Rapid Prototyping: An Overview

Simulators have evolved. Today, more than ever before, Micro Nav's BEST (Beginning to End for Simulator Training) Suite goes above and beyond training.

It is an operational powerhouse, helping to boost efficiency, cut costs, and reduce your carbon footprint.

Today, simulators are used for prototyping and testing operational ATC data items, airport infrastructure changes, and controller ATM displays.

Rapid Prototyping Tools

Data Preparation

The **BEST Data Preparation** program automates the tasks of creating airspaces and airspace elements by importing data.

Manually performing such tasks is complex and time-consuming. Automating them negates that, letting you focus on testing and improvement.

Airspace Data Translator

A function of the **BEST Data Preparation** program that converts operational data into the required format.

Previously, this process would have taken several hours. Today, with Micro Nav's BEST simulator, it takes seconds.

Flight Plan Translator

Part of **BEST Data Preparation**, Flight Plan Translator uses operational data from several data sources to create flights representative of real-world traffic.

BEST 3D Create

The **BEST 3D Create** program contains our **Scene Editor** and **Fast Airport Builder (FAB)**.

Fast Airport Builder, an industry-first, creates airport scenes consisting of ground elements and other miscellaneous items.

Scene Editor takes the 2D output from **FAB** so 3D objects can be placed and edited, with results viewable in real time.

ODS© Open Platform

An open platform solution built by our partners Frequentis Orthogon. The **ODS© Open Platform** supports Human-Machine Interfaces for safety-critical applications. When paired with Micro Nav's SimCWP display, our customers can accurately mirror operational CWPs in a simulation environment.

Tools Supporting Rapid Prototyping

BEST Insights

The newest member of Micro Nav's BEST suite, **BEST Insights**, extracts simulator data to assess training success and operational performance.

On the training side, the wealth of data that BEST Insights collects supports instructors and managers in advancing students. On the operational side, Insights assesses performance and empowers business decision-makers to make validated decisions, increasing their ability to quickly adapt, adjust, and accept new concepts and standards.

Applications of Rapid Prototyping Tools

Airspace Creation

The **Airspace Data Translator Tool** pulls pre-existing operational data and converts it to create a new or adapted airspace.

A Translate and Defaults form must be completed before airspace creation begins. The Translate form defines the FIR name, ICAO code, and extent of airspace needed. The Defaults form defines map layers and other airspace elements.

Once these forms are completed, airspace creation will be completed in seconds.

Modifying Existing ATC Procedures

As well as creating new airspaces, **Data Preparation Program** can be used to quickly amend operational procedures for instant export into simulation files.

The **BEST Data Preparation** can also implement broader changes to operational procedures. When paired with **BEST Insights**, any changes you wish to make can be validated, proving tangible operational benefits before real-world implementation.

Exercise Creation

Creating exercise elements such as flight plans for deployment in training and airspace development used to be a very time-consuming process. But, with Micro Nav's Flight Plan translator, customers can now process four hours of real-time data ready for use in just two minutes.

Airport Design

Micro Nav's **BEST 3D Create** suite creates ground elements for 2D and 3D airports. A high-fidelity underlay acts as a visual guide for accurate airport positioning.

All 3D elements can then be added to provide realistic and immersive scenes. While some elements may require third-party software for accurate modelling, we supply a library of sample 3D elements, including lighting effects, bodies of water, terrain texture, and elevation tools, allowing users to quickly build out the practical elements of their airport.

Customers can take this further with **Procedural Design**, a powerful tool that uses OpenStreetMap data to visualise your airport and surrounding area.

Modifying Airport Layout

With infrastructure changes at major airports on the horizon, **FAB** and **Scene Editor** are ideal for prototyping proposed changes.

Once relevant additions and/or amends are made, the new model can be exported to your simulator, allowing you to assess the impact of proposed changes.

With BEST, changing your existing airport layout and conducting an impact assessment of changes can be completed in a fraction of the time, at a fraction of the cost.

Human Machine Interface (HMI) Prototyping

Having a library of simulated controller displays ready-to-go, and being able to create bespoke displays rapidly, means that solutions can be adapted to customer needs. Meanwhile, the technology allows controllers-in-training to conduct realistic scenarios, shortening the transition from simulator training to operational duty.

The Qatar CAA

The Qatar CAA came to Micro Nav with projections that their traffic density would grow over the next decade.

Due to various constraints, Qatar's airspace is compact, and large portions are military airspace.

Working for Independent Business Group (IBG), Micro Nav's task was to tackle operational constraints and growing traffic density with broad airspace changes, including developing new SIDs and STARs, optimised flight paths, and a revision of the ATC Sectorisation.

A small team of operational controllers collaborated with Micro Nav and IBG on a proposal to address airspace optimisation in time for the World Cup 2022 in Qatar.

