

Air Force Research

Defending America by Unleashing the Power of Innovative Aerospace Technology



Technologies for Efficient Certification (TEC)

International Test & Evaluation Summit & Exhibition

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U.S. AIR FORCE

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Air Vehicles Directorate
Air Force Research Laboratory

Integrity - Service - Excellence



What is Certification?

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“A structured mechanism of identifying and reducing risk to insure a system is safe to operate and meets performance goals”
--- AFMAN 63-119

Airworthiness Certification

(AFPDs 62-4, 62-5, 62-6)

OT&E Readiness Certification

(AFMAN 63-119, AFIs 99-101, 99-102)

FAA Certifications

(FAR 23 & 25)

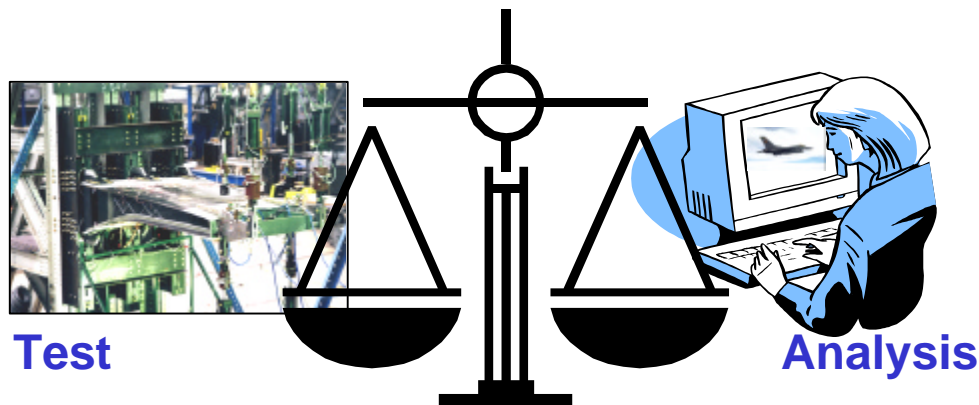


Elements of Certification



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- **Compliance with specified certification criteria demonstrated through**
 - *Flight or ground test*
 - *Analysis*
 - Simulation
 - Previously verified
 - Demonstration
 - Inspection
 - Similarity to proven capability

