

Integrated Solutions for a Sustainable Built Environment

BIM for Design, Construction & Operations: Opportunities and Challenges

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Engineering & Design Director

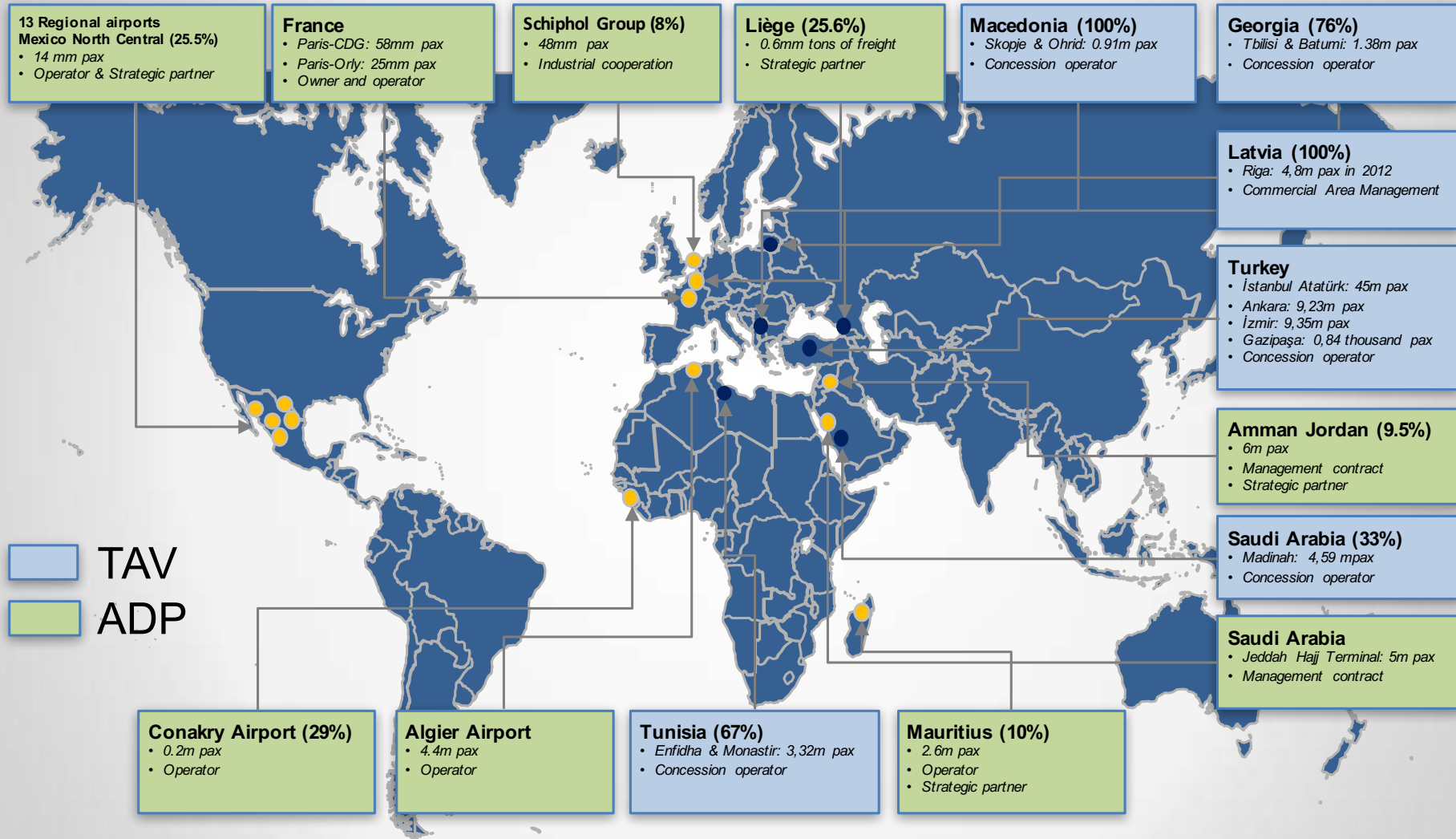
TAV Construction

TAV Integrated Solutions

OVERVIEW

- TAV Airports + TAV Construction + Integrated Solutions
- BIM Design & Construction
TAVis + Projects
Opportunities + Challenges + Implementation
- BIM FM + Lifecycle Management
Opportunities + Challenges + Implementation

ADP + TAV AIRPORTS



TAV AIRPORTS

TAV Airports Holding is an integrated airport services company providing design and construction, terminal / airport operations and maintenance services, duty free services, food and beverage services, airport security, ground handling and other auxiliary services

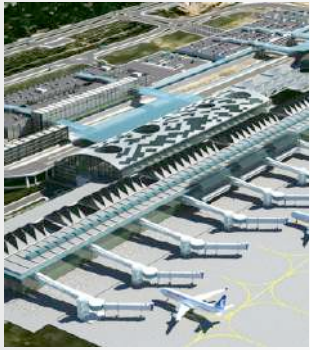
- Listed public company with 2.85 billion USD market capitalization (2013)
- 1.6 billion EUR revenue in 2016
- 95 million passengers served in 2014
- Major shareholders:
 - Aéroports de Paris Management (38%)
 - Tepe (8,1%)
 - Akfen (8,1%)
 - Sera (2%)
- Operates 16 airports
 - Turkey, Georgia, Tunisia ,Macedonia,
 - Latvia, Croatia and the Kingdom of Saudi Arabia

TAV CONSTRUCTION

**Largest Airport Construction Company
in the World [ENR]**

- Established in 2003 from TAV Airports
- Total value of projects under contract 16,2 billion USD
- TAV Construction has been undertaking construction of airport infrastructure projects in Turkey, Georgia, Tunisia, Macedonia, Egypt, Libya, Qatar , KSA, Oman and UAE.
- Total construction projects contracted over 5,000,000 m²
- Corporate headquarters located in Istanbul with branch offices in Dubai, Doha, Cairo, Tripoli, Bahrain and Tunisia.
- Technical O&M for airports, technical consultancy for aviation infrastructure, high-rise construction

TAV Construction Ongoing Projects



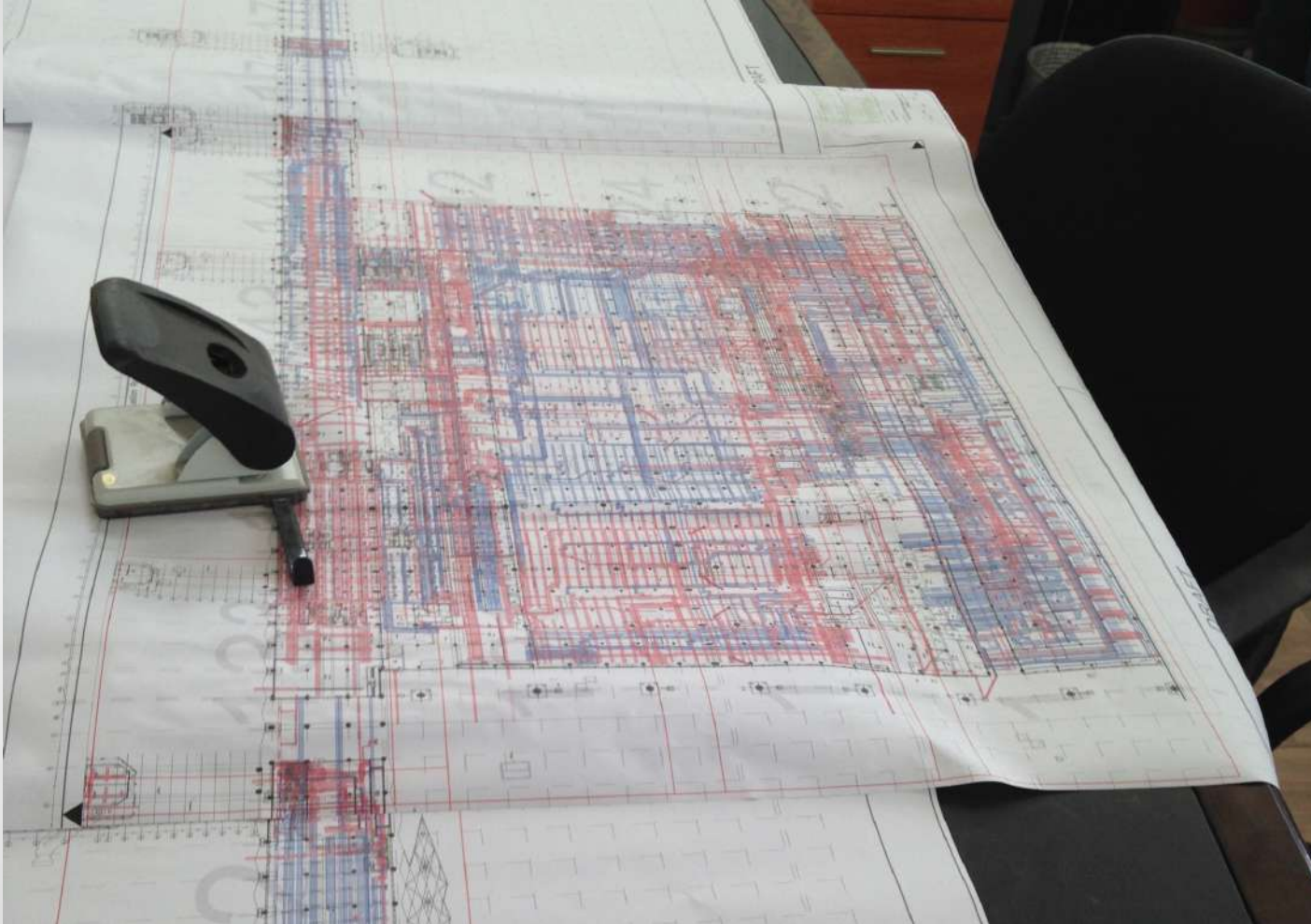
- Muscat Int., Oman
- Jeddah Maintenance Hangers, KSA
- Abu Dhabi Airport Midfield Terminal, UAE
- Medina Int. Airport, KSA
- İzmir Int. Airport Domestic Terminal, Turkey
- Riyadh Airport T5, KSA
- Damac Dubai Lotus Towers UAE
- Istanbul Emaar Square, Turkey
- Istanbul Atatürk Airport Int. Terminal Ext., Turkey
- ADP Headquarters, CDG, Paris, France
- Bahrain Int'l Airport, Bahrain
- Tblisi Airport Terminal Ext, Georgia

TAV Integrated Solutions

To formalize, utilize and commercialize the combined design, construction, and operation know-how of TAV Construction, TAV Airports and partners based on available tools and technologies created for the built environment industry.

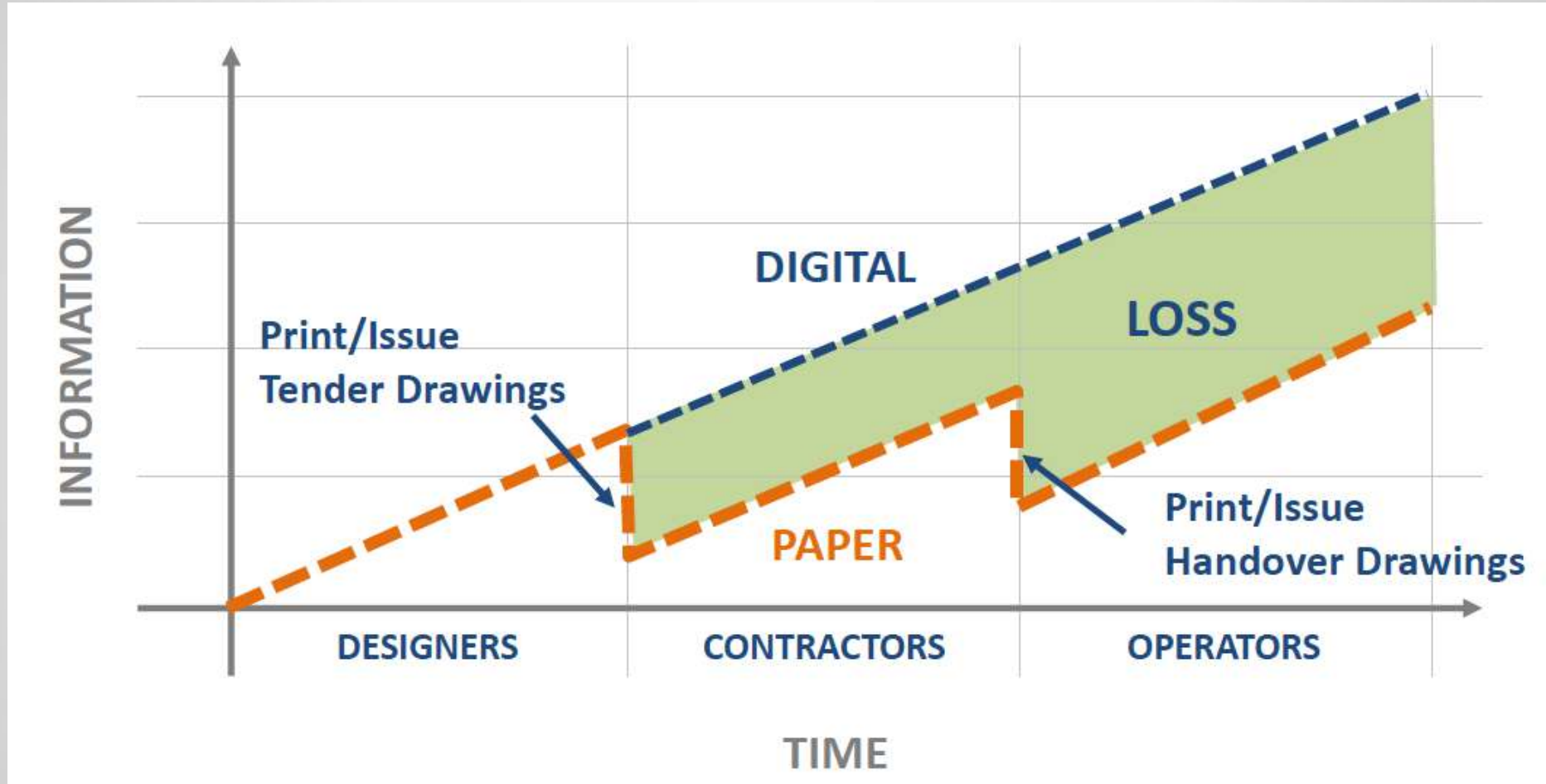
More than 6,500,000 m² of built environment with BIM

