

9 Lessons of Successful 4D Delivery: Dragging Project Controls into the 21st Century

Dr. David-John Gibbs – Senior Manager, Digital
April Angela Santos – 4D Planning Engineer



Balfour Beatty



- Main contractor based in Hong Kong
- 7,000+ people
- Owned by Balfour Beatty and Jardine Matheson (50:50)
- Smart and digital contractor of choice



Theatres
~US\$700m



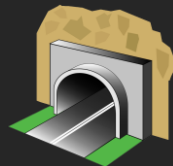
Data centres
~US\$undisclosed



Airport Terminals
~US\$2bn



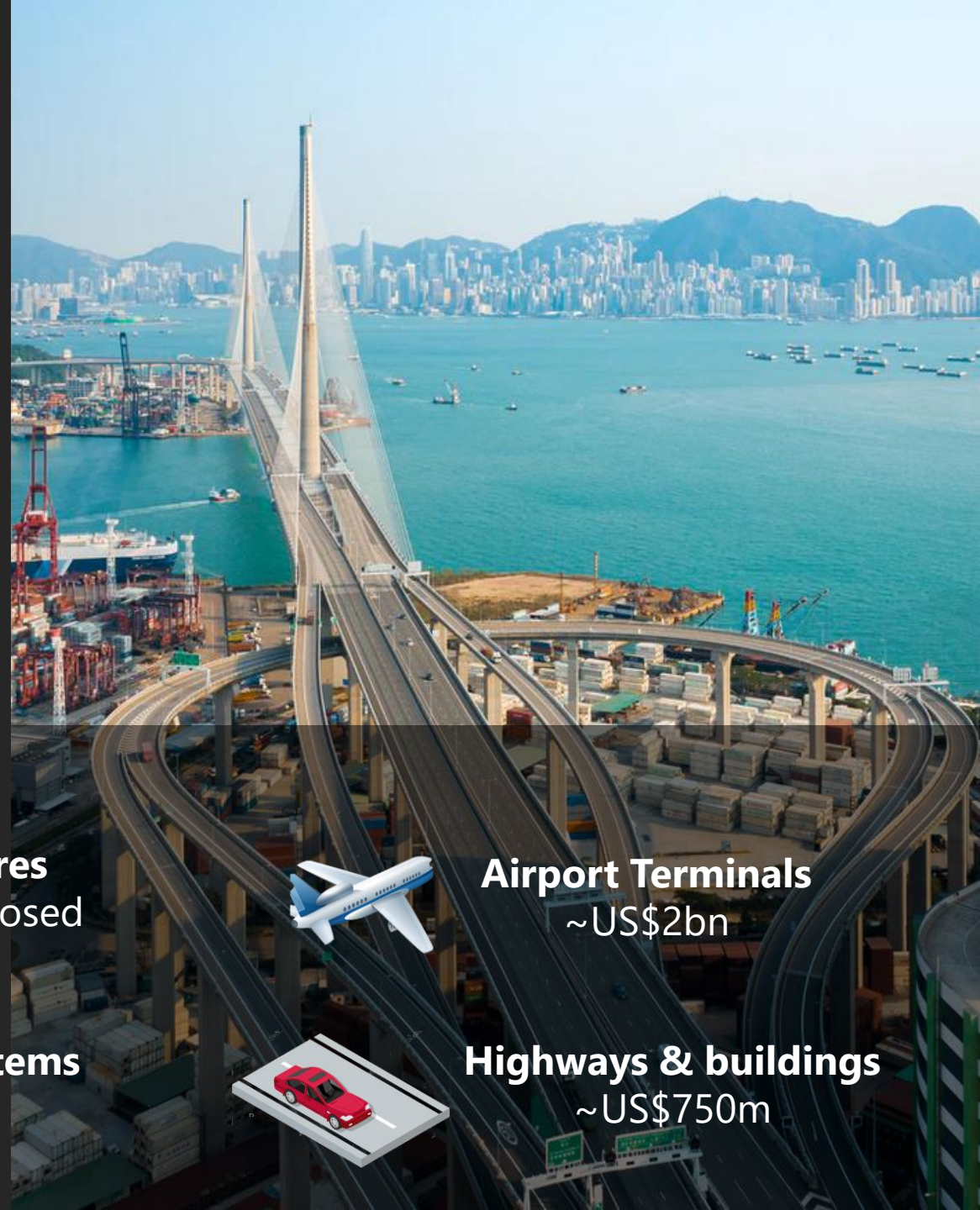
Manufacturing Centres
US\$700m



Tunnels & systems
~US\$1bn



Highways & buildings
~US\$750m





4d.construction/maturity matrix

	1 Adhoc	2 Defined	3 Managed	4 Integrated	5 Optimized
Scope				4 Integrated (Organisation wide)	5 Optimized
Detail			3 Managed (Project Implementation)	4 Integrated (Organisation wide)	5 Optimized
Technology		2 Defined	3 Managed (Project Implementation)	4 Integrated (Organisation wide)	5 Optimized
Impact		2 Defined	3 Managed (Project Implementation)	4 Integrated (Organisation wide)	5 Optimized
Process	1 Adhoc	2 Defined	3 Managed (Project Implementation)	4 Integrated (Organisation wide)	5 Optimized
Timing	1 Adhoc	2 Defined	3 Managed (Project Implementation)	4 Integrated (Organisation wide)	5 Optimized
Efficiency	1 Adhoc	2 Defined	3 Managed (Project Implementation)	4 Integrated (Organisation wide)	5 Optimized
Decision	1 Adhoc	2 Defined	3 Managed (Project Implementation)	4 Integrated (Organisation wide)	5 Optimized
Reporting	1 Adhoc	2 Defined	3 Managed (Project Implementation)	4 Integrated (Organisation wide)	5 Optimized
Project planning	1 Adhoc	2 Defined	3 Managed (Project Implementation)	4 Integrated (Organisation wide)	5 Optimized
Acceleration options & trends	1 Adhoc	2 Defined	3 Managed (Project Implementation)	4 Integrated (Organisation wide)	5 Optimized
