Delivering

NextGen

Next Generation Air Transportation System

Verification and
Validation

Presented to: V&V Summit Participants
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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

Federal Aviation Administration

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

RESEARCH AND SYSTEMS ANALYSIS

NEW SERVICE NEEDS

MISSION ANALYSIS

INVESTMENT ANALYSIS

SOLUTION IMPLEMENTATION

IN SERVICE MANAGEMENT

Concept Formulation

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

Concept Feasibility

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

Concept Development

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

Low-Fidelity Modeling

High-Fidelity Modeling

Representative System

Mature Product

Product Acceptance

In-Service

Full Scale Development

Mods & New Capabilities

IOT&E of In-Service Fixes
– T&E of In-Service modifications and enhancements
Strategy

• 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

  - 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.*
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