MEFISTO

Modeling of Environmental Factors in Surface/Terminal Traffic Optimization

New Project – October 2007

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NRA Topic AP-1: Modeling of Environmental Constraints in Surface Traffic Optimization

METRON AVIATION

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Motivation

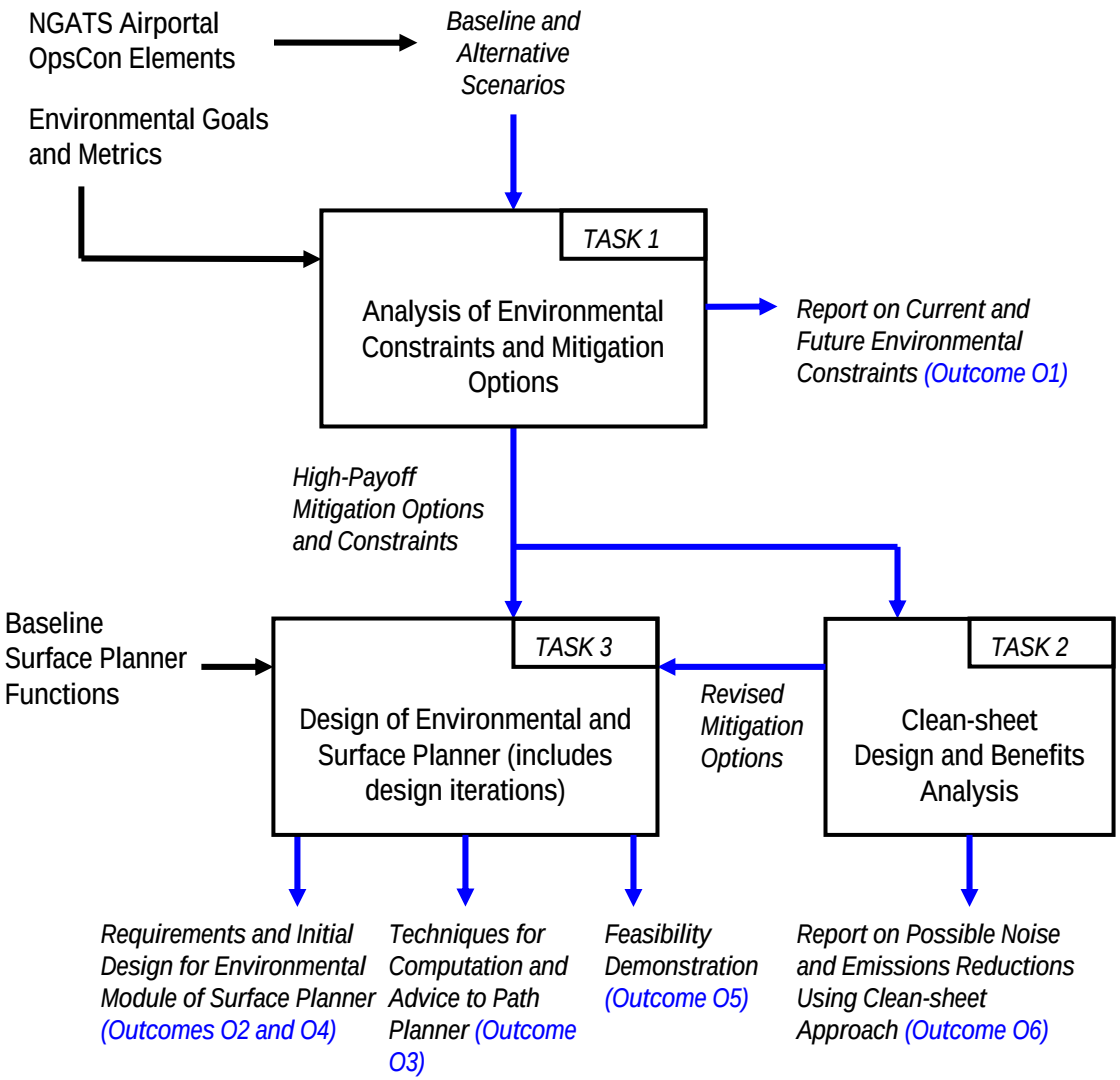
- **Significant increases in capacity sought for NextGen.**

- **Environmental constraints likely to increase with regard to noise, fuel efficiency, and local/regional air quality.**