Information Mobility

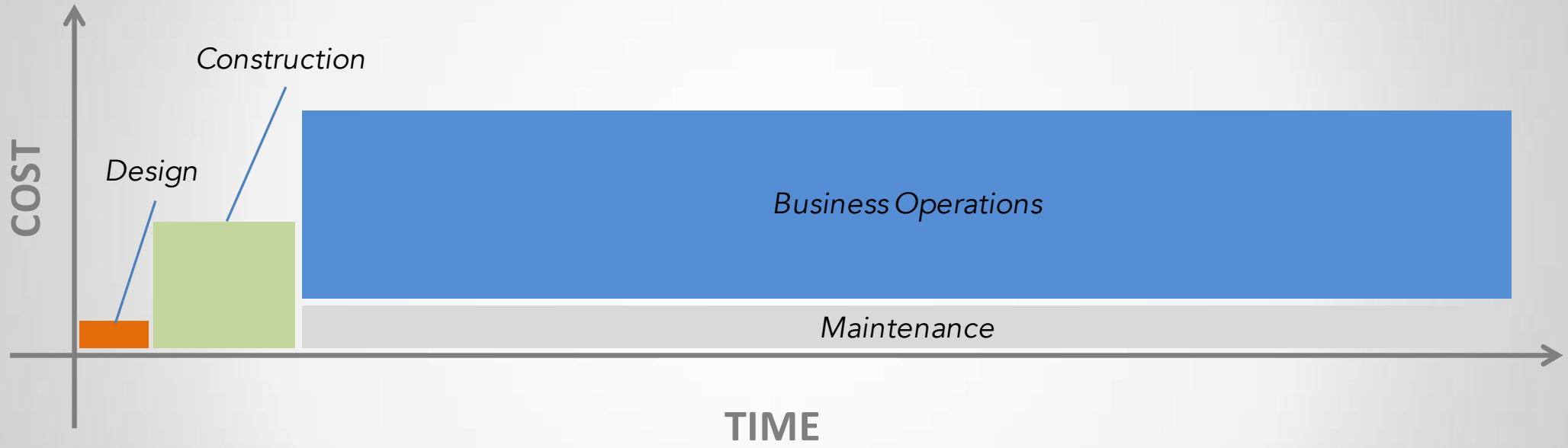


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BIM - Bucket for Information Mobility



BIM - Impact at Throughout Lifecycle



TAV Integrated Solutions

DESIGN & CONSTRUCTION

- 3D model:
 - Coordination
 - BOQ extraction
 - Shop drawings
 - Visualization
 - Rendering
- 4D scheduling/logistics:
 - Trade coordination
 - Site coordination
 - Resource allocation
- 5D cost control:
 - Cost planning
 - Estimation
 - Variation tracking
 - VE / Energy modeling

OPERATION READINESS & TRANSFER

- Digital data delivery
- Familiarization:
 - Visualization
 - Staff training
- Virtual commercial planning
- Virtual walk through and stakeholder engagement
- Laser scanning and validation
- Increased post-opening activities

FACILITY MANAGEMENT & OPERATIONS

- Navigation
- Asset management
- OEM documentation access
- Building management/automation system (BMS/BAS) integration
- Facility management system integration (i.e. CMMS)
- Energy performance validation
- Operation analytics and prediction
- Staff training

Adnan Menderes Int. Airport - İzmir, Turkey

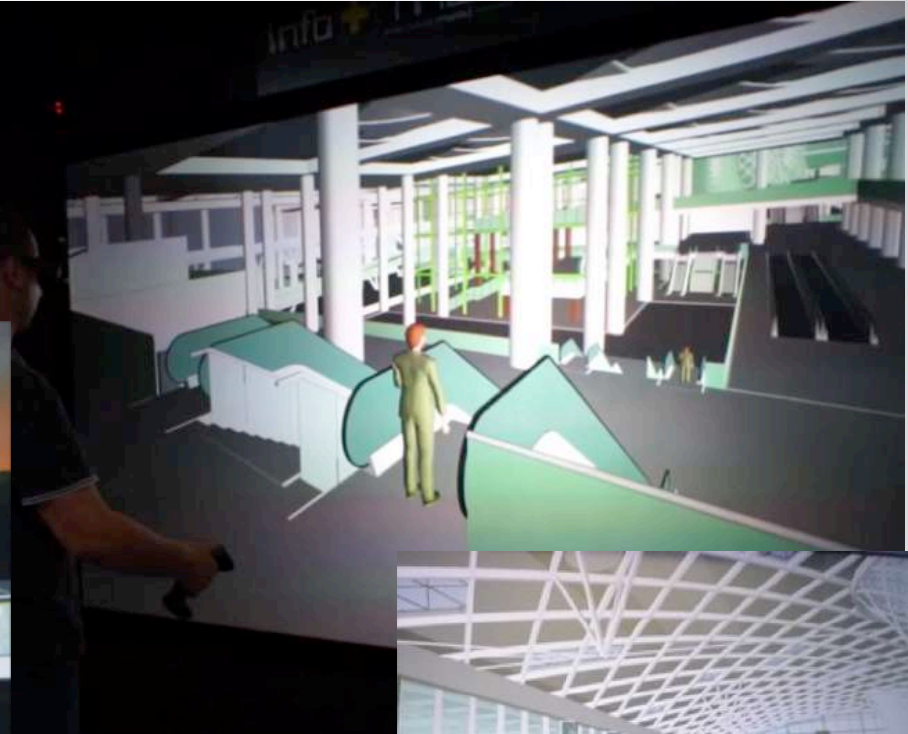
Scope - project and construction management with weekly deliverable cycles:

- Creation of LOD300 model
- Use of BIM model for project coordination and communication
- Energy simulations for efficient design decisions
- Immersive Virtual Reality Environment for familiarization and commercial use.
- Creation of 4D/5D coordination model for Terminal's Trigen facility



Adnan Menderes Int. Airport - İzmir, Turkey

Immersive Virtual Reality Application



Abu Dhabi Int'l Airport Midfield Terminal- Abu Dhabi, UAE

Scope of TAV in conjunction with Joint Venture partners is full BIM project and construction management:

- Architecture, Structure and MEP modeling
- LOD 300, 400, 500
- Managing RFI and updating BIM
- Clash Detection
- Trade Coordination
- BOQ Extraction
- Cost Estimation
- Variation Monitoring
- 4D Simulation, site logistics, phasing
- Production of shop drawings
- Time Impact analysis
- Visualization



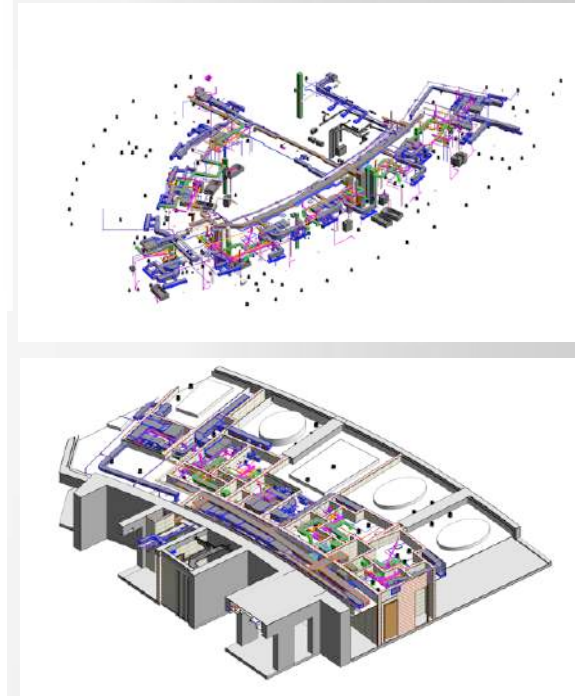
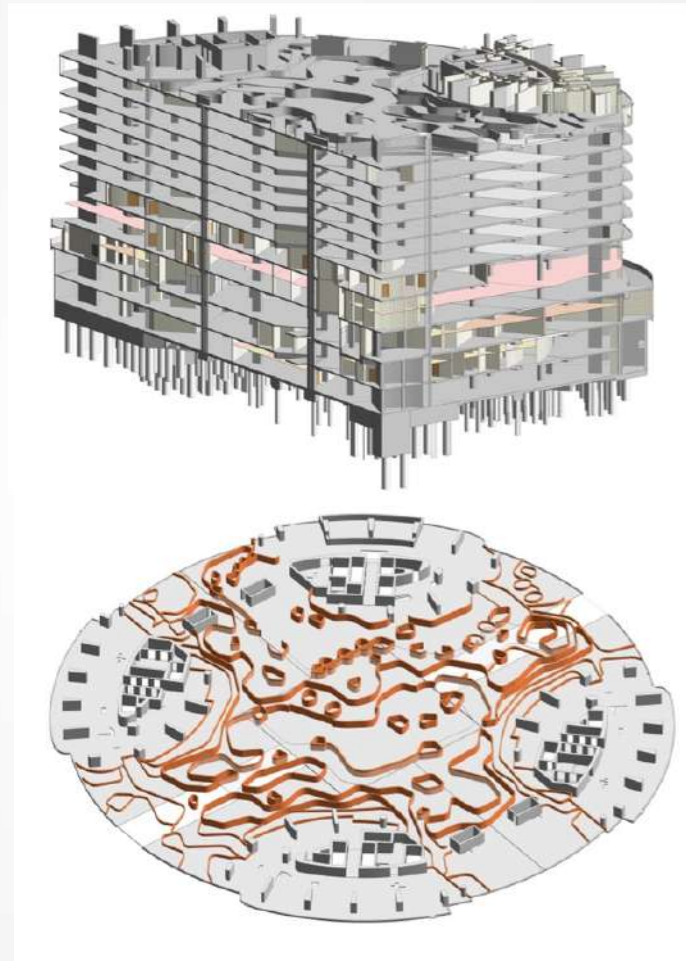
Damac Paramount Towers - Dubai, UAE

Scope - project and construction management with weekly deliverable cycles:

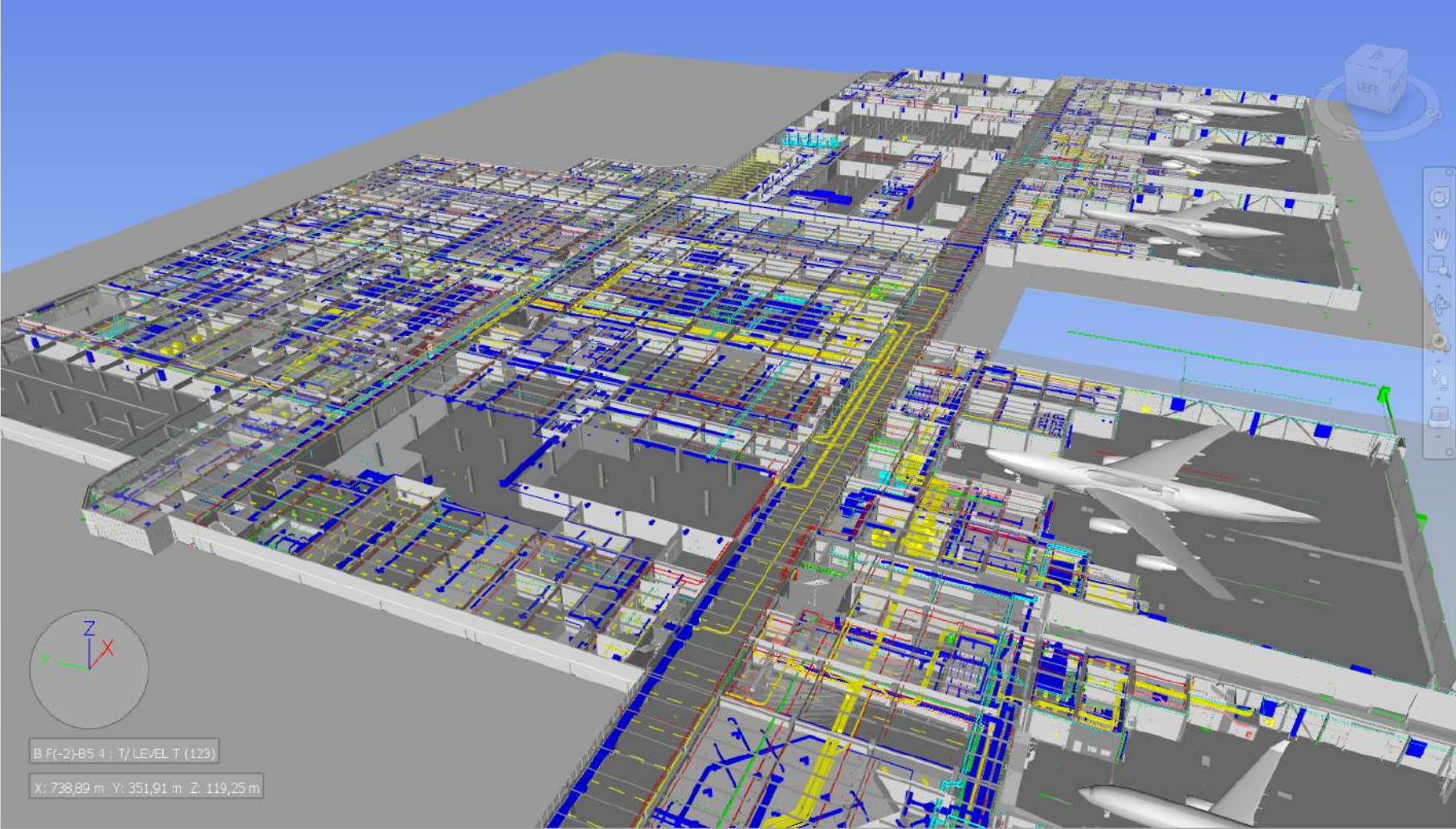
- Architecture, Structure and MEP modeling
- LOD 300, 400, 500
- Managing RFI and updating BIM
- Clash Detection
- Trade Coordination
- BOQ Extraction
- 4D Simulation
- Variation monitoring



