Integrated Solutions for a Sustainable Built Environment

BIM for Design, Construction & Operations: Opportunities and Challenges

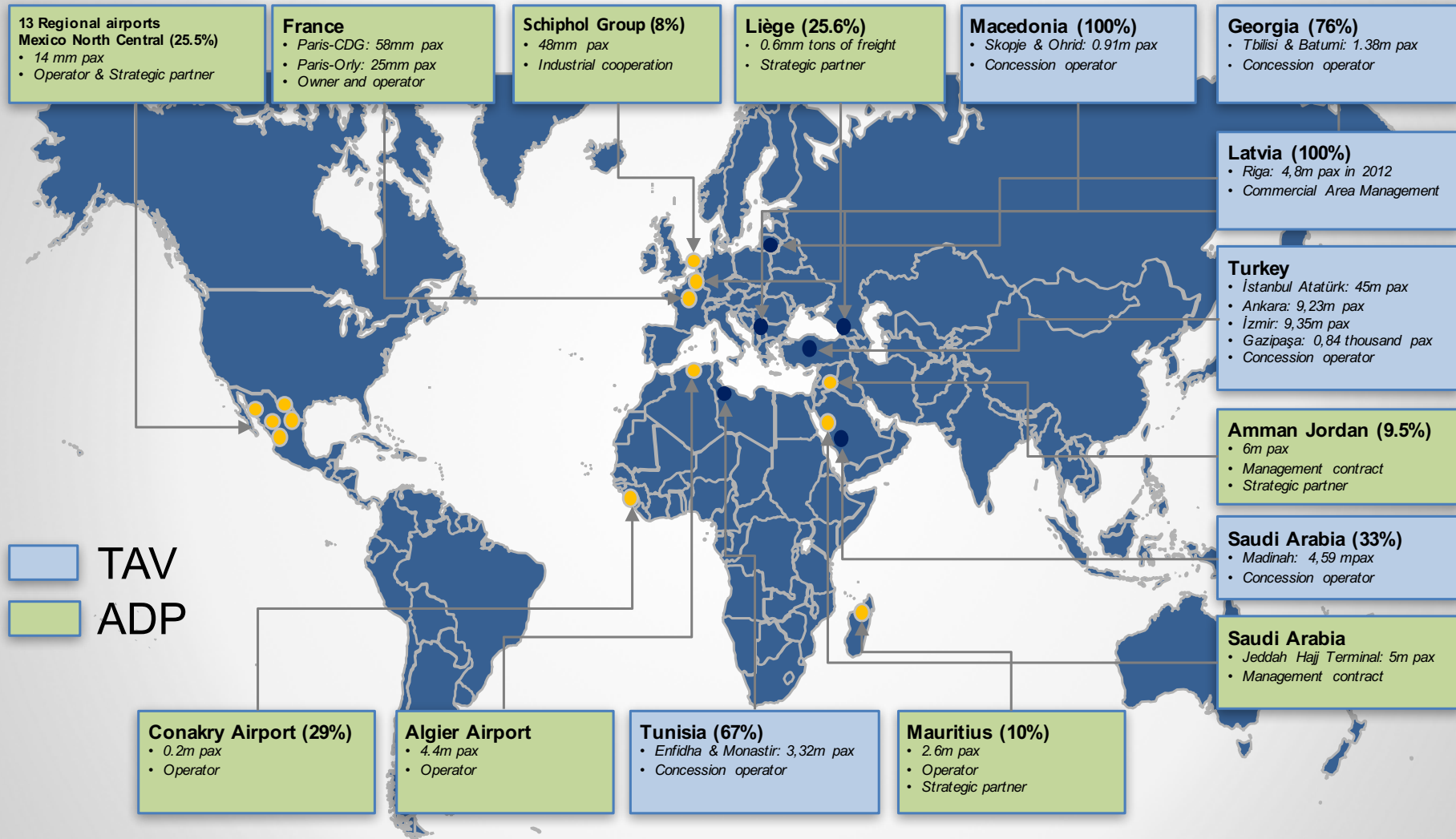**Ahmet Çıtıpıtıoğlu, Ph.D., P.E.**
Engineering & Design Director
TAV Construction
TAV Integrated Solutions

TAV

OVERVIEW

- TAV Airports + TAV Construction + Integrated Solutions

- BIM Design & Construction
  TAVis + Projects
  Opportunities + Challenges + Implementation

- BIM FM + Lifecycle Management
  Opportunities + Challenges + Implementation

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ADP + TAV AIRPORTS

13 Regional airports Mexico North Central (25.5%)
- *14 mm pax*
- *Operator & Strategic partner*

France
- *Paris-CDG: 58mm pax*
- *Paris-Orly: 25mm pax*
- *Owner and operator*

Schiphol Group (8%)
- *48mm pax*
- *Industrial cooperation*

Liège (25.6%)
- *0.6mm tons of freight*
- *Strategic partner*

Macedonia (100%)
- *Skopje & Ohrid: 0.91m pax*
- *Concession operator*

Georgia (76%)
- *Tbilisi & Batumi: 1.38m pax*
- *Concession operator*

Latvia (100%)
- *Riga: 4,8m pax in 2012*
- *Commercial Area Management*

Turkey
- *İstanbul Atatürk: 45m pax*
- *Ankara: 9,23m pax*
- *İzmir: 9,35m pax*
- *Gazipaşa: 0,84 thousand pax*
- *Concession operator*

Amman Jordan (9.5%)
- *6m pax*
- *Management contract*
- *Strategic partner*

Saudi Arabia (33%)
- *Madinah: 4,59 mpax*
- *Concession operator*

Saudi Arabia
- *Jeddah Hajj Terminal: 5m pax*
- *Management contract*

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ADP

Conakry Airport (29%)
- *0.2m pax*
- *Operator*

Algier Airport
- *4.4m pax*
- *Operator*

Tunisia (67%)
- *Enfidha & Monastir: 3,32m pax*
- *Concession operator*

Mauritius (10%)
- *2.6m pax*
- *Operator*
- *Strategic partner*

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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

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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

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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
- Riyad 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 m^2 of built environment with BIM
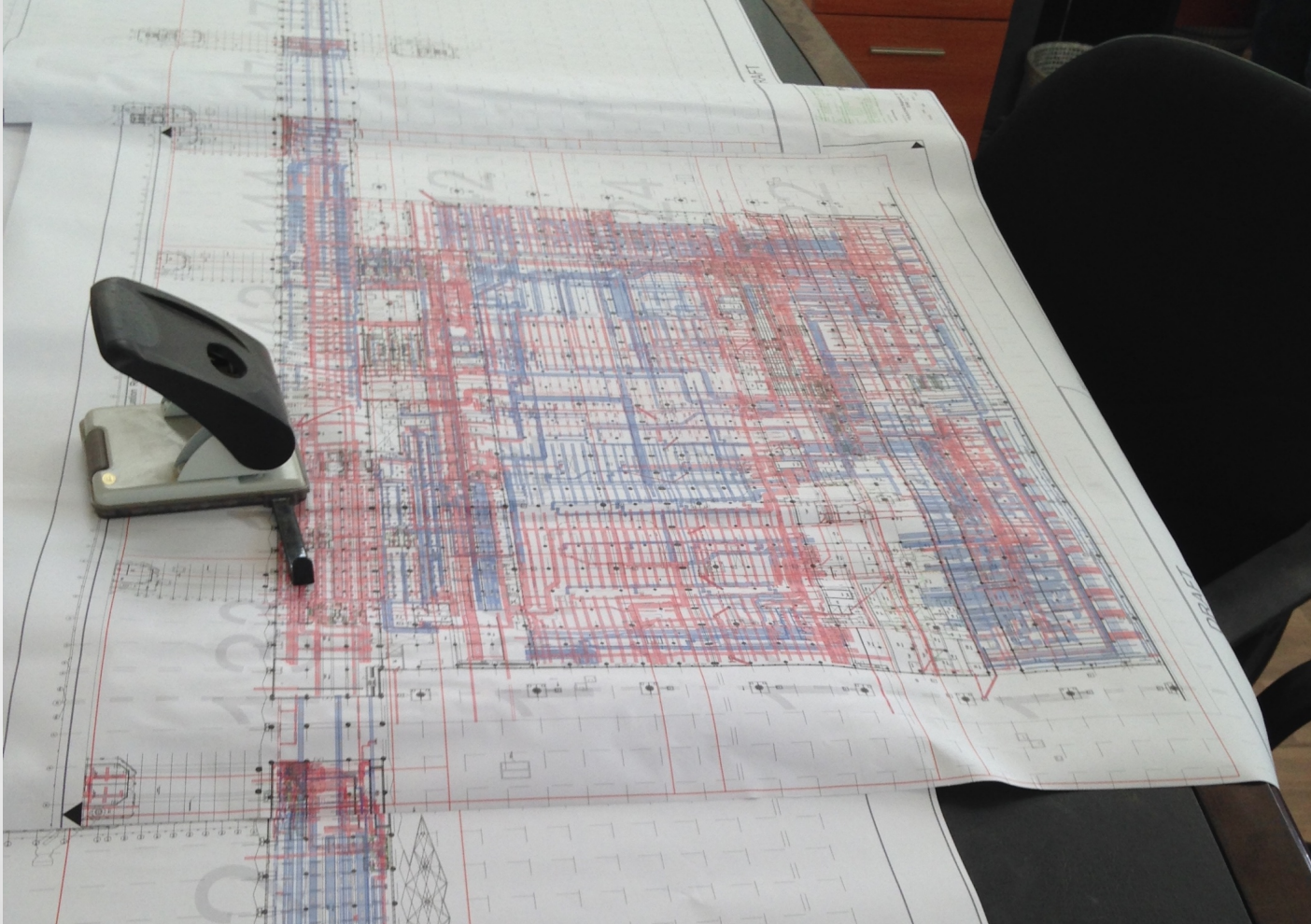
TAV

