)			
Critical Penetrations/Openings		Critical Penetrations/Openings		Critical Penetrations/Openings	

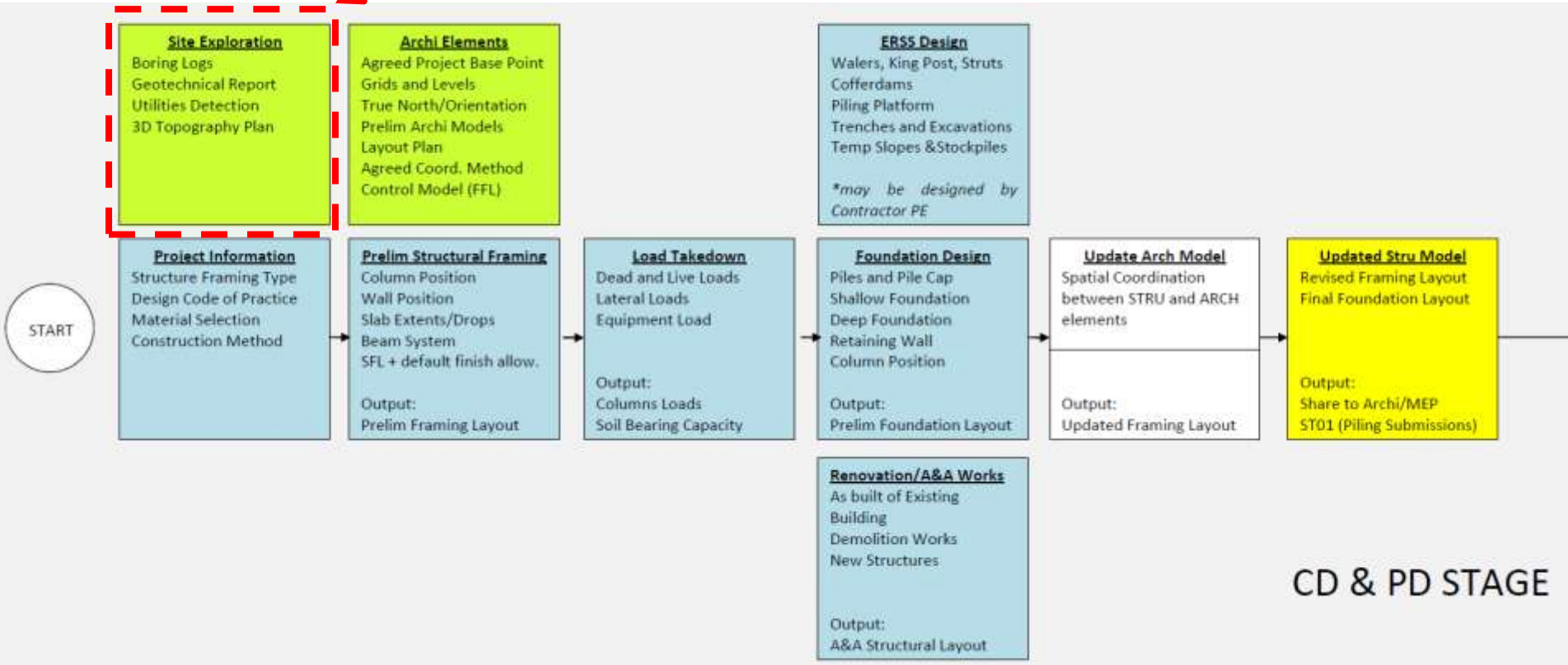
BIM for FM

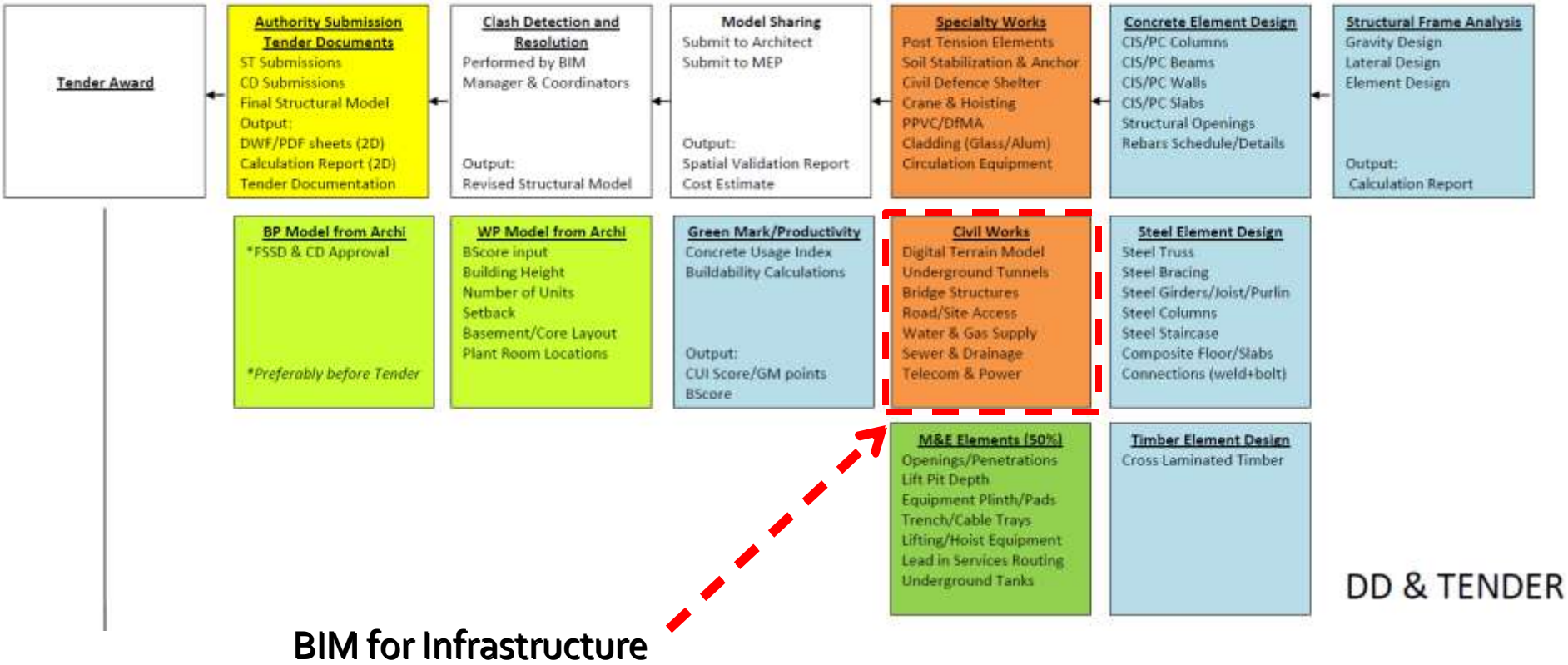
BIM for Infrastructure (Civil)

