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Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin



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DIGITAL TWIN A 360° VIEW



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Head of Capital Projects & Planning
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Roger West

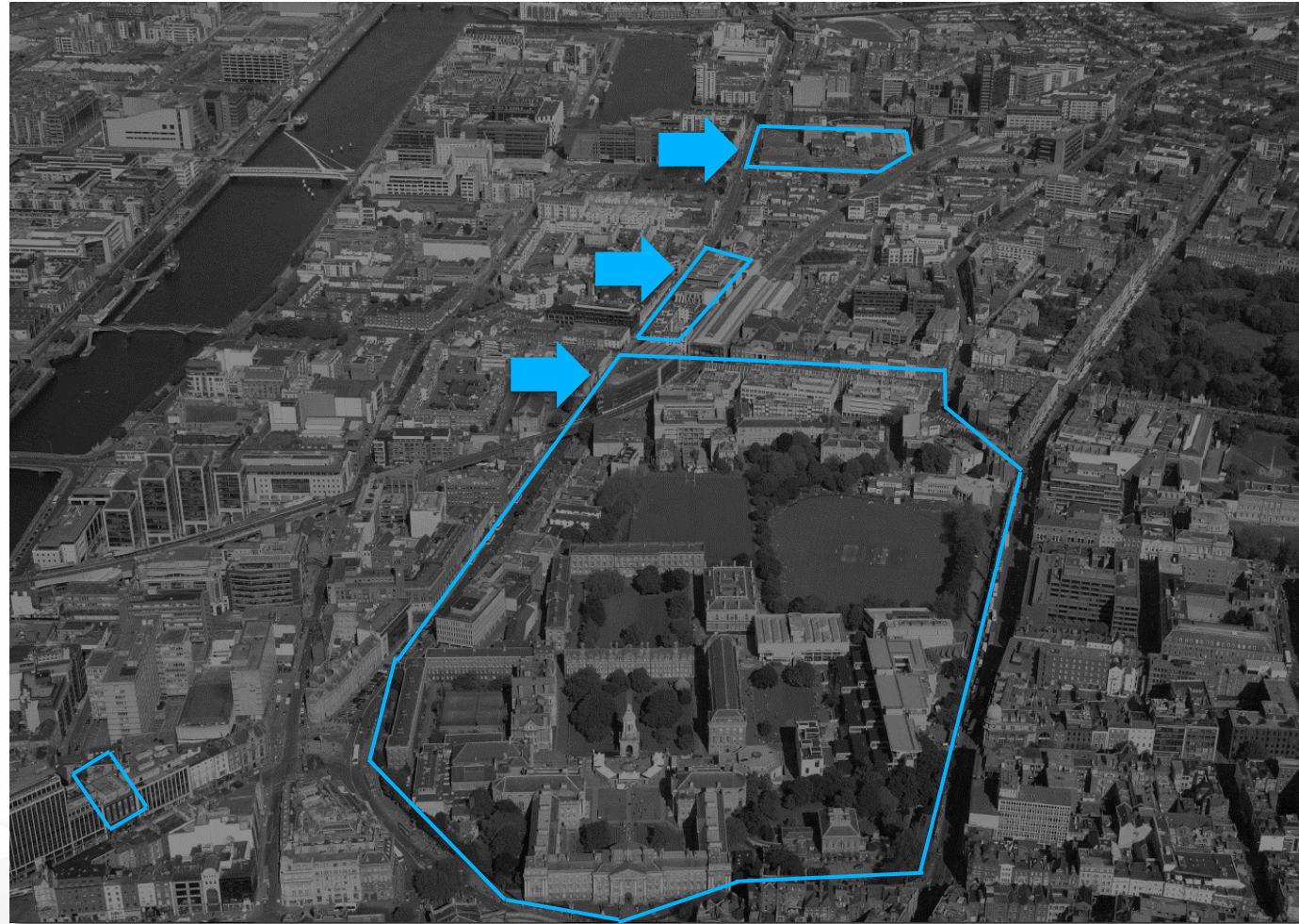
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THE UNIVERSITY OF DUBLIN

TRINITY COLLEGE DUBLIN



THE UNIVERSITY OF DUBLIN

TRINITY COLLEGE DUBLIN

- Chartered 1592
- 3 Faculties:
 - Arts, Humanities & Social Sciences
 - Engineering, Mathematics & Science
 - Health Sciences
- 17,500 students
- 3,500 staff
- 3,100,000 sq.ft.
- 108 acres over 13 sites in 167 buildings
- 68% of building stock >100 years old, (25% of stock >200 years old)
- 2,500 bedspaces (700 on main campus, 1000 off campus, 800 in PBSA)
- 1.1M visitors to the Book of Kells; more than 2M visitors to the campus



BIM LEVEL 2 PROJECTS

PORTFOLIO

Trinity Business School



E3 Learning Foundry



Dartry Student Rooms



**Historic Accommodation
Refurb and Deep Energy
Retrofit**



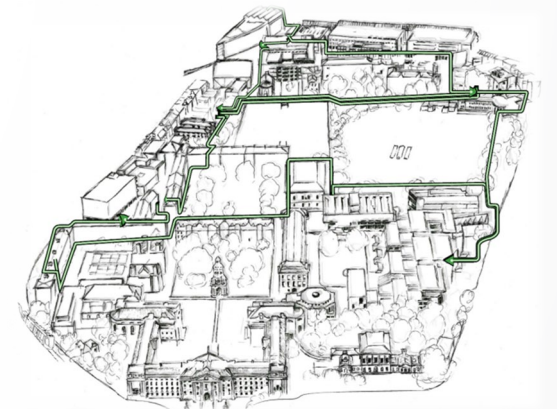
Trinity Visitor Experience



Printing House Square



TTec at Grand Canal Dock



**New Medium Voltage
Infrastructure**

TRINITY BUSINESS SCHOOL OVERVIEW

- 14,000 m²
- On budget: €80M
- On schedule: 22nd May 2019



Turner & Townsend

ARUP

DESIGNER
GROUP

Scott Tallon Walker Architects

pro
cert
ASSIGNED
CERTIFICATION
PARTNERSHIP

T BOURKE

IN2
ENGINEERING DESIGN PARTNERSHIP

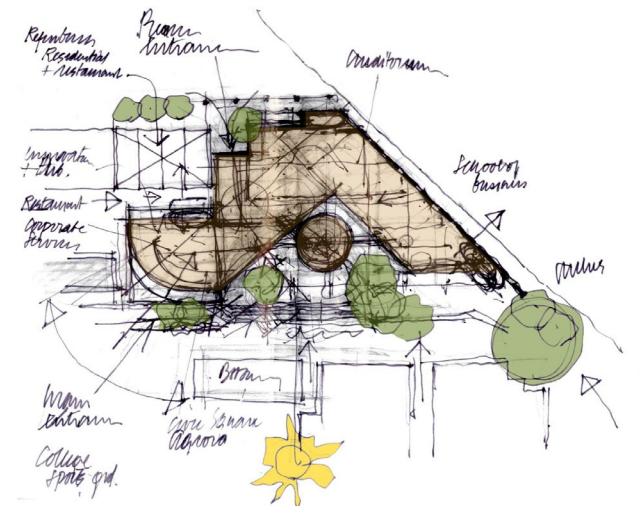
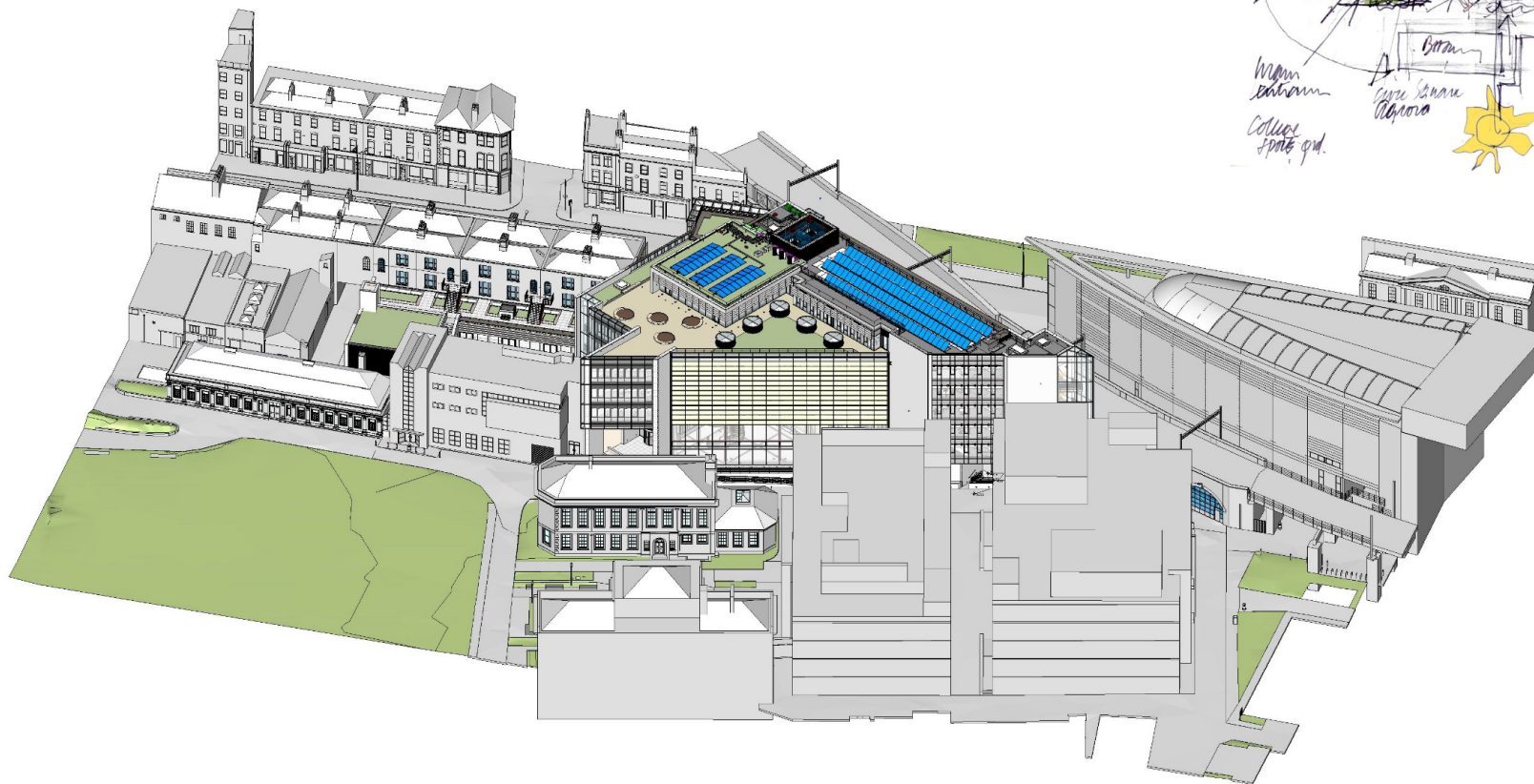
JJ Rhatigan
Building Contractors

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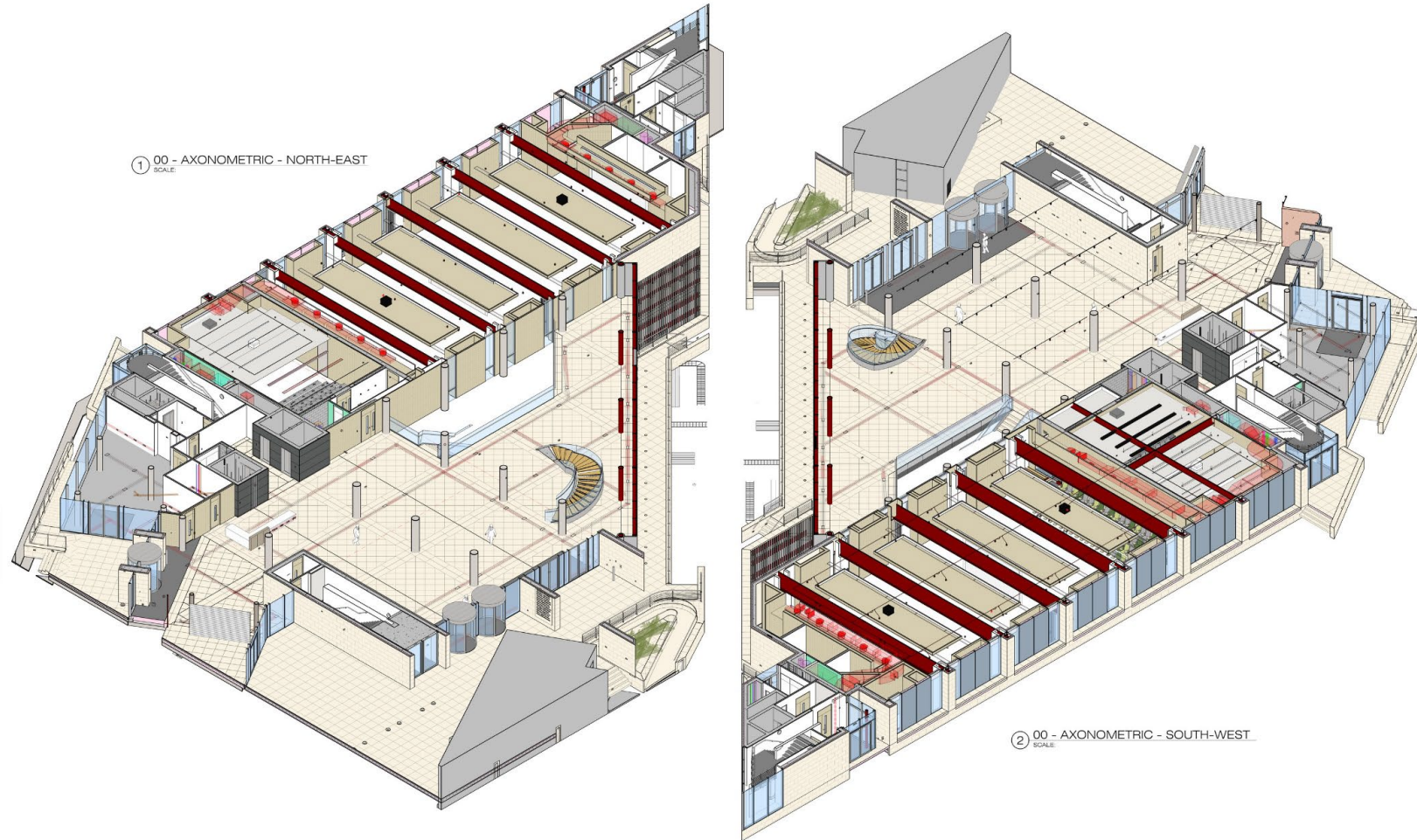
TRINITY BUSINESS SCHOOL: BIM LEVEL 2