Information Mobility

BIM – Bucket for Information Mobility
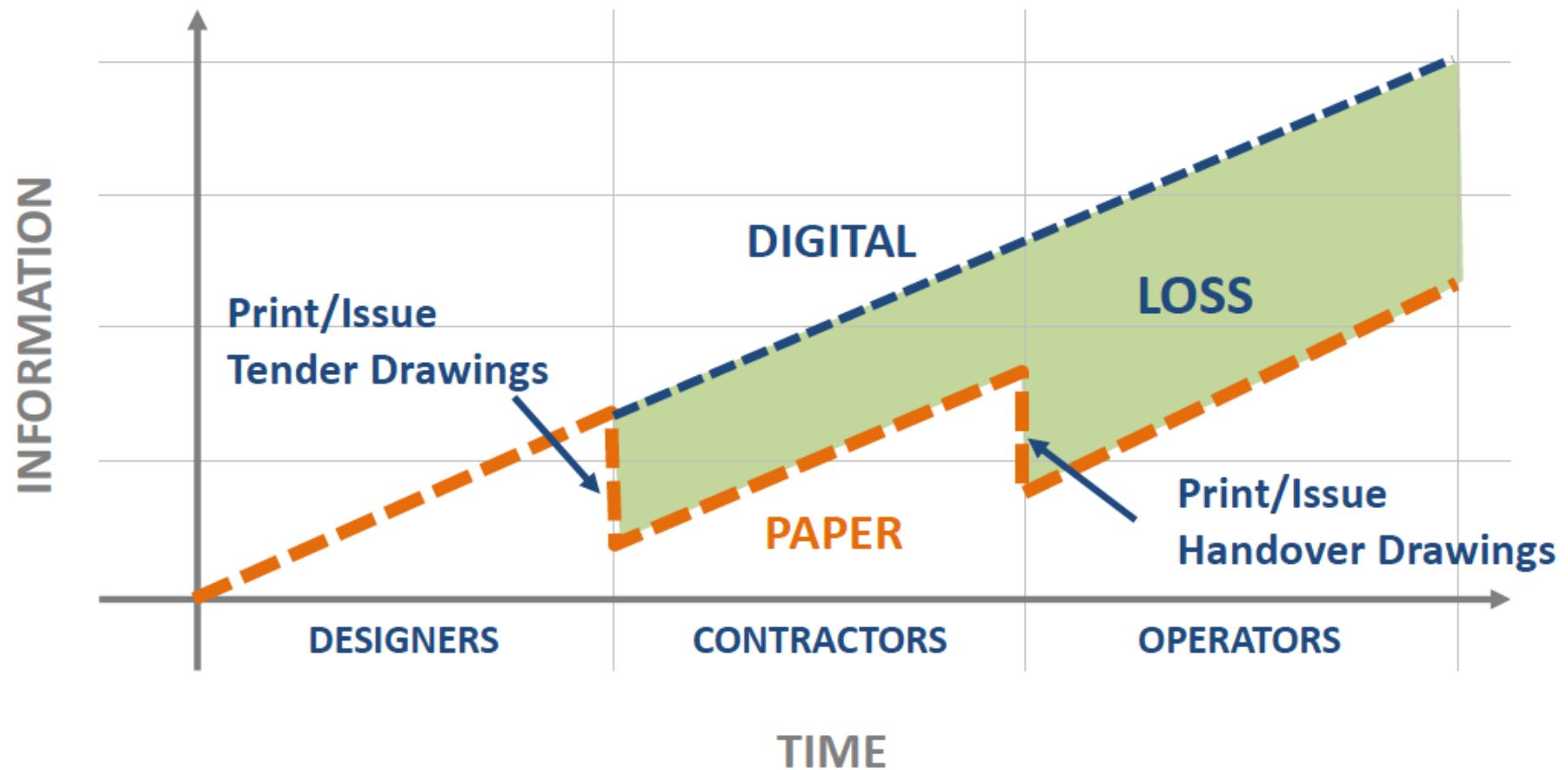
BIM – Impact at Throughout Lifecycle
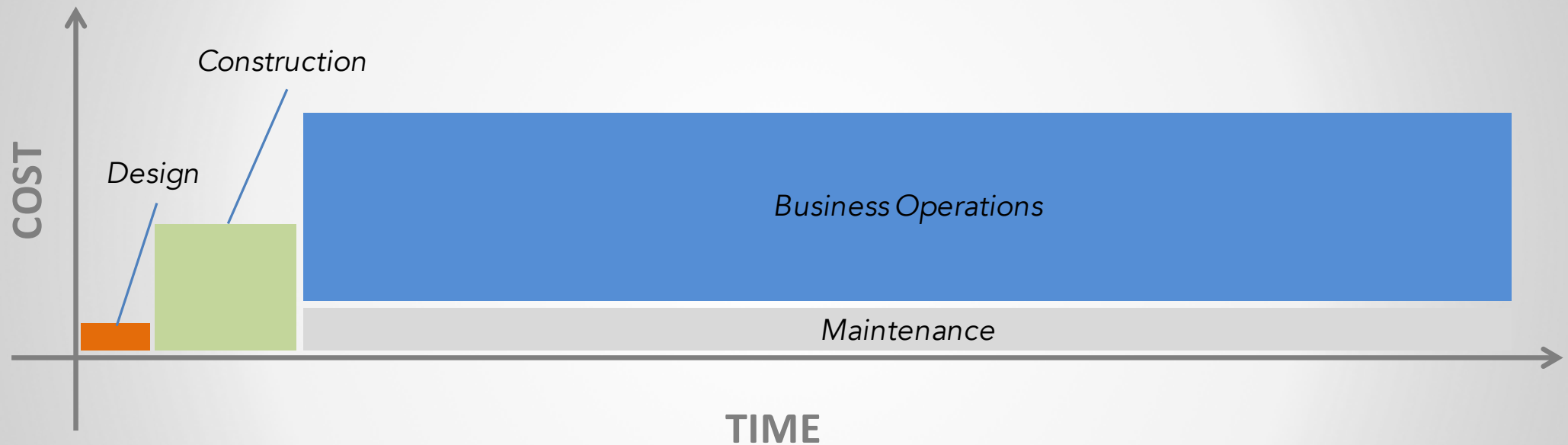
TAV Integrated Solutions

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

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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

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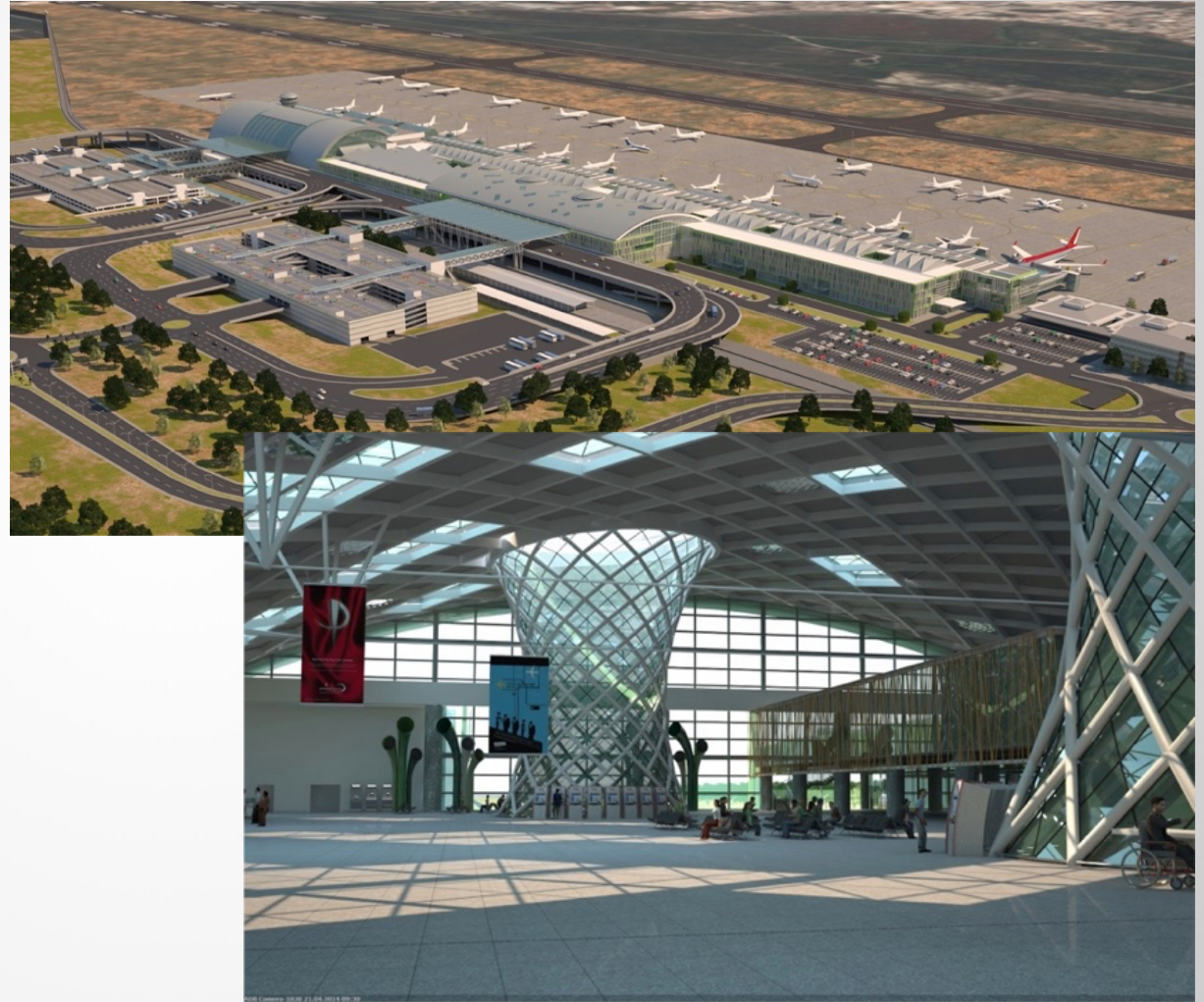
Adnan Menderes Int. Airport – İzmir, Turkey

Immersive Virtual Reality Application
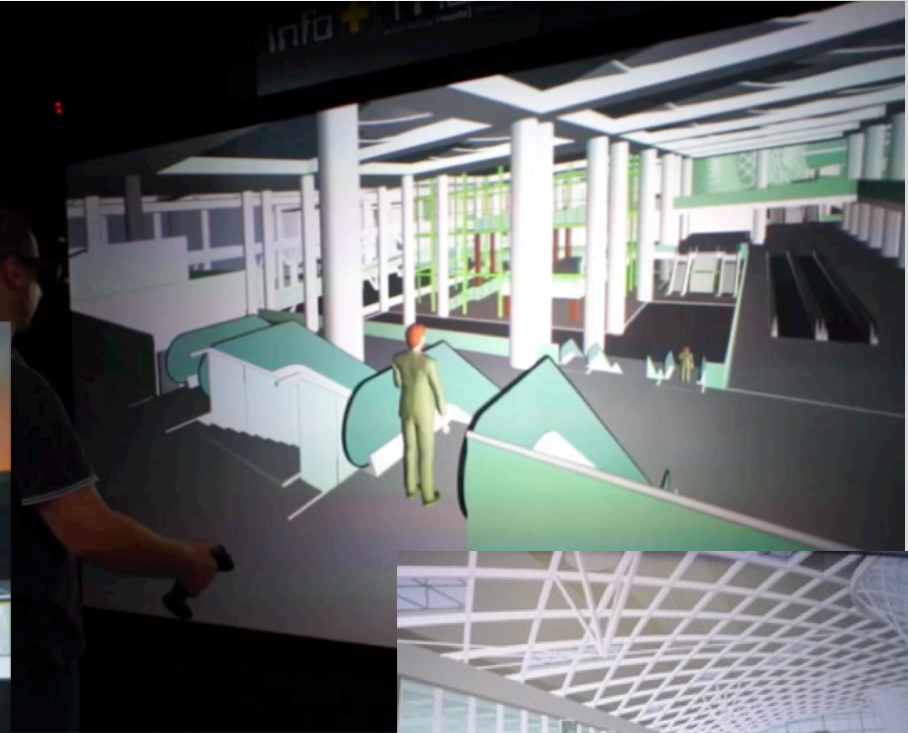
Abu Dhabi Int'l Airport Midfield Terminal- Abu Dhabi, UAE

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

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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

