

# Aviation Environmental Design Tool (AEDT)

## OVERVIEW

Presented to: TRB AEDT/APMT Workshop #4

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Federal Aviation  
Administration

## AEDT Development Team

Co-Managed by Lourdes Maurice and Gregg Fleming



**ATACA**



# Outline

- **Statement of needs and motivation**
  - ICAO/CAEP and JPDO
  - TRB Guidance
  - User community
- **AEDT Version 1.0 – Current State**
  - Databases
  - Modules
  - Other
- **Capability Demonstration**
- **Schedule**
- **Next steps and summary**



## Motivation: ICAO/CAEP and JPDO

- **Upon completion AEDT is designed to interface with EDS and APMT to provide users with the necessary information for future aircraft so as to:**
  - Enable more informed Federal research, policy and budgetary decision-making (JPDO, FAA, NASA, EPA, Industry)
  - More effectively assess and communicate environmental effects, interrelationships, and economic consequences based on integrated analyses (JPDO, FAA, ICAO-CAEP, Industry)
  - Facilitate international agreements on standards, recommended practices, and mitigation options for international policy making (ICAO-CAEP, FAA, Industry)
  - Serve as a mechanism for an expert-driven process for collecting, incorporating and quantifying long-term technology impact assessments (JPDO, FAA, NASA, ICAO-CAEP, Industry)



## TRB November 2004

✓ = good progress ✓ = limited progress

Vision and Objectives for AEDT	Status	Notes
1. The AEDT should provide <b>clear benefits</b> to the current users of existing analytical tools and should be designed so that these users can <b>easily access it</b> . When developed, the AEDT should be able to serve <b>multiple users</b> .	✓	1,000's of local installations; global web-based interface
2. It is important to assure <b>international acceptance</b> of the AEDT and to make the tool consistent with <b>international databases</b> .	✓	ICAO model and database work ongoing; engagement with SAE groups
3. Existing tools such as Integrated Noise Model (INM) and Emissions & Dispersion Modeling System (EDMS) should be <b>upgraded</b> as the AEDT is developed.	✓	INM Versions 6.2, 6.2a & 7.0; EDMS Version 4.3, 4.4, 4.5, 5.0



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Vision and Objectives for AEDT	Status	Notes
4. The AEDT should be <b>open, available,</b> and <b>transparent</b> in concept and execution; in addition, original versions of certain models should be retained and be accessible for call up if needed.	✓	Versioned controlled modules and databases
5. The AEDT should have flexibility to <b>adapt</b> to and <b>accept future modifications</b> , be able to respond to changing future needs, and be able to access <b>future technologies</b> and new functionalities. It should also be <b>modular</b> and <b>flexible</b> , to allow users to incorporate <b>other tools</b> .	✓	Modularization enables this, e.g., multiple emissions methodologies currently being coded
6. The AEDT should have <b>interactive capability</b> between noise and emissions, and it should have <b>modularity</b> to accommodate various components of these two attributes.	✓	See #5 above
7. The AEDT should be developed through use of an <b>integrated database management system</b> .	✓	Common Database Access Module being developed



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Vision and Objectives for AEDT	Status	Notes
8. The first version of the AEDT (“alpha version”) should be <b><u>PC based</u></b> .	✓	AEDT-Local – public; AEDT-Global – limited access via web.
9. The information incorporated within the AEDT should be <b><u>consistent across all models</u></b> that are developed for similar or closely related purposes.	✓	Achieved through harmonization
10. The AEDT should be able to <b><u>manage uncertainties</u></b> within its modeling capacity.	✓	In cooperation with SAE groups
11. The AEDT should have a <b><u>predictive capability</u></b> as part of its functionality.	✓	FOM applies FESG and other forecasts; EDS will define future technology



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Vision and Objectives for AEDT	Status	Notes
12. The AEDT inputs must be <b><u>nonproprietary</u></b> .	✓	Use agreement with EUROCONTROL on BADA
13. The AEDT should be able to accommodate additional and <b><u>newer aircraft types</u></b> , such as <b><u>helicopters</u></b> and <b><u>general aviation</u></b> and various <b><u>military</u></b> aircraft. It should also have the capability to include significant variations within existing fleets of aircraft.	✓	Integration with EDS
14. The AEDT should be able to accommodate additional emissions species and fates that have not been subject to analysis in the past.	✓	Modularity enables this (e.g., FOA, HAPs)



