

NASA V&V

V&V for Enterprise Architecture

NASA's Airspace Operations and Safety Program

Airspace Operations and Safety Program



- Develops and explores fundamental concepts, algorithms, and technologies to increase throughput and efficiency of the National Airspace System safely

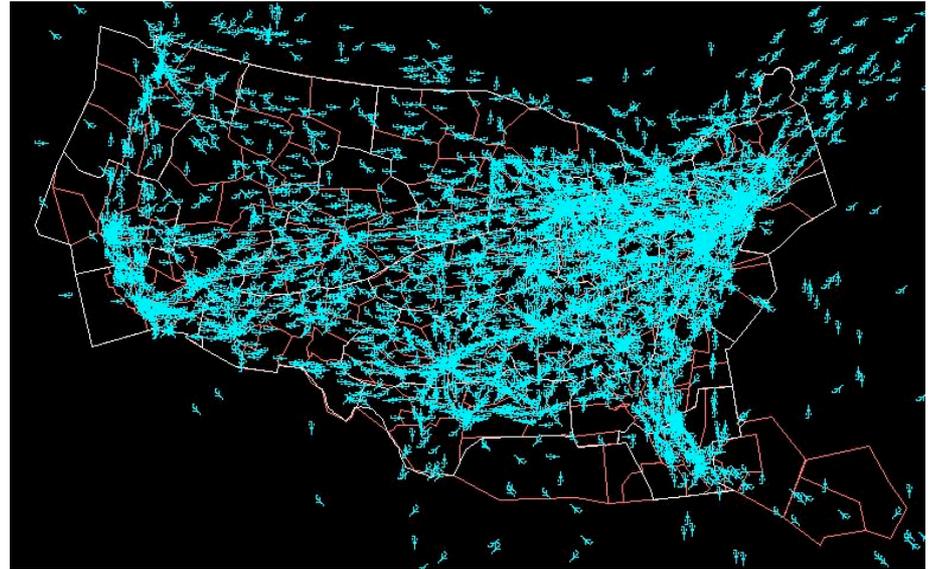
- Provides knowledge, concepts, and methods to the aviation community

Projects

- Airspace Technology Demonstrations (ATD)
- SMART NAS for Safe Trajectory-Based Operations
- Safe Autonomous System Operations (SASO)