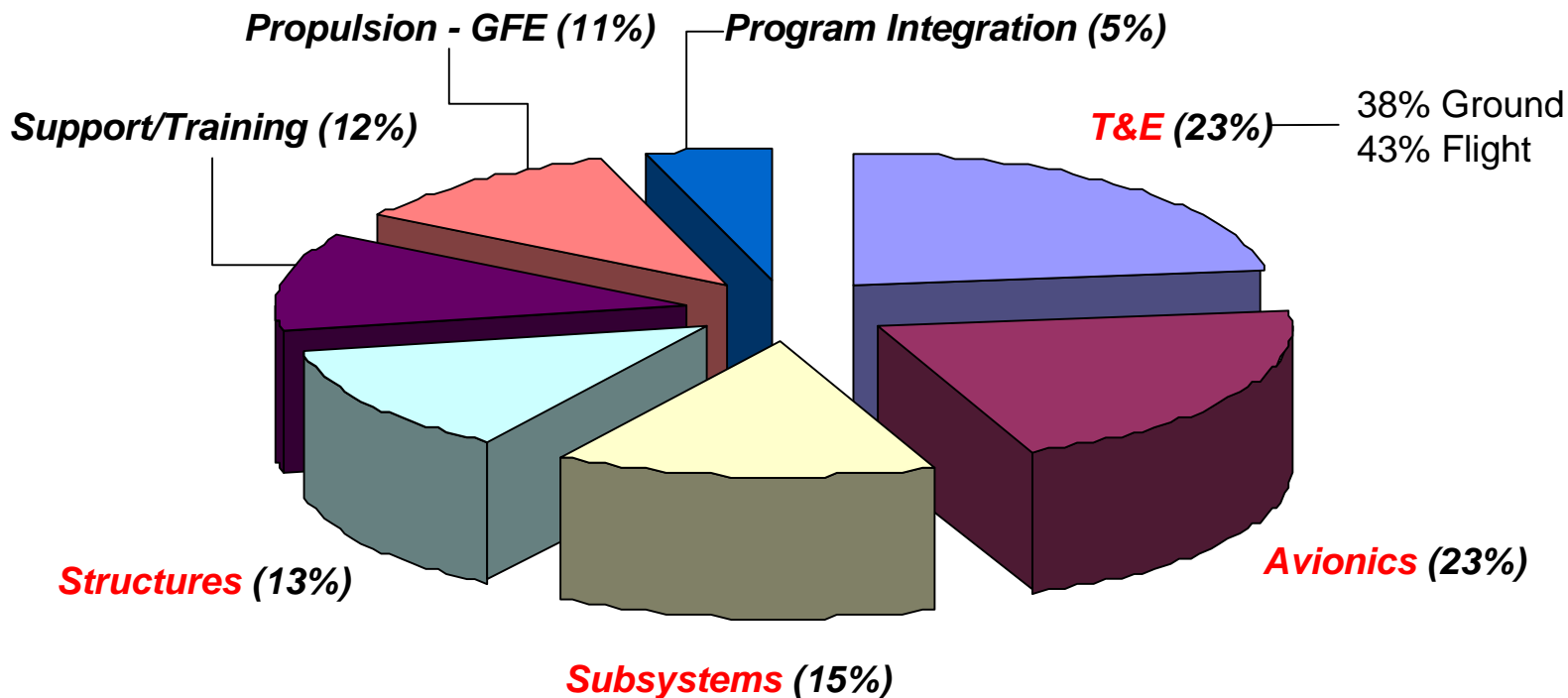




Engineering Design and Certification Costs



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Notes:

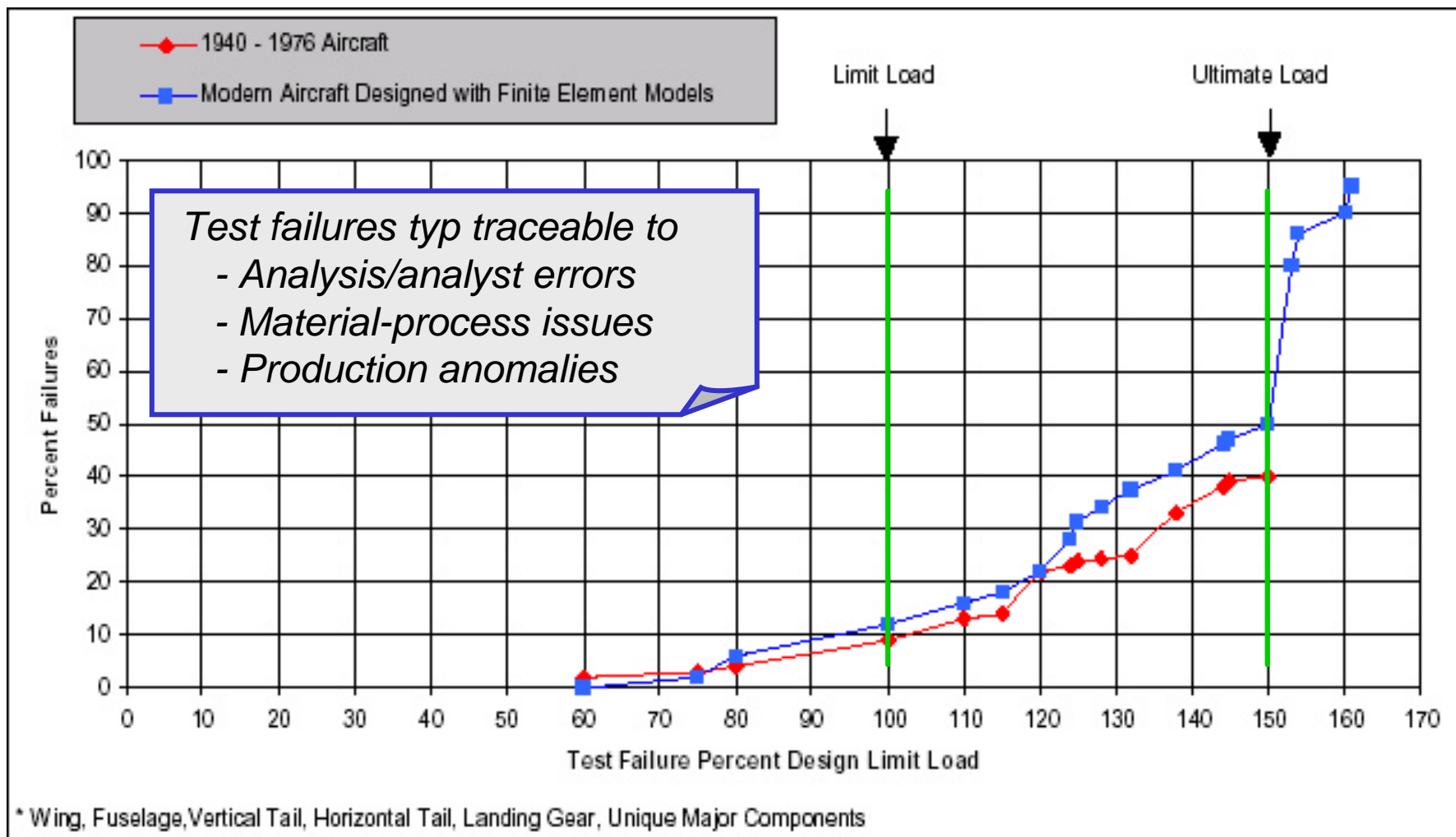
- Engr design (structures, avionics, & systems) nearly half of program costs
- More than 75% of DT test resources go to ground/flight tests



