Lunch by Our Gold Sponsor

indra

INNOVATION FAIR

12 | 14 MARCH 2024

Digital twins in aviation: twice as many opportunities?

Thomas Romig

Vice President Safety, Security and Operations

Airports Council International (ACI)

Panel Speakers

John Gradek

Faculty Lecturer and Academic program Coordinator, Supply Networks

McGill University

Richard Vilton

CEO

Emu Analytics

Robert Freitag

Assistant Vice-President, Chief Technology Officer

NAV CANADA

Lynette DuJohn

VP Innovation and Chief Information Office

Vancouver Airport Authority (YVR)

Jia Xu

CEO

SkyGrid

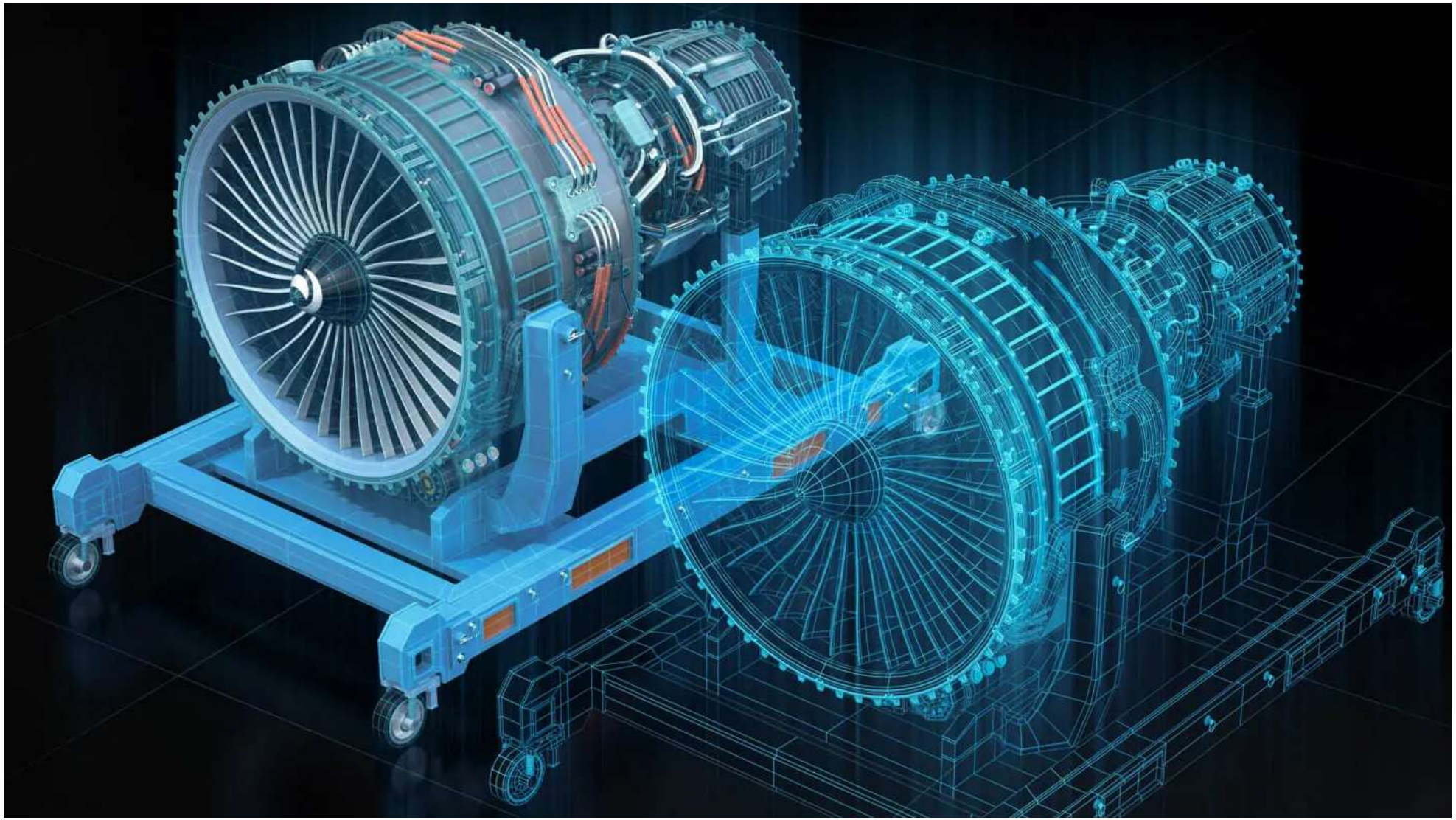
John Gradek

Faculty Lecturer and Academic program Coordinator,