ARCHITECT'S PERSPECTIVE



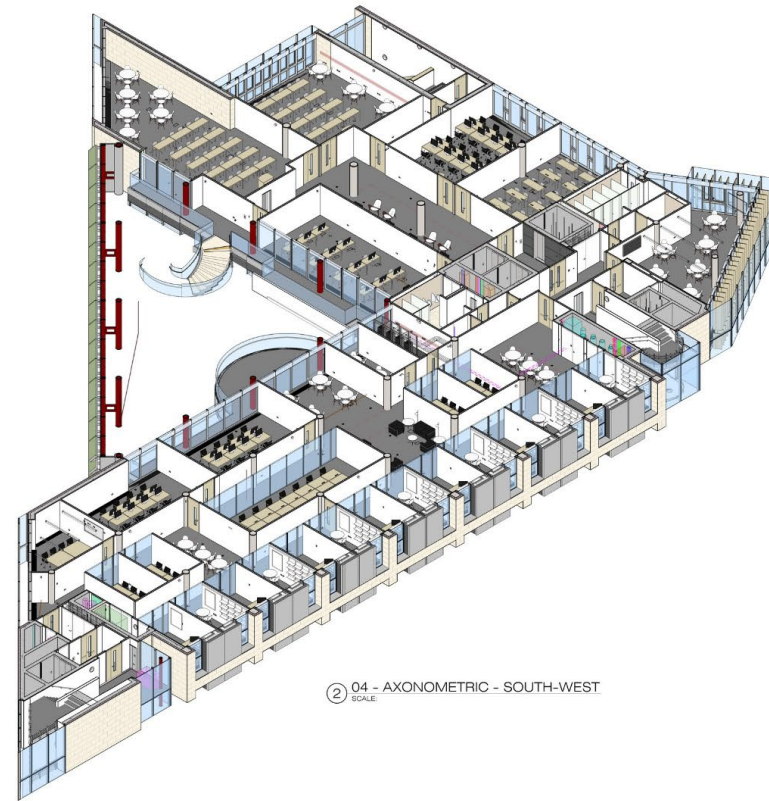
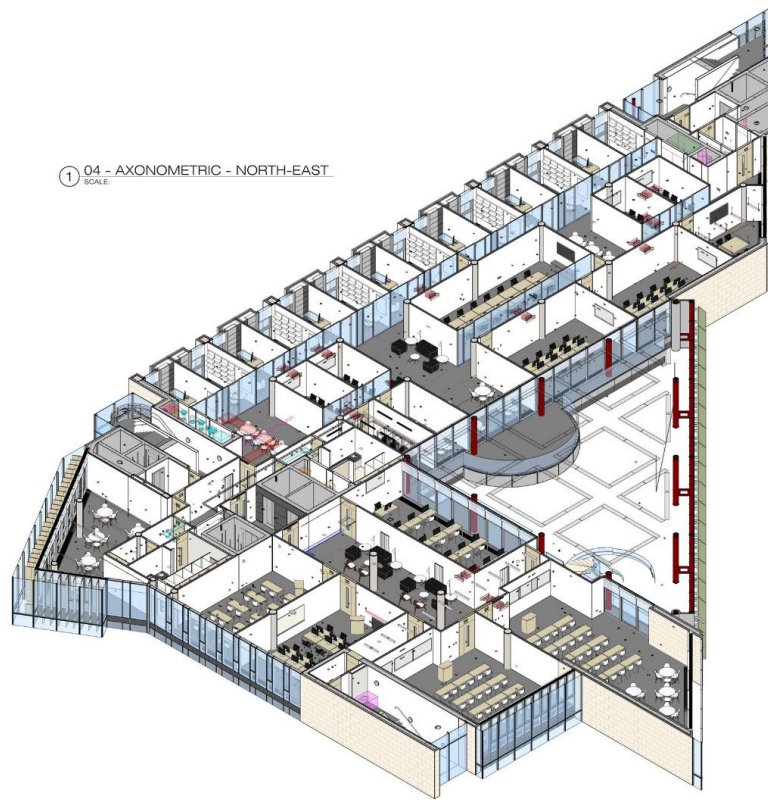
TRINITY BUSINESS SCHOOL: BIM LEVEL 2

ARCHITECT'S PERSPECTIVE



TRINITY BUSINESS SCHOOL: BIM LEVEL 2

ARCHITECT'S PERSPECTIVE



TRINITY BUSINESS SCHOOL

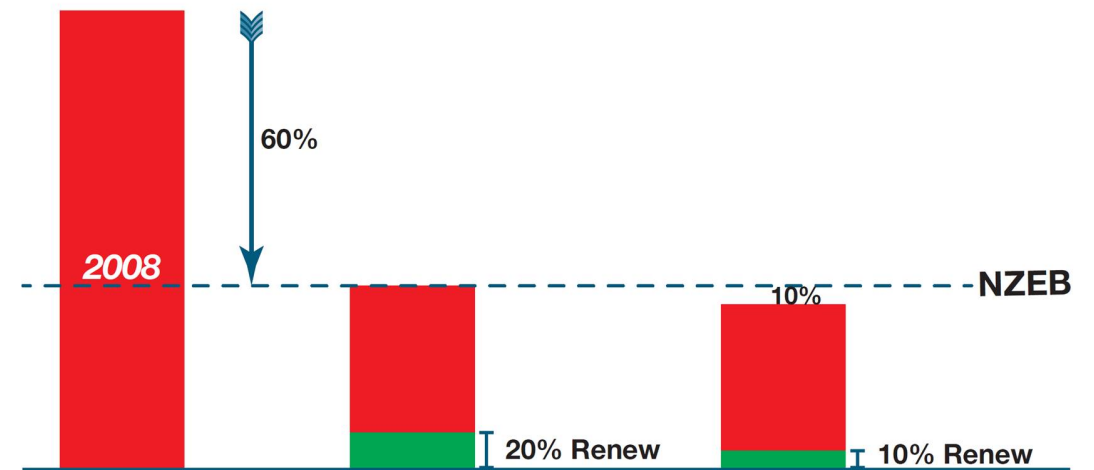
NZEB

Near Zero Energy Buildings (NZEB) is an EU-wide Directive which takes effect for new buildings by 2020 and all existing by 2050.

It has been interpreted in Ireland's 'Part L' 2017 Building Regulations as requiring a 60-70% reduction in Primary Energy (against 2008 benchmark) with 10-20% contributed by renewable energy technologies.