Typical Test Failures (Structures)



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Source: T. Jennewine, ASIP 2002 Special Session on Certification
http://jafar.ncsa.uiuc.edu/aiaa/lean_certification/Docs/UAVCERT.pdf

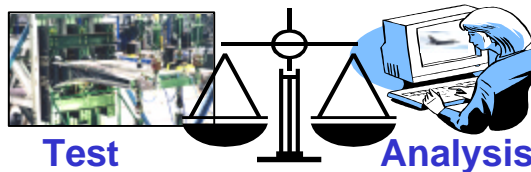


Technologies for Efficient Certification (TEC)



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- **Increase reliance on analytical methods and tools throughout the certification process to**
 - Reduce time and costs associated with certification process
 - Increase system knowledge through more robust and reliable analysis processes
 - Improve reliability of predictions to eliminate surprises in tests and in field



-- **Best Value Certification** --



The Role of R&D in Certification



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Support the development of an integrated set of analytical methods and tools to enable more efficient certification of aerospace vehicles, systems, subsystems, and components

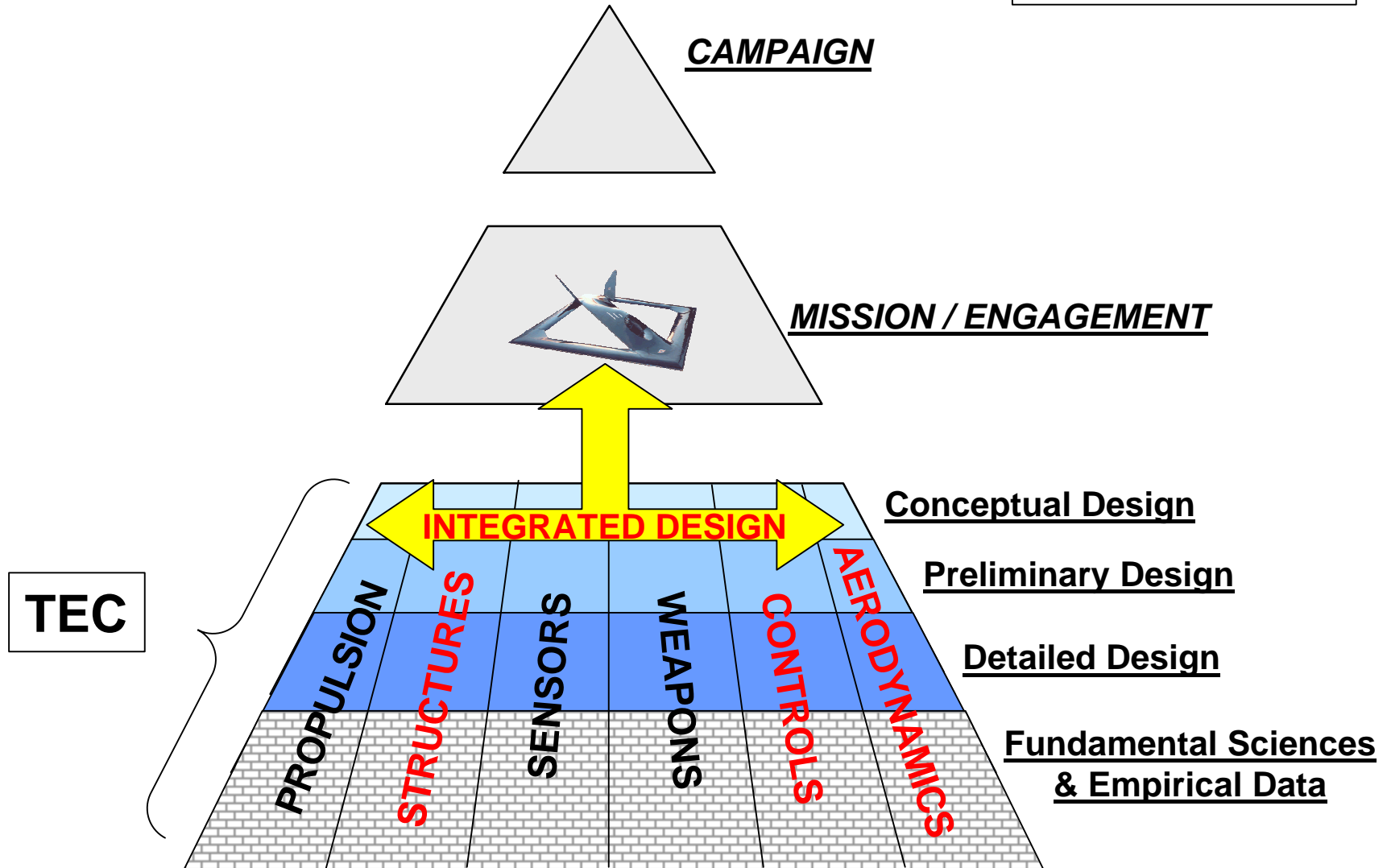


Analytical Methods and Tools

Horizontal and Vertical Integration



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Identification of TEC Opportunities

