

| REPORT DOCUMENTATION PAGE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                 |                                                                | Form Approved<br>OMB No. 0704-0188                |                                                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|----------------------------------------------------------------|---------------------------------------------------|---------------------------------------------------------------|
| Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate only, other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (07804-0188), Washington, DC 20503. |                                                                 |                                                                |                                                   |                                                               |
| 1. AGENCY USE ONLY (LEAVE BLANK)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                 | 2. REPORT DATE<br>20 June 1996                                 |                                                   | 3. REPORT TYPE AND DATES COVERED<br>Professional Paper/Slides |
| 4. TITLE AND SUBTITLE<br>The Role of Verification and Validation in an Electronic Combat Installed System Test Facility                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                 |                                                                | 5. FUNDING NUMBERS                                |                                                               |
| 6. AUTHOR(S)<br>James Young                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                 |                                                                |                                                   |                                                               |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)<br>Commander<br>Naval Air Warfare Center Aircraft Division<br>22541 Millstone Road<br>Patuxent River, Maryland 20670-5304                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                 |                                                                | 8. PERFORMING ORGANIZATION<br>REPORT NUMBER       |                                                               |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)<br>Naval Air Systems Command<br>Department of the Navy<br>1421 Jefferson Davis Highway<br>Arlington, VA 22243                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                 |                                                                | 10. SPONSORING/MONITORING<br>AGENCY REPORT NUMBER |                                                               |
| 11. SUPPLEMENTARY NOTES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                 |                                                                |                                                   |                                                               |
| 12a. DISTRIBUTION/AVAILABILITY STATEMENT<br>Approved for public release; distribution unlimited.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                 |                                                                | 12b. DISTRIBUTION CODE                            |                                                               |
| 13. ABSTRACT (Maximum 200 words)<br><br><ul style="list-style-type: none"> <li>• <i>ISTF Definition and Purpose</i></li> <li>• <i>Verification and Validation (V&amp;V)</i></li> <li>• <i>Description of the U.S. Navy's ISTF</i></li> <li>• <i>The Air Combat Environment Test and Evaluation Facility (ACETEF)</i></li> <li>• <i>ACETEF V&amp;V Process Development</i></li> <li>• <i>Summary</i></li> </ul>                                                                                                                                                                                                                                                                                                            |                                                                 |                                                                |                                                   |                                                               |
| 14. SUBJECT TERMS<br>ACETEF;Verification and Validation (V&V);ISTF;Electronic Combat                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                 |                                                                | 15. NUMBER OF PAGES<br>18                         |                                                               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                 |                                                                | 16. PRICE CODE                                    |                                                               |
| 17. SECURITY CLASSIFICATION<br>OF REPORT<br><br>UNCLASSIFIED                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 18. SECURITY CLASSIFICATION<br>OF THIS PAGE<br><br>UNCLASSIFIED | 19. SECURITY CLASSIFICATION OF<br>ABSTRACT<br><br>UNCLASSIFIED | 20. LIMITATION OF ABSTRACT<br><br>UL              |                                                               |

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)  
Prescribed by ANSI Std. Z39-18

DTIC QUALITY INSPECTED 3

Enclosure (11)

19960916 025

# DISCLAIMER NOTICE



**THIS DOCUMENT IS BEST  
QUALITY AVAILABLE. THE  
COPY FURNISHED TO DTIC  
CONTAINED A SIGNIFICANT  
NUMBER OF PAGES WHICH DO  
NOT REPRODUCE LEGIBLY.**

**NAVAL AVIATION SYSTEMS  
TEAM**



# **The Role of Verification and Validation in an Electronic Combat Installed System Test Facility**

**Jeff Barratt  
MITRE, Inc  
USA**

**Jim Young  
NAWC-AD  
NAS Patuxent River, MD  
USA**



# Outline



- ISTF Definition and Purpose
- Verification and Validation (V&V)
- Description of the US Navy's ISTF
  - The Air Combat Environment Test and Evaluation Facility (ACETEF)
- ACETEF V&V Process Development
- Summary