Executive evaluating acceleration options & trends	1 Adhoc	2 Defined	3 Managed (Project Implementation)	4 Integrated (Organisation wide)	5 Optimized
Site team using it to explore sequence options	1 Adhoc	2 Defined	3 Managed (Project Implementation)	4 Integrated (Organisation wide)	5 Optimized
Supports the planning of the works by project team and management. Used for reporting.	1 Adhoc	2 Defined	3 Managed (Project Implementation)	4 Integrated (Organisation wide)	5 Optimized
Does not fully support planning of the works. May be used for reporting past events.	1 Adhoc	2 Defined	3 Managed (Project Implementation)	4 Integrated (Organisation wide)	5 Optimized
High-level monthly video for reporting the past	1 Adhoc	2 Defined	3 Managed (Project Implementation)	4 Integrated (Organisation wide)	5 Optimized
Not suitable for project planning or reporting.	1 Adhoc	2 Defined	3 Managed (Project Implementation)	4 Integrated (Organisation wide)	5 Optimized



1. PROCESS

What workflows and processes are adopted during the development of the 4D model?

香港特別行政區政府
The Government of the Hong Kong Special Administrative Region

政府總部
發展局
工務科

香港添馬添美道2號
政府總部西翼18樓

Ref : DEVB(W) 430/80/01
Group : 2, 5, 6

Development Bureau
Technical Circular (Works) No. 9/2019

Adoption of Building Information Modelling (BIM) technology for Capital Works Projects in Hong Kong

Scope

This Circular sets out the policy and requirements for the use of Building Information Modelling (BIM) technology.

2. This Circular applies to works either by government departments or by contractors.

Effective Date

3. This Circular takes effect on 1 January 2020.

Effect on Existing Circulars and Circular Memoranda

4. This Circular supersedes DEVB TC(W) 9/2019.

Annex 1

BIM Uses

1. Works Departments shall adopt the stipulated mandatory BIM uses in respective stages of a project. Works Departments may adopt the optional BIM uses when necessary.