**within site boundary+ public infrastructure*



BIM for Infrastructure





BIM Authoring Tools





AUTODESK
NAVISWORKS



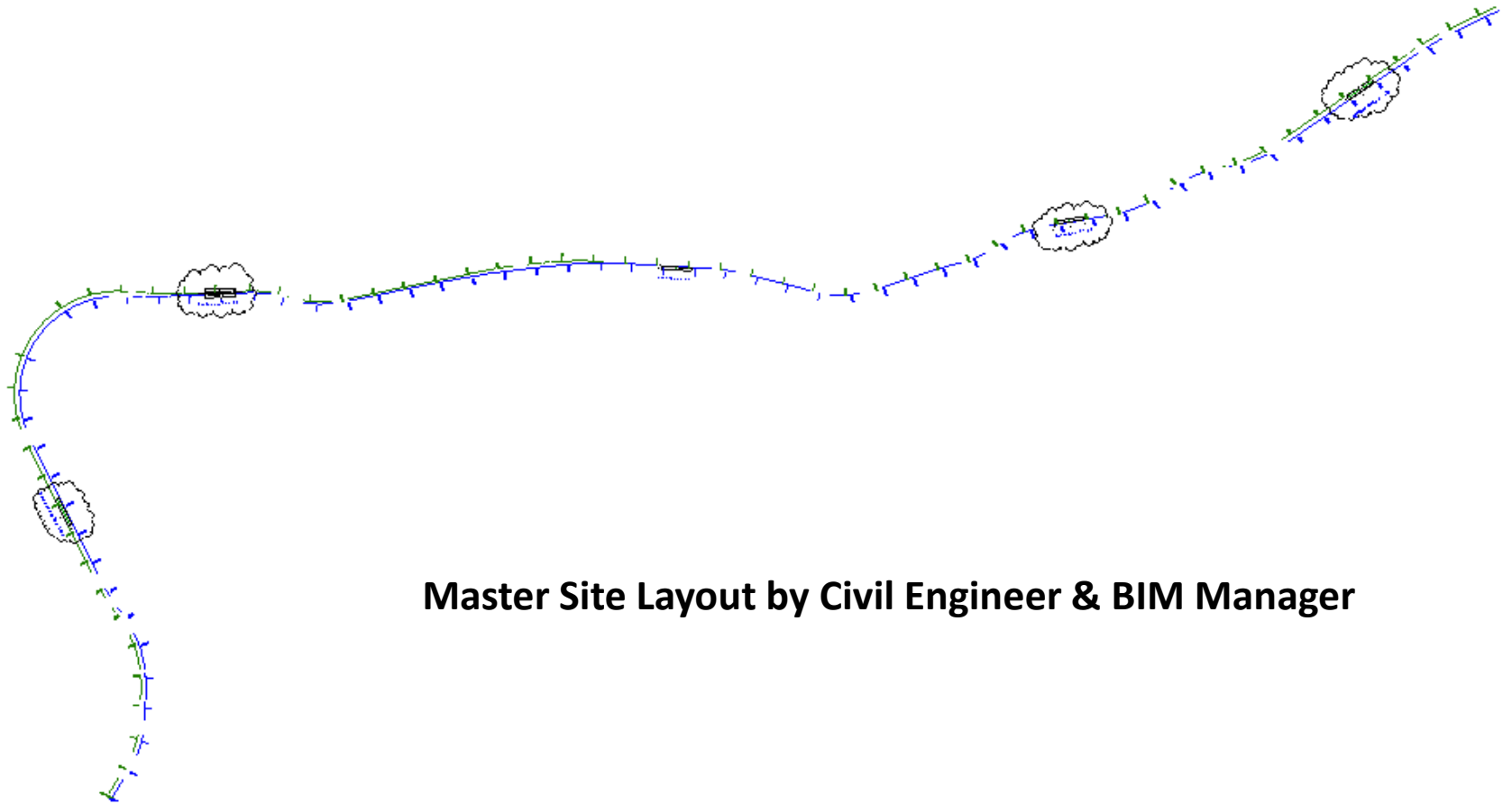


All Revit Models are converted to i-Models:

1. Creating Content (Parametric Content Modeler)
2. Content Repository and Management (Content Management Service)
3. **Utilizing Existing Manufacturers' Content** (RFA Interpreter)

An RFA is Revit's file format for storing their parametric families (parametric components) and are similar to AECOsim's PAZ files for parametric components.

