

# Delivering NextGen

Next Generation Air Transportation System

## Verification and Validation

Presented to: V&V Summit Participants

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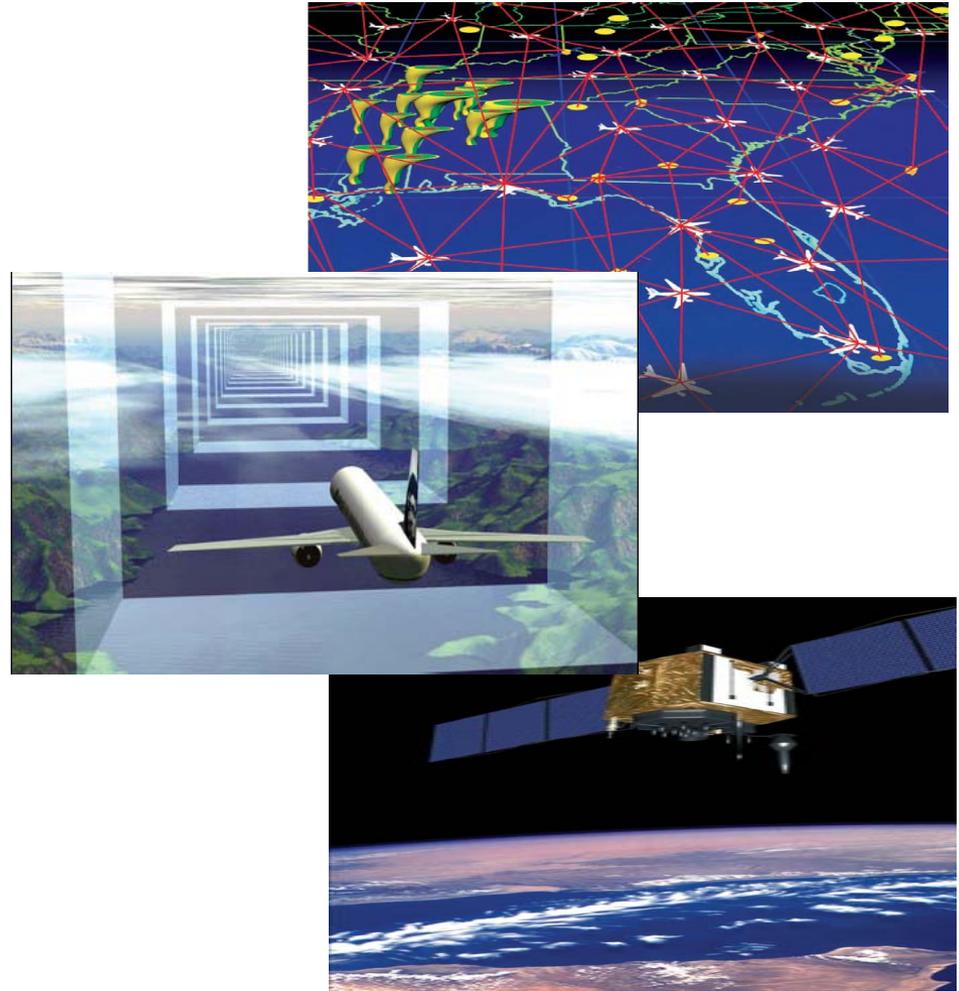
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Federal Aviation  
Administration

# Purpose of V&V Improvements

- Reduce latent defects encountered in the field
- Improve test, evaluation and analysis effectiveness and efficiency for acquisitions
- Support the successful implementation of NextGen capabilities



# Benefits to FAA/Programs

- Reduction of problems encountered in the field
- Reduction of overall V&V cost
- Better V&V cost and schedule information including a focus on test, evaluation and analysis strategies and contractual requirements
- Better V&V consistency across all programs
- Consistency in test, evaluation and analysis through program lifecycle
- Smoother and more efficient transition between all phases
- Better understanding of risks in NextGen including NAS integration