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Damac Paramount Towers - Dubai, UAE
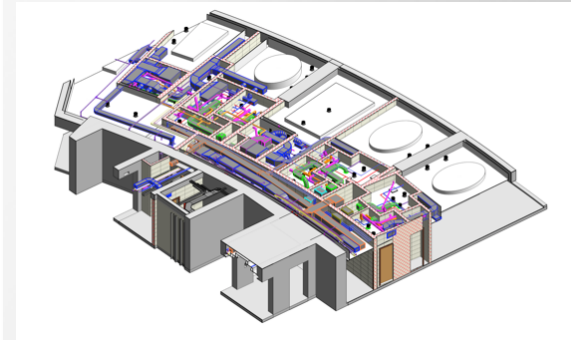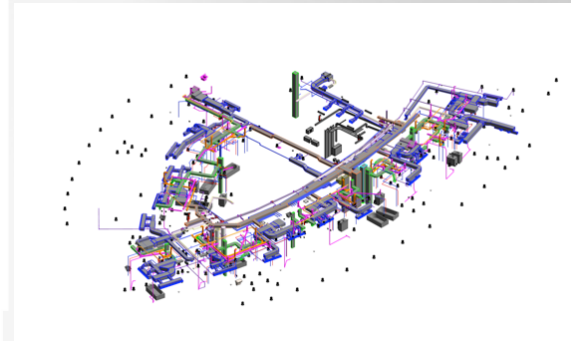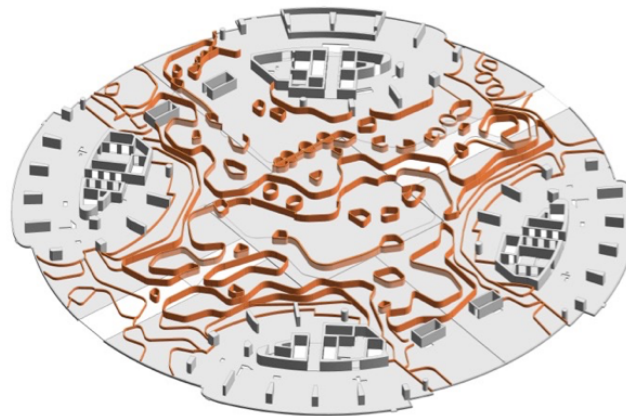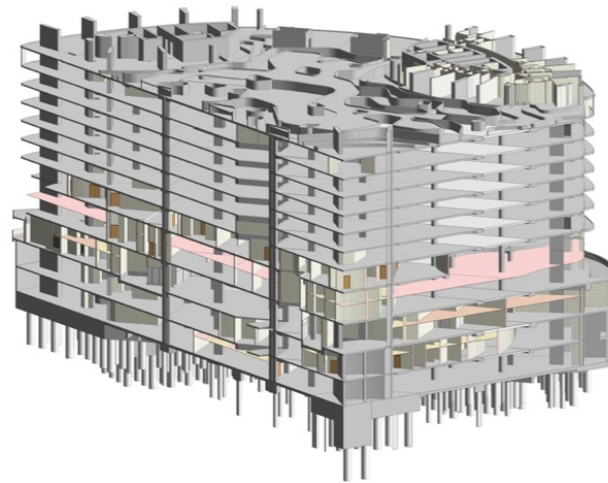
Aircraft Maintenance Hangars - Jeddah, KSA
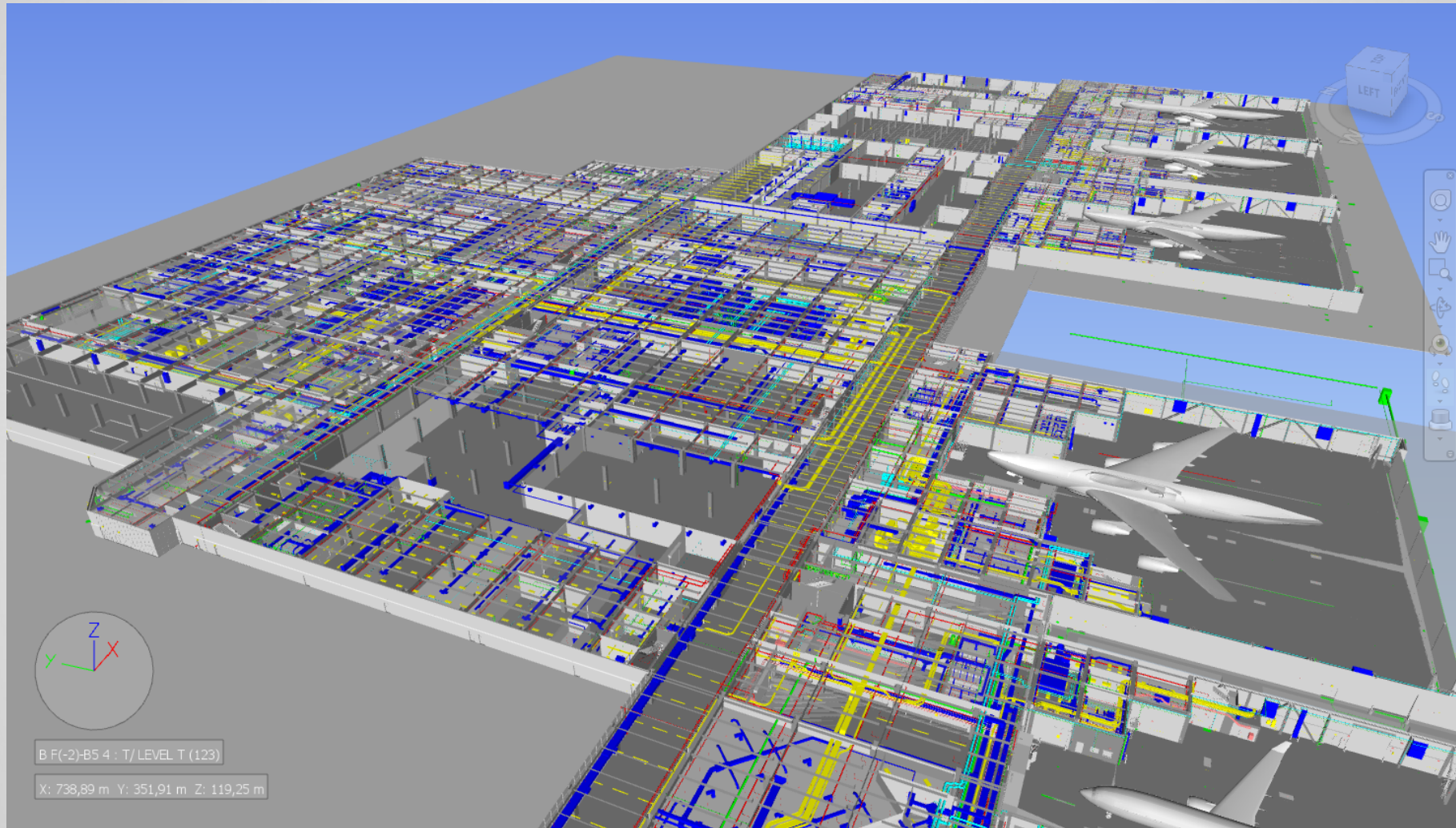
ADP Headquarters – Paris, France

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

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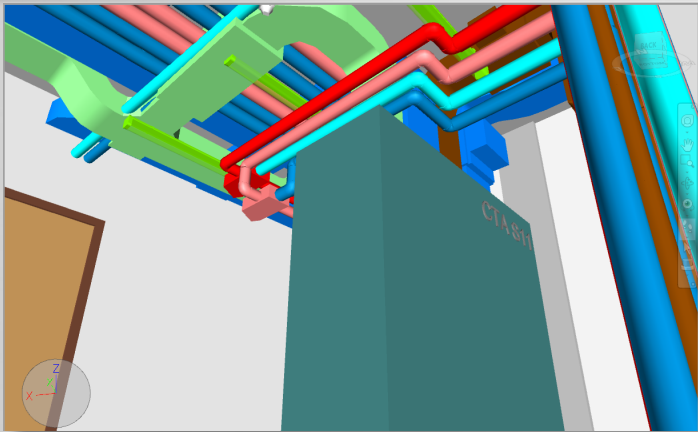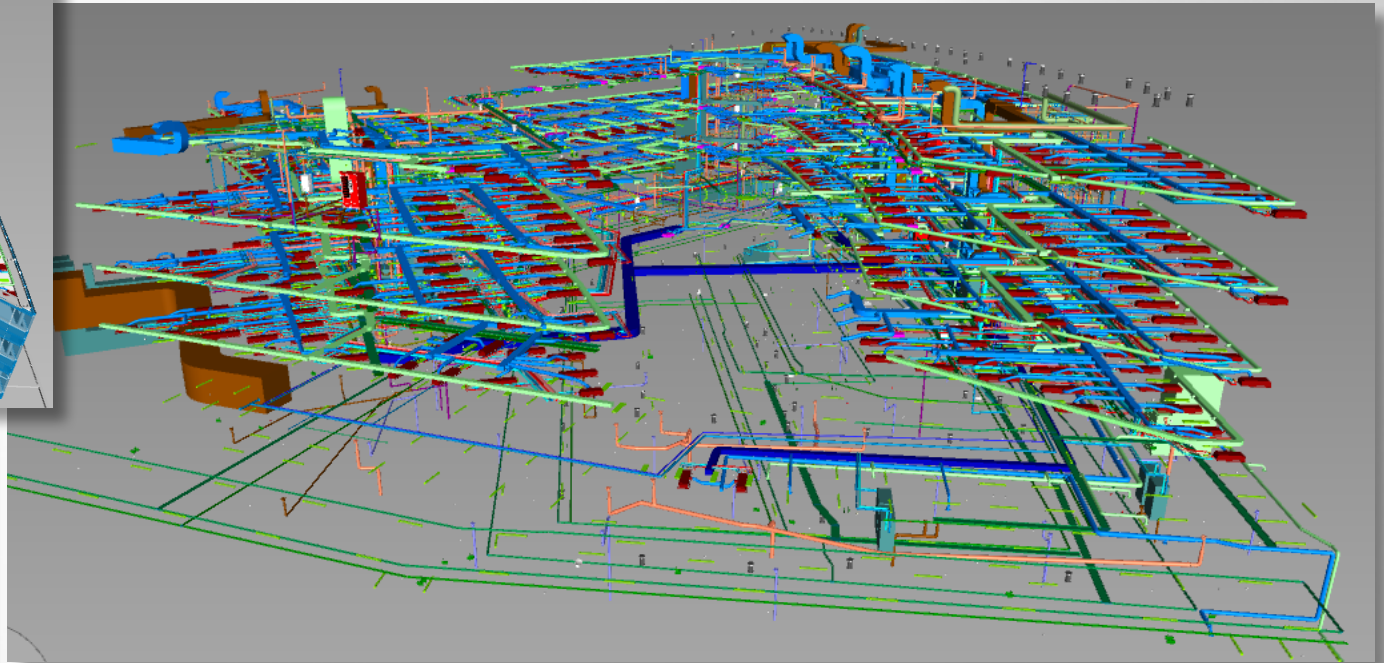- 4D Simulation, site logistics, phasing
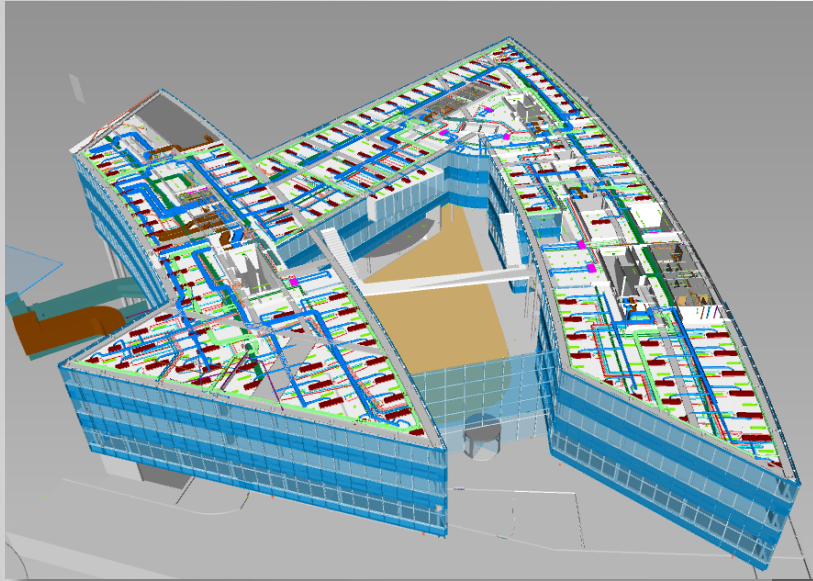- Facilities Management
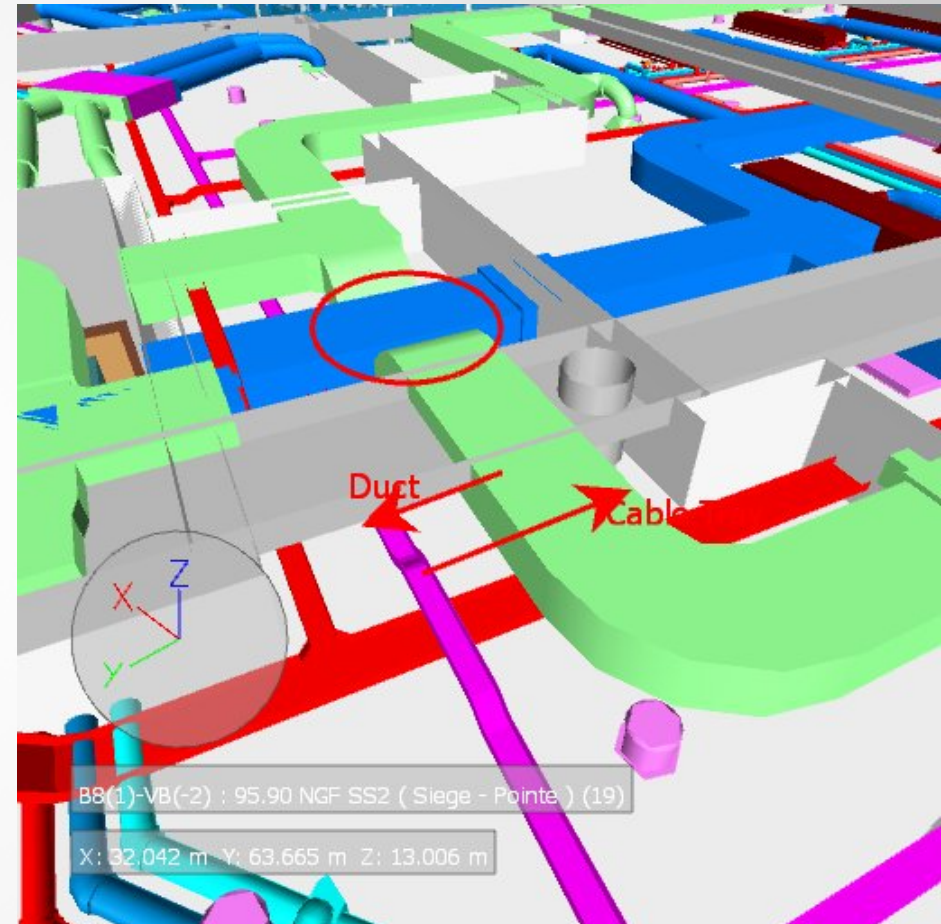
ADP Headquarters – Paris, France