Damac Paramount Towers - Dubai, UAE



Aircraft Maintenance Hangars - Jeddah, KSA



ADP Headquarters – Paris, France

BIM modeling is delivered for PRO Design phase and at completion :

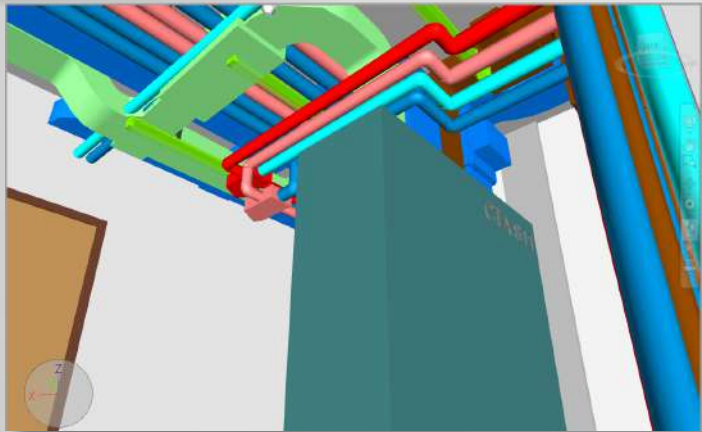
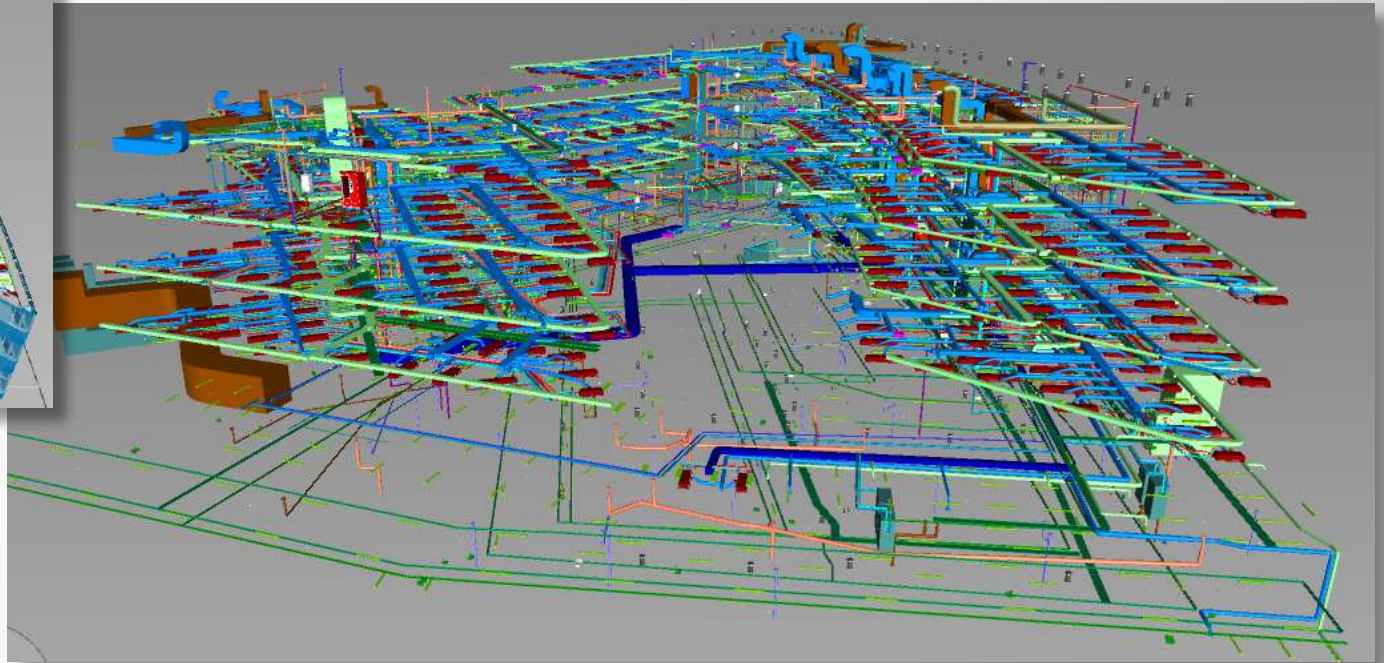
- Architecture, Structure and MEP modeling
- LOD 300, 500
- Clash Detection
- 4D Simulation, site logistics, phasing
- Facilities Management



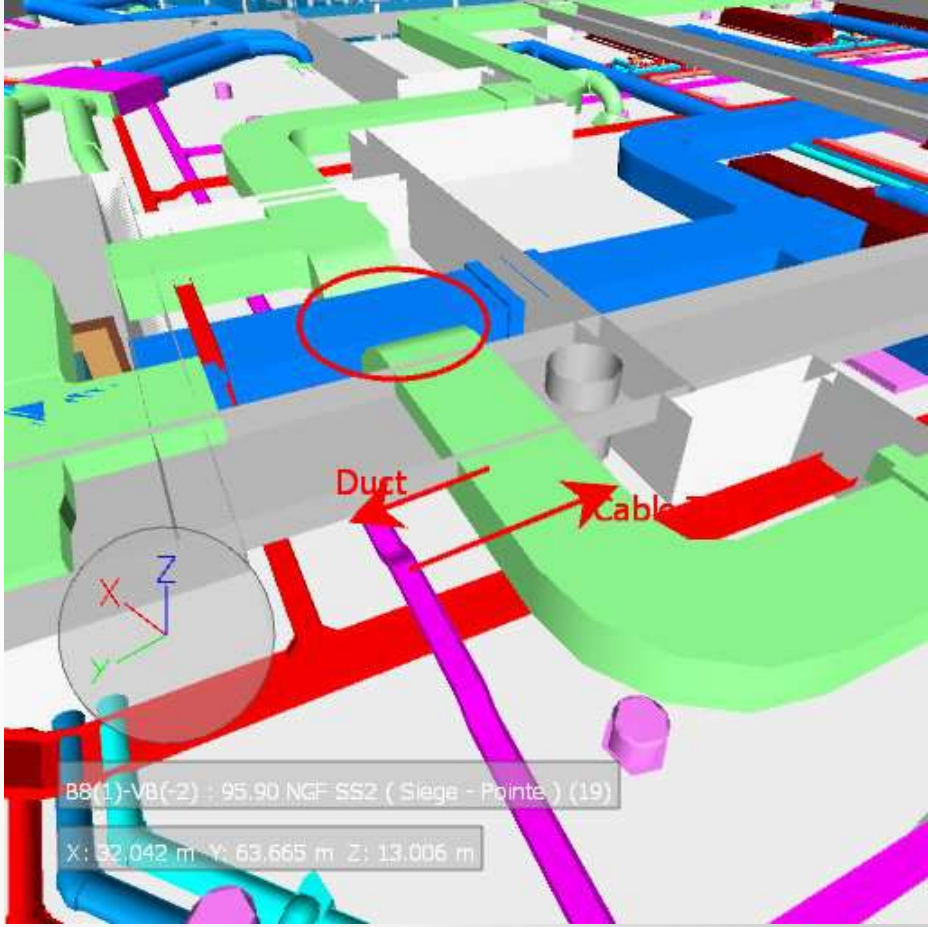
ADP Headquarters – Paris, France



ADP Headquarters – Paris, France



ADP HQ @ CDG - Paris, France



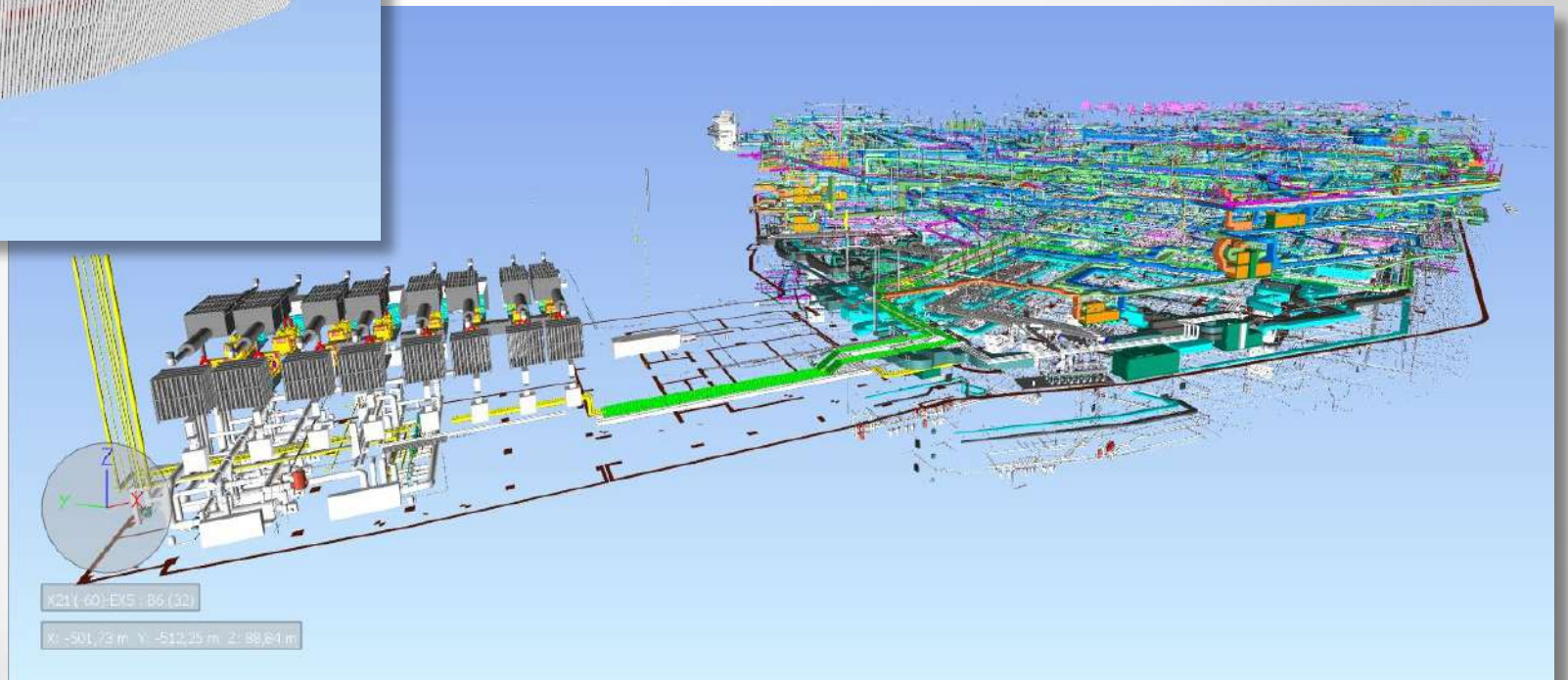
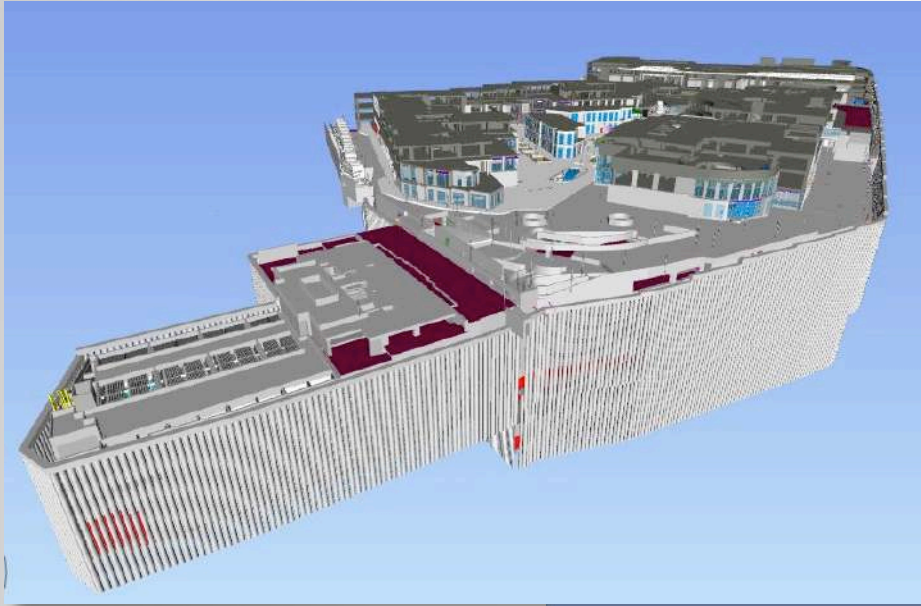
Emaar Square – Istanbul, Turkey