Supply Networks

McGill University

Digital Twins – past, present, future

Apollo 13 – The first incarnation of the Digital Twin



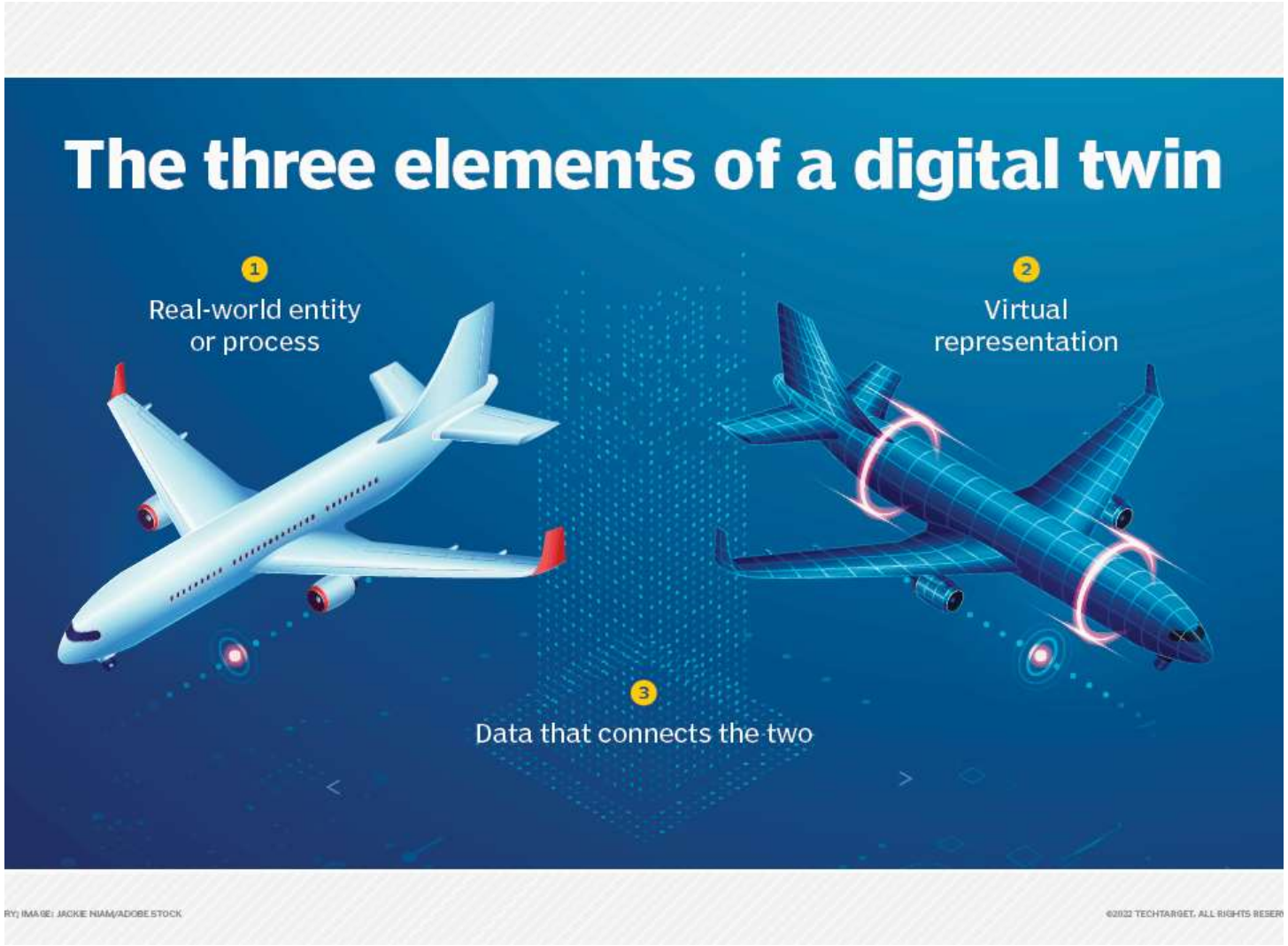
Today’s Digital Twin

Today's Digital Twin

ICAO INNOVATION

Elements of a Digital Twin

Beyond a simulator by incorporating real-time data capture

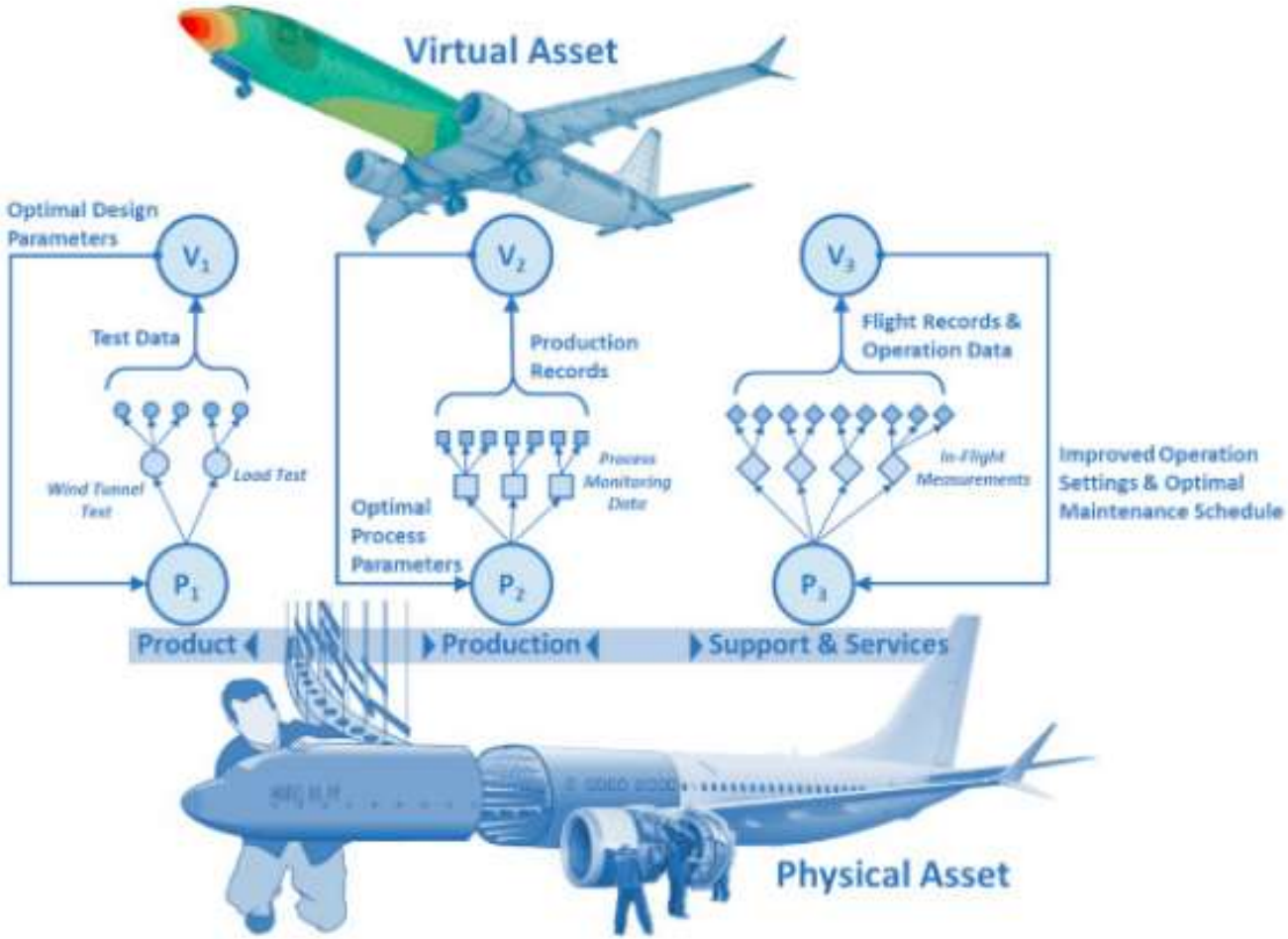


Application of Digital Twin in Aviation

Power Plant Performance

Application of Digital Twin in Aviation

Aircraft Manufacture



Building and Scaling a Digital Twin

A three-step approach

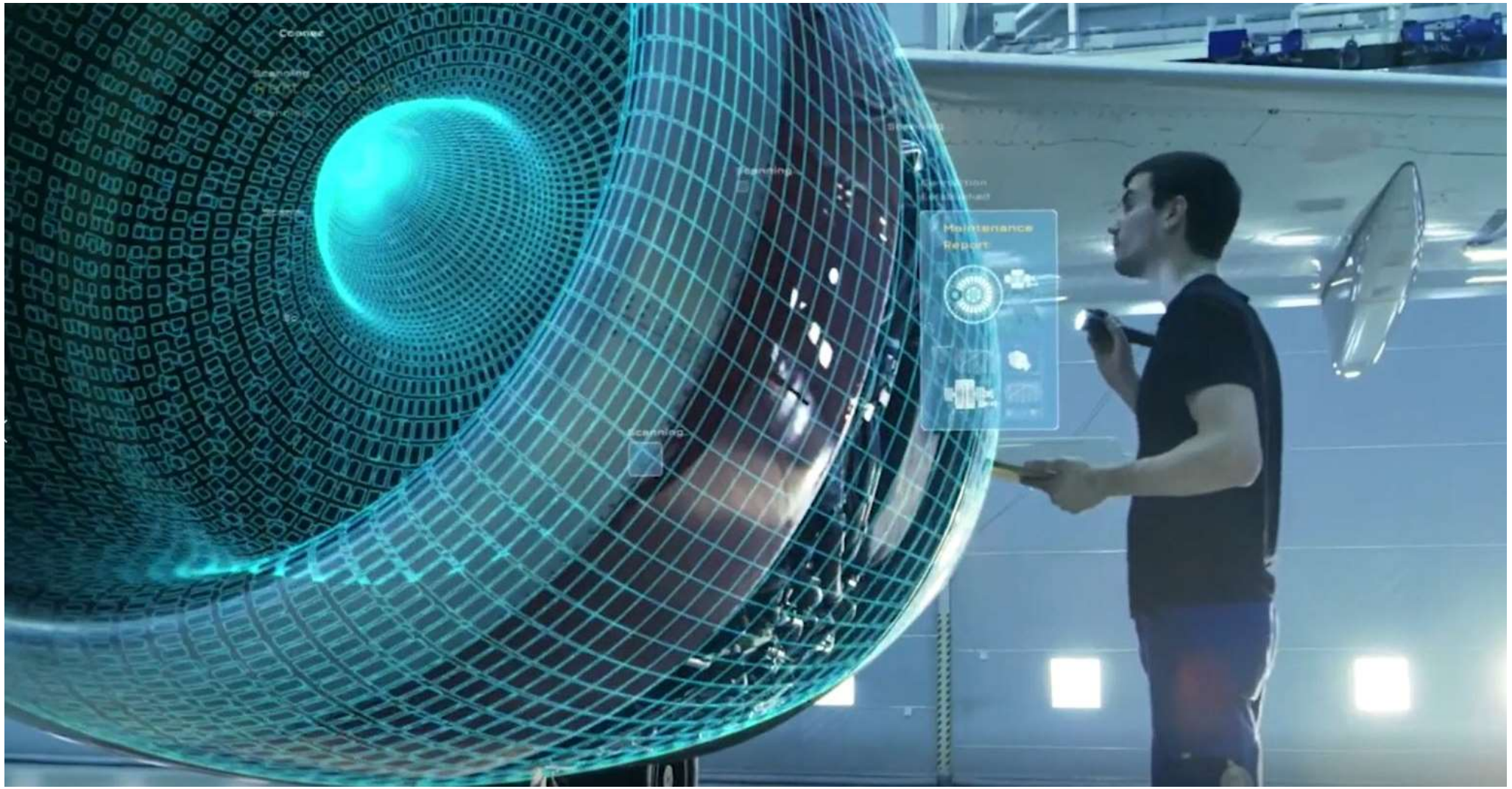
creating a blueprint

building the initial digital twin

boosting its capabilities

Digital Twin of Tomorrow