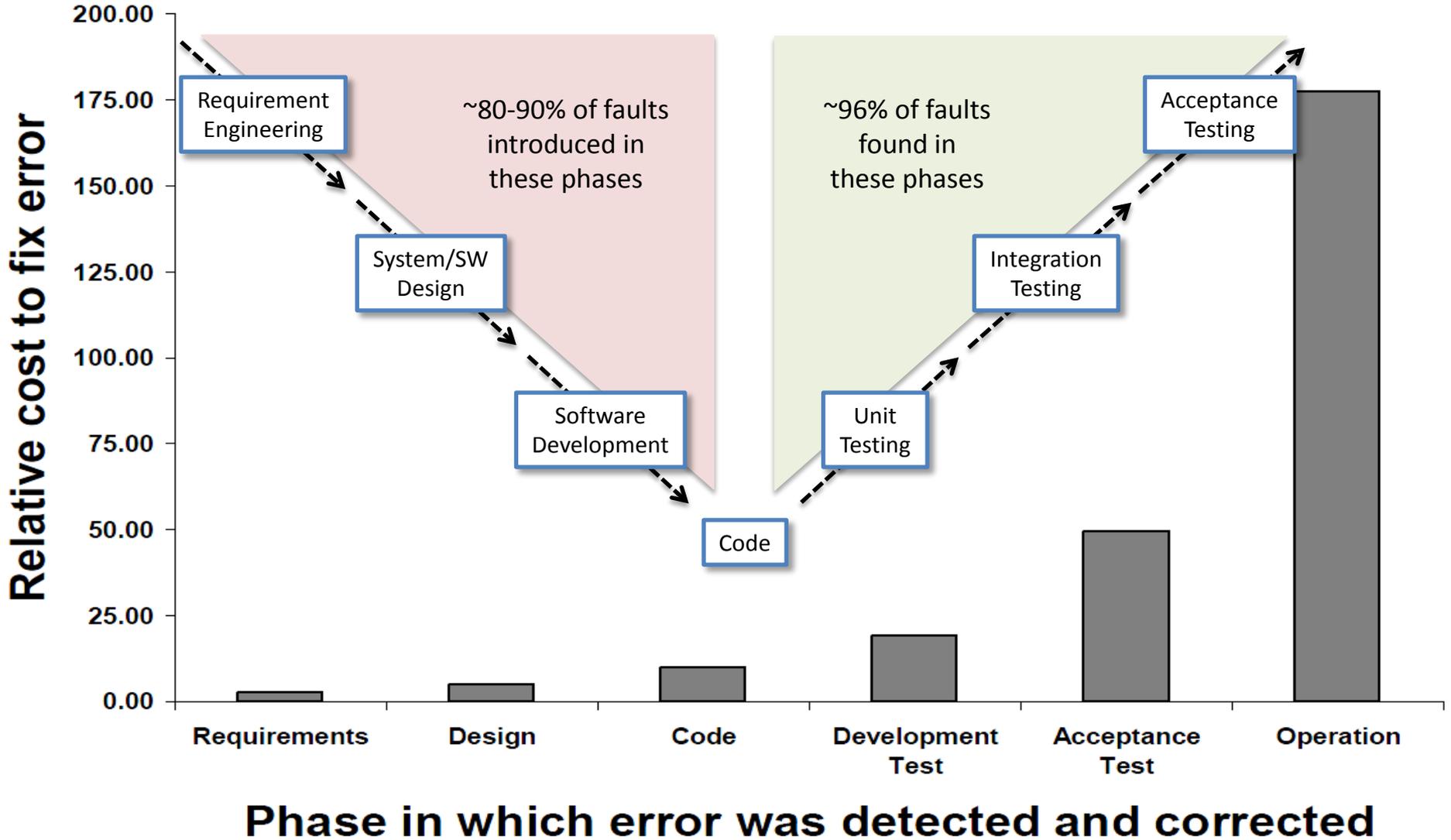
Enterprise Architectures

- Many examples in Aeronautics
 - The NAS



- The SMART NAS Testbed
- These complex systems present significant challenges in terms of V&V