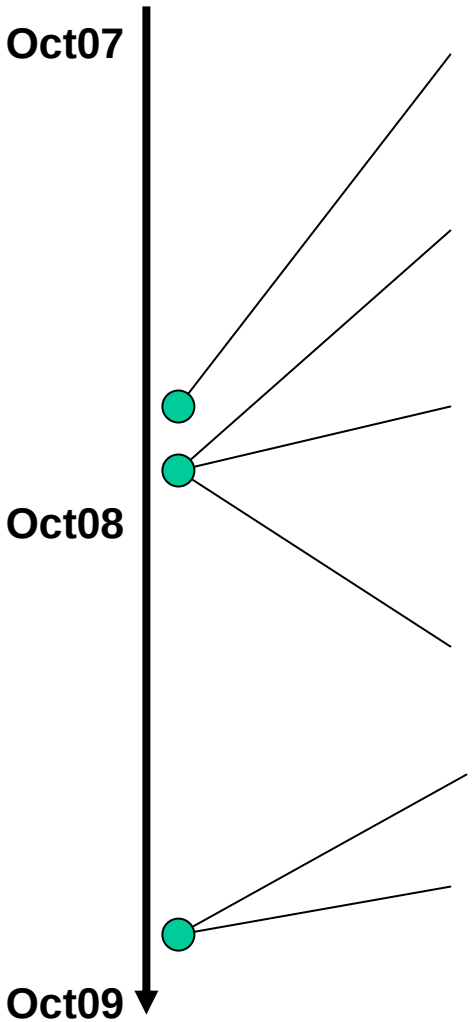
- **Optimization of surface/terminal operations will become multi-objective problem.**

- **How will environment be factored into surface/terminal planning?**

Overview


NGATS Airportal OpsCon Elements
Environmental Goals and Metrics
Baseline and Alternative Scenarios
TASK 1
Analysis of Environmental Constraints and Mitigation Options
Report on Current and Future Environmental Constraints (Outcome O1)
High-Payoff Mitigation Options and Constraints
Baseline Surface Planner Functions
TASK 3
Design of Environmental and Surface Planner (includes design iterations)
Revised Mitigation Options
TASK 2
Clean-sheet Design and Benefits Analysis
Requirements and Initial Design for Environmental Module of Surface Planner (Outcomes O2 and O4)
Techniques for Computation and Advice to Path Planner (Outcome O3)
Feasibility Demonstration (Outcome O5)
Report on Possible Noise and Emissions Reductions Using Clean-sheet Approach (Outcome O6)

Outcomes



O1. Report on characterization of environmental constraints in both current and future surface/terminal air traffic operations (FY2008)

O2. Develop concepts and requirements for environmental planner and interfaces with NASA surface simulation tools (FY2008)