Digital Twin of Tomorrow



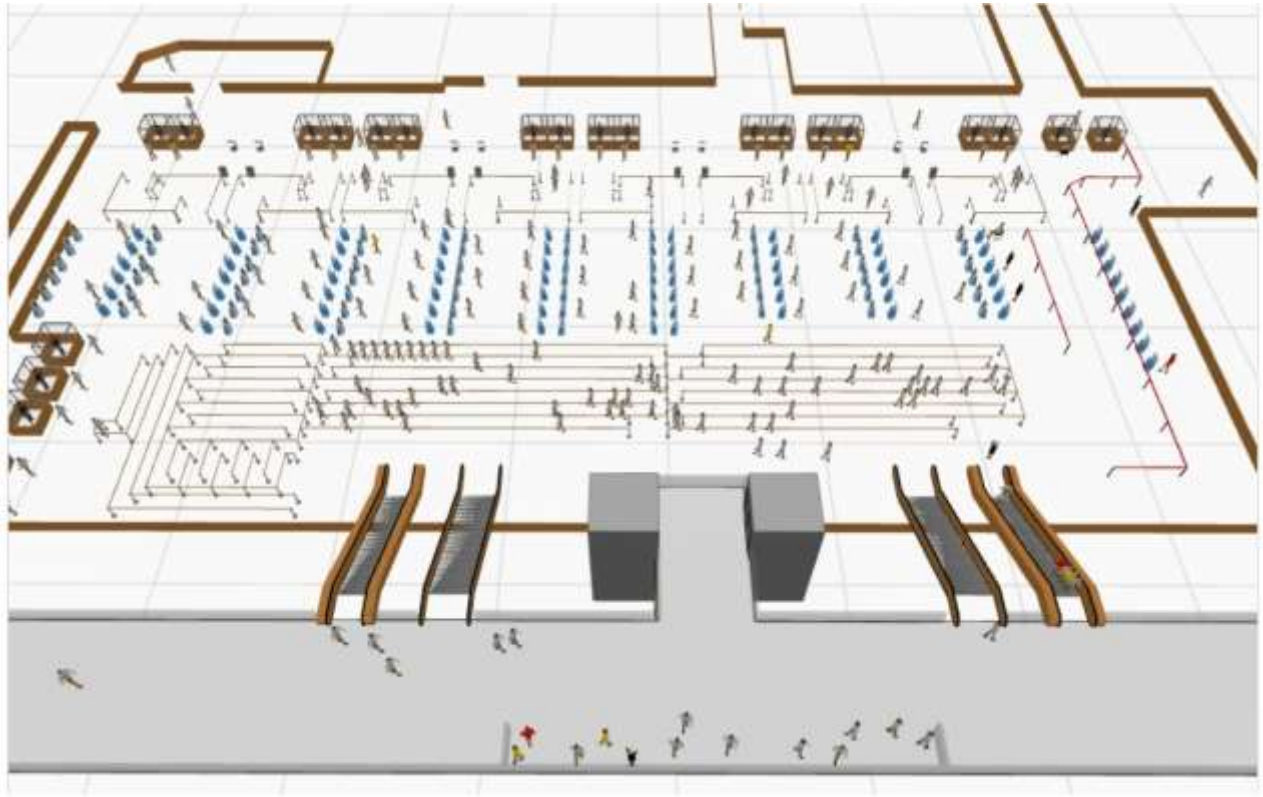
Airport Digital Twin

Evaluate alternative solutions to optimize airport capacity

The ADM experience

YUL Montréal-Trudeau International Airport

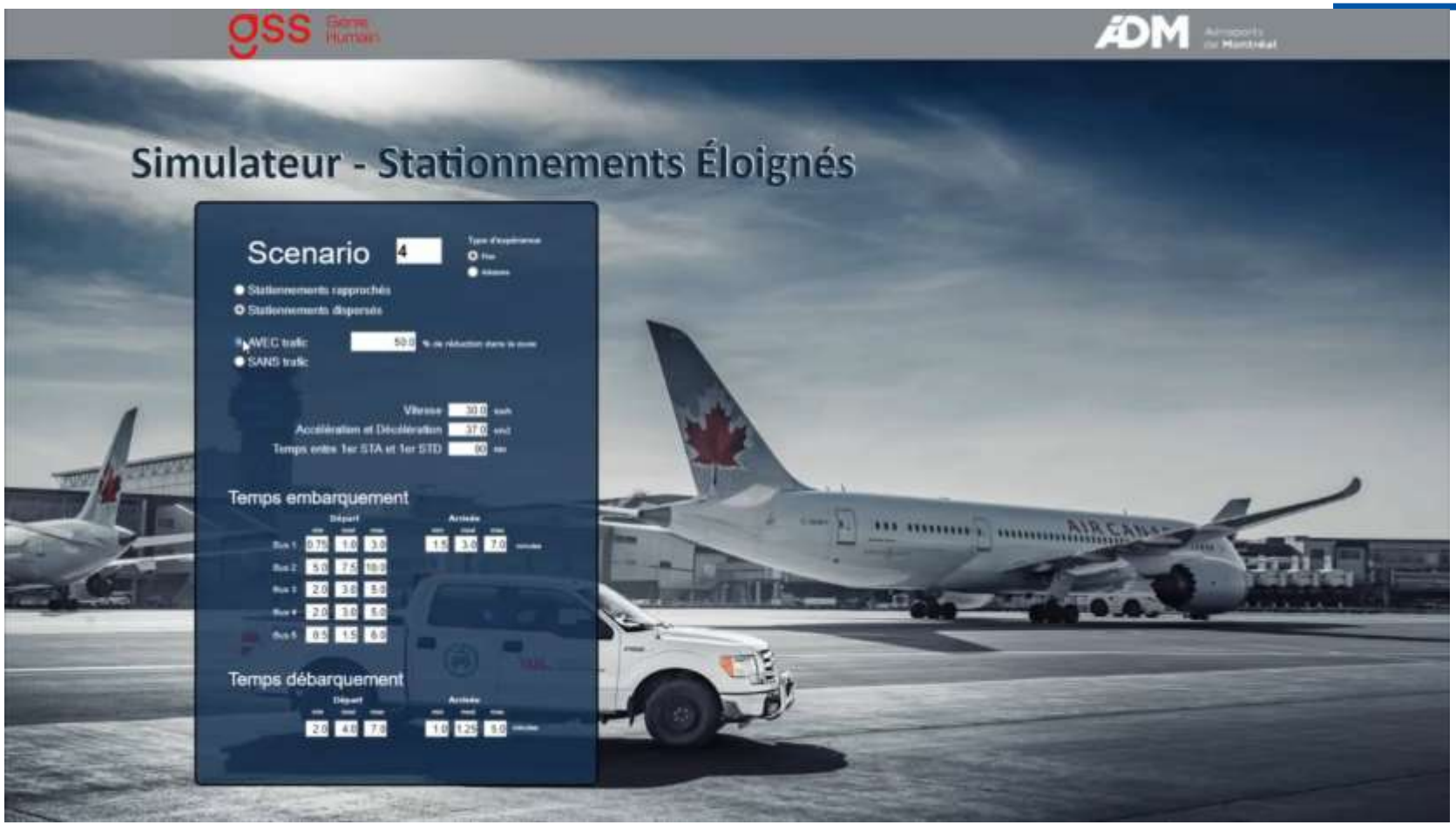
gss Human Engineering



Airside Digital Twin

Evaluate aircraft parking and passenger handling capacities

The ADM experience



Thank You

ICAO | INNOVATION

Richard Vilton

CEO

Emu Analytics

Emu Introduction

Bootstrapped SME founded in 2015, creating software for **Smart Cities**, **Digital Twin** and **IoT-** initiatives

Analytics & visualisation software solution **Flo.w** for **big, real-time geospatial** data

