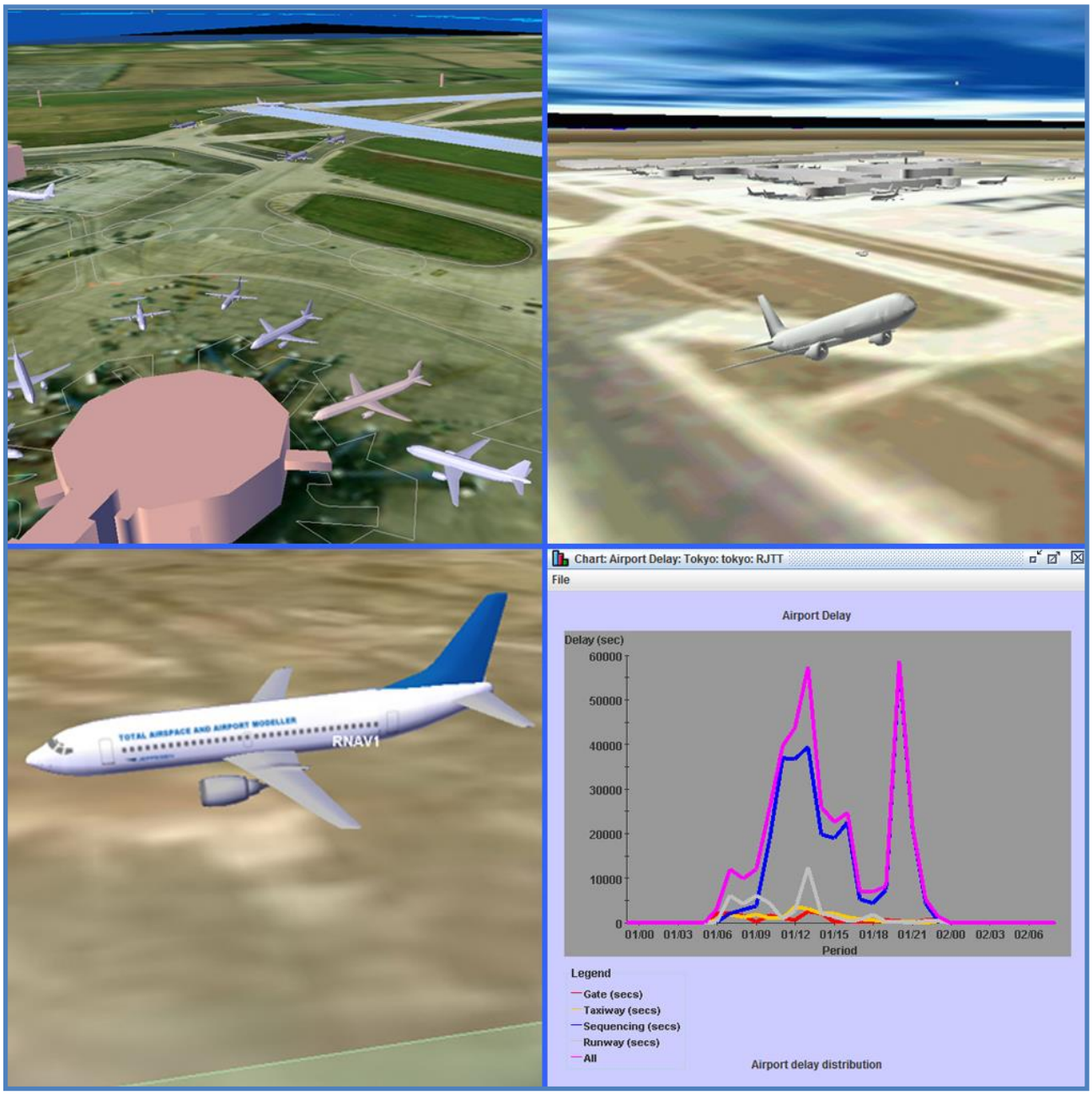
`



TOTAL AIRSPACE AND AIRPORT MODELLER (TAAM)

PRODUCT PROFILE

JEPPESEN
A BOEING COMPANY

TAAM PRODUCT PROFILE

Jeppesen's TAAM® - Total Airspace and Airport Modeller - is Jeppesen's fast-time gate-to-gate simulator of airport and airspace operations. This sophisticated software tool simulates 4D (3D plus time) models of airspace and airports to facilitate decision support, planning and analysis.

With TAAM an analyst can develop models of airports and/or airspace, and then evaluate the impact of changes to infrastructure, operations, or schedules. TAAM enables the operator to identify the system benefits of such changes as building a new taxiway, re-architecting sectors, modifying airways, changing runway configurations, or determining when saturation will be reached, among many others.

Recognised as a standard in the aviation industry, TAAM is widely used by major air navigation service providers, air carriers, leading airports, aviation research establishments, system integrators and universities around the globe.

