Roadmap to Sustainable Airport Digital Twins

JUNE 2023

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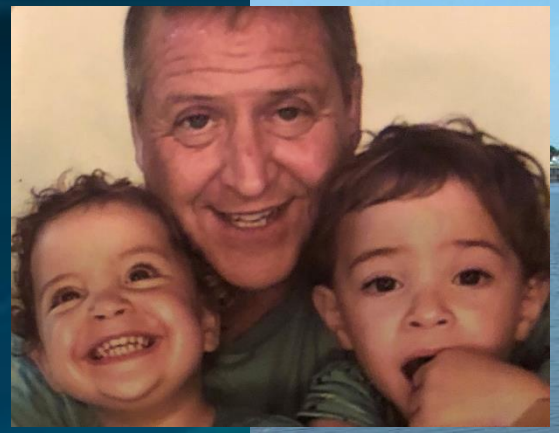
David Tamir



David with his Fraternal Twins

- Aeronautical & Space Systems Engineer (11 years)
  - Space Shuttle "Swamp Engineer"
- Airport Systems & Business Process Improvement Engineer (27 years)
  - Greater Orlando Aviation Authority
  - Consultant for 30+ Airports
  - AAAE Digital Twin Working Group Lead
  - AirportDigitalTwin.org Lead Director

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Objective

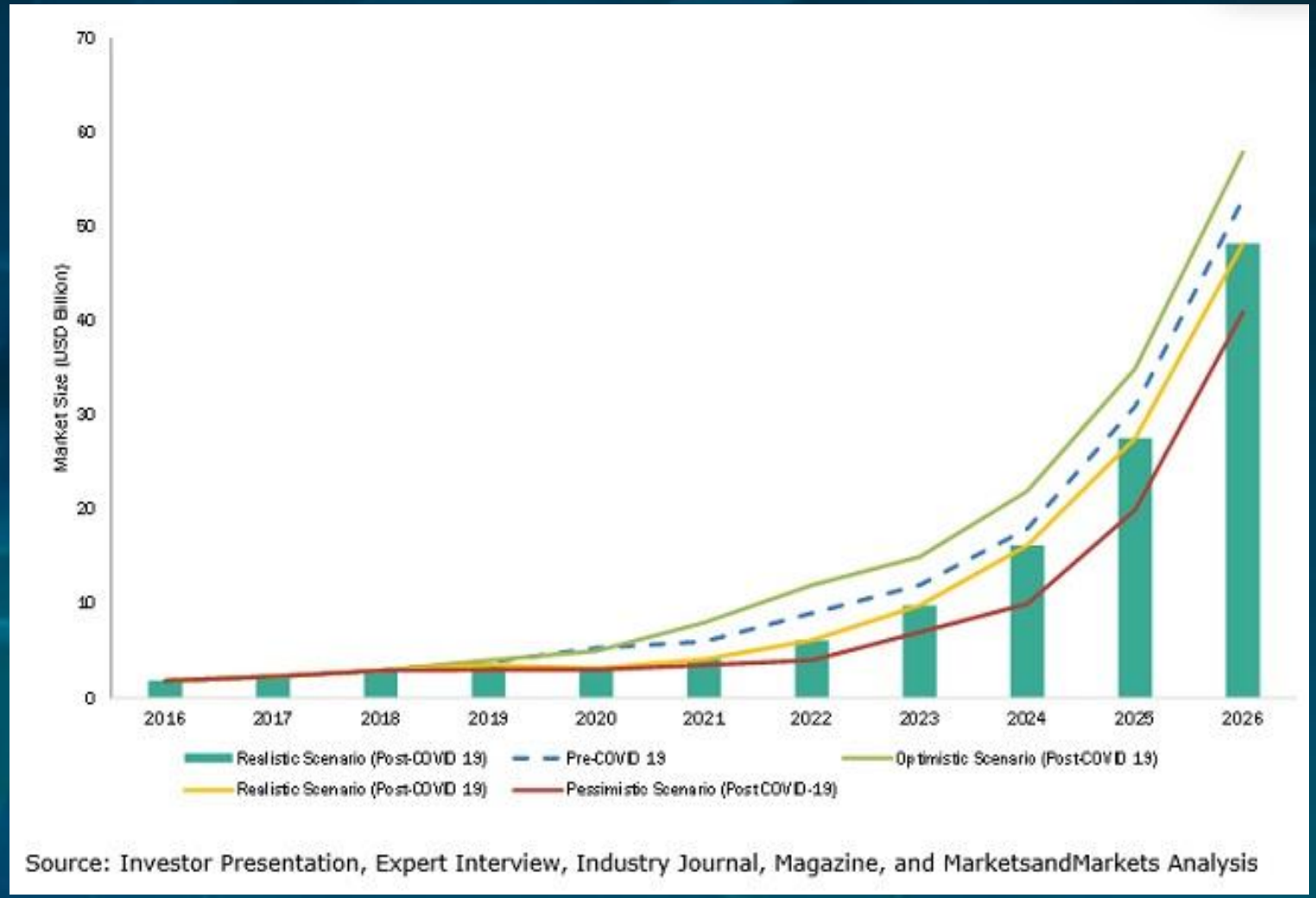
Manage Expectations of Airport Owners

to Successfully Achieve & Sustain

Airport Digital Twin (DT) Capabilities

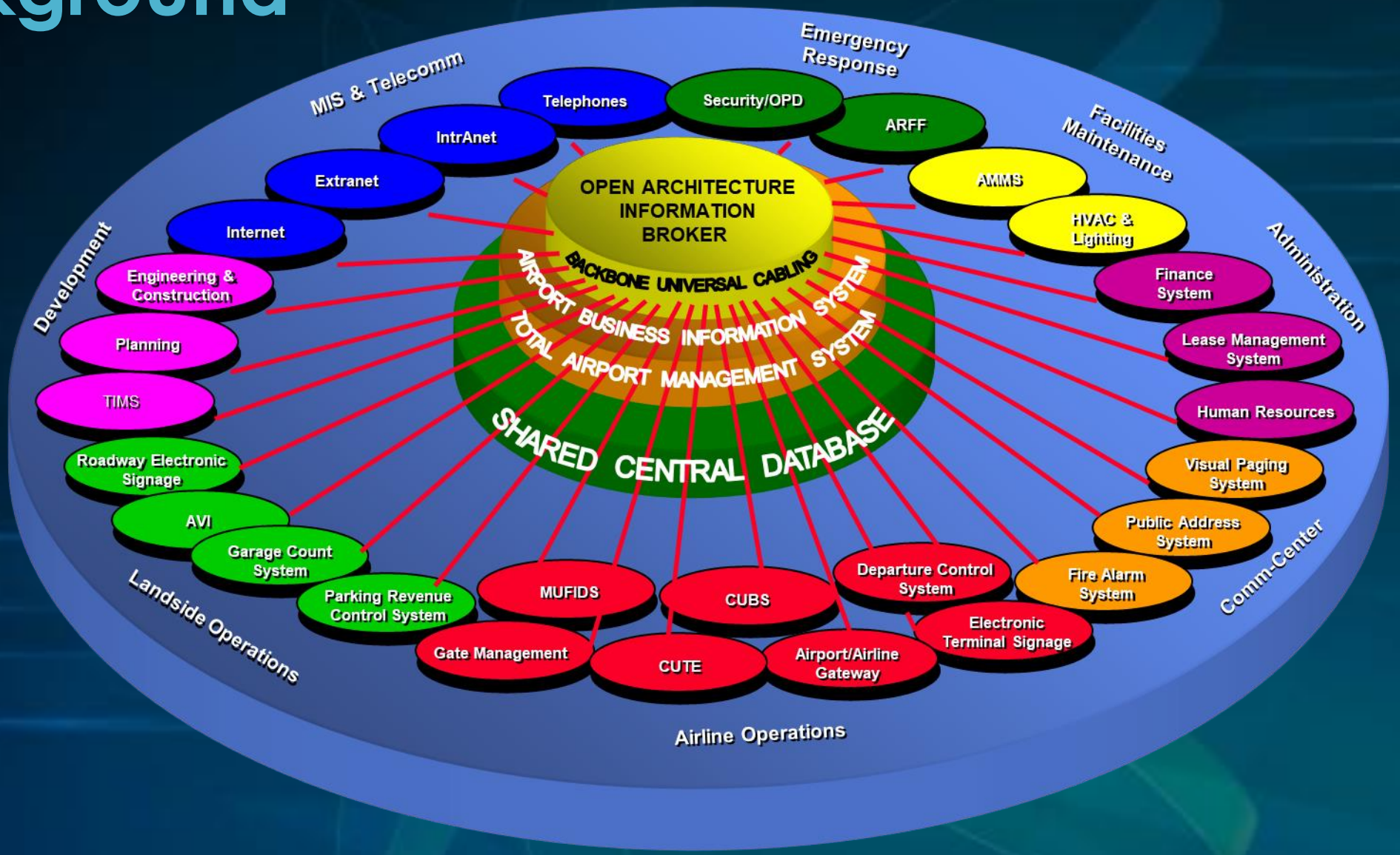
Background

In 2019, researchers at Markets & Markets reported that Digital Twin industry generated $3.8 billion USD in revenue around the world , and is projected to grow to $35.8 billion USD by 2025



Source: Investor Presentation, Expert Interview, Industry Journal, Magazine, and MarketsandMarkets Analysis

Background



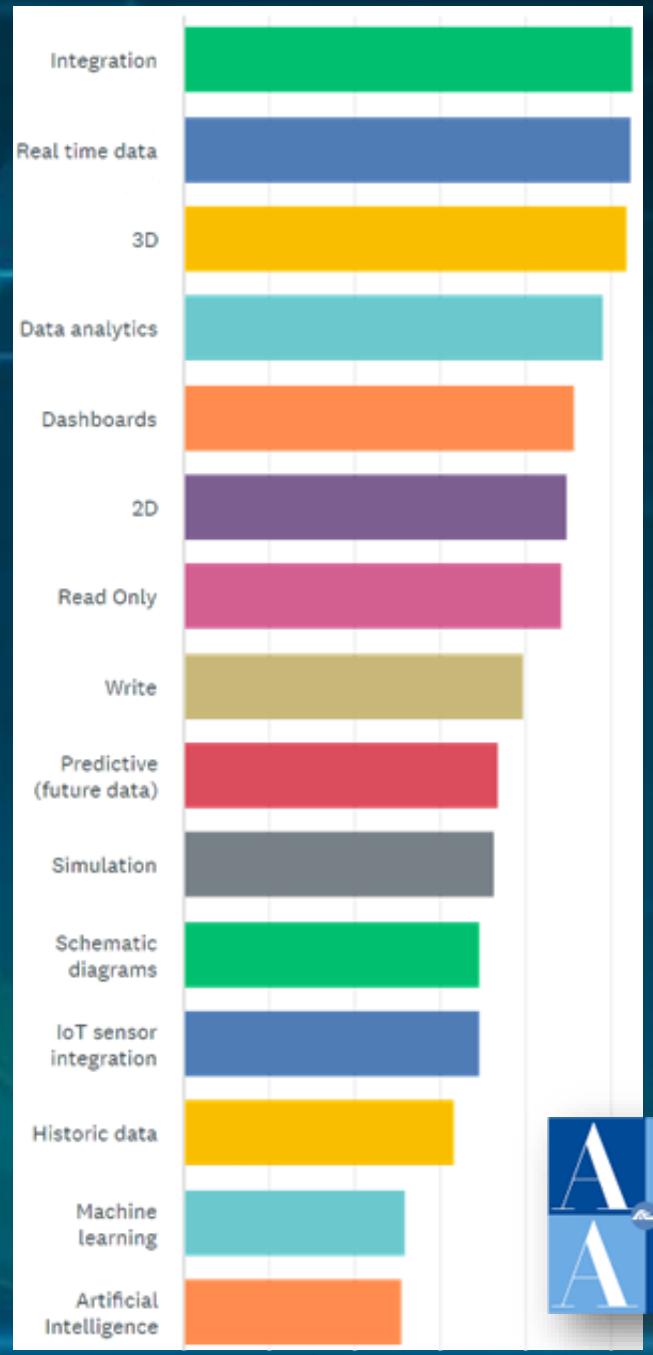
Nearly 30-Year-Old Concept …

Background

- Digital Twin terminology along with IoT interoperability and analytics are **renovating previous concepts**
- Digital Twin **software solutions being marketed** to airports
- Airport **executives hearing and asking** about Digital Twin
- Airport Digital Twin **implementations beginning**
- Airport Cooperative Research Program (**ACRP**) begun to **study** Digital Twins for Airports (ACRP 03-66)

Surveyed Impressions

- Integration
- Real-time data
- 3D visualization
  (2D and schematics are ok too)
- Data analytics
- Dashboards
- 2-way flow of data
- Simulated & Predicted
- IoT sensors



Source: AAAE / TRB 2022 Survey

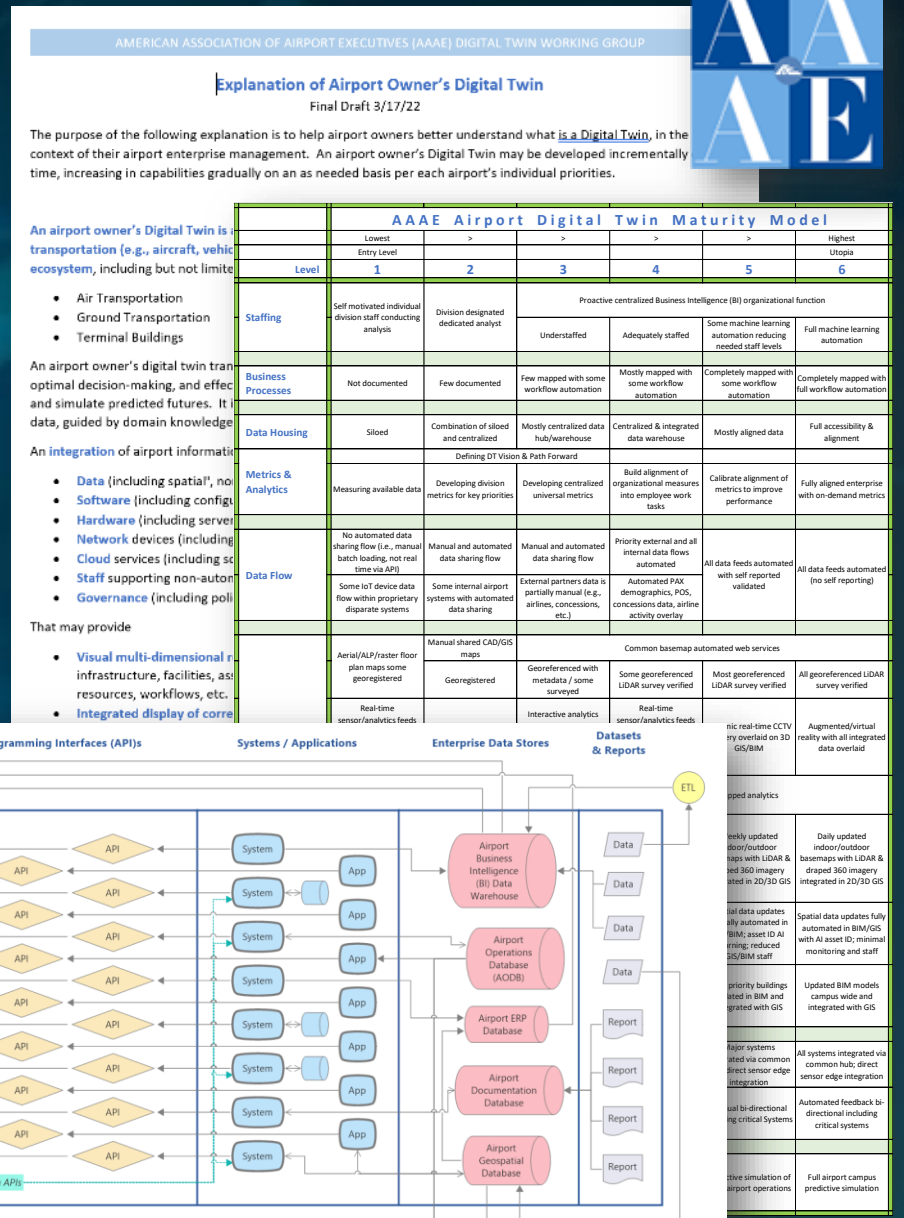
AAAE Digital Twin Working Group

- Formed **Digital Twin Working Group (DT-WG)** December 2021 (under Facilities & Technical Services Committee)
- Primary Objective: **Develop Roadmap for Airport Owners**
- Regular Zoom Meetings
  - **Monthly**: All Working Group Members Invited for Inputs & Reviews of Airport Examples
  - **Weekly**: Smaller Sub-Working Group Developing Roadmap Content Details
- DT-WG Membership
  - 20 Airport Owners
  - 40 Solution & Service Providers
- AAAE Conference Panels
  - 2022 Ops & Tech in San Antonio
  - 2022 NAC in Orlando
- \+ AAAE Airport Magazine Article (Oct/Nov)

AAAE Digital Twin Working Group

Roadmap for Airport Owners

- Definition / Explanation
- Top Use Cases / Examples
- Maturity Model
- System Architecture
- Implementation Approach
- Governance to Sustain
- Funding



AMERICAN ASSOCIATION OF AIRPORT EXECUTIVES (AAAE) DIGITAL TWIN WORKING GROUP

Explanation of Airport Owner's Digital Twin

Final Draft 3/17/22

The purpose of the following explanation is to help airport owners better understand what is a Digital Twin, in the context of their airport enterprise management. An airport owner's Digital Twin may be developed incrementally time, increasing in capabilities gradually on an as needed basis per each airport's individual priorities.