V&V Cost Analysis



V&V for Air Space Applications

Authority
&
Autonomy

- Human/Automation Analysis

Distributed
Systems

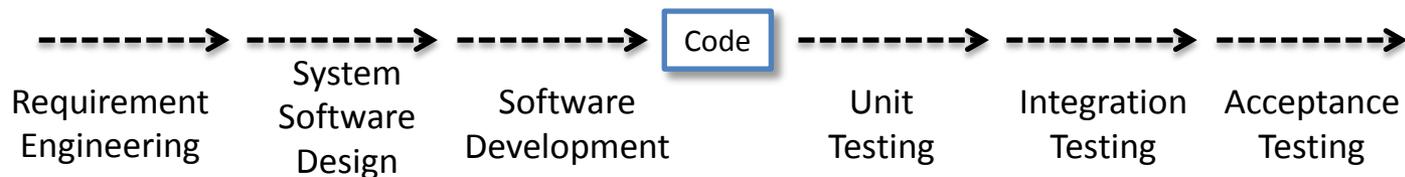
- Distributed System Models

Software
Intensive
Systems

- Model checking
- Compositional Verification

- Static Analysis
- Numerical analysis

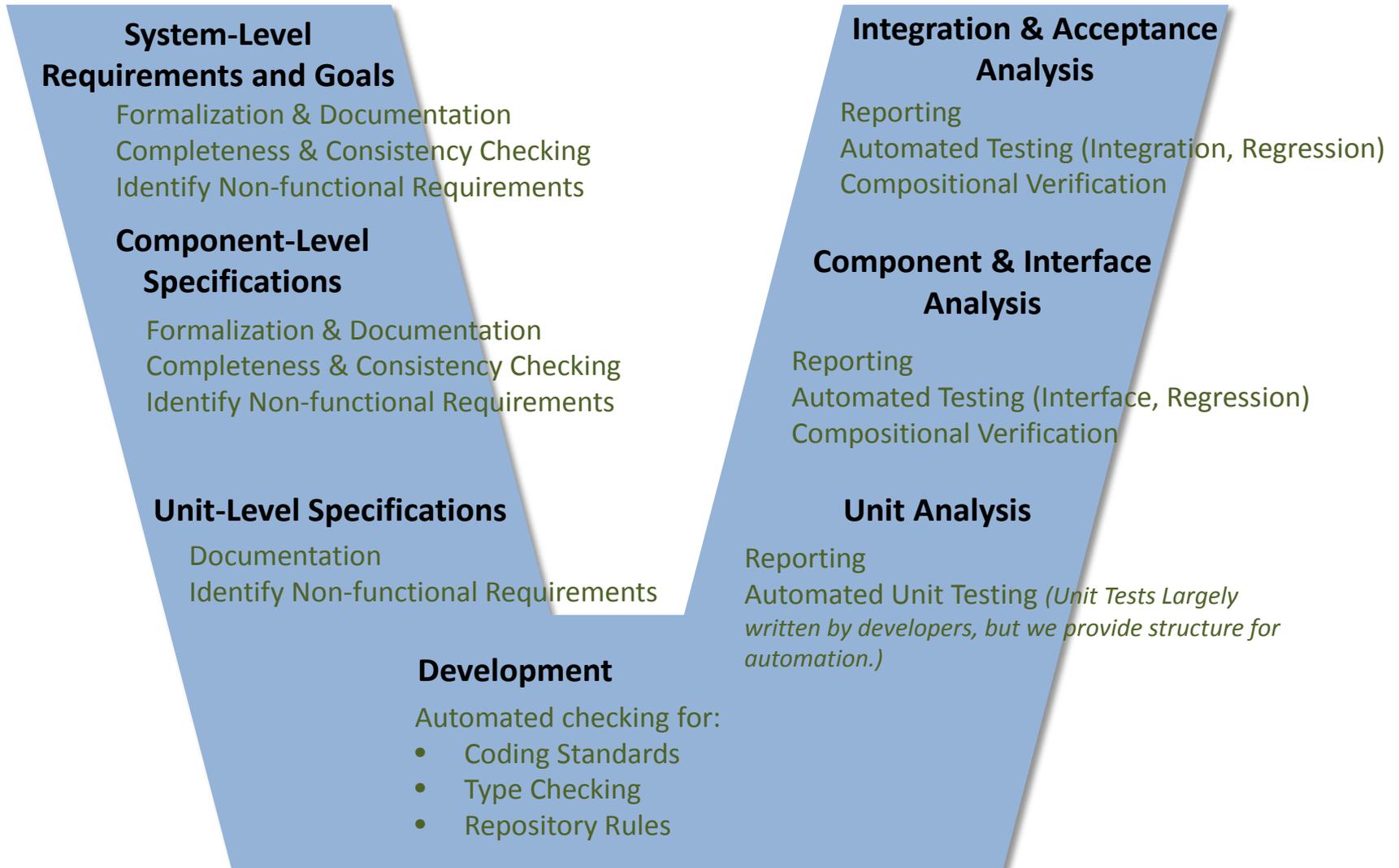
- Validation testing
- Automated test case generation