Dynamic, intuitive **map-based** web interface **accessible to all users**

ICAO INNOVATION

Our UK footprint in Aviation

Emu Analytics

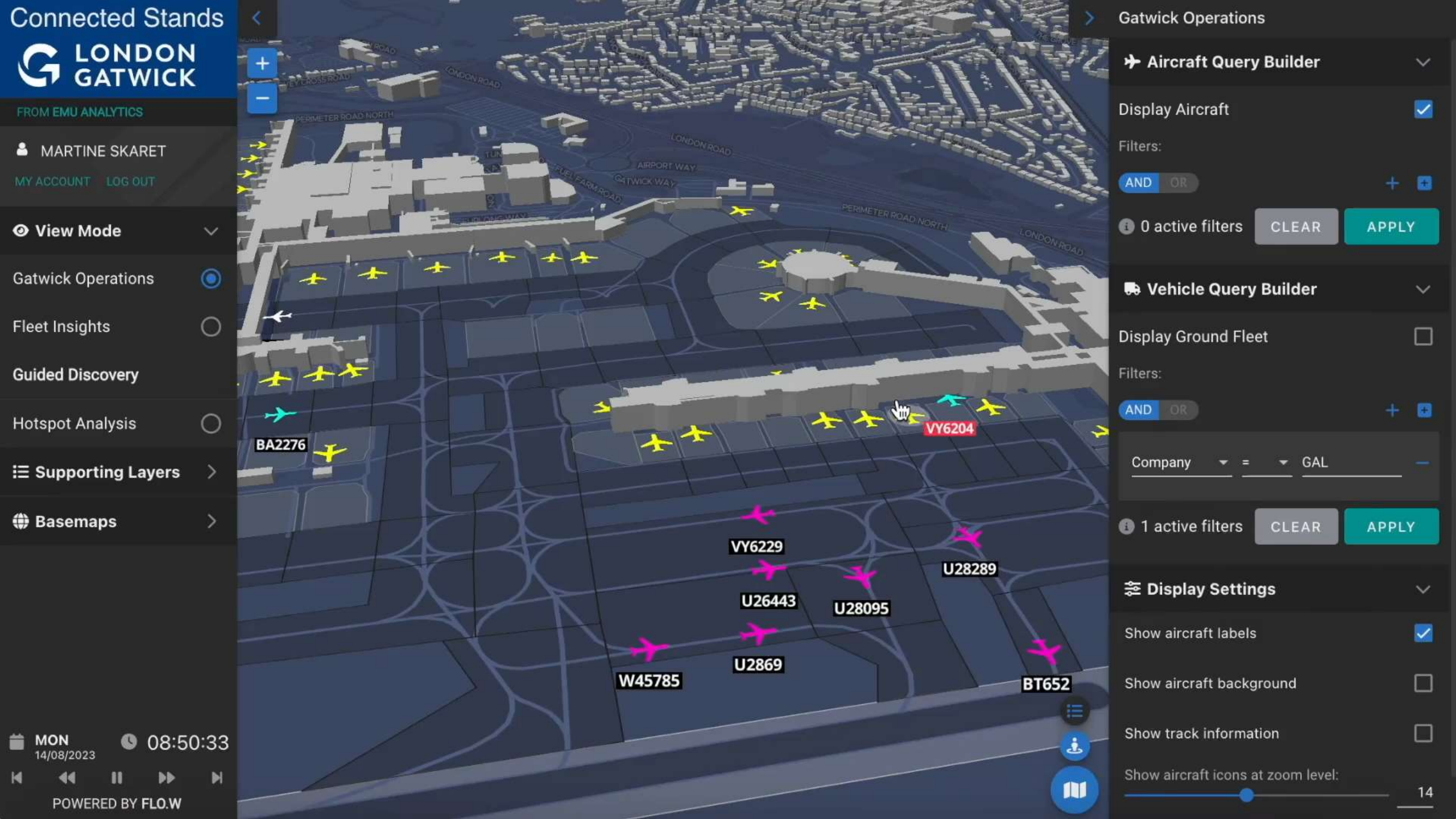
ICAO INNOVATION

Our Innovation Credentials

9-time winner of corporate accelerator programmes

5-time winner of Innovate UK funding

Winner of EIT Digital funding


Connected Stands
LONDON GATWICK
FROM EMU ANALYTICS
MARTINE SKARET
MY ACCOUNT
LOG OUT
View Mode
Gatwick Operations
Fleet Insights
Guided Discovery
Hotspot Analysis
Supporting Layers
Basemaps
MON
14/08/2023
08:50:33
POWERED BY FLO.W
BA2276
VY6204
VY6229
U26443
U28095
U28289
U2869
W45785
BT652
Gatwick Operations
Aircraft Query Builder
Display Aircraft
Filters:
AND
OR
0 active filters
CLEAR
APPLY
Vehicle Query Builder
Display Ground Fleet
Filters:
AND
OR
Company
=
GAL
1 active filters
CLEAR
APPLY
Display Settings
Show aircraft labels
Show aircraft background
Show track information
Show aircraft icons at zoom level:
14

Meet us at Booth 23

CEO and Co-Founder:

Richard.Vilton@emu-analytics.com

Marketing & Growth Lead:
Martine.Skaret@emu-analytics.com

www.emu-analytics.com

Robert Freitag

Assistant Vice-President, Chief Technology Officer

NAV CANADA

Digital Twin:
Sector Performance Optimizer

Keeping Canada's Skies Safe:

Shaping the future of air navigation services

Our Shared Purpose is supported by four pillars

Safety is at the core

It is integral to everything we do and continues to mature as the industry evolves.

Innovation is key

We are passionate about modernizing Canada's air navigation system to deliver value to our customers.

Expertise is the cornerstone

The skill, agility, leadership, and collaboration of our people make the difference.

Partnerships are essential

Our partnerships help the aviation industry improve efficiency and support an environmentally sustainable future.

Safety Every Step of the Way

As the owner and operator of Canada's civil air navigation system, NAV CANADA tracks and guides aircraft from all over the world safely through Canadian airspace. Our role begins well before takeoff and continues right up to arrival.

Technology

is at the forefront of NAV CANADA's business – designing, delivering, adapting, maintaining and securing all the technology for air traffic services and business systems.

Helping the Industry Reduce its Environmental Impact

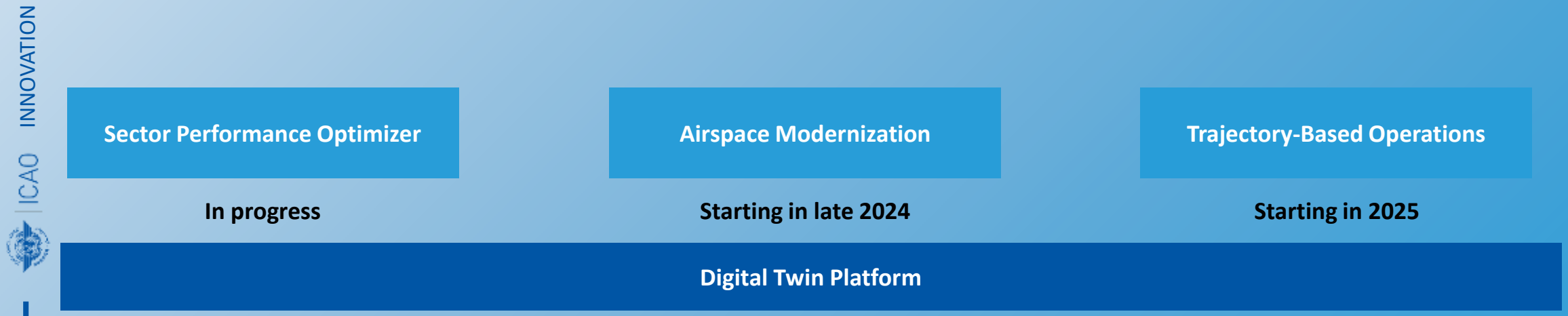
Collaborating on improving air traffic management, modernizing Canada’s airspace and implementing new technologies.

Digital twin technology, a key to our AI Strategy

- Digital twin capabilities provide NAV CANADA with probabilistic decision models and experimentation platforms that are central to the long-term success of NAV CANADA's ability to deliver value to its customers and the flying public.

- Digital Twin capabilities benefit NAV CANADA through the creation of:
  - a digital operational planning environment;
  - an integrated data platform that acts as a fundamental pillar for decision support;
  - offline and consequence-free what-if scenario analysis;
  - Support for proactive decision-making through information and recommendations.

- Digital Twin capabilities support the shift to a data-first mindset at NAV CANADA.
  - A fundamental key to long-term success is a dynamic, continually improving data foundation.



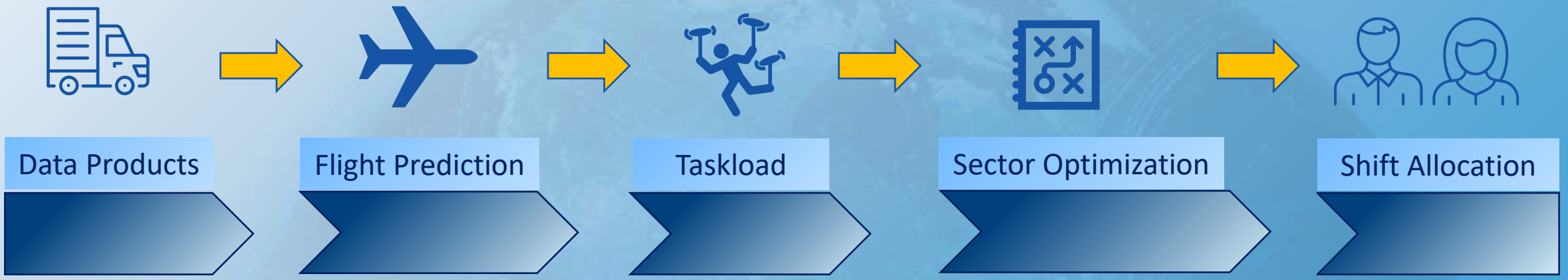
Our vision for advanced analytics and AI

> Transform NAV CANADA to become a **digitally enabled** ANSP **safely**, **cost-effectively** and **sustainably** to address the needs of our **customers** and create a more **resilient** organization for the future.

Guiding Principles:

1. Safety is always at the forefront.
2. Consider human in the loop to manage and mitigate risks.
3. Importance of data, people, process and governance.
4. Take an iterative, phased approach.

Digital Twin Sector Performance Optimizer - How does it work?



Algorithms generate predictions and recommendations
- Based on user-defined parameters

Digital Twin Sector Performance Optimizer (DT-SPO)

Virtual representation of NAV CANADA's airspace

In sync with the physical world, data streams to digital twin system processor

Uses simulation, machine learning optimization, and analysis to create a digital environment

