

# Digital Twin Sector Performance Optimizer (DT-SPO)

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# Sector Performance Optimizer

NAV CANADA's First Digital Twin

1 Why? Key Challenges for NAV CANADA

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# Why? Key Challenges for NAV CANADA



## Digital Operating Model

- Operating model of future is digital.



## Data Platforms

- A fundamental pillar for decision support.



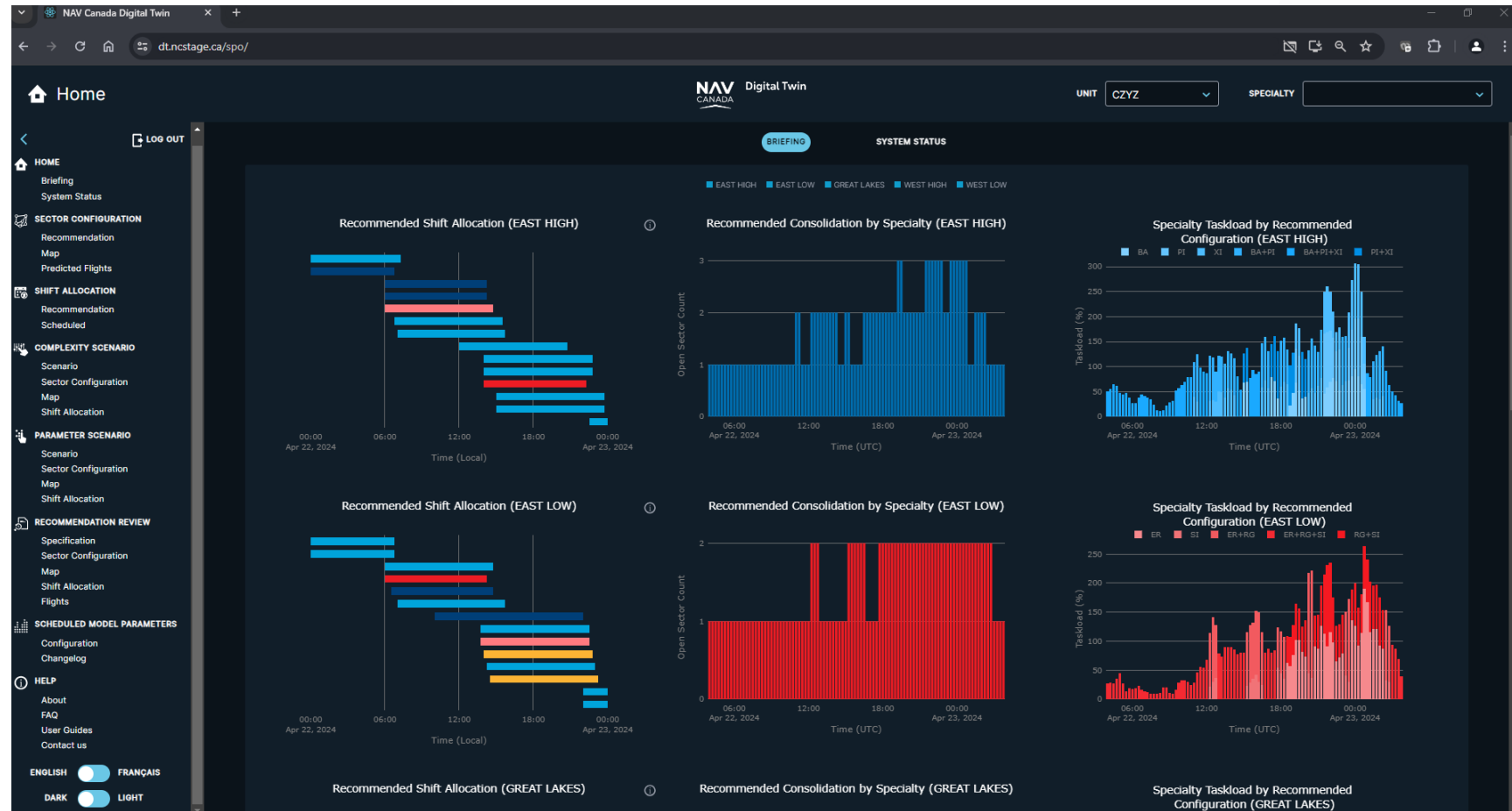
## Proactive Decisions

- Support employees with information, recommendations.



# What is Digital Twin Sector Performance Optimizer?

- Virtual representation of NAV CANADA's airspace.
- Cloud based application, uses data, simulation, machine learning optimization, analysis to create a digital environment of NAV CANADA's airspace.
- In sync with the physical world, data streams from NAV CANADA's operational systems to digital twin system processor.



# How does Digital Twin Sector Performance Optimizer Work?

*Your digital assistant for sector configuration optimization and planning for a better today and tomorrow.*



Data Products



Flight Prediction



Taskload



Sector Optimization



Shift Allocation



Use data from operational sources



Generate a probable outcome of tomorrow using light gradient boosting and random forest classifier algorithms



Identify and measure taskload using algorithms to process flight trajectories that identify air traffic controller tasks and subtasks

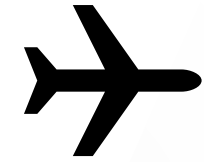


Identify ideal sector combinations using dynamic programming, shortest path



Propose optimized shift allocation for better coverage using recommended sectorization, parameters, and business rules

# Machine Learning and SPO



## 6 Stages of the Flight Prediction Process

### Data Engineering

Creating, building, managing, storing, processing required data for ML Models



### Feature Engineering

Process of selecting, transforming, creating new features from data to improve performance of ML Models

### Count Model (LGB)

How many flights will fly tomorrow?

### Flight Route Model (RF)

What route will flight take tomorrow?

### Flight Schedule Model (LGB)

What's the probability of a flight flying tomorrow?

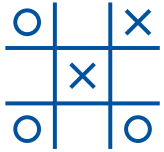
### Post Processing

How are the three models combined?

Model(s) performance, monitoring, and degradation managed using MLOps

# How is it being used by Operations?

SPO in the Operation since November 2023



- Daily Planning Session(s) with Operations Duty Managers and ATC Supervisors.



- Produces recommendations alongside considerations such as weather, routes, and more.
- Supports the strategic planning of optimal sectorization and shift coverage to improve service delivery where possible.



- Provides post operational capabilities to review what was planned, what was predicted, and what actually happened to assist with operational analytics and longer term, strategic decision making.

# How is SPO Performing?

Lessons learnt on trust, quality, performance, and monitoring

## Quality & Representation

- Representative of the Operation.
- Conducted deep dive technical reviews with users.
- Users continually provided feedback on flight prediction components, taskload verification, etc.

## Trust

- Trusted by Operations.
- Partnership mentality between Operations and Technology.
- In Person at the Area Control Centres.
- Focused on addressing their challenges.

## Monitoring Systems

- System is monitored.
- MLOps process monitors inference performance daily.
- Daily and hourly flight prediction accuracy between 85% - 95%.

## Degradation

- Degradation is addressed.
- As flight patterns change the models need to be re-trained.
- MLOps process is automated.
- Manages degradation using a Champion and Challenger process.