C12(-15)-CE(-1) : 95.90 NGF SS2 (Siege - Pointe) (13)

X: 105,268 m Y: 9,786 m Z: 7,254 m

ADP Headquarters – Paris, France
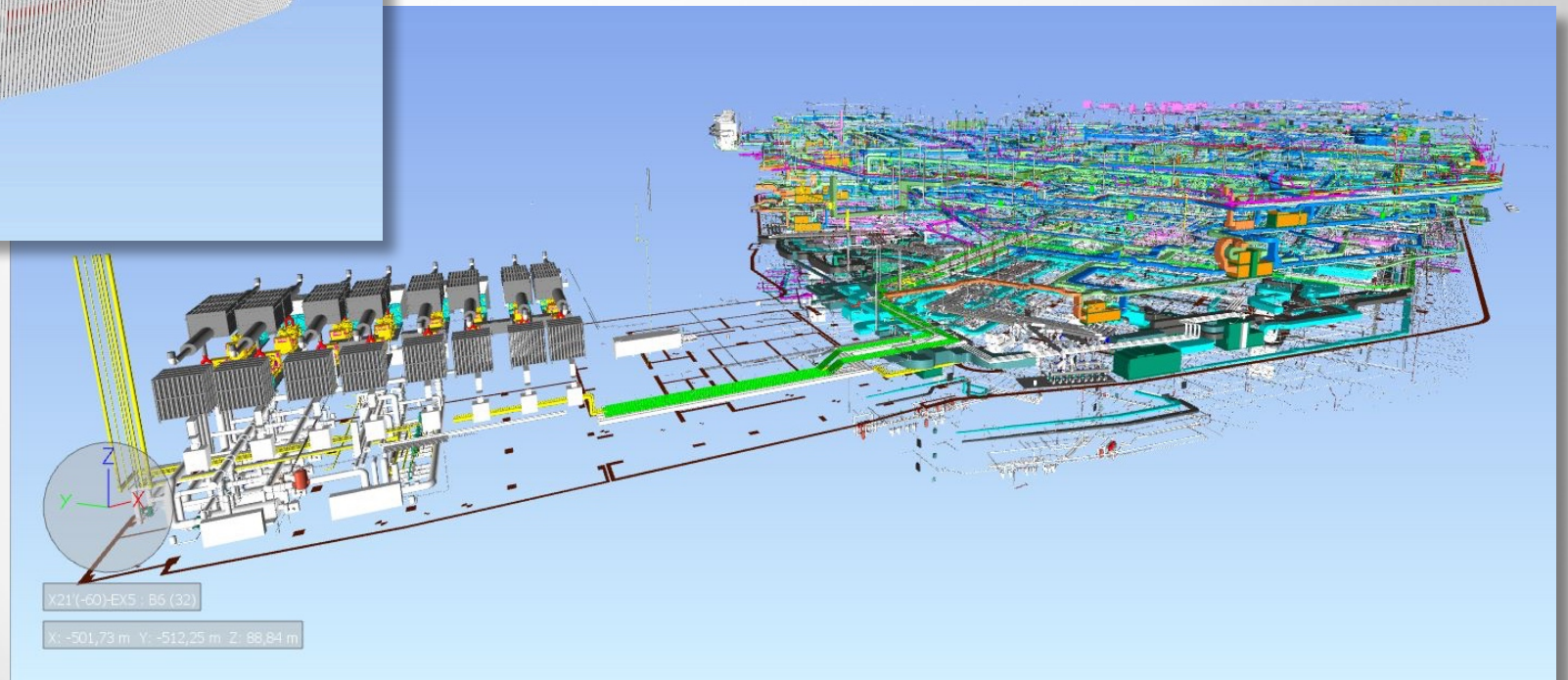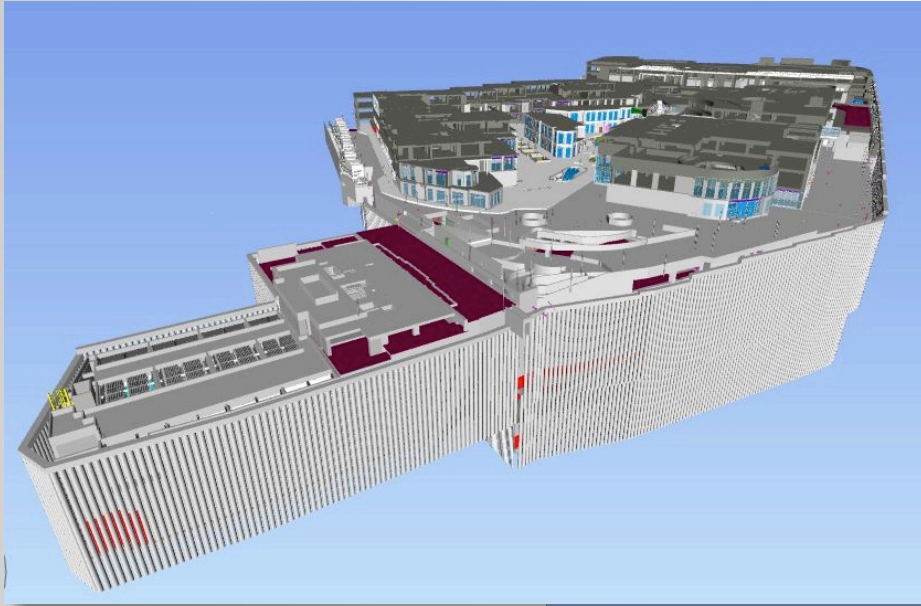
ADP HQ @ CDG – Paris, France

Emaar Square – Istanbul, Turkey

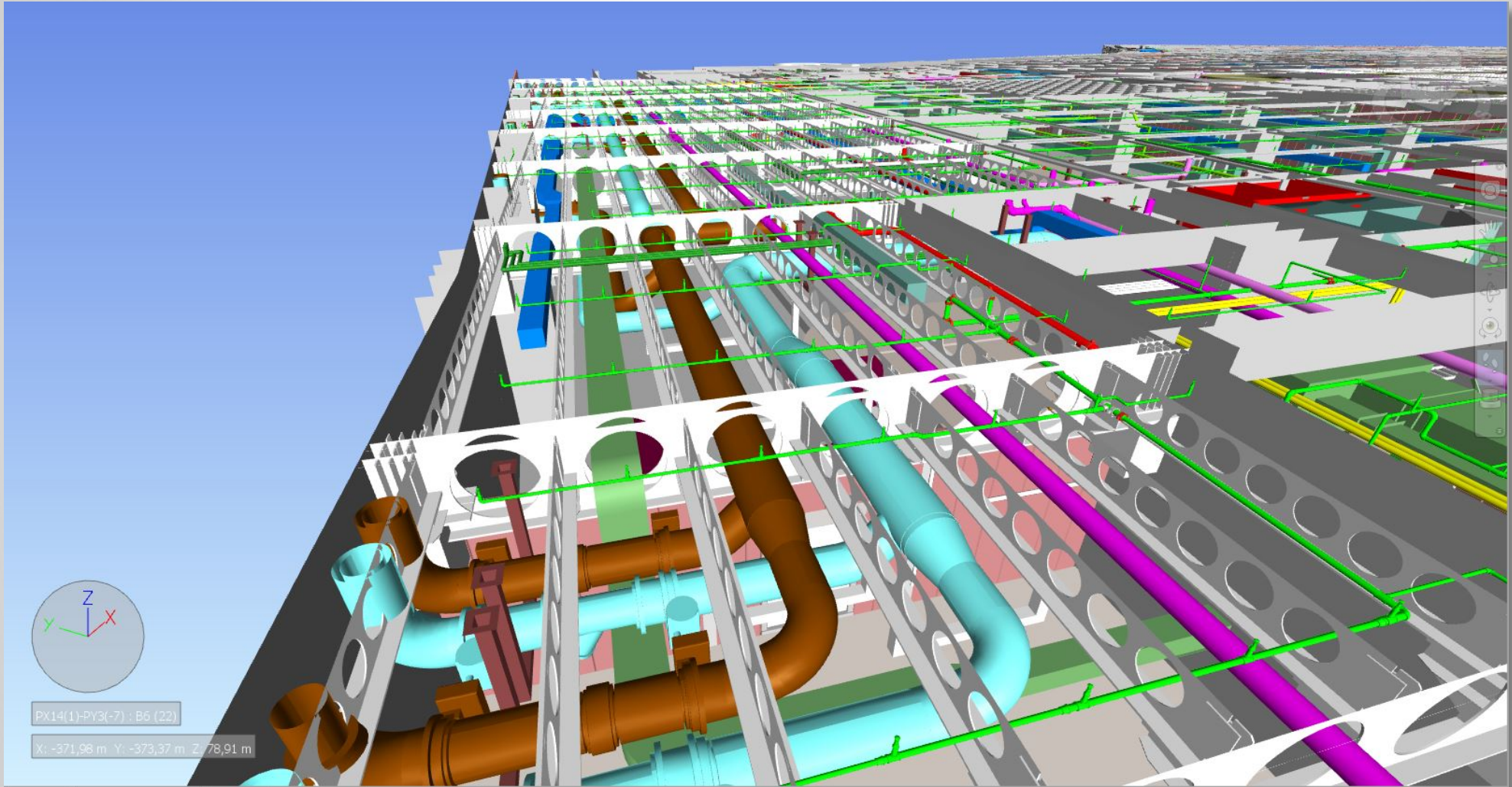BIM modeling is utilized in project and construction management with weekly deliverable cycles:

- 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
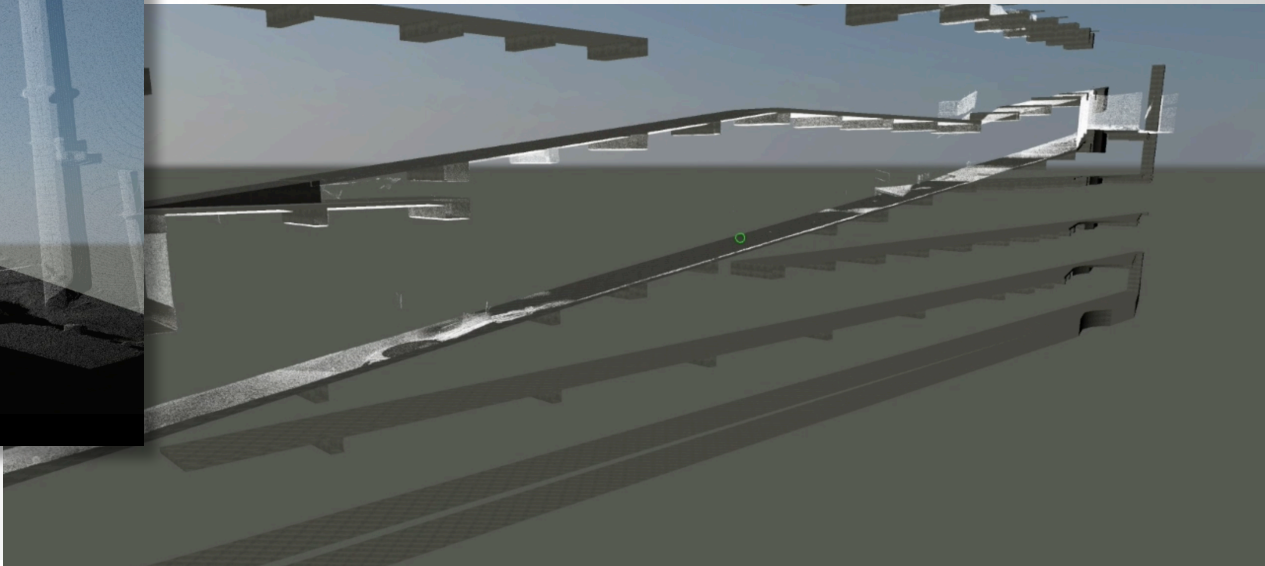
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Emaar Square – Istanbul, Turkey

Emaar Square – Istanbul, Turkey

Emaar Square – Istanbul, Turkey "Reality Check"

Laser Scanning for BIM model verification

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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."

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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

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BIM Organization: Design Phase Challenges

(Synthesis Architect)

Architect

Structural

MEPF

COMMON
BIM Supporting Design
1-3 week gap

IDEAL
Design Integrated with BIM
Real-time

⬤ Design ⬤ BIM Coordination ⬤ BIM Authoring

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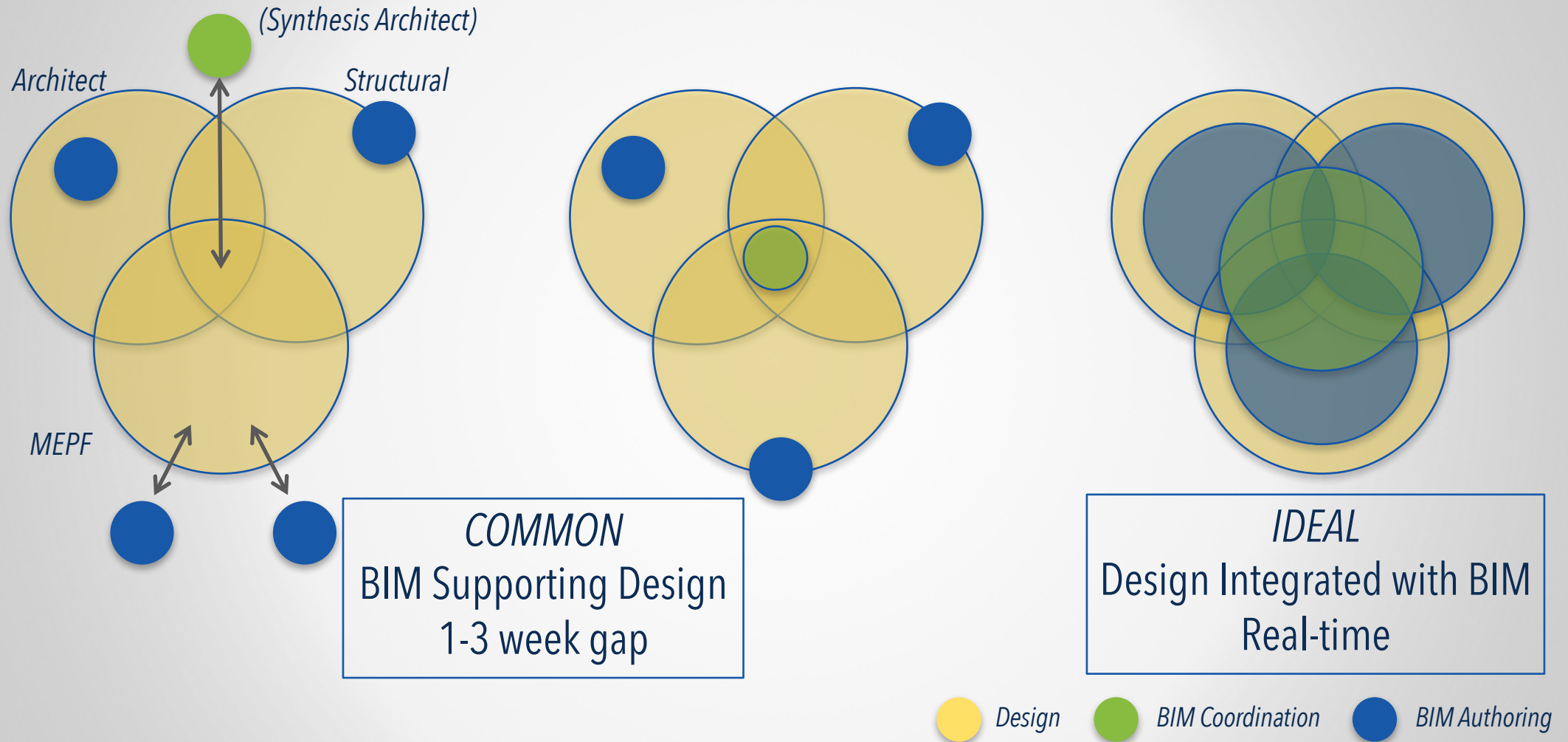
BIM Organization: Construction BIM Resourcing Challenges

COMMON: BIM delivery risks + incoherence
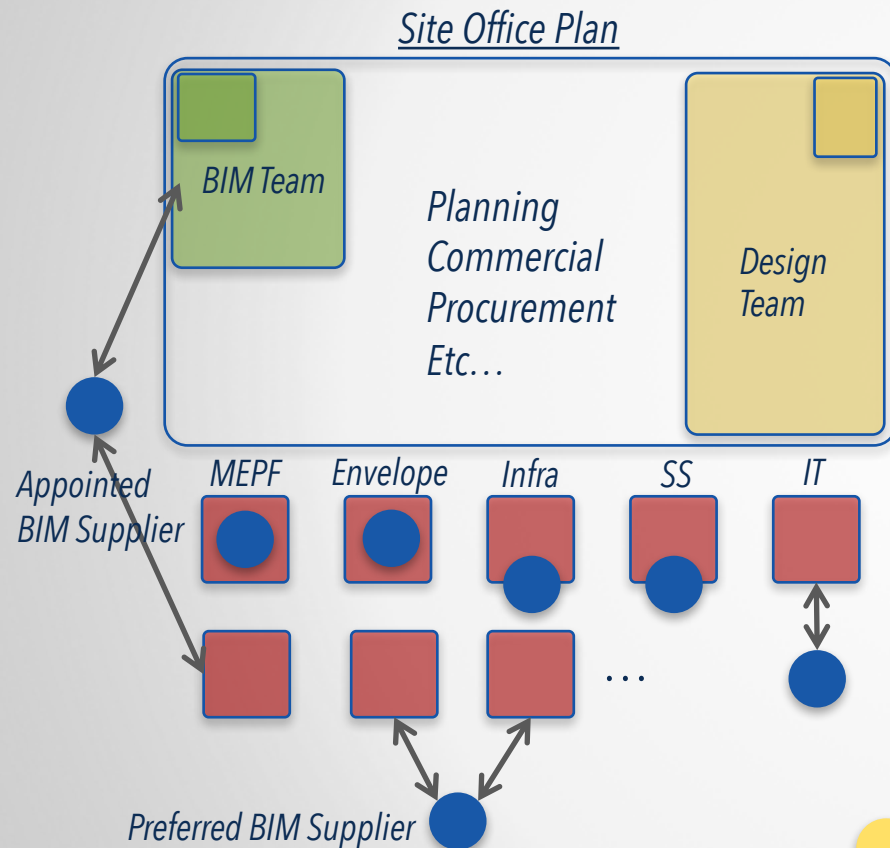
IDEAL: Integrated team + coherence

Site Office Plan

BIM Team

Planning
Commercial
Procurement
Etc…

Design
Team

Appointed
BIM Supplier

MEPF   Envelope   Infra   SS   IT

…

Preferred BIM Supplier

Site Office Plan

Planning
Commercial
Procurement
Etc…

Design
Team

BIM Team

MEPF   Envelope   Infrastructure

Coordination   BIM Coordination   BIM Authoring   Sub-Contractor

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BIM Organization: Construction Phase

Site Office Plan

Planning
Commercial
Procurement
Etc…

Design Team

BIM Team

MEPF   Envelope   Infrastructure

Package Cluster (SE)

Package Manager
Package Eng/Arch
BIM Tech Drafter
Package Chief
BIM Coordinator
BIM Modeler

Package Cluster (Arch)

Package Manager
Package Eng/Arch
BIM Tech Drafter
Package Chief
BIM Coordinator
BIM Modeler

Package Cluster (MEP 1)

Package Manager
Package Eng/Arch
BIM Tech Drafter
Package Chief
BIM Coordinator
BIM Modeler

Package Cluster (MEP 2)

Package Manager
Package Eng/Arch
BIM Tech Drafter
Package Chief
BIM Coordinator
BIM Modeler

Design Manager

Deputy Design Manager (Architectural)