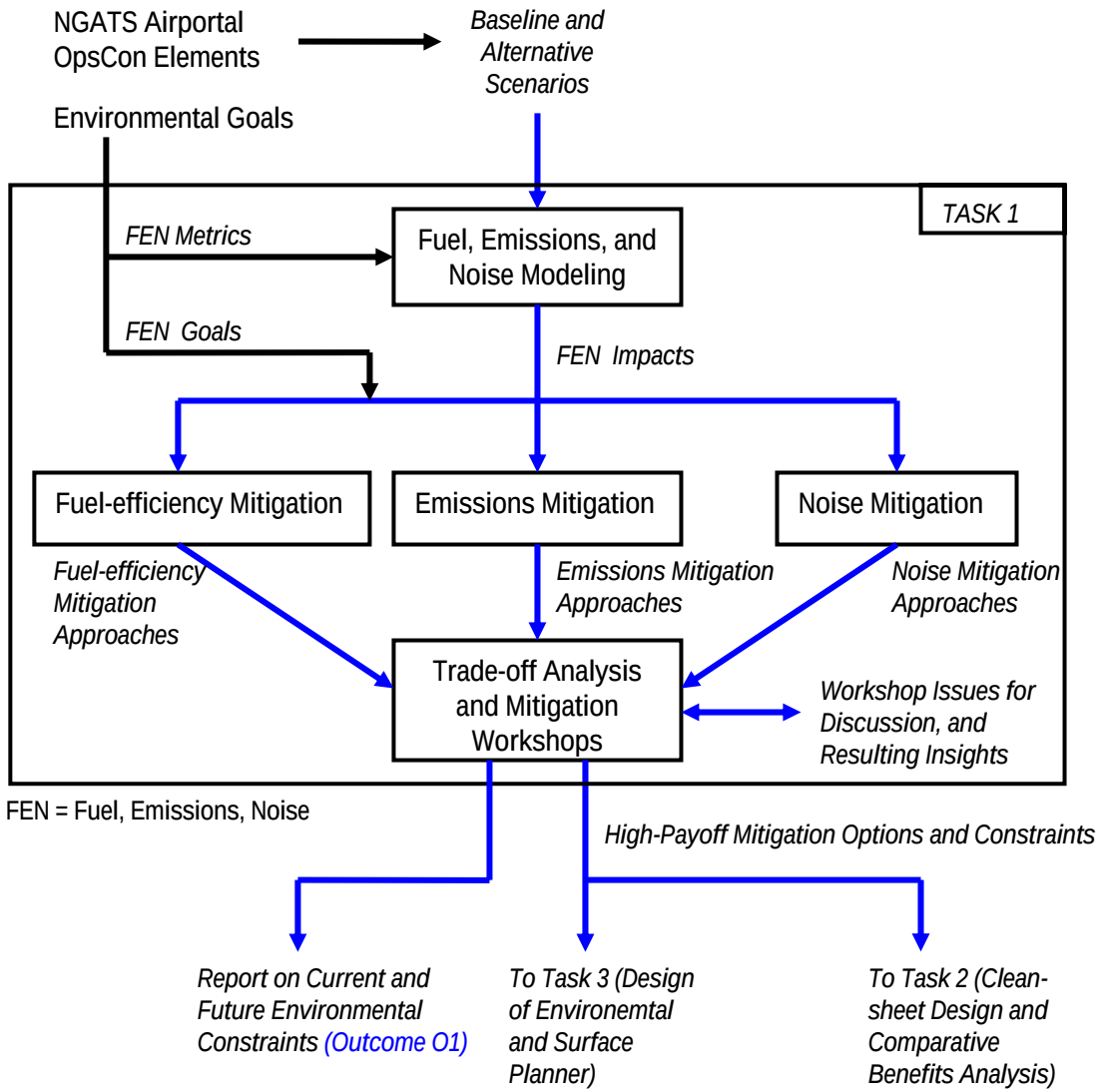
O3. Identify/develop techniques to analyze noise/emissions output in near real-time based on data from recent flights, and develop techniques to advise the surface path planner on individual (or ensemble) constraints to mitigate critical noise and emissions issues (FY2008)

O4. Develop software interface requirements between the environmental planner and the surface path planner (FY2008)

O5. Demonstrate feasibility of proposed solutions (FY2009)