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Vision and Objectives for AEDT	Status	Notes
15. The AEDT should be able to accommodate weather factors within its analyses—especially analyses that consider dispersion of emissions.	✓	Comprehensive weather database in AEDT
16. <b>Certification standards</b> should be available to evaluate AEDT performance.	✓	Working closely with SAE groups
17. The AEDT should have built-in <b>validation functions</b> , and tools that are subsets of the AEDT should be validated before they are incorporated.	✓	Working closely with SAE groups



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Next Steps in AEDT Development	Status	Notes
1. The AEDT should be developed with <b>active stakeholder involvement</b> ; the following steps would be useful to assure that goal: a. Conduct periodic surveys of the user community. b. Create partnerships with the relevant international community. c. Establish steering groups with diverse viewpoints and expertise to help guide major decisions.	✓	AEDT Local DRG, EDS TAB; ICAO CAEP WG2
2. The AEDT development process should include a validation plan that involves input from a variety of stakeholders.	✓	Working with SAE groups
3. The development process should include a plan to assure a smooth transition from existing models to the AEDT.	✓	INM and EDMS releases harmonized; AEDT Local DRG



# TRB November 2004

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Next Steps in AEDT Development	Status	Notes
5. The development process should <b>set priorities</b> for emissions requirements and noise requirements.	✓	Working with SAE groups, DRG, EDS TAB
6. The AEDT should incorporate <b>best practice tools</b> as part of the development process.	✓	See #5 above
7. The AEDT development plan should include <b>realistic schedules</b> , accurate definitions of level of effort, go/no-go decision points, and parallel efforts for some aspects of the process.	✓	INM and EDMS releases harmonized; detailed MS Project schedules; milestones tied to ICAO CAEP



# TRB April 2005

✓ = good progress    ✓ = limited progress

AEDT Priorities, Schedule & Budget	Status	Notes
The committee recommends that FAA <b>develop a more rigorous process for determining the required budget for developing AEDT</b> measured against clearly stated priorities within the development process. The committee is concerned that current budget allocations will not cover the plans outlined.	✓	Detailed, multi-year integrated budget and task planning process
There is also a need to <b>establish consensus-based priorities</b> for FAA's goals in accomplishing AEDT and APMT. <i>For example, harmonizing the global models (SAGE and MAGENTA) will require rewriting of at least one of the models (a very costly endeavor) because each is essentially monolithic. This harmonization effort could use most of the available resources, and, therefore, its priority within the total AEDT must be examined continually.</i>	✓	TRB process initiated this



## TRB April 2005

✓ = good progress ✓ = limited progress

AEDT Project Management	Status	Notes
The committee recommends that FAA establish a stronger project management program, including one <b>designated full-time project manager</b> to centralize communications and accountability.	✓	Volpe technical and project management lead
In addition, a more <b>detailed plan of work</b> over the next year is essential for better evaluation of FAA's process and approach.	✓	Work plan, architecture, module and database documents available
Budget estimates presented by FAA indicate that the total costs of maintaining all models will begin to decrease by the end of CY 2008, when models begin to operate on common data sources. Whether these <b>cost savings</b> will be achieved <b>must be continually evaluated</b> .	✓	"Efficiencies" in legacy models/ processes continually being realized



## TRB April 2005

✓ = good progress ✓ = limited progress

AEDT Project Management	Status	Notes
The committee also recommends that FAA indicate how it plans to <b>coordinate with</b> international and national nongovernmental organization ( <b>NGO</b> ) <b>stakeholders</b> .	✓	More prominent lead in ICAO CAEP and other groups
FAA should <b>initiate interaction with international stakeholders</b> , international and domestic governmental entities, NGOs and corporations, and U.S. air carriers.	✓	Same as previous
The committee recommends that future workshops <b>include</b> , especially during the APMT discussions, <b>more participants</b> from airlines and manufacturers <b>that have an economic stake in the outcome</b> .	✓	Dedicated workshop