An airport owner's Digital Twin is
transportation (e.g., aircraft, vehic
ecosystem, including but not limite

- Air Transportation
- Ground Transportation
- Terminal Buildings

An airport owner's digital twin tran
optimal decision-making, and effec
and simulate predicted futures. It
data, guided by domain knowledge

An integration of airport informati

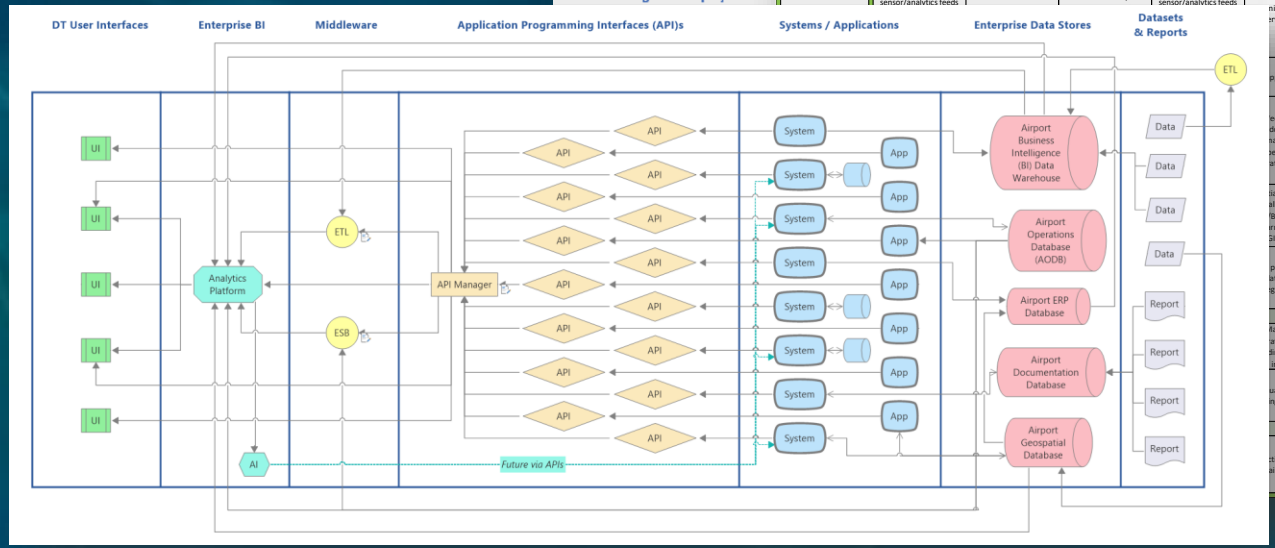
- Data (including spatial*, no
- Software (including config
- Hardware (including serve
- Network devices (including
- Cloud services (including s
- Staff supporting non-auton
- Governance (including poli

That may provide

- Visual multi-dimensional r
infrastructure, facilities, as
resources, workflows, etc.
- Integrated display of corre

AAAE Airport Digital Twin Maturity Model

	Lowest	>	>	>	>	Highest
	Entry Level					Utopia
Level	1	2	3	4	5	6
Staffing	Self motivated individual division staff conducting analysis	Division designated dedicated analyst	Proactive centralized Business Intelligence (BI) organizational function			
			Understaffed	Adequately staffed	Some machine learning automation reducing needed staff levels	Full machine learning automation
Business Processes	Not documented	Few documented	Few mapped with some workflow automation	Mostly mapped with some workflow automation	Completely mapped with some workflow automation	Completely mapped with full workflow automation
Data Housing	Siloed	Combination of siloed and centralized	Mostly centralized data hub/warehouse	Centralized & integrated data warehouse	Mostly aligned data	Full accessibility & alignment
			Defining DT Vision & Path Forward			
Metrics & Analytics	Measuring available data	Developing division metrics for key priorities	Developing centralized universal metrics	Build alignment of organizational measures into employee work tasks	Calibrate alignment of metrics to improve performance	Fully aligned enterprise with on-demand metrics
Data Flow	No automated data sharing flow (i.e., manual batch loading, not real time via API)	Manual and automated data sharing flow	Manual and automated data sharing flow	Priority external and all internal data flows automated	All data feeds automated with self reported validated	All data feeds automated (no self reporting)
	Some IoT device data flow within proprietary disparate systems	Some internal airport systems with automated data sharing	External partners data is partially manual (e.g., airlines, concessions, etc.)	Automated PAX demographics, POS, concessions data, airline activity overlay		
	Aerial/ALP/raster floor plan maps some georegistered	Manual shared CAD/GIS maps	Common basemap automated web services			
		Georegistered	Georeferenced with metadata / some surveyed	Some georeferenced LiDAR survey verified	Most georeferenced LiDAR survey verified	All georeferenced LiDAR survey verified
	Real-time sensor/analytics feeds		Interactive analytics	Real-time sensor/analytics feeds		Augmented/virtual reality with all integrated data overlaid



AIRPORT OWNER'S DIGITAL TWIN ROADMAP

May 16, 2023

Prepared by David Tamir

AAAE Digital Twin Working Group Lead

under the direction of AAAE Facilities and Technical Services Committee

This work product reflects the results of the AAAE Digital Twin Working Group's efforts spanning 2022-2023

Image courtesy of www.AirportDigitalTwin.org

AMERICAN ASSOCIATION OF AIRPORT EXECUTIVES (AAAE) DIGITAL TWIN WORKING GROUP (DT-WG)

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What's an Airport Digital Twin (DT)

Digital representation of airport campus

- **integrating data** from disparate systems / sources
- to enable **safe, secure,** and **efficient** airport functions
- with **past, present**, and **predicted** views

AirportDigitalTwin.org Proprietary Information

What's an Airport Digital Twin

An airport owner's Digital Twin is a virtual digital representation of the airport's real-world assets, intermodal transportation (e.g., aircraft, vehicles, passengers, cargo), and processes which may span the entire aerodrome ecosystem, including but not limited to:

- Air Transportation
- Ground Transportation
- Terminal Buildings
- Other Buildings
- Infrastructure
- Properties & Environment

An airport owner's digital twin transforms the airport business enterprise by accelerating holistic understanding, optimal decision-making, and effective action. It uses real-time and historical data to represent the past and present and simulate predicted futures. It is motivated by outcomes, tailored to use cases, powered by integration, built on data, guided by domain knowledge, and implemented in IT/OT systems.[i]

Source:

AAAE Airport Owner's Digital Twin Working Group Roadmap

(based on Digital Twin Consortium's Definition)

What's an Airport Digital Twin cont'

An **integration** of airport information systems (including processes, data, and technologies)

- **Data** (including spatial[ii], non-spatial, real-time, historic, forecast, and simulated)
- **Software** (including configurable COTS solutions, data maintenance, and business intelligence & analytics)
- **Hardware** (including servers, desktops, laptops, tablets, smartphones, and sensors)
- **Network** devices (including switches, routers, and hotspots)
- **Cloud** services (including software, data, databases, and infrastructure "as a service")
- **Staff** supporting non-automated data updates (such as airport configuration changes)
- **Governance** (including policies, standards, compliance, processes, and procedures)

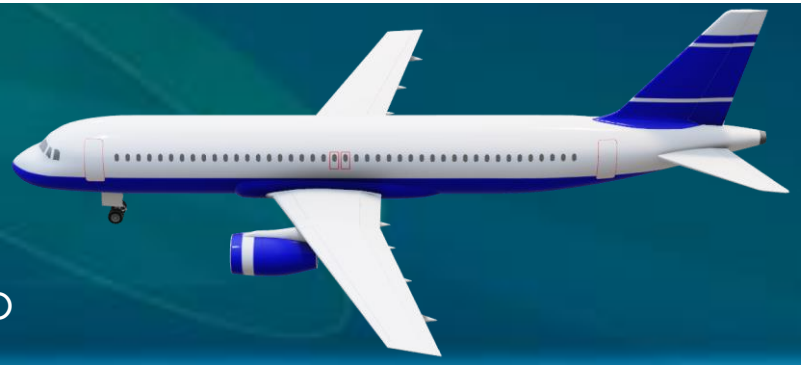
That may provide

- **Visual multi-dimensional representation** of the airport's ecosystem including its airspace, surroundings, infrastructure, facilities, assets, systems, flux (e.g., aircraft, vehicles, passengers, meeter greeters), staff resources, workflows, etc.
- **Integrated display of correlated information** from multiple systems/sources (aka business intelligence) in the form of analytic graphs, tables, and maps
- **Temporal analysis** of past, current, real-time, forecast, and/or simulated data

What's an Airport Digital Twin cont'

To enable

- **Efficient collection, access, correlation, and understanding of quality**[iii] **data** from multiple airport systems/sources to support faster and more confident decisions to improve airport:
  - Level of Service
  - Safety & Security
  - Operations & Maintenance
  - Planning & Development
  - Costs & Revenue
  - Compliance & Risk Management
- **Autonomous** operations and decision making



Source: AAAE Airport Owner's Digital Twin Working Group Roadmap

What's an Airport Digital Twin cont'

In support of all airport management disciplines

- Planning & Environmental
- Engineering & Construction
- Facilities & Asset Maintenance
- Operations (Landside, Terminal, Airside, Security, Fire, Police)
- Property Leasing & Concessions
- Business Development
- Public & Governmental Affairs
- Information Technology & Communications
- Finance & Procurement
- Legal & Administration

Addressing informational needs of various airport stakeholders

- Board members
- Management
- Staff
- Vendors / Consultants / Contractors / Service providers
- Tenants
- Passengers
- Meeters & Greeters
- Governing agencies (e.g., local, state, federal)
- Surrounding Community

Source: AAAE Airport Owner's Digital Twin Working Group Roadmap

What's an Airport Digital Twin cont'

An airport owner's digital twin is

- NOT a single system, but rather an integration of systems/data,
  which are assembled into a Digital Twin head-end system
- NOT replacing existing airport systems, but rather expanding their utility;
  some existing systems may become obsolete or consolidated as a result of a Digital Twin
- NOT the Architectural-Engineering-Construction (AEC) Digital Twin used to design-build-activate new facilities;
  however, the AEC's Digital Twin data may be leveraged by the airport owner's Digital Twin
- NOT a Building Information Modeling (BIM) nor a Geospatial Information System (GIS),
  although BIM and GIS are parts of a digital twin

Source: AAAE Airport Owner's Digital Twin Working Group Roadmap

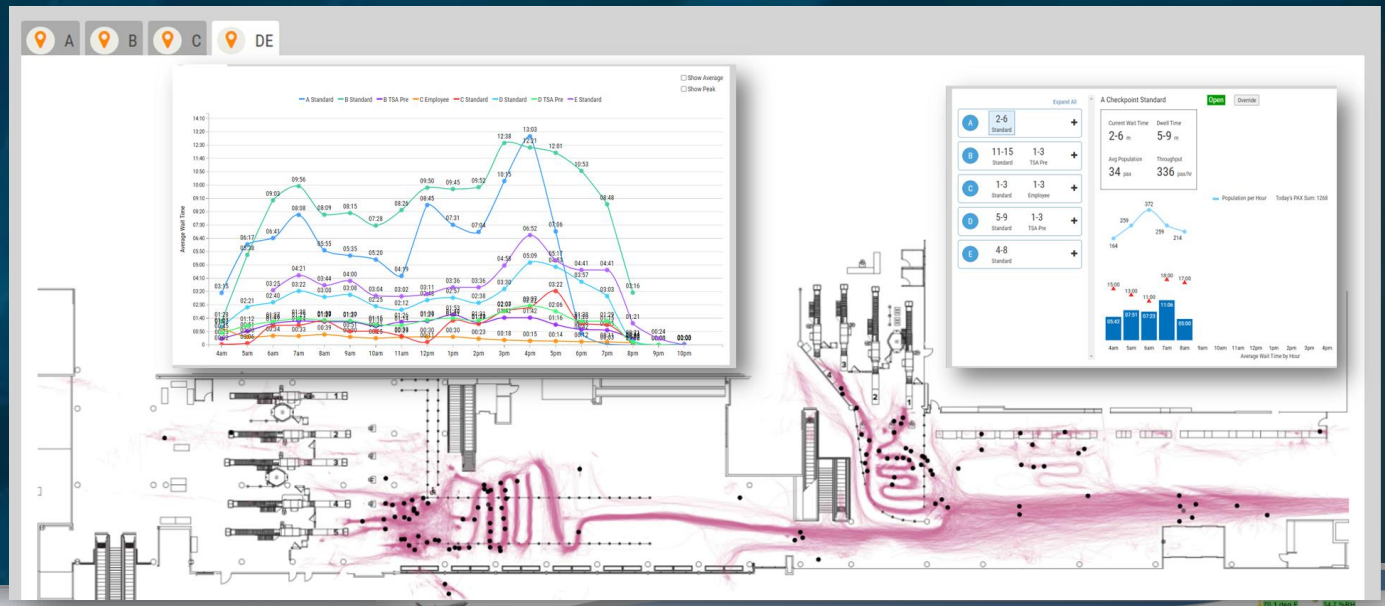
Challenges Facilitated by Digital Twin

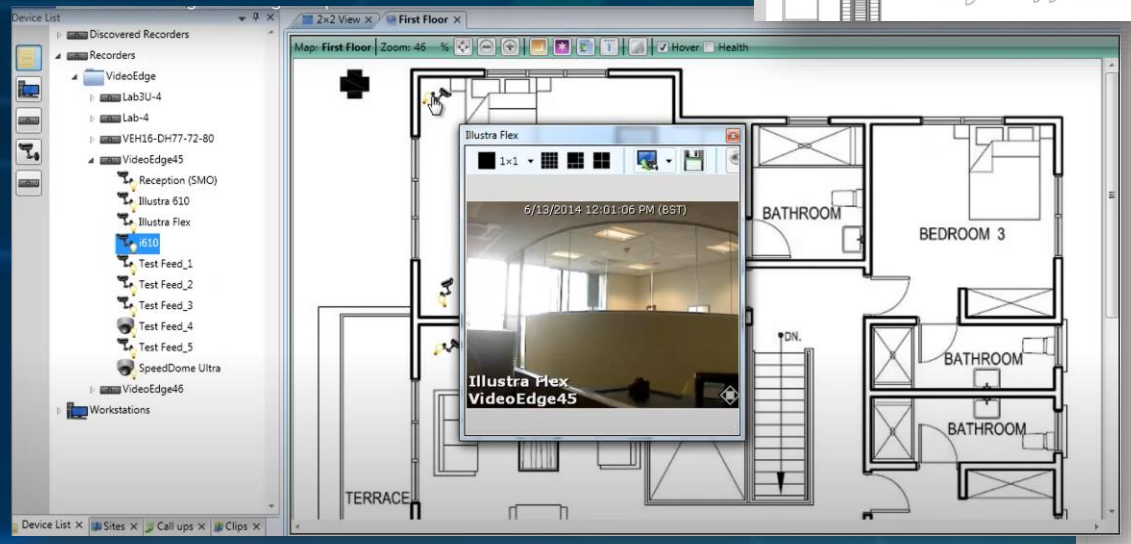
- Internet of Things (IoT) with analytics have become common place (e.g., **CCTV cameras, sensors, alarms, elevators, escalators, etc**.)
- Different IoT types overlayed on disparate system maps/floorplans **need to be updated more efficiently with constant airport changes**
- **Need to correlate interdependencies** of various IoT types across large and complex airport facilities that are constantly evolving
- **Need** various IoTs with analytics **on same "page"** via shared up-to-date airport maps/floorplans

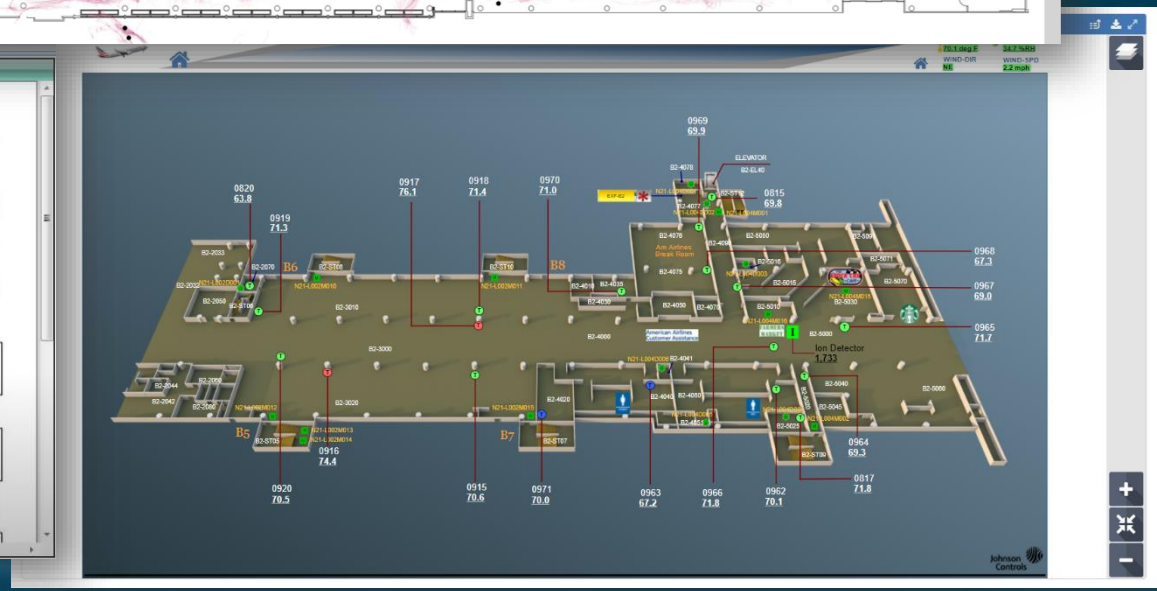
AirportDigitalTwin.org Proprietary Information