BIM Use	Investigation, Feasibility and Planning	Design	Construction
1 Design Authoring	<u>M^b</u>	M	M
2 Design Reviews	<u>M^b</u>	M	M
3 Existing Conditions Modelling	<u>M^f</u>	M	M
4 Site Analysis	<u>M^f</u>	M	
5 3D Coordination		M	M
6 Cost Estimation	O	M ^a	M ^b
7 Engineering Analysis		O	O
8 Facility Energy Analysis		O	O
9 Sustainability Evaluation	O	<u>M^j</u>	<u>M^l</u>
10 Space Programming	O	M ^c	
11 Phase Planning (4D Modelling)		M ^d	M
12 Digital Fabrication		<u>M^k</u>	M ^e
13 Site Utilization Planning			M ^f
14 3D Control and Planning			O
15 As-Built Modelling			M
16 Project Systems Analysis			O
17 Maintenance Scheduling			M ^g
18 Space Management and Tracking			O
19 Asset Management			O
20 Drawing Generation (Drawing Production)		M	M

Legend:

M – Mandatory BIM Use for the mentioned stage, including that carried forward from previous stage. The underlined items are new mandatory BIM uses.

O – Optional BIM Use

DEVB TC(W) No. 9/2019 Page 7 of 12

4.5.2 The Contractor shall base on the 4D Model established in Clause 4.6 for the works and prepare a financial model for:

- interim payment simulation in video format with dynamic bar chart showing time and cost relationship for major construction activities;
- cashflow forecast to compare actual cashflow against planned cashflow; and
- estimate of variations including the schedule for the cost of omission and addition.

PHASE PLANNING (4D)
Mandatory for Design and Construction

A process of linking a programme to the model which is used to plan the phased occupancy or to show construction sequence and space requirements.

SITE UTILISATION PLANNING (4D)
Mandatory Construction

The model shall include permanent and/or temporary facilities on site for all the phases of the construction process. This BIM use is normally worked with Phase Planning to review space planning, site logistics, sequencing requirements, temporary works and safety.



Month 1

2. SCOPE

- Remo Tak Seawall to 3.5mPD

- In

Does the 4D model include a visual and time representation for all project scope?



例如運送支撐組件的躉船因斜面海堤及較淺水深

our barge transporting the struts cannot get close to the shore side of the cofferdam

3. DETAIL

Is the right level detail for design and time information included in the 4D model?