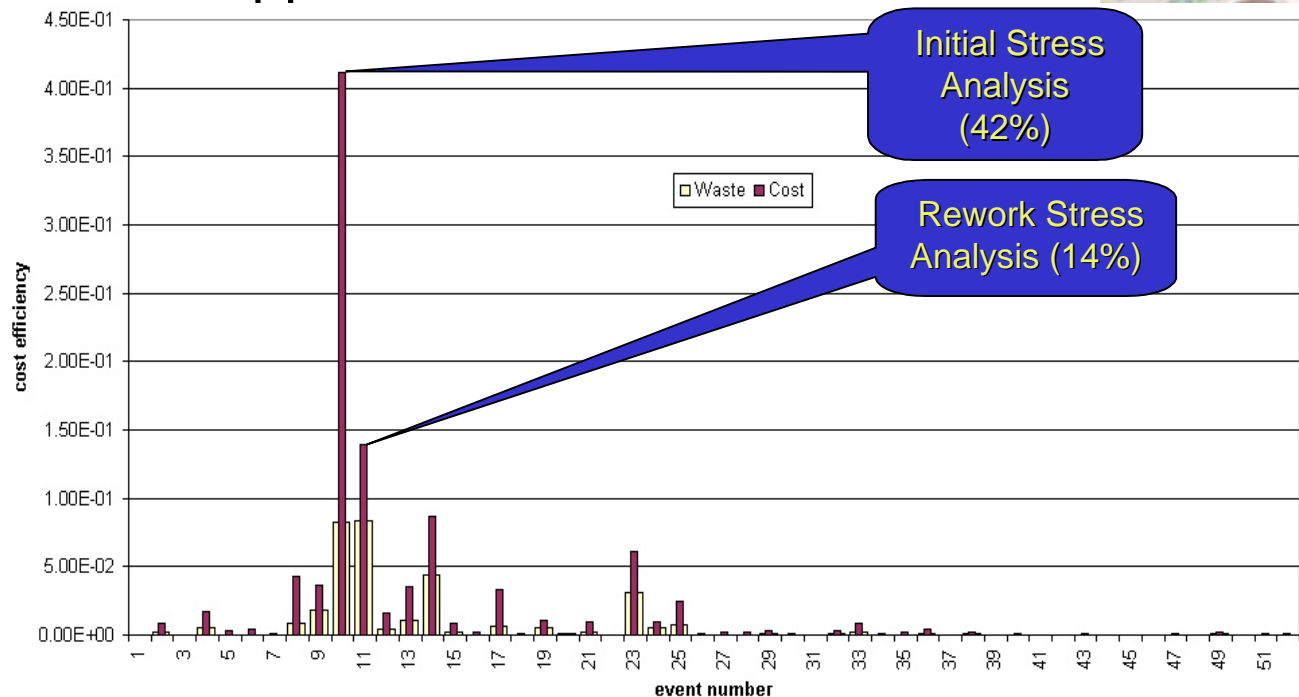
Value Stream Analysis – Structural Certification



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- **Objective**

- Identify cost and time drivers in current cert process
- Identify near- and long-term R&D opportunities



Overall Process Improvements

Method Development

Method Credibility



TEC Approach



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	Overall Certification Process	Analysis Methods	Analysis Credibility
Identified Deficiencies	<ul style="list-style-type: none">• Slow and fragmented design process<ul style="list-style-type: none">- Model development- Config management- Sequential processing• Test typ not modeled• Applicability to future systems??		
Potential TEC Contributions	<ul style="list-style-type: none">• Rapid modeling techniques• Object oriented programming• Info/data management• Virtual test		



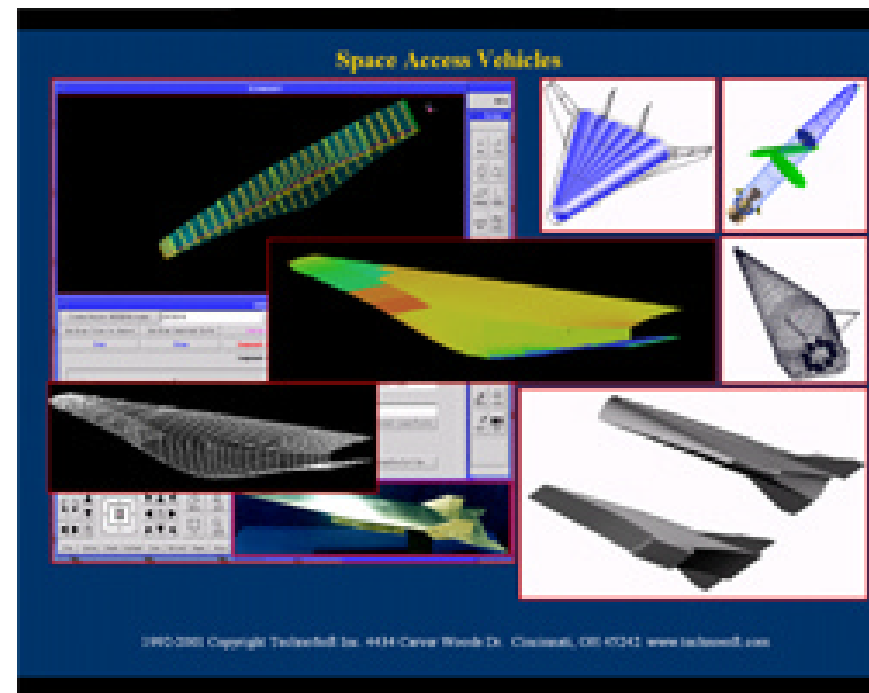
Efficiencies in Certification of Complex Structural Components