Examples requiring Correlation via a Digital Twin

- PAX Movements Analytics
- Building Sensors Analytics
- CCTV Imagery Analytics







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DT Fusion

Airport Assets & Infrastructure

- **Airspace**
  - Part-77
  - TERPS
  - GPS Surfaces
  - Other
- **Navaids**
  - Radar
  - Visual Guidance
  - Non-Visual Guidance
  - Weather
  - Other
- **Airfield**
  - Runways
  - Taxiways
  - Taxi-lanes
  - Aprons
  - Other
- **Access Control**
  - Fences
  - Gates
  - Doors
  - Keys/Locks
  - Badges
  - Other
- **Roadways & Rail**
  - Non-Secure
  - Secure
  - Off-Airport
  - Other
- **Parking**
  - Passengers & Meeters/Greeters
  - Rental Cars
  - Taxis
  - Limos/Vans
  - Busses
  - Employee
  - Other
- **Security & Life Safety Systems**
  - Sensors
  - Alarms
  - Access Control Readers
  - CCTV Cameras
  - Other
- **People**
  - Staff
  - Board/Management
  - Passengers
  - State/Federal Government
  - Meeters/Greeters
  - Community
  - Signatory Airlines
  - Non-Signatory Airlines
  - Tenants
  - Consultants & Contractors
  - Other
- **Financials**
  - FAA Grants
  - DOT Grants
  - Bonds
  - Other
  - PFCs
  - Aviation Revenues
  - Non-Aviation Revenues
- **Properties**
  - Other
  - Ownership
  - Leases
  - Easements
  - Avigation
  - Noise
  - Mitigation
- **Environmental**
  - Wildlife
  - Water Bodies
  - Fauna
  - Other
  - Monitoring Wells
  - Air Quality
- **Buildings & Structures**
  - Terminals
  - Hangars
  - ARFF Station(s)
  - AOC/EOC
  - Other
  - Central Utilities Plant
  - Offices/Shops
  - Bridges
- **Utilities**
  - Other
  - Electric
  - HVAC
  - Fuel
  - Natural Gas
  - Water
  - Sewer
  - Storm
  - Communications
- **Fixtures Furnishings & Equipment**
  - Furniture
  - Artwork
  - Vehicles
  - People Movers
  - Baggage Processing
  - Bathrooms
  - Carpeting
  - Lighting
  - Signage
  - Other
- **IT & Communication Systems**
  - Passenger Processing Systems
  - Back-Office Systems
  - Communication Infrastructure
  - Network Operations Center(s)
  - Other
- **Data & Records**
  - Contracts
  - Agreements
  - Specifications
  - As-Built Drawings
  - Plans
  - O&M Manuals
  - Reports
  - Financial Records
  - HR Records
  - Other

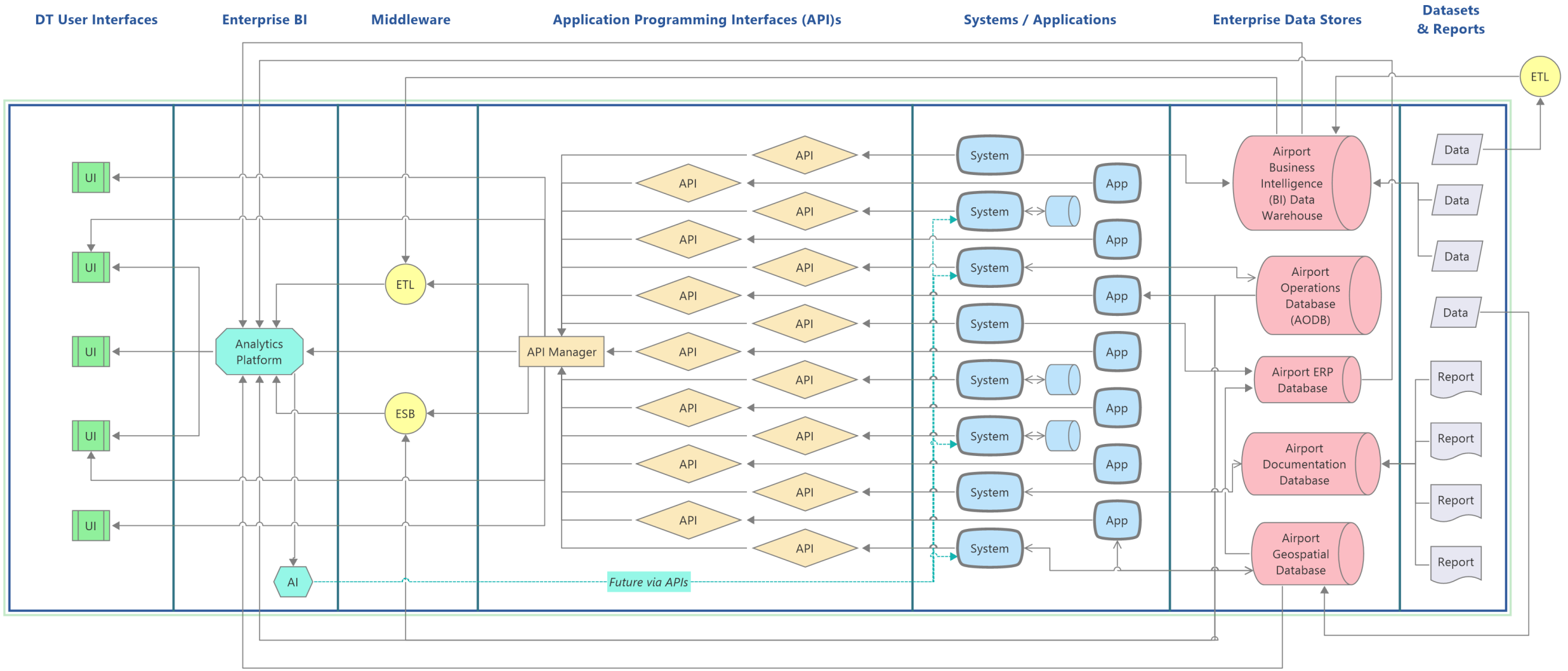
AirportDigitalTwin.org Proprietary Information

Examples of DT Data Fusion Needs

- ALP & Floor Plans
- 3D LiDAR with Draped Imagery Outdoors & Indoors
- Airspace / AOA Traffic & NOTAMS
- Aircraft Gate Turn-Around Status
- On-Airport Roadways / Curbs
- Parking Garages / Lots Status
- People Movers Status
- Elevators / Escalators Status
- Ticket Counters Status
- Security Checkpoints Status
- PAX Congestion / Queues
- Bathrooms Status
- Alarms / Sensors / CCTV
- Incidents / Complaints
- Inspections / Issues / Weather
- Projects, Work Orders, Outages…

AirportDigitalTwin.org Proprietary Information

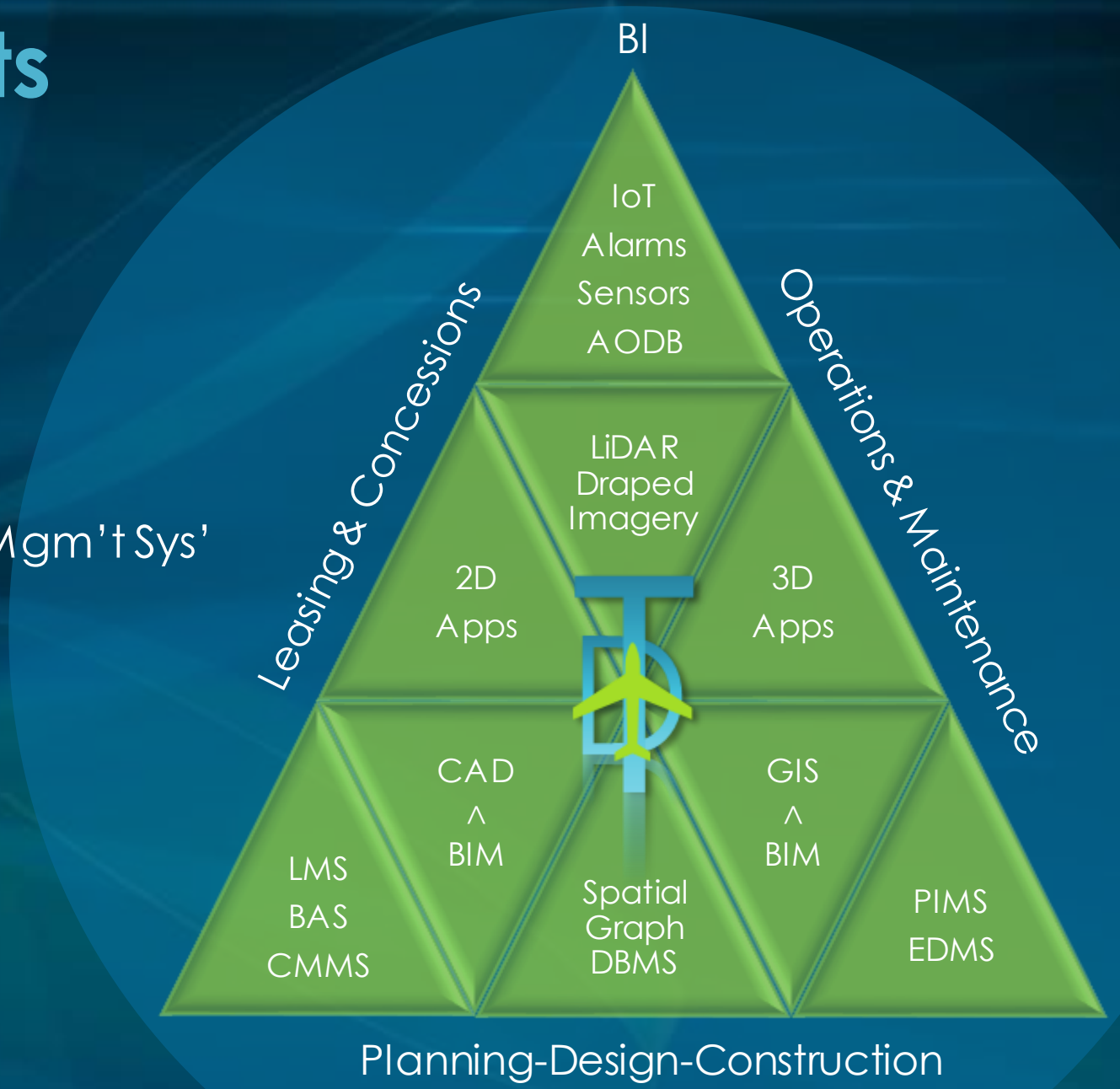
Open System Architecture Approach



Source: AAAE Digital Twin Working Group

Airport DT Components

- AODB – Airport Operations Database
- BAS – Building Automation System
- BI – Business Intelligence
- BIM – Building Information Modeling
- CAD – Computer Aided Design
- CMMS – Computerized Maintenance Mgm't Sys'
- DBMS – Database Mgm't Systems
- EDMS – Electronic Doc's Mgm't System
- GIS – Geospatial Information System
- IoT – Internet of Things
- LiDAR – Light Detection and Ranging
- LMS – Lease Management System
- PIMS – Project Info' Mgm't System



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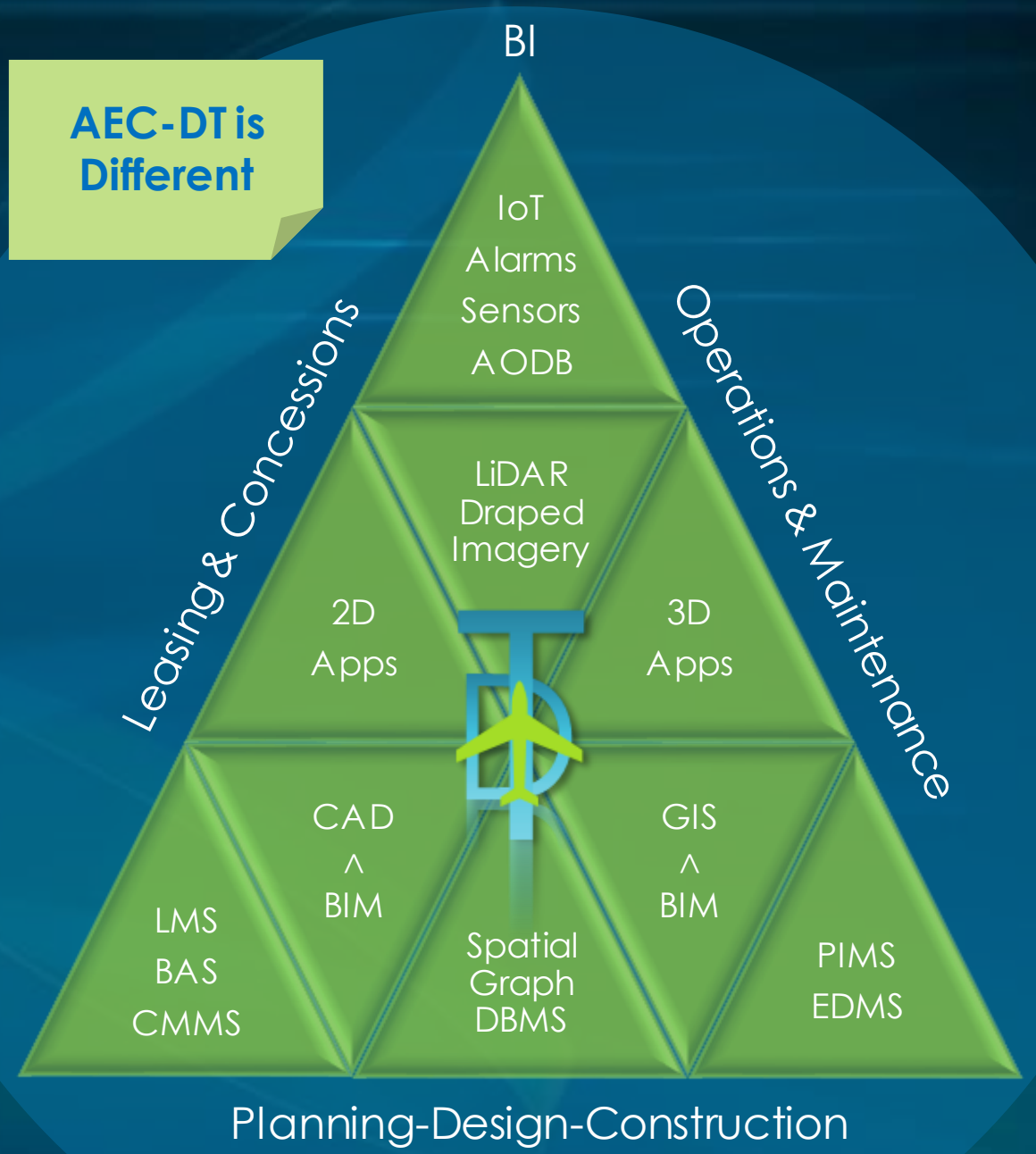
Holistic DT Stakeholders
Airport Owner-Side ---------->

- Planning & Environmental
- Engineering & Construction
- Operations & Security
- Facilities Maintenance
- IT Systems & Infrastructure
- Leasing & Concessions (Revenues)
- Finance & Procurement
- Legal & Administration

AEC-DT is Different



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DT Foundation

"Skeleton"