TAAM records detailed simulation metrics, and results are presented to enable easy analysis and comparison so decision makers can determine the best possible solution before an investment has been made. TAAM uses high-detail 3D graphics to ensure that stakeholder engagement is easy.

Business Benefits

Revenue can be increased due to:

- Improved performance and utilisation of ATC systems
- Increased productivity of existing resources
- Increased capacity as a result of better management of existing and future traffic volumes

Operating costs can be substantially decreased due to:

- Reduction of ground and airborne delays
- Reduction in operating and fuel costs
- Better management of existing infrastructure and resources
- Optimisation of future investments in infrastructure through better planning and timing
- Reduction in workload through improved load balancing

Principal Features

- Unmatched fast-time and accurate 'real world' simulation capabilities
- Configurable to any airport or airspace anywhere in the world
- Unlimited 'what-if' scenario capabilities
- 3D multi-colour models of airports and aircraft
- 4D full airspace & flight profile calculations
- Access to Jeppesen's worldwide aviation database for rapid project setup
- Detailed Ground functionality, including:
    - Stands (Gates, Deice Stations, Long Term Parking Positions, Standoffs)
    - Terminals
    - Pushback Paths
    - Taxiways
    - Runways
    - Aprons
    - Towing & Maintenance Operations
- Detailed Airside functionality, including:
    - Terminal Airspace
    - En-route and Oceanic Airspace
    - Conflict Detection with separation requirements configurable by aircraft equppage
    - Flight Level Allocation System (CVSM / RVSM)
    - Flow Management
    - In-trail separation
    - Wind (terminal and enroute)
    - SIDs/STARs
    - Mixed IFR/VFR traffic, including circuit training and touch & go airport operations
- A flexible rule base to accommodate different modelling requirements
- In-application help to allow intuitive rule creation
- Randomisation of model parameters for increased realism
- Electronic input using industry standard data for rapid simulation model set-up
- Statistical data generated in a wide variety of report forms at different levels of detail, including support for customized database queries and reports
- Direct output to spreadsheet and database tools for further in-depth analysis
- Output to industry-standard noise and emissions modelling tools
- TAAM® Control Gateway – a flexible API allowing simulation control from 3rd-party applications

TAAM Applied

See a brief summary of the features TAAM can offer to benefit your operations:

CAAs and Air Services Providers:	Airport Operators:	Airlines:
➢ Analyse the impacts of global growth in air traffic ➢ Increase traffic flow and airspace utilization, while maintaining safety ➢ Analyse capacity for national route systems with current and future traffic levels ➢ Re-design, re-sectorisation and re-classification of airspace ➢ Measure benefits of reduced vertical separation minima ➢ Evaluate the implications of introducing new enroute and terminal procedures ➢ Assess the impact of changes in controller workload due to traffic growth, new airspace designs and procedures ➢ Assess oceanic separation procedures ➢ Improve cooperation between civil and military air services ➢ Manage the impact of adverse weather conditions ➢ Study new CNS/ATM technologies	➢ Reduce the costs of congestion and delays, while maintaining safety ➢ Capitalise on the better use of existing airport infrastructure and resources. Increased capacity means greater revenues from landing fees. ➢ Plan for the introduction of new large aircraft ➢ Evaluate the financial implications of future infrastructure investments including new terminals, additional gates, taxiways or runways ➢ Improve irregular operations ➢ Measure the impact of disruptions, such as proposed runway works, on your schedule and operations ➢ Assess the effect of changes in sequencing strategies and separation standards ➢ Plan noise abatement, de-icing and other operations in the most cost-effective way	➢ Plan operations, fleet changes, aircraft substitutions, de-icing and other procedures in the most cost-effective way ➢ Enhance competitiveness and profitability through reduced fuel use, shorter delays, and efficient block times. ➢ Optimise schedule design from early stages to ongoing adjustments ➢ Manage the introduction of regional jets and other fleet mix changes ➢ Evaluate past days' performance, train operations staff to handle disruptions more efficiently ➢ Analyse the initiatives of the national or local air services providers and their impact on your operation ➢ Propose initiatives to air services providers to reduce delays and increase efficiency

How TAAM Works

TAAM simulation relies upon comparing a known and existing system in order to analyse the impact of the proposed change(s). Once the need for the project has been identified and the scope defined, data is entered to create a baseline that reflects the current operations. Alternatives are then created within the simulation, using the baseline as a starting template and comparative tool. TAAM's flexibility enables the user to move easily between simulations, and return to earlier simulations run.

The simulation is run in fast-time on a desktop or laptop computer. The user can observe the traffic movements on the screen, interact with the model, vary the outcomes and arrive at best-possible solutions. Simulation run time depends upon the available computer hardware and the complexity of the model.