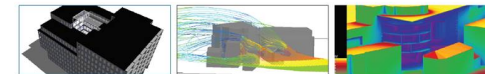
2.0 NZEB Requirements

IN2 Engineering Design Partnership



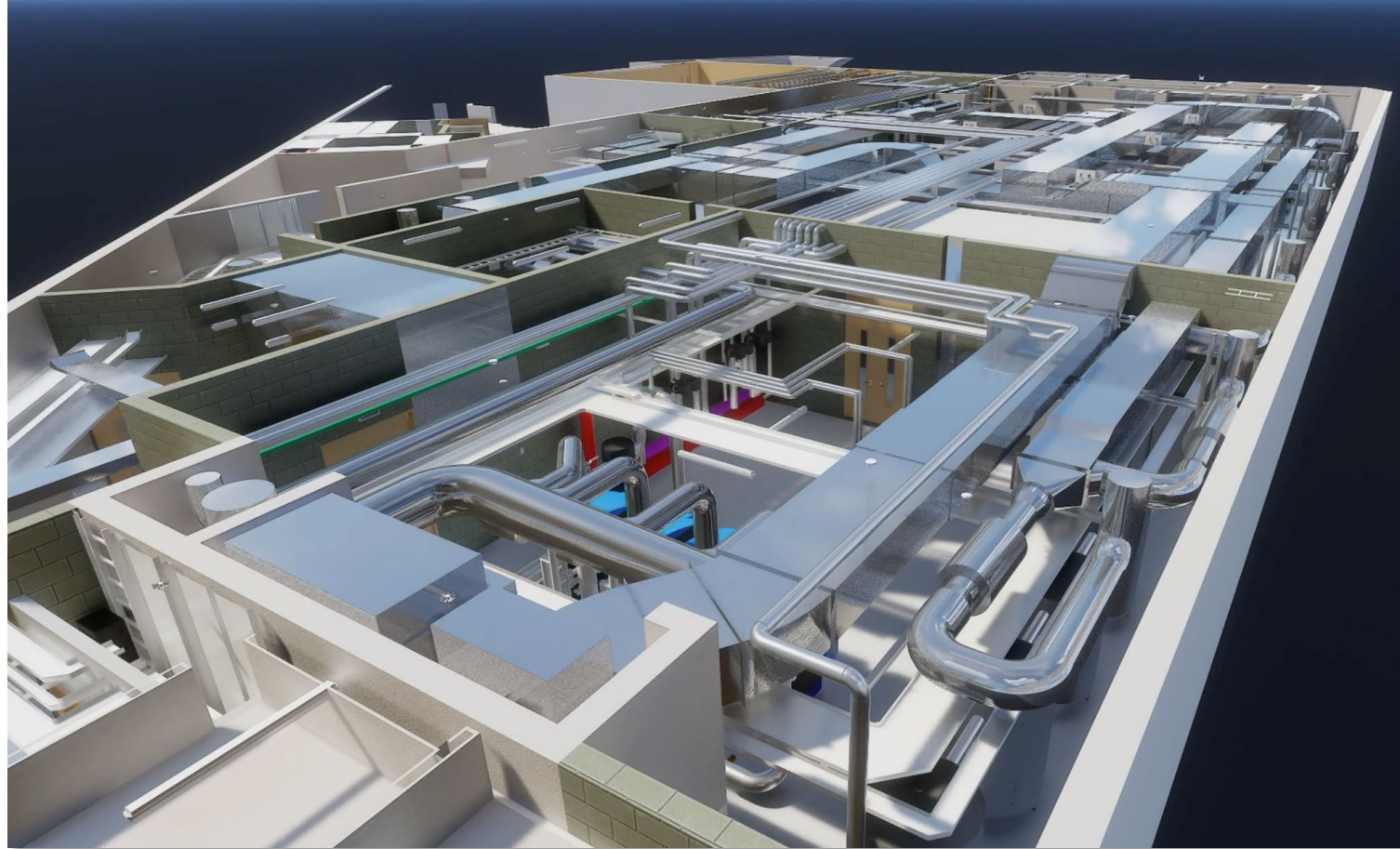
IN2
ENGINEERING DESIGN PARTNERSHIP

network
riaicpd



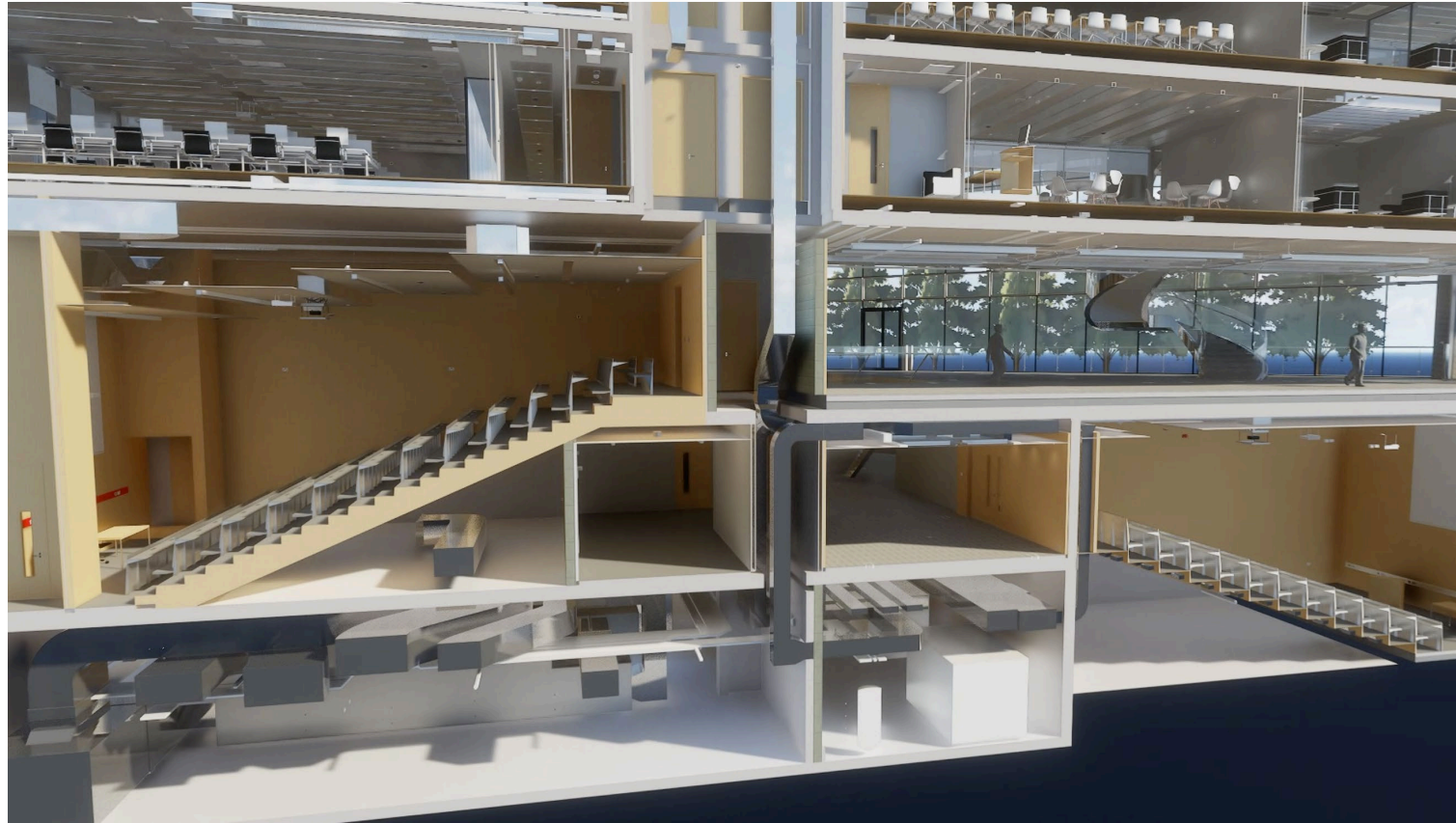
TRINITY BUSINESS SCHOOL: BIM LEVEL 2

M&E PERSPECTIVE



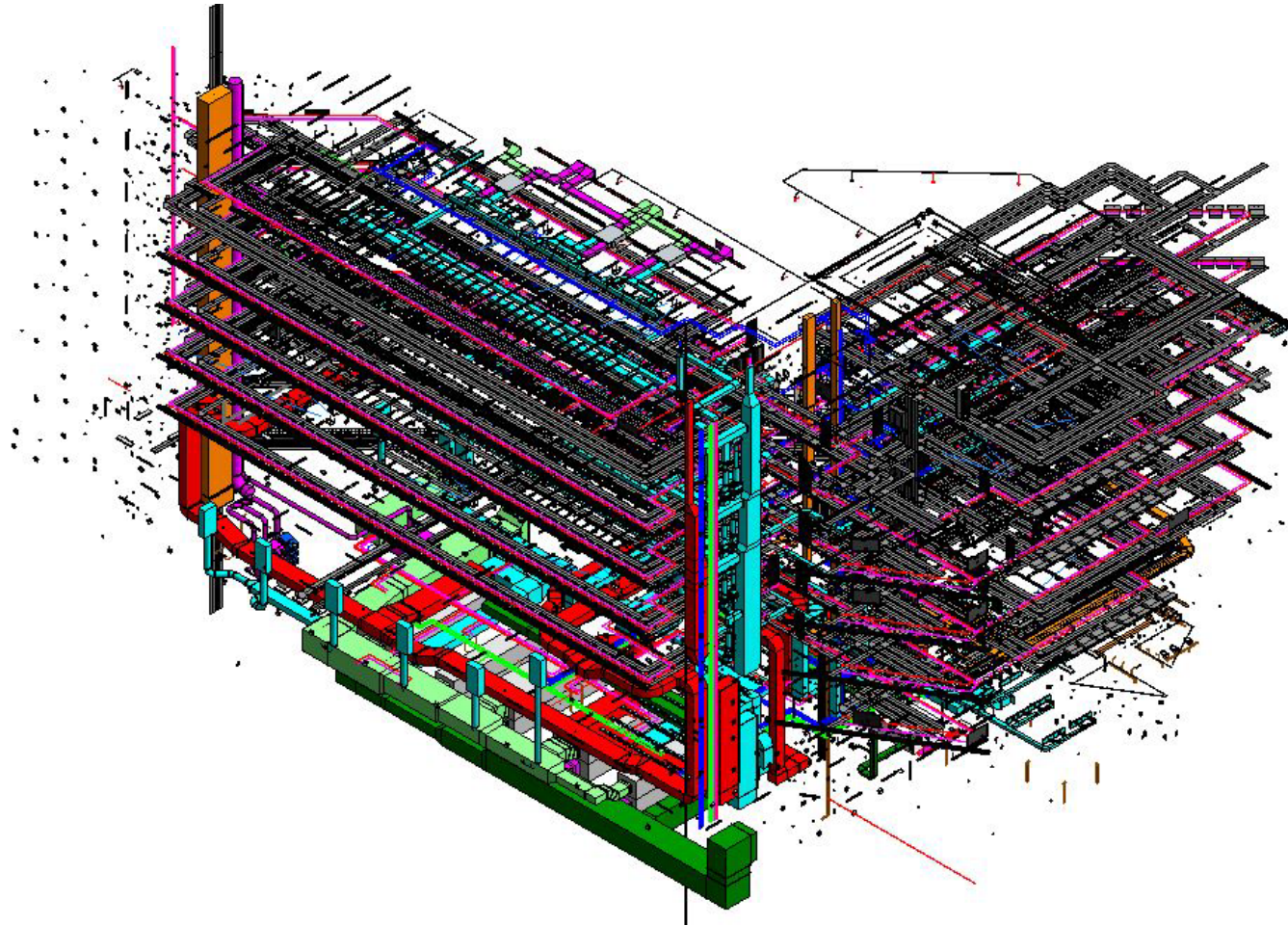
TRINITY BUSINESS SCHOOL: BIM LEVEL 2

M&E PERSPECTIVE



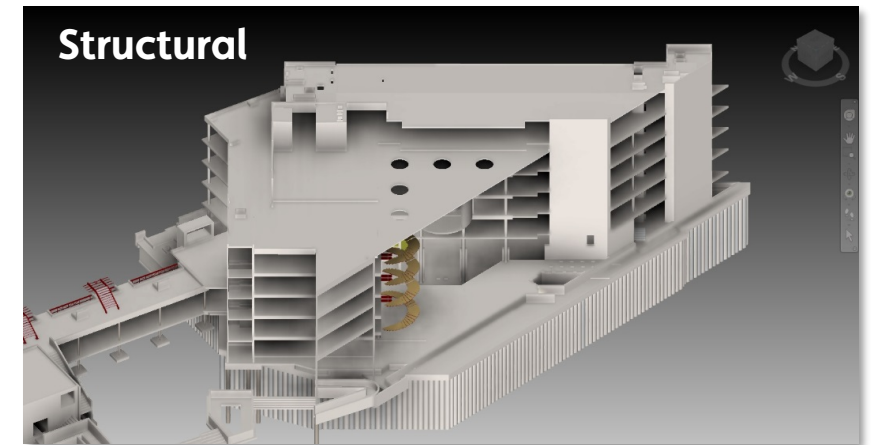
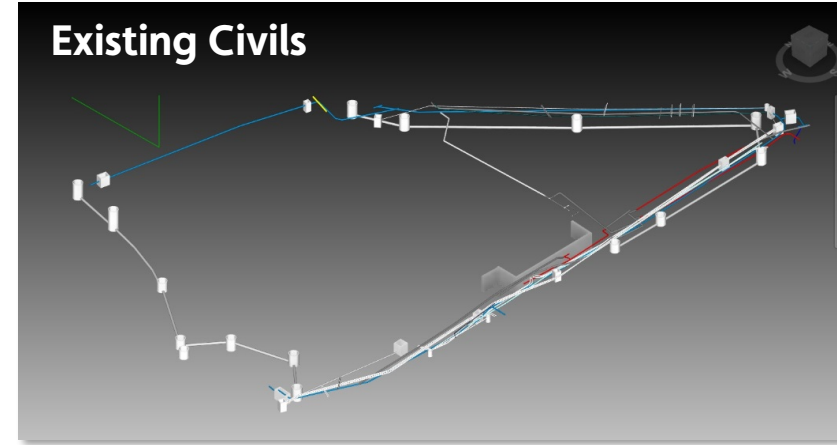
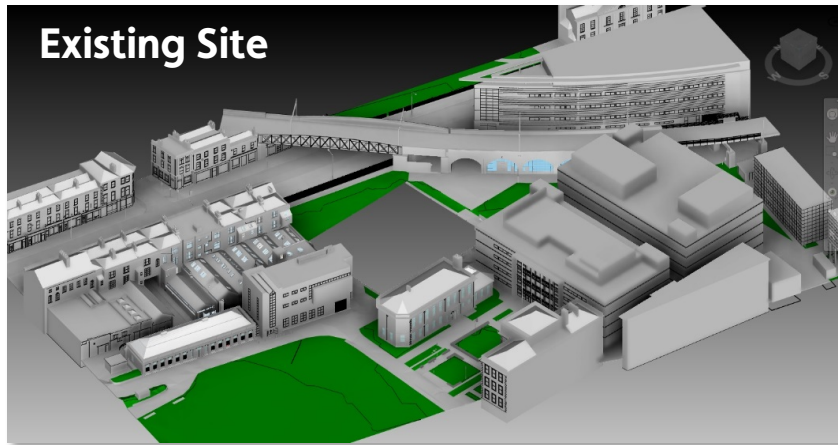
TRINITY BUSINESS SCHOOL: BIM LEVEL 2

M&E PERSPECTIVE



TRINITY BUSINESS SCHOOL: BIM LEVEL 2

CONTRACTOR'S PERSPECTIVE





TRINITY BUSINESS SCHOOL: BIM LEVEL 2

CONTRACTOR'S PERSPECTIVE



Client:

 **Trinity College Dublin**
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin



Project Number:
13094

Project Name:
TRINITY BUSINESS SCHOOL

Project Stage:
STAGE 4

Project Architect:
WAYNE ROTHWELL

Model Description:
Architectural Model

Model Reference:
TBS-STW-00-ZZ-M3-A-0003

Revision Date:
07/03/2017

Data and Information Drop:
-

Project Information Manager:
LIAM FARRELLY

Status Code:
S2

Revision Code:
C4

Scott Tallon Walker Architects

19 Merrion Square, Dublin 2, Ireland
Tel: +353 1 6693000
Fax: +353 1 6613300
Email: 13094@sttwaarchitects.com
Web: www.sttwaarchitects.com

Building Information Model

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Model Status
Work In Progress: S0 - Work in Progress
Shared: S1 - Fit for Coordination, S2 Fit for Information, S3 Fit for Internal Review and Comment, S4 Fit for Construction Approval, S5 Fit for Manufacture, S6 Fit for PM Authorisation, S7 Fit for AIM Authorisation, D1 Fit for Cladding, D2 Fit for Tender, D3 Fit for Contractor Design, D4 Fit for Manufacture/Procurement, AM As Manufactured
Publish: A Fit for Construction, B Partially Signed-off, AB As Built handover Documentation

**THIS MODEL IS FOR INFORMATION PURPOSES ONLY.
INFORMATION ON DRAWINGS AND IN SCHEDULES TAKES
PRECEDENCE OVER ANY INFORMATION IN THIS FILE.**

Model Update Summary

CEI:
Nominal thickness of 100mm assigned to all ceilings to account for secondary support tracks and build-up. Ceiling hangers not included. Model to be read in conjunction with detail drawings and any discrepancies between model and contract documents to be reported to STW for clarification.