# TRB Workshop Guidance

- In summary:

*AEDT development is following the guidance of the TRB study committee and workshop participants*



## AEDT Users

### **SAGE and MAGENTA**

- Used by FAA and FAA development team
- Support ICAO/CAEP and JPDO analyses
- Migrates to ***AEDT-Global***

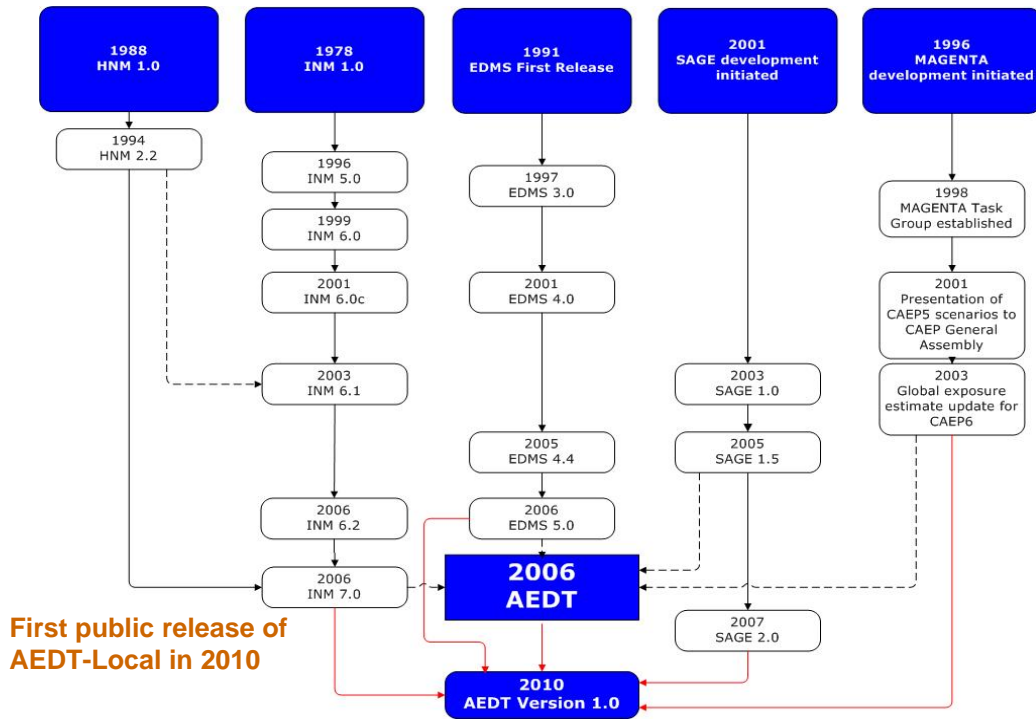
### **EDMS and INM**

- Used by over 1000 organizations worldwide
- Support various environmental analyses, e.g., EIS, Part 150s, etc.
- Migrates to ***AEDT-Local***