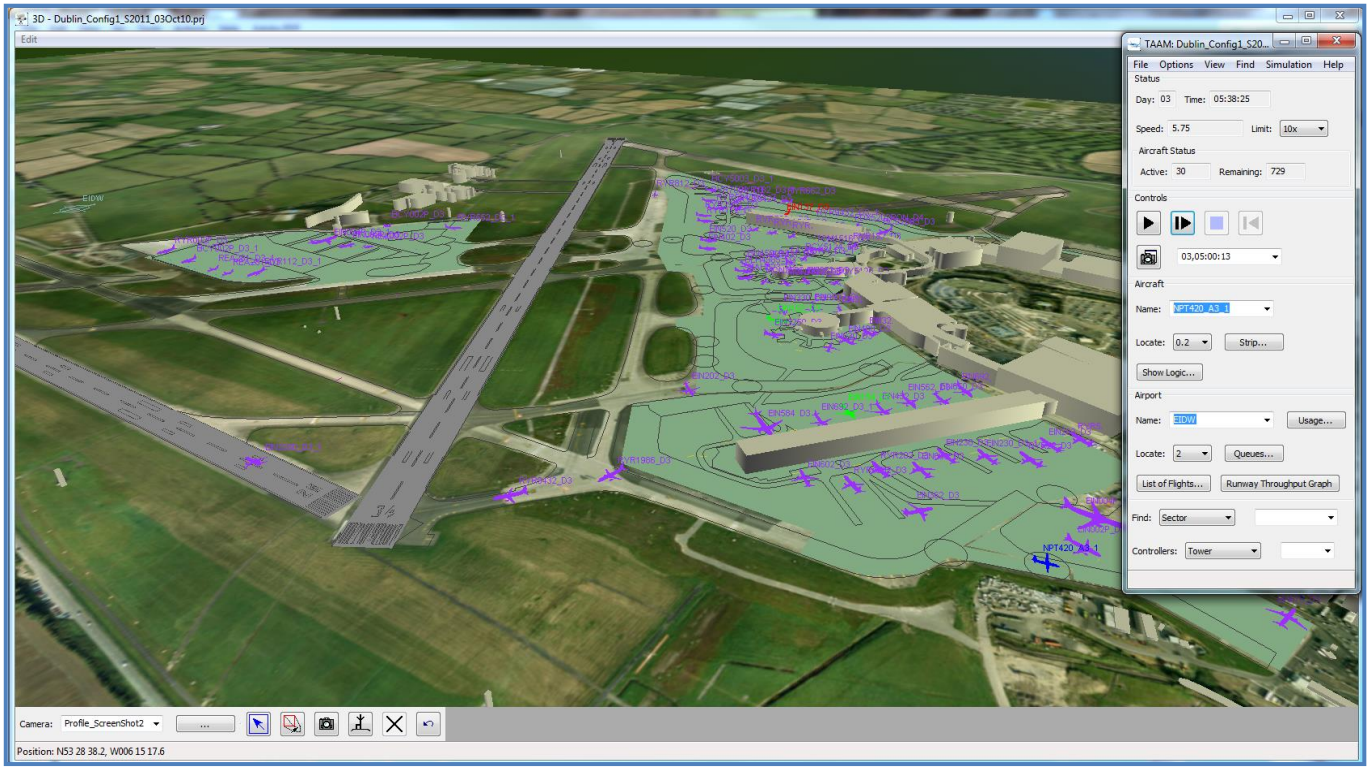


Figure 1 - The TAAM Graphical User Interface

The entire process from data input right through to the final analysis can all be done within the TAAM package.

TAAM is comprised of the TAAM Integrated Environment (TIE), the TAAM Simulation Engine, and the Post-Processing Suite (for analysis of TAAM output).

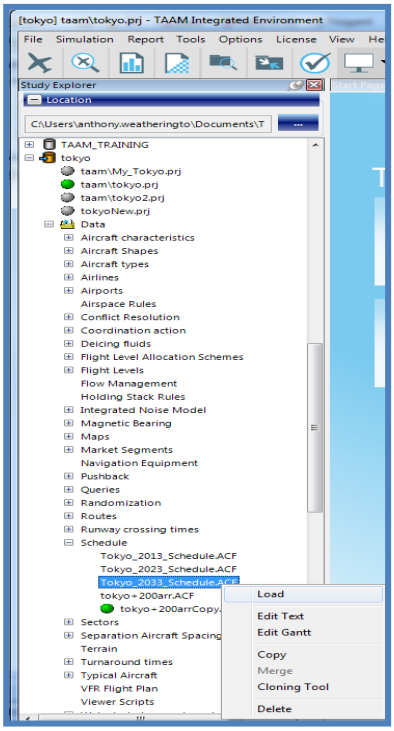
TAAM Integrated Environment – TIE

Created as the primary interface window for TAAM, the TAAM Integrated environment provides a single location for data management, simulation setup, model building, and launch of analysis and playback utilities. Data such as flight schedules, waypoints & airport location coordinates, and airfield & sector maps are managed by TIE.