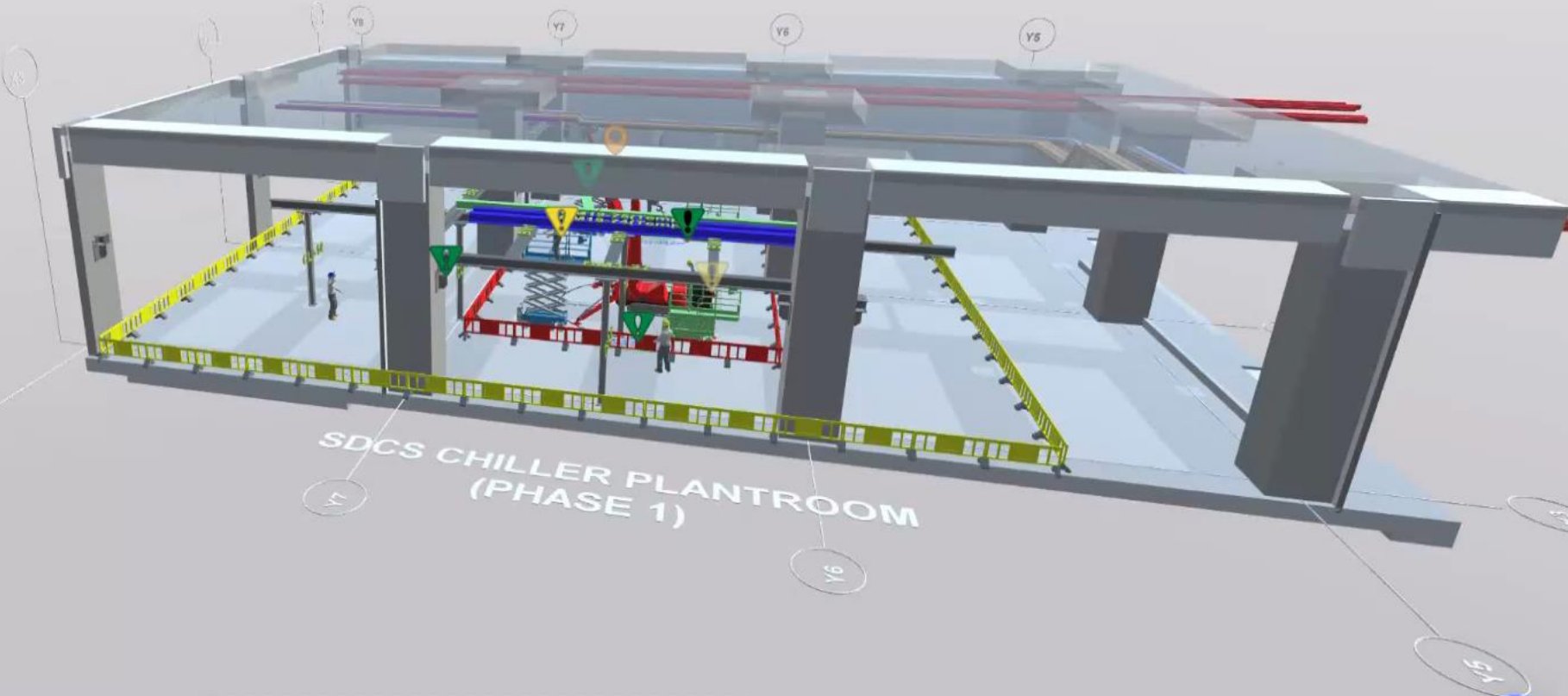
3D REPO

INSTALLATION SEQUENCE OF SUPPORTING FRAME - INSTALLATION OF HORIZONTAL BEAMS (12m) - SF005_3

SafetiBase

- 7 MEWP position
11 May 2022
djgibbs (No Description)
- 6 Connection details
11 May 2022
djgibbs (No Description)
- 5 Lifting temp steel
01 Sep 2021
BIMCAVE1 (No Description)
- 4 Fall from height
17 Aug 2021
djgibbs (No Description)
- 3 Barrier position
12 Aug 2021
djgibbs (No Description)
- 2 Incomplete line of sight for sig...
20 May 2021
streamlinegammon
The line of sight of the signal person may be blocked by column X4-Y7 or other steel members during lifting.

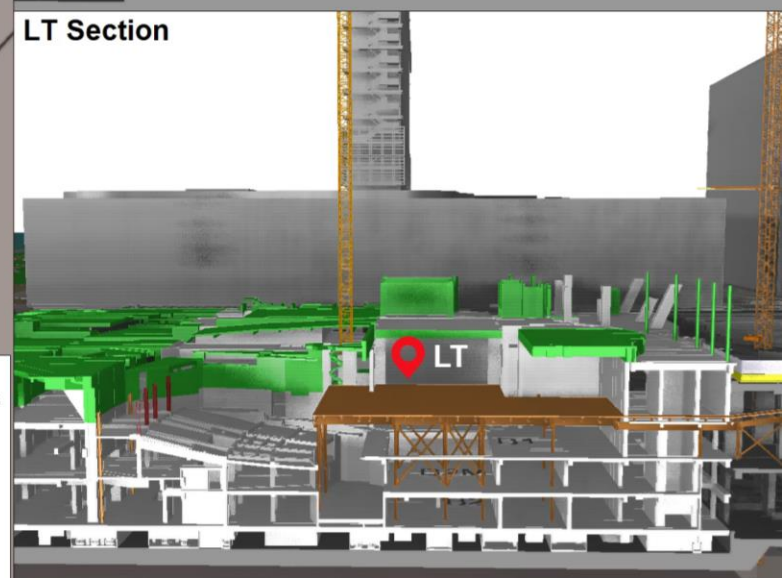
7 results displayed



4. TIMING

ACTUAL TO 31 JAN 2022

What is the frequency of 4D updates and the persistence through multiple project phases?