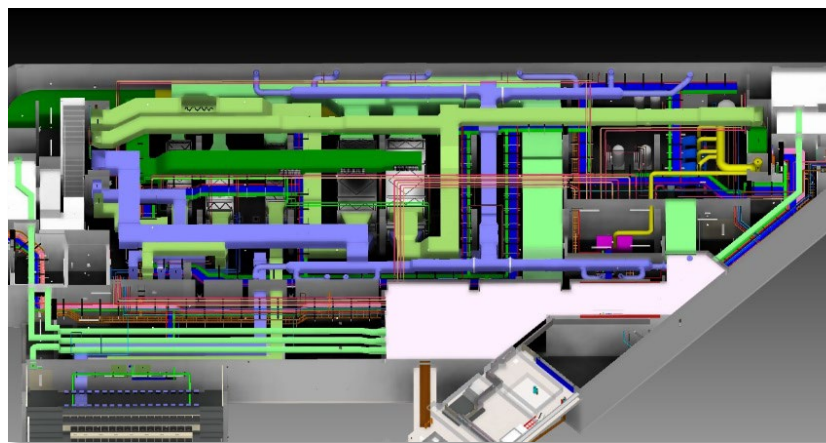
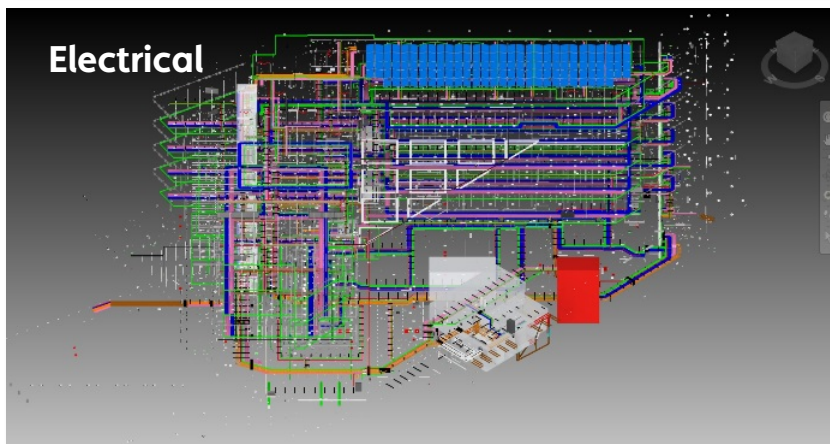
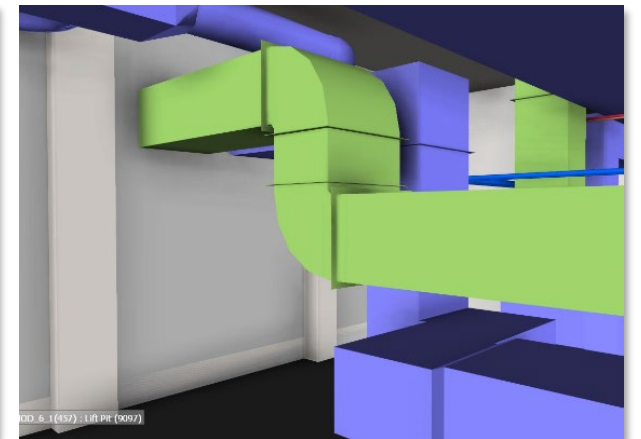
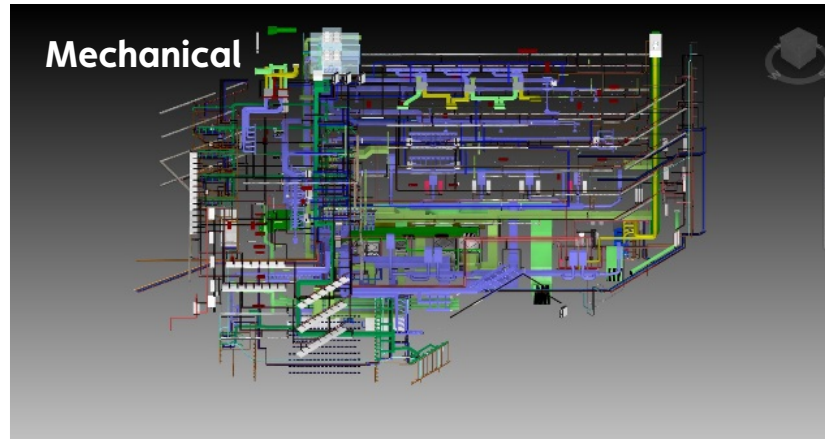
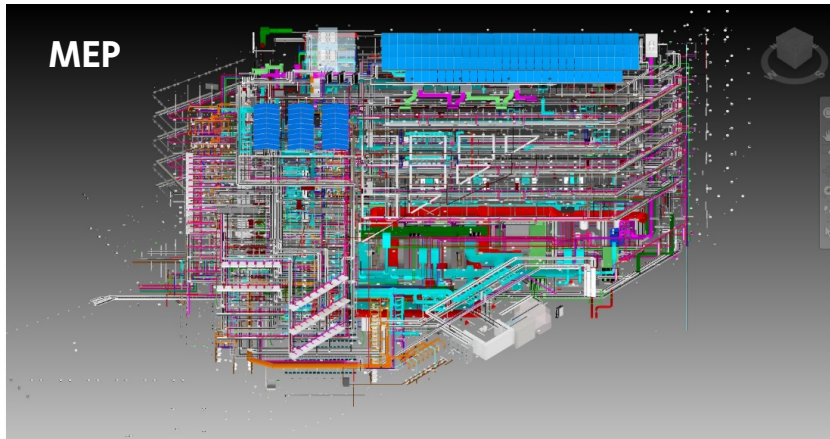
PAR:
Nominal thickness of acoustic and fire insulation has been added beneath all partitions to coincide with existing RAF drawings and details. Model to be read in conjunction with RAF series of drawings and any discrepancies between model and contract documents to be reported to STW for clarification.

PAR/DOR:
Fire rating requirements added to the properties of all doors and partitions. Drawings to be read in conjunction with fire cert and any discrepancies between the model and the contract documents to be reported to STW for clarification.

Courtesy of Celine O'Connor,
JJ Rhatigan & Co.

TRINITY BUSINESS SCHOOL: BIM LEVEL 2

CONTRACTOR'S PERSPECTIVE



TRINITY BUSINESS SCHOOL: BIM LEVEL 2

MODEL OWNERSHIP

3.1 APPENDIX 1 – PRODUCTION AND DELIVERY TABLE FOR BIM PROTOCOL USER GUIDE

Data and Information Drop: PW-CF1 Workstage		1 Stage 1 - Preliminary Design		1 Stage 2a - Scheme Design		2 Stage 2b - Developed Design and Planning		3 Stage 2c - Detail Design and Tender Documentation		3 Stage 3 - Tender Issue, Evaluation & Award		4 Stage 4 - Construction		5 Stage 5 - Handover and Final Account		5 Operations and Maintenance	
		Model Originator	LoMD	Model Originator	LoMD	Model Originator	LoMD	Model Originator	LoMD	Model Originator	LoMD	Model Originator	LoMD	Model Originator	LoMD	Model Originator	LoMD
1	Brief																
	Requirements																
	Surveys																
2	Strategies																
	Fire Strategy					ARCH / FCON	3	ARCH / FCON	4								
	Security Strategy					ARCH		ARCH									
	Acoustic Strategy					ARCH		ARCH									
	Sustainability Strategy					SERV	3	SERV	4								
	Disabled Access Strategy					ARCH	3	ARCH	4								
	Maintenance Access Strategy					ARCH	3	ARCH	4								
	Waste Management Strategy					ARCH		ARCH									
3	Solutions																
	Site Planning and Sections					ARCH	3	ARCH	4			MCON	5	MCON	6	FMSP	7
	Space Planning					ARCH	3	ARCH	4			MCON	5	MCON	6	FMSP	7
	Architectural Facility Layouts, Sections and Elevations					ARCH	3	ARCH	4			MCON	5	MCON	6	FMSP	7
	Structural Facility Layouts, Sections and Elevations					STRU	3	STRU	4			MCON	5	MCON	6	FMSP	7
	Services Facility Layouts, Sections and Elevations					SERV	3	SERV	4			MCON	5	MCON	6	FMSP	7
	Architectural Specifications					ARCH	3	ARCH	4								
	Structural Specifications					STRU	3	STRU	4								
	Services Specifications					SERV	3	SERV	4								
4	Analysis																
	Thermal Analysis			SERV	2												
	Sustainability Analysis			SERV	2												
	Energy Analysis			SERV	2												
	Acoustic Analysis																
	4D Programme Analysis																
	5D Cost Analysis																
5	Impacts																
	Safety																
	Security																
	Sustainability																
	Commercial																
6	Implementation																
	Phasing											MCON	5				
	Sequence											MCON	5				
	Site Access											MCON	5				
	Site Set-Up											MCON	5				
	End																

Courtesy of Celine O'Connor, JJ Rhatigan & Co.

TRINITY BUSINESS SCHOOL: BIM LEVEL 2

PROS & CONS

Pitfalls

- Skillsets; Client (in 2014 procurements for consultants)
- Progress / Model Status
- Ownership of data
- Clash detection
- Operations, Operations, Operations
- Major translational project (Invicara)
- Consultant costs are significant

Successes

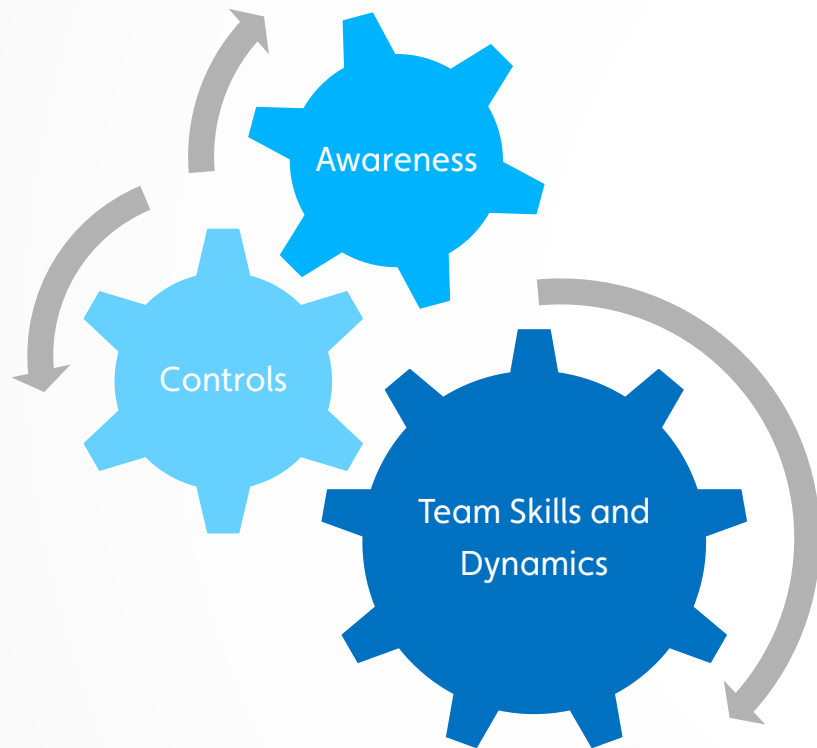
- Coordination model
- Contractor success
- Naming conventions
- Model for documentation and information
- Early adoption - Learning curve

IS BIM REALLY WORTH IT?

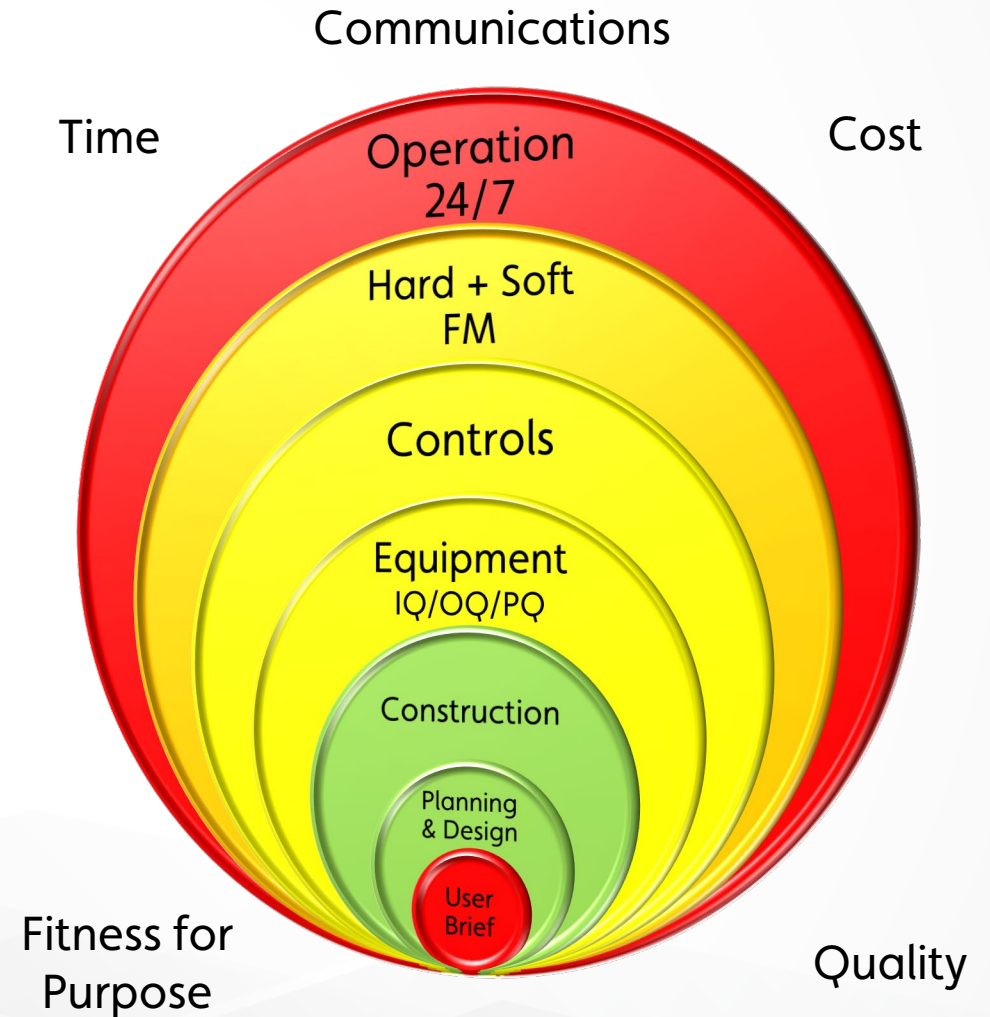
**IF SO, SHOW ME THE VALUE
NOW**

**WHAT DID TRINITY GET FOR
ITS MONEY?**

TRINITY BUSINESS SCHOOL SUCCESS MODEL



Where is BIM Currently Successful?