BIM modeling is utilized in project and construction management with weekly deliverable cycles:

- Architectural, Structural and MEP
- LOD 300, 400
- Clash Detection
- Trade Coordination
- BOQ Extraction
- 4D Simulation
- Production of shop drawings
- Variation monitoring
- + LOD 500 BIM FM Integration w/ Maximo

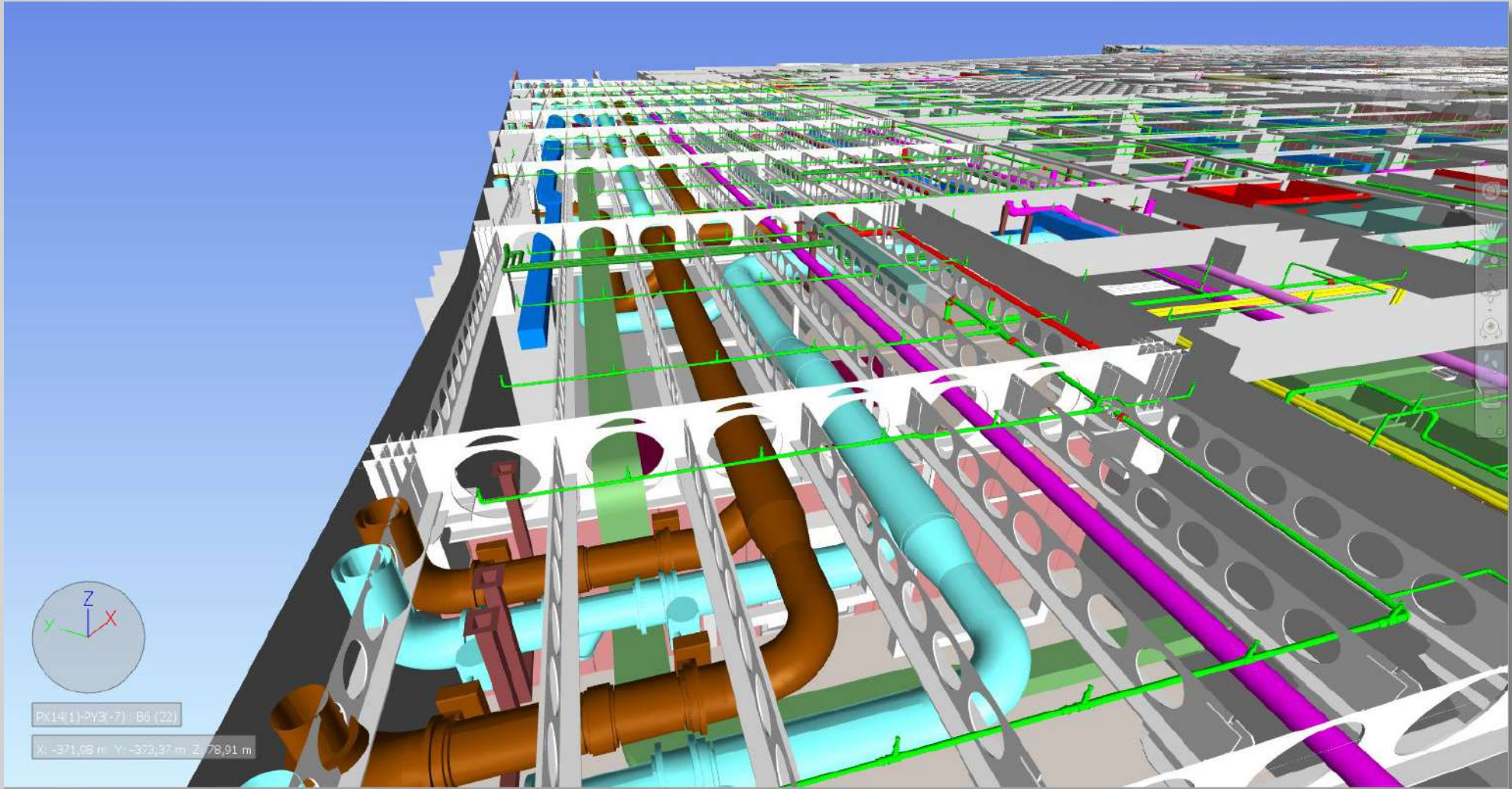


Emaar Square - Istanbul, Turkey



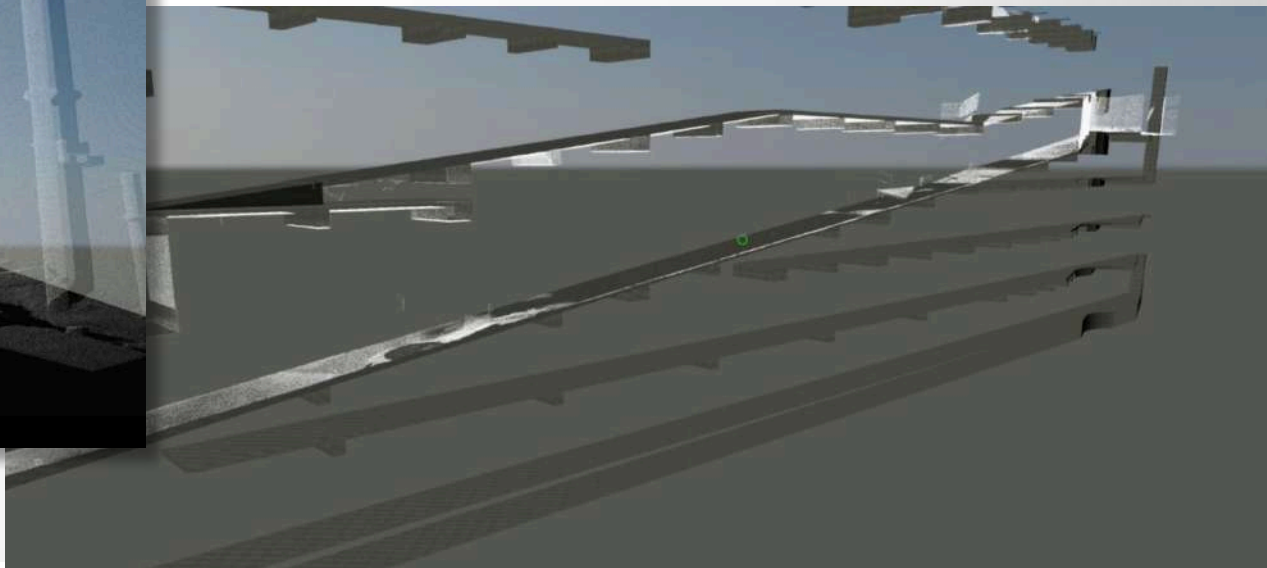
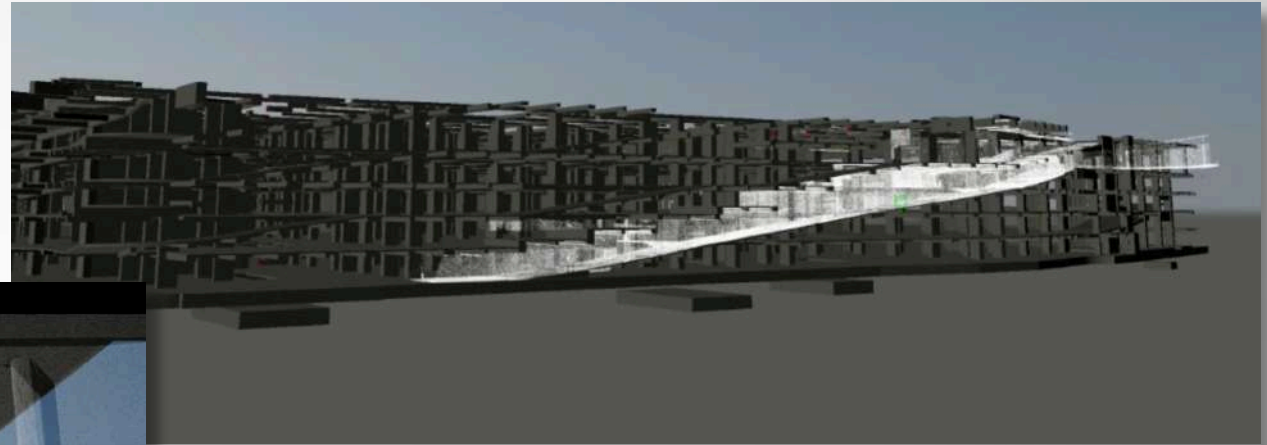
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Emaar Square – Istanbul, Turkey



Emaar Square – Istanbul, Turkey “Reality Check”

Laser Scanning for BIM model verification



BIM Scope Challenges

Project Specifications are not sufficient - Broad requirements lead to scope gaps:

"In addition to the CAD submittals, the Contractor shall maintain a REVIT model of the construction design, fully coordinated, at LOD 400. This model shall be submitted, via EDMS, for Engineer's review on a weekly basis, every week's end COB."

"In addition to the CAD submittals, the Contractor shall submit the As-Built Documentation via a Revit model of the construction design, fully coordinated, at LOD 400."

"The Contractor shall coordinate, document and issue submissions for the construction of this project using a Building Information Modeling (BIM) system in accordance with latest industry best practice and the requirements of Dubai Municipality - Circular No. 196."

"...Project Close Out: Prior to Substantial Completion the Contractor shall provide to the Employer a fully compliant BIM Model including the following... All As-Built Information shall include the following...Hand-over to Facility Management team for lifecycle cost and data capture, asset operation and maintenance."

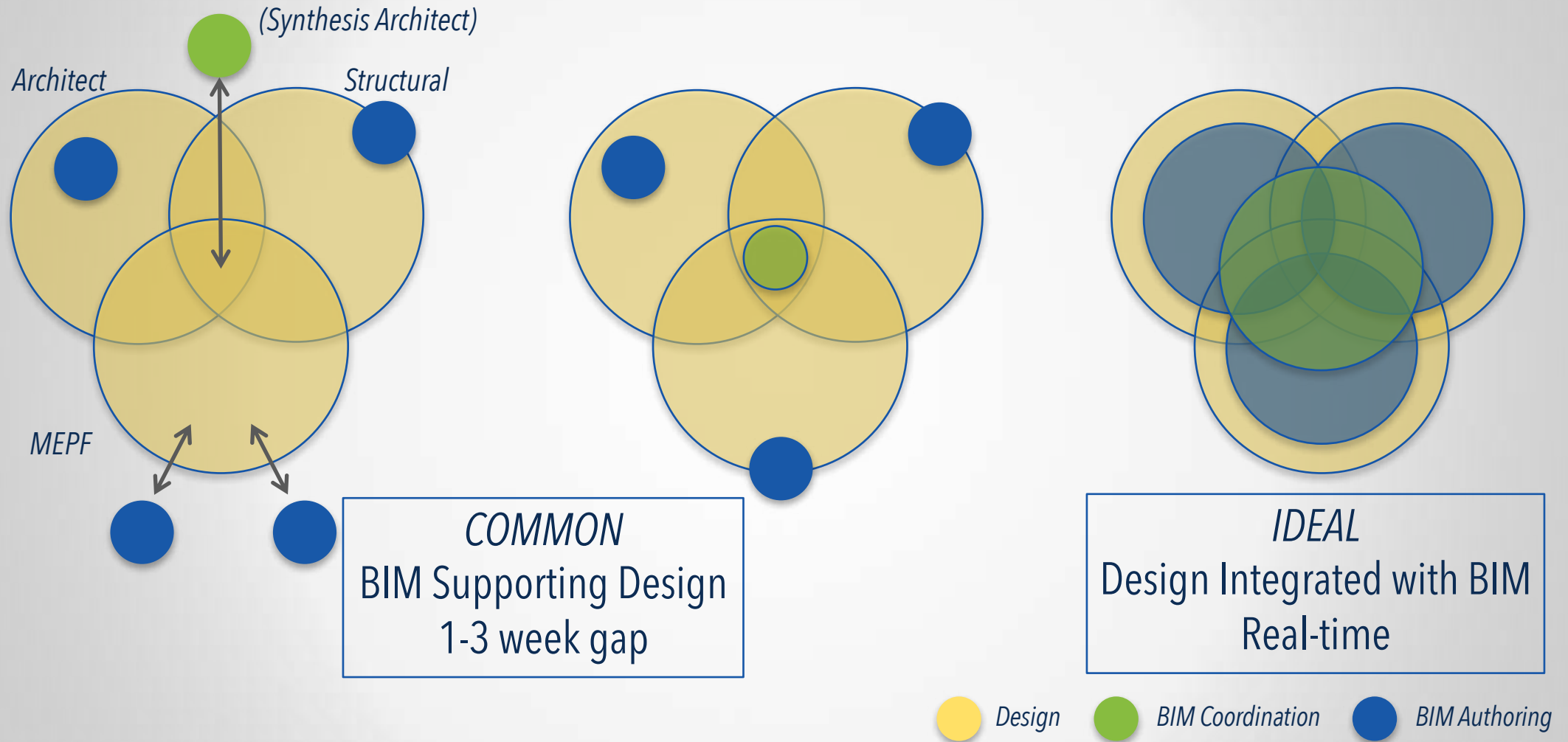
BIM Budget Challenges

- Currently Project Specifications are the main driver for BIM implementation on projects.
- Insufficient Scope makes budgeting BIM on projects difficult.
- Proper budgeting requires clarity on the intent and the knowledge that it requires continuous delivery throughout the project.
- In general the market is still pricing BIM as a model delivery:

You do not buy BIM models

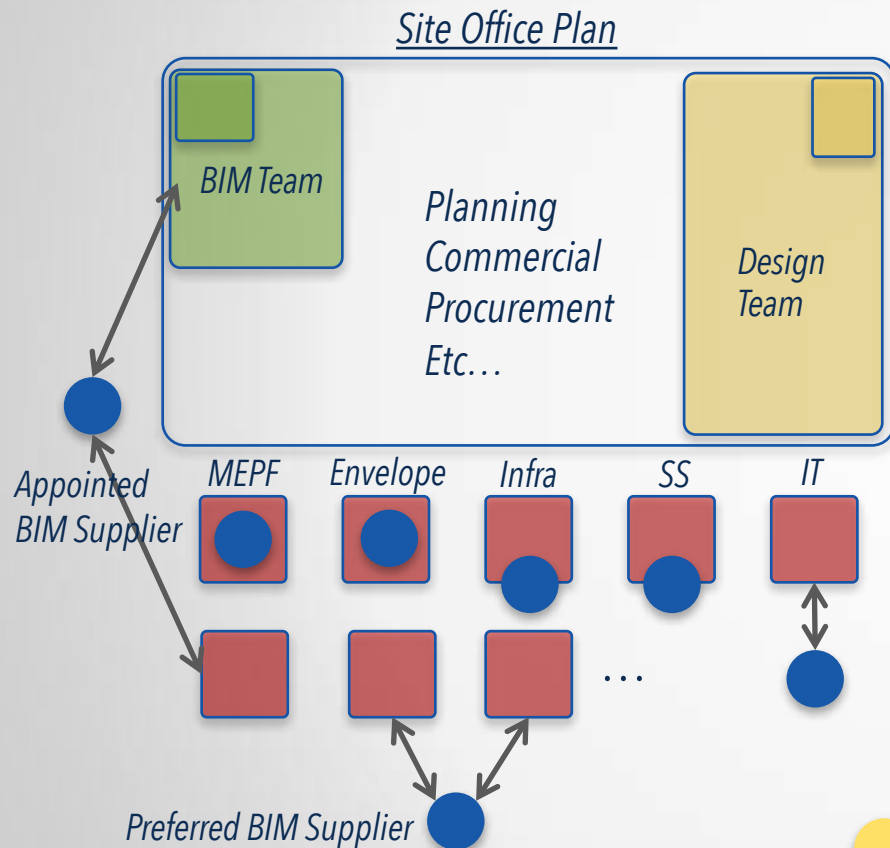
BIM is not a product – it is a process

BIM Organization: Design Phase Challenges

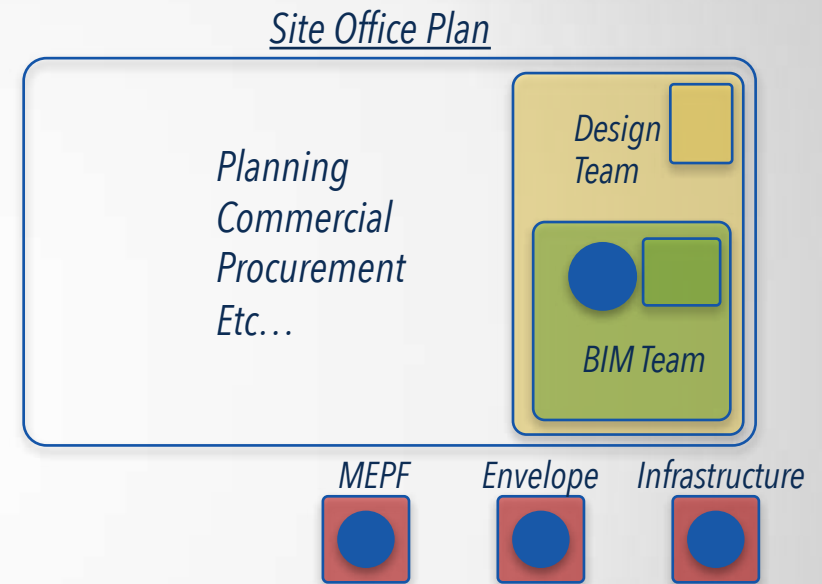


BIM Organization: Construction BIM Resourcing Challenges

COMMON: BIM delivery risks + incoherence

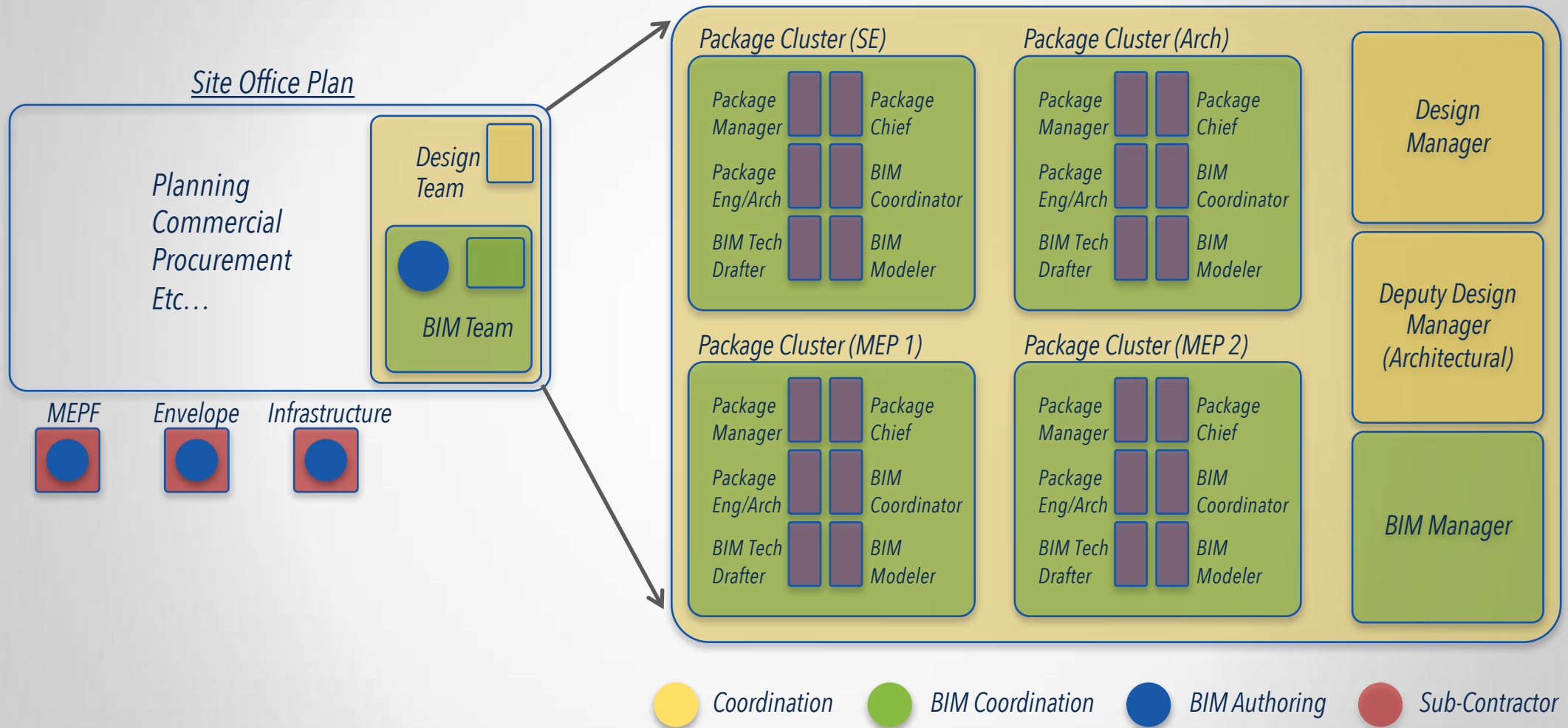


IDEAL: Integrated team + coherence

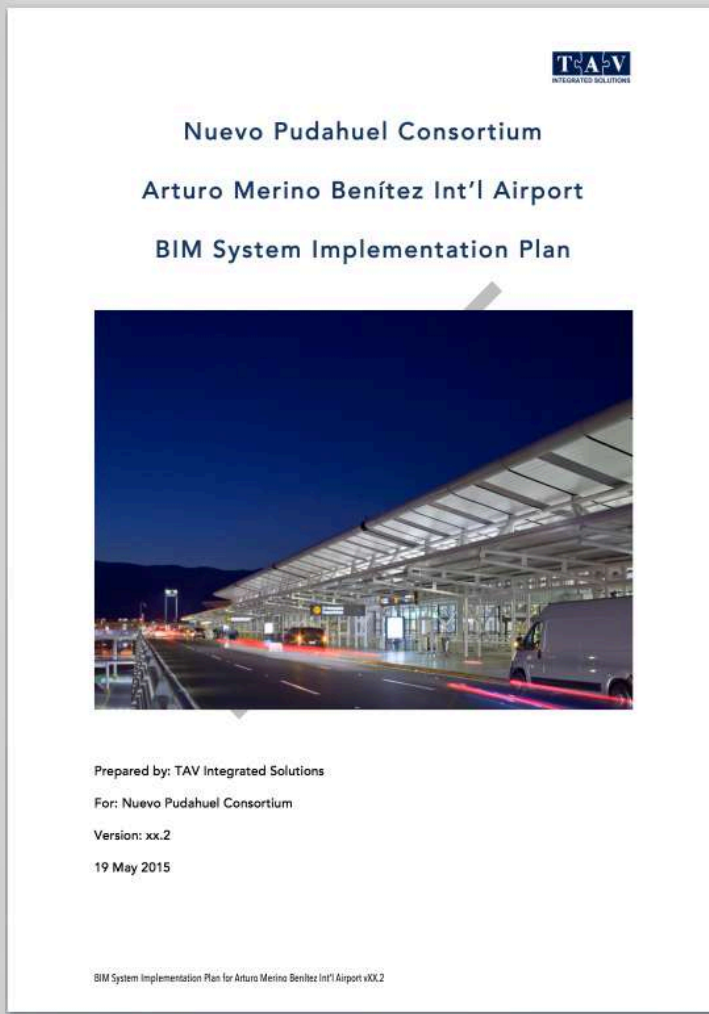


● Coordination
 ● BIM Coordination
 ● BIM Authoring
 ● Sub-Contractor

BIM Organization: Construction Phase



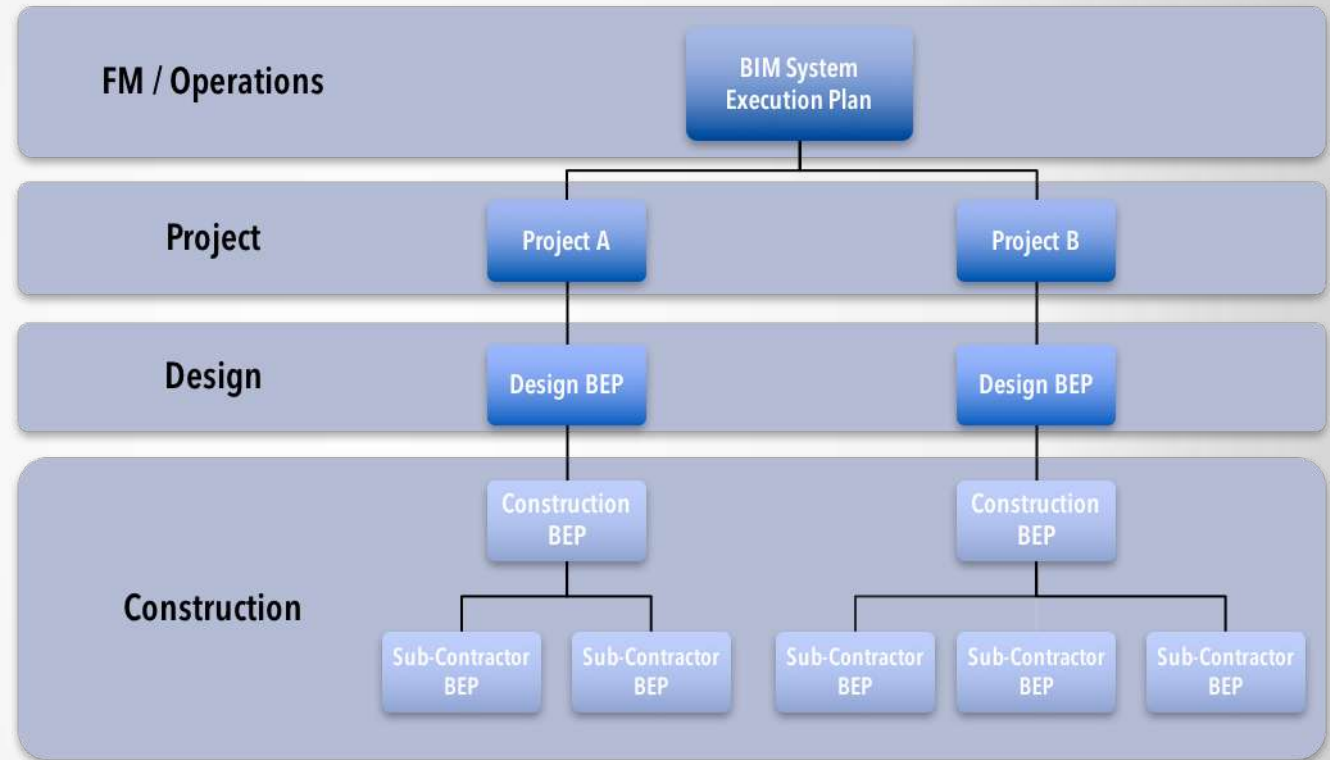
BIM Lifecycle Management: Santiago Airport, Chile