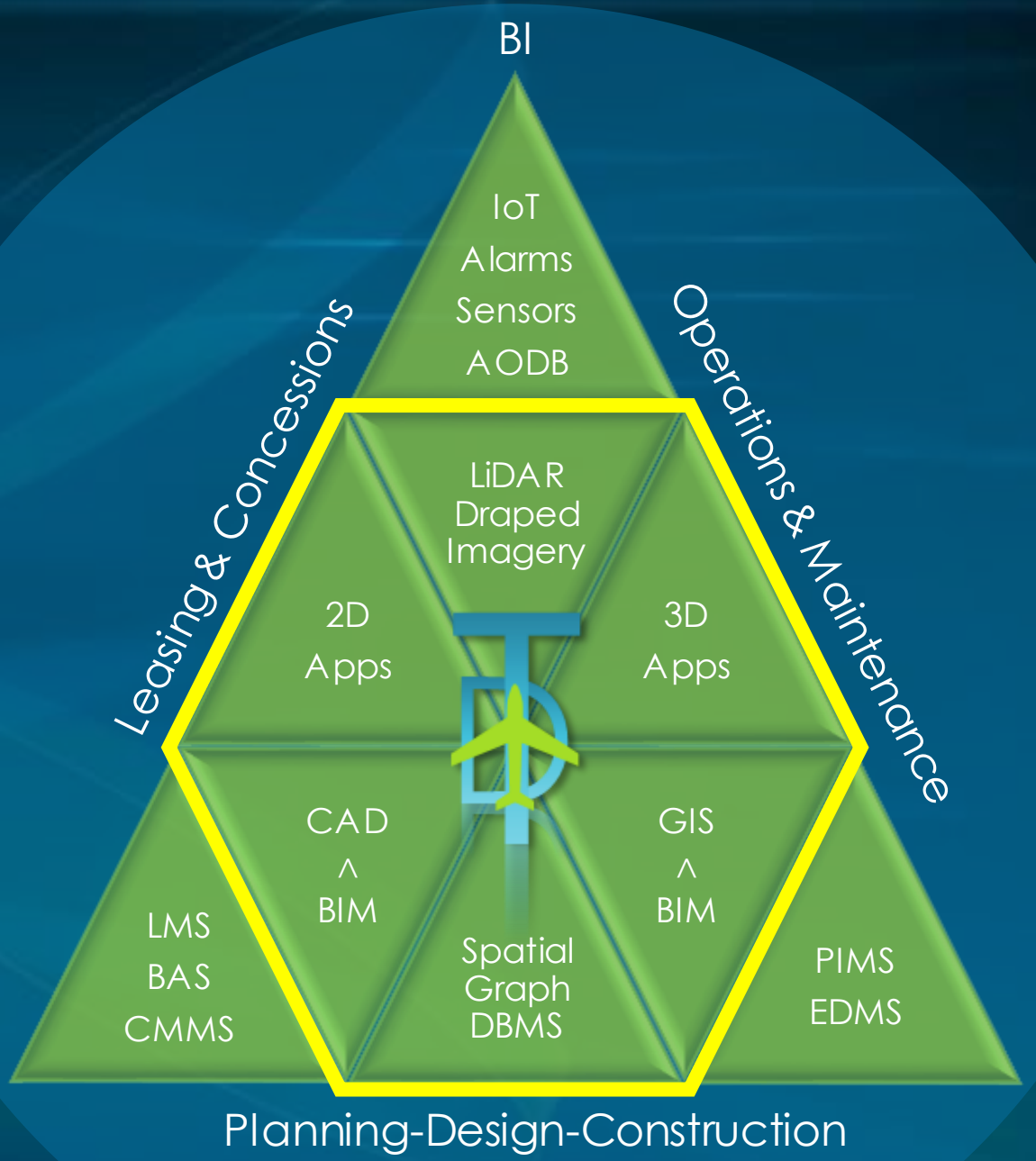
correlates DT components together

via common denominator

Spatial Database

key

to achieving DT



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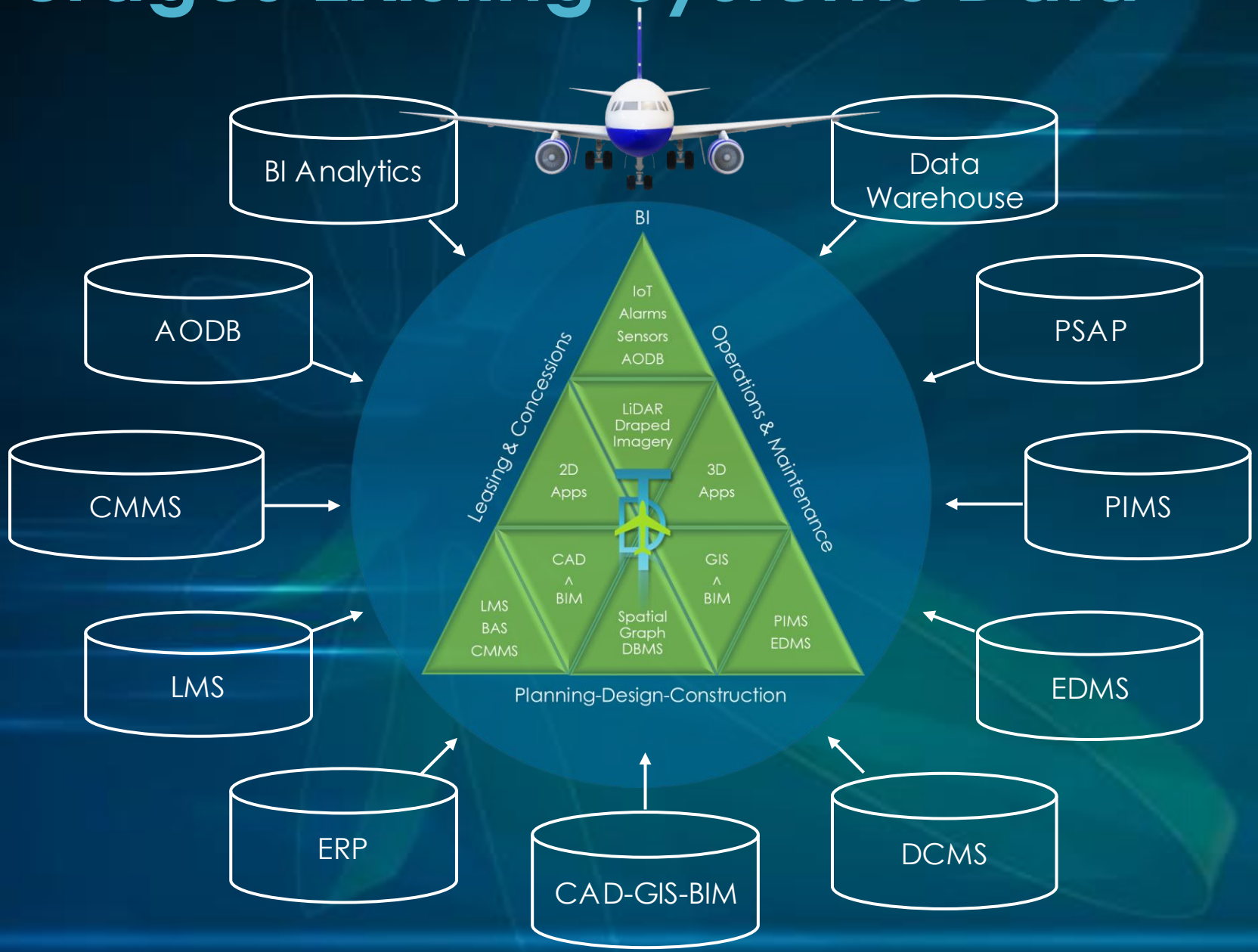
DT Leverages Existing Systems Data

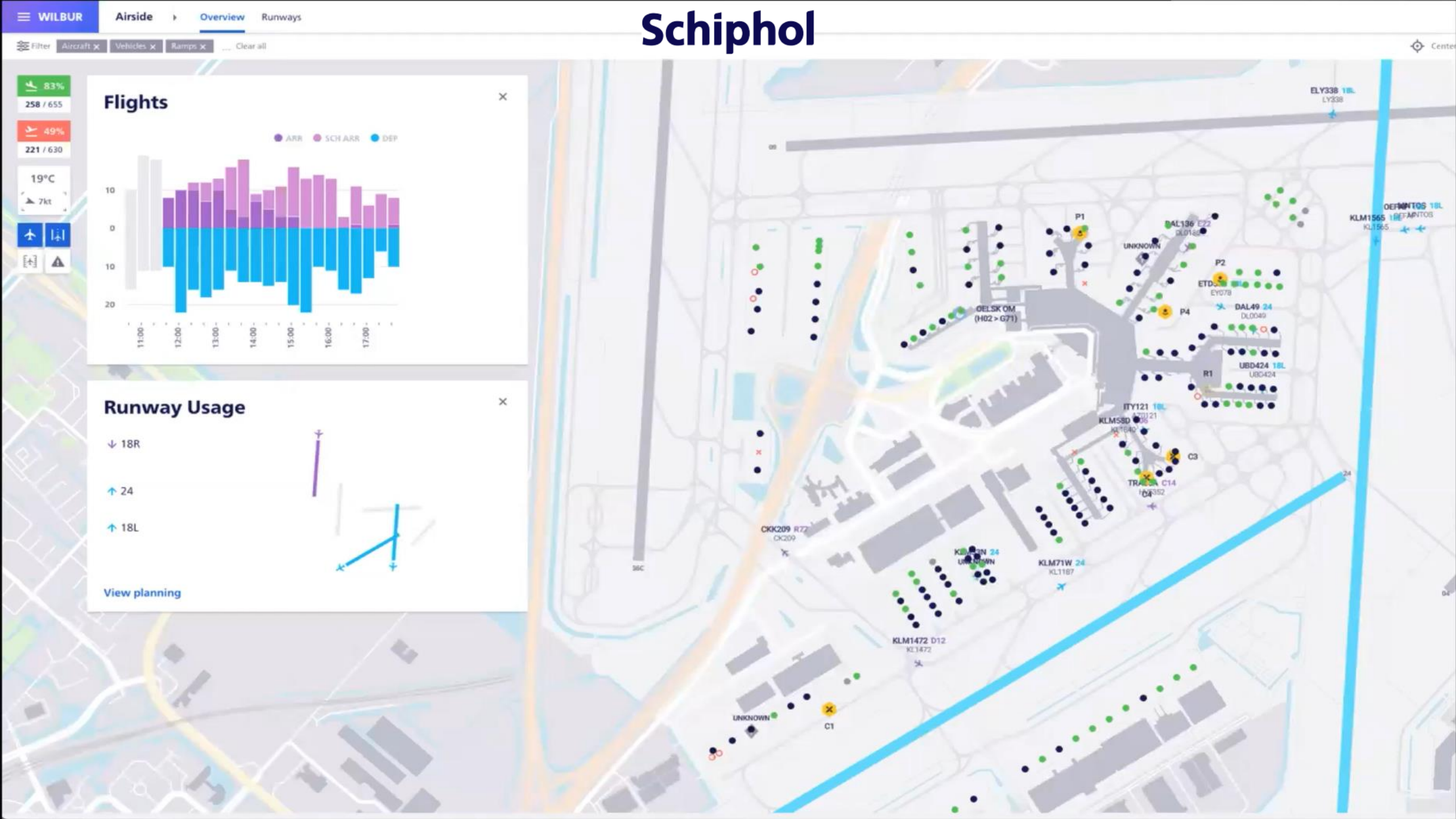


AirportDigitalTwin.org Proprietary Information

AAAE DT-WG Review of Airport Examples

- AMS
- YVR
- PANYNJ
- DFW
- MCO
- CLT
- SFO
- LAS

Schiphol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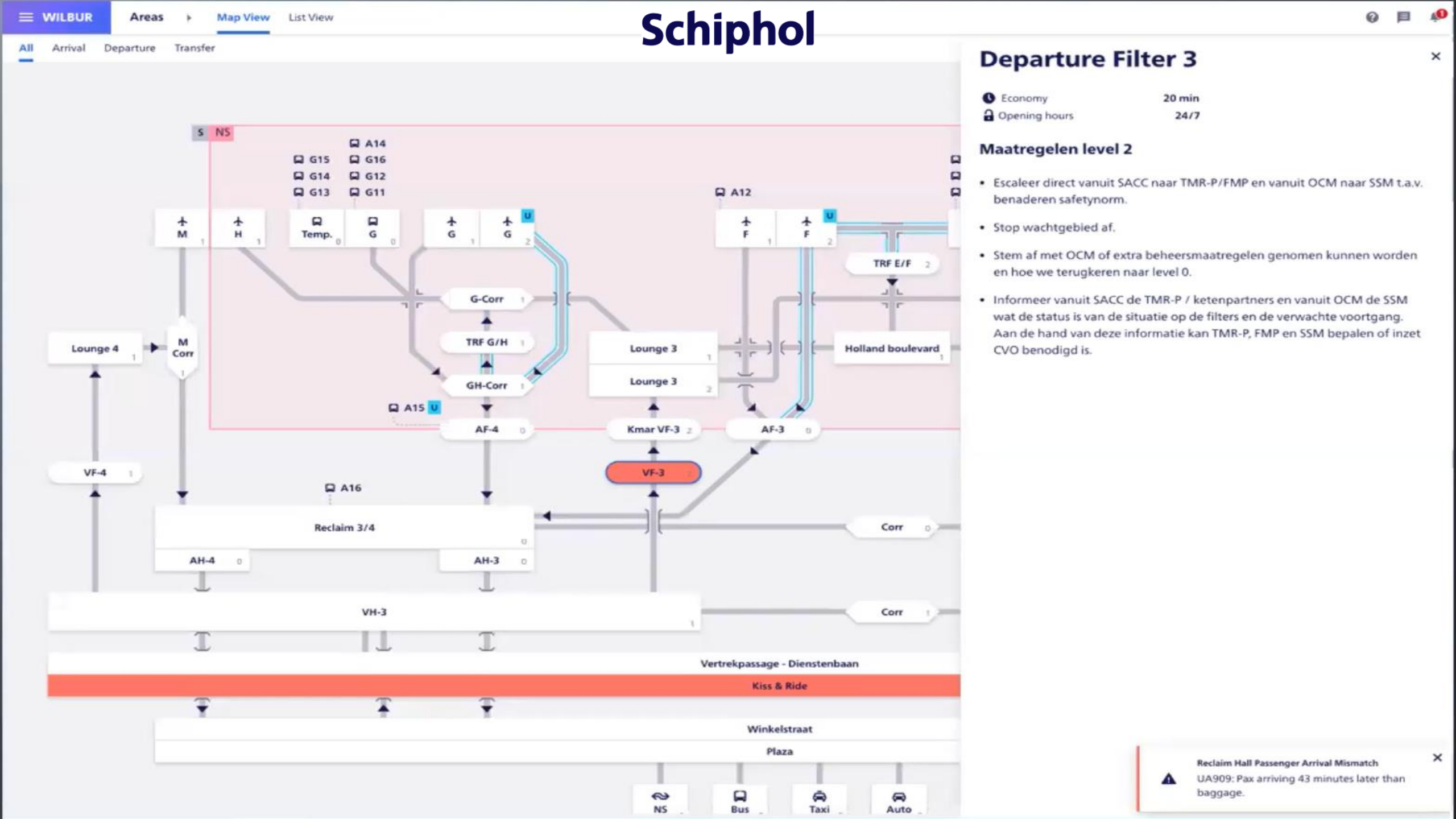
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Reclaim 3/4
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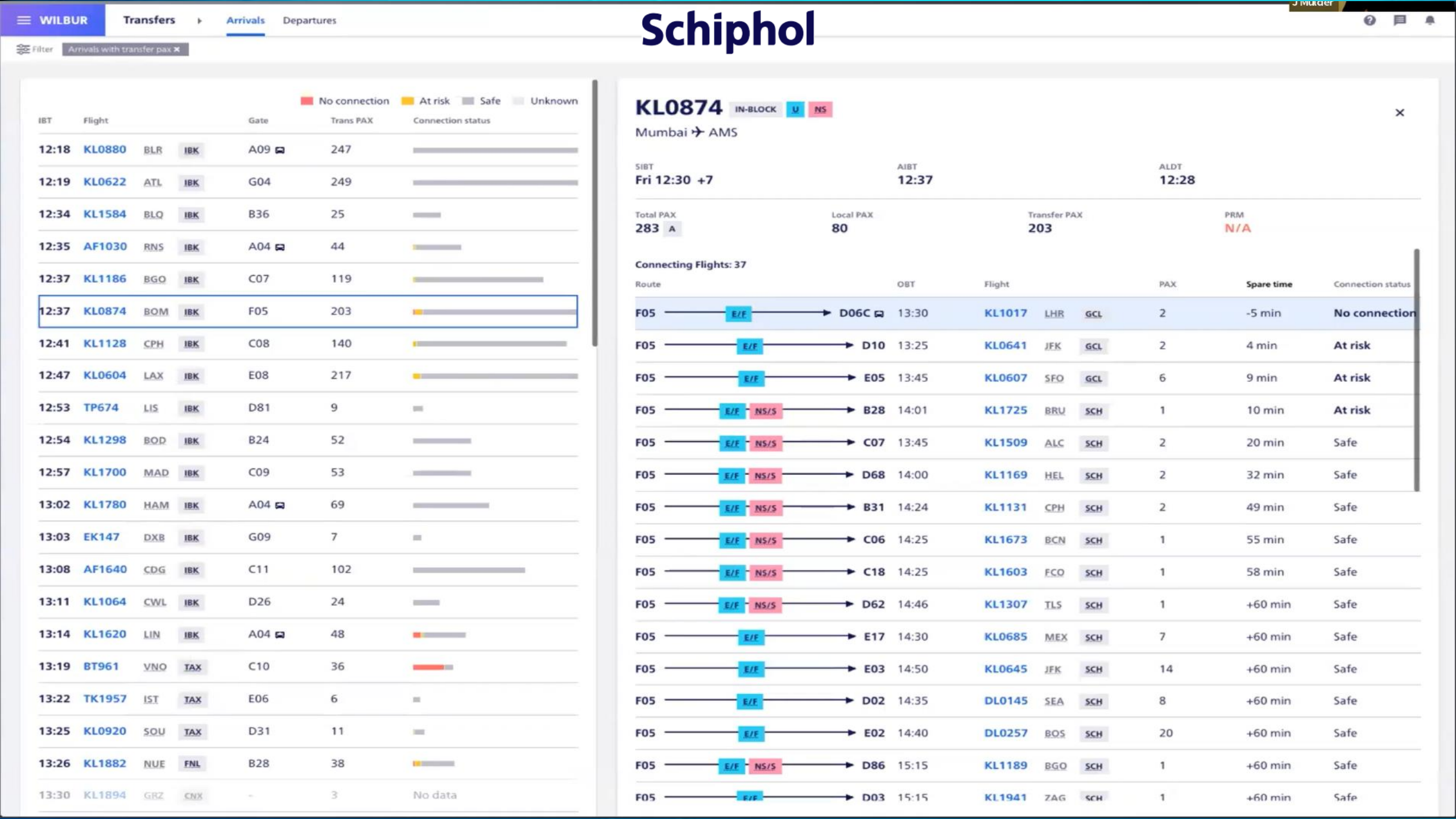
AH-4
AH-3
VH-3
Corr
Vertrekpassage - Dienstenbaan
Kiss & Ride
Winkelstraat
Plaza
NS
Bus
Taxi
Auto
Departure Filter 3
Economy 20 min
Opening hours 24/7
Maatregelen level 2
Escaleer direct vanuit SACC naar TMR-P/FMP en vanuit OCM naar SSM t.a.v. benaderen safetynorm.
Stop wachtgebied af.
Stem af met OCM of extra beheersmaatregelen genomen kunnen worden en hoe we terugkeren naar level 0.
Informeer vanuit SACC de TMR-P / ketenpartners en vanuit OCM de SSM wat de status is van de situatie op de filters en de verwachte voortgang. Aan de hand van deze informatie kan TMR-P, FMP en SSM bepalen of inzet CVO benodigd is.
Reclaim Hall Passenger Arrival Mismatch
UA909: Pax arriving 43 minutes later than baggage.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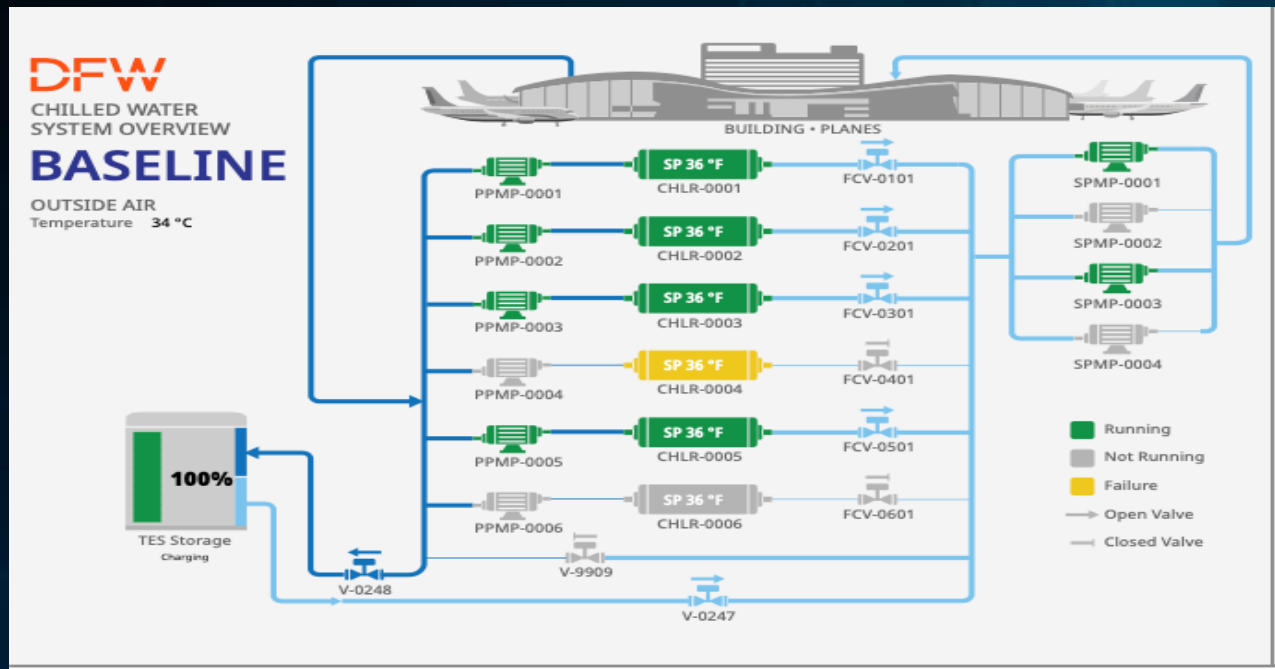
Transfers
Arrivals
Departures
Schiphol
J Mulder
Filter
Arrivals with transfer pax
No connection
At risk
Safe
Unknown
IBT
Flight
Gate
Trans PAX
Connection status
12:18 KL0880 BLR IBK A09 247
12:19 KL0622 ATL IBK G04 249
12:34 KL1584 BLQ IBK B36 25
12:35 AF1030 RNS IBK A04 44
12:37 KL1186 BGO IBK C07 119
12:37 KL0874 BOM IBK F05 203
12:41 KL1128 CPH IBK C08 140
12:47 KL0604 LAX IBK E08 217
12:53 TP674 LIS IBK D81 9
12:54 KL1298 BOD IBK B24 52
12:57 KL1700 MAD IBK C09 53
13:02 KL1780 HAM IBK A04 69
13:03 EK147 DXB IBK G09 7
13:08 AF1640 CDG IBK C11 102
13:11 KL1064 CWL IBK D26 24
13:14 KL1620 LIN IBK A04 48
13:19 BT961 VNO TAX C10 36
13:22 TK1957 IST TAX E06 6
13:25 KL0920 SOU TAX D31 11
13:26 KL1882 NUE FNL B28 38
13:30 KL1894 GRZ CNX - 3 No data
KL0874
IN-BLOCK
U
NS
Mumbai ✈ AMS
SIBT
Fri 12:30 +7
AIBT
12:37
ALDT
12:28
Total PAX
283 A
Local PAX
80
Transfer PAX
203
PRM
N/A
Connecting Flights: 37
Route
OBT
Flight
PAX
Spare time
Connection status
F05 E/F D06C 13:30 KL1017 LHR GCL 2 -5 min No connection
F05 E/F D10 13:25 KL0641 JFK GCL 2 4 min At risk
F05 E/F E05 13:45 KL0607 SFO GCL 6 9 min At risk
F05 E/F NS/S B28 14:01 KL1725 BRU SCH 1 10 min At risk
F05 E/F NS/S C07 13:45 KL1509 ALC SCH 2 20 min Safe
F05 E/F NS/S D68 14:00 KL1169 HEL SCH 2 32 min Safe
F05 E/F NS/S B31 14:24 KL1131 CPH SCH 2 49 min Safe
F05 E/F NS/S C06 14:25 KL1673 BCN SCH 1 55 min Safe
F05 E/F NS/S C18 14:25 KL1603 FCO SCH 1 58 min Safe
F05 E/F NS/S D62 14:46 KL1307 TLS SCH 1 +60 min Safe
F05 E/F E17 14:30 KL0685 MEX SCH 7 +60 min Safe
F05 E/F E03 14:50 KL0645 JFK SCH 14 +60 min Safe
F05 E/F D02 14:35 DL0145 SEA SCH 8 +60 min Safe
F05 E/F E02 14:40 DL0257 BOS SCH 20 +60 min Safe
F05 E/F NS/S D86 15:15 KL1189 BGO SCH 1 +60 min Safe
F05 E/F D03 15:15 KL1941 ZAG SCH 1 +60 min Safe