5. ENGAGEMENT

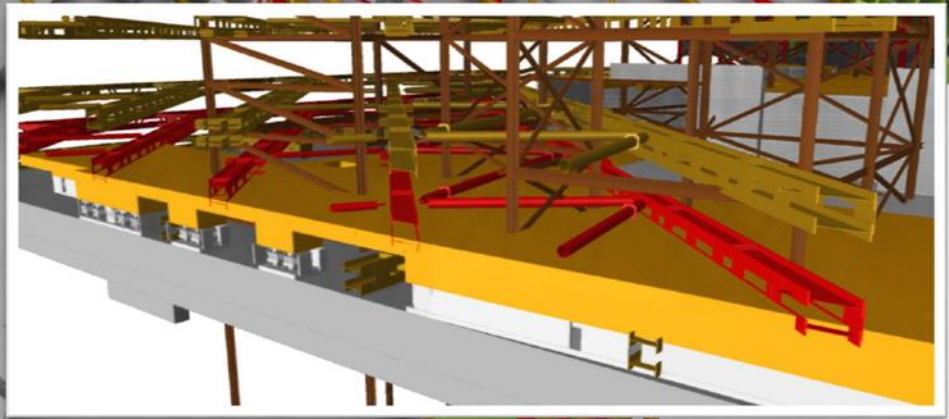
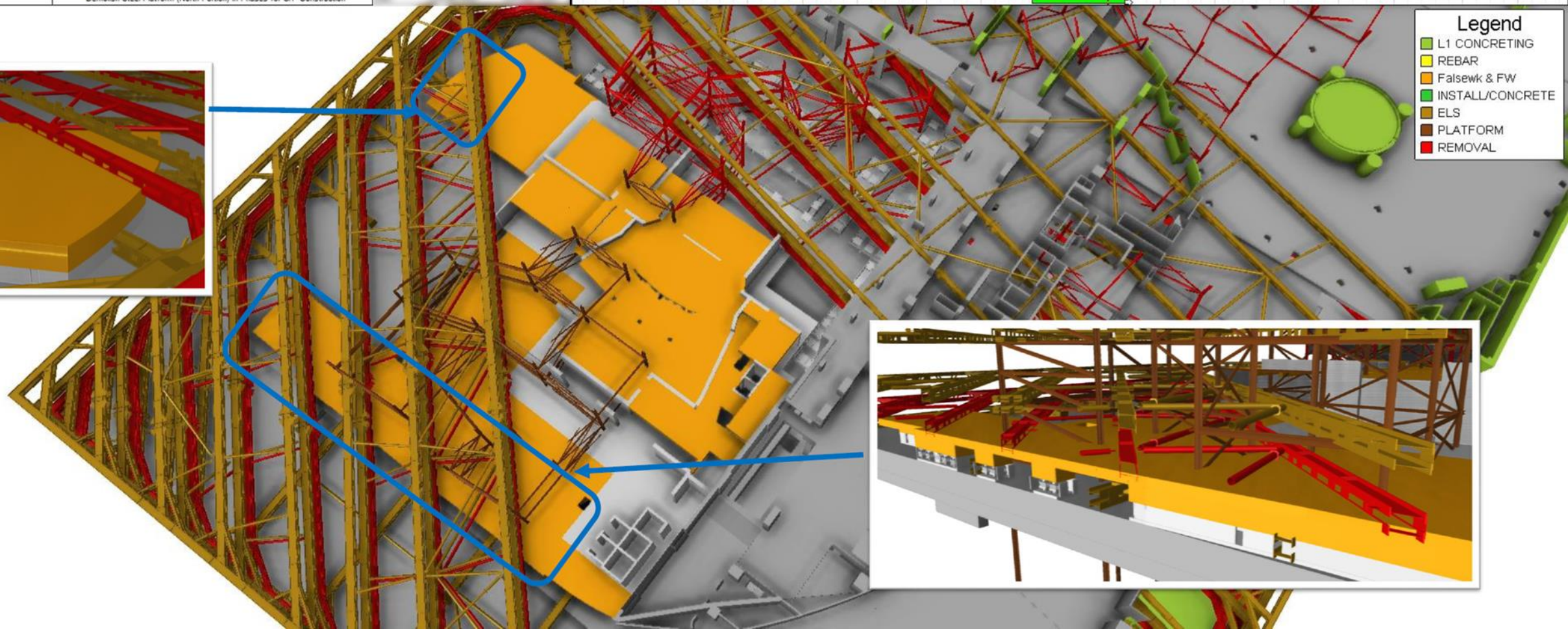
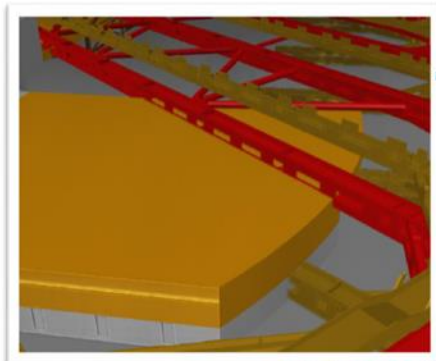
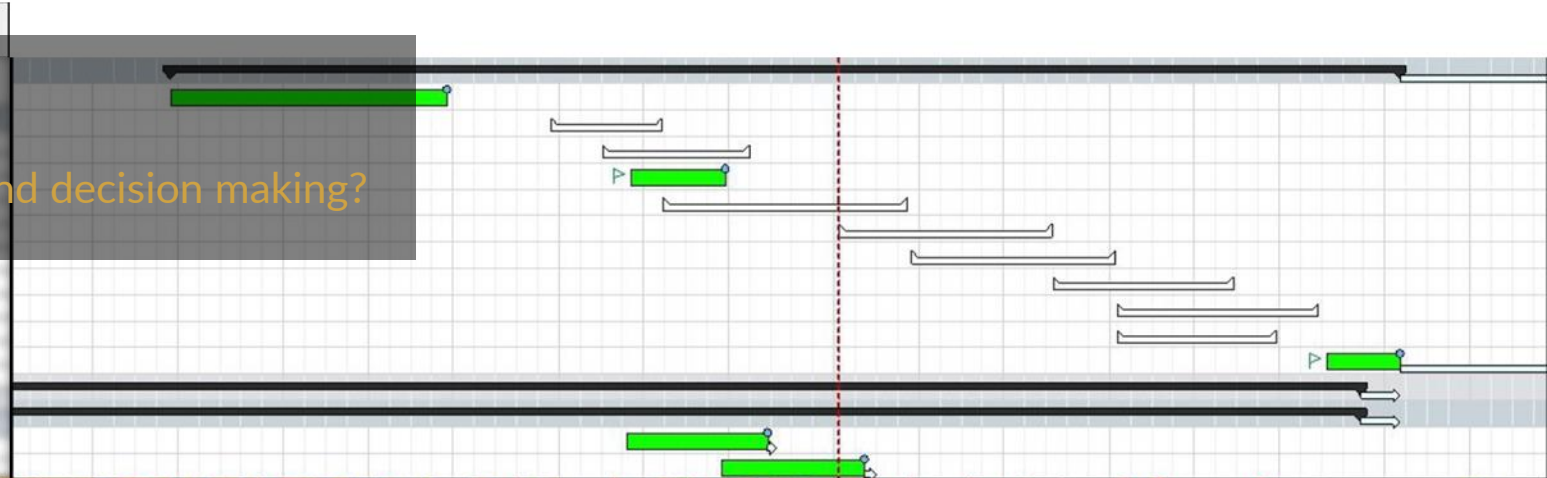
Who provides feedback on the 4D model at a creation and consumption level?