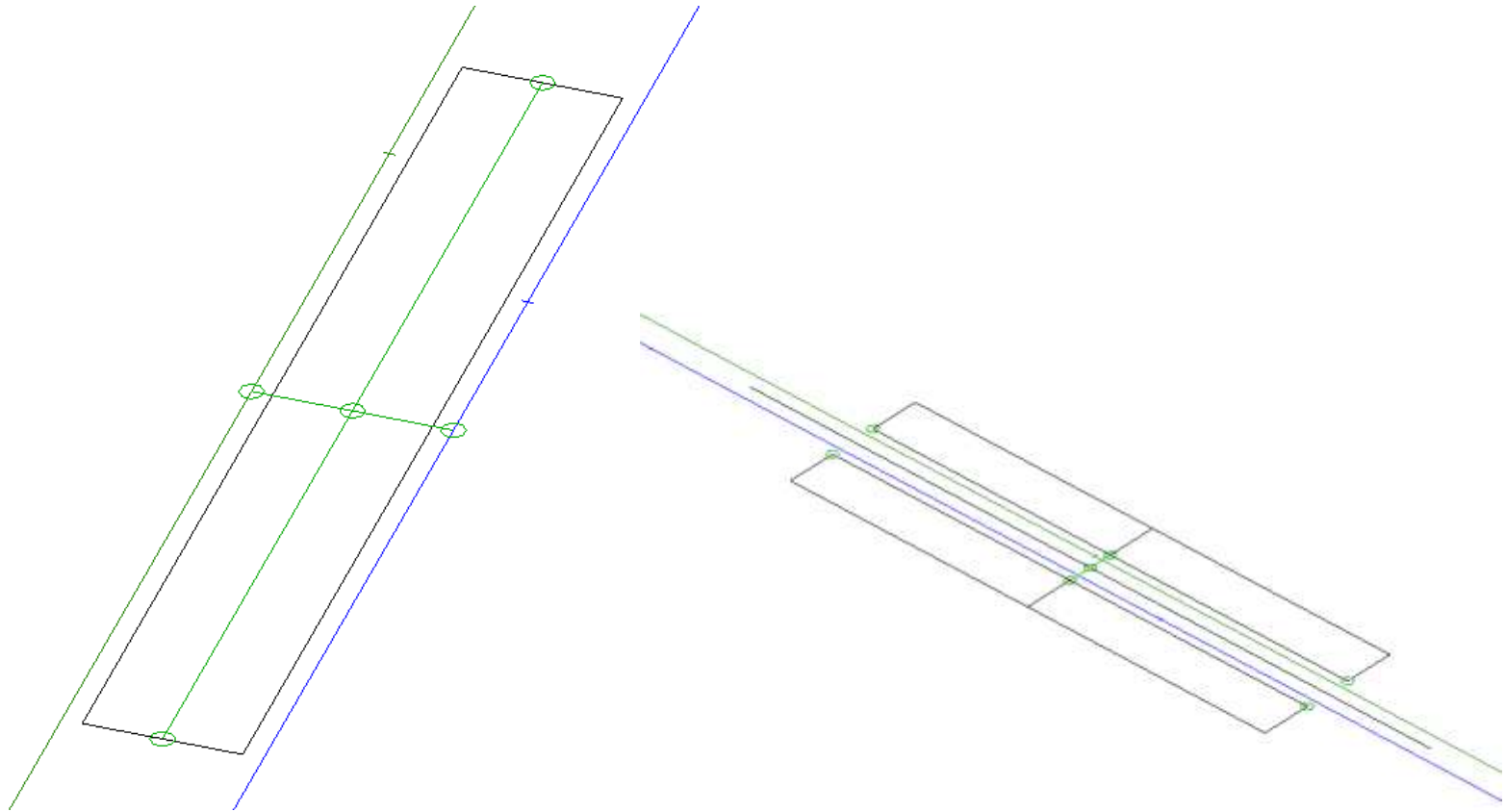




Master Site Layout by Civil Engineer & BIM Manager

**Courtesy of DP Architects*



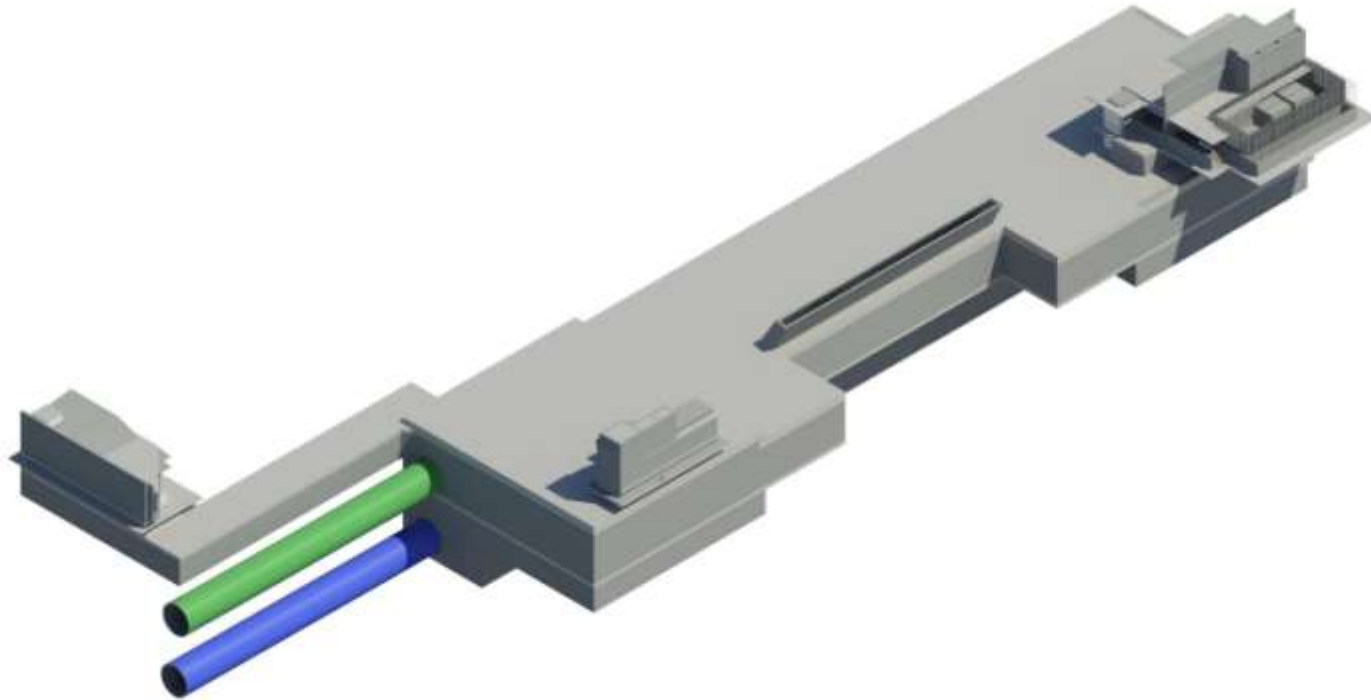


**Courtesy of DP Architects*

Control & Survey Points-Centre Line of Rail -Station Platform



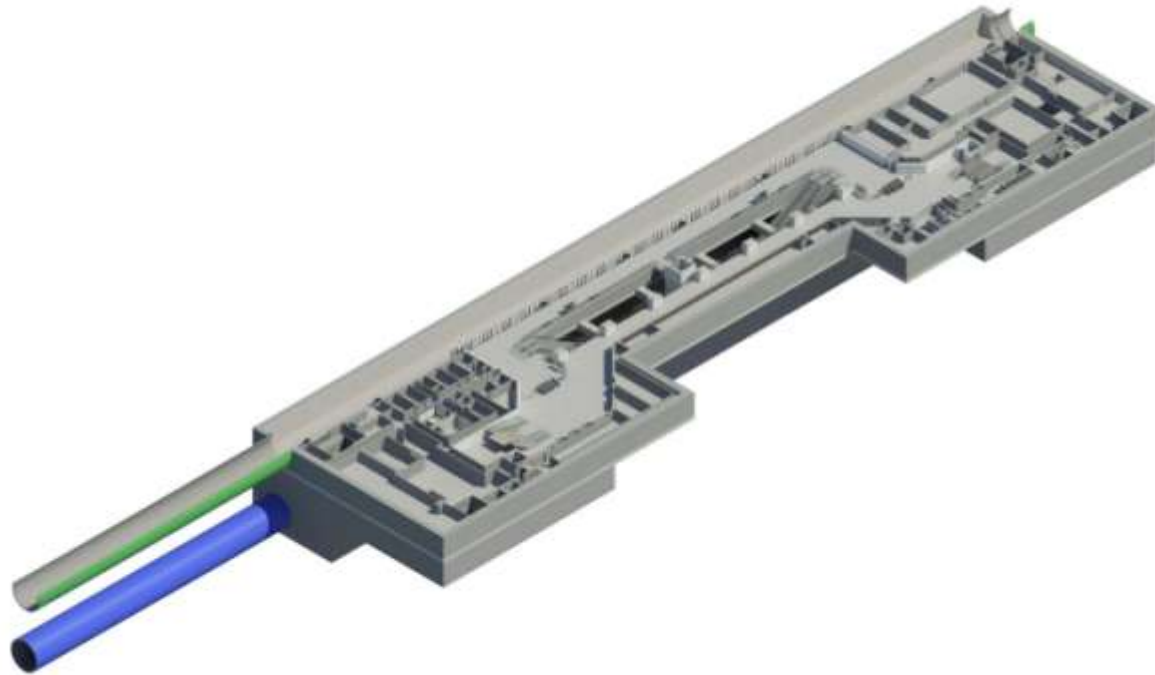
Station E3 - Entrance Roof Level



**Courtesy of DP Architects*



Station E3 - Concourse / Upper Platform Level