Predicts tomorrow, today

Supports decision making with analytics

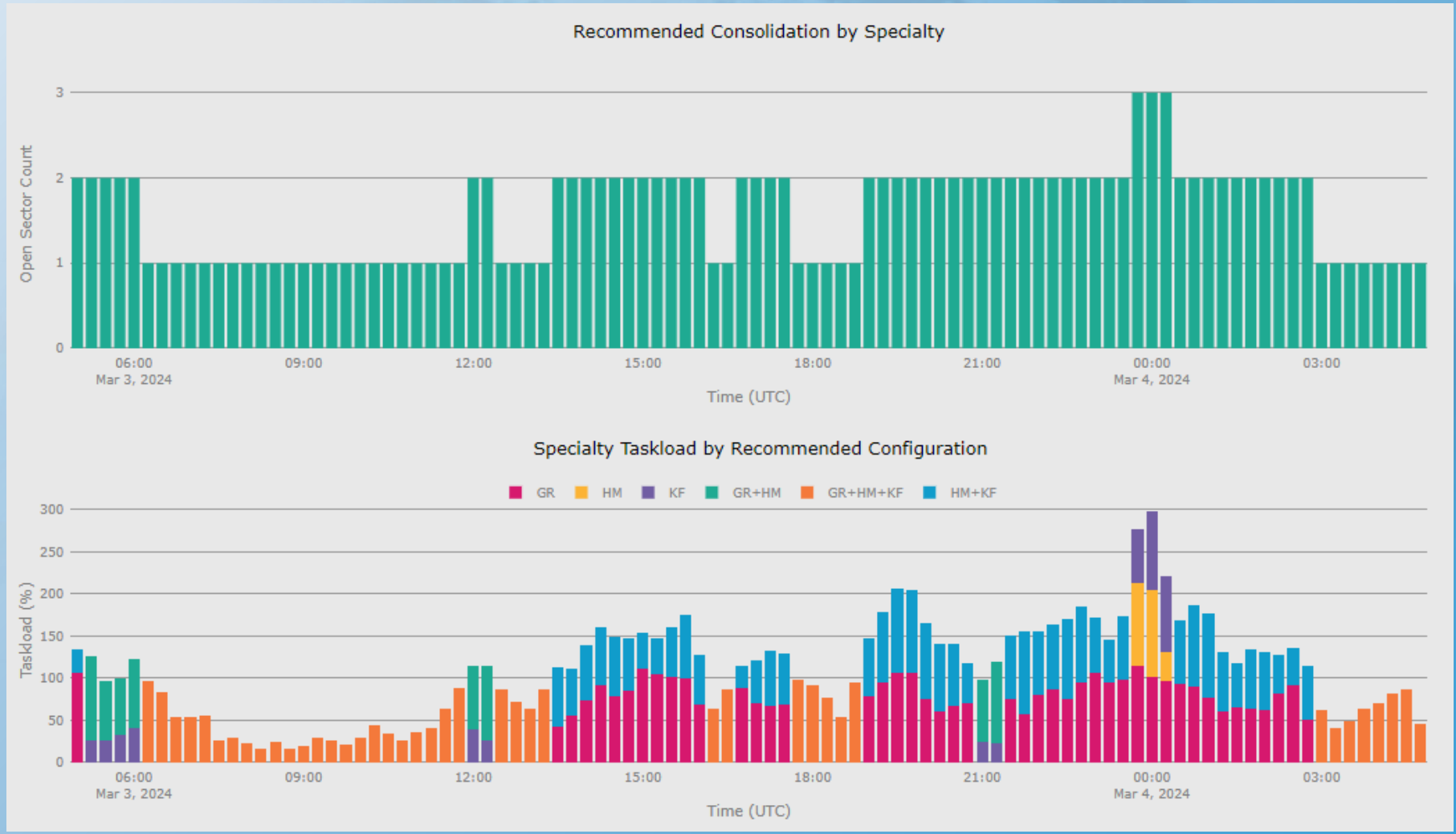
Provides insight into flight & task load complexity

Supports:
Post-Ops analysis
What-if analysis
Sector recommendation
Shift recommendation
ATC training

DT-SPO: Use Cases

Shift and Sector Configuration Recommendation

To be used daily in operational briefing sessions to incorporate recommendations into operational decisions



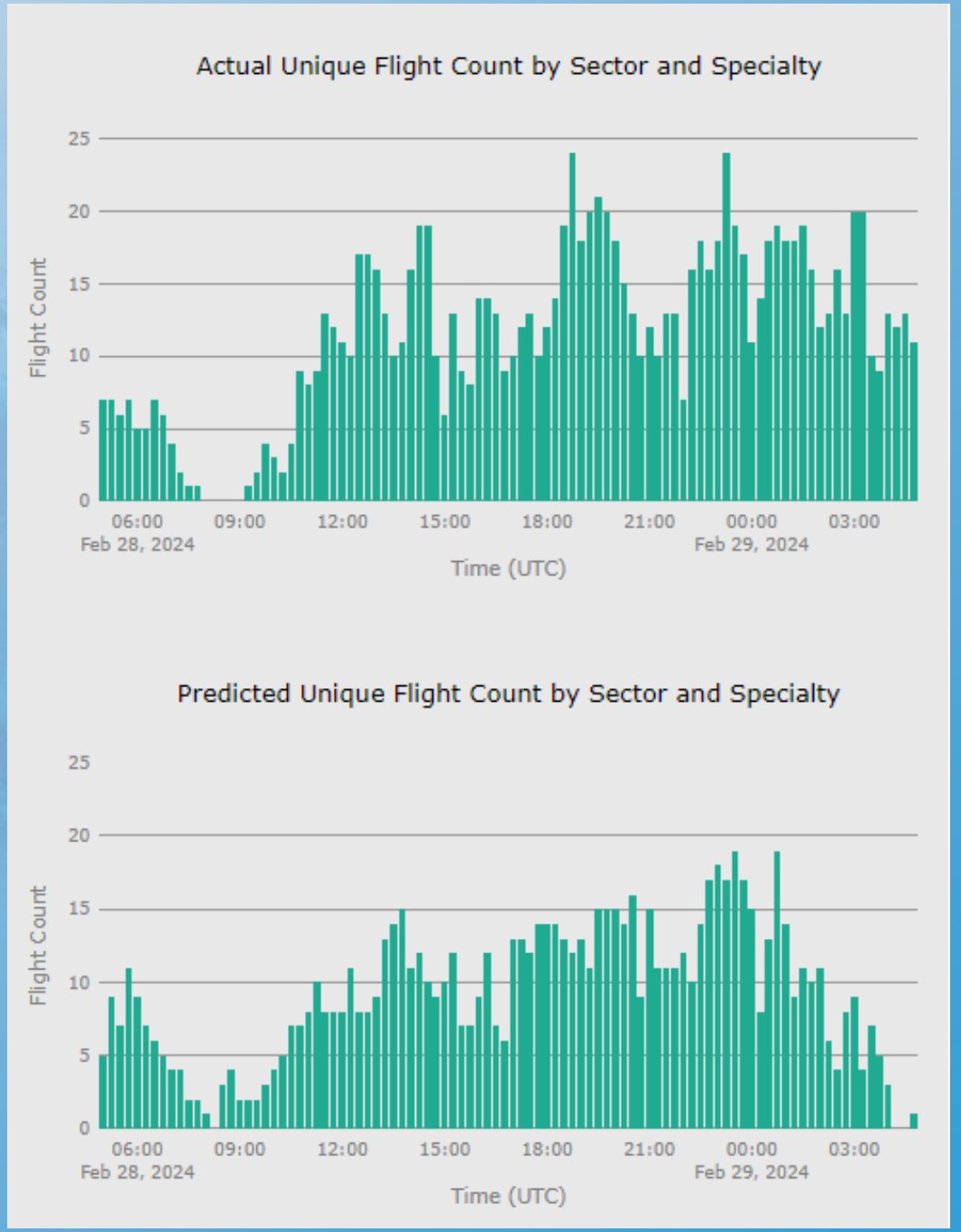
ICAO | INNOVATION

DT-SPO: Use Cases

Recommendation Review (Post Ops Analytics)

Operational decision makers will review Traffic Management Initiatives [TMI] to analyse and compare the predicted against what happened operationally.

Example: early morning thunderstorms shifted flights, workload impact, and demand recovery to later in the day.