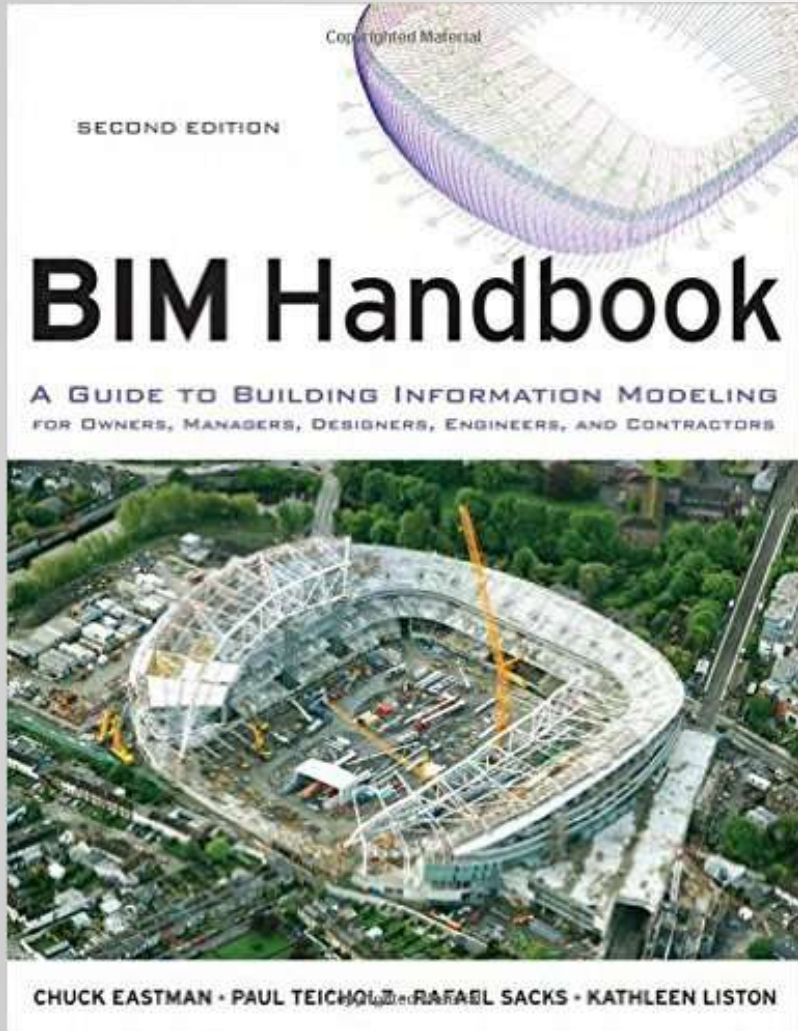
BIM System Implementation Plan:

- BIM elements and element attribute definitions
- Existing facility BIM model requirements
- New and Future facility BIM model requirements
- BIM model update methodology
- Data management
- BIM hardware and software updates
- BIM Management workflows

BIM Lifecycle Management: Santiago Airport, Chile



Prince Mohammed Airport: Medina, KSA - Case Study

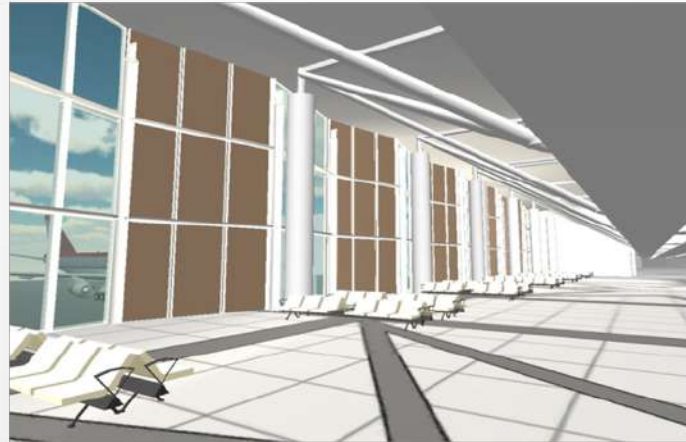
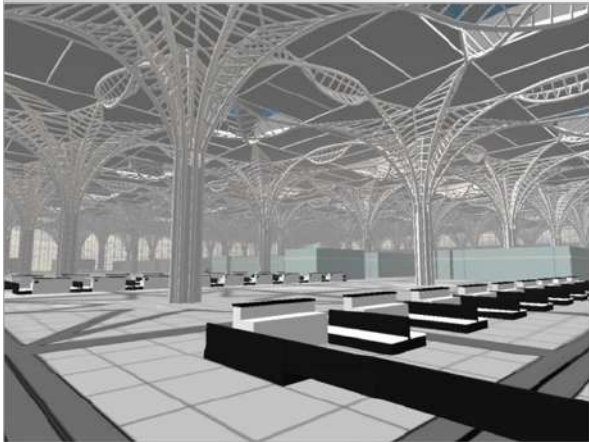


BIM Handbook 3rd Edition
Case Study:

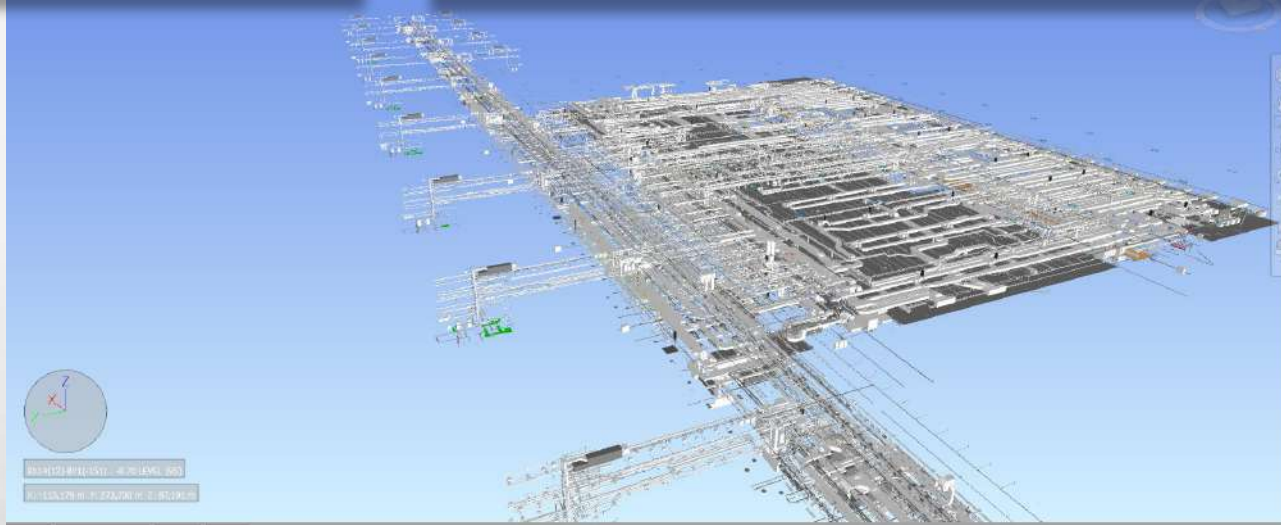
Medina International Airport
BIM – FM Integration

Prince Mohammed Airport - Medina, KSA

- Post design/construction BIM modeling based on As-built drawings - LOD500
- Visualizations for ORAT familiarization
- Organize and integrate BIM with Facility Management and Operation objectives enabling access and connectivity to all terminal physical information and systems



Prince Mohammed Airport: Medina, KSA

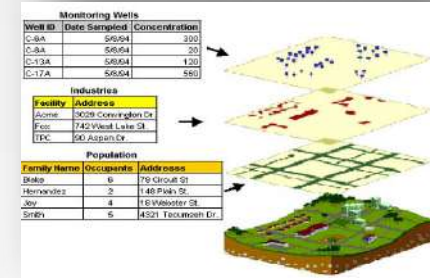


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BIM FM Integration: Information Mobility for Sustainable Facilities



Building Information Model (BIM)



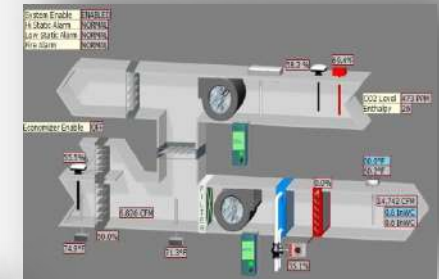
Geographical Information System (GIS)



BIM for FM



Computerized Maintenance Management System (CMMS)



Building Automation System (BAS)



Computer Aided Facility Management (CAFM)




Enterprise Resource Planning (ERP)


Data Granularity using BIM

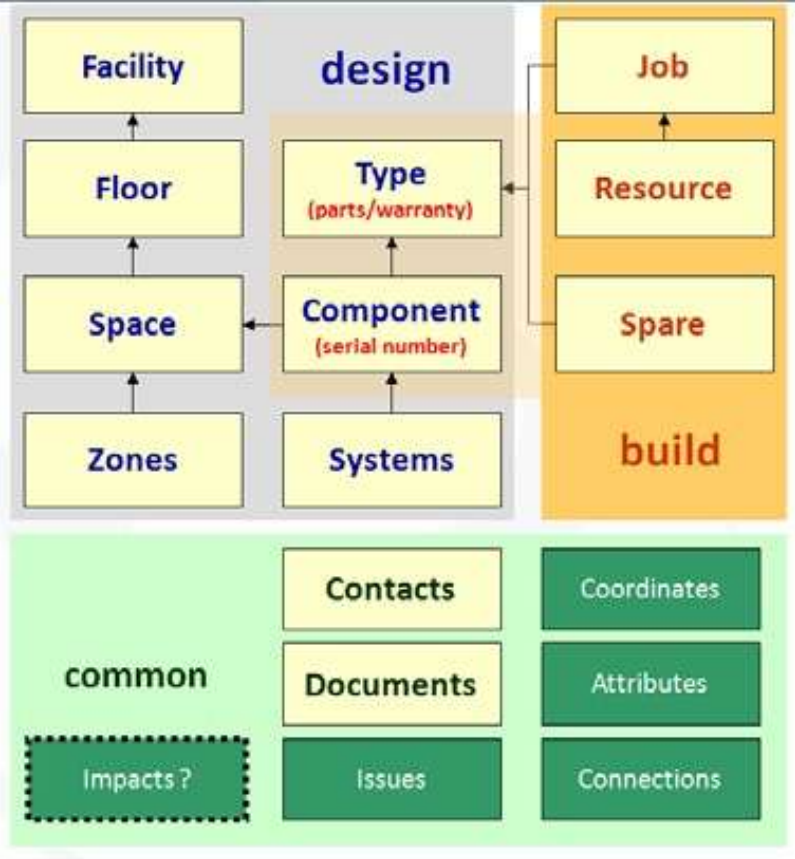
The BIM models for Medina provide granular information on more than 580,000 individual components for maintainable asset database.

Compared to manually tagged assets: 8,000 assets.

BIM Content: Begin with End in Mind

VI032 Arkitekt Urinal (mains supply) White		
BIM Object or Element Item Category - SANITARY		
Description: A 3D Element. Urinal (mains supply) White		
		
Level of Development	Information Category	Information Item
LOD 400-Fabrication		
Specific Assemblies that are Accurate in Terms of Size, Shape, Location, Quantity, and Orientation with Complete Fabrication, Assembly, and Detailing Information.	Physical Properties	Nominal Size
	Physical Properties	Length
	Physical Properties	Height
	Physical Properties	Width
	Physical Properties	Material
	Physical Properties	Colour
	Location Properties	Building ID
	Location Properties	Building Name
	Location Properties	General Location
	Location Properties	Floor ID
	Location Properties	Floor Name
	Location Properties	Zone/Space Name
	Location Properties	Zone/Space ID
	Location Properties	Elevation
	Annotation Properties	Brand
	Annotation Properties	Product Code
	Annotation Properties	Model
	Annotation Properties	System Abbreviation
	Annotation Properties	Sub-System Abbreviation
	Annotation Properties	TAG (Eng)
Annotation Properties	TAG (Tr)	
Annotation Properties	Accessory Type	
Annotation Properties	Reference	
Quantification Properties	BOQ Reference No	
Quantification Properties	WBS number	
FAMILY TYPES		
	1	Vitra - VI032 - Arkitekt Urinal (mains supply) White - 4106B003-5291

F03 HOSE CABINET			
BIM Object or Element Item Category - Fire Protection			
Description: A 3D Element. Fire Protection System Hose Cabinets.			
			