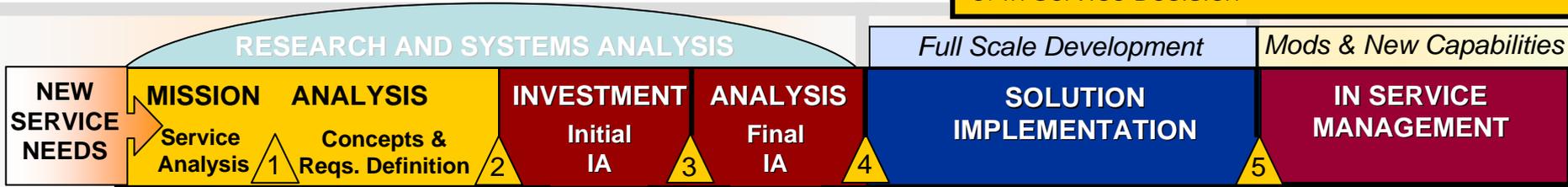
# Benchmark Findings/Best Practices

- Operational perspective in all testing
  - Address operational conditions during DT
  - Early OT involvement and evaluations in programs
- Capability-based T&E reporting for decision makers throughout development and deployment
- Executive accountability paths for T&E
- Definitive criteria for entering major test phases
- Standards for maintaining T&E proficiencies
- Independent OT



# AMS and V&V

- :KEY**
1. Mission Need Decision
  2. Investment Analysis Readiness Decision
  3. Initial Investment Decision
  4. Final Investment Decision
  5. In-Service Decision



**Concept Formulation**

**Concept Feasibility**

**Concept Development**

**Low-Fidelity Modeling**

**High-Fidelity Modeling**

**Representative System**

**Mature Product**

**Product Acceptance**

**In-Service**

- Support Identification & prioritization of critical needs
- Support determination of best alternative solutions
- Support development and Validation of Concepts
- Feasibility demos

- Prototyping/Evaluations of candidate solutions
- Support development and refinement of requirements
- Verification/Validation of requirements/concepts

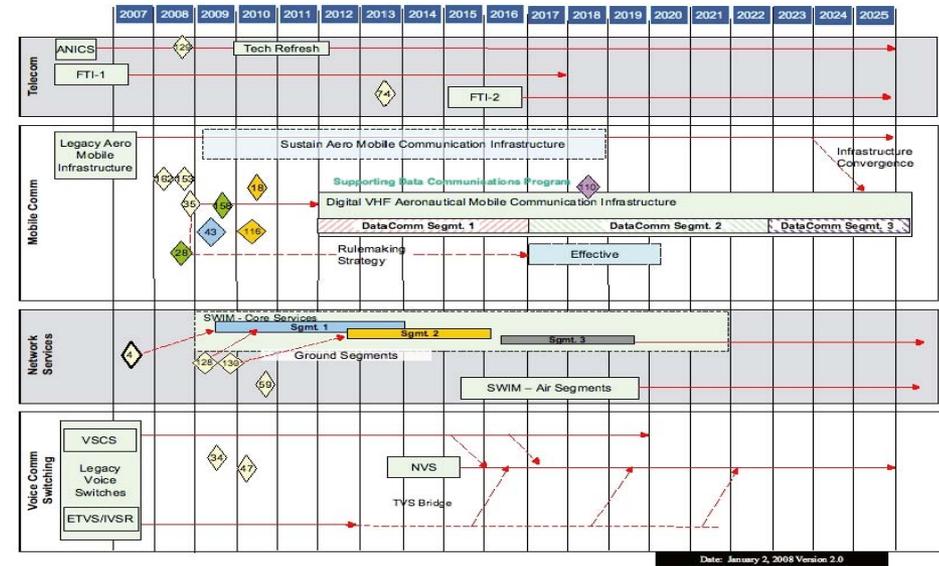
- Verification & validation design/work products
- System test and field familiarization testing (DT & OT)
- IOT&E

- T&E of In-Service Fixes
- T&E of In-Service modifications and enhancements



# Strategy

Communication Roadmap



- Focus on system lifecycle
  - Strengthen test, evaluation and analysis processes (robust, integrated, and seamless)
  - Problem prevention, detection, and resolution as early in the lifecycle as possible
  - Support program and user product education
- Refine new integrated procedural test practices
- Explore new theory of test for highly flexible and complex system of systems (academia, industry, and other government agencies)
- Conduct resource gap analysis (people and infrastructure)
- Acquire proficiencies in new technologies