Argument-Based
Safety Assurance

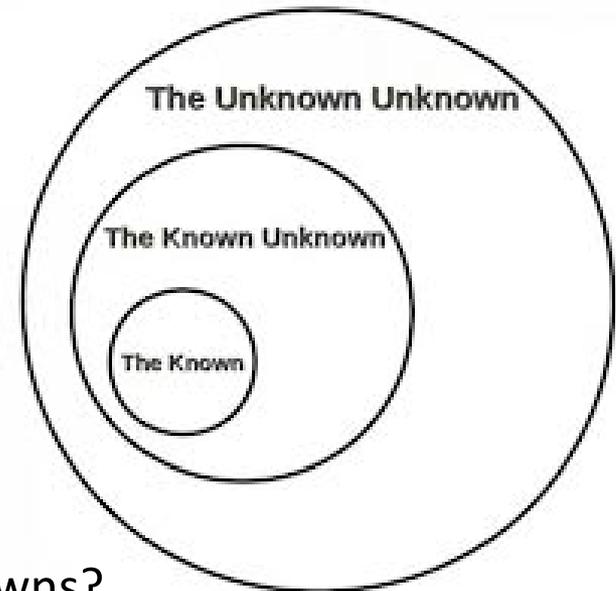


QA Plan for SMART NAS Testbed



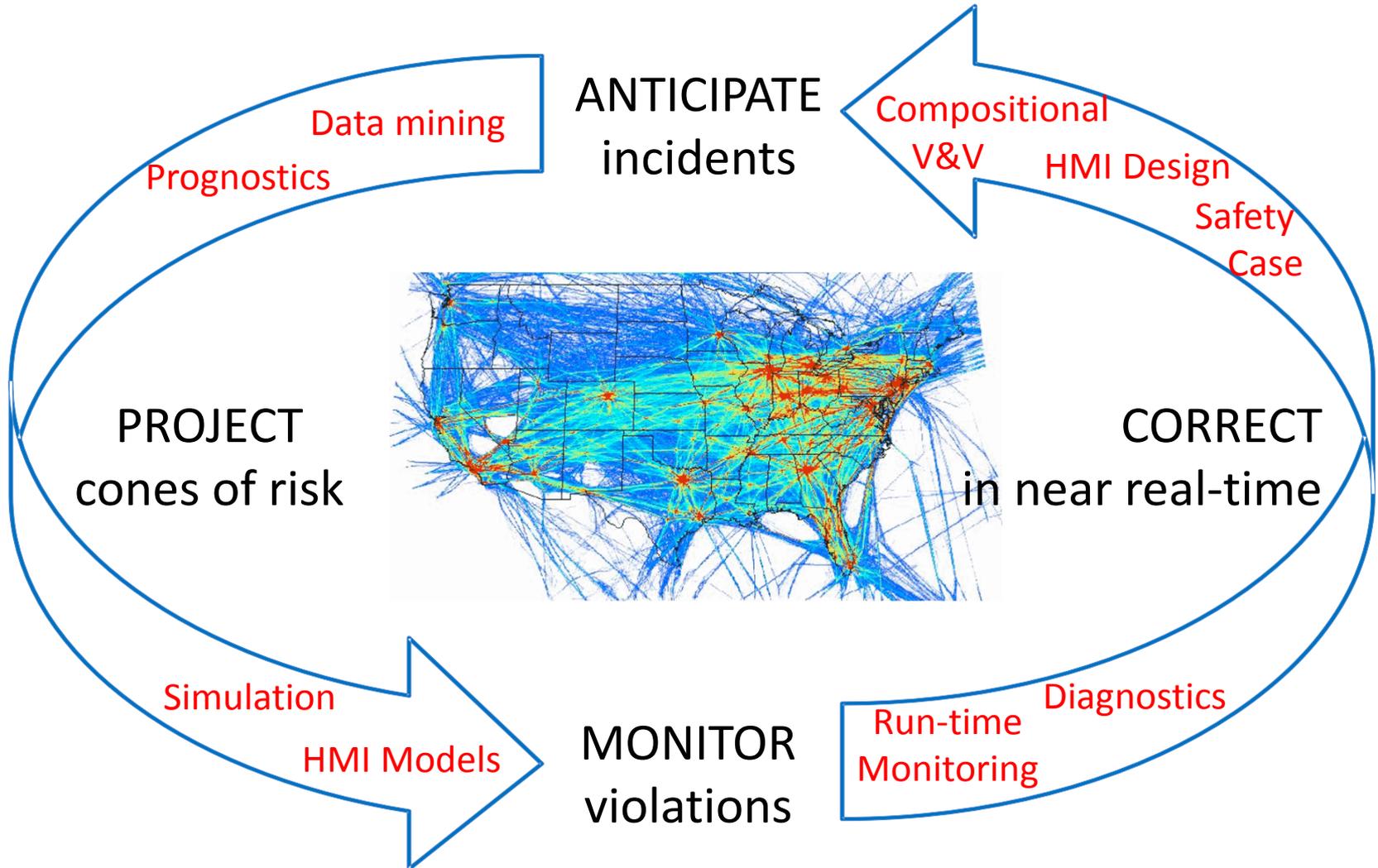
Can we plan for everything before deployment?

