PAPER SESSION I-B:
Program Office Perspective on T&E

Practical Ways of Integrating T&E and Systems Engineering

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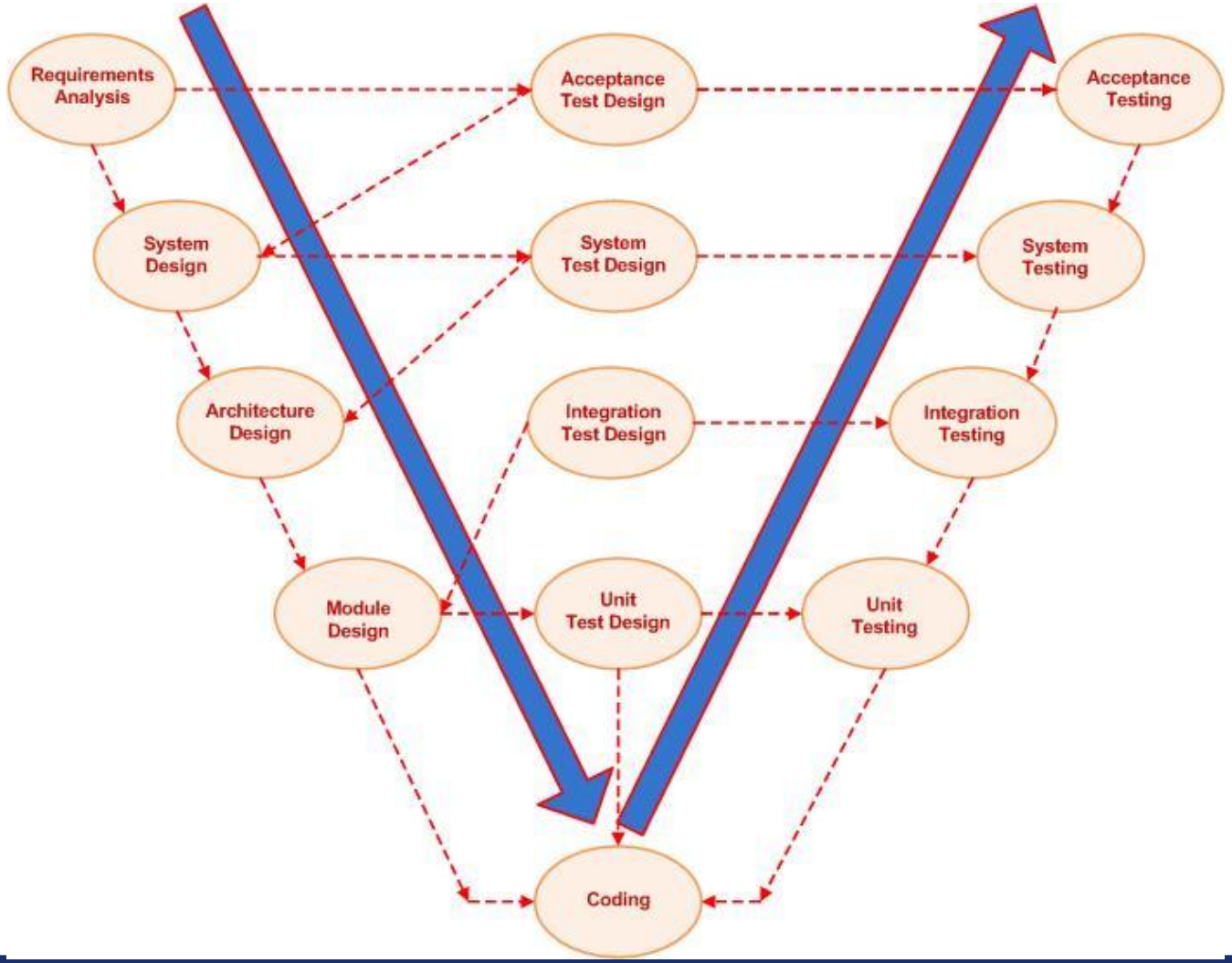
Topics

- **Key concepts for integrated T&E/SE**
  - Harmonizing T&E and SE
  - Methodical Approach
  - Systems Thinking
- **Common pitfalls**
- **Explore FAA challenges**
- **Practical ways to integrate T&E/SE**
  - General Practices
  - FAA Initiatives
- **Benefits to acquisitions**
- **Summary**

Key Concepts: Harmonizing T&E and SE

- **T&E is an integral part of the SE discipline**
- **T&E/SE practices need to complement and feed each other**
- **T&E/SE roles alternate from driving activities or providing information to receiving or reacting throughout the lifecycle**

Key Concepts: Alternating Roles in the "V"



Key Concepts: Methodical Approach

- **Encourages a methodical approach – premised on the Deming "PDCA" Cycle for quality management:**
  - **Plan**: Identifying and analyzing the problem.
  - **Do**: Developing and testing a potential solution.
  - **Check**: Measuring how effective the test solution was, and analyzing whether it could be improved in any way.
  - **Act**: Implementing the improved solution fully.