Model setup files are accessible via a data tree structure in the "Study Explorer" window, while editing and configuration may be done in the work area.

Files may be easily manipulated and inserted into simulation scenarios by means of navigating the data tree and performing simple right-click actions, including copying, deleting, and loading/unloading files. File editing is easily accomplished within the work area, which includes individual tabbed windows which may be docked in a user-configurable manner or pulled out of the TIE application to take full advantage of multiple monitor environments.

Figure 2 – The TAAM Integrated Environment



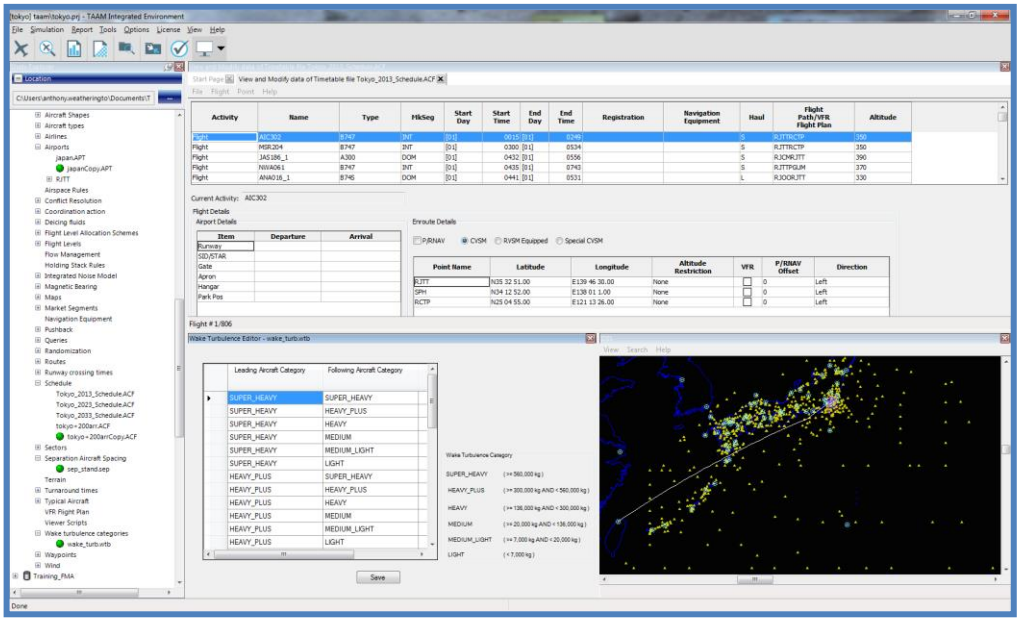


Figure 3 (Above) – The TIE window, including tabbed file browsing and multiple docked windows
Figure 4 (Left) – Loading and unloading files may be accomplished through simple right-click interaction

TAAM Simulation Engine

At the core of TAAM is the Simulation Engine (SIM), a software representation of air traffic behaviour. SIM combines hardcoded behaviour such as aircraft trajectory building, along with user configurable behaviour such as taxi paths. Control of the comprehensive SIM model is achieved through three generalised means:

- **Static files**: Included in TAAM are static files containing ATC system data tables such as wake turbulence separation standards and aircraft performance tables. Jeppesen supplies examples of these so users can quickly establish their initial models then modify the contents of these files to suit their local modelling needs. For example, users can reduce the wake turbulence separation requirements to reflect a change in standards, or increase aircraft performance attributes to reflect operator preference.
- **Parameter settings**: Many objects in the simulation have a number of control parameters. The role of these parameters range from setting ATC requirements such as in-trail requirements over fixes, to methods for emulating ATC procedures such as closing taxiways in one direction to generate racetrack taxiing patterns. Setting parameters on individual items is as simple as clicking on the item and modifying its characteristics in the resultant dialog window.
- **Rules**: While the static files and parameters are defined at simulation start-up and remain unchanged, the rule base provides context sensitive control of the simulation behaviour. The TAAM user can emulate complex operational behaviour, such as load switching between runways depending on traffic demand. The TAAM interface provides a defined graphical framework allowing users to create conditional rule behavior.

This approach enables users without programming skills to develop TAAM models, without limiting those users needing to develop highly complex scenarios.