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- **Near-Term Approach**

- Integrated computational environment
 - Streamline design development and certification processes
 - Insert/evaluate new analytical methods & assurance techniques
- Virtual test capabilities
- Data automation & correlation
- Planned validation using component-level testing



- **Far-Term Approach**

- Studying concepts for certification of new materials and structural systems



TEC Approach



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	Overall Certification Process	Analysis Methods	Analysis Credibility
Identified Deficiencies	<ul style="list-style-type: none">• Slow and fragmented design process<ul style="list-style-type: none">- Model development- Config management- Sequential processing• Test typ not modeled• Applicability to future systems??	<ul style="list-style-type: none">• Physics not always understood• Risk quantification and uncertainty modeling generally lacking• High fidelity methods typically computationally intensive	
Potential TEC Contributions	<ul style="list-style-type: none">• Rapid modeling techniques• Object oriented programming• Info/data management• Virtual test	<ul style="list-style-type: none">• Non-deterministic methods• Faster turn-around times• Nonlinear methods• Transition to design	



Airframe Integration of Modern Stores



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OBJECTIVE: Improved store separation predictions for internal/external store carriage and release

CHALLENGES

- Many possible configurations
- Uncertainties in parameters
- Error band determination

APPROACH

- Research: Assess applicability of uncertainty analysis
- Development: Incorporate results into trajectory program
- Validation: Wind tunnel testing and T&E leveraging



Computationally-based weapons separation simulation R&D tool

- Expanded Weapons Delivery Envelope
- Improved Stores Clearance & Cert Process



TEC Approach



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	Overall Certification Process	Analysis Methods	Analysis Credibility
Identified Deficiencies	<ul style="list-style-type: none">• Slow and fragmented design process<ul style="list-style-type: none">- Model development- Config management- Sequential processing• Test typ not modeled• Applicability to future systems??	<ul style="list-style-type: none">• Physics not always understood• Risk quantification and uncertainty modeling generally lacking• High fidelity methods typically computationally intensive	<ul style="list-style-type: none">• Error quantification is very challenging• Limited VV&A metrics...how valid is it?• Credibility of results, esp. predicting untested cases
Potential TEC Contributions	<ul style="list-style-type: none">• Rapid modeling techniques• Object oriented programming• Info/data management• Virtual test	<ul style="list-style-type: none">• Non-deterministic methods• Faster turn-around times• Nonlinear methods• Transition to design	<ul style="list-style-type: none">• Expert systems• Benchmarking• Validation metrics



V&V of Integrated and Adaptive Control Systems



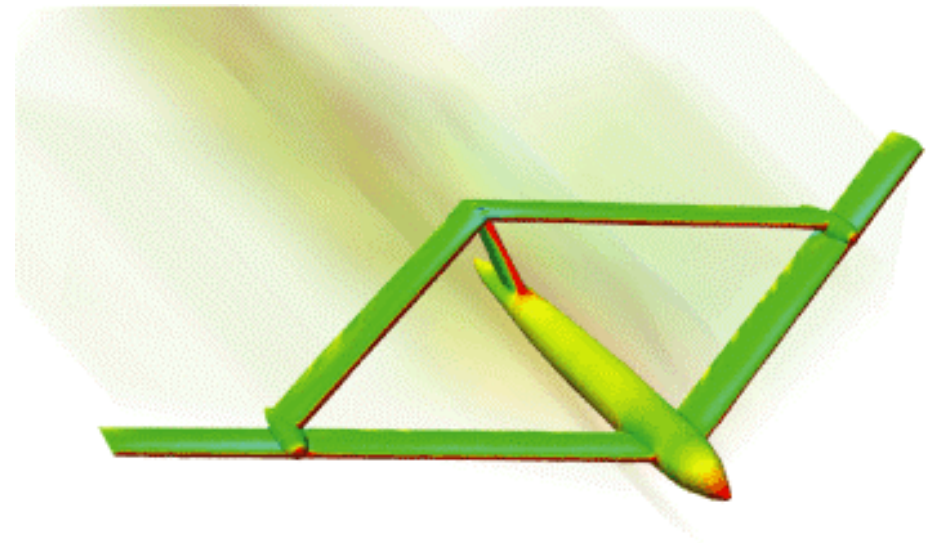
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- **Objective**