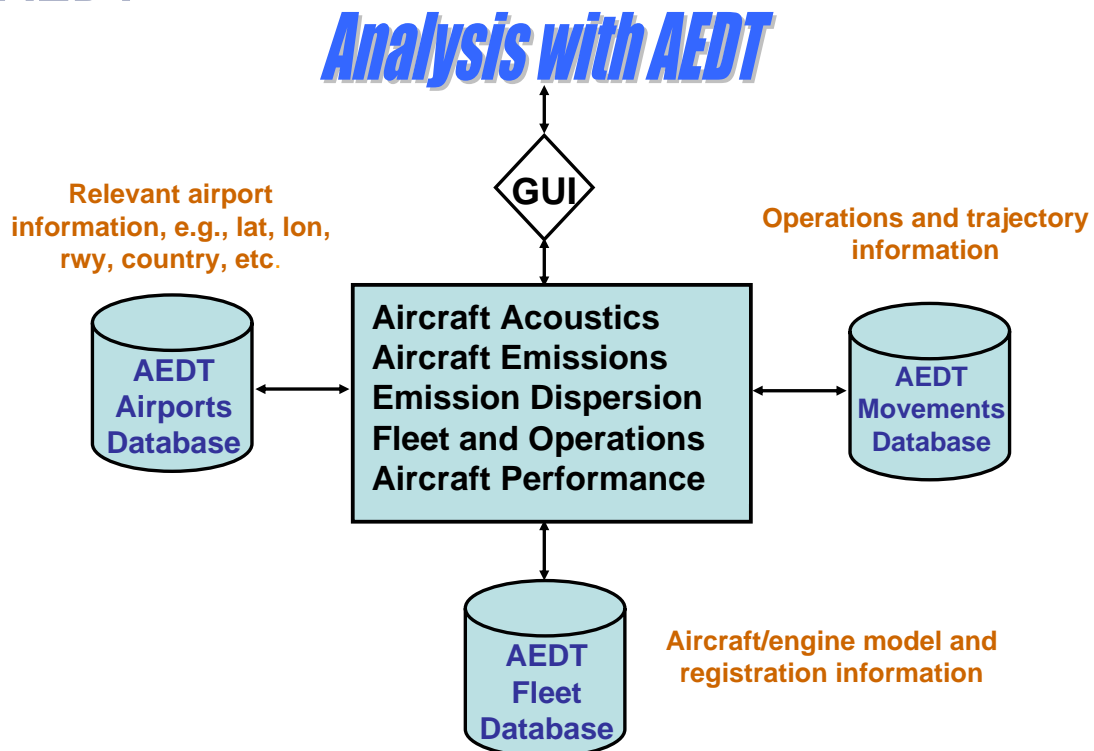




# Legacy Model Development Timelines



## AEDT



# Airport Database

Relevant airport information,  
e.g., latitude, longitude,  
runway, country, etc.

AEDT-Local: Provides  
basic airport template to  
support analysis

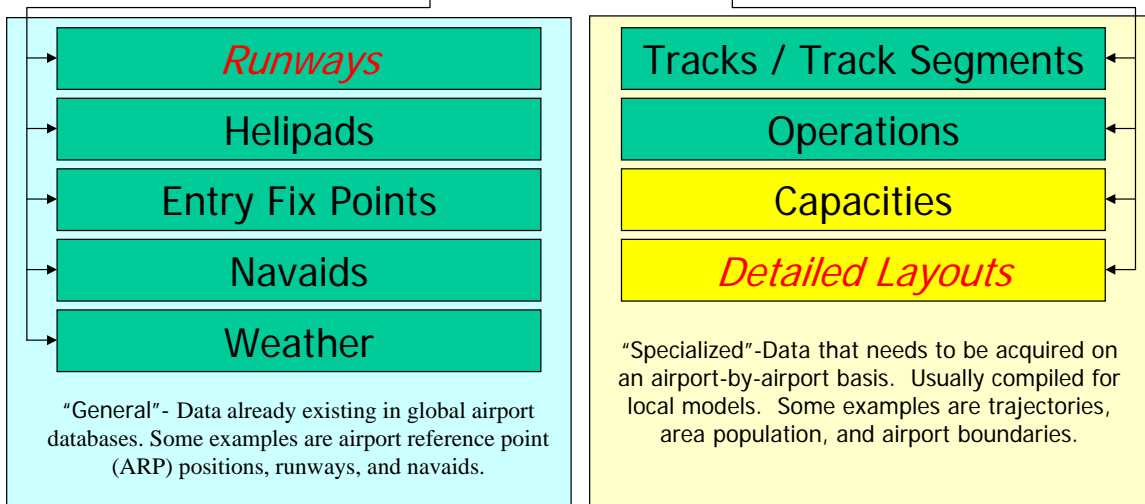


AEDT-Global: Provides  
“key” for attributing noise  
and emissions to airport,  
country, region, etc.