BIM Manager

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

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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
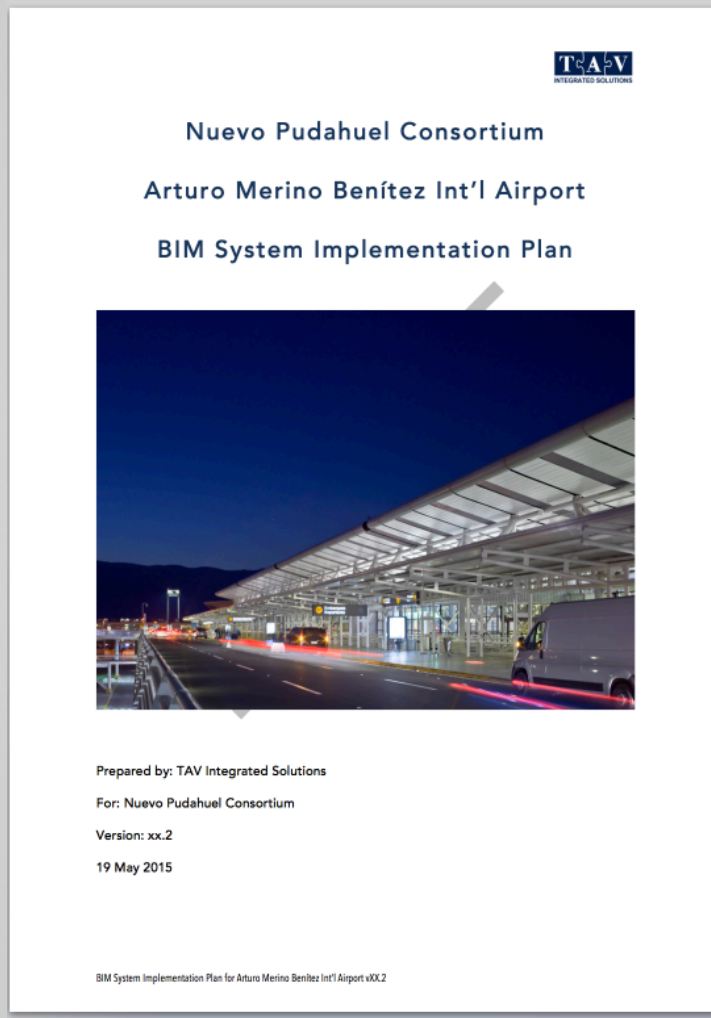
BIM Lifecycle Management: Santiago Airport, Chile
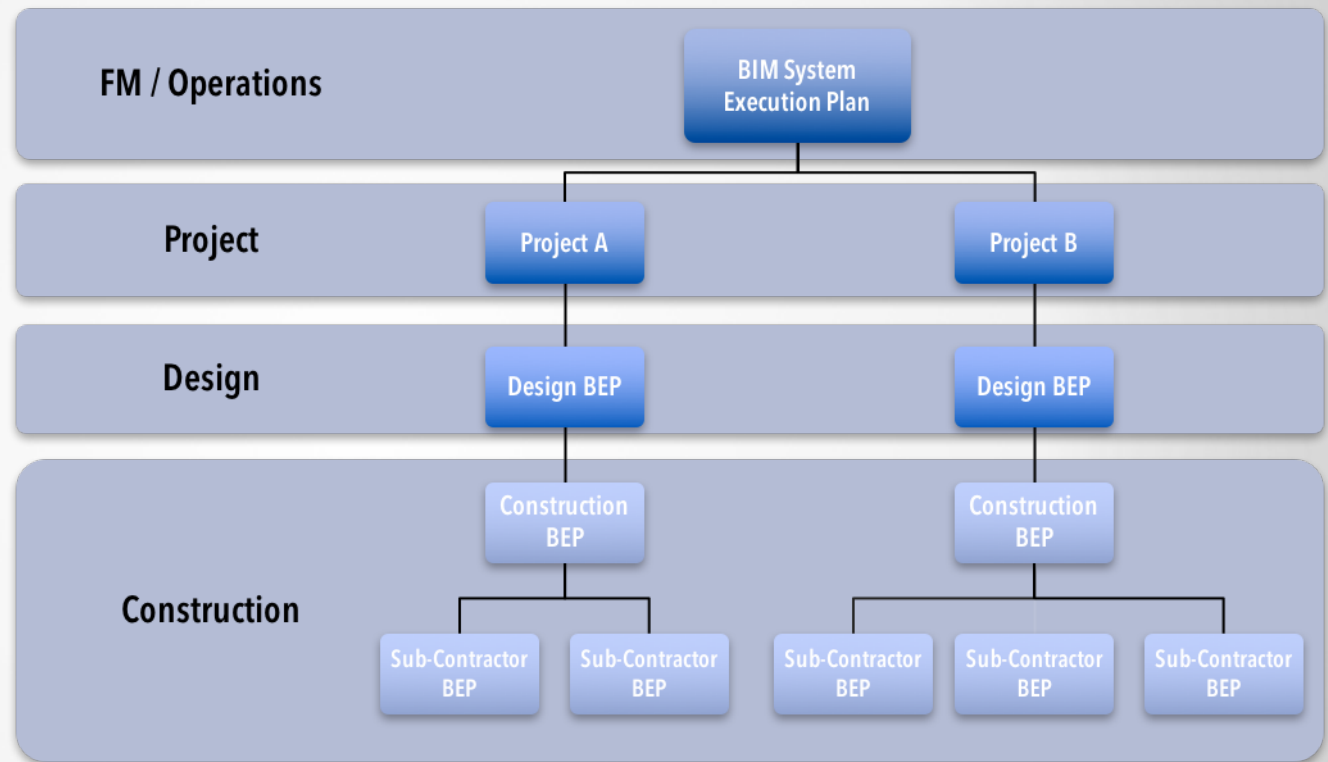
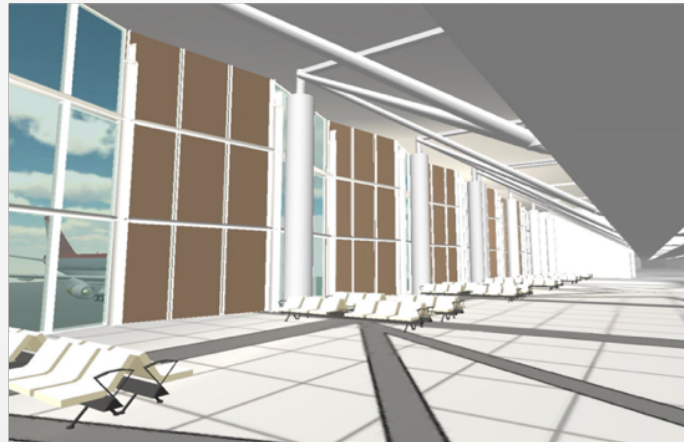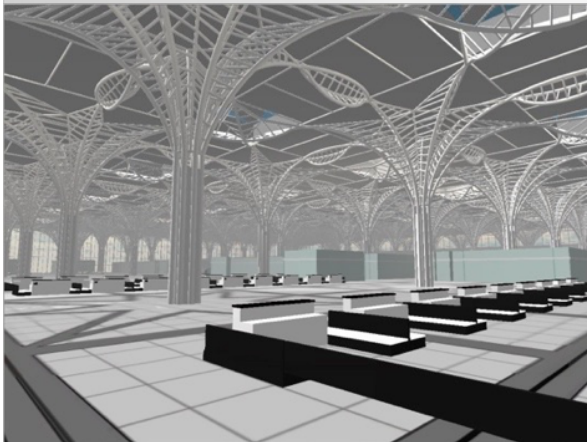# Prince Mohammed Airport: Medina, KSA - Case Study
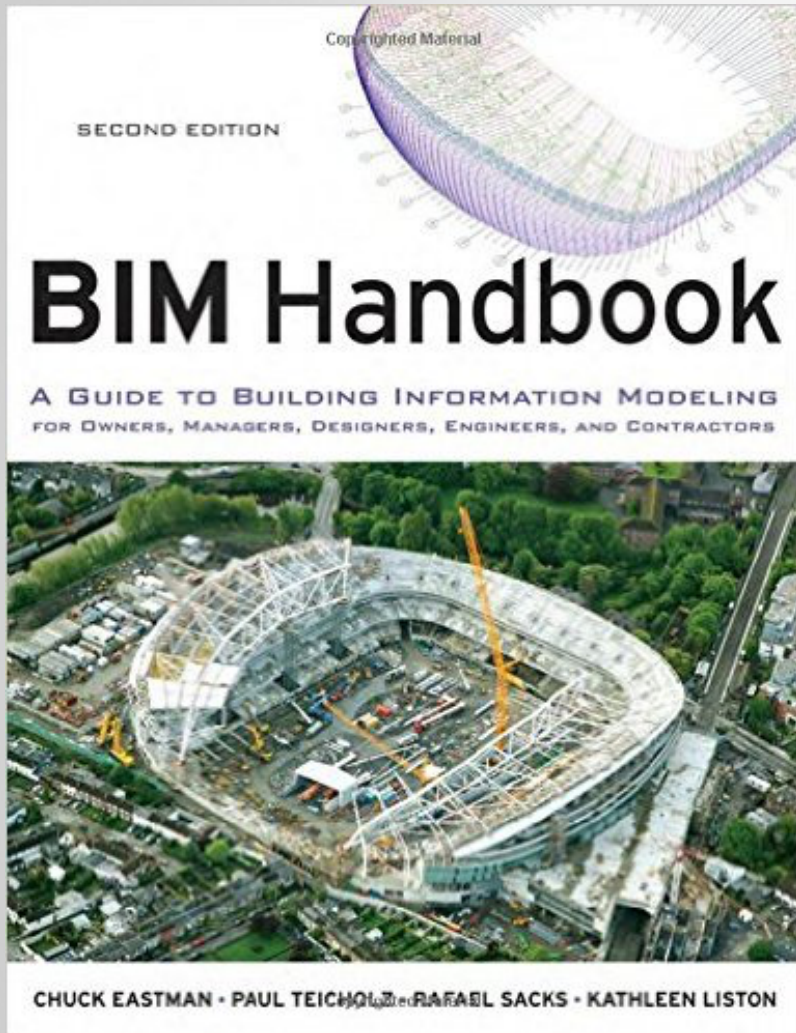
BIM Handbook 3rd Edition
Case Study:
Medina International Airport
BIM – FM Integration

Prince Mohammed Airport - Medina, KSA

- Post design/construction BIM modeling based on As-builts 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
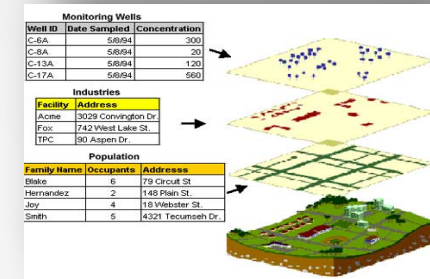
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Prince Mohammed Airport: Medina, KSA
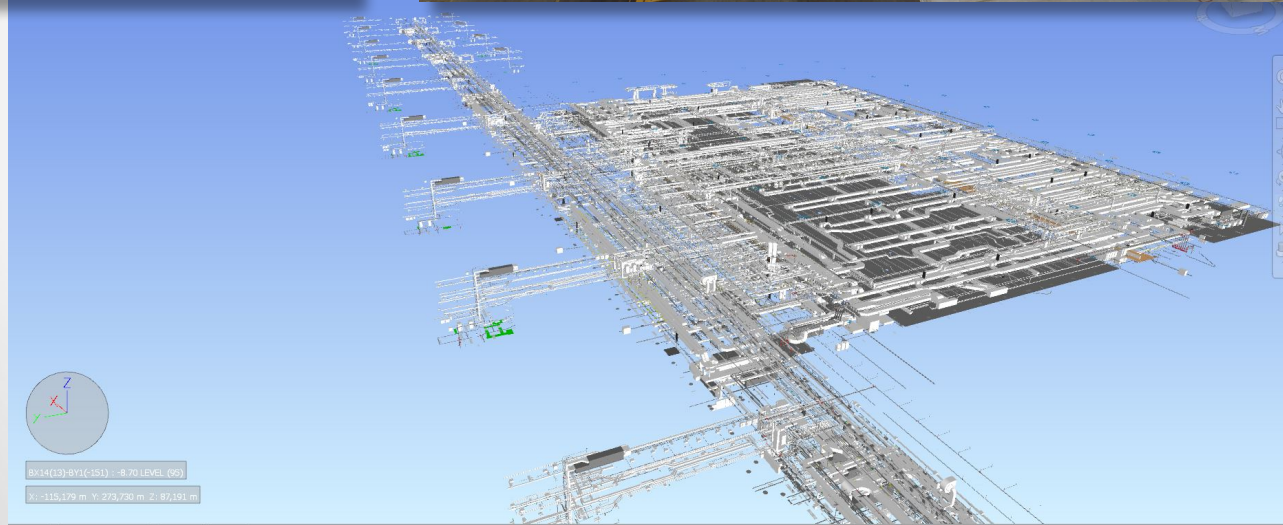
BIM FM Integration: Information Mobility for Sustainable Facilities
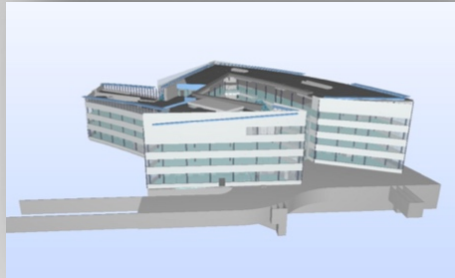
Building Information Model (BIM)