## The Bottom Line

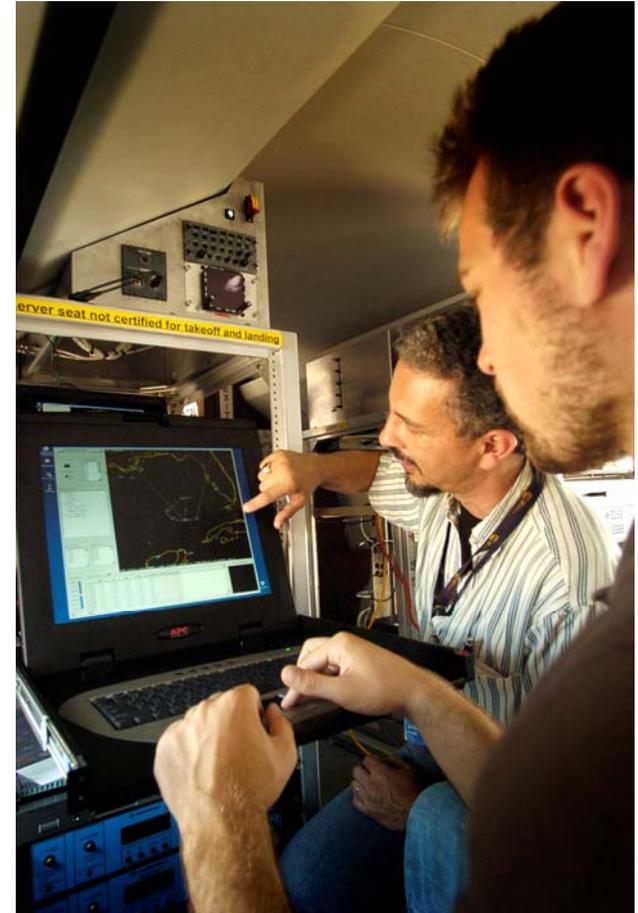
**How do we strengthen the ability to identify the risk to operational usability and safety?**

# Approach

- **Initiated a V&V Protocol of Operations project in NextGen and Operations Planning**
  - Documented quality processes for solution implementation
  - Established a Test Standards Board (TSB) for quality T&E standards oversight
  - Establishing accountability paths under NextGen and Operations Planning
  - Institutionalizing quality processes

# T&E Process Documents

- **Verification and Validation Operations Guide**
- **Test and Evaluation Handbook**
- **Foundational Processes**
  - Project Management Process
  - Configuration Management Process
  - T&E Training Process
  - Peer Review Process
  - Quality Assurance Process