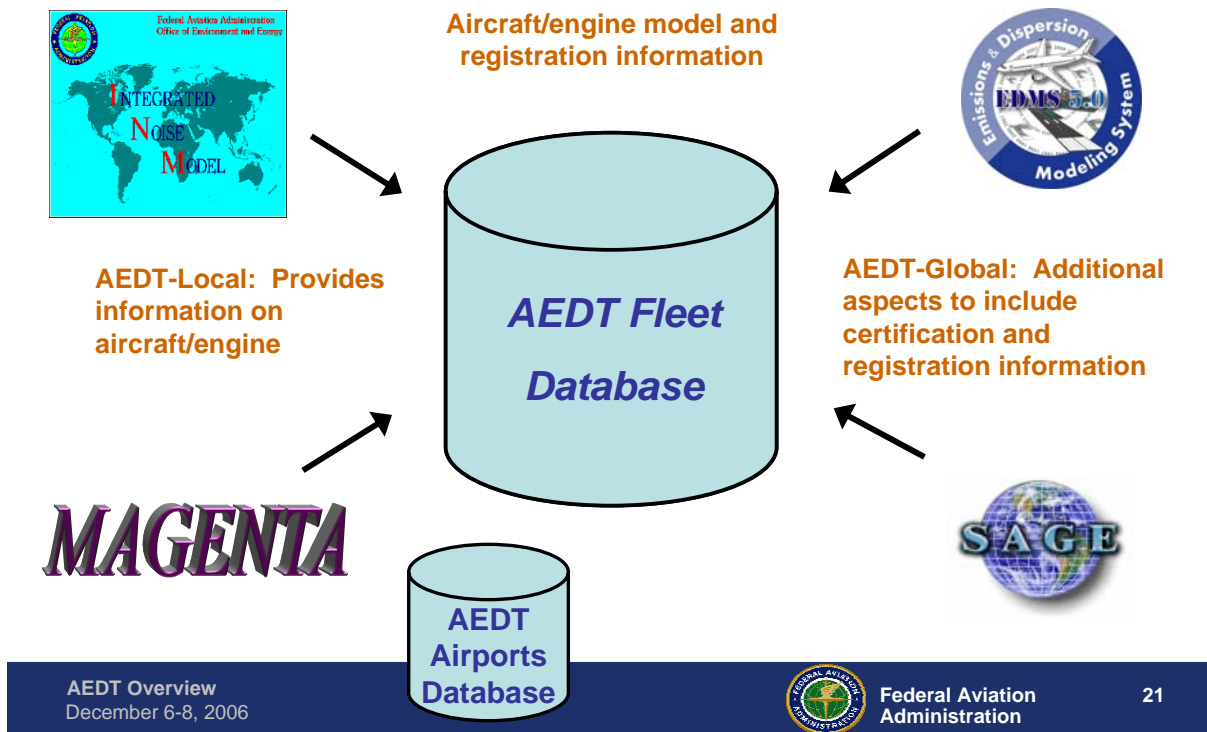


# Airports Database

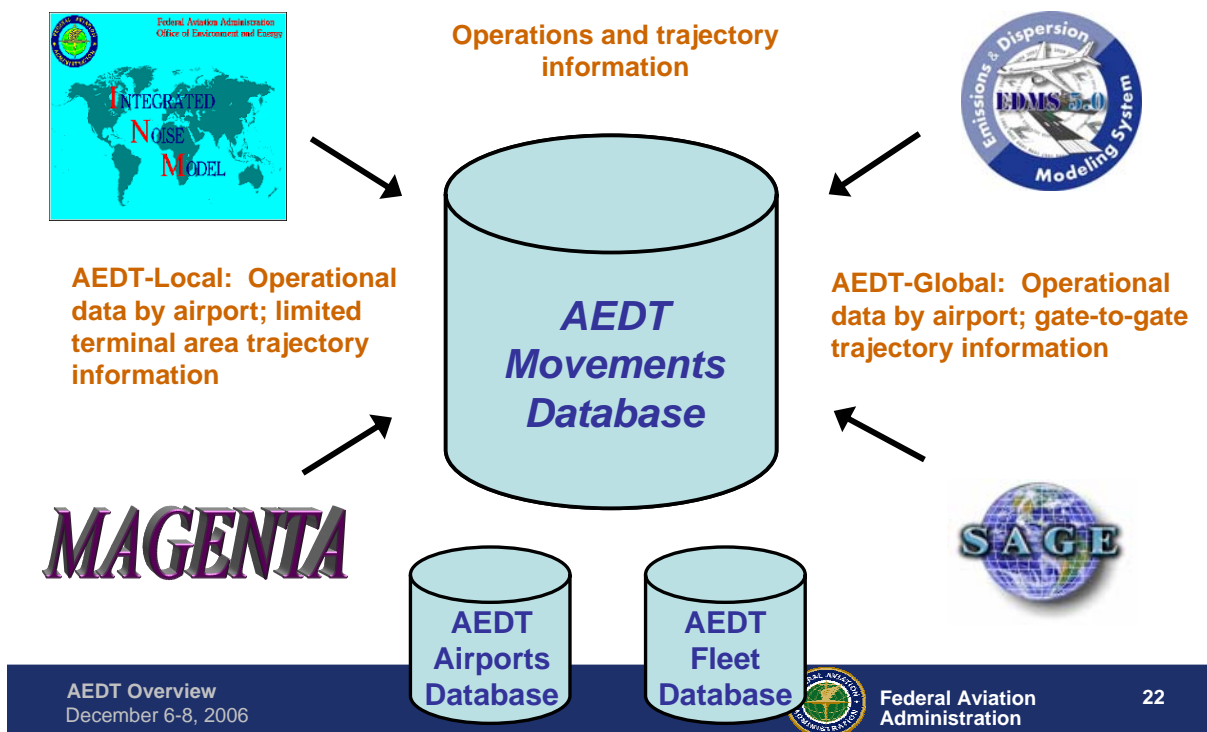
## Main Airports Database



# Fleet Database

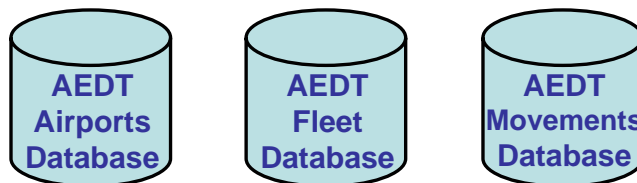


# Movements Database



## Project Status - Databases

- Redesigned database structure to support all legacy tools (i.e., INM, EDMS, MAGENTA, SAGE)
- Data harmonized across legacy tools
- Harmonization with available international sources ongoing