- **Integrated T&E/SE fosters methodical checks and balances**
  - Promotes quality
  - Essential to continually maturing products

Key Concepts: Systems Thinking

- **Integrated T&E/SE promotes and fosters Systems Thinking**
- **Challenge concepts - drives programs to a comprehensive understanding of the product**
- **Fully considers interaction between all elements and environments**

Systems Thinking provides a means to identify all interactions and supports cause and effect analysis to mitigate undesirable emergent behavior

Addressing Common Pitfalls

- Poorly documented operational concepts
- Immature or misunderstood operational concepts
- Defective or incomplete requirements
- Poor operational requirements or design
- Ineffective test environments
- Overly redundant testing
- Poorly managed system baseline
- Systems/services that are operationally unacceptable or do not integrate well into the operational environment

Integrated T&E/SE can overcome pitfalls commonly encountered in programs by applying a systems thinking and methodical approach

FAA Challenges: Changes and Gaps

- **Next Generation Air Transportation System**
  - System-of-systems architecture
  - New Operational Concepts
  - More stakeholders engage with the National Airspace System

- **Cultural and organizational stovepipes inhibiting integrated T&E/SE**

- **Test capabilities and infrastructures based on old legacy systems and programs**
  - Independent systems providing FAA services
  - Labs, simulators and models focused on independent systems

FAA Challenges: Operational View

Practical Ways to Integrate:
General Practices

- **Early T&E involvement**
  - Define T&E/SE roles and accountability during mission and investment analysis
  - Define organizational empowerments to support early involvement

- **Set acquisition checkpoints**
  - Decision points and milestones for T&E/SE oversight and validation
  - Opportunities to incorporate knowledge gained into concepts, requirements, and plans

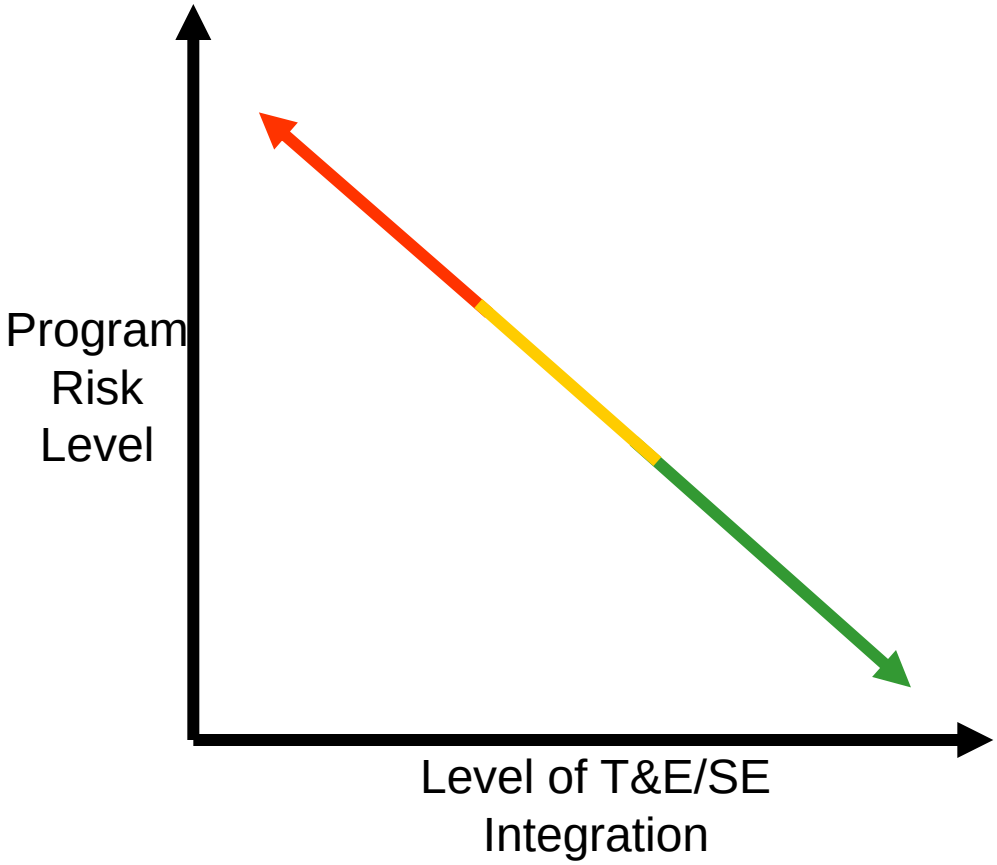
Practical Ways to Integrate:
FAA Initiatives