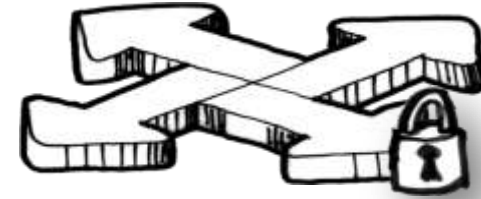


**Courtesy of DP Architects*

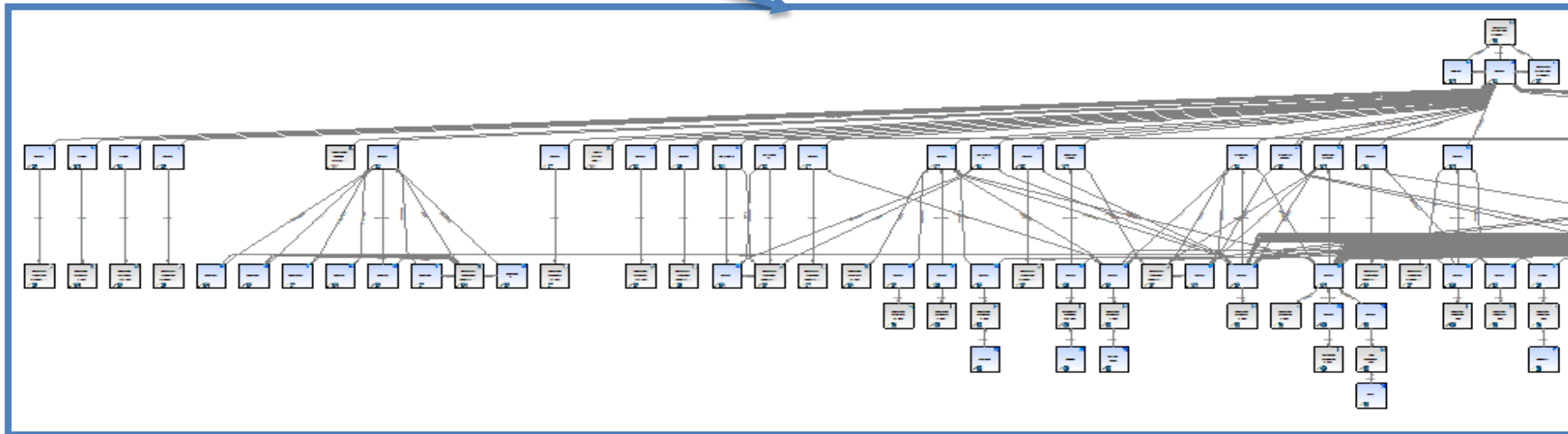


Case Study: Rail

Master BIM Model Federation

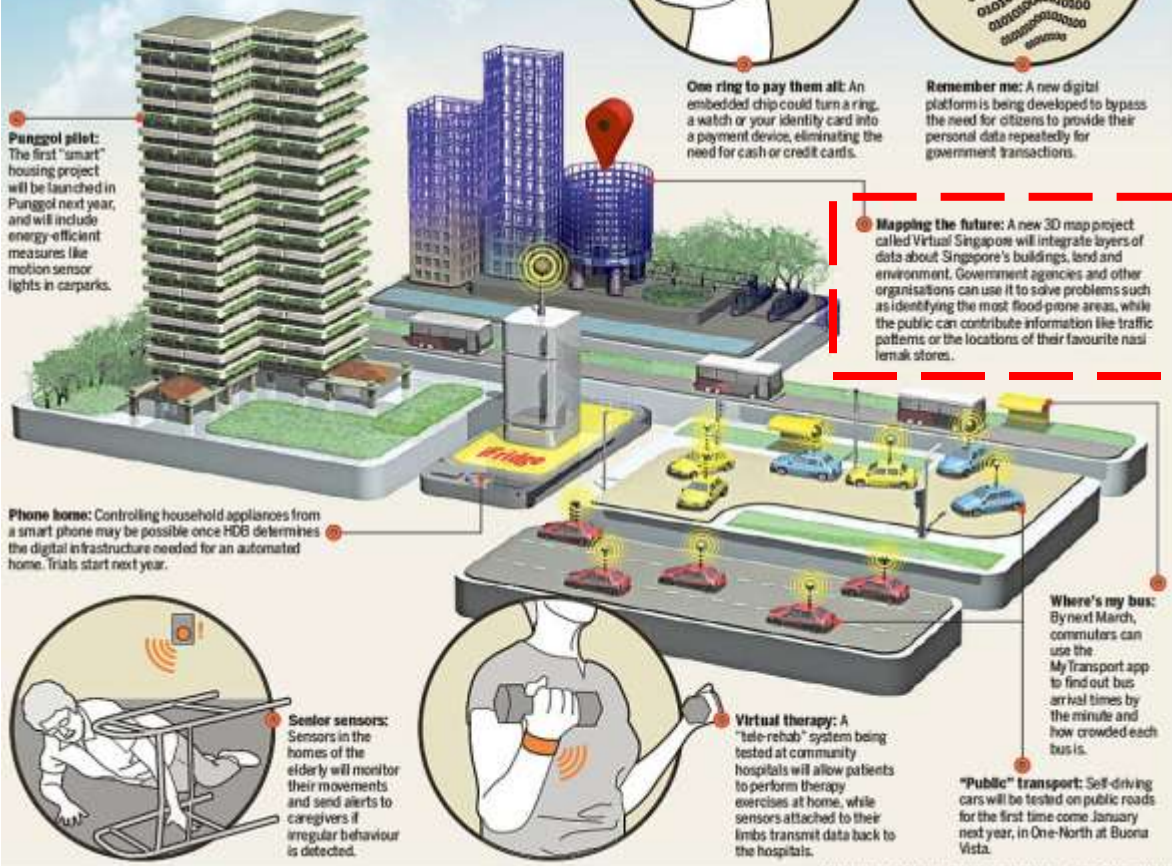


Connect/Collaborate



Smart Singapore

Singapore is expanding its use of technology to entrench its position as a leading global city and improve Singaporeans' quality of life. Here are some upcoming initiatives:



GRAPHICS: WEE EWE BOON AND CHENG CHUAN HONG. TEXT: BACHEL ALIYOND



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Singapore to build Asia's first 3D Semantic Map of a country

Government announces US\$200 million to develop region's advanced visualization of the entire country, to improve urban planning and develop smart city solutions.

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OPINION

Mind the gap
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If at first you don't succeed.
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The downside of Open Data
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It isn't as clear-cut as it sounds.
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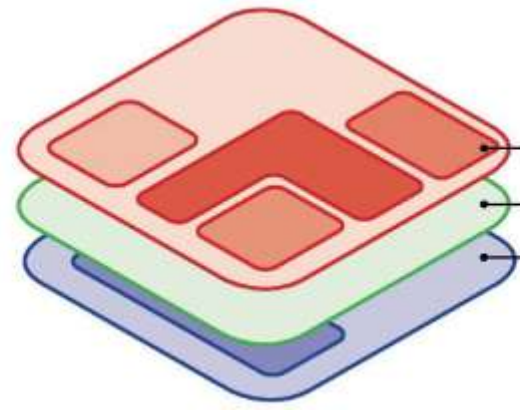
Virtual Singapore



Underground Master Plan 2020

Subterranean Land Usage Informed by:

- Master Plan 2014
- Geological Conditions
- Policy



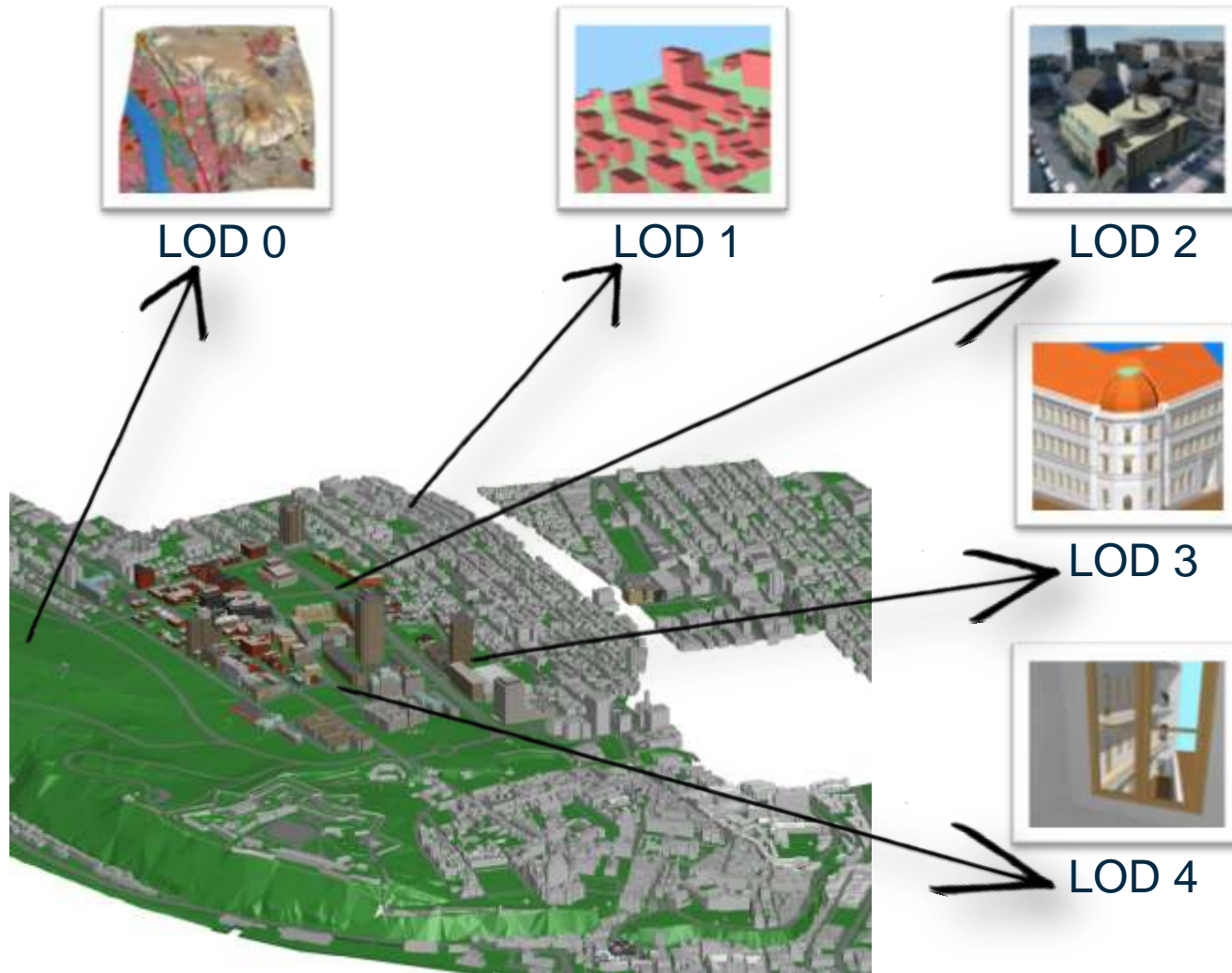
Master Plan 2014

Underground Master Plan 2020

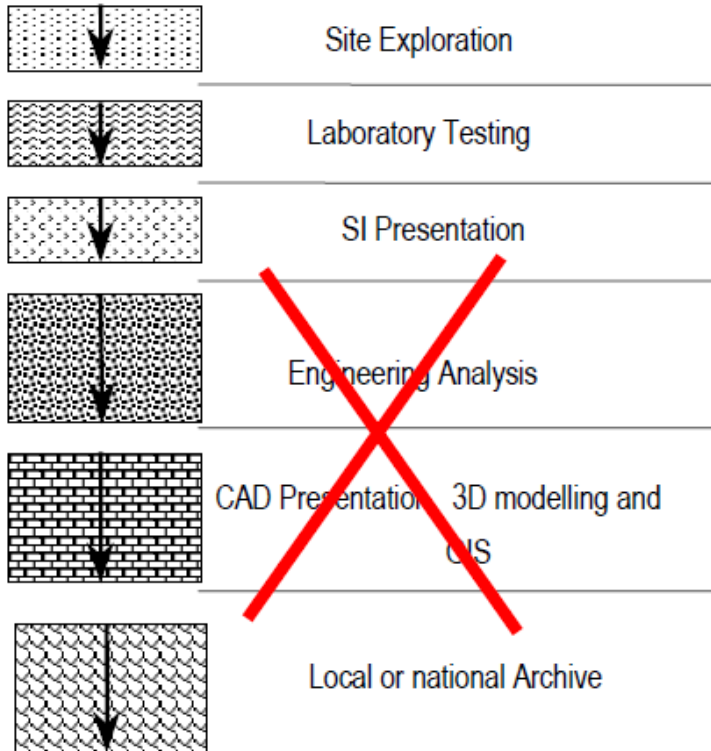
Geology



Virtual Singapore

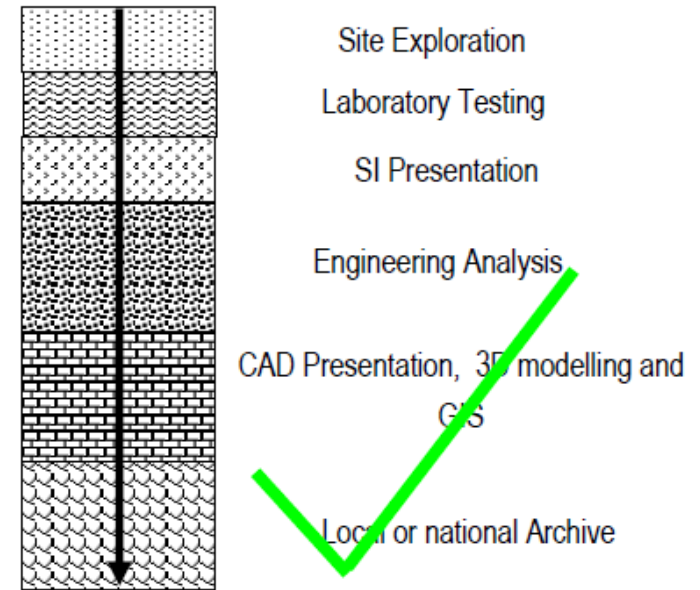


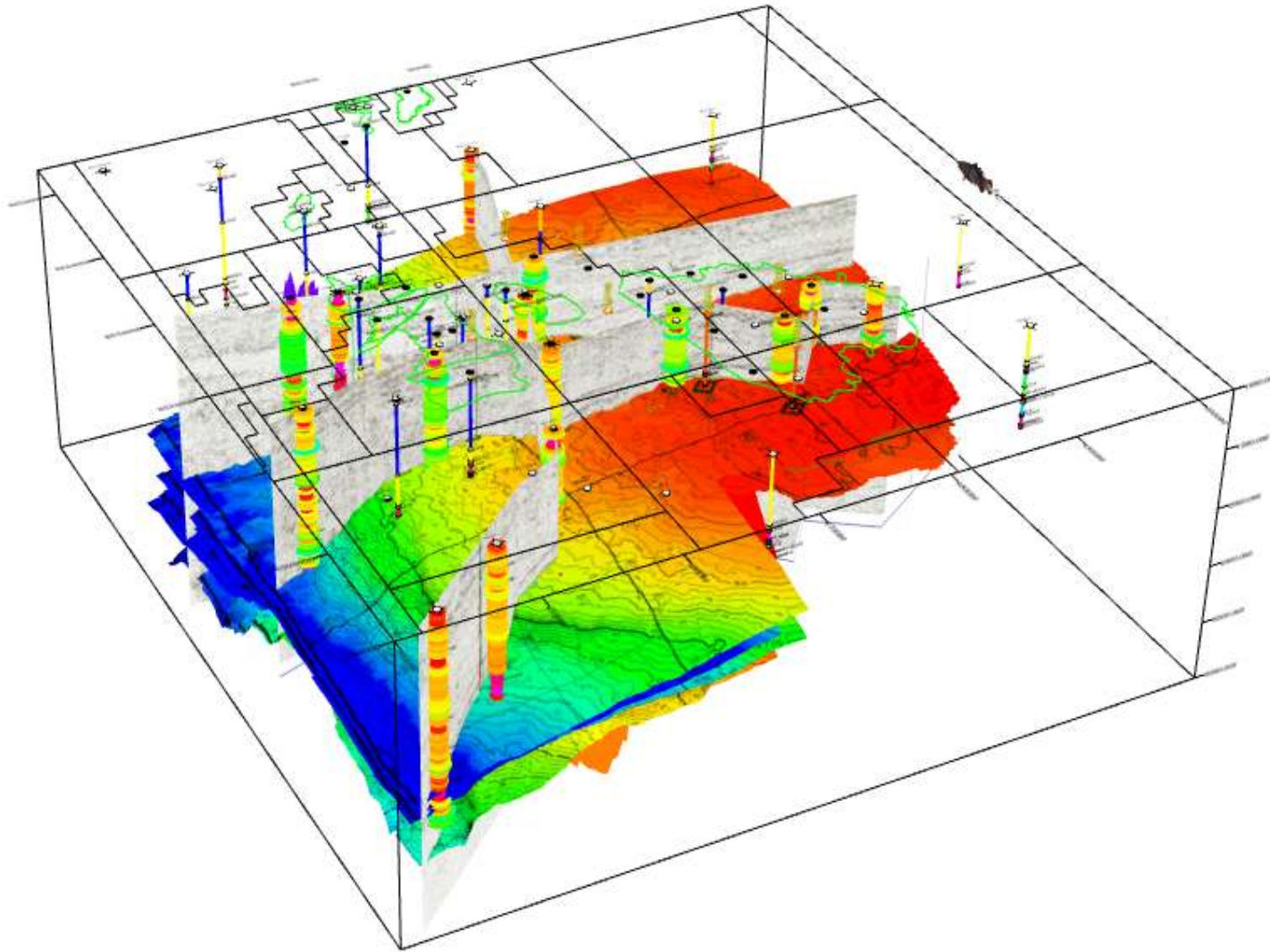
A fragmented paper based system



Streamlined electronic transfer

OR





1. Mandatory regulatory submissions in BIM will cover both hard and soft infrastructure exceeding 5,000m² GFA by **July 2015**
2. Upcoming guidelines will define BIM requirements for facility & asset management
3. All BIM models and alignment must be geo-referenced for “federated” systems integration.
3. To encourage the use of BIM models instead of drawings/sheets in projects





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