- Scaled-down version of global databases available to AEDT-Local tools



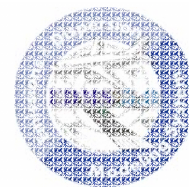
## Aircraft Acoustics Module



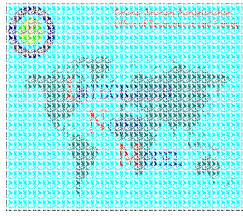
Acoustic computation in  
AEDT; compliant with  
international standards



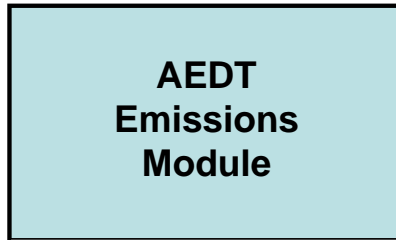
**MAGENTA**



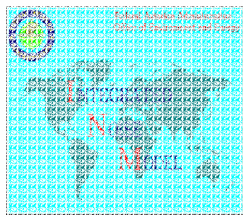
# Emissions Module



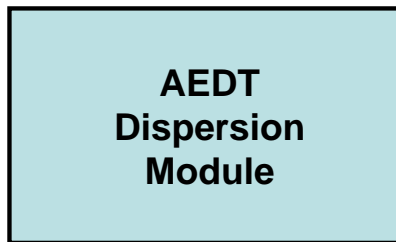
Emissions computation in AEDT; currently no applicable international standards