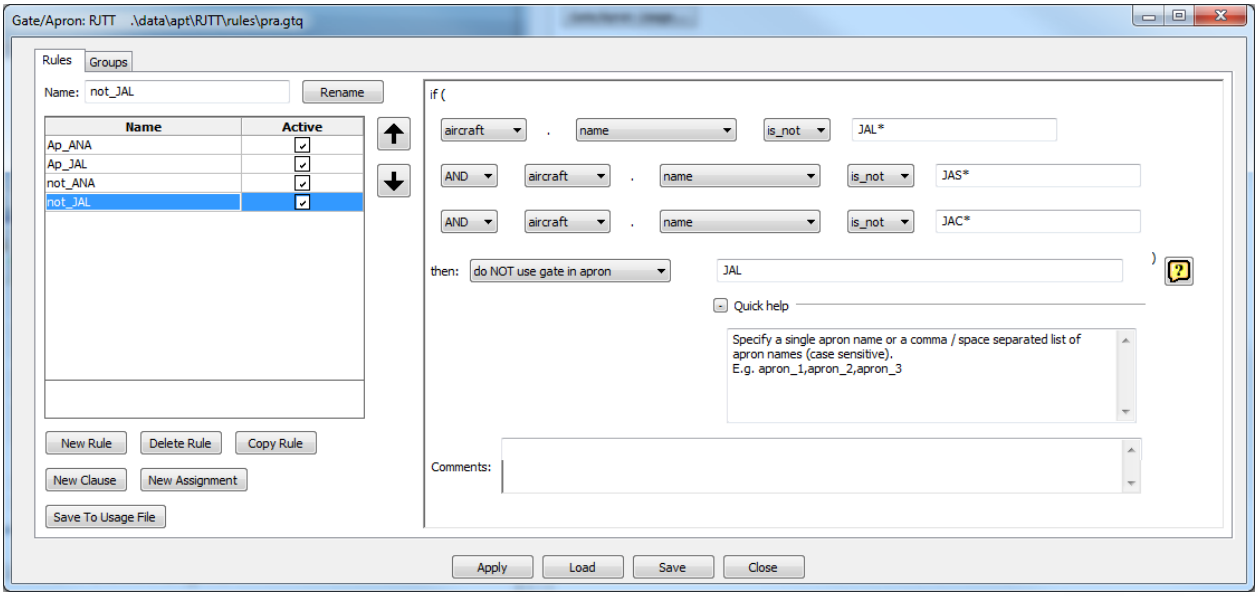


Figure 5 – The TAAM Rulebase Dialog

The simulation model also includes:

At an airport level

- Rulebases for Runway, Taxiway, Gate/Apron, SID/STAR, Departure/Arrival Separation, Pushback, Consequential Delay, and LAHSO.
- Users may set towing, weather, deicing, taxiing, remote parking, ground metering, and many other parameters
- Maintenance activity may be simulated on specified airframes at specified times

In the airspace

- Global aircraft separation and global rules may be applied
- Specific areas of airspace may be set up to operate in distinctly different ways, utilizing features such as 'Flow Management' for the simulation of en route congestion or FLAS to allocate different flight levels available in unique sectors. These features may also be used to set up traffic metering in line with established or potential letters of agreement.
- Separation parameters may be set, allowing the user to collect conflicts based upon the volume of airspace and specific aircraft equipage

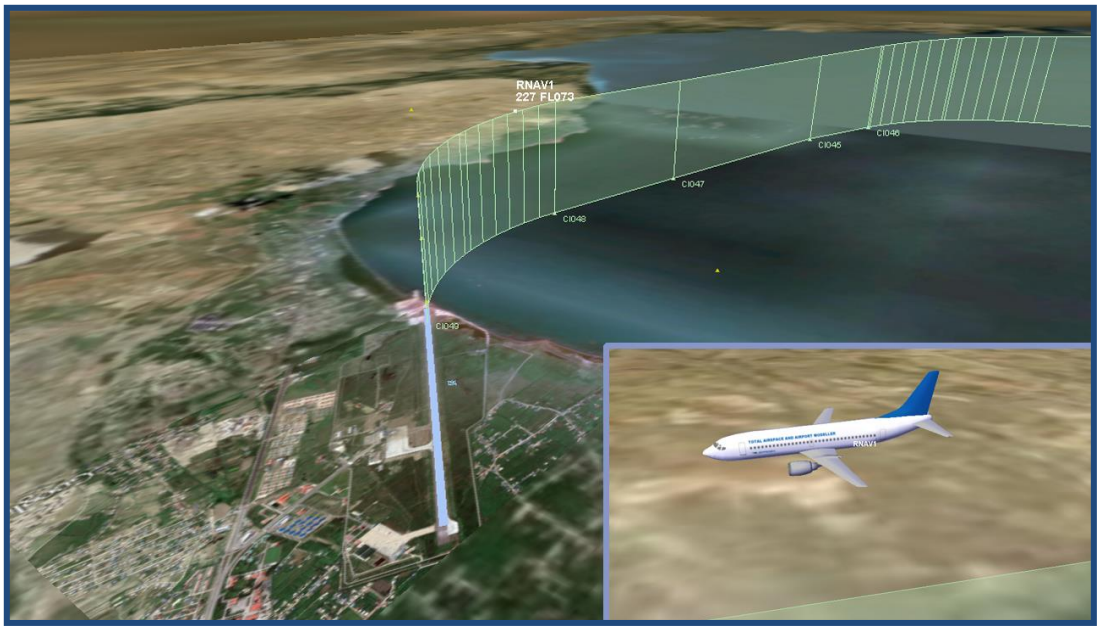


Figure 6 TAAM Aircraft following a real-world STAR

Reading simulation data set up in TIE, SIM is used to debug simulations and set up additional parameters in order to generate iterations for statistical analysis. Through the graphic user interface the user can specify all the simulation run settings and controls, including:

- The fidelity and simulation run-time, by selecting the time step and speed.
- Complete simulation control – start/stop/restart/snapshots.
- Display rulebase to customise the graphical presentation of the simulation (display or exclude aircraft based upon certain characteristics, change aircraft colour, etc.)
- Rulebases for airport and airspace specific behaviours

Post-Processing Suite

TAAM Reporter

Used to extract data from the simulation, the TAAM Reporter provides powerful analysis and reporting functionality through a mySQL database. TAAM reporter provides a wide range of predefined reports, graphs, and queries to fast-track the user's analysis. TAAM Reporter also provides users the flexibility to add their own customised reports, assisted by a query wizard. Reports can be output to paper, images for inclusion in documents, or formatted data for third-party software such as Microsoft Excel.

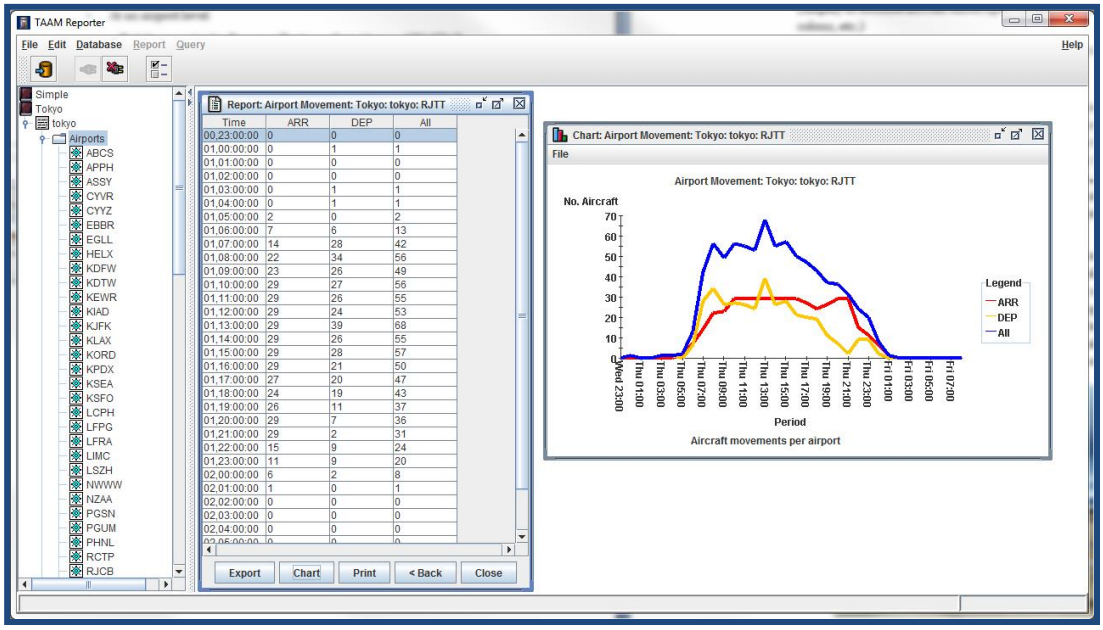


Figure 7 TAAM Reporter

TAAM Viewer

Free flowing 3D playback of the simulation data is provided by this high performance, OpenGL visualisation tool. The viewer runs at up to 1000 times faster than real-time, using compelling 3D graphics. It can load texture maps or images such as aerial photographs and 'draw' metrics generated by the TAAM Reporter such as taxiway delay or runway occupancy times. The TAAM Viewer provides a compelling visualisation method especially when presenting to people without ATC domain knowledge.