Geographical Information System (GIS)

Computerized Maintenance Management System (CMMS)

BIM for FM
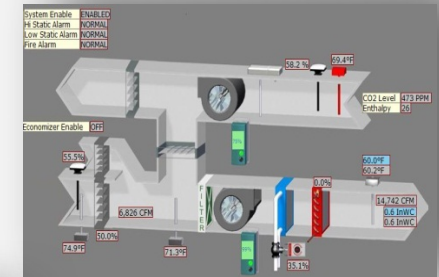
Building Automation System (BAS)

Computer Aided Facility Management (CAFM)

Enterprise Resource Planning (ERP)

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Data Granularity using BIM

The BIM models for Medina provide granular information on more than 580,000 individual components for maintainable asset database.
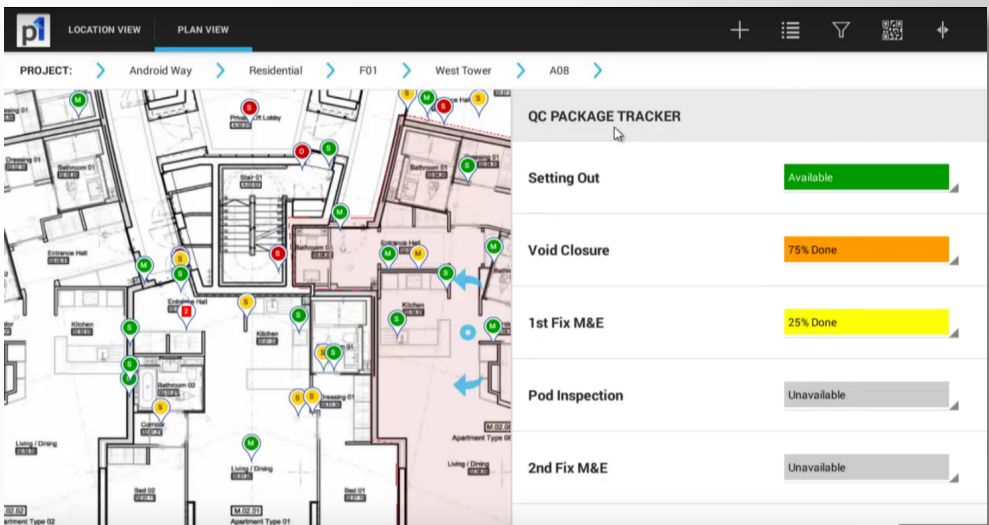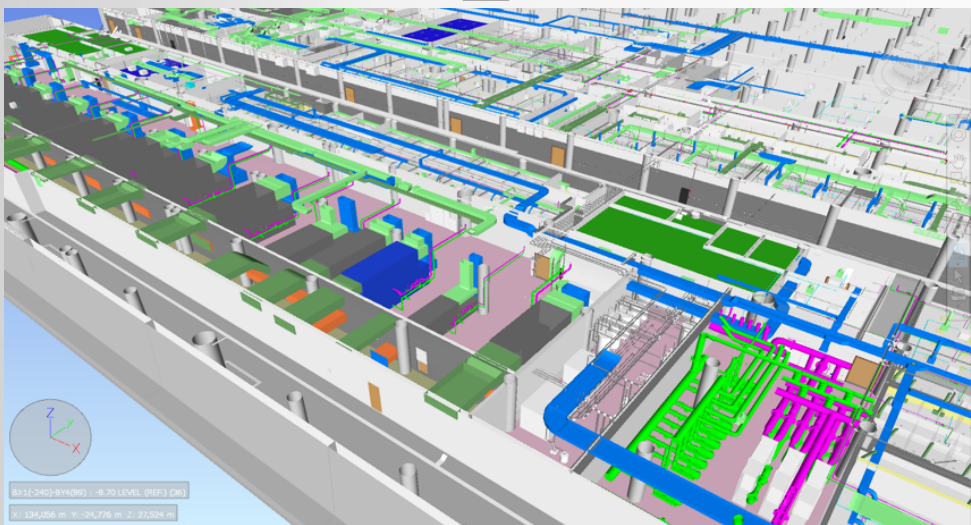
Compared to manually tagged assets: 8,000 assets.

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BIM Content: Begin with End in Mind

VI032 Arkitekt Urinal (mains supply) White	BIM Object or Element	
	Item Catergory - SANITARY	
	Description: A 3D Element. Urinal (mains supply) White	

Level of Development	Information Category	Information Item
LOD 400-Fabrication		
	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
Specific Assemblies that are Accurate in Terms of Size, Shape, Location, Quantity, and Orientation with Complete Fabrication, Assembly, and Detailing Information.	Location Properties	Zone/Space Name
	Location Properties	Zone/Space ID
	Location Properties	Elevation
	Annotation Properties	Brand
	Annotation Properties	Prodcut 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 Referance 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 Catergory - 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 Referance No
	Quantification Properties	WBS number

FAMILY TYPES	
1	Left Reccessed Type
2	Right Reccessed 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

BIM/FM Integration: Sustainable Facilities
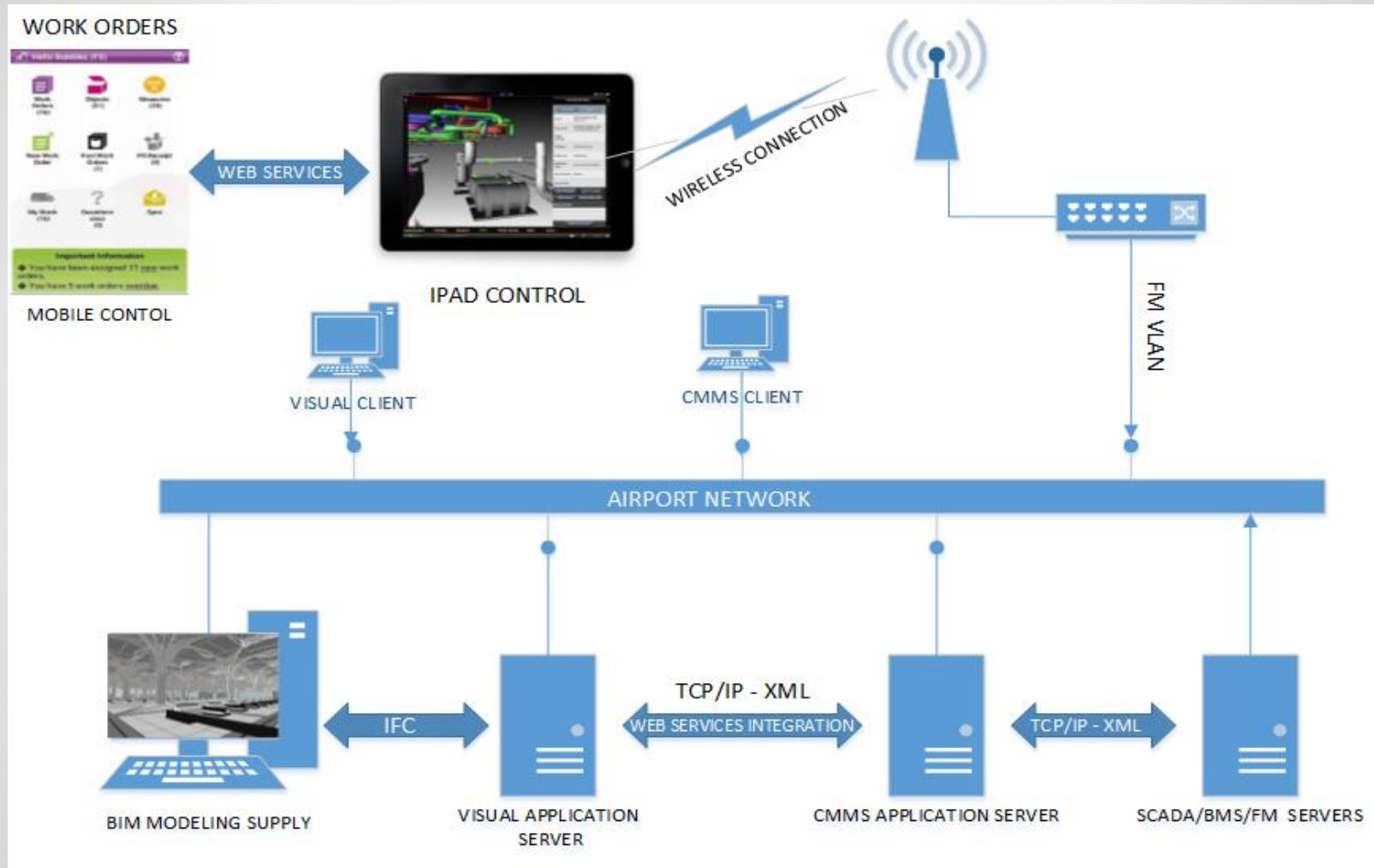
Aconex ConnectedBIM: Model + Information

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
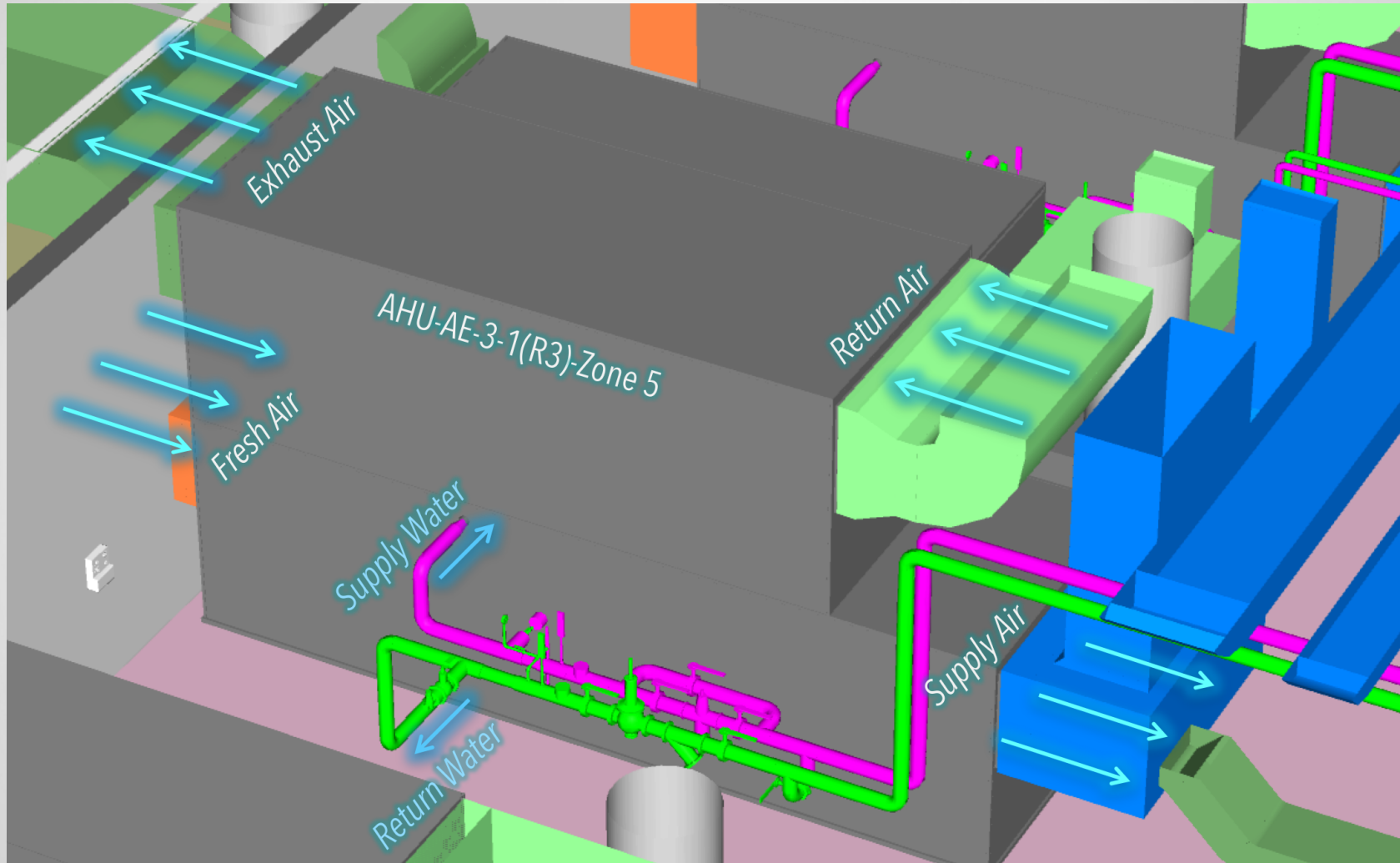- BIM GUID tags