Example 1:
Position of scissor platform and
steel connection

6. IMPACT

How useful is the 4D model for problem solving and decision making?

ID	Name	Duration	Start	Finish
L2-4D_BIM-1.3.14	Structure (for Construction Model)			
CC1010	Installation of L1 B2/F Open Area (255 nos)			
CC1025	[Z1] B2/F SLAB			
CC1055	[Z1b] B2/F SLAB			
CC1021	Installation of L1 B2/F Rys Area (147 nos)			
CC1190	[Z1] B2/F SLAB			
CC1100	[Z2] B2/F SLAB			
CC1140	[Z3] B2/F SLAB			
CC2265	[Z2] B2/F ~ B2U/F & B1L/F			
CC2355	[Z4] B2/F ~ B2U/F			
CC2298	[Z3] B2/F ~ B2U/F			
CC2390	L1 Remove Steel Temp Platform			
L1RCMWP-REVA-1D.CC-B	Cost Centre B - Excavation and Lateral Support (ELS) Stage 2			
L1RCMWP-REVA-1D.CC-B.015	Temporary Steel Platform			
CB140300	Demolish Steel Platform (South Portion) in Phase 1 for G/F Construction			
CB162200	Demolish Steel Platform (North Portion) in Phases for G/F Construction			



- Legend**
- L1 CONCRETING
 - REBAR
 - Falsework & FW
 - INSTALL/CONCRETE
 - ELS
 - PLATFORM
 - REMOVAL

7. ORGANIZATION

How is 4D planning driven across the organization?