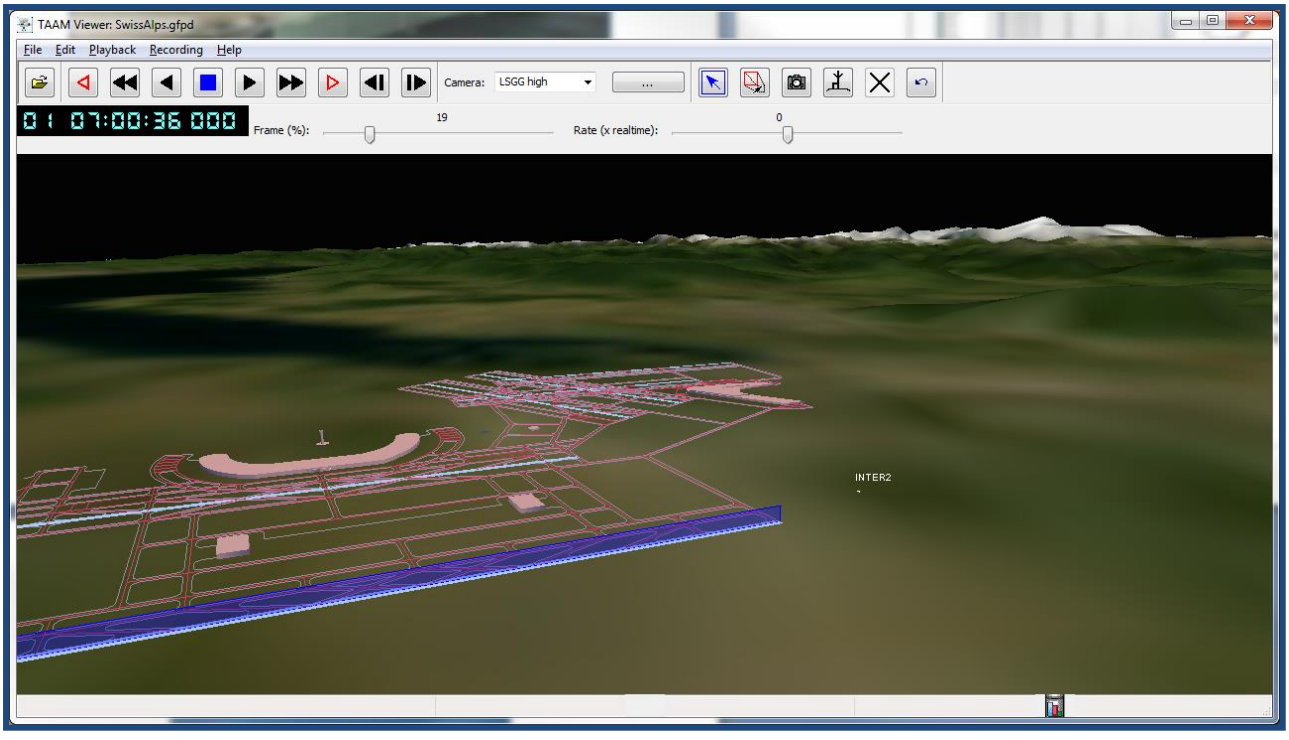


Figure 8 TAAM Viewer using 3D terrain and graphical usage reporting

The TAAM viewer also allows for demonstration of the model to stakeholders without a TAAM license. By utilizing the *TAAM Viewer Lite,* users may create a distributable recording of the simulation that may be played back on any suitably equipped computer just as in the full version of the viewer, including the ability to manipulate 3D viewing angles and magnification. Viewer Lite packages may be sent via file transfer or storage media to any interested parties.

Simulations may also be record as AVI (Audio-Video Interleave) files, a Microsoft video format, which can be sent as an attachment to emails or included in presentations. These options provide a powerful way for enabling stakeholders to view simulations for validation or acceptance.

Gate-to-Gate Simulation

TAAM is a gate-to-gate simulation tool, allowing for simulation at multiple levels of detail.

As a gate-to-gate tool, TAAM may be used to show aircraft departing from an airport (including pushback, taxi, takeoff roll and SID), transiting airspace (utilizing appropriate climb rates, flight levels, speeds, and separation criteria), and landing at a destination airport (including STAR, landing, taxi, and arrival at gate). Utilizing flight linking and TAAM tail routing, the same airframe may be shown to move from airport to airport throughout an entire airspace system.

For users interested in more localized studies, any portion of the above mentioned stages of flight may be simulated as an individual project based upon user setup. Individual airports may also be modelled as complete entities with taxiing and gate usage, as runways only, or as simple point locations to originate or terminate aircraft.

Figure 9 – TAAM screen shots depicting aircraft at various stages

Top left – aircraft taxiing and awaiting takeoff clearance.

Top Right – Aircraft in the enroute phase

Bottom Left – Aircraft landing

Rapid Project Setup with Jeppesen's Comprehensive Worldwide Aviation Database

When creating a simulation, one of the most difficult tasks is collection of data. TAAM provides the user with everything needed to set up a simulation environment suitable for processing aircraft. Jeppesen is in a unique position as the distributor of one of the most comprehensive aviation databases in the world. Within the TAAM product, users are given access to the most recent compilation of aviation data available from the Jeppesen database, allowing for rapid project setup. With just a few clicks, users can create a complete environment by importing airport locations, runway layouts, airspace boundaries, navaids, SIDs, STARs, and airways.