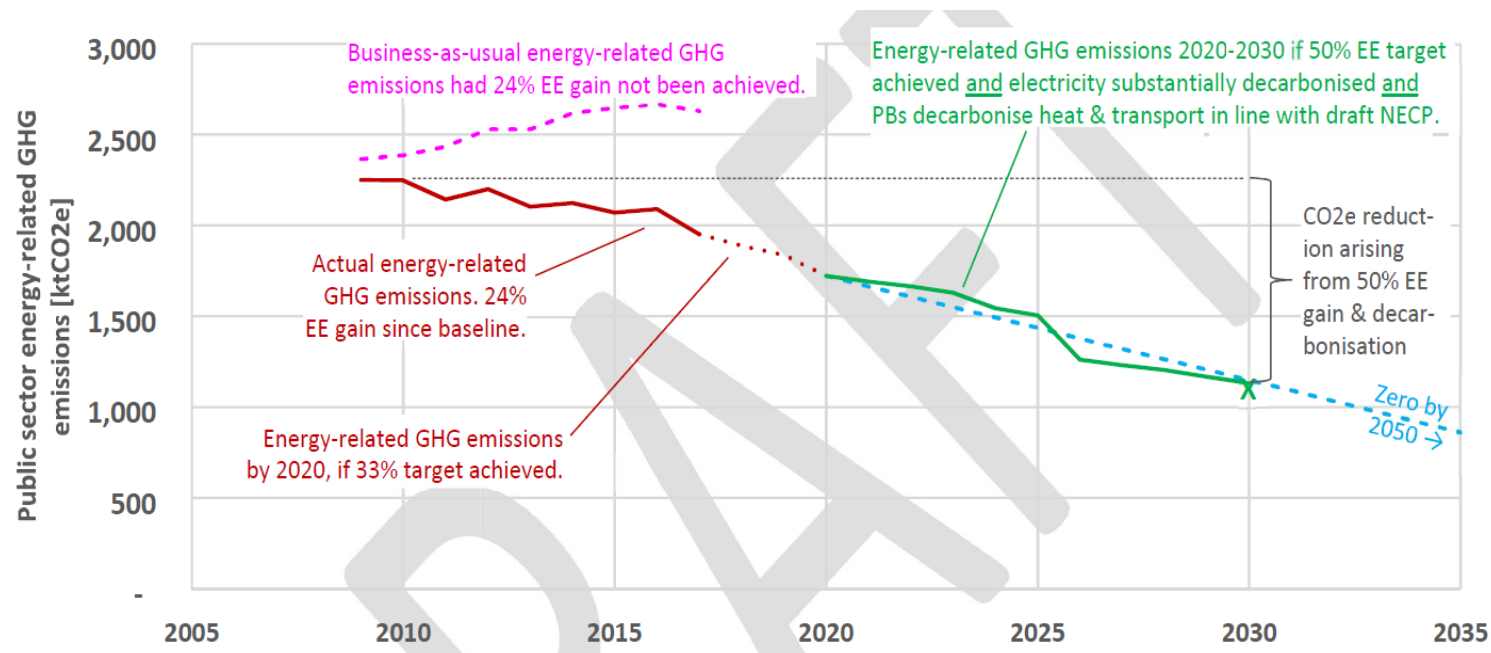


WHAT NEXT? ExCEED & 2050-ZERO: CAN BIM HELP?

Energy Efficient Design

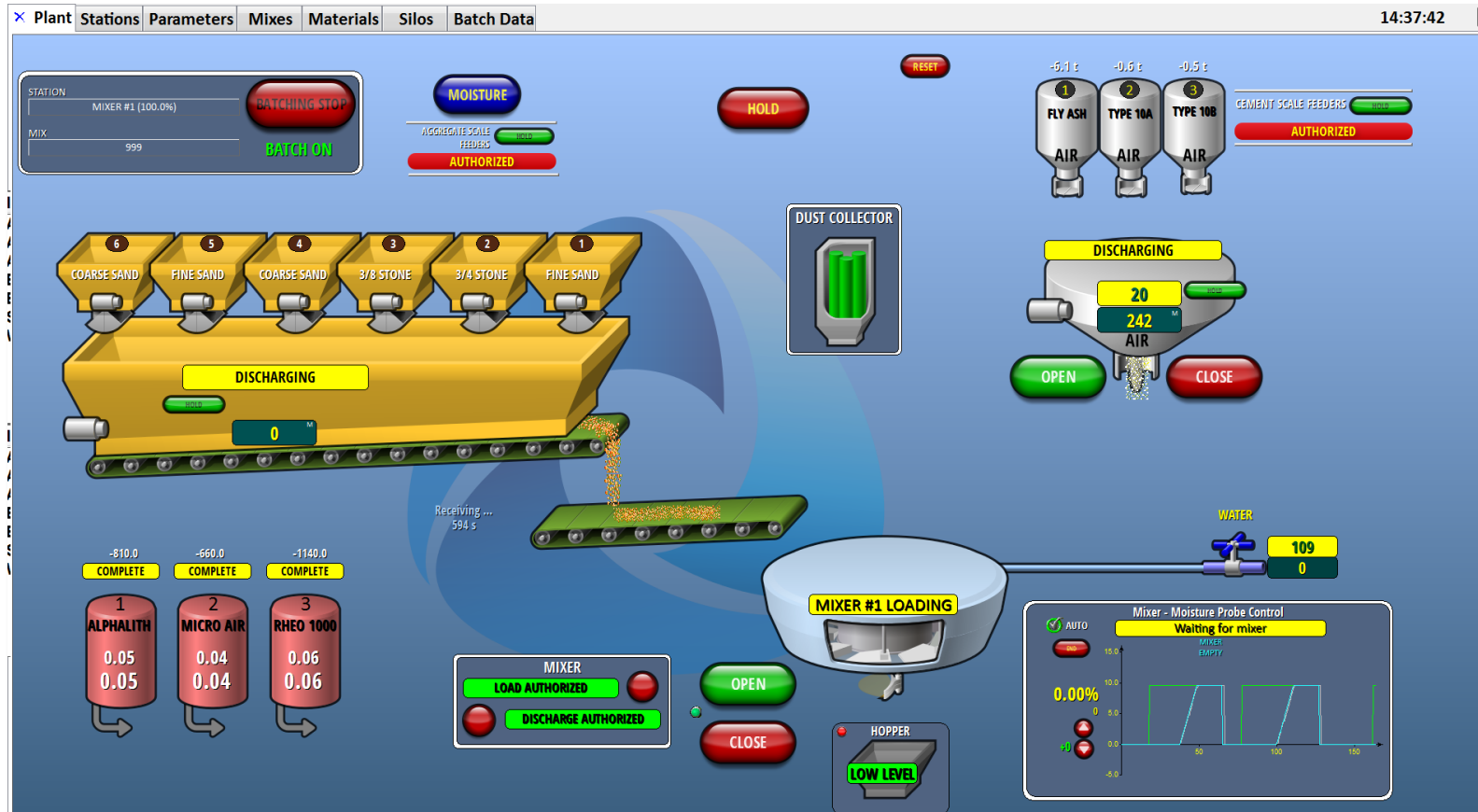
Based on IS399 (2014)

"...to enable organisations establish a systematic approach to the design, construction and commissioning of new investment projects so as to minimise energy use over their operating lifecycles."



TRINITY BUSINESS SCHOOL

THE DIGITAL TWIN



A Concrete Production Digital Twin

THE STATIC DIGITAL TWIN

01 Concept Phase:

- Planning
- Building mass optimisation
- Estimate construction and operational costs



02 Design Phase:

- Representation and visualisation
- Simulation
- Design optimisation
- Higher occupant comfort
- Lower capital and operational costs

03 Construction Phase:

- Work progress
- Earned value
- Site conditions
- Tracking of material, assets, people and plant,
- Visualise
- Promote collaboration,
- Accurate costs estimates



THE DIGITAL TWIN

CLIENT'S PERSPECTIVE IN PRINCIPAL

- ECI could also stand for “Early Client Involvement”
- EIR is more onerous as Client needs to get organised to derive an AIM
- Regret using BIM due to extra problems, such as far too much irrelevant data in BIM model, or model not up to date at hand-over
- BIM useless for client if not for savings or operation – BIM for FM
- No realisation of theoretical benefit in practice

CONSULTANT'S PERSPECTIVE IN PRINCIPAL

- Challenging learning curve
- Need for BIM Co-ordination
- BIM Financial Claims, with evidence of cause
 - Faults in BIM drafting leading to delay
 - Poor data co-ordination
 - Poor quality information
 - Timing of data drops
 - Gaps in progress reports
 - Massive number of clashes

THE DIGITAL TWIN

CONSULTANT'S PERSPECTIVE IN PRINCIPAL

BIM for Construction

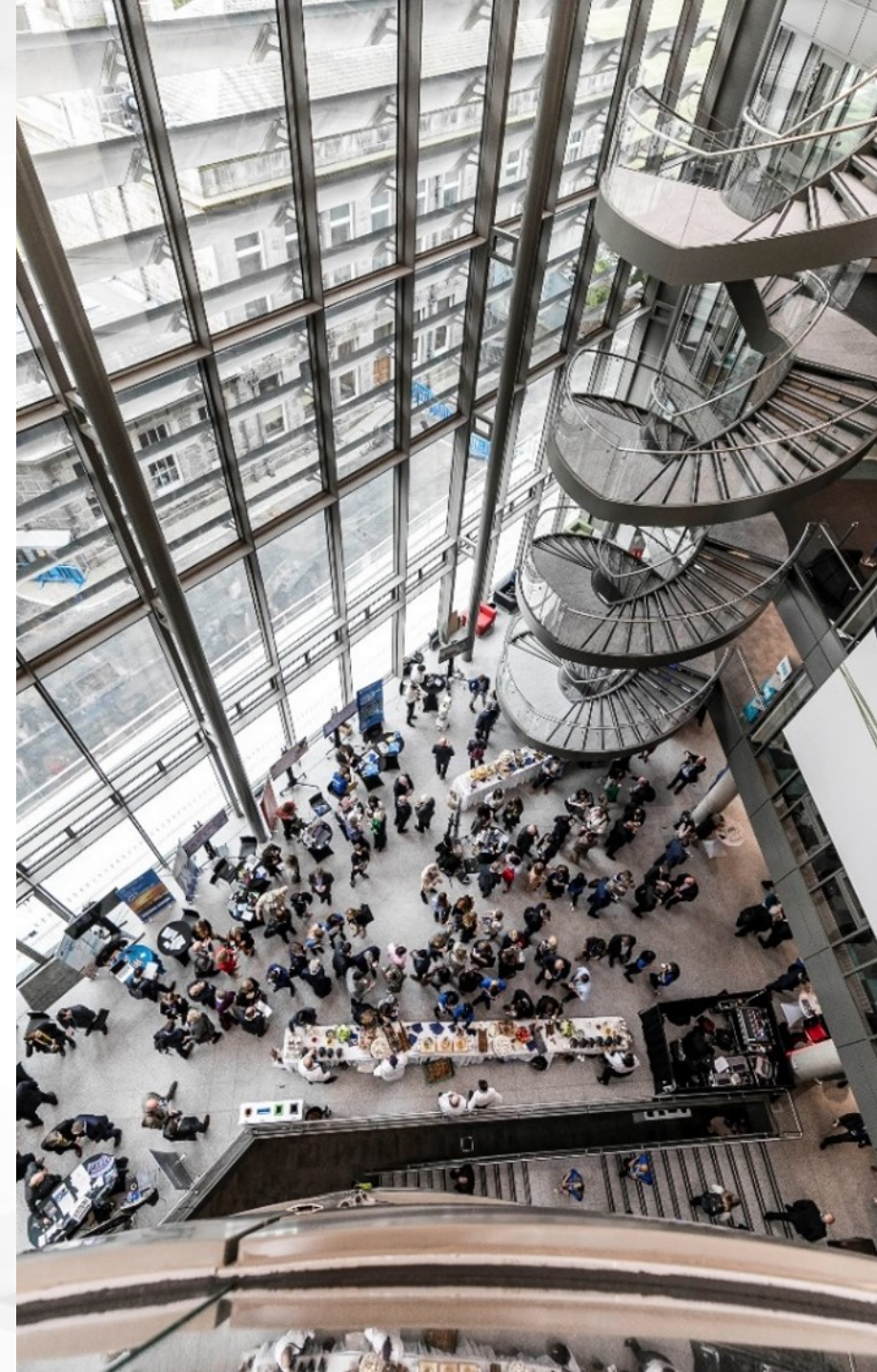
Where is the value ?