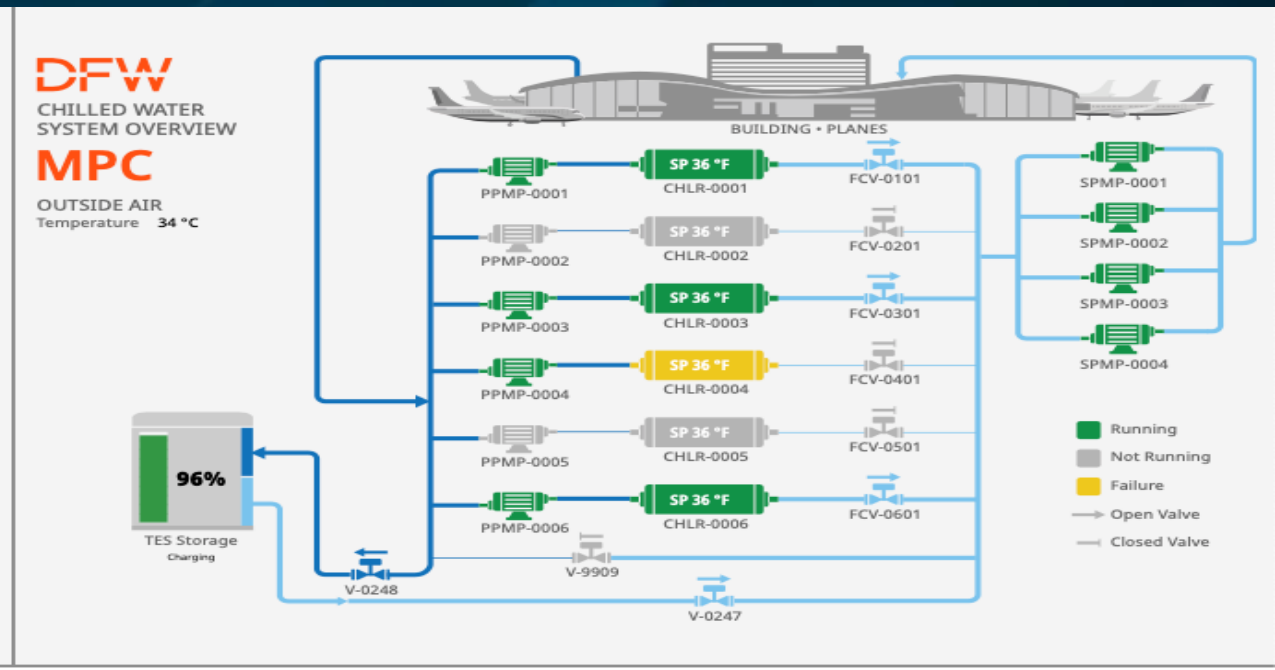
YVR
Digital Twin
Search...
Flight Information
Live
Passenger 2,943
Levels
1
2
3
4
5
6
E Gates Security
Current Assignee
Unassigned
Reported
Time
Wait Times (minutes)
Predicted Pax
Threshold
05
10
15
20
25
30
(minutes)
08:15
08:30
08:45
09:00
09:15
09:30
09:45
10:00
10:09
10:15
10:30
17
24
21
11
08
11
10
06
99
83
69
61
59
64
81
104
129
142
154
D53 12:15
E73 09:25
E80 09:10
E81 10:20
E82 08:55
E83 10:32
E85
E86 09:39
E87 09:52
E 67-99
D52 13:00
C52 09:12
D51 10:41
C51 09:54
D50A 09:17
C50A 11:00
E90 09:29
E96 19:03
no callsign
Live
Alerts
Sep 02, 2022
08:00
09:00
10:00
10:09
11:00
12:00
Connections
Pre-Board Screening
Customs
Safety and Security

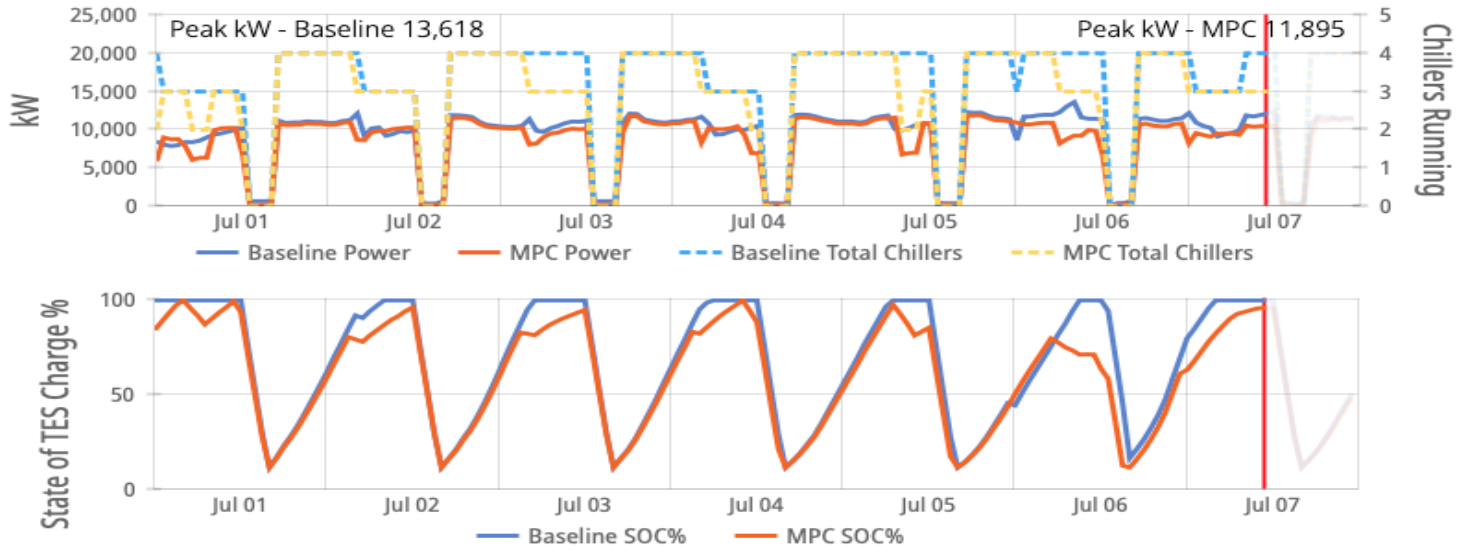
YVR
Digital Twin
Search...
D67
W Foward
S Backwards
A Left
D Right
Look Around

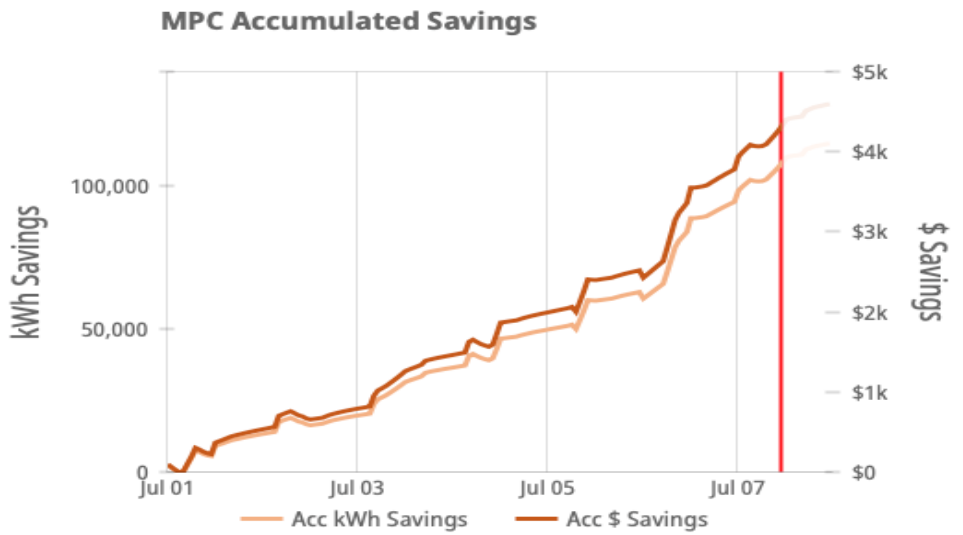
AIR CANADA

Central Plant









Passenger Processing

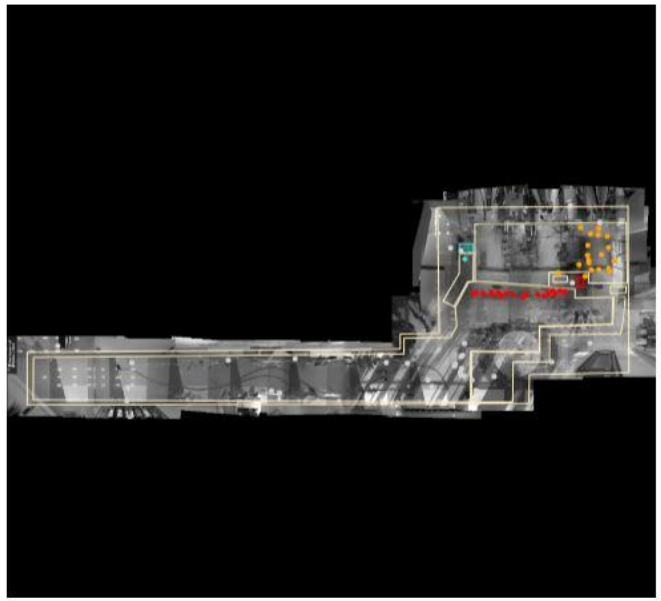
DFW - Production › DFW - TSA › Terminal - D › D22

19:22

- DFW - Production
  - DFW - CBP
  - DFW - TSA
    - Terminal - A
    - Terminal - B
      - B09
      - B30
    - Terminal - C
      - C10
      - C21
      - C30
    - Terminal - D
      - D18
      - **D22**
      - D30
    - Terminal - E

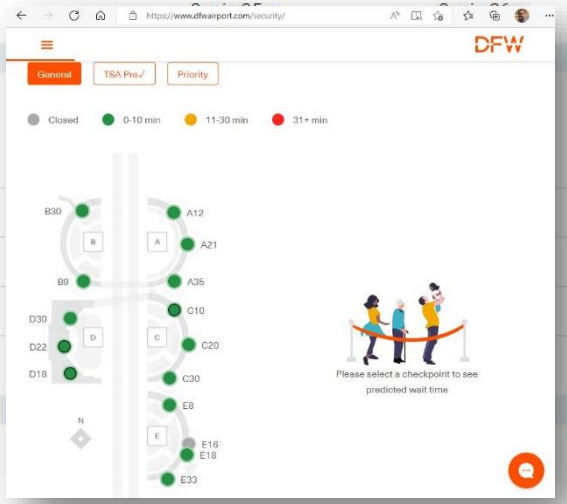
Overall | Waiting Times (Char... | Waiting Times (Gau... | Physical Distancing

Checkpoint - D22



Queues

Name	Queue Length	Waiting Time	Predicted Waiting Time	Outflow
General	19 PAX	2 min 33 s	3 min 51 s	278 PAX/h
TSA Precheck	0 PAX	0 min	0 min 10 s	0 PAX/h
KCM	0 PAX	0 min 7 s	0 min	84 PAX/h
Security	17 PAX			314 PAX/h



Screening

Name	Outflow	Status
TDC 1	0 PAX/h	No PAX
TDC 2	278 PAX/h	PAX
TDC 3	0 PAX/h	No PAX
TDC 4	84 PAX/h	PAX

Waiting Times

General

Waiting Times

General

- 4' 14 A-21 Gen
- 0' 1 E33-Gen General
- 0' 0 A35-Gen General
- 0' 0 E8-Gen General
- 0' 0 E16-Em...
- 0' 0 D18-Gen General
- 0' 0 E16-Pre...
- 0' 0 E16-Clear

Conveyance Monitoring

LIST | DASHBOARDS | MAP | THRESHOLDS | NOTIFICATIONS | CONVERSIONS | ANALYTICS | DISPATCH | VERIFICATION | ADMIN | USER | HELP

Measurements | Hardware | Last 4 hours

Search

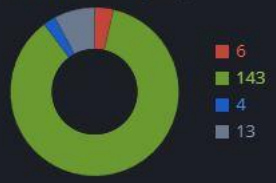
PARENT ACCOUNT
- Conveyance Monitoring
  - ANA303 Mech Rm (PX9F)
    - ANAES14-1 D (A002VD) — CONTACT Yes
    - ANAES14-2 D (A002UM) — CONTACT Yes
    - ANAES14-3 U (A000EH) — CONTACT Yes
  - ANA307 Mech Rm (6WNG)
    - ANAES16-1 D (A002VU) — CONTACT Yes
    - ANAES16-2 D (A002T8) — CONTACT Yes
    - ANAES16-3 U (A002W0) — CONTACT Yes
  - AS FIS (4M4D)
    - ASAES-FIS (A004C3) — CONTACT Yes
  - ASA303 Mech Rm (PF7X)
    - ASAES29-1 D (A002V2) — CONTACT Yes
    - ASAES29-2 D (A002UX) — CONTACT Yes
    - ASAES29-3 U (A002UR) — CONTACT Yes
  - ASA307 Mech Rm (PWUS)
    - ASAES34-1 D (A002UV) — CONTACT Yes
    - ASAES34-2 D (A002VN) — CONTACT Yes
    - ASAES34-3 U (A002SV) — CONTACT Yes
  - B01FIS901DD Mech Rm (5FES)
    - B01AMS01 (A0045L) — CONTACT Yes
  - B02A324 Elev Mach Rm (4GNG)
    - B01AES01 (A004EJ) — CONTACT No

ACCOUNT
Conveyance Monitoring

ACCOUNT NUMBER: 702.947
CREATION DATE: 2021-09-09
LANGUAGE: English
TIME ZONE: -06:00 CST - Chicago (+DST)
RETENTION PERIOD: 1 year

Account Summary

THRESHOLD STATUS (166)



ABNORMAL HARDWARE

5	77	
11	166	
0	166	

Critical Measurements (6)

MEASUREMENT	ABNORMAL
D38AES01 (A004Z6) CONTACT No	24 mins
ESB35A126 (A004NV) CONTACT No	38 mins
D23LES01 (A00678) CONTACT No	3.5 days
D23LES03 (A004S9) CONTACT No	3.5 days
D23LES04 (A005EL) CONTACT No	3.5 days
D23LES02 (A004VH) CONTACT No	3.5 days

Warning Measurements

NONE

Offline Gateways (5)

GATEWAY	OFFLINE
CSA307 Mech Rm (275V)	19 mins
B04A317 Custodial Closet A/B Conn (2FEF)	3 hours
D Gar LV5 Elev E4 Vestibule (5FUU)	3.3 days
BNA308 Mech Rm (ZU6Q)	3.6 days
D Gar LV1 Elev E4 Vestibule (655S)	26 days

Offline Sensors (11)