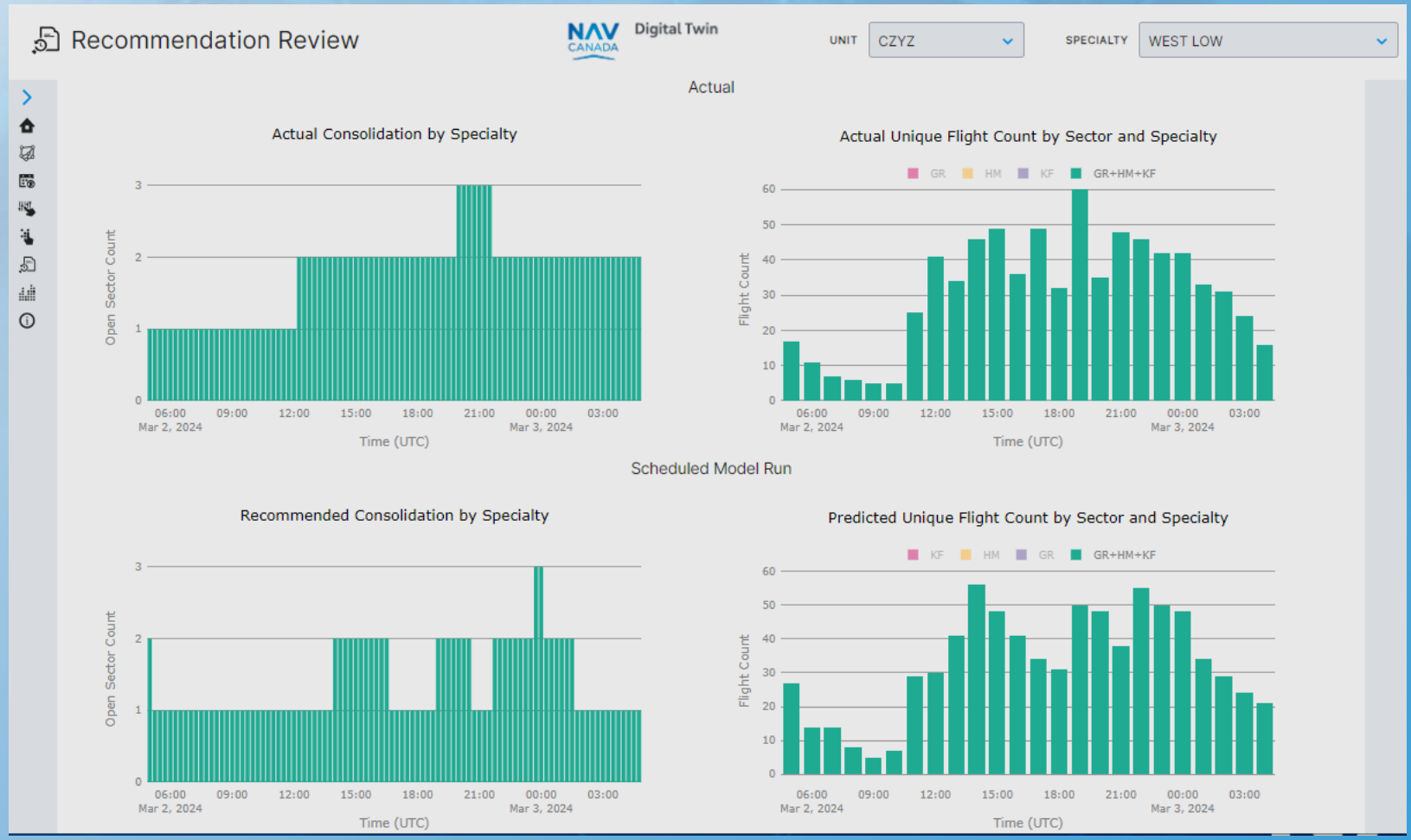


DT-SPO: Use Cases

Building Trust Through Monitoring the Accuracy of Predicted Flight Count

Monitor daily and report weekly accuracy of predicted flights.

Measured by count of flights by Specialty per given time range.

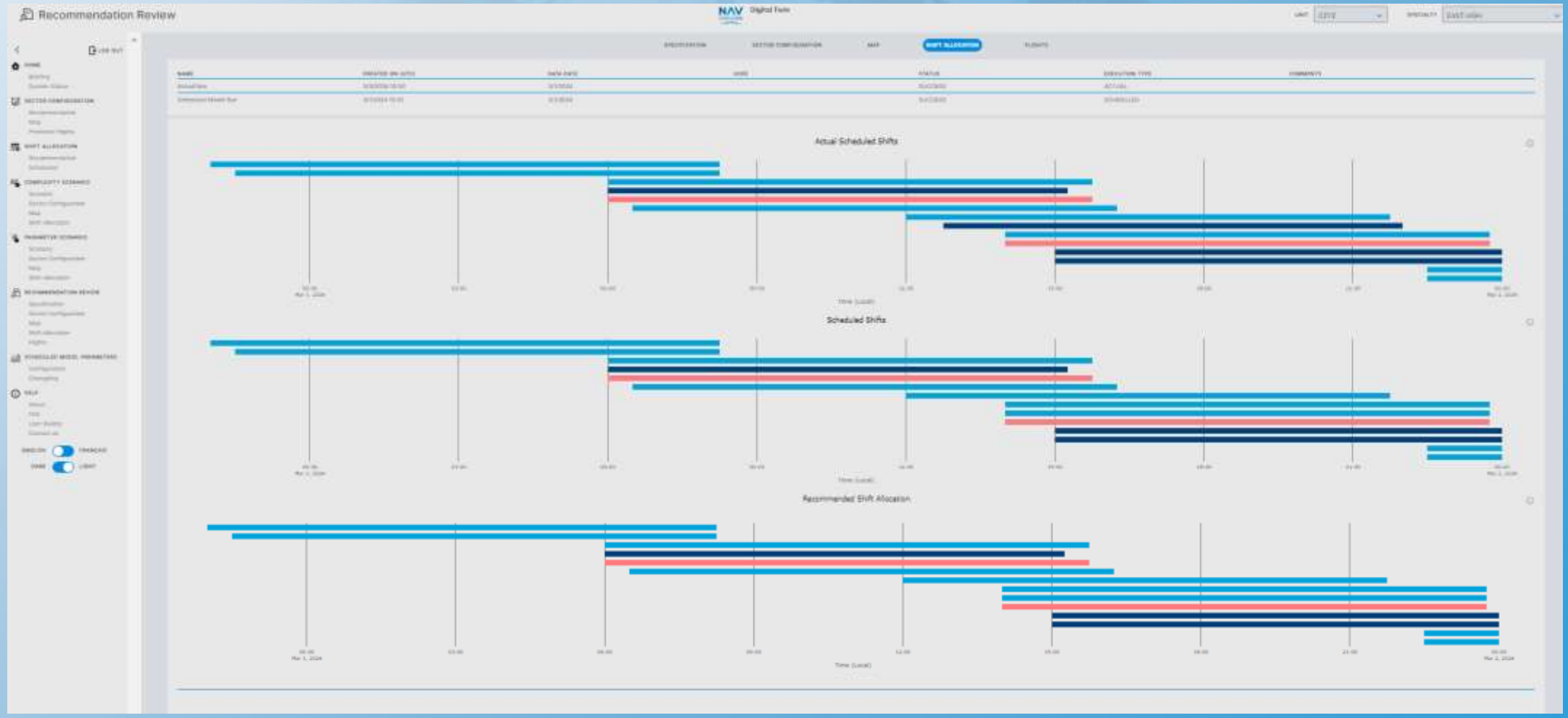


ICAO INNOVATION

DT-SPO: Use Cases

Shift Allocation Review

Review actual shifts, scheduled shifts, recommended shifts to compare staffing recommendations