THE DYNAMIC DIGITAL TWIN

04 In-Use Stage:

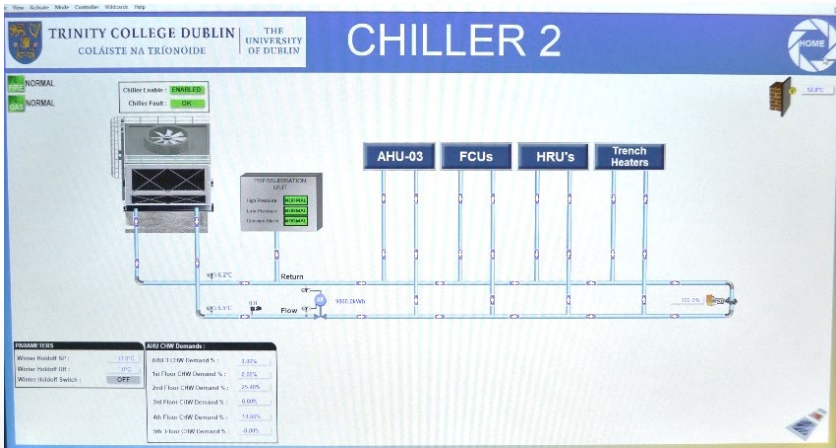
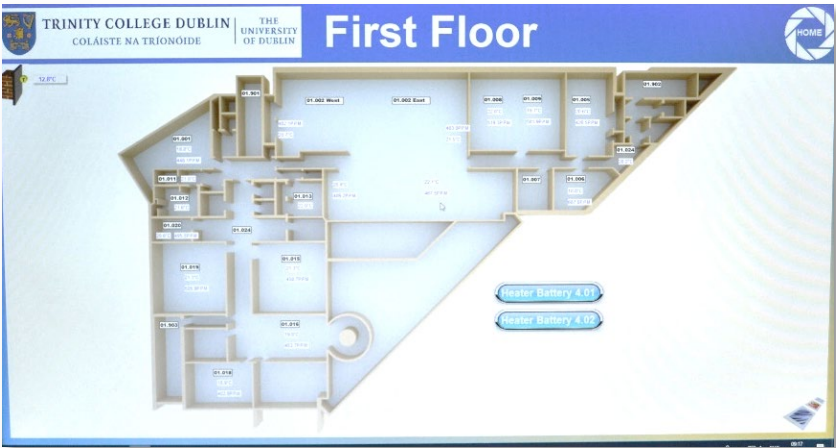
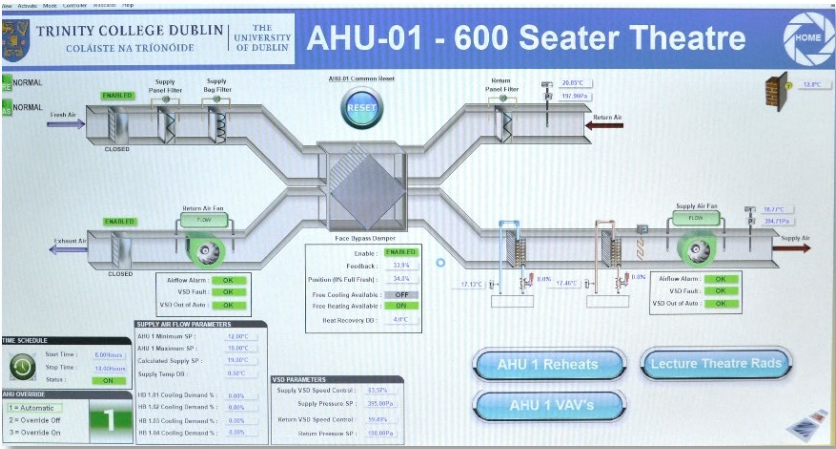
Digital building manual with:

- As-built status
 - Maintainable assets
 - Asset Information Model (AIM)
-
- AIM reflects as-maintained condition
 - Track building performance as-used vs as-built
 - Energy demand, occupant comfort
 - Space and asset utilisation
 - Enable analytics to predict and optimise