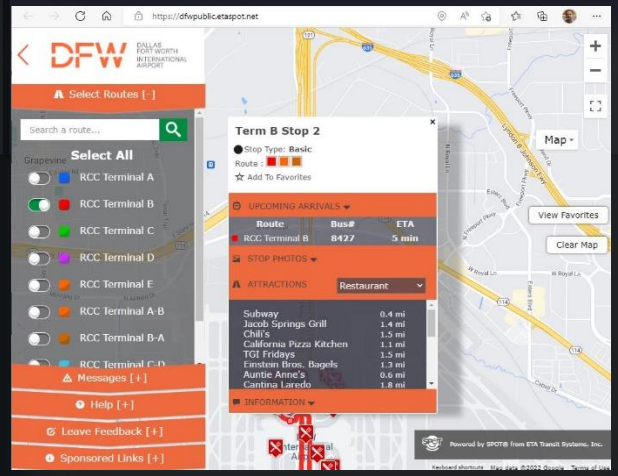
SENSOR	OFFLINE
CSAES32-1 D (A002VP)	37 mins
CSAES32-2 D (A002TU)	37 mins
CSAES32-3 U (A002V5)	37 mins
ESB6A26 U (A004EG)	3 hours
ESB6A27 D (A004RN)	3 hours
MSW #1 (A0048S)	3 hours
W1b (A005YE)	1.5 days

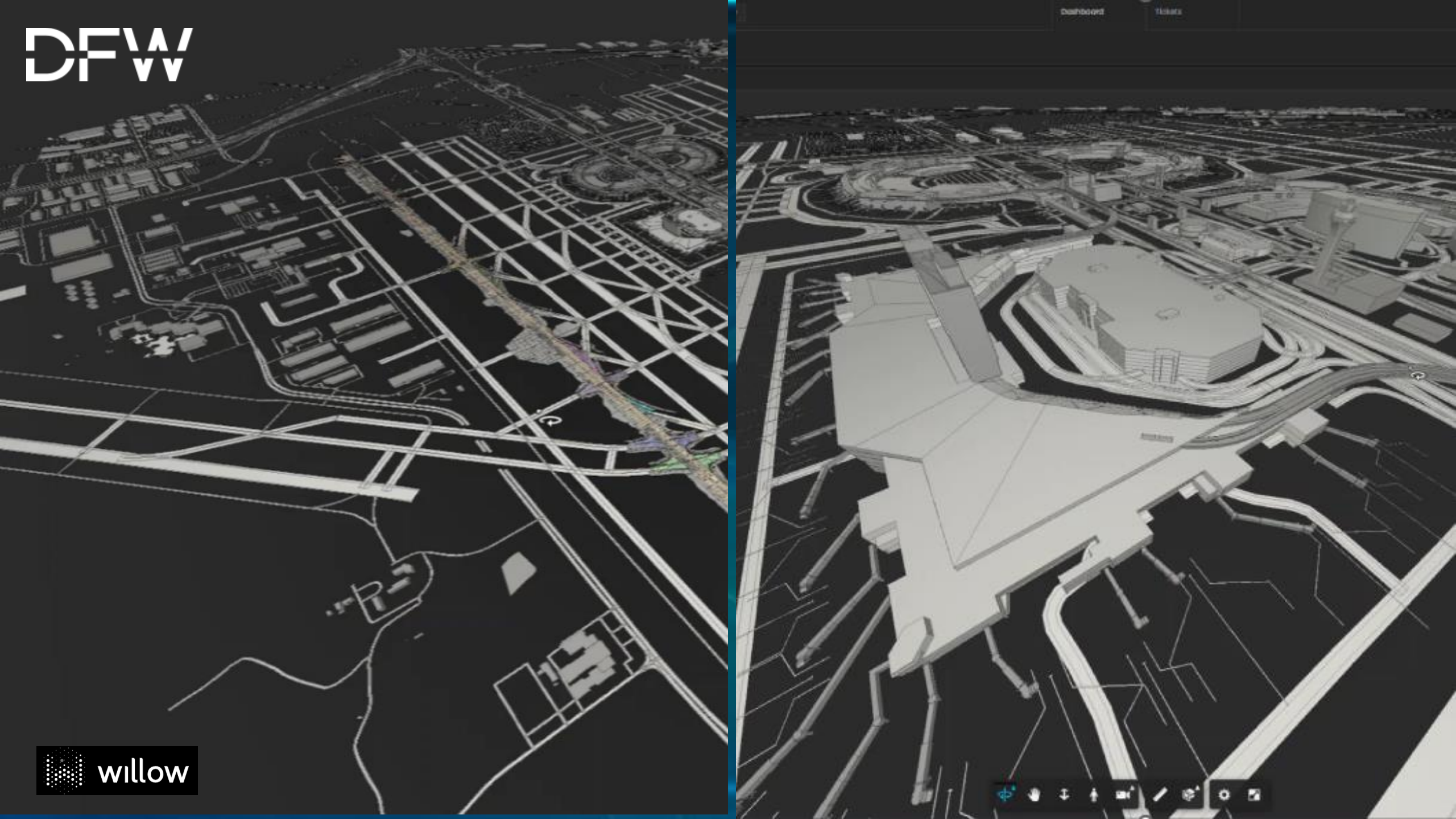
Low Battery Sensors

NONE

Unmapped Hardware

NONE




DFW
willow

Dallas Fort Worth Airport

Central Utility Plant

SW

Back

L2

Capture

Add insight +

Assets

- Search -

Select category

Operations Level - L2

33072.CHIL.004

Chiller 4

Alternate Classification	uniFormat: {"code":"D3030.10"}
Description	33072.CWTR.CHIL.004
External ID	33072.CHIL.004
Geometry Spatial Reference	Mechanical
model number	5500OM
Site ID	ef30e559-4016-46ea-bfc1-f421bd598f52

Files

- 8500129_6_CHIL_MN_1_4
- 20220803_145947_photo
- 20220816_144920_photo
- Central Utitlity Plant Asset Photos 139

willow

DFW

Dallas Fort Worth Airport

Central Utility Plant

SW

Back L2

Capture Add insight +

Assets - Search -

Select category

Operations Level - L2

Chiller

24H 48H 7D This Month Prev. Month 3M Nov 14, 2022, 11:44 - Nov 16, 2022, 11:44

CURRENT SELECTION Go To Time Series

Nov 14, 2022 11:44 Nov 14, 2022 19:44 Nov 15, 2022 03:44 Nov 15, 2022 11:44 Nov 15, 2022 19:44 Nov 16, 2022 03:44 Nov 16, 2022 11:44

15 Minutes Stacked

psi 22.67 10.83 -1.00

15.60 7.90 0.19

degF 54.53 45.13 35.72

Layers

Details

Time Series

Insights

Tickets in progress

History

Relationships

willow

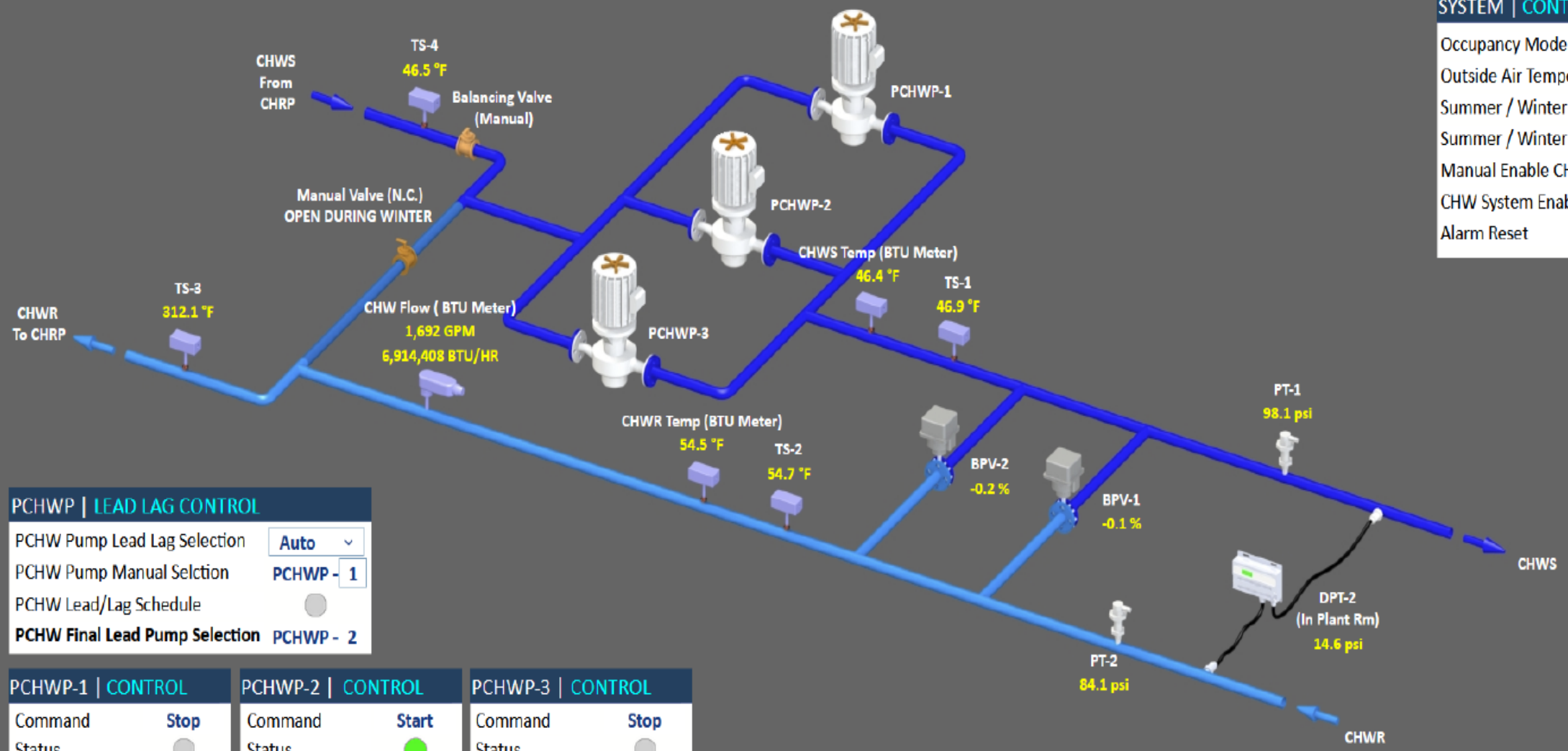
DFW

NEW TERMINAL-A

PRIMARY CHILLED WATER SYSTEM (PCHWP-1,2,3)

North Pier Apron Level

DryBulb Temp	WetBulb Temp	Humidity
87.2 °F	70.7 °F	44.6 %RH



SYSTEM | CONTROL

Occupancy Mode	Occupied
Outside Air Temperature	87.2 °F
Summer / Winter Setpoint	55.0 °F
Summer / Winter Mode	Summer
Manual Enable CHWS	Inactive
CHW System Enable	
Alarm Reset	Normal

MORE INFO

PCHWP | LEAD LAG CONTROL

PCHW Pump Lead Lag Selection	Auto
PCHW Pump Manual Selction	PCHWP - 1
PCHW Lead/Lag Schedule	
PCHW Final Lead Pump Selection	PCHWP - 2

PCHWP-1 | CONTROL

Command	Stop
Status	
Speed	0.0 %
VFD Fault Alarm	Normal
Run Fail Alarm	Normal
Run Hours	761 hrs
Out of Service	Inactive

PCHWP-2 | CONTROL

Command	Start
Status	
Speed	58.2 %
VFD Fault Alarm	Normal
Run Fail Alarm	Normal
Run Hours	680 hrs
Out of Service	Inactive

PCHWP-3 | CONTROL

Command	Stop
Status	
Speed	0.0 %
VFD Fault Alarm	Normal
Run Fail Alarm	Normal
Run Hours	761 hrs
Out of Service	Inactive

PORT AUTHORITY NY NJ

NEW TERMINAL-A

PRIMARY HOT WATER SYSTEM

NORTH PIER PUMP ROOM

DryBulb Temp	WetBulb Temp	Humidity
87.0 °F	70.3 °F	43.9 %RH

SYSTEM | CONTROL

Occupancy Mode	Unoccupie
Outside Air Temp	87.0 °F
Summer / Winter Setpoint	50.0 °F
Summer / Winter Mode	Summer
HTHWS Temp Low Limit	130.0 °F
HTHW Low Limit Cutoff	Active
HX Isolation Valve Enable	Disable
PHW Pump Enable	Disable
HTHW Control Valve Enable	Disable
Lag PHW Pump Demand	Disable
Lag HX Demand	Disable
Alarm Reset	Normal

PHWP-1 | CONTROL

Command	Stop
Status	
Speed	0.0 %
VFD Fault	Normal
Run Fail	Normal
Run Hours	1,643 hrs
Out of Service	Inactive

PHWP-2 | CONTROL

Command	Stop
Status	
Speed	0.0 %
VFD Fault	Normal
Run Fail	Normal
Run Hours	2,622 hrs
Out of Service	Inactive

PHWP-3 | CONTROL

Command	Stop
Status	
Speed	0.0 %
VFD Fault	Normal
Run Fail	Normal
Run Hours	1,357 hrs
Out of Service	Inactive

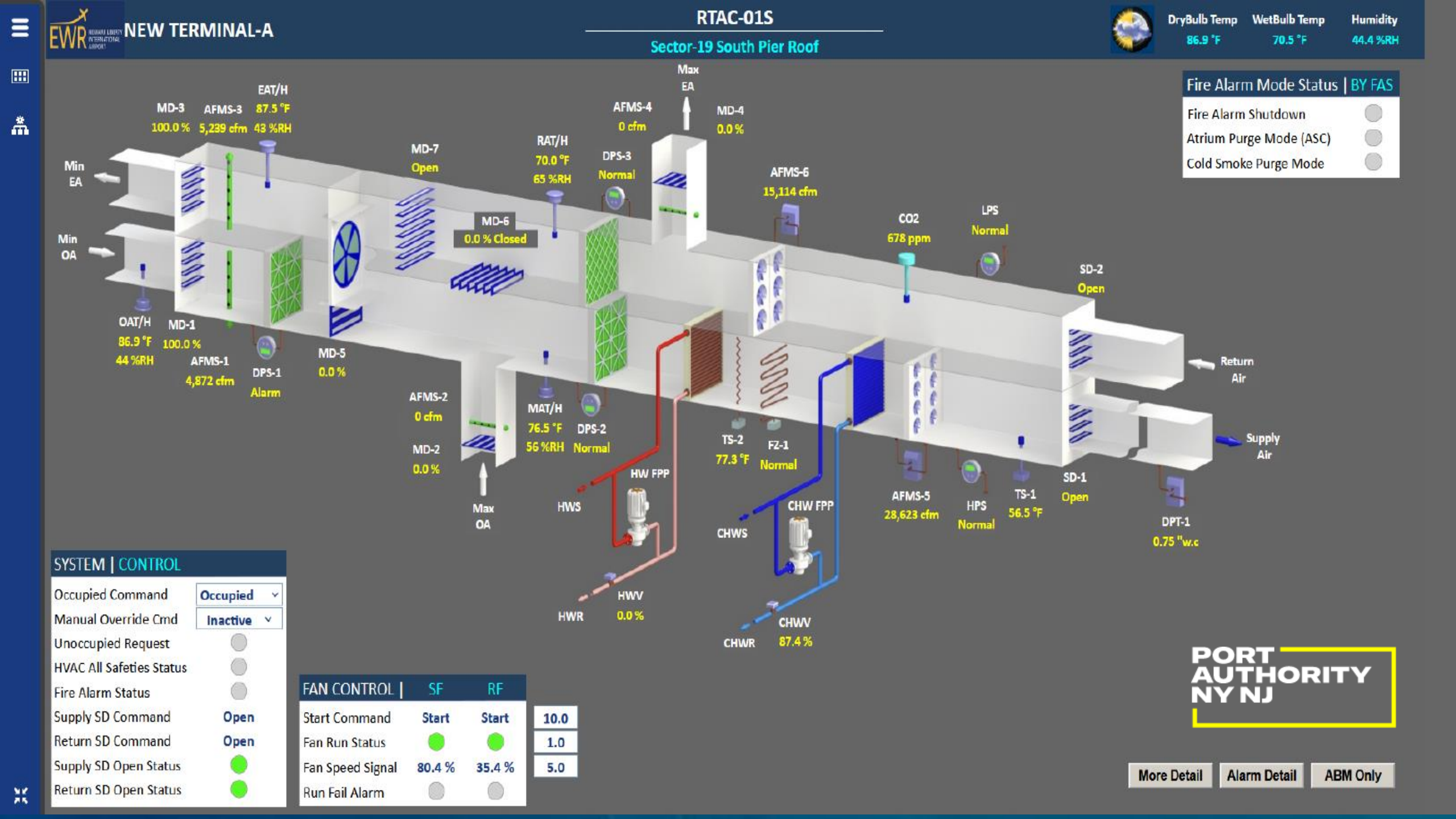
HX AND PHWP | LEAD LAG CONTROL

HX Lead Lag Selection	Auto
HX Manual Selction	HX - 1
HX Auto Selection	HX - 3
HX Lead/Lag Schedule Point	Auto
HX Lead Selected	HX - 3
PHW Pump Lead Lag	Auto
PHW Pump Manual Selction	PHWP - 1
PHW Pump Auto Selection	PHWP - 3
PHW Lead/Lag Schedule	Manual
PHW Pump Lead Selected	PHWP - 3

MORE INFO

HTHWS from CHRP
TS-1 74.6 °F
TS-2 75.6 °F
HTHW AUX from CHRP
HTHWR to CHRP
TS-3 74.3 °F
HTHW BTU Meter 0.0 gpm 0.0 BTU
HTHWS (BTU Meter) 0.0 °F
HTHWR (BTU Meter) 73.9 °F
(2/3) HTHWV-2 1.9 % 25.0
(1/3)
HTHWV-1 0.5 % 25.0
TS-6 73.5 °F
(2/3) HTHWV-4 1.1 % 25.0
(1/3)
HX-1
V-1 Closed
HTHWV-3 1.1 % 25.0
TS-7 -56.0 °F
(2/3) HTHWV-6 1.2 % 25.0
(1/3)
HX-2
V-2 Closed
TS-5 73.7 °F
DP SP 10.0 psi
DPT-2 0.1 psi
HTHWV-5 -0.3 % 25.0
TS-8 73.0 °F
TS-4 72.9 °F
0.0 %
PHWP-1
0.0 %
PHWP-2
0.0 %
PHWR
DPT-1 (In Plant Rm) 0.1 psi
DP SP 12.0 psi
PHWS
HX-3
V-3 Closed
BPV-1 99.9 % 100.0 %