# What is an ISTF?

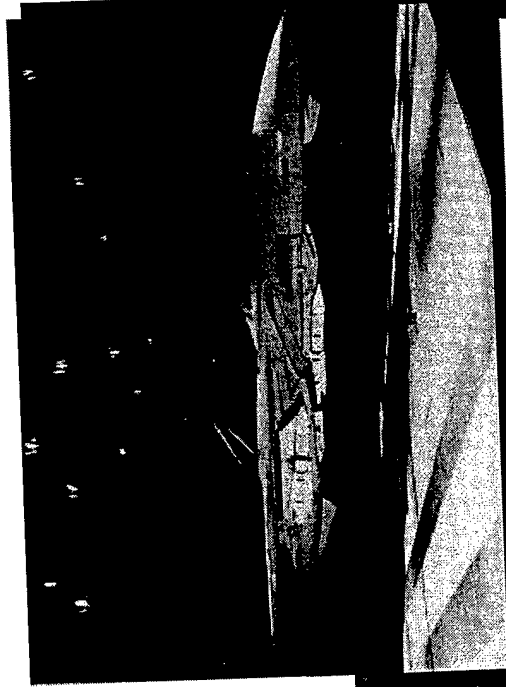


**Installed System Test Facility (ISTF)**- A facility where avionics installed and integrated in their host platform can be stimulated to determine performance.

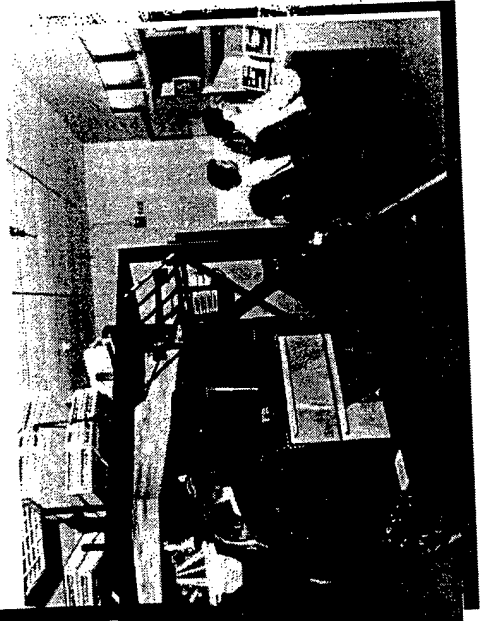
**HANGARS**



**ANECHOIC CHAMBERS**



**SIMULATION &  
STIMULATION  
LABS**



# Requirement



## •DoD Directive 5000.2

- "...threat or threat representative forces, targets, and threat countermeasures, validated in coordination with DIA, shall be used"
- "Whenever models and simulations are to be used: identify the planned models and simulations; explain how they are proposed to be used; and provide the source and methodology of the verification, validation, and accreditation underlying their credible application for the proposed use."



# Definitions



**VERIFICATION** - The process of determining that a model implementation accurately represents the developers conceptual description and specifications.

DoDD 5000.59

## REQUIRES:

- State of the art test equipment for measurement of stimulator parameters
- Design specification validation report (DSVR) meetings attended by laboratory personnel
- Complete assessment of stimulator actual operation vs intended operation by laboratory personnel