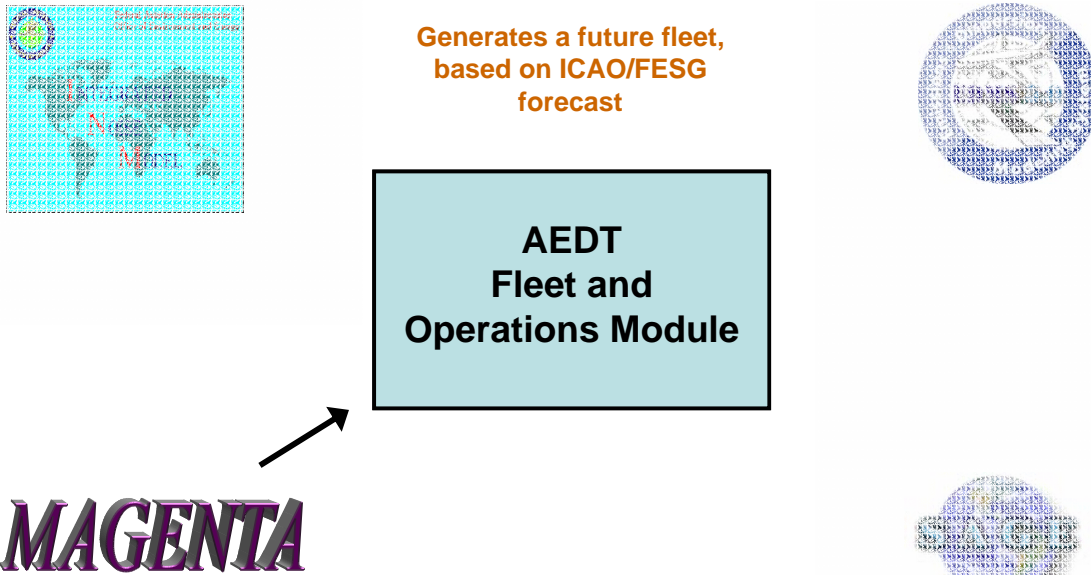
# Dispersion Module



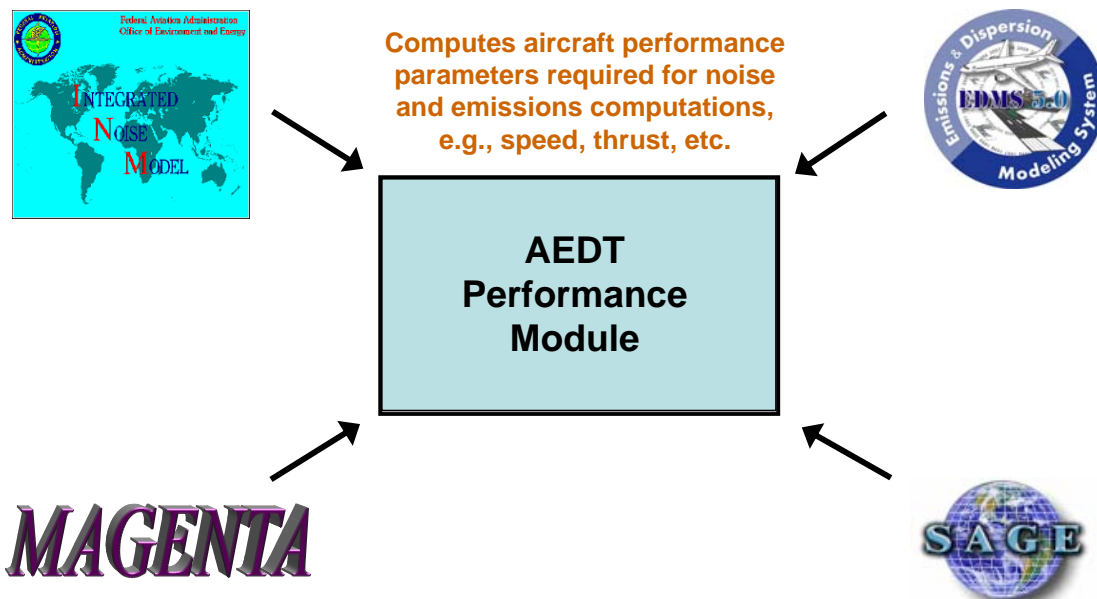
Emissions dispersion computation in AEDT; based on EPA's AERMOD