Thank You

ICAO | INNOVATION

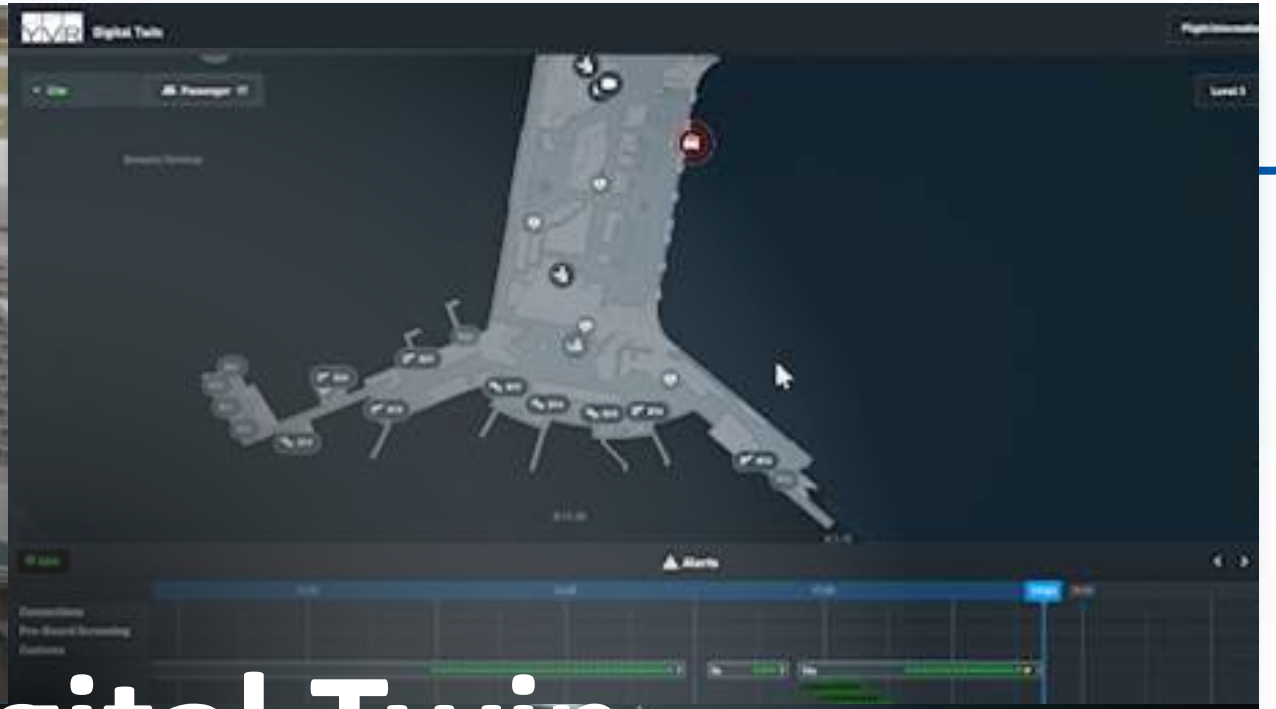
Lynette DuJohn

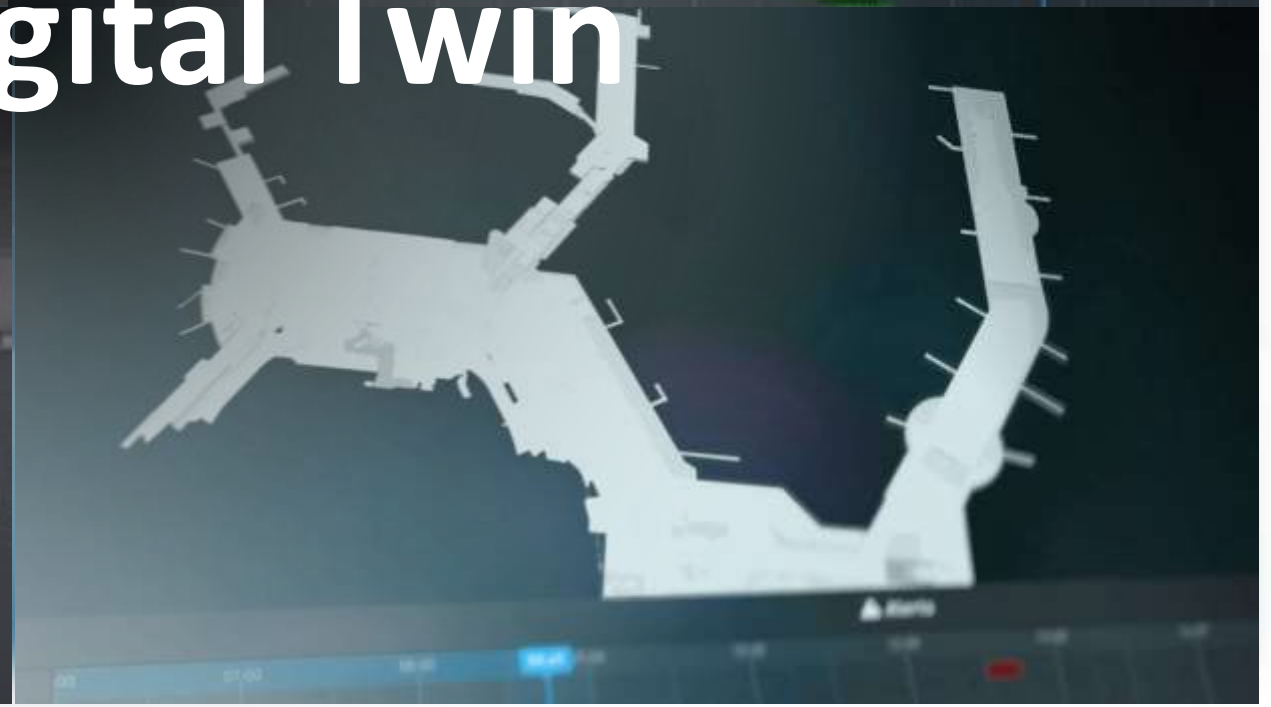
VP Innovation and Chief Information Office

Vancouver Airport Authority (YVR)

YVR’s Digital Twin

Supporting the airport’s snow operations





YVR's Digital Twin

JANUARY 2024 WINTER STORM | At a Glance

FORECAST

~30cm of snow on Jan 17, 2024 – about 5cm more than Dec 19, 2022.

7th highest single day of snowfall since 1938.

Temperatures dropped as low as -14C.

TEAM

80% of our winter operators were experiencing their first snow event at YVR.

50% of the Snow Control desk were new to the team.

AIRSIDE

Operated 80% of our regular schedule vs. 35% on Dec 20, 2022.

All arrival aircraft gated in less than 30mins – flow management at work.

Deicing cleared up to 40cm of accumulation on some aircraft.

BAGGAGE

99% of baggage delivery maintained throughout weather disruption

JANUARY 2024 WINTER STORMI Timelapse

JANUARY 2024 WINTER STORMI Digital Twin

Thank you

Jia Xu

SkyGrid

CEO

SKYGRID | A Boeing, SparkCognition Company.

OPEN THE AIRSPACE

We build high-assurance certified third-party services (**3PS**) to open the sky for autonomous flight and scale advanced air mobility.

3PS (Third Party Services)

A distributed service provided by someone other than the vehicle operator or the ANSP. Examples include dat suppliers (SDSP), UAM integration and air traffic services (PSU), and drone air traffic services (UTM).

ICAO INNOVATION

The Future of Aviation is Autonomous

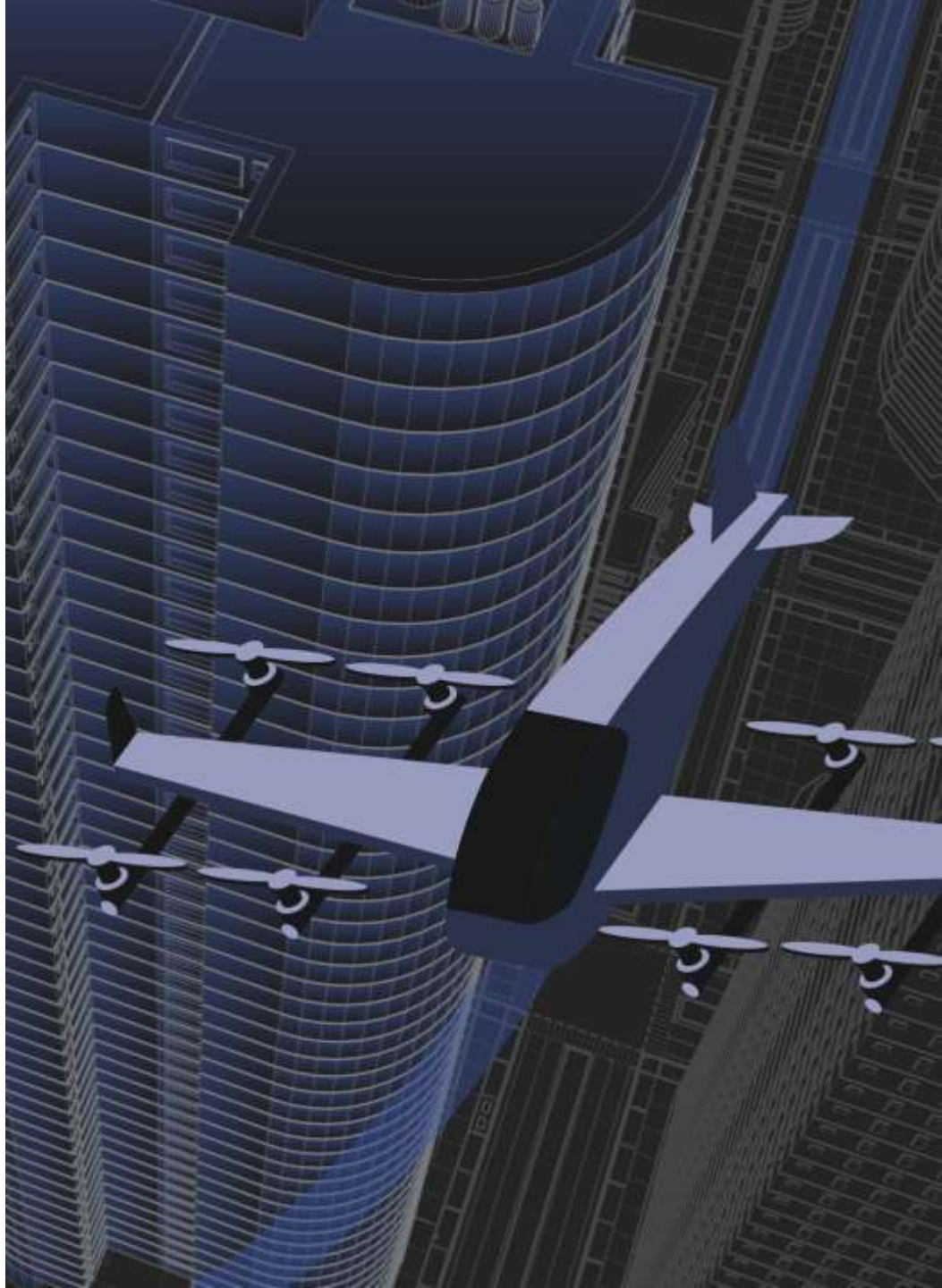
Autonomous aviation and advanced aerial mobility (AAM) will **multiply** the positive economic and social impact of flight.

P1: As autonomous aircraft come to the market, we still face challenges in **integrating** and **operating** these aircraft in the airspace.

P2: Today's airspace is not configured to support UAS and AAM operations at **scale**.

ICAO INNOVATION

SKYGRID



Problem Space for Autonomous Flight Operations

	Integrate UAS Operations Required for operational approval				Automate Air Traffic Management Required to scale operations			
	High-integrity traffic	High-integrity data	CNS monitoring	Dispatch for autonomy	Strategic deconfliction	Separation support	Network contingency mgmt.	Conformance monitoring
 **Autonomous eVTOL**	✓	✓	✓	✓	✓	✓	✓	✓
 **Autonomous CTOL**	✓	✓	✓	✓		✓	✓	✓
 **Crewed eVTOL**	✓	✓			✓	✓	✓	✓
 **High Assurance sUAS**	✓	✓	✓	✓	✓	✓	✓	✓
 **Autonomous / SPO Part 25**	✓	✓	✓	✓			✓	✓
Foundation: High-integrity data and services and common operating picture								

ICAO | INNOVATION

SKYGRID

What's a Digital Twin?

A set of virtual information constructs that mimic the structure, context, and behavior of an individual / unique physical asset, or a group of physical assets, is dynamically updated with data from its physical twin throughout its life cycle and informs decisions that realize value.