# Definitions



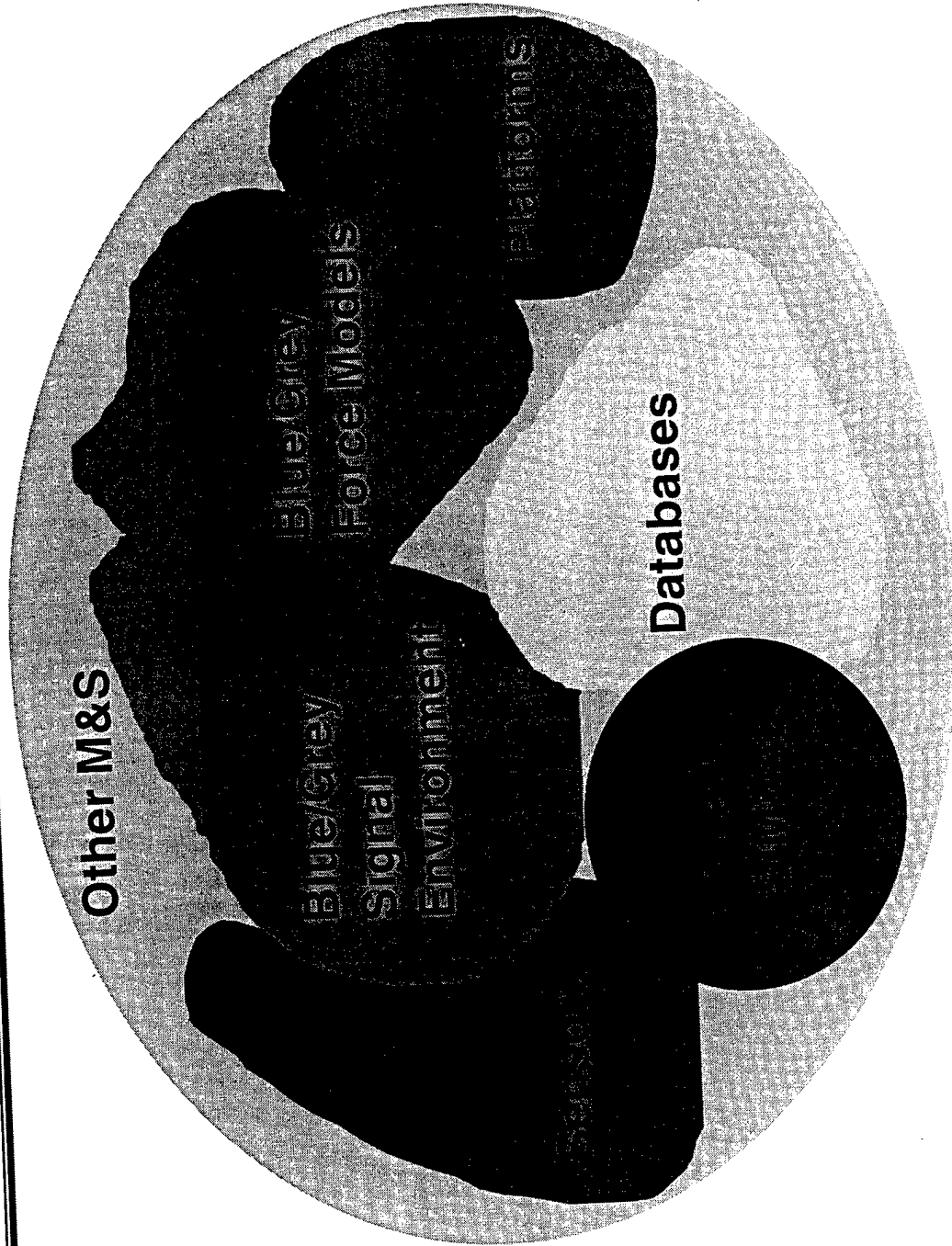
**VALIDATION** - The process of determining the degree to which a model is an accurate representation of the real world from the perspective of the intended uses of the model.