The proposal included the following:

- Total revision of SIDs, STARs, and Missed Approach Procedures for runways at Hamad International Airport (OTHH) and Doha International Airport (OTBD), including new Independent Parallel Runway Operations procedure

- A revision of the ATC sectorisation to complement new procedures

- Changes to the Concept of Operations to suit revised airspace and procedure designs

The proposal was actioned and ready for approval in two weeks.

The team employed the BEST Data Preparation program for the task, using it in a rapid prototyping 'whiteboard' capacity to:

- Visualise the impact of changing procedures

- Assess interaction between new procedures and associated ones

- Identify and theoretically resolve conflict points

- Model sector changes to optimise smooth sequencing of flights based on revised procedures

SIDs and STARs Revision with the BEST Data Preparation Program

The Data Preparation program allowed rapid profile visualisations when revising SIDs and STARs so the team could make assessment changes and visualisation updates. It was a considered, efficient approach preceding the commitment of designs to live simulations.

Superimposing the SIDs and STARs designs allowed for conflict points to be assessed. Once any points of conflict had been resolved, vertical profiling and level constraints could be considered.

Modifying Airspace Sectorisation

After completing the initial design of SIDs and STARs, the focus shifted to airspace structure and associated ATC sectors.

Incompatibility with the existing airspace structure was resolved by adjusting boundaries to optimise traffic flow and sector changes. Overlaying lateral SIDs and STARs with ATC sector boundaries meant lateral and vertical volumes could be changed quickly, ensuring effective sectorisation revision

Adopting a rapid prototyping approach allowed for delivering a revised airspace structure and associated operational procedures that benefitted operational capacity and safety while allowing for the validation of airspace design to continue uninterrupted.

Simulator view – QCAA

Heathrow Airport 3rd Runway

One real-world scenario highlighting the power of rapid prototyping within BEST 3D Create came when Heathrow Airport was considering a third runway.

Micro Nav was approached at short notice to demonstrate the operational impact caused by the introduction of a third runway.

The full task was to modify the Heathrow Airport environment to include the proposed third runway position, associated taxiways, and representative terminal buildings. The desired result was to demonstrate aircraft using the new areas and being integrated with existing airport operations in an active simulation.

Having already produced a 3D model of Heathrow, Micro Nav was supplied with a scale schematic diagram of the proposed third runway.

By scaling the provided diagram down to fit our existing Heathrow infrastructure in BEST 3D Create, it was quick to add elements required for the new layout, which included:

- A new runway — 09-27 — in the specified location
- A new apron with three terminal buildings and additional remote parking stands
- New and revised taxiways to connect the existing taxiway structure to the new runway and apron area
- Rapid runway exits connecting the new runway to the new taxiway structure

With the basic airport infrastructure work completed, the revised Heathrow Layout became immediately available in the BEST simulator in a 2D environment, allowing us to assess viability before moving on to the 3D model. In the 3D model, we were able to:

- Add textures for the new runway, taxiways, and Apron areas
- Remove existing cityscape models from the new operations area
- Add representative terminal buildings on the new Apron area

Once this had been completed, the 3D airport model and revised ground environment were ready for use in the BEST 3D Tower environment, where the overall impact of the proposed airport layout changes could be assessed. The process took less than a day.

Rapid Prototyping in Action: A reconstructed Heathrow Airport starts to take shape.

The benefits of **Rapid Prototyping**

- Using Micro Nav's **Data Preparation** and **Airspace Data Translator** programs, new airspaces can be available in your simulator in under 10 minutes.

- Test and validate the changing of operational procedures or the addition of new ones. This may include modifying STARs and SIDs, Airspace Sectorisation, assessing new procedure interactions, and so on.

- Using real-world operational data, processed by the **Airspace Data Translator** program, exercises and scenarios can be translated, ready for use within your simulator, within minutes.

- Using Micro Nav's **BEST 3D Create**, you can design your airport using underlays for exact element placement and a library of 3D assets for quick builds.

- For stakeholders, dynamic prototyping that can be assessed in a real-time simulation environment is more engaging and easier to understand.

- The combination of the BEST suite and SimCWP increases the efficiency of ATCO training, allowing for more realistic training scenarios and shortening the transition from training to operational duty.

- SimCWP allows new operational procedures to be evaluated and tested for CWP visualisation and interaction capabilities.

- Assess the impact of airport infrastructure changes like traffic routings, siting new buildings, hangers, towers, and more. Prototyping such additions in tandem with analytics from **BEST Insights** means impact assessment can be conducted at a greater pace and marginal cost

- Extrapolating data to inform operational decisions is a fundamental part of **Rapid Prototyping**.

  BEST Insights automatically logs simulation progress for future student performance analysis or informs instructors and managers.

Simulator view – QCAA

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The Quadrant Group's mission is to make a meaningful positive difference to aviation safety by providing and enabling the world's best-trained air traffic controllers.
We do this by engineering the industry-leading tool for training, development, and operational testing, as well as offering consultancy and support services to assist customers in establishing and running training centres of excellence.