- **Establish policies for verifying and validating every major work product throughout the lifecycle**
- **Develop and oversee standards that foster integrated T&E/SE relationships and methodical V&V practices on each program**
- **Establish capabilities and infrastructures that effectively enable early and continuous evaluations**
  - Support system-of-system (holistic) evaluations
  - Assessments of concepts, functionality, and performance

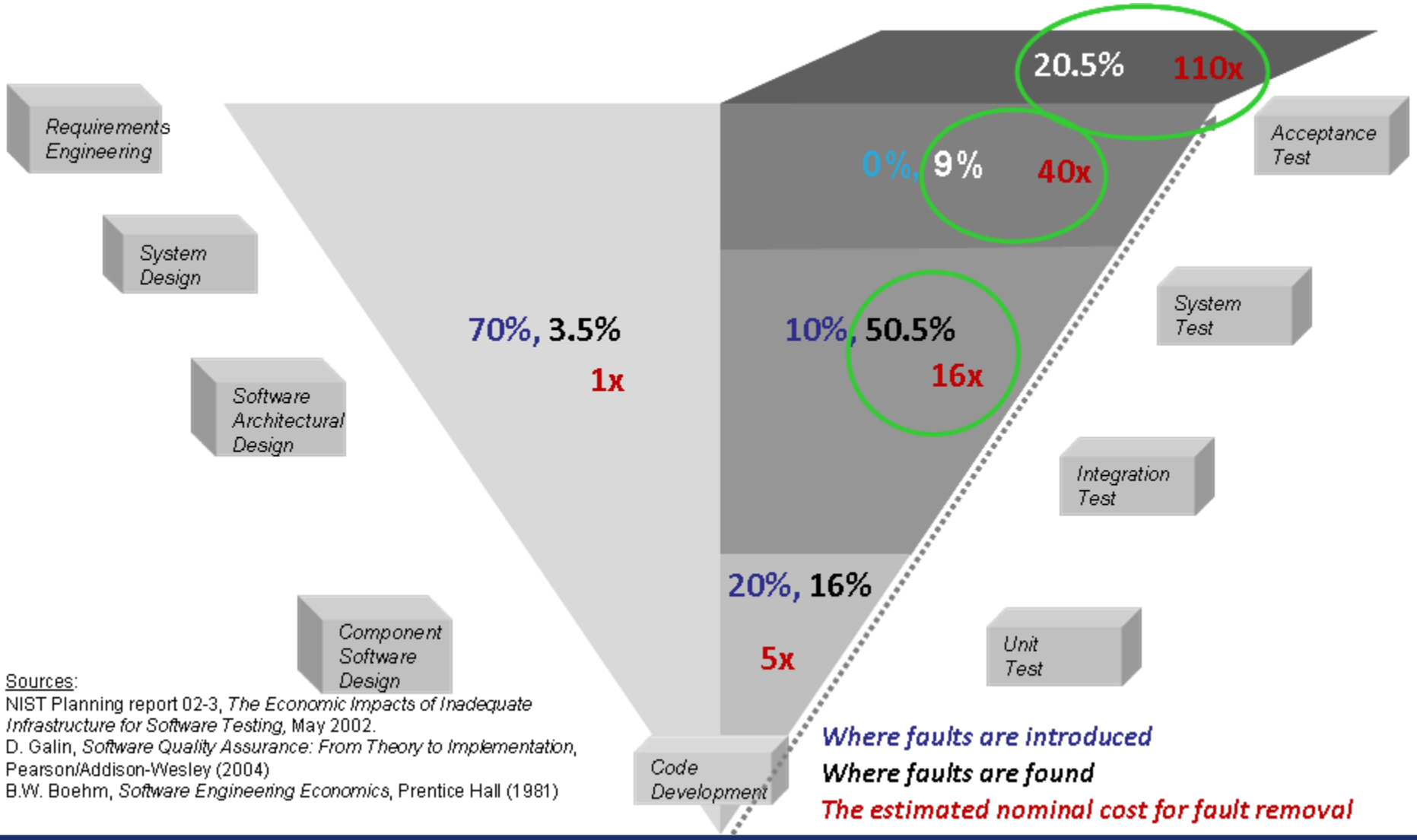
Instituting Verification and Validation (V&V) standards into Policy, Practices, & Infrastructure

Risk Benefits

- **Complex net-centric systems increases the risk level**
- **Integrated T&E/SE can drive down the risk level**



Benefits: Cost Avoidance



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B.W. Boehm, *Software Engineering Economics*, Prentice Hall (1981)

Summary

- **Integrated T&E/SE Concepts**
  - A healthy “give and take” relationship that increases quality
  - Fosters system thinking to increase the knowledge of the product
  - Is most needed for complex system-of-systems
  - Reduces risks and costs

- **Ways to Integrate**
  - Early T&E/SE relationship
  - Mandate checkpoints
  - Ensure knowledge from validation feeds back into concepts, requirements and plans