DRIVERS

Executive buy-in & mandatory requirements



CHAMPIONS

Central team to support and coordinate efforts



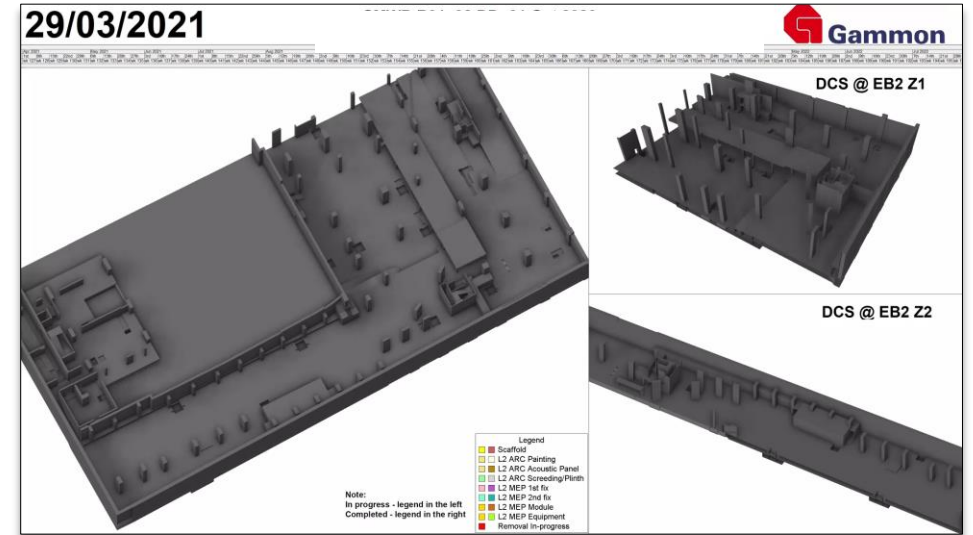
IMPLEMENTATION

Dedicated roles on site for 4D planning



END-USERS

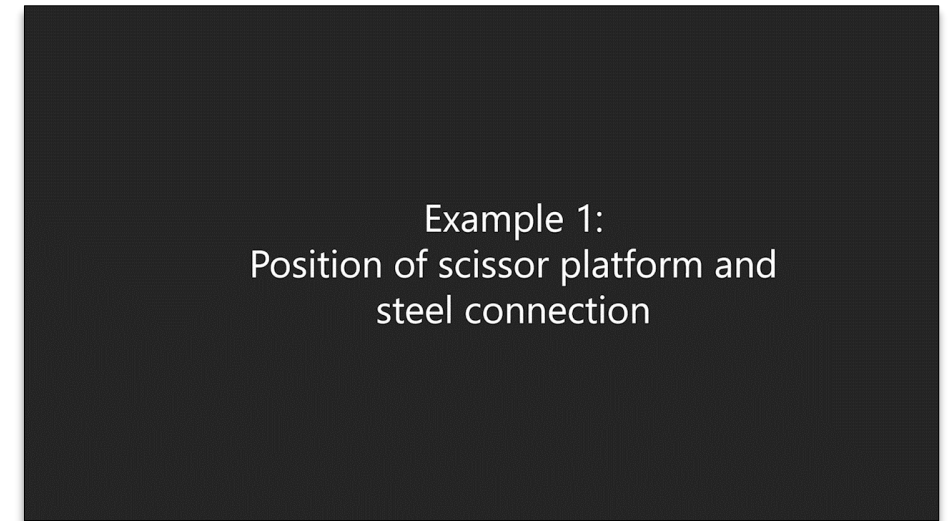
Not just the BIM team. Wider site engagement.



OUTPUT



INPUT



8. COMPETENCY

How are 4D skills developed?



9. TECHNOLOGY

Is the hardware, software and network supporting 4D modelling fit-for-purpose?



Immersive
Smart
Lab

Innovation

Co-Creation

KEY LEARNINGS

For those considering starting their 4D journey

- ① INPUT NOT OUTPUT
- ② YOU DON'T HAVE TO START WITH EVERYTHING
- ③ DON'T WAIT FOR ALL THE INFORMATION
- ④ COMPLIMENT EXISTING PROCESSES
- ⑤ CELEBRATE THE WINS
- ★ USE THE 4D MATRIX TO GUIDE YOU!



4d.construction/maturitymatrix
www.gammonconstruction.com