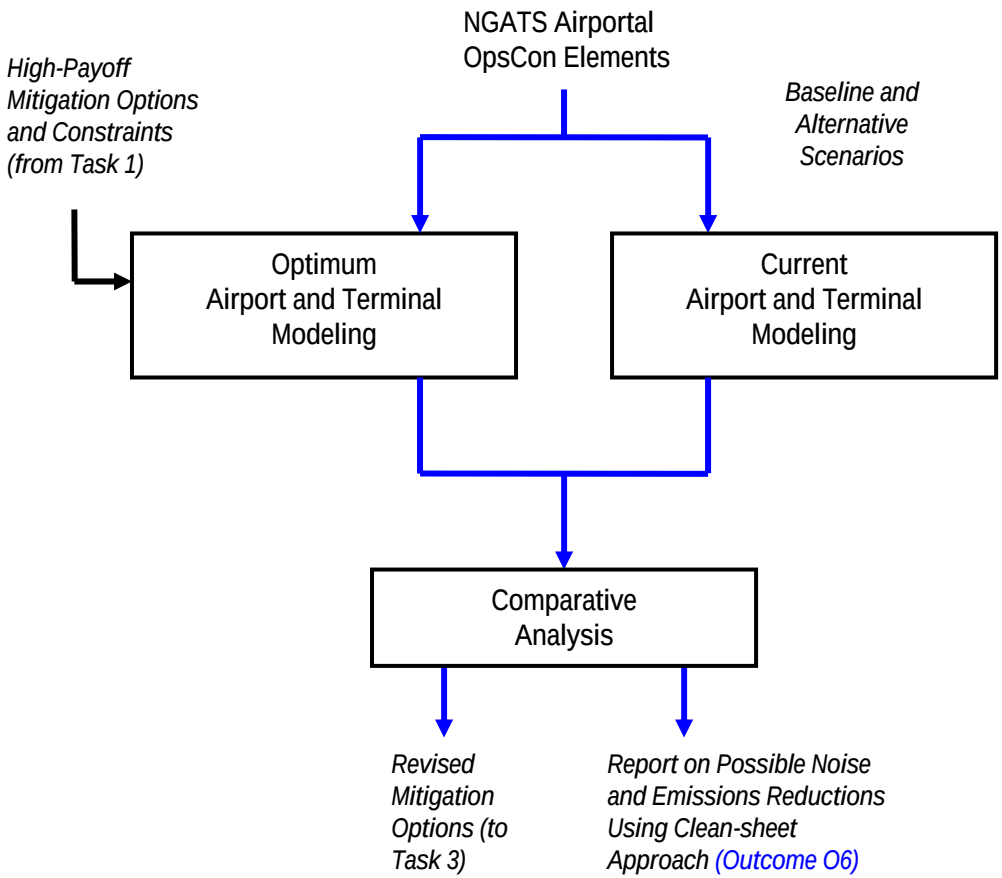
O6. Report on results of study to determine noise/emissions reductions possible for a given airport runway configuration using a clean-sheet-of-paper approach to taxiway and gate-area design, and unconventional operational or procedural concepts (FY2009)

Task 1 – Analysis of Environmental Constraints and Mitigation Options



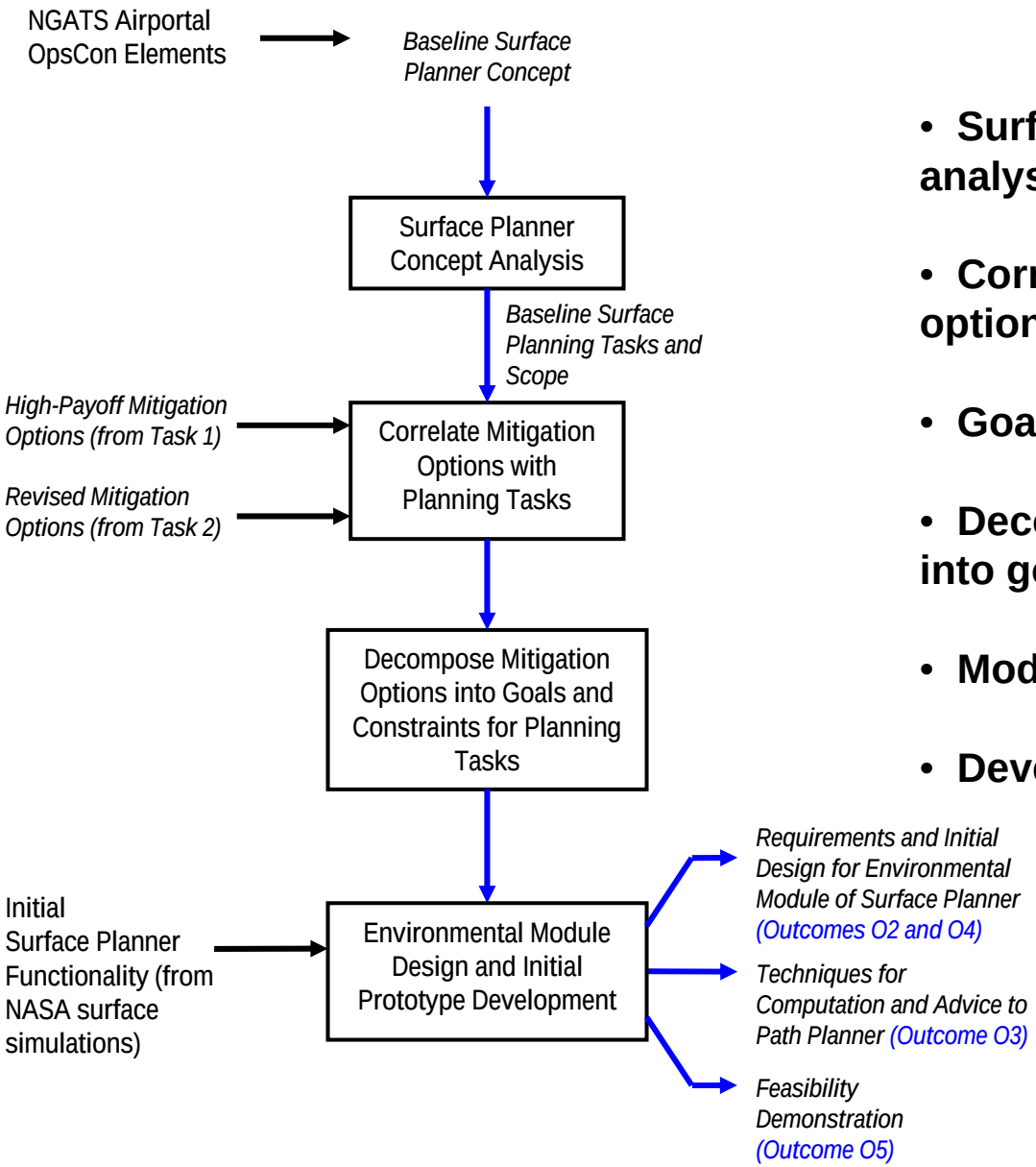
- **Literature review (supports all tasks)**
- **Scenario review and augmentation**
- **Goals and metrics review**
- **Fuel, emissions, and noise modeling**
- **Sensitivites and mitigation**
- **Tradeoff analysis**
- **Mitigation workshops**