- Emergent behavior is the global consequence of local interactions of individuals in the system's population



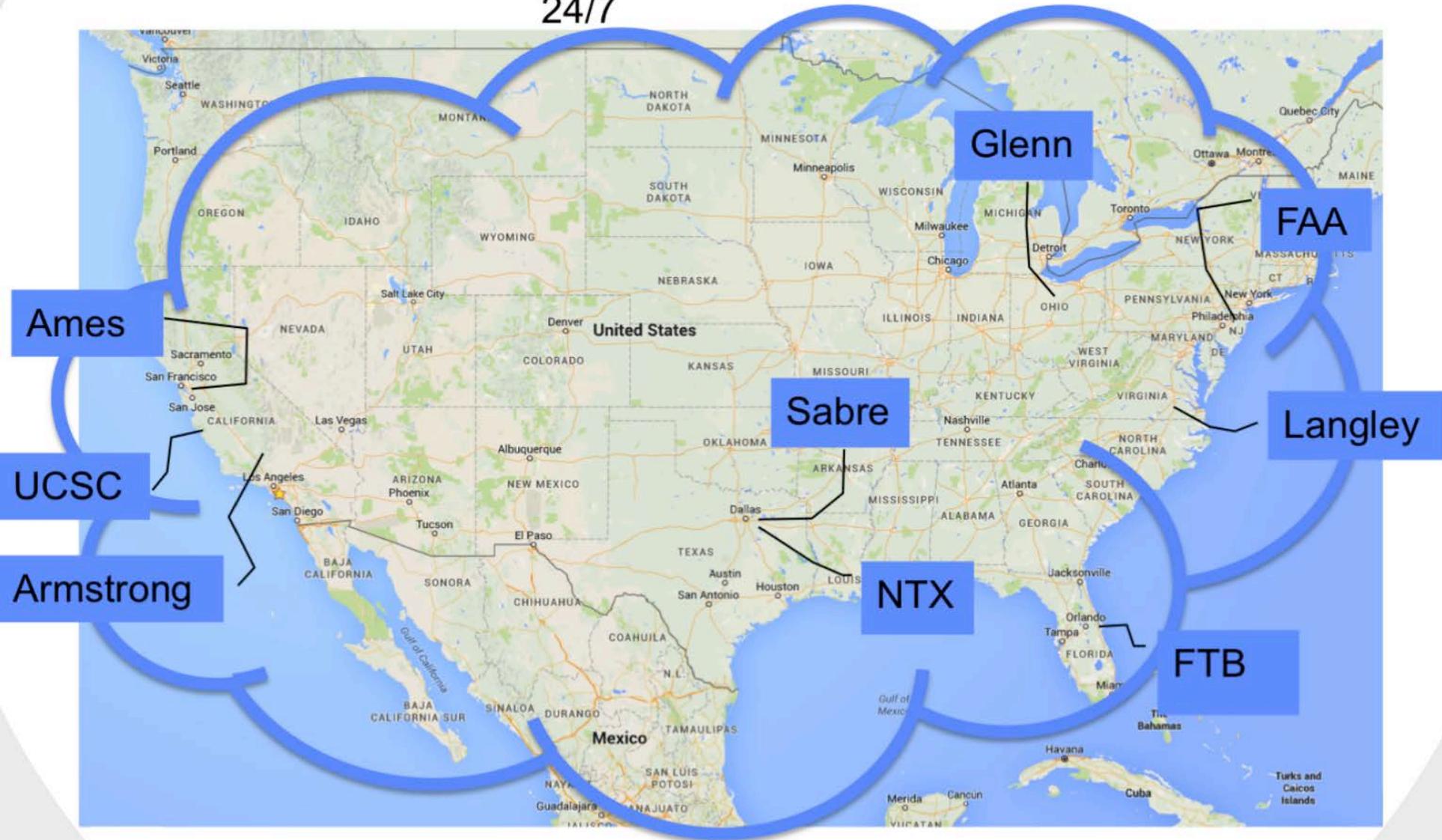
- What can we do in the face of unknown unknowns?
- The NAS is a complex system in which emergent behavior can happen