TRINITY BUSINESS SCHOOL

BMS SYSTEM IN USE



TRINITY BUSINESS SCHOOL

STATIC BIM TO DYNAMIC MODEL



gbXML/IFC



**Validated or
Calibrated
Model**

TRINITY BUSINESS SCHOOL

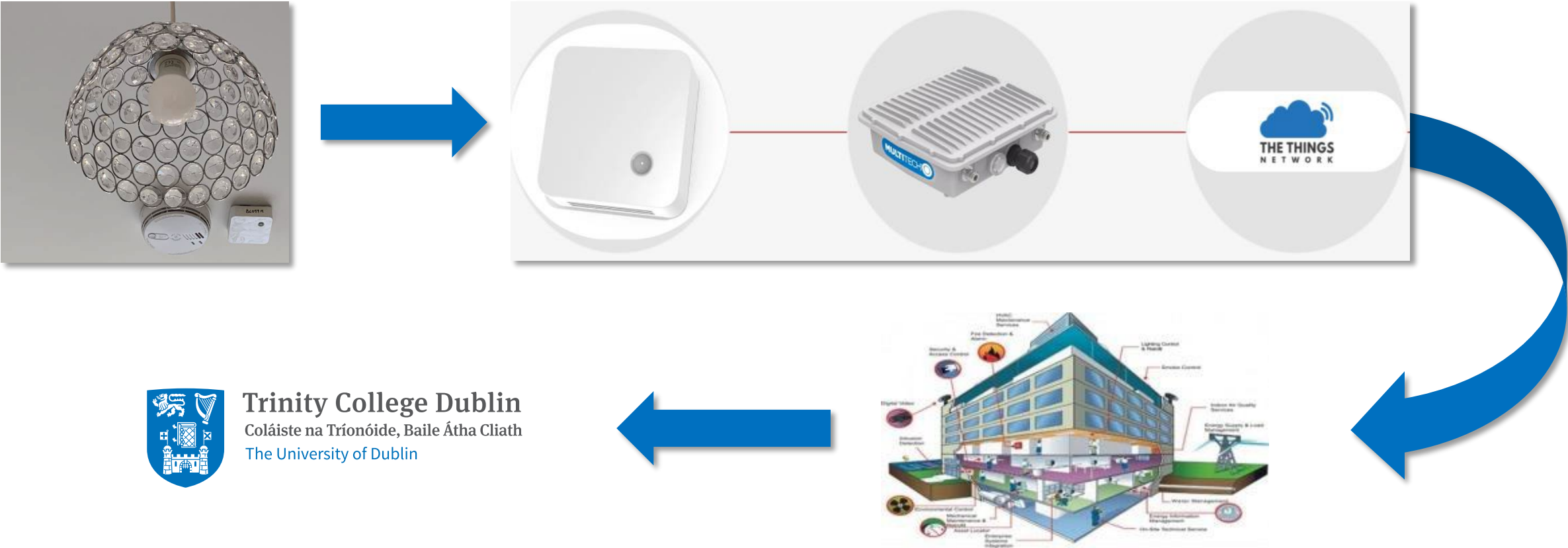
ADDITIONAL MONITORING



TRINITY BUSINESS SCHOOL

ADDITIONAL MONITORING

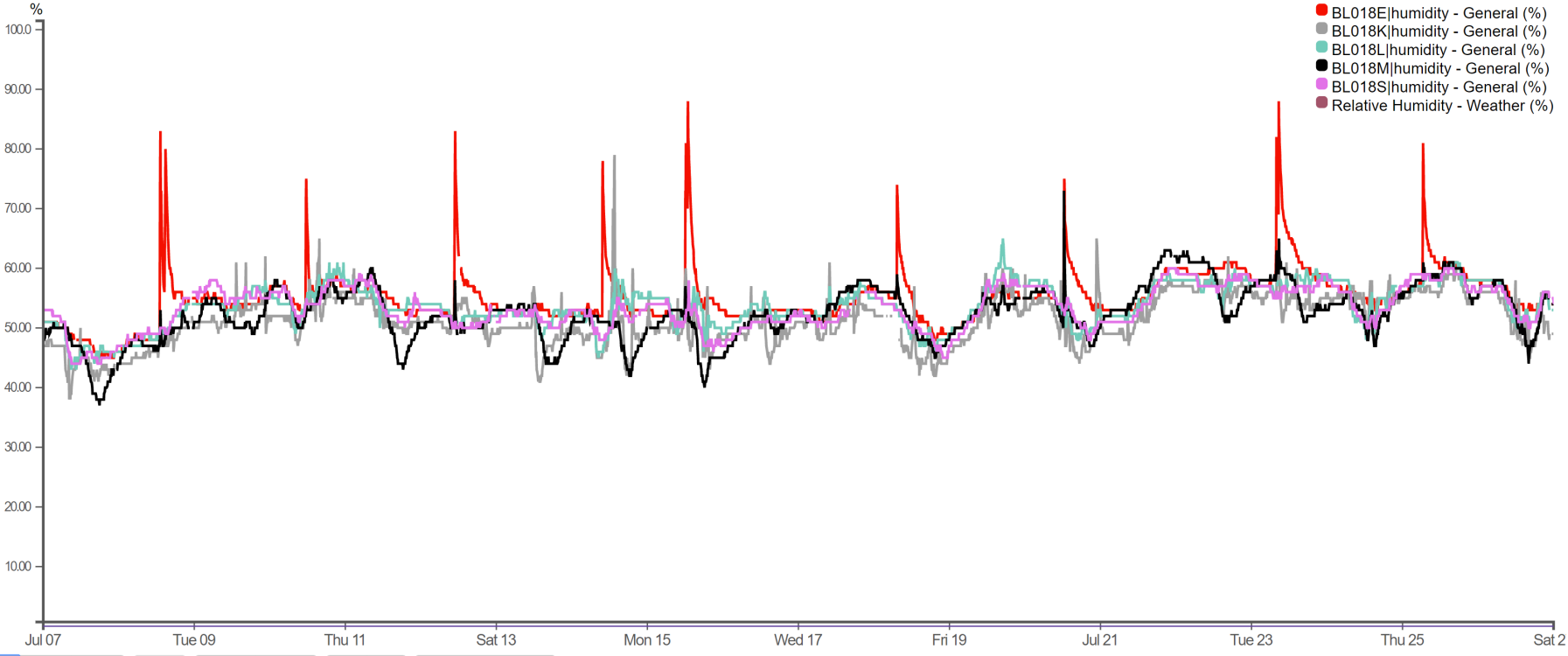
LoRAWAN



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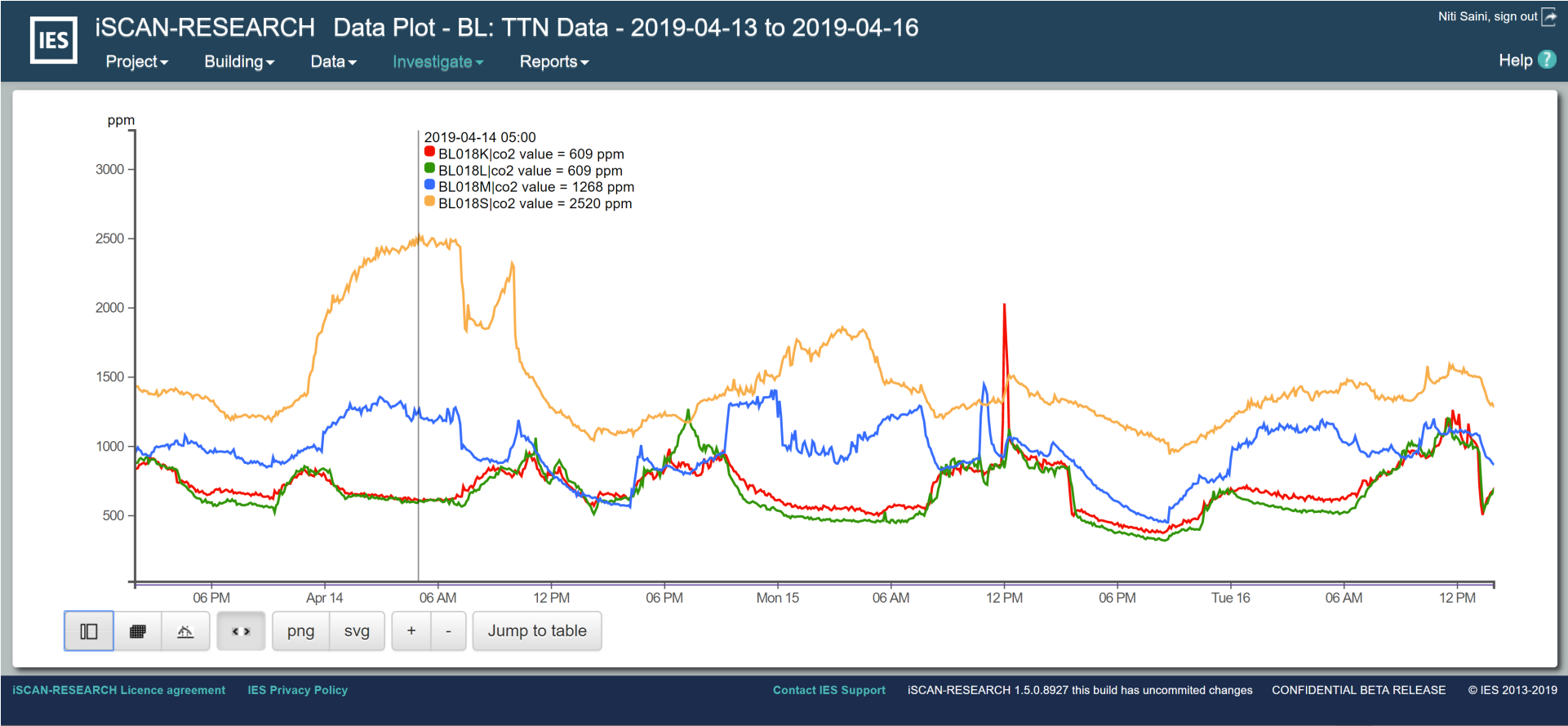
TRINITY BUSINESS SCHOOL

IES-VE: RELATIVE HUMIDITY MONITORING

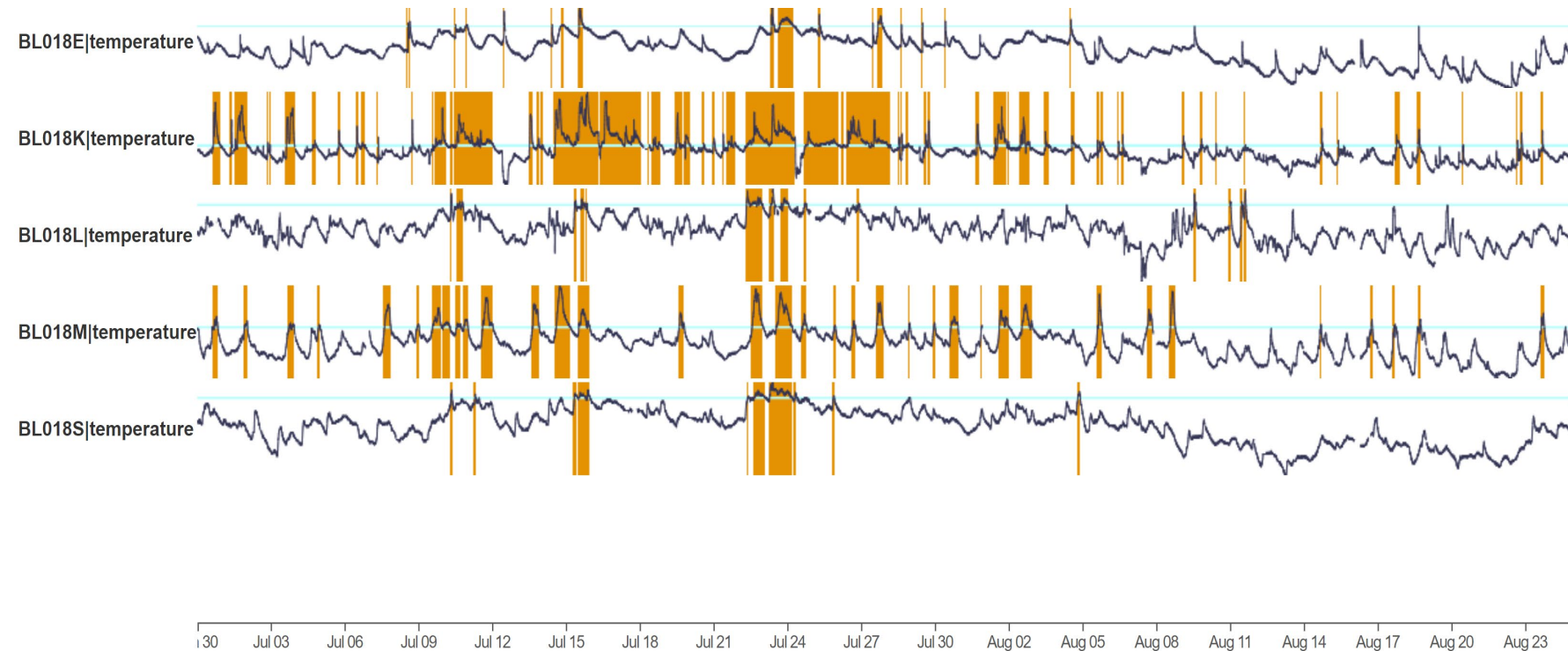


TRINITY BUSINESS SCHOOL

iSCAN: CO₂ MONITORING

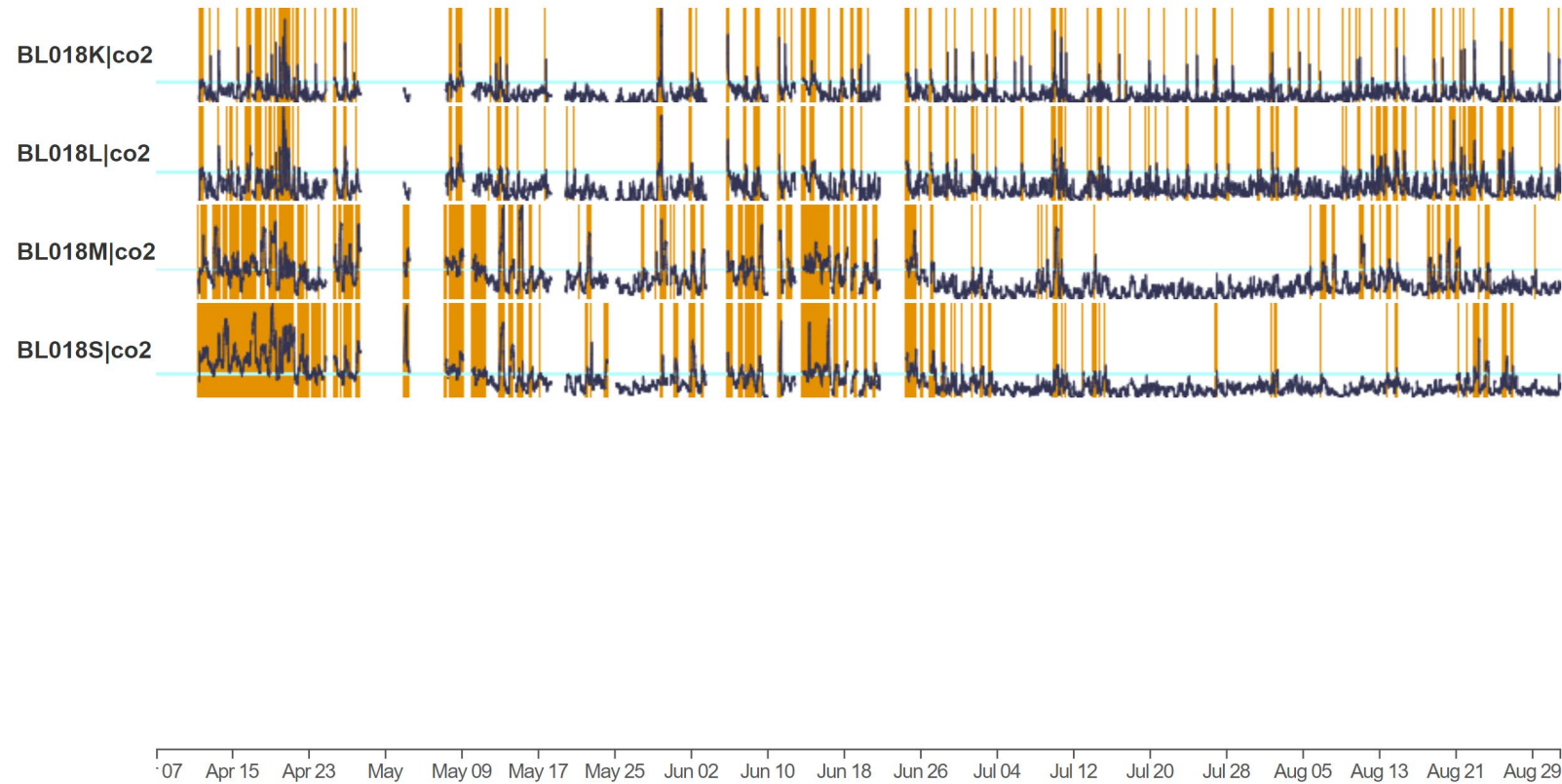


iSCAN: TEMPERATURE EXCEEDANCES



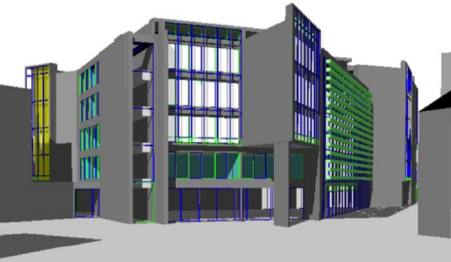
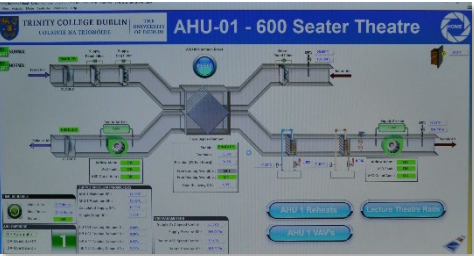
TRINITY BUSINESS SCHOOL

iSCAN: CO₂ EXCEEDANCES



TRINITY BUSINESS SCHOOL

DIGITAL TWIN – FEEDBACK



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FROM VISION TO EXECUTION **THE STEPS TO GET THERE**

DIGITAL TWIN MATURITY LEVELS

INFORMATION STRATEGY

Strategy & Goals



Information Requirements



01

Digital Twin Strategy: Business outcomes clearly defined with well-structured owner information requirements for the full building lifecycle: design, construction, commissioning, and operations.

DIGITAL TWIN MATURITY LEVELS

PLANNING PLATFORM

02

Project Twin: Model data management processes and system implemented to get data relating to tracked assets to establish what they are and where they are located.

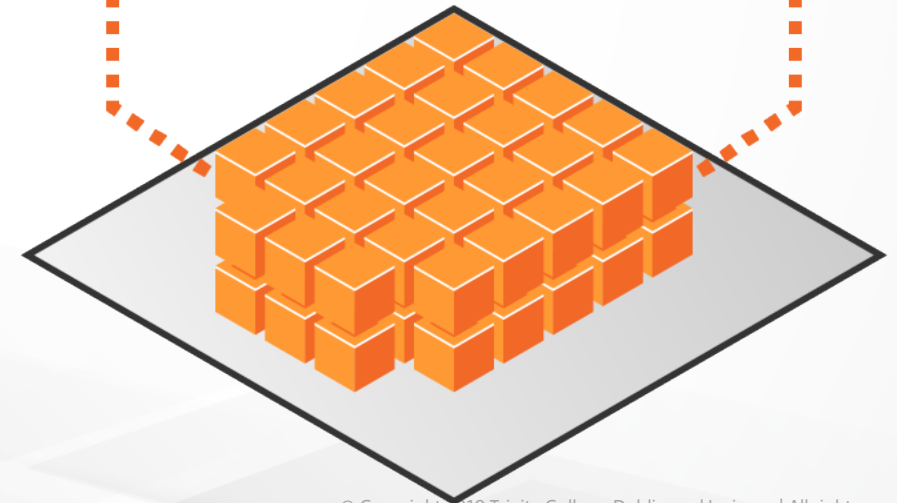
01

Digital Twin Strategy: Business outcomes clearly defined with well-structured owner information requirements for the full building lifecycle: design, construction, commissioning, and operations.