DoDD 5000.59

- Threat SIMVAL is a well-defined, established process
- Validation for the universe of other models and simulations is not yet well-defined
- Defense Modeling and Simulation Office (DMSO) initiatives encompass the “gray” areas



# Modeling and Simulation Universe





# ISTF Validation



- Threat SIMVAL focuses on relatively static *things*: Threat Simulators
  - Once device and signal is validated, it remains so unless object being modeled changes
- Flexibility and complexity of ACETEF requires focus on *tests*
  - Scenarios, stimulator mix, test objectives all may change from test to test
  - Requires some validation activity for each test configuration



## WHAT IS SO HARD ABOUT V&V IN AN ISTF?!



- Multiple complex simulations of various types
- Physical placement of stimulator hardware
- Unforseen interactions between stimulators and the system under test

***AN AGGREGATION OF VALIDATED  
STIMULATORS IS NOT NECESSARILY VALID!***



# US Navy ISTF



## Air Combat Environment Test and Evaluation Facility

*Test installed avionics systems*

*Provide a realistic simulated environment*

*Provide ground test to complement flight test*

*Maximize platform test productivity*

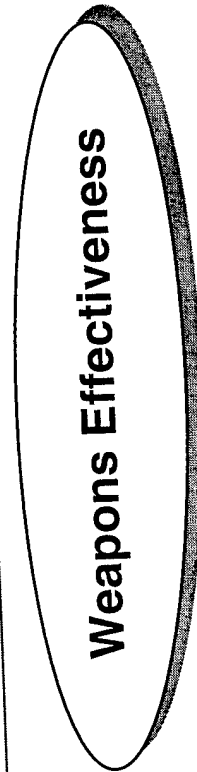
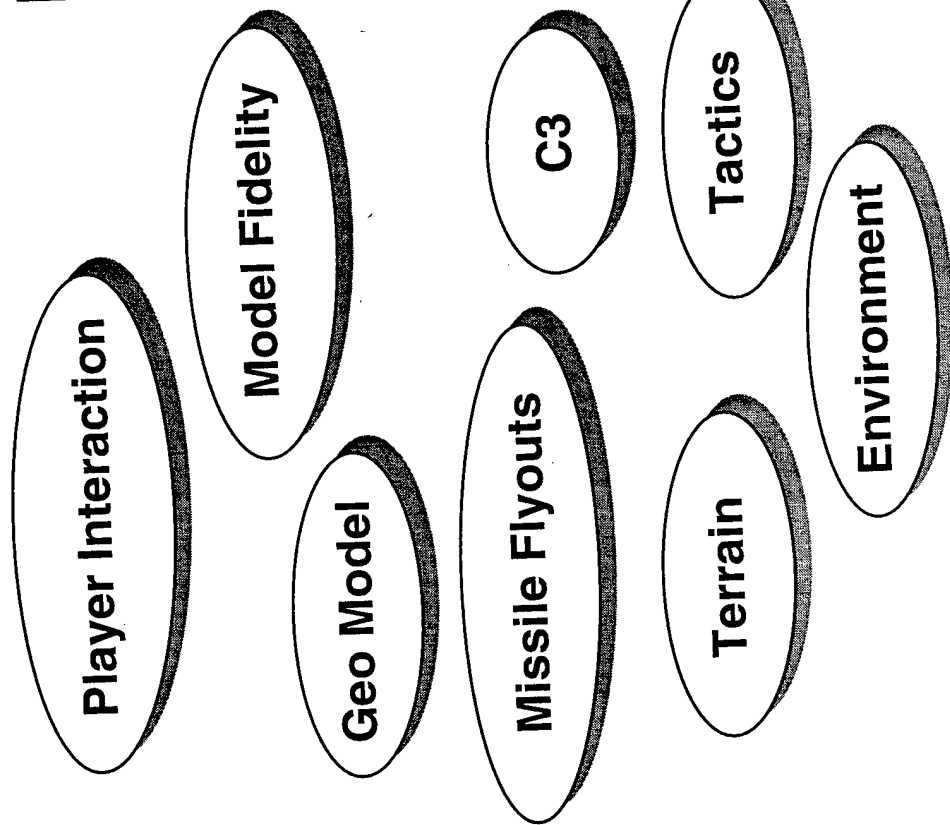
**Reduce program risk!**