AIAA

A virtual replica of a physical entity that is synchronized across time. Digital twins exist to replicate configuration, performance, or history of a system.

US DOD

A set of virtual information constructs that mimics the structure, context, and behavior of a natural, engineered, or social system (or system-of-systems), is dynamically updated with data from its physical twin, has a predictive capability, and informs decisions that realize value. The bidirectional interaction between the virtual and the physical is central to the digital twin.

Committee on Foundational Research Gaps and Future Directions for Digital Twins, NAE

A virtual replica of a physical asset, system, or process that can monitor, model or simulate, analyze, and optimize the physical world. It aims to bridge the physical-digital gap at the right frequency and fidelity, enabling continuous improvements to performance and sustainability.

Capgemini Research Institute

A virtual representation of an object or system designed to reflect a physical object accurately. It spans the object's lifecycle, is updated from real-time data and uses simulation, machine learning and reasoning to help make decisions

IBM

The digital representation of the "current state" of a manufactured product or system at any given point in time –

David Grasso

An integrated multi-physics, multi-scale, probabilistic simulation of a complex product and uses the best available physical models, sensor updates, etc., to mirror the life of its corresponding twin.

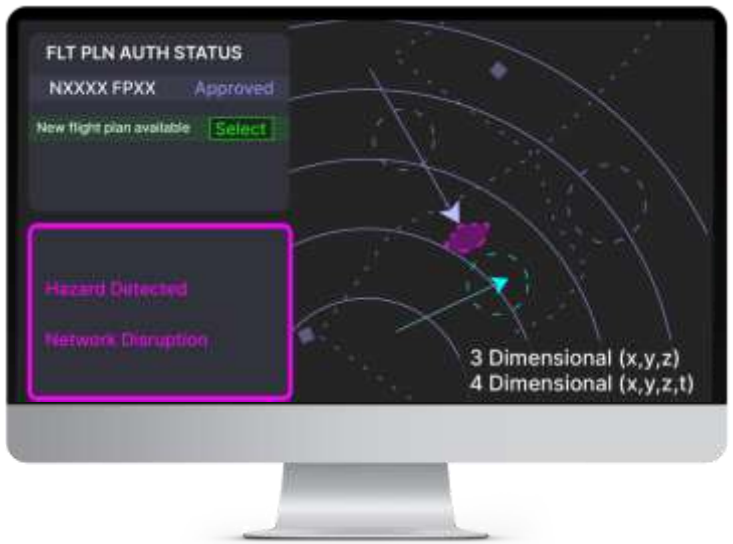
Glaessgen and Stargel

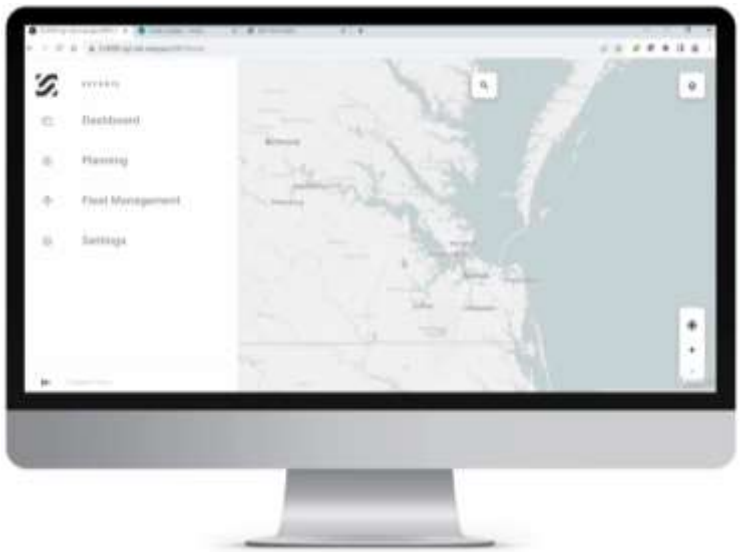
A computational model (or a set of coupled computational models) that evolves over time to persistently represent the structure, behavior, and context of a unique physical asset such as a component, system, or process

Kapteyn, Pretorius and Willcox

TLDR: it's a thing in the computer that's like a thing in the real world. The two are linked.

SKYGRID





Fleet Dispatcher
Dispatch view and data for mission planning and optimization

AAM Traffic Manager
Situational awareness and decision support

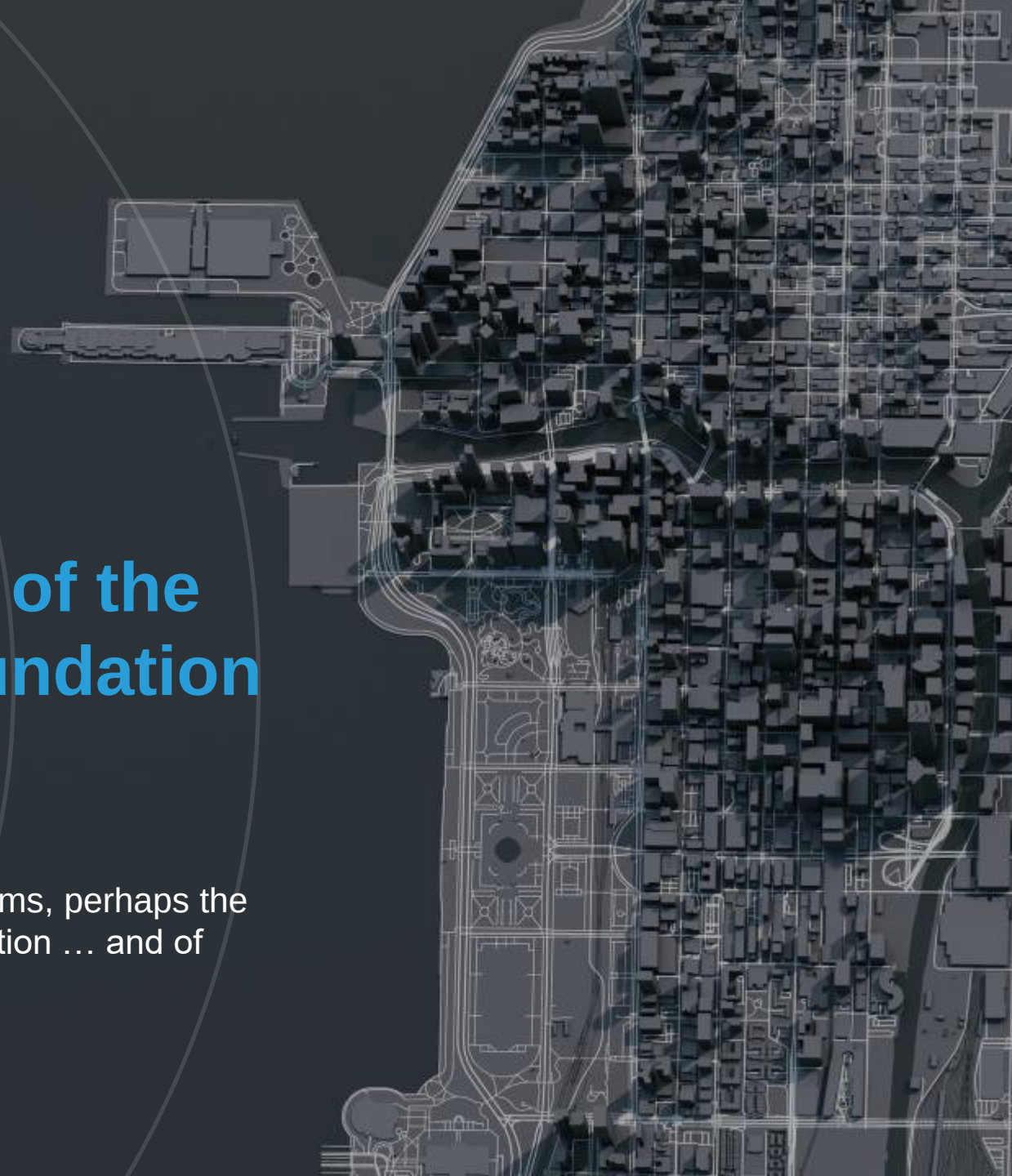
Remote Operator
Operator view and data for situational awareness and decision support

What we need for autonomy and scaled AAM operations:
A high-integrity and fidelity digital twin of the operating environment

Enable Advanced Functions
- Hazard Awareness
- End-to-end ops optimization
- Conformance Monitoring
- Tactical Deconfliction
- Strategic Deconfliction
- Efficient Dispatch

ICAO | INNOVATION

SKYGRID | A Boeing, SparkCognition Company.



A high-integrity digital twin of the operating domain is the foundation for safe aviation autonomy

*You will of course also need digital twins of onboard systems, perhaps the operational intent, the vehicle and system in scaled simulation … and of course, a safe autonomous aircraft =)

ICAO INNOVATION

A high-integrity digital twin of the operating domain is the foundation for safe aviation autonomy

SKYGRID

- We must think beyond the vehicle to make autonomy work. ICAO is leading here.
- Elevate the integrity of data and functions to enable autonomy
- Autonomy is a powerful forcing function for digitizing aviation
- Empower 3rd party services via rulemaking and regulatory advances

Thank You

ICAO | INNOVATION

ICAO INNOVATION