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BIM/FM: Element Tagging

1	2	3	4
System Code	Sub-system Code	Room Number	Unique ID

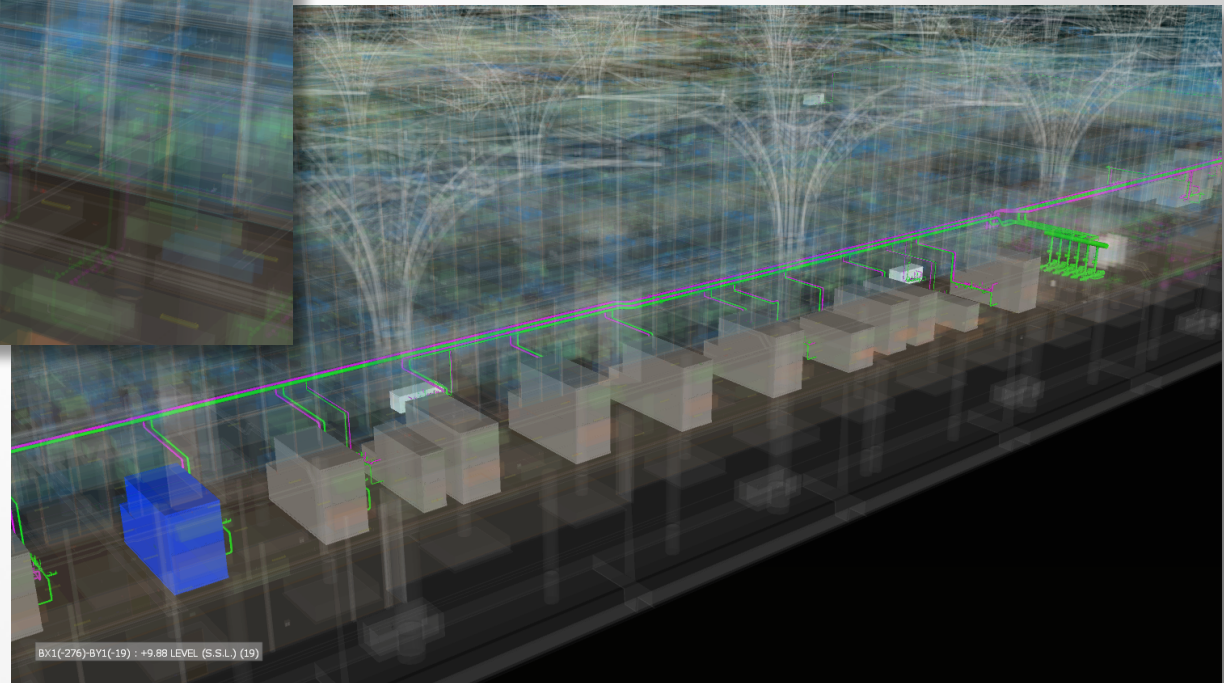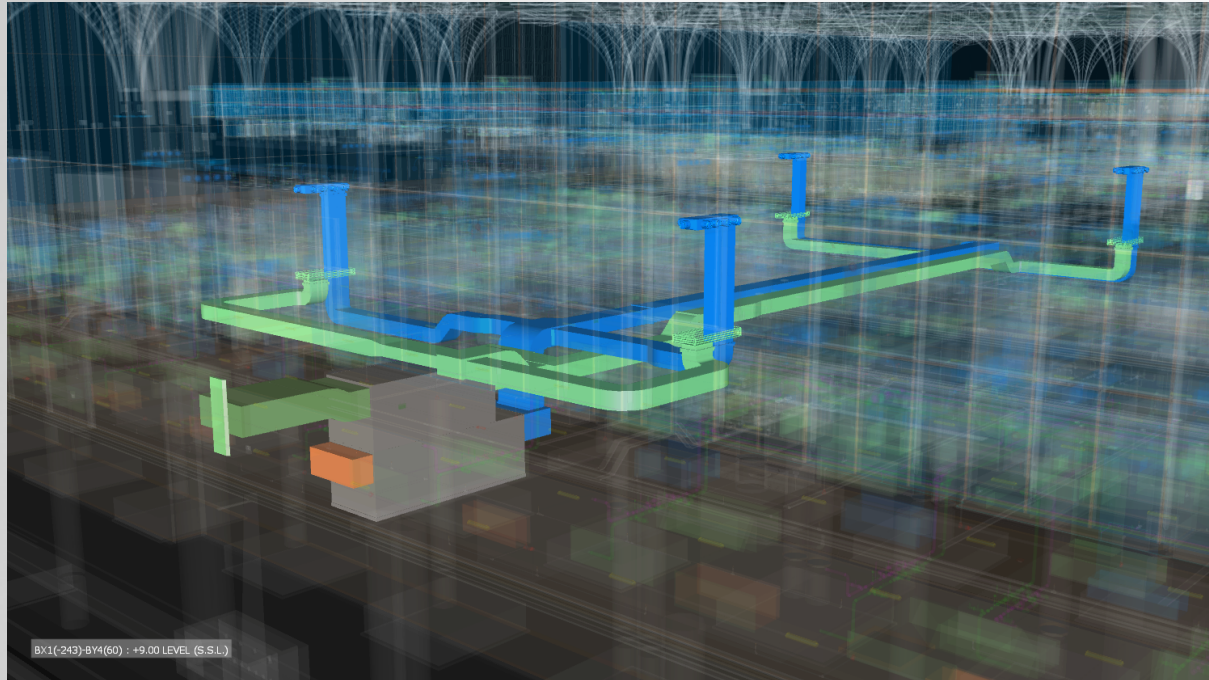| Object ID Naming Levels	Description
Level 1: System Code	<u>AA</u>: Two-digit System code as defined by Tibah i.e. 04 for HVAC System
Level 2: Sub-System Code	<u>BB</u>: Two digit Sub-System code as defined by Tibah i.e. 01 for Air Condition Units under HVAC system
Level 3: Room Number	<u>CCCC</u>: 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

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BIM/FM: Multiple System Definition

Labels in figure: Exhaust Air, Fresh Air, AHU-AE-3-1(R3)-Zone 5, Return Air, Supply Water, Return Water, Supply Air

BIM/FM: System Definition

BX1(-243)-BY4(60) : +9.00 LEVEL (S.S.L.)

BX1(-276)-BY1(-19) : +9.88 LEVEL (S.S.L.) (19)

BIM/FM: System Definitions

Location of shutdown valve for fire sprinkler zone highlighted as a defined system within the BIM model.

BX1(-21)-BY1(-148) : -2.88 LEVEL (FIRE ENCASEMENT)

TAV
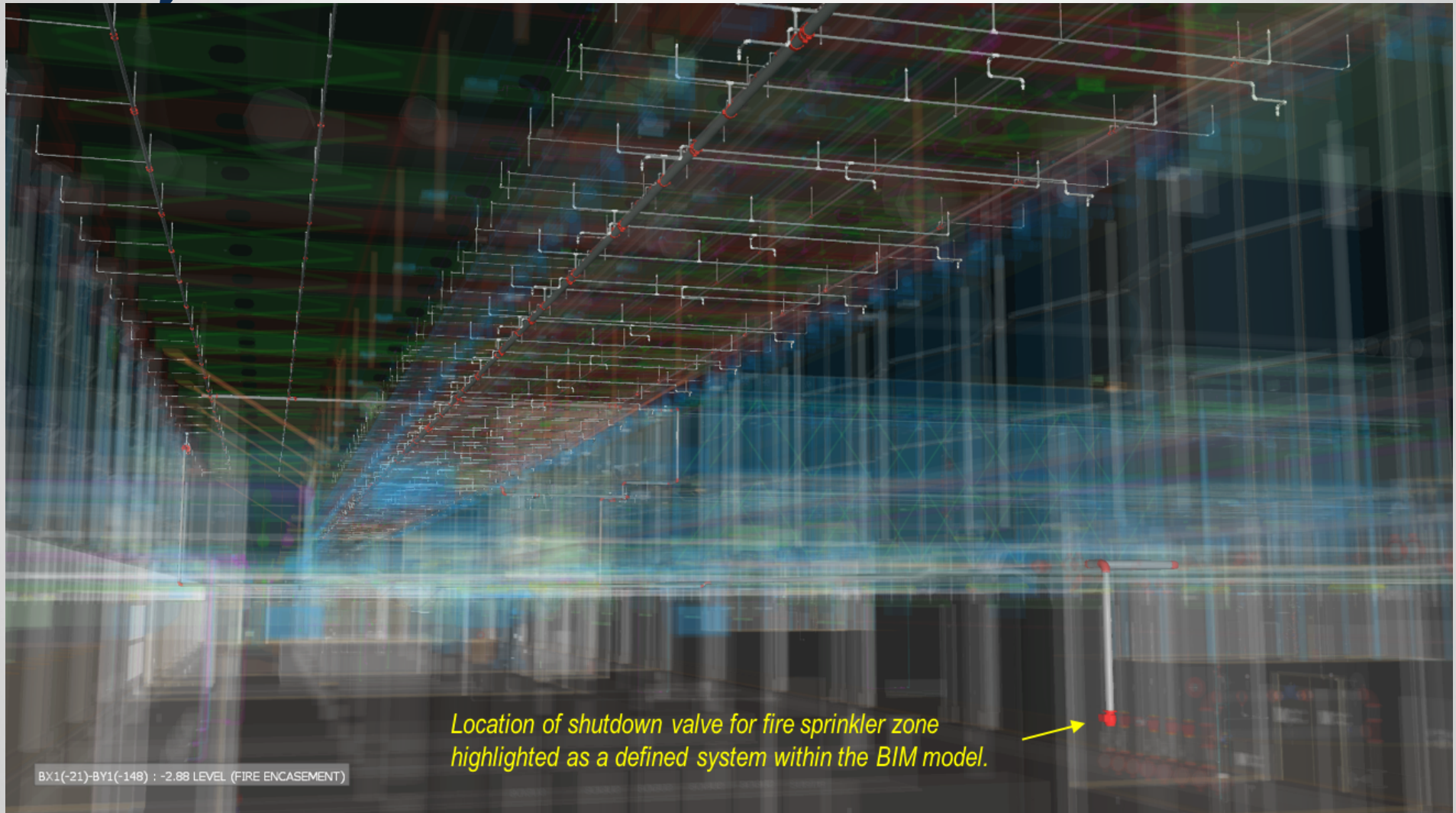
buildingSMART Airport Room

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…

T A V

Thank You