Level of Development	Information Category	Information Item	
LOD 400-Fabrication			
Specific Assemblies that are Accurate in Terms of Size, Shape, Location, Quantity, and Orientation with Complete Fabrication, Assembly, and Detailing Information.	Physical Properties	Nominal Connection Size	
	Physical Properties	Connection Type	
	Physical Properties	Length	
	Physical Properties	Width	
	Physical Properties	Height	
	Location Properties	Building ID	
	Location Properties	Building Name	
	Location Properties	Floor ID	
	Location Properties	Floor Name	
	Location Properties	Zone/Space Name	
	Location Properties	Zone/Space ID	
	Location Properties	Elevation	
	Annotation Properties	System Abbreviation	
	Annotation Properties	Sub-System Abbreviation	
	Annotation Properties	Fire Zone Abbreviation	
	Annotation Properties	Equipment Type	
	Quantification Properties	BOQ Reference No	
	Quantification Properties	WBS number	
	FAMILY TYPES		
		1	Left Recessed Type
	2	Right Recessed Type	
	3	Left Exposed Type	
	4	Right Exposed Type	



COBie framework

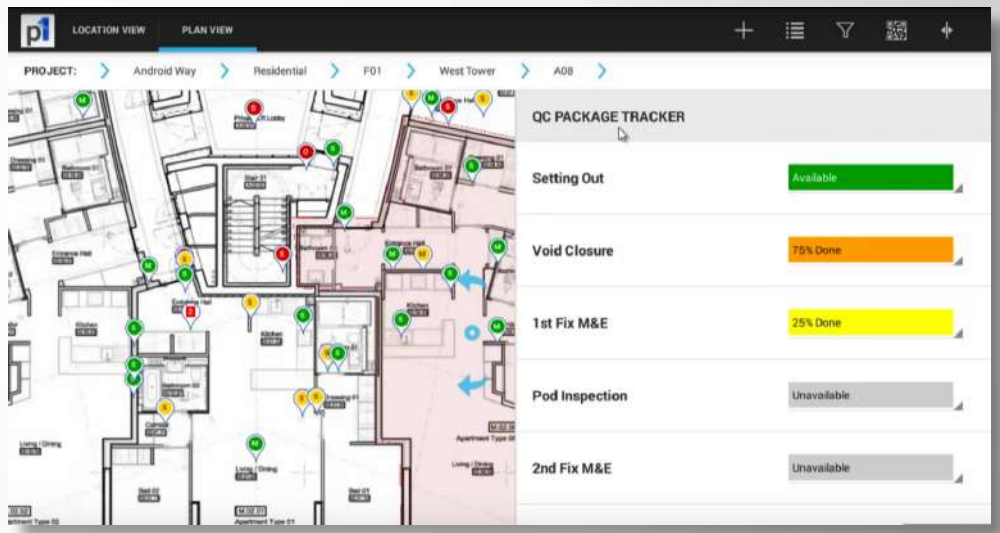
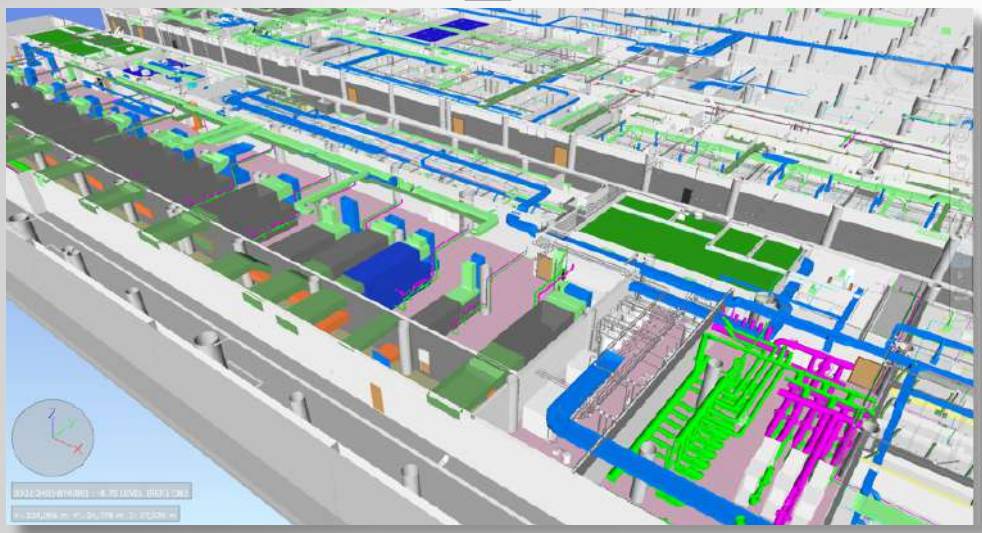
Construction-Operations Building information exchange

BIM/FM Lifecycle Management: QA/QC

BIM

Asset Data from BIM

Site Handheld Device



Asset Data from Site

BIM/FM Data Broker via BIM

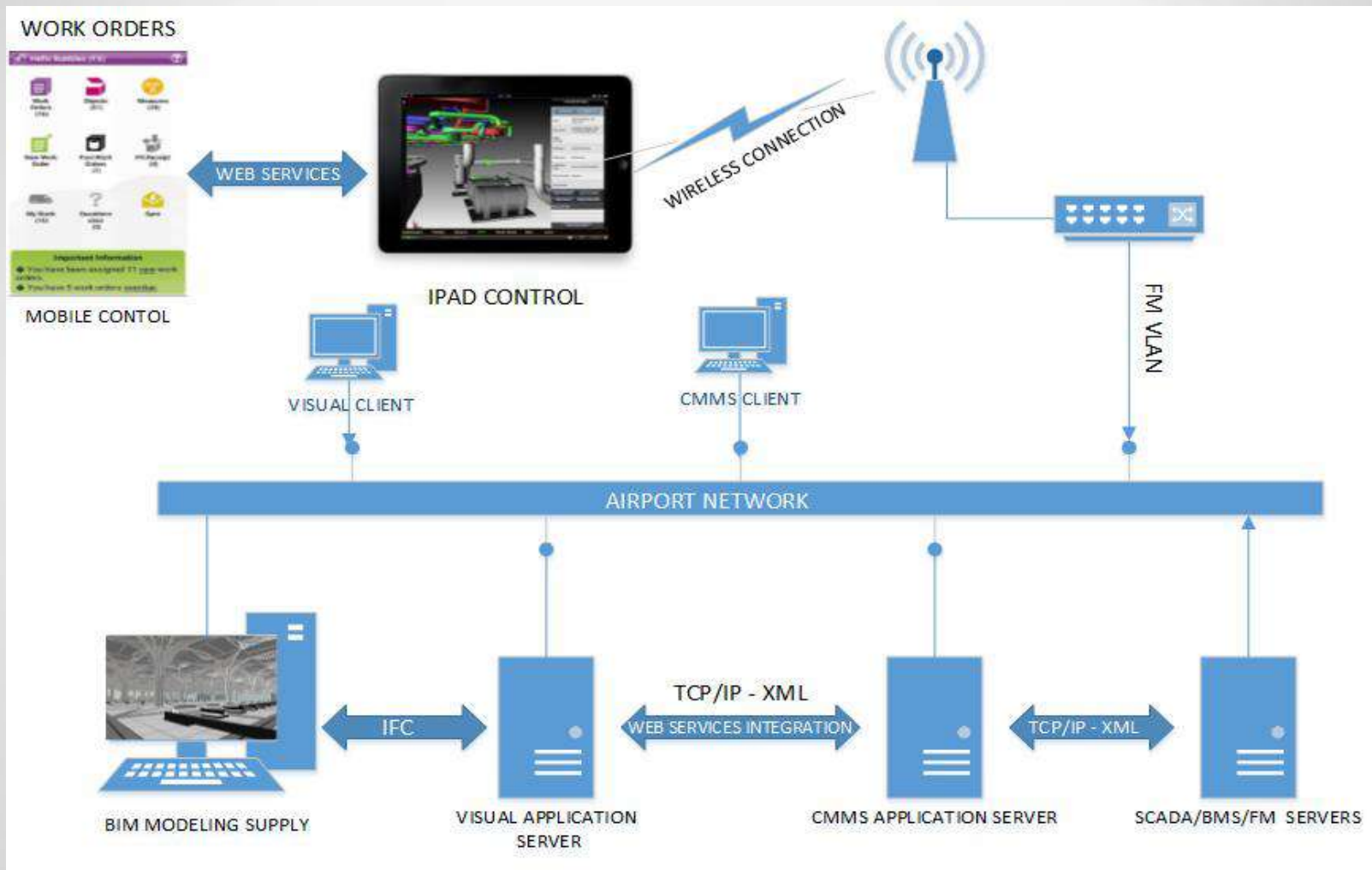
The screenshot displays the ecodomus software interface, which serves as a BIM/FM Data Broker. The top portion shows a 3D perspective view of a building's internal structure, including a complex network of pipes, ducts, and structural elements. A vertical list of levels is visible, ranging from +0.88 LEVEL (S.S.L.) down to -4.70 LEVEL (REF.).

The bottom portion of the interface shows a detailed data table for a specific asset, 'AHU-AE-1-2(R5)-Zone 5'. The table is organized into several groups of attributes, each with a checkbox for selection. The 'Value' and 'Stage' columns provide key information for each attribute.

Group	Attribute	Value	Stage
Group: Constraints	<input type="checkbox"/> Offset	500	As Built
Group: Dimensions	<input type="checkbox"/> Area	73 m²	As Built
	<input type="checkbox"/> Side Mouth Height	2100	As Built
	<input type="checkbox"/> Volume	79.14 m³	As Built
Group: Electrical - Loads	<input type="checkbox"/> Circuit Number		As Built
	<input type="checkbox"/> Panel		As Built
Group: Graphics	<input type="checkbox"/> Back Connector	Yes	As Built
	<input type="checkbox"/> Side Connector	No	As Built
Group: Identity Data	<input type="checkbox"/> Comments		As Built
	<input type="checkbox"/> Mark	55	As Built
	<input type="checkbox"/> TAV_Subsystem	AHU-AE-1-2(R5)-Zone 5_Supply Air/AHU-AE-1-2(R5)-Zone 5_Return Air/AHU-AE-1-2(R5)-	As Built
	<input type="checkbox"/> TAV_System	AHU-AE-1-2(R5)-Zone 5,CP-ALL-01-25,31	As Built
Group: Mechanical	<input type="checkbox"/> mod_cooling_sen_dp	0.0 Pa	As Built
	<input type="checkbox"/> mod_piping_sen_dp	0.0 Pa	As Built
Group: Text	<input type="checkbox"/> BIM Sequence No	0403B40111	As Built
	<input type="checkbox"/> Object ID		As Built
	<input type="checkbox"/> TAV_Room_Name	AHU AREA 1	As Built



BIM/FM Integration: Sustainable Facilities



Aconex ConnectedBIM: Model + Information

The screenshot displays the Aconex ConnectedBIM interface. At the top, the user is logged in as Mrs Rabia Tosun. The main area shows a 3D model of a building structure with various levels and components highlighted in yellow and blue. On the left, there is a 'Model Stacks' panel listing different model categories like Medinah_Structural, Medinah_Arch, etc. On the right, an 'Explorer' panel shows a hierarchical tree of the model's structure. Below the model, a 'Linked documents' panel lists various documents related to the project, including drawings and PDFs. At the bottom, a table shows a list of documents with their revision history.

Revision date	Type	Size	Lock
02/02/2013	Drawing	12.4 MB	🔒
07/07/2013	Drawing	14.5 MB	🔒
10/10/2014	Drawing	202.7 KB	🔒
10/10/2014	Drawing	7.5 MB	🔒
07/07/2013	Drawing	148.4 KB	🔒
07/07/2013	Drawing	5.7 MB	🔒
09/09/2014	Drawing	5.8 MB	🔒
12/12/2014	Drawing	856.2 KB	🔒

Document ID	Description	Revision	Status	System	Supplier	Created	Approved	Type	Size
101_PT_B_W_001_004	General Arrangement - Escalator E11, Moving Ramp MR1.1, MR1.2 & MR1.3	02	Approved with Comments	LET System	ThyssenKrupp Elevator	07/05/2013	05/05/2013	Drawing	3 MB
101_PT_B_W_001_004.dwg	General Arrangement - Escalator E11, Moving Ramp MR1.1, MR1.2 & MR1.3	04	Approved	LET System	ThyssenKrupp Elevator	01/08/2013	25/07/2013	Drawing	13.5 MB
MAJV-MIF-CW-LET-PTB-0035	MIF-Escalator E11	00	Approved	LET System	ThyssenKrupp Elevator	02/01/2014	02/01/2014	Material Inspection Form	226.8 KB

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BIM/FM: Element Tagging

There may be several unique equipment identifiers used in parallel that are necessary to capture as attribute information within BIM models:

- Barcode tag numbers
- Equipment serial numbers
- As-built shop drawing tags
- Object IDs compiled of several naming levels
- BIM GUID tags