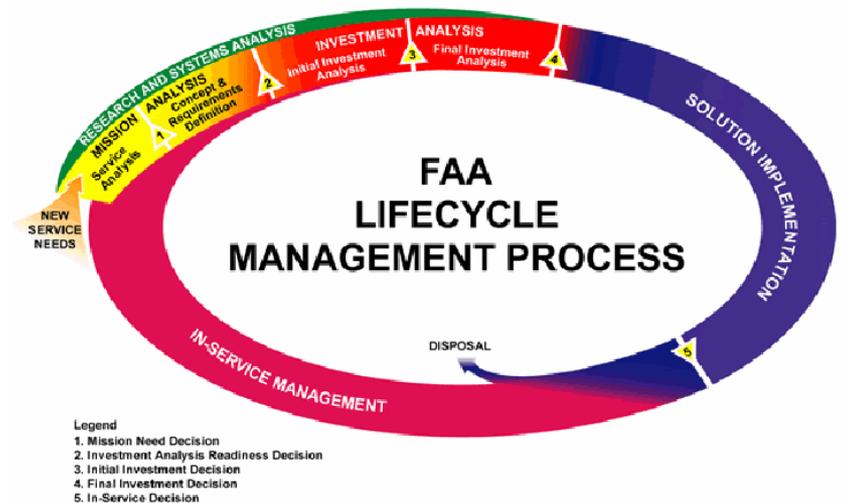


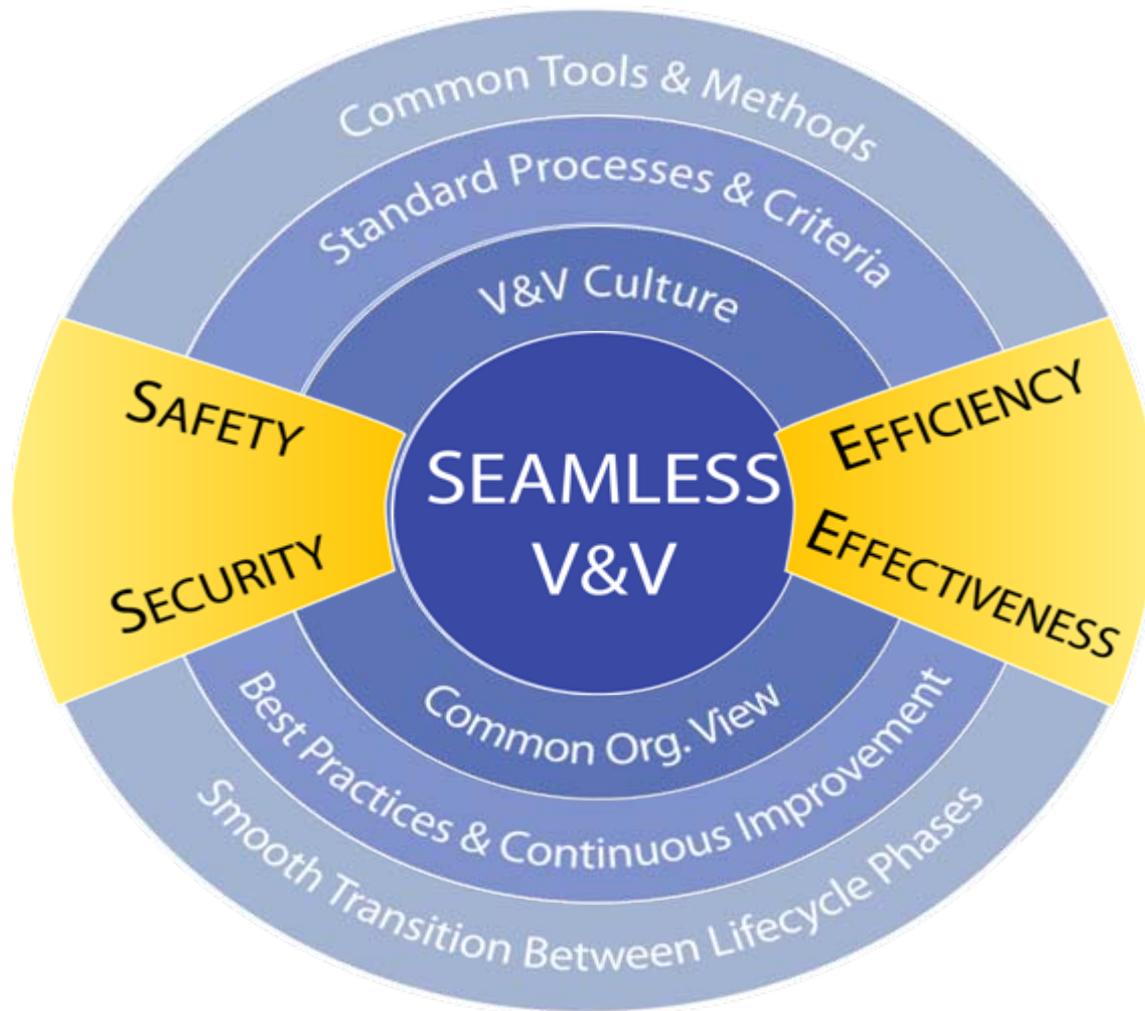
# TSB Responsibilities

- **Establish and maintain T&E standards**
- **Review and make recommendations on test plans and reports**
- **Monitor T&E activities; provide guidance and address standard issues**
- **Support T&E quality reviews**
- **Identify T&E process improvement opportunities**
- **Establish and maintain T&E training requirements**

# Lifecycle Test

- How do we get to a V&V level that gets the benefits needed for NextGen?
- How do we get consistent risk assessment throughout the lifecycle of a program?
- How do we get the best practices from each phase into the whole lifecycle ?





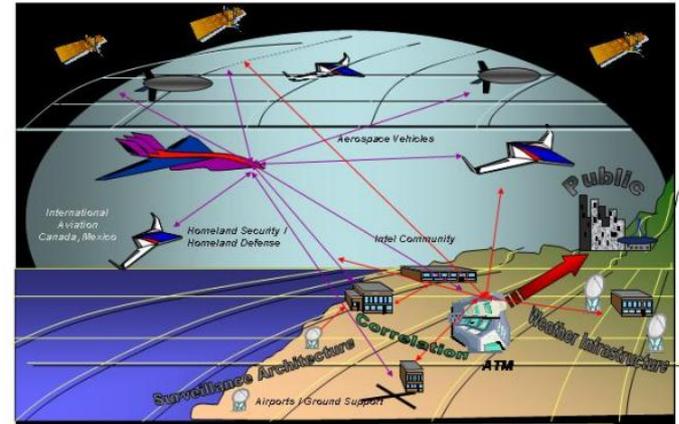
# Emergent Evolution . . .