Task 2 – Cleansheet Design and Benefits Analysis



- **Representative models of current airports**
- **Model of optimum terminal and airside layout**
- **Comparative analysis of optimum and actual airports**

Task 3 – Design of Environmental and Surface Planner



- **Surface planner concept analysis**
- **Correlation of mitigation options with planner tasks**
- **Goals and metrics review**
- **Decomposition of options into goals and constraints**
- **Module design**
- **Development of prototype**

Coordination with Other Projects

- **Current projects**

  - **Core NASA research on optimization (surface, terminal, …)**

  - **NRA AP-2: Surface Traffic Optimization in the Presence of Uncertainties (Clarke, GaTech)**

  - **NRA AP-2: Integrated Approaches for Surface Traffic Optimization in the Presence of Uncertainties (Wei, San Jose State)**

  - **NRA AP-3: Integrated Analysis of Airportal Capacity and Environmental Constraints (LMI, Metron)**

  - **NRA AS-20: Metroplex Design (3 teams)**

  - **JPDO System Modeling and Analysis**

  - **Others TBD**

- **Upcoming projects**

  - **ATCSCC mitigation analysis**
  - **Others TBD**

Surface Optimization Research Project (AP-2)

Purpose:

1) analyze and baseline today's surface operations;
2) develop a system architecture of optimization processes based on assumptions made for future surface operations;
3) formulate optimization problems; and
4) evaluate the feasibility and performance of proposed solutions.

Scope:

Airport configuration planning, departure scheduling, and taxi-route planning are some examples.

Robust against uncertainties: pushback time, pilot conformance to 4D taxi clearances, aircraft performance, surveillance data, estimated arrival time, and runway exit time.

Major hub airport surface should be modeled for current-and future demand schedule data.

Assess sensitivity of outputs to choice of objective function (e.g., throughput, delays, variance from desired airline schedules).