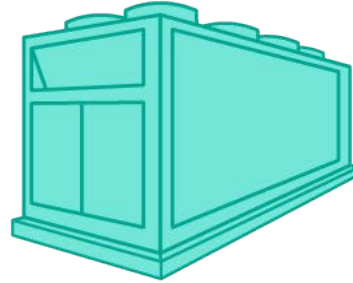
Tracked Assets



What & Where



AGGREGATING ASSET INFORMATION



01 DESIGN: Design Data

Asset ID
Uniclass code, description
Dimensions

Design Performance Data

Total Capacity
EER
Entering Water Temp
Leaving Water Temp

02 CONSTRUCTION: Specifications Data

Model Number
Manufacturer
Description

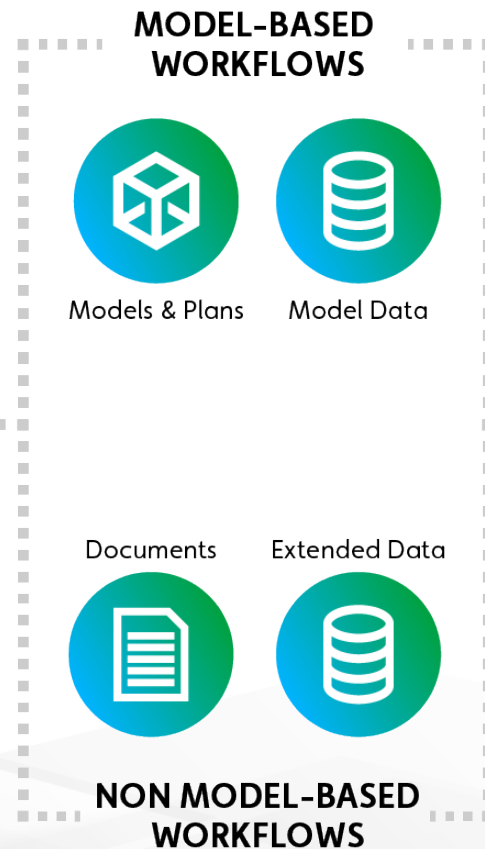
03 COMMISSIONING: Commissioning Data

Serial Number
Commissioning Date
Test Certificates

PRODUCING AN ASSET TWIN



Information strategy informs and guides model-based and non model-based information workflows



An Asset Twin aggregates data from model-based and non model-based workflows and is the foundation for many possible solutions.



DIGITAL TWIN MATURITY LEVELS

DIGITAL BUILDING MANUAL

03

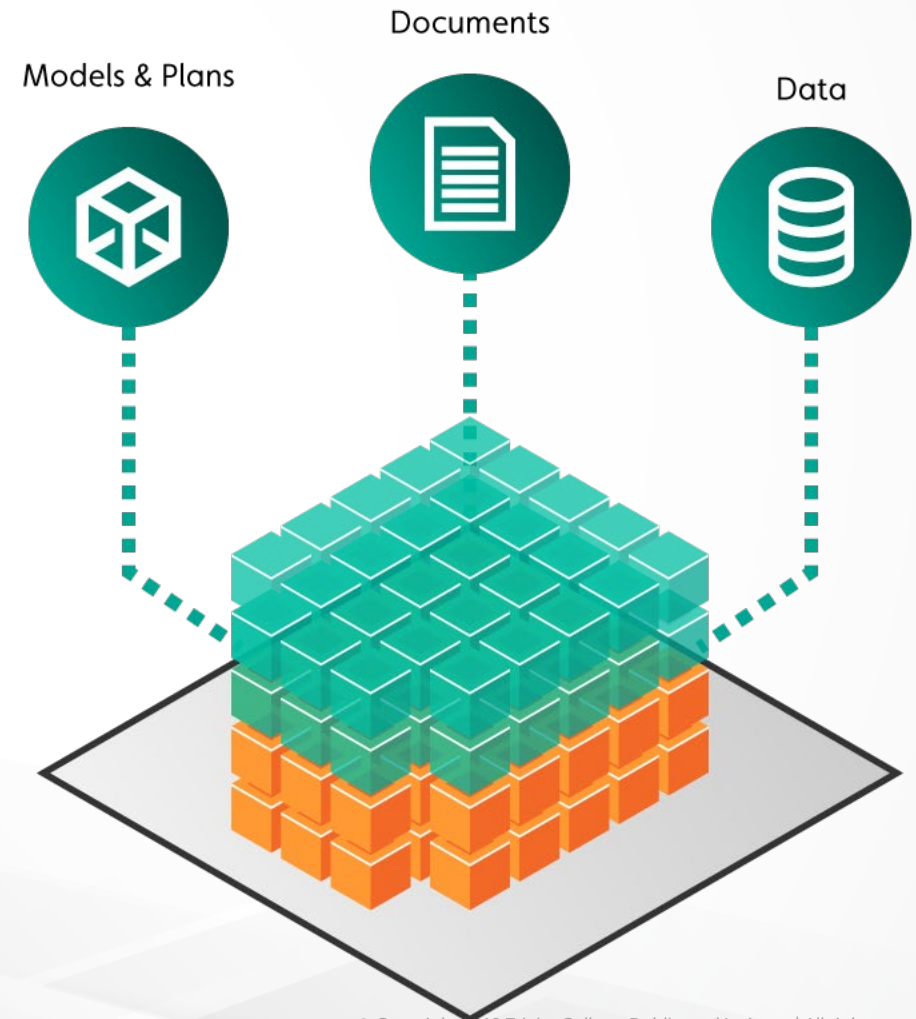
Asset Twin: Asset information management processes and system implemented to bring together building graphics, data, documents, to create a unified and living Asset Information Model.

02

Project Twin: Model data management processes and system implemented to get data relating to building elements to drive design optimisation and sustainability.

01

Digital Twin Strategy: Business outcomes clearly defined with well-structured owner information requirements for the full building lifecycle: design, construction, commissioning, and operations.



DIGITAL TWIN MATURITY LEVELS

DATA HUB

04

Performance Twin: Asset Twin integrated with Maintenance Management, Building Automation and IoT systems to join data across adjacent processes, to generate Business Intelligence and insights.

03

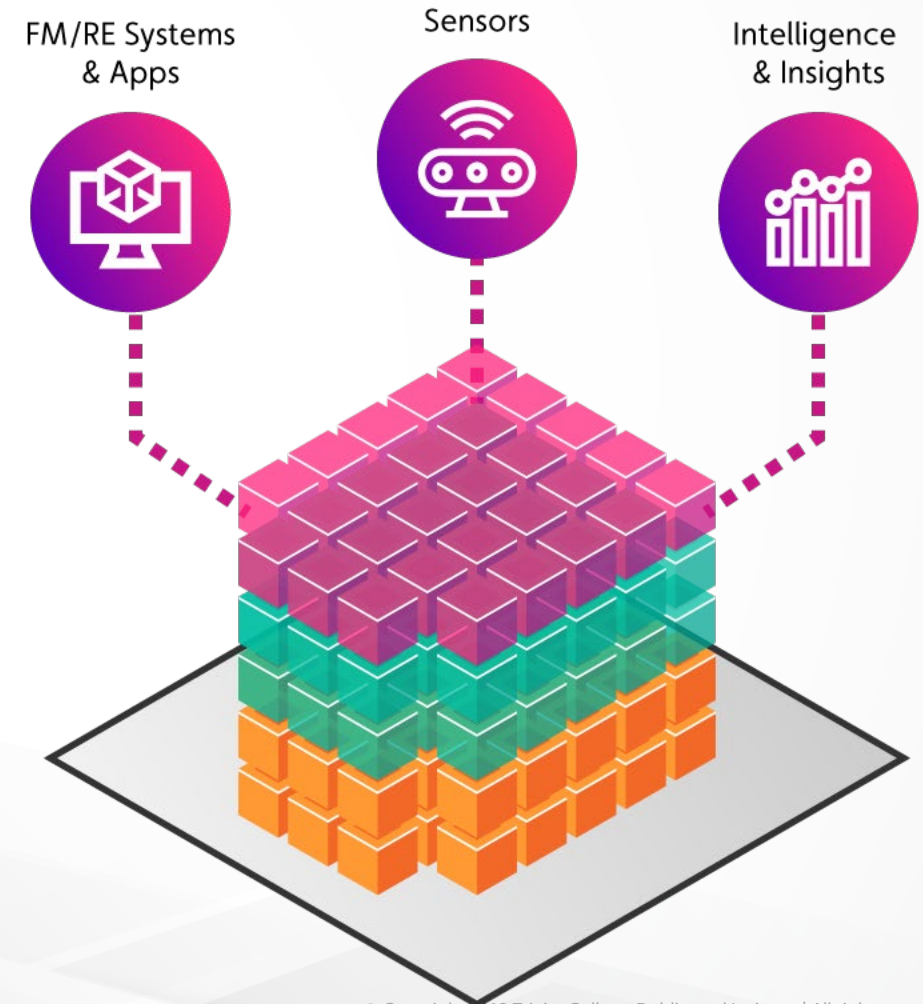
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02

Project Twin: Model data management processes and system implemented to get data relating to building elements to drive design optimisation and sustainability.

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Digital Twin Strategy: Business outcomes clearly defined with well-structured owner information requirements for the full building lifecycle: design, construction, commissioning, and operations.



DIGITAL TWIN MATURITY LEVELS

DIGITAL TRANSFORMATION

05

A Platform for Continuous Improvement: Automate existing and new processes involving asset, operations or performance data for a building or an entire portfolio. Continually optimize building performance and real estate business operations.

04

Performance Twin: Asset Twin integrated with Maintenance Management, Building Automation and IoT systems to join data across adjacent processes, to generate Business Intelligence and insights.

03

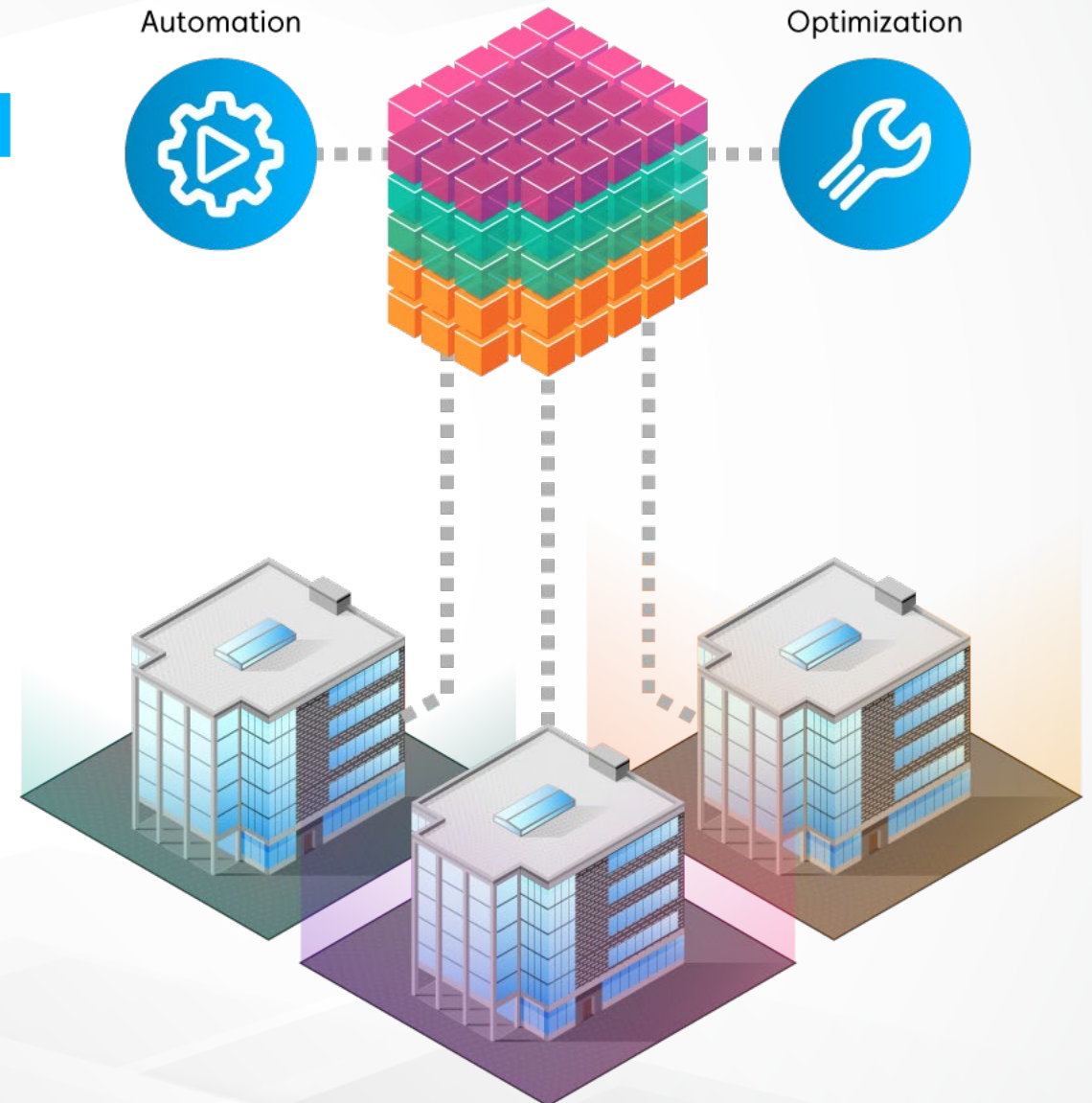
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THANK YOU QUESTIONS?

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