- More cost effective V&V of complex digital flight control systems

- **Challenges**

- Flight critical SW requires extensive certification
- Complex SW systems
 - Diagnostic capabilities
 - Reconfigurable controls
 - Performance optimization



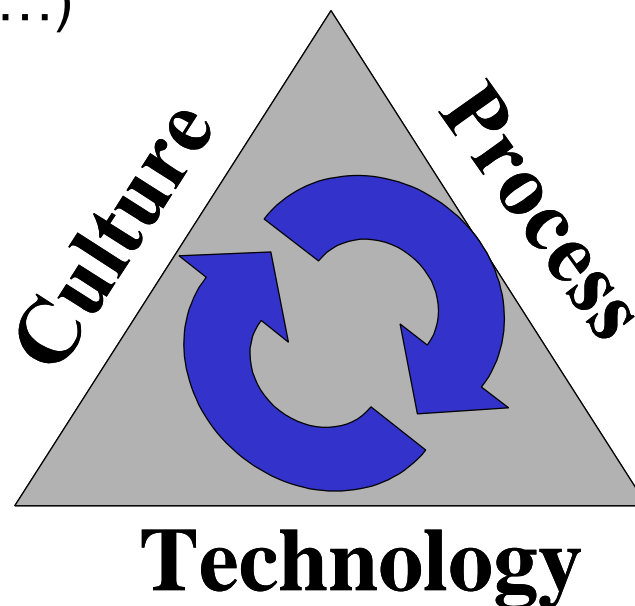


Transition to Acquisition



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- **Partnering is key!**
- **Gov't-industry structures IPT to coordinate activities**
 - USAF (AFRL, ASC, AFFTC, ...)
 - USN
 - FAA
 - NASA
 - DARPA
 - Industry
 - Academia
 - NATO RTO WGs



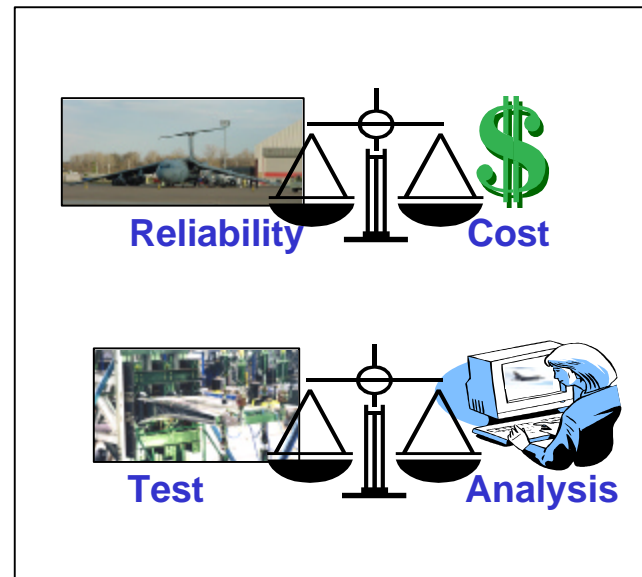


TEC Payoffs



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- Smarter designs
- Smarter testing
- Better analysis decisions
- Increased understanding of system interactions
- Design innovation



Risk reduction, design driven process for more effective and efficient certification



Contact Info



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