PORT AUTHORITY NY NJ


NEW TERMINAL-A
RTAC-01S
Sector-19 South Pier Roof
DryBulb Temp
86.9 °F
WetBulb Temp
70.5 °F
Humidity
44.4 %RH
Fire Alarm Mode Status | BY FAS
Fire Alarm Shutdown
Atrium Purge Mode (ASC)
Cold Smoke Purge Mode
Min EA
Min OA
MD-3
100.0 %
AFMS-3
5,239 cfm
EAT/H
87.5 °F
43 %RH
MD-7
Open
RAT/H
70.0 °F
65 %RH
MD-6
0.0 % Closed
DPS-3
Normal
AFMS-4
0 cfm
Max EA
MD-4
0.0 %
AFMS-6
15,114 cfm
CO2
678 ppm
LPS
Normal
SD-2
Open
Return Air
Supply Air
OAT/H
86.9 °F
44 %RH
MD-1
100.0 %
AFMS-1
4,872 cfm
DPS-1
Alarm
MD-5
0.0 %
AFMS-2
0 cfm
MD-2
0.0 %
Max OA
MAT/H
76.5 °F
56 %RH
DPS-2
Normal
TS-2
77.3 °F
FZ-1
Normal
HW FPP
HWS
HWR
HWV
0.0 %
CHW FPP
CHWS
CHWR
CHWV
87.4 %
AFMS-5
28,623 cfm
HPS
Normal
TS-1
56.5 °F
SD-1
Open
DPT-1
0.75 "w.c
SYSTEM | CONTROL
Occupied Command
Occupied
Manual Override Cmd
Inactive
Unoccupied Request
HVAC All Safeties Status
Fire Alarm Status
Supply SD Command
Open
Return SD Command
Open
Supply SD Open Status
Return SD Open Status
FAN CONTROL | SF RF
Start Command
Start
Start
10.0
Fan Run Status
1.0
Fan Speed Signal
80.4 %
35.4 %
5.0
Run Fail Alarm
PORT AUTHORITY NY NJ
More Detail
Alarm Detail
ABM Only

EWR OPERATIONAL DASHBOARD

PORT AUTHORITY NY NJ
AIR LAND RAIL SEA

There are no active alerts at this time. # 0

PA TRAFFIC ENGINEERING

TERMINAL A | TERMINAL B | TERMINAL C

Congestion Level ⓘ

GREEN

PEAK VOLUME/TIME

	210	17:50
	182	5:50
LF ⓘ		61.9%

THRESH.	% OVER
1m 52s	0%
PEAK	**PK. TIME**
52 s	22:10

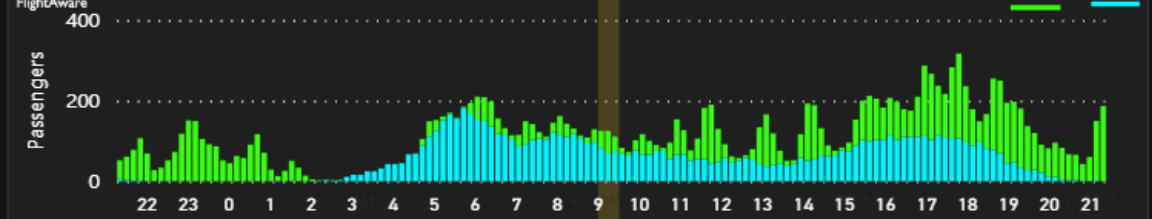
AIS				
0	0	0	0	0

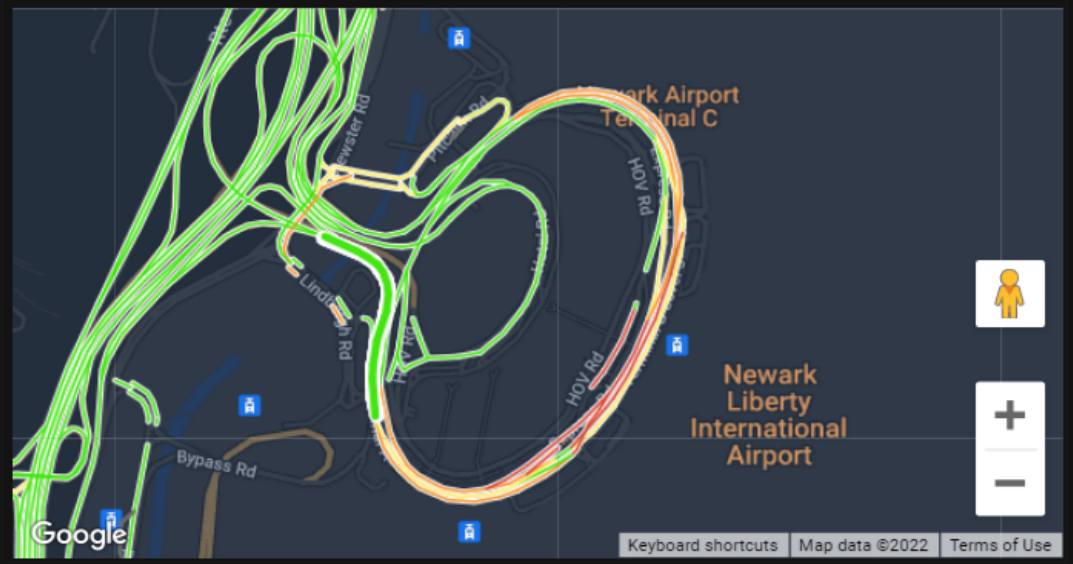
NOW 09:23

HISTORICAL | PREDICTIVE

21:00	01:00	04:00	07:00	11:00	14:00	17:00	21:00
76 °F	74 °F	75 °F	74 °F	83 °F	87 °F	86 °F	79 °F

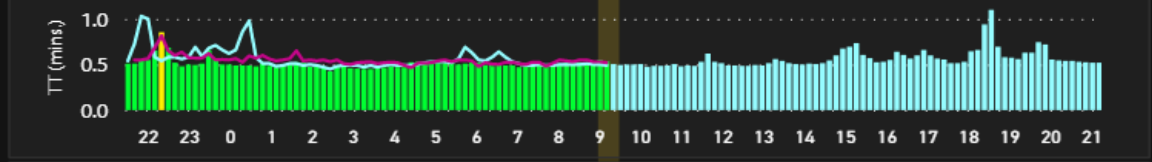
TERMINAL PAX ⓘ





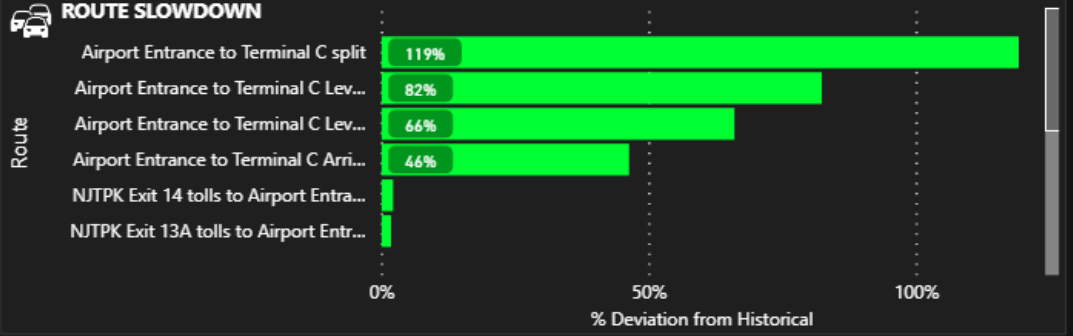
AIRPORT ENTRANCE TO TERMINAL A ... ⓘ

Threshold ⓘ | Hist | Waze



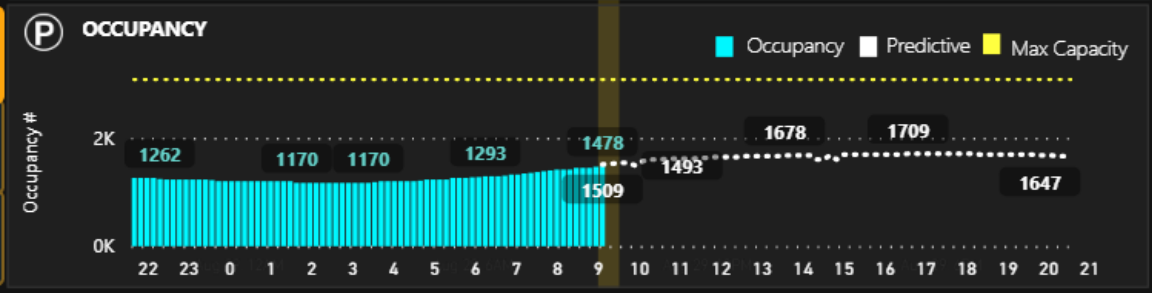
AIS | Incidents | Const | Alerts | Transit

ROUTE SLOWDOWN

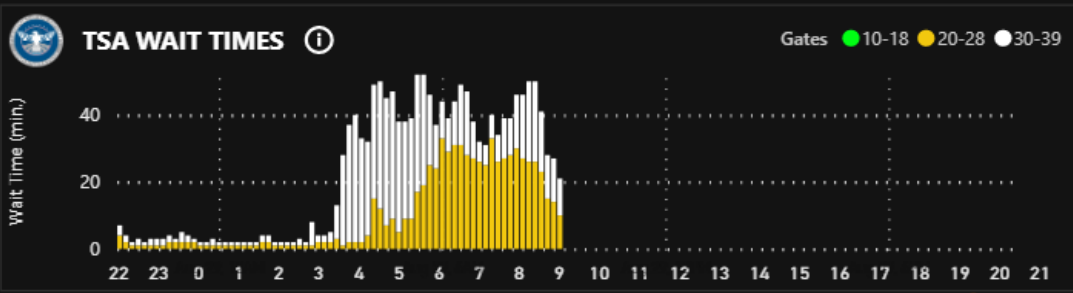


	OCCUP	% OCC	
P4	1,478	48%	P4
P6	3,298	81%	P6
ST	3,255	52%	P-ST

OCCUPANCY



TSA WAIT TIMES ⓘ



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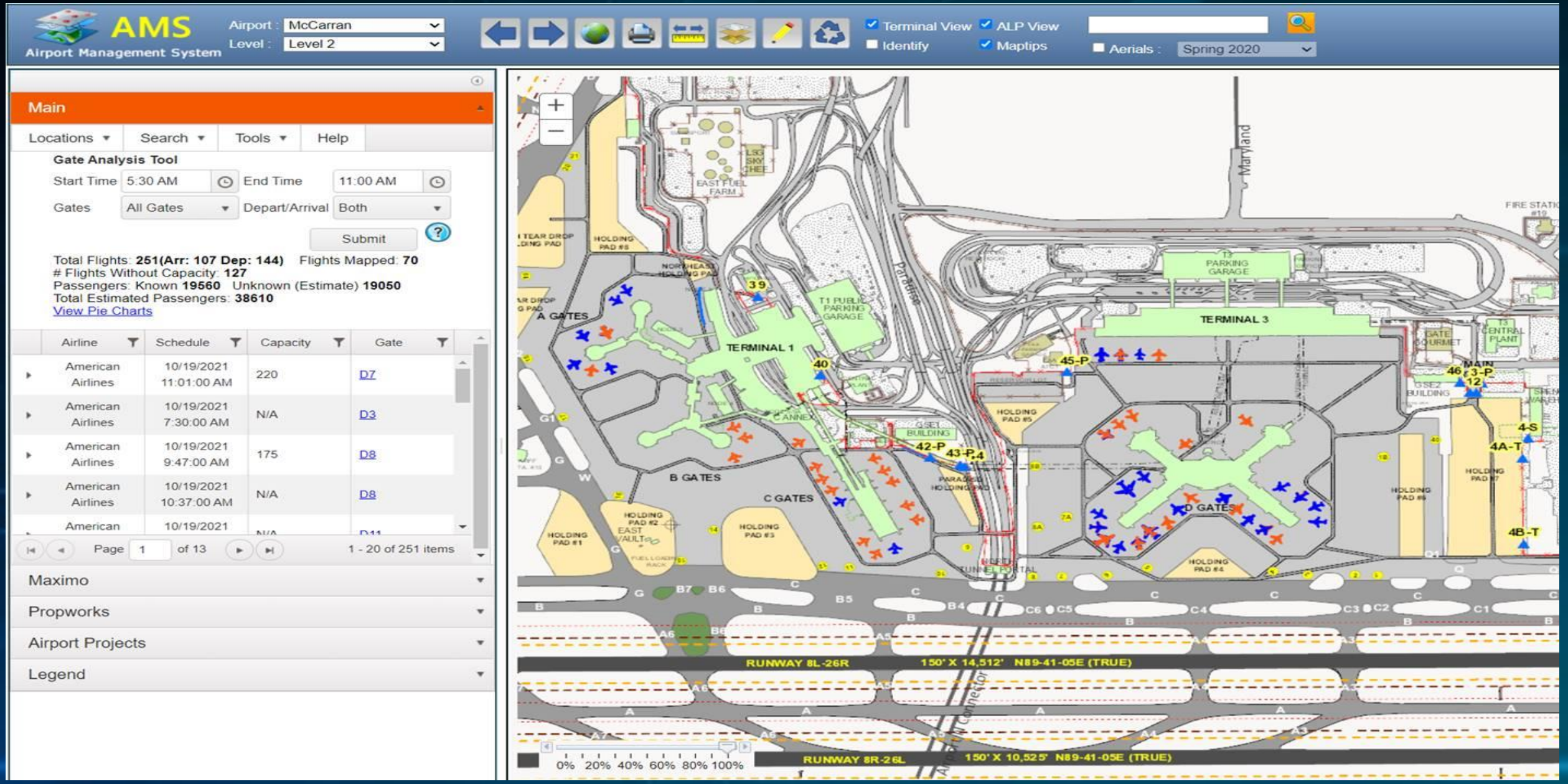
Most Use-Cases Require 2D