# Fleet and Operations Module

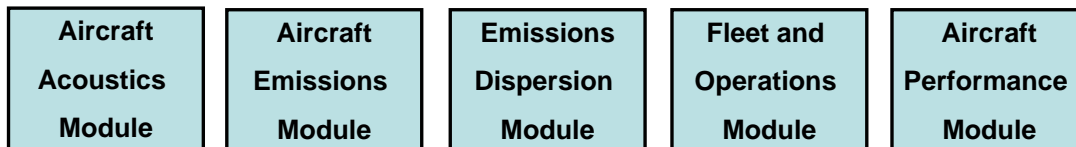


# Performance Module



## Project Status - Modules

- Redesigned computational modules, e.g., emissions (Boeing Fuel Flow Method 2), aircraft performance (including BADA fuel burn)
- Harmonized common modules across legacy tools
- Integrated common modules across legacy tools







## Initial AEDT Capability Demonstrations

- **AEDT Initial Capability Demonstrations:**
  - NO<sub>x</sub> Stringency
  - Continuous Descent Profile (CDA)
  - Reduced Vertical Separation Minimum (RVSM)
  - Goal Assessment (ICAO/CAEP)




***Analysis with AEDT***

## AEDT 2005/2006 Accomplishments

Standardized software and database documentation discipline (i.e., ICDs, etc.)	
Standardized software development environment, including architecture design tools (i.e., MS.NET, MS Visio)	
Software module exchange protocol (including source code)	
Annual global noise and emissions inventories (AEDT/SAGE and AEDT/MAGENTA)	





## AEDT 2005/2006 Accomplishments

Legacy model releases (INM 6.2, 6.2a, 7.0-BETA; EDMS 4.3, 4.4, 4.5, 5.0-BETA)	
Society of Automotive Engineers (SAE) Aerospace Information Report (AIR) 5662, <i>"Method for Predicting the Lateral Attenuation of Airplane Noise"</i>	
ICAO/CAEP Support (Goals Assessment, Model Evaluation, Database Harmonization, Circular 205 Update, Reduced Thrust Sample Problem)	





# Long-term Schedule

End of CY	CAEP Cycle	AEDT Deliverable
✓ 2004	<del>End CAEP/6</del> CAEP/7	AEDT Work Plan Completed and Development Effort Initiated
✓ 2005		EDS (v 0.0) and Breadboard AEDT (v 0.0)
✓ 2006		AEDT Version 1.0 for CAEP/7 Introduction <i>Not a seamless model</i>
ON TRACK 2007	CAEP/8	AEDT Version 1.1 <i>First generation assessment of air toxics and PM</i>
2008		AEDT Version 1.2 for CAEP/8 Application <i>Fully validated; May not be a seamless model</i>
2010	CAEP/9	AEDT Version 2.0 for Airport Planning Application <i>Meets criteria for seamless and publicly available</i>



## Next Steps

- **AEDT**
  - JPDO analysis support
  - Database harmonization process (primarily ICAO/CAEP-centric)
- **AEDT-Global**
  - ICAO/CAEP model evaluation and acceptance process, sample problems and analyses
  - Web-based query tool migrating to full application (limited availability)
- **AEDT-Local**
  - INM 7 and EDMS 5 release
  - Integrated local graphical user interface (GUI); developed and coordinated with an integrated design review group (public availability)



# Summary

- **From November 2004 to December 2006 we have harmonized the legacy databases and modules of AEDT based on a set of requirements and overall model architecture and work plan**
  - Fully-consistent with prior TRB workshop recommendations
- **We have exercised the tool suite for a series of significant sample problems as well as “real” analyses**
- **We will be pleased to share much more with you**
- **We welcome your input and engagement**



## ??? Questions ???

FAA Environmental Tools web site:

[http://www.faa.gov/about/office\\_org/headquarters\\_offices/aep/models/](http://www.faa.gov/about/office_org/headquarters_offices/aep/models/)