Towards Continual V&V



SMART NAS Testbed

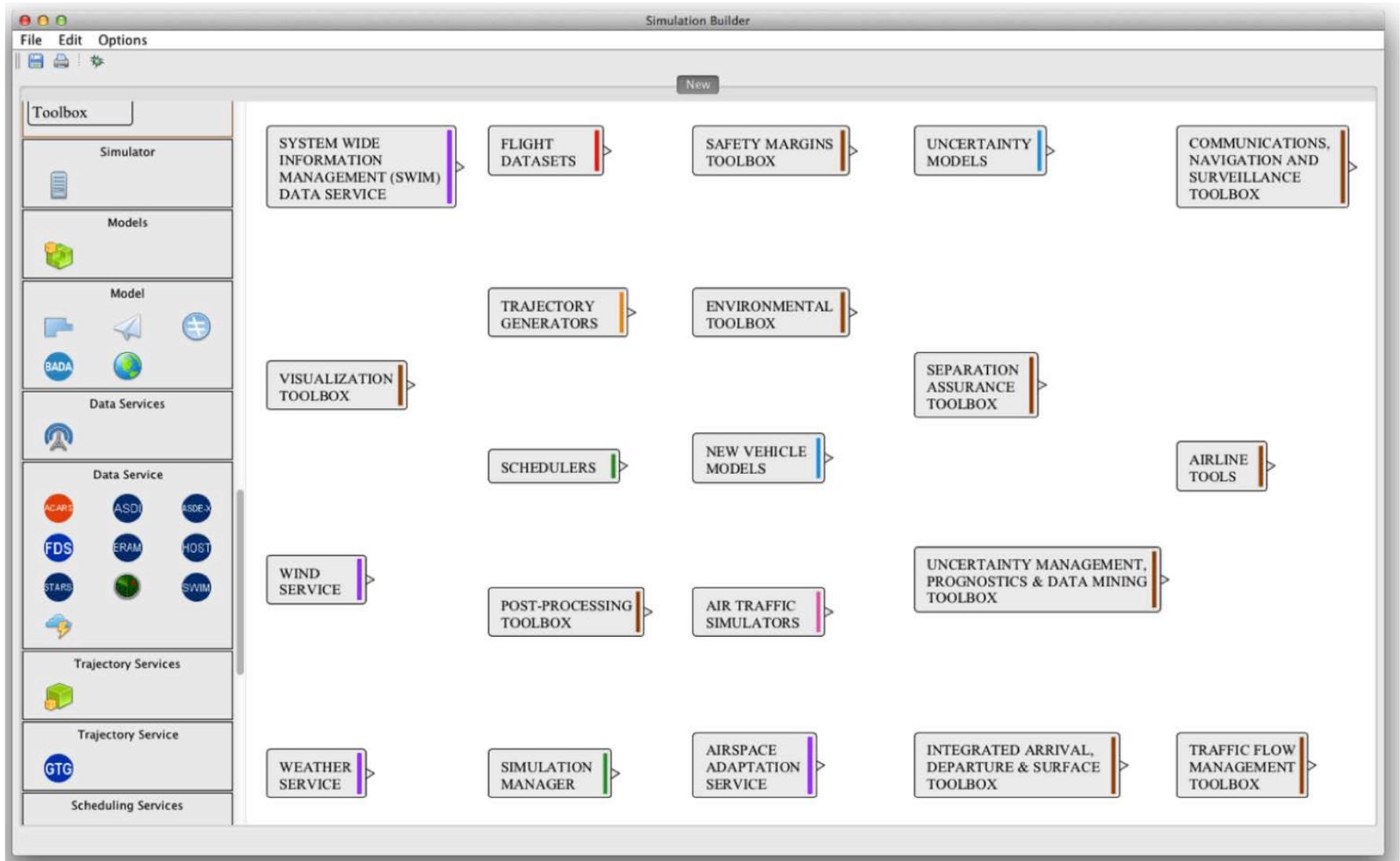
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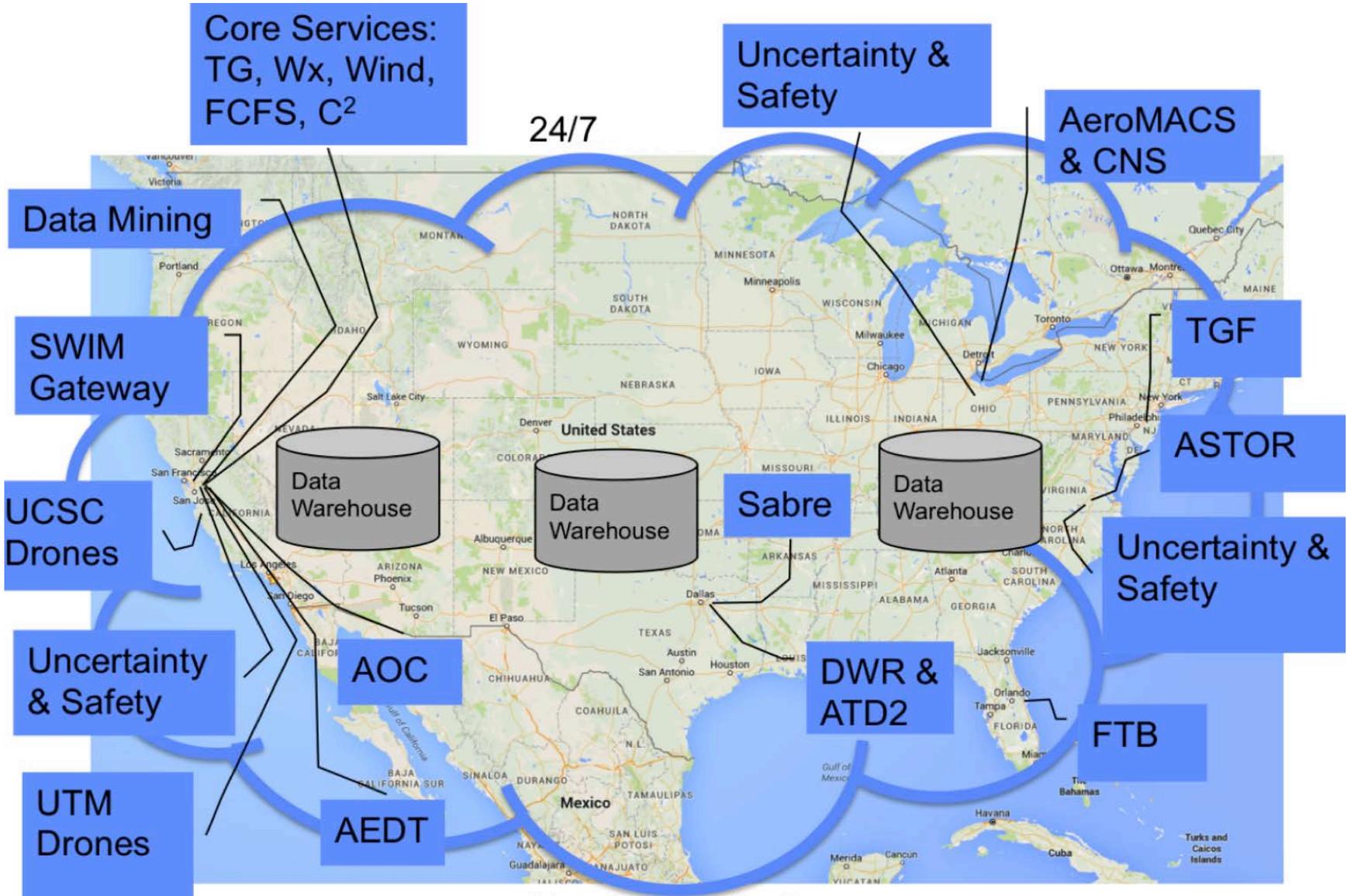
SMART NAS Test Bed Capability

- UC1: Auto-generation of high-fidelity simulation scenarios using big-data analytics
- UC2: Evaluation of emergent air traffic behavior due to novel air traffic control paradigms
 - Exploration of radical concepts that require new NAS architectures
- UC3: Determination of integration requirements associated with existing systems and procedures
- UC4: Operational integration assessment, operational test and evaluation, and flight testing of new concepts/technologies
- UC5: Air navigation service provider and airspace user training of end-state concept/technology
- UC6: Extension of existing ATM systems with “What-If” capabilities to evaluate the potential results of alternative ATC and ATM decisions
- UC7: Automated regression testing and requirements verification in response to procedural changes and adaptation updates

An original 5 year roadmap



Potential Contributions



Summary

- V&V of complex systems present significant challenges
 - Use of models allows us to perform V&V earlier
 - Emergent behaviors and unknown unknowns force us to consider continuous V&V
- Vision and requirements for test-bed
 - Accelerate deployment
 - Provide decision support
- Five-year plan and yearly progress demonstrations
 - Data integration using infrastructure layer
 - Easy plugin capability
 - Scalability via large-scale simulation
 - Integrated Arrival, Departure, and Surface impact on NAS
 - Shadow mode experiment