CLARK COUNTY DEPARTMENT OF AVIATION



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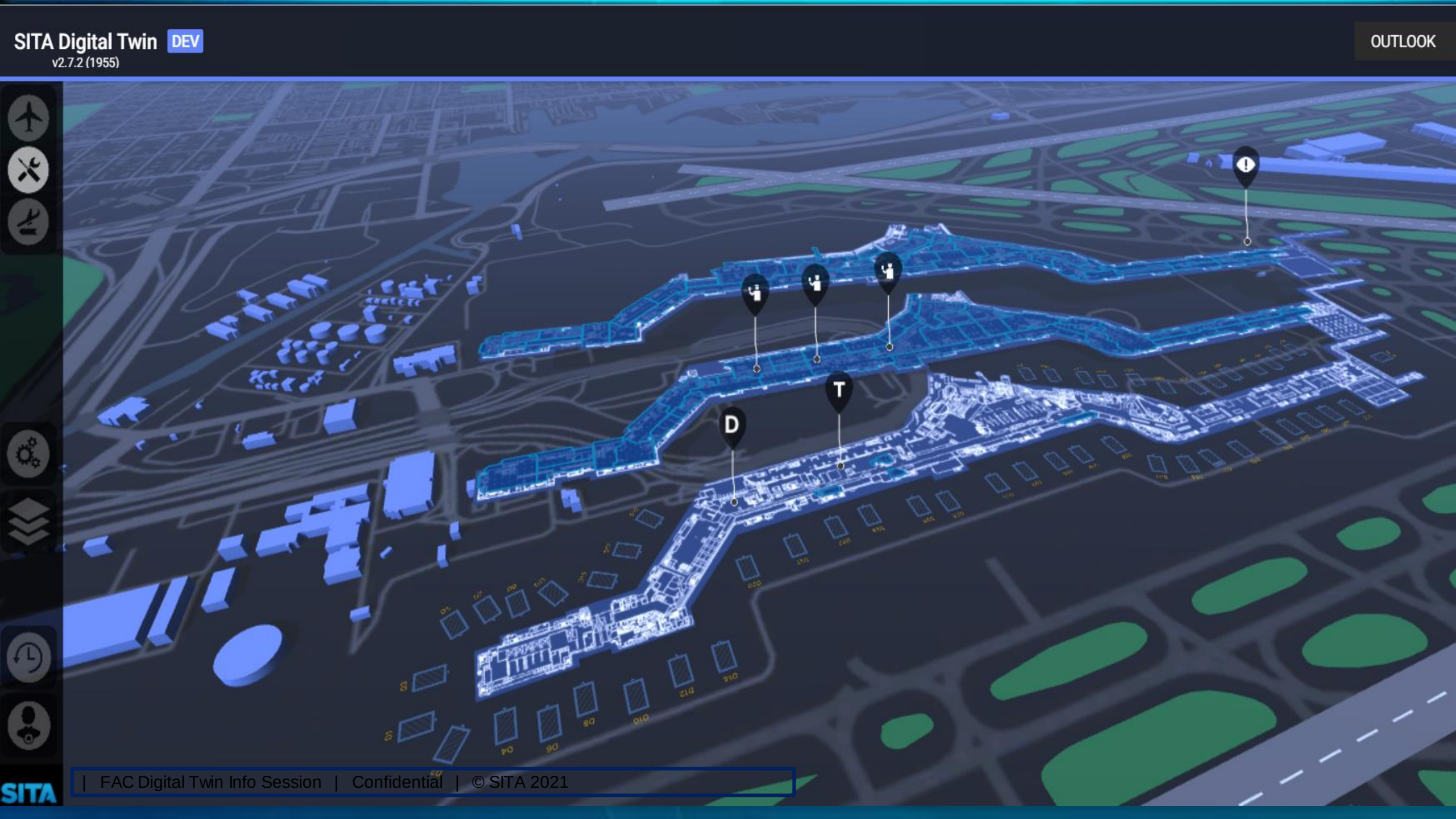
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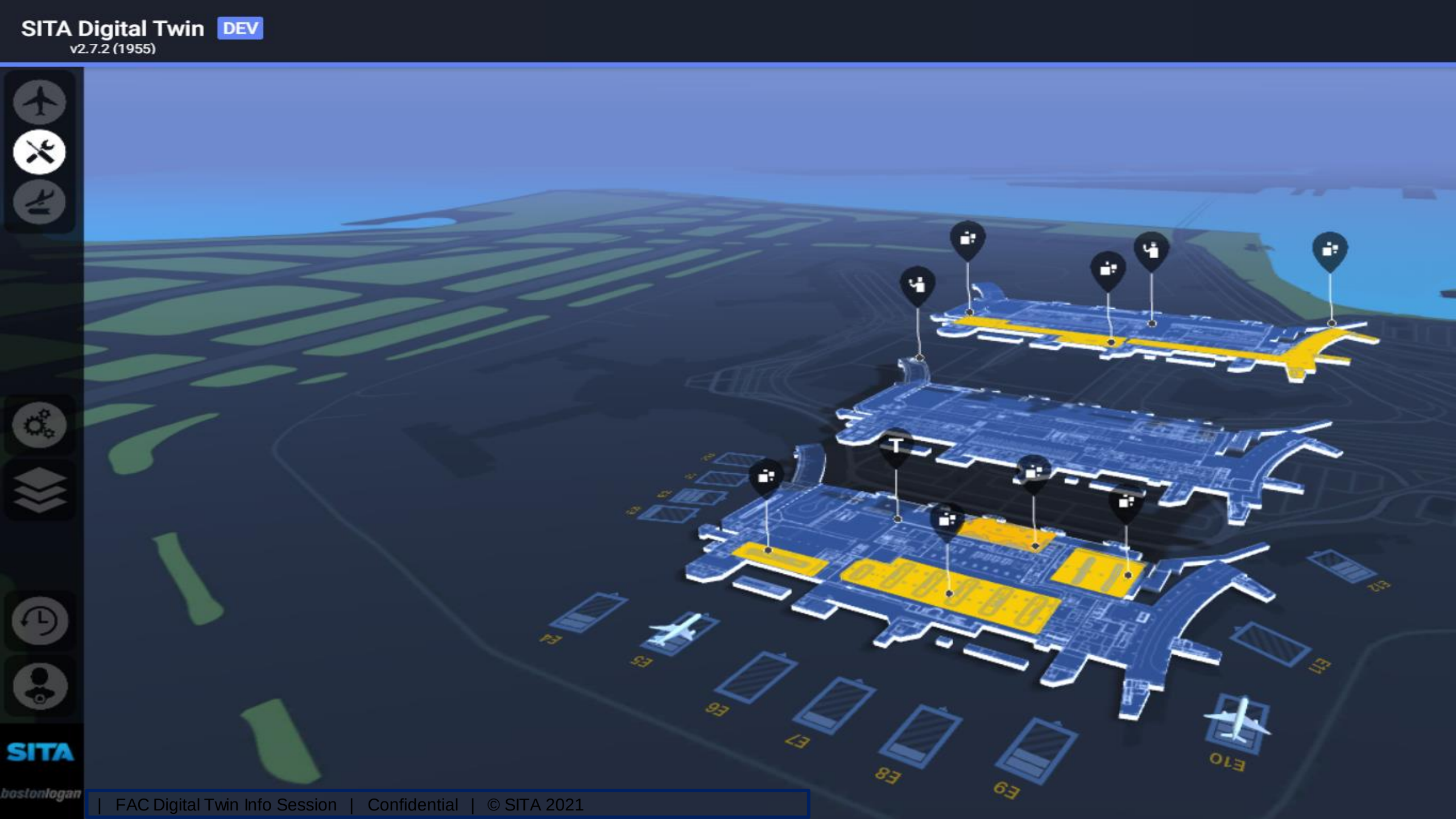
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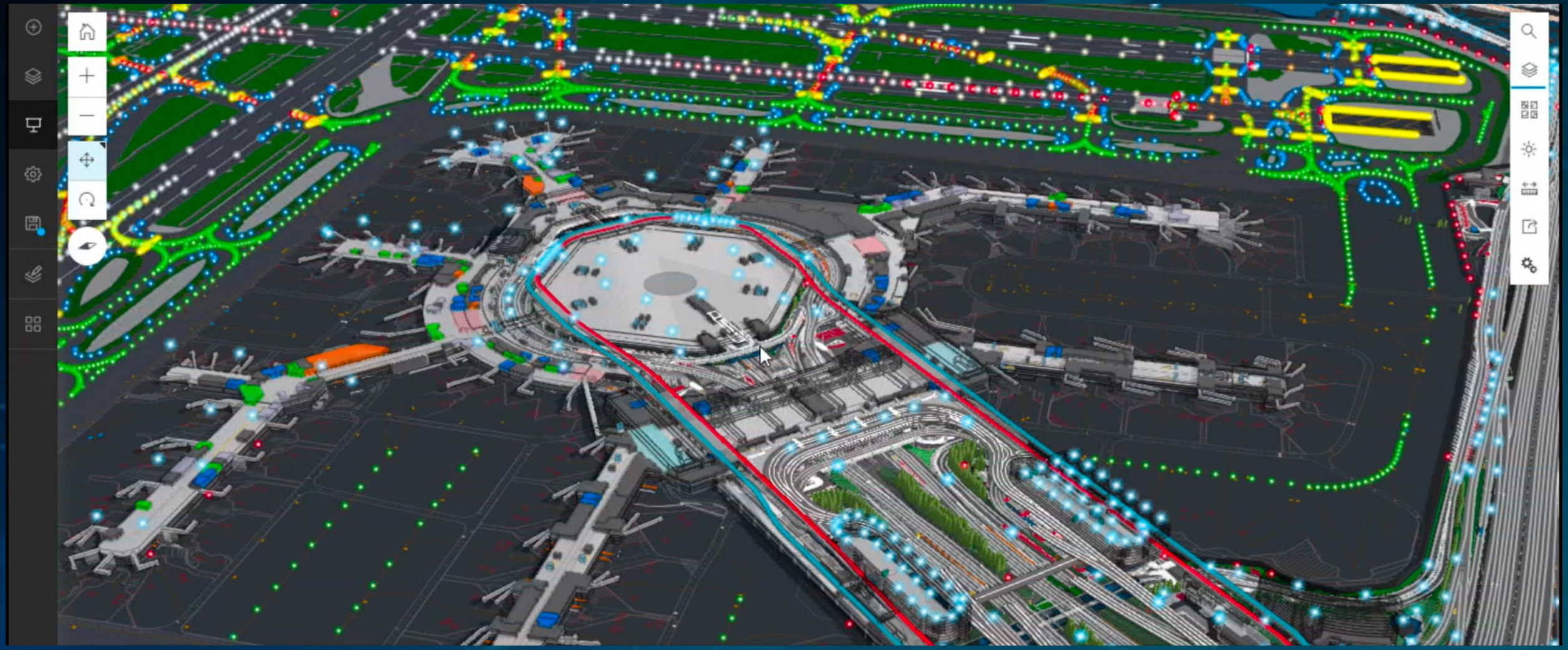
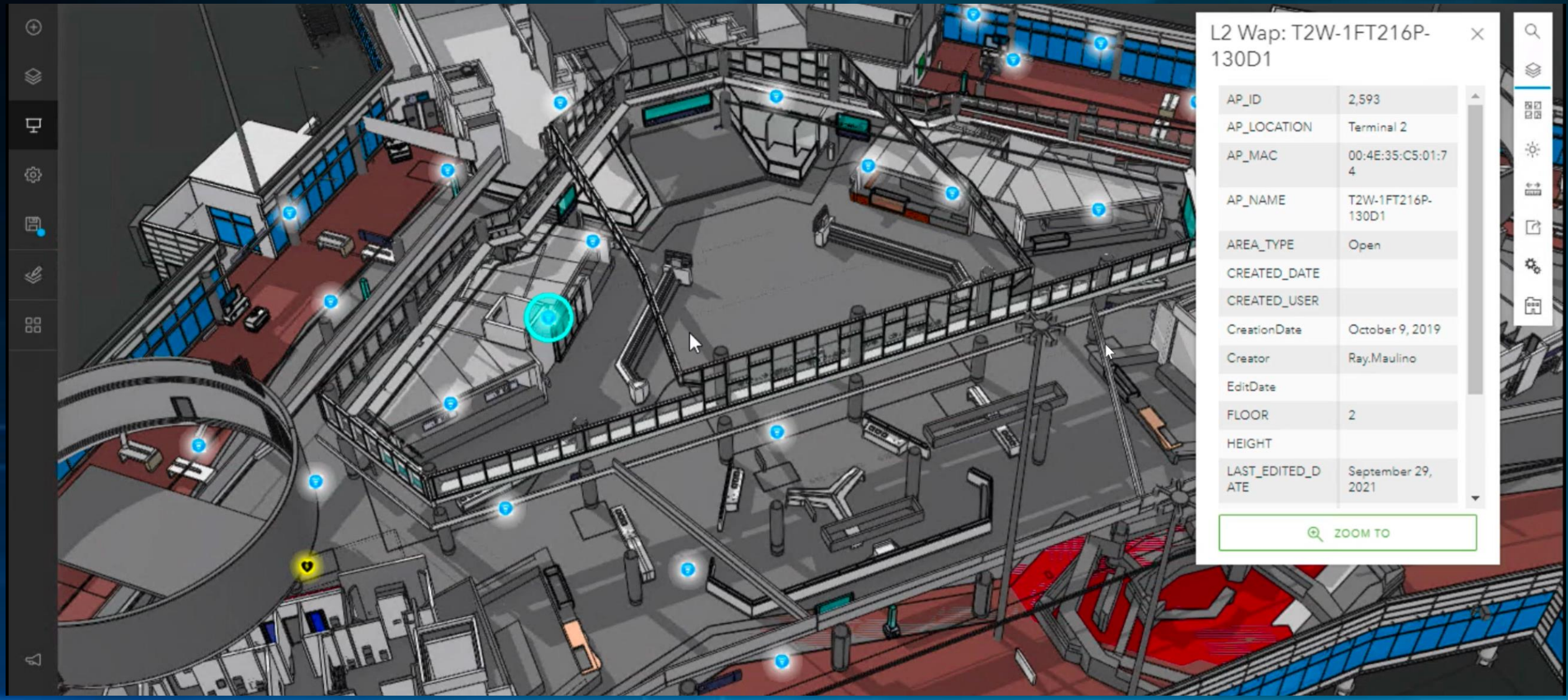
SFO Capabilities to be Evaluated

SFO San Francisco International Airport



SFO Capabilities to be Evaluated

SFO San Francisco International Airport



Top Use Cases

- Landside Arrivals
- Shuttle Bus Frequency
- Security Checkpoints
- Digital Content
- APM Frequency
- Concessions
- Connecting Flights/PAX Loads

Needed @ Airports

- Terminal Resources
- Terminal Energy Management
- Terminal Cleaning
- PAX Health
- Safety Management System (SMS)
- Security/Emergency Situational Awareness
- Predictive Maintenance
- Work Scheduling (e.g., O&M, CIP)

Path to Achieving Airport Digital Twin

Maturity Model

- Staffing
- Business Processes
- Data Housing
- Metrics & Analytics
- Data Flow
- Spatial Correlation
- Systems Integration
- Predictive Simulation

	AAAE Airport Digital Twin Maturity Model					
	Lowest	>	>	>	>	Highest
	Entry Level					Utopia
Level	**1**	**2**	**3**	**4**	**5**	**6**
Staffing	Self motivated individual division staff conducting analysis	Division designated dedicated analyst	Proactive centralized Business Intelligence (BI) organizational function			
			Understaffed	Adequately staffed	Some machine learning automation reducing needed staff levels	Full machine learning automation
Business Processes	Not documented	Few documented	Few mapped with some workflow automation	Mostly mapped with some workflow automation	Completely mapped with some workflow automation	Completely mapped with full workflow automation
Data Housing	Siloed	Combination of siloed and centralized	Mostly centralized data hub/warehouse	Centralized & integrated data warehouse	Mostly aligned data	Full accessibility & alignment
Metrics & Analytics		Defining DT Vision & Path Forward				
	Measuring available data	Developing division metrics for key priorities	Developing centralized universal metrics	Build alignment of organizational measures into employee work tasks	Calibrate alignment of metrics to improve performance	Fully aligned enterprise with on-demand metrics
Data Flow	No automated data sharing flow (i.e., manual batch loading, not real time via API)	Manual and automated data sharing flow	Manual and automated data sharing flow	Priority external and all internal data flows automated	All data feeds automated with self reported validated	All data feeds automated (no self reporting)
	Some IoT device data flow within proprietary disparate systems	Some internal airport systems with automated data sharing	External partners data is partially manual (e.g., airlines, concessions, etc.)	Automated PAX demographics, POS, concessions data, airline activity overlay		
	Aerial/ALP/raster floor	Manual shared CAD/GIS maps	Common basemap automated web services			

Source: AAAE Digital Twin Working Group

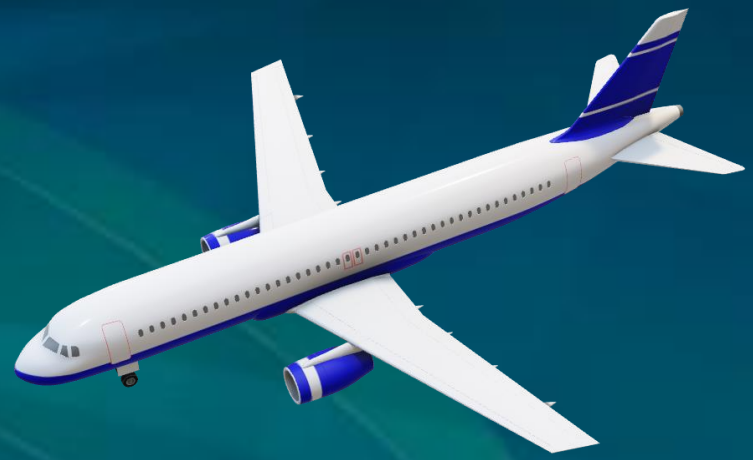
Takeaways

- Airport Owner's Digital Twin (DT) is not a single software solution; it's an **integration of data, processes, and technology**
- DT is **NOT replacing existing airport systems**, but rather expands their utility via integration
- DT **requires sustainable geospatial framework**
- Airport **CIP builds and renovates** assets physically and should **also virtually via DT**

AirportDigitalTwin.org Proprietary Information

Biggest Challenges

- **Funding** resources to build & sustain it
- **Organizational** placement of steward
- **Data update** process lag time



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First Steps Towards Achieving DT

Setup Airport Business Intelligence (BI) Group

Equipped with:

- **Enterprise analytics platform** such as Tableau, Microsoft Power BI, and/or ArcGIS Insights

  (**Overlaid on GIS** across terminal complex and campus-wide)

- **Data warehouse and middleware** for processing and integrating data from multiple sources

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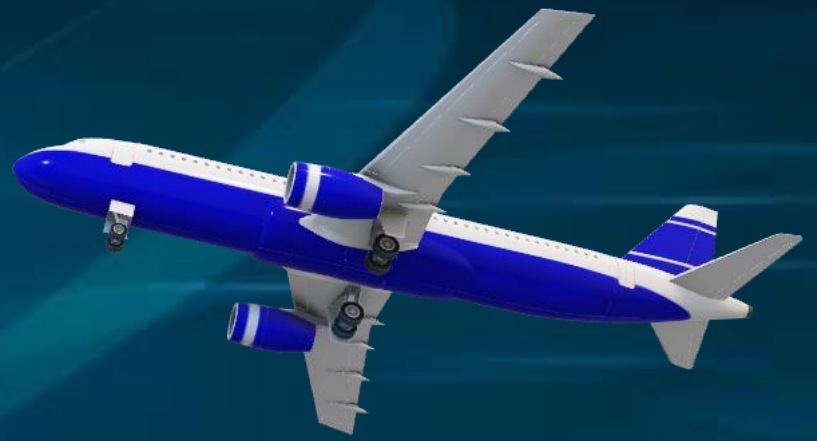
Keys to Success



- Business **use-case** driven
- Enterprise **analytics correlated over GIS** spatial maps
- **Updated** floor plans and campus basemap (including sensor locations)
- Stewardship by Airport's Business Intelligence **(BI) Group**

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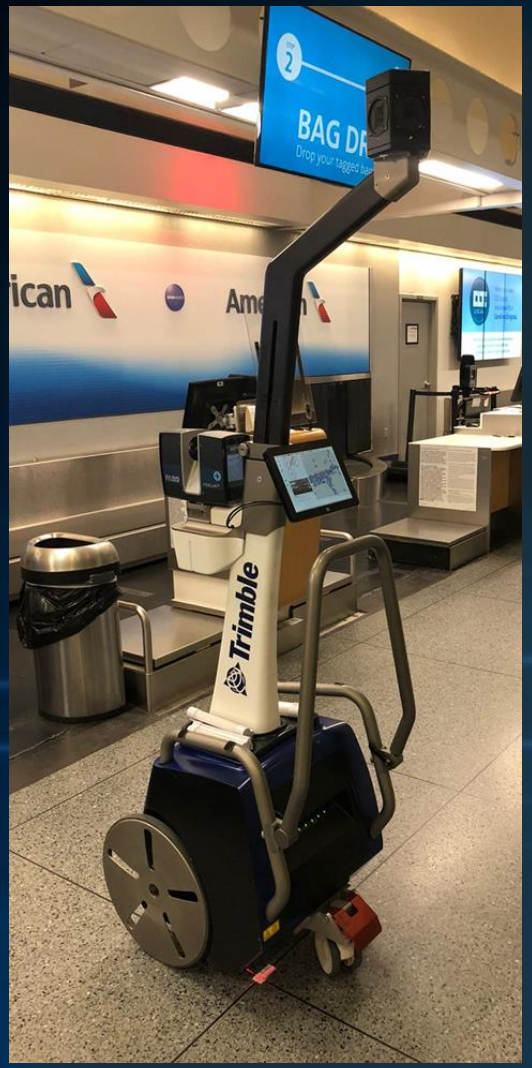
Keys to Sustaining Airport Digital Twin



- Keep it Simple & Sustainable **(KISS) Principle**
- Leverage **IoT sensors with APIs to automate overlay** of real-time (and historical) data
- **Update spatial "skeleton"** with IoT sensors, assets, etc...; **leverage simple GIS symbolized point features in 2D/3D**
- Leverage **LiDAR draped imagery** with **semi-automated/robotic scanning platforms indoors and outdoors**

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Roadmap to Sustainable Airport Digital Twins

JUNE 2023

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