## Maximizing Test and Evaluation Capacities in a Hyper-Morphing Millennium



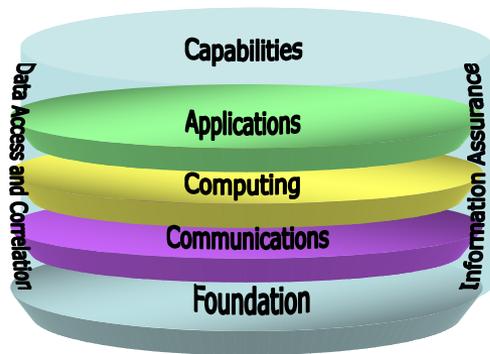
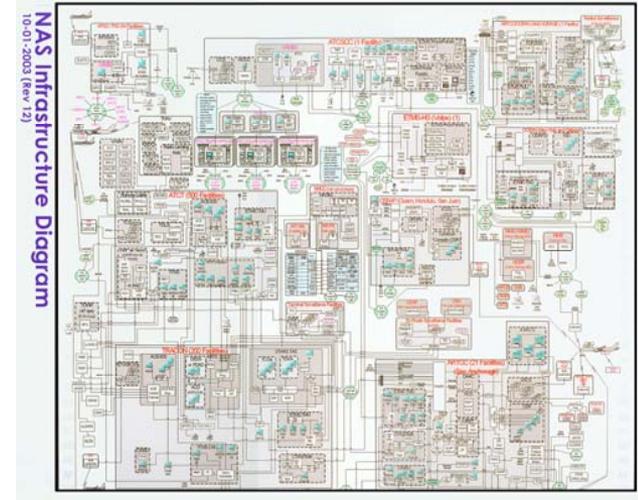
# The Changing Environment

- Small systems with little software
- Proprietary stand alone systems with limited interfaces
- Integrated proprietary systems with clearly defined interfaces
- Commercial available hardware with custom software
- System of systems
- Complex adaptive systems (CAS)



# Complex Adaptive Systems

- Complex system addresses the relationship between parts that determine specific collective behaviors and how that system interfaces with the environment



- Complex adaptive system provides an interdisciplinary approach designed to answer questions about dynamic, changeable systems

# Complex Adaptive Systems

- **Kevin Dooley - Three key behavioral principles in complex adaptive systems:**
  - *Order is emergent, not pre-determined*
  - *History is irreversible*
  - *Often times the future is unpredictable.*
- ***Complex adaptive systems have a unique quality to adapt (homeostasis) or evolve and modify in changing environments (metamorphosis=morphing)***

# V&V Roles in Complex Adaptive Systems

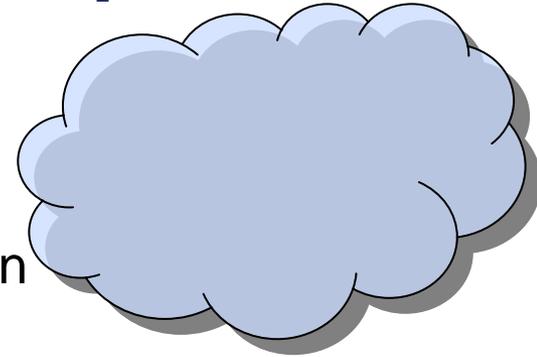
- Resolutions for managing requirements “creep”
- Production of dynamic test solutions as technology “hyper-morphs”
- Addressing consumer mandates



# Thoughts on V&V of Complex Adaptive Systems

- **V&V should consider:**

- Lifecycle involvement to recognize fluctuations in requirements at early stages
- The dynamics of testing CAS in its entirety; evaluate components
- The provision of clear V&V program direction; less process detail; allowing opportunities for innovation
- The continuous technical evaluations and assessments for trends and forecasting
- The use of knowledge ecology to foster awareness and cultivate subject matter experts
- The sophisticated application of tools for accurate resource evaluation and allocation as obligations increase