BIM/FM: Element Tagging

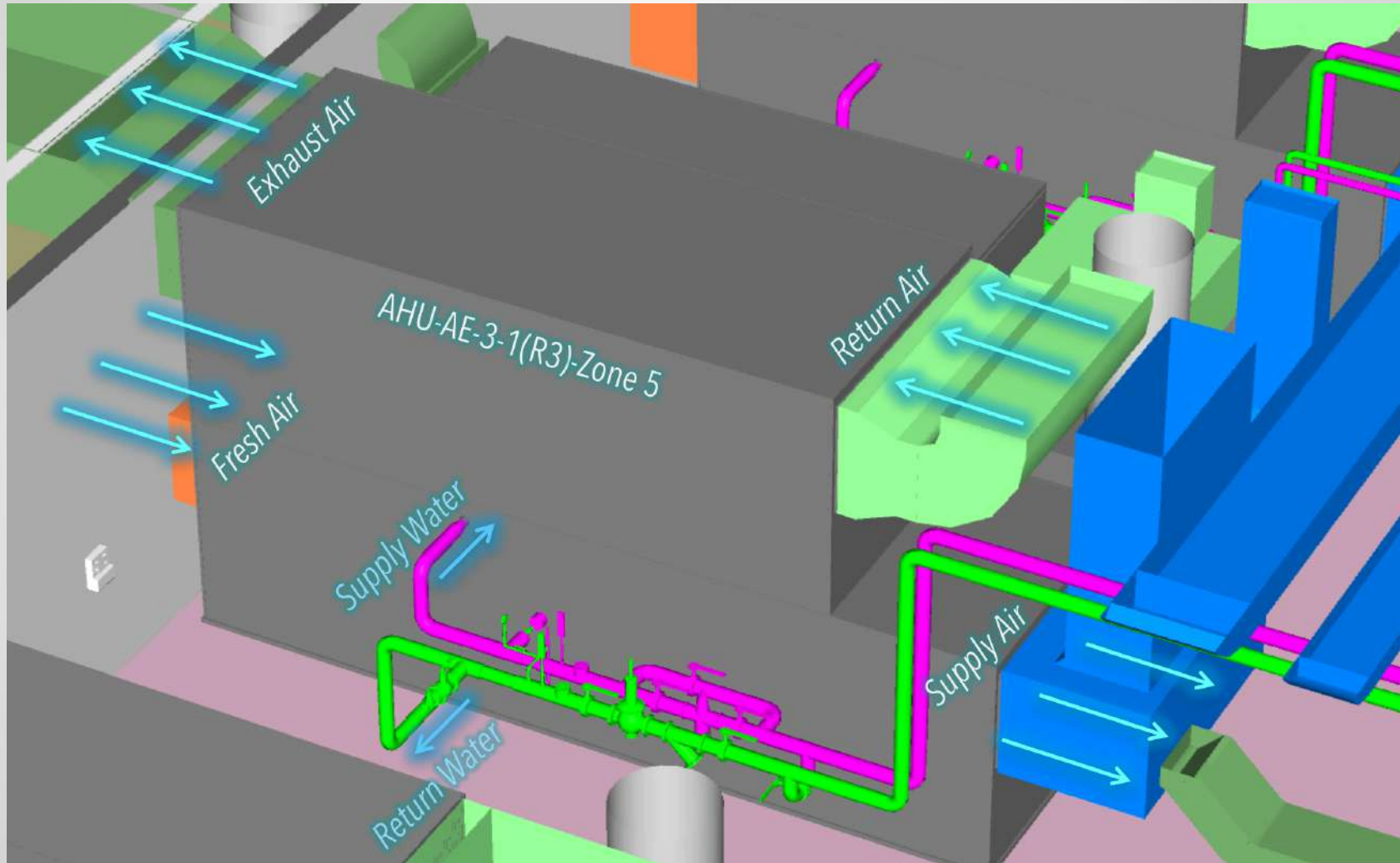


Object ID Naming Levels	Description
Level 1: System Code	<u>AA</u> : Two-digit System code as defined by Tibah i.e. 04 for HVAC System
Level 2: Sub-System Code	<u>BB</u> : Two digit Sub-System code as defined by Tibah i.e. 01 for Air Condition Units under HVAC system
Level 3: Room Number	<u>CCCC</u> : Terminal room number as defined by Tibah i.e. M281
Level 4: Unique ID	<u>DDD</u> : Numbering restarting at each room. i.e. 1,2,3, etc.

Example Object ID for the three Air Condition Units in Room M281:

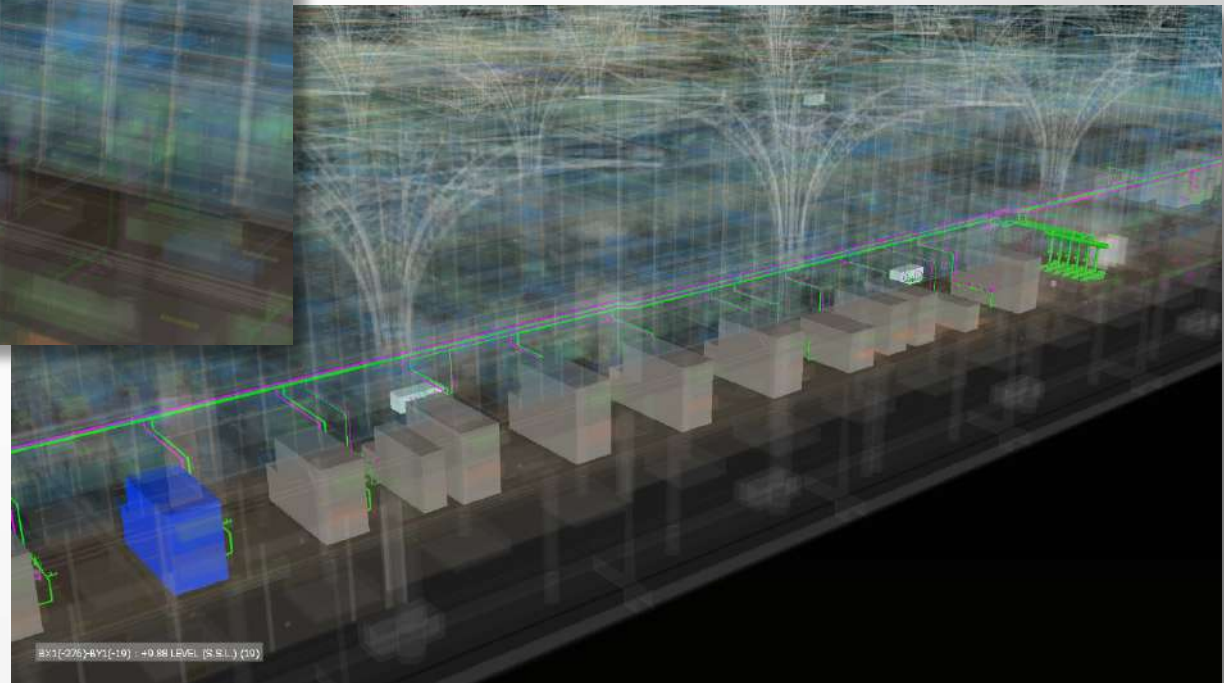
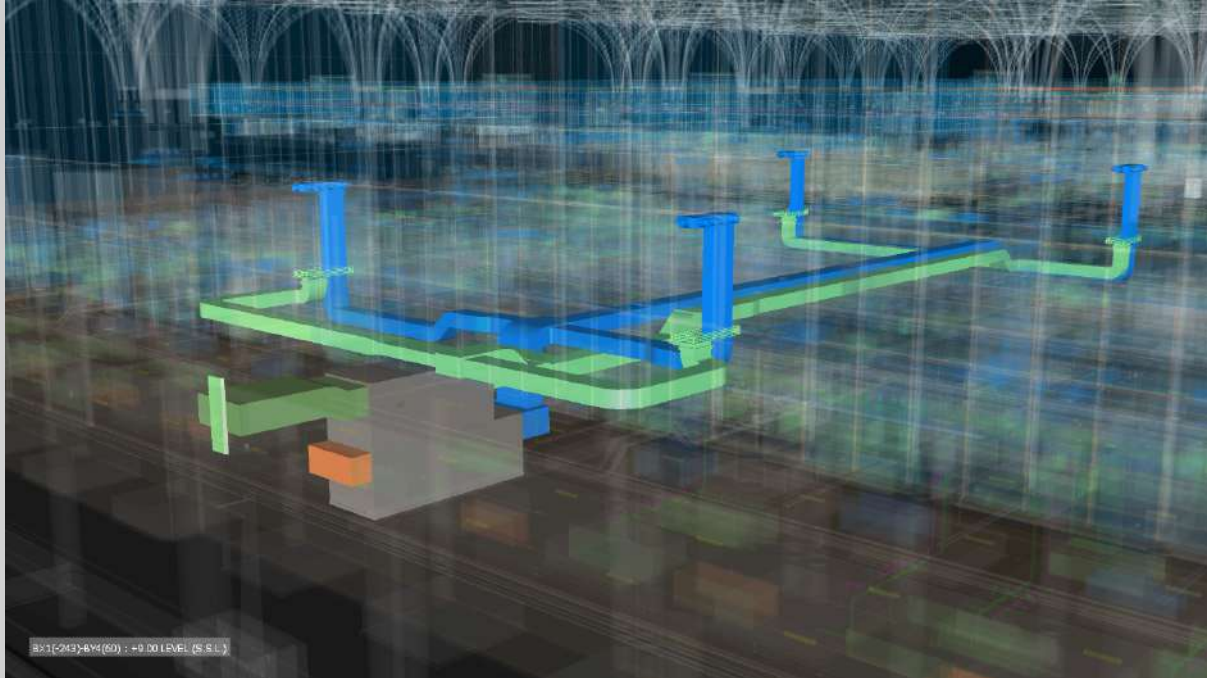
- 0401M2811
- 0401M2812
- 0401M2813

BIM/FM: Multiple System Definition

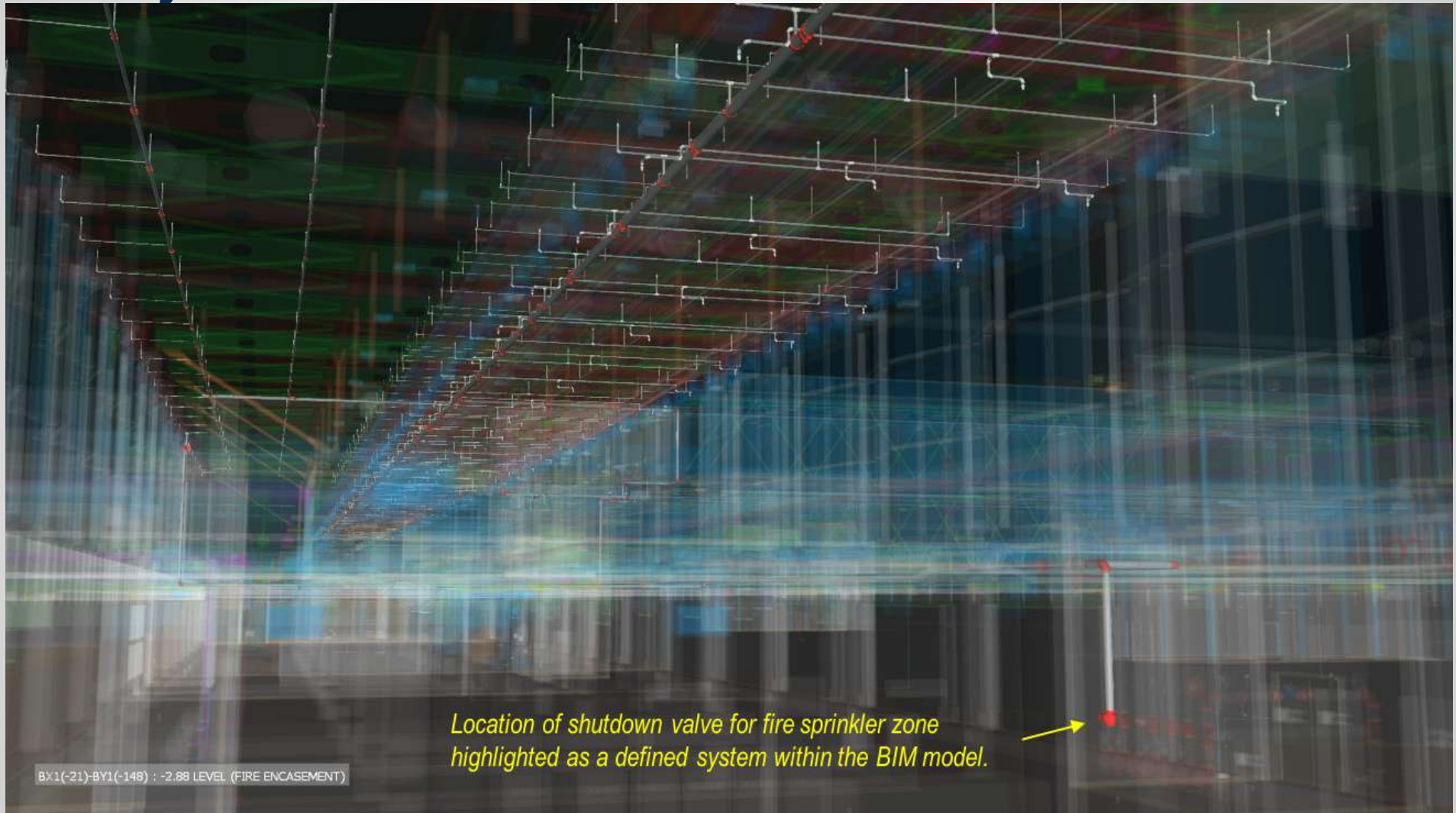


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BIM/FM: System Definition



BIM/FM: System Definitions



buildingSMART Airport Room



buildingSMART International is launching a new specialist forum for developing and deploying open digital standards specifically for the Airport environment. The Asset Management department at Amsterdam's Schiphol Airport is taking the lead. The benefits to be derived are:

- Unification of digital standards to enable more efficient working from the common supply chain.
- Enable Asset management decisions based on cost, risk and performance for the entire lifecycle of airport facilities to be easier to make and more robust
- Make innovative design and build solutions, reducing disruption at the Airport, easier to justify and re-purposing of the facilities easier to execute.
- Enable economies of scale with the supply chain and maintenance suppliers. Currently each airport group is developing its own BIM standards and there is not a uniform data exchange format to approach the market for airport facilities (eg. APBB, LEPC, airfield lights, scanners etc.).
- Link to the wider [buildingSMART Industry Foundation Class \(IFC\)](#) environment to allow Airport Asset Managers to use the IFC developments for Buildings and Infrastructure in their portfolio



Future of BIM + Operations

Using BIM, data now has the means to coalesce, become information and be analyzed as never before. Data granularity and its volume achieved around BIM opens the doors for the creation of the Google for the built environment.

Using BIM as a platform to integrate existing FM systems such as the Computerized Maintenance Management System (CMMS) and Building Management/Automation System (BMS/BAS) means better analytics and performance for operations, energy, business and beyond...

Thank You