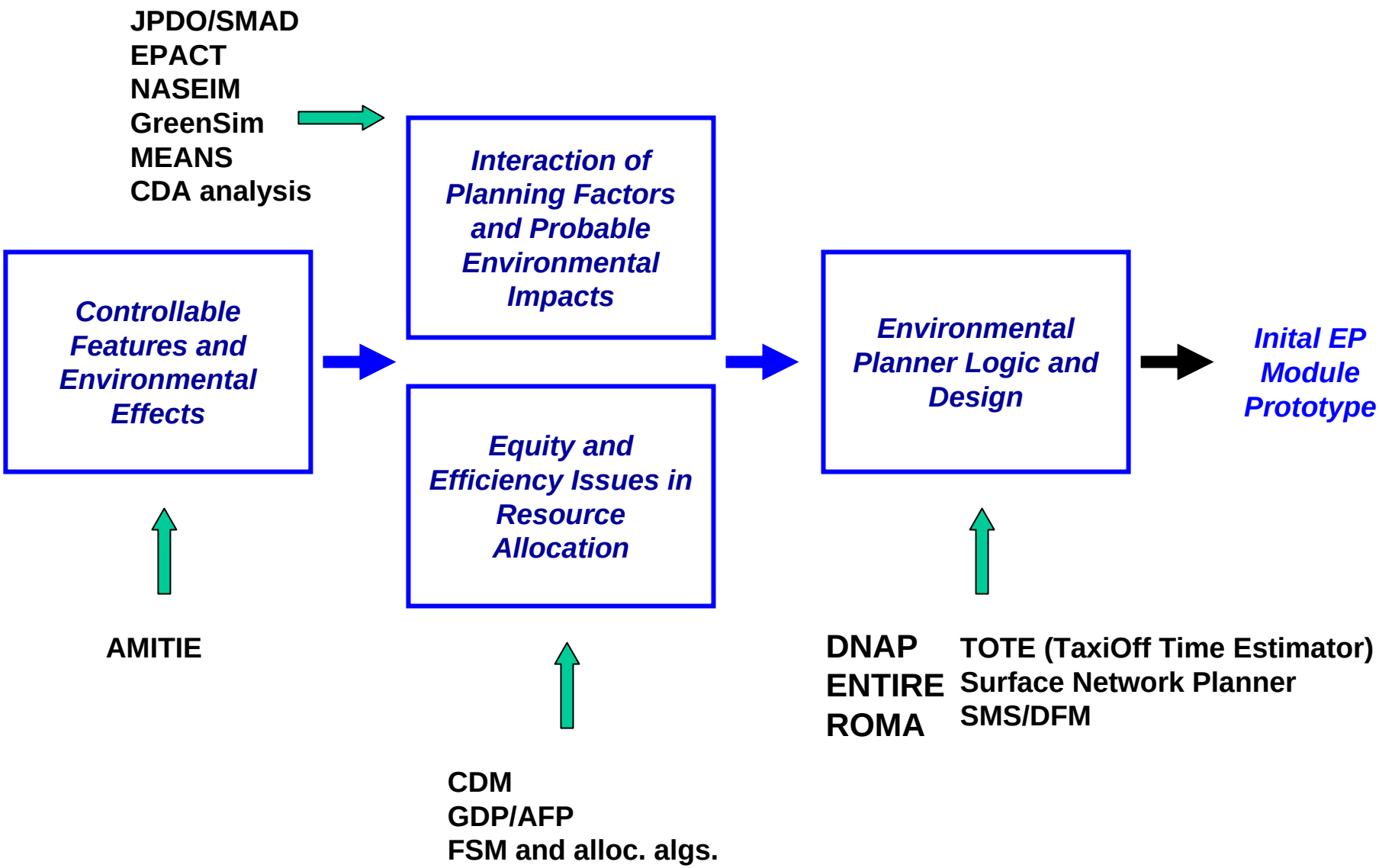
Candidate Airport Partners

- **Port Authority of New York and New Jersey (LGA, JFK, EWR)**
- **Metropolitan Washington Airport Authority (IAD, DCA)**
- **San Francisco (SFO)**
- **Others?**

European Perspectives

- **Zurich (e.g., A-CDM, ZEUS)**
- **Frankfurt**
- **London Heathrow**
- **Amsterdam Schiphol (e.g., DHL EMS)**
- **Eurocontrol**
- **DLR**

Envisioned Technology Evolution



Key Scoping Questions

- **What is the domain of action of the surface path planner (SPP)?**
- **What are the objectives of the SPP? What are supporting objective functions?**
- **What are highest-payoff options for the SPP, from an operational point of view?**
- **What is the role of the environmental planner (EP) vis-a-vis the SPP?**
- **Others TBD**

Workshop One (~February 2008)

- **Environmental mitigation/control in the context of optimization of surface/terminal operations.**

- **Identify key R&D issues, constraints, priorities...**

- **Draft agenda:**

  - **Surface optimization scope, assumptions, and techniques**
  - **Environmental metrics and goals**
  - **Environmental trade-offs: noise, emissions, fuel**
  - **Linkages and trade-offs between operational and environmental goals**
  - **Concepts for functional architecture**