# Conclusion

**The keen management of Verification and Validation programs in Complex Adaptive Systems environments require creativity, flexibility, adaptability to adjust to ever-changing scopes and mandates to ensure a competitive edge and maximum productivity.**

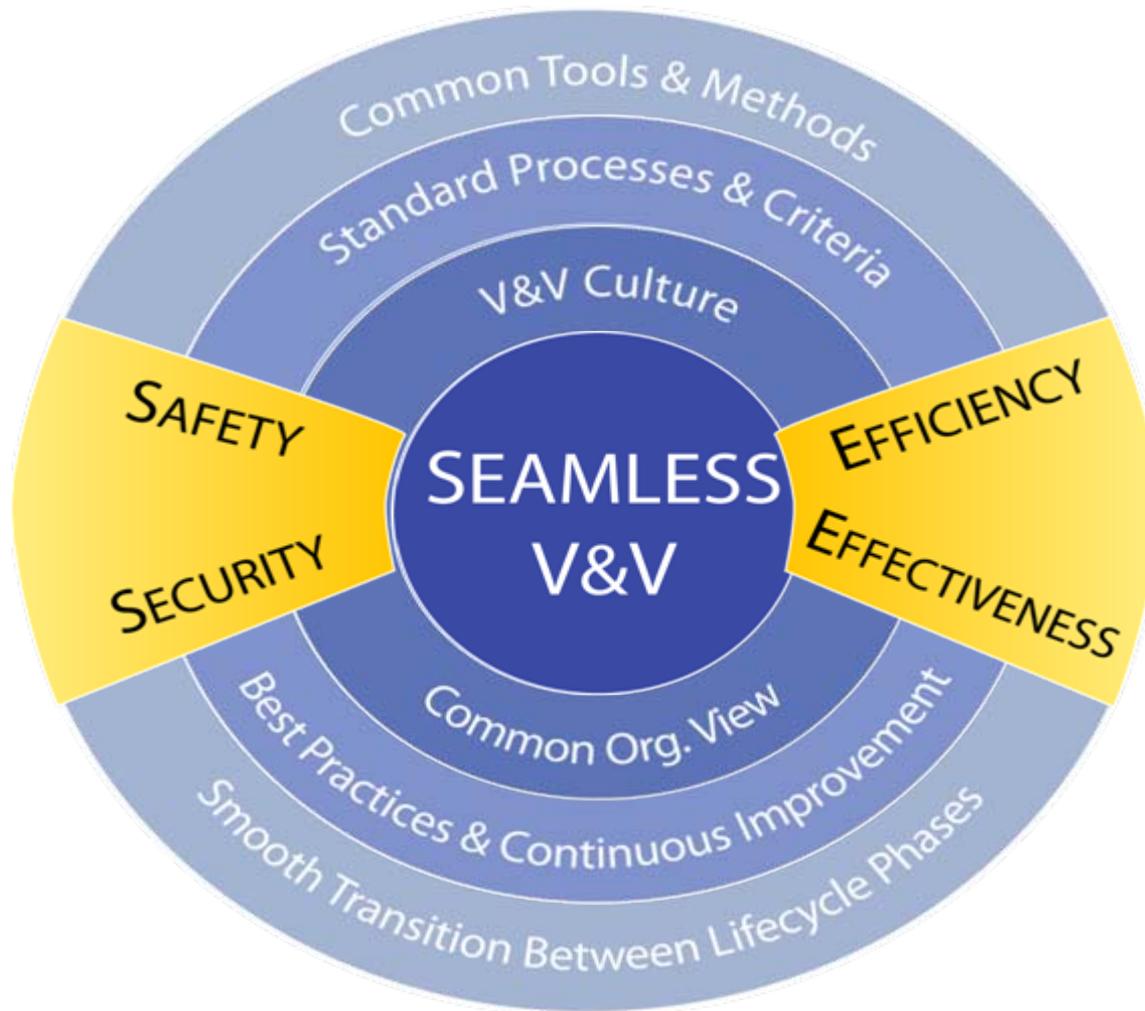
***Change is inevitable -  
Knowledge and preparation hold the key to our future  
success.***

# 2008 Annual ITEA Symposium

## *“Advancing T&E in the Global Community”*



**Atlantic City Convention Center  
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# Backup