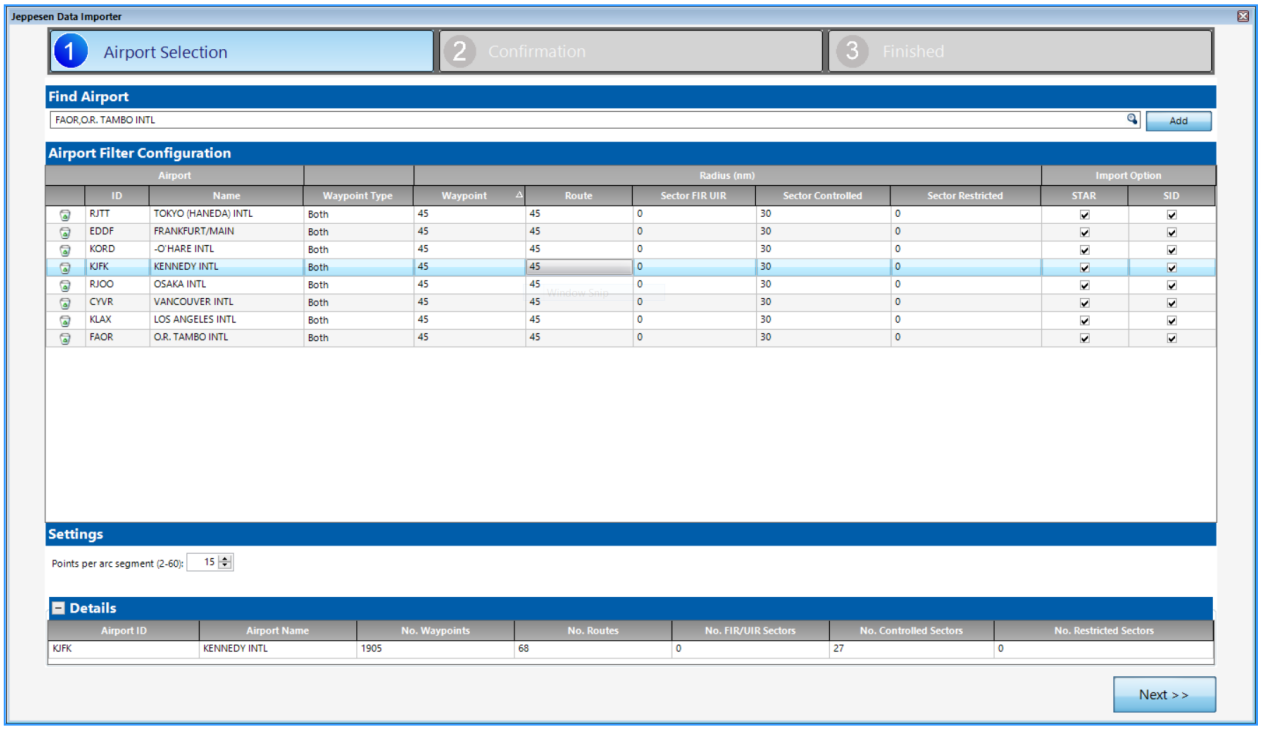


Figure 10 – Import information from Jeppesen's Worldwide Database

Jeppesen's Commitment to TAAM and Our Customers

TAAM is a mature simulation tool with its origins and original release in 1992. The software has been continuously upgraded and enhanced on a regular basis ever since its inception. Jeppesen maintains a full-time, ISO-certified software development team responsible only for the maintenance, enhancement, and upgrade of the TAAM product.

New TAAM releases occur on a quarterly basis each year. Subscribers to our annual software rental licensing programme have access to each new release, as well as TAAM software support personnel.

Customer Testimonials

"TAAM is the only tool that allows us to examine the overall system impact holistically; from gate, to surface through terminal and en route airspace when evaluating new technologies."

– Michael Yablonski, ATC Simulation and Modeling Manager, Noblis Inc.

"NAV CANADA uses TAAM extensively for our business case analyses and as a decision support tool when assessing options in collaboration with our customers. It is an excellent tool to evaluate the direct impact of changes to many aspects of our business."

– Rudy Kellar, Executive Vice President, Service Delivery, NAV CANADA

"Our Experience with TAAM has been amazing. We have been able to collaborate with our authorities in high-impact projects and influence their decisions with high-level technical data. Parallel to that, at an internal level inside the airline, we have been able to make our planning department take into consideration operational concerns for the first time. TAAM has helped us to identify potential cost savings totaling several million dollars."

– Cesar Oglivie, Operational Efficiency Manager, Copa Airlines

For more information on TAAM or to arrange a product demonstration, please contact sales.gma@jeppesen.com

TAAM Hardware Requirements		
	Minimum Requirement	**Recommended**
Operating System	Windows 7 64 Bit	Windows 10 64 Bit
Processor	Intel® Core™ 2 Duo 6600	Fastest x86 processor available
Memory (RAM)	3 GB	12 GB
Hard Disk	80 GB	500 GB
Graphics Card	ATI Radeon X1300PRO, or equivalent	Nvidia GeForce GTX 680MX (Notebook) Nvidia GeForce GTX 690 (Desktop) Or equivalent graphics cards
Screen Resolution	1280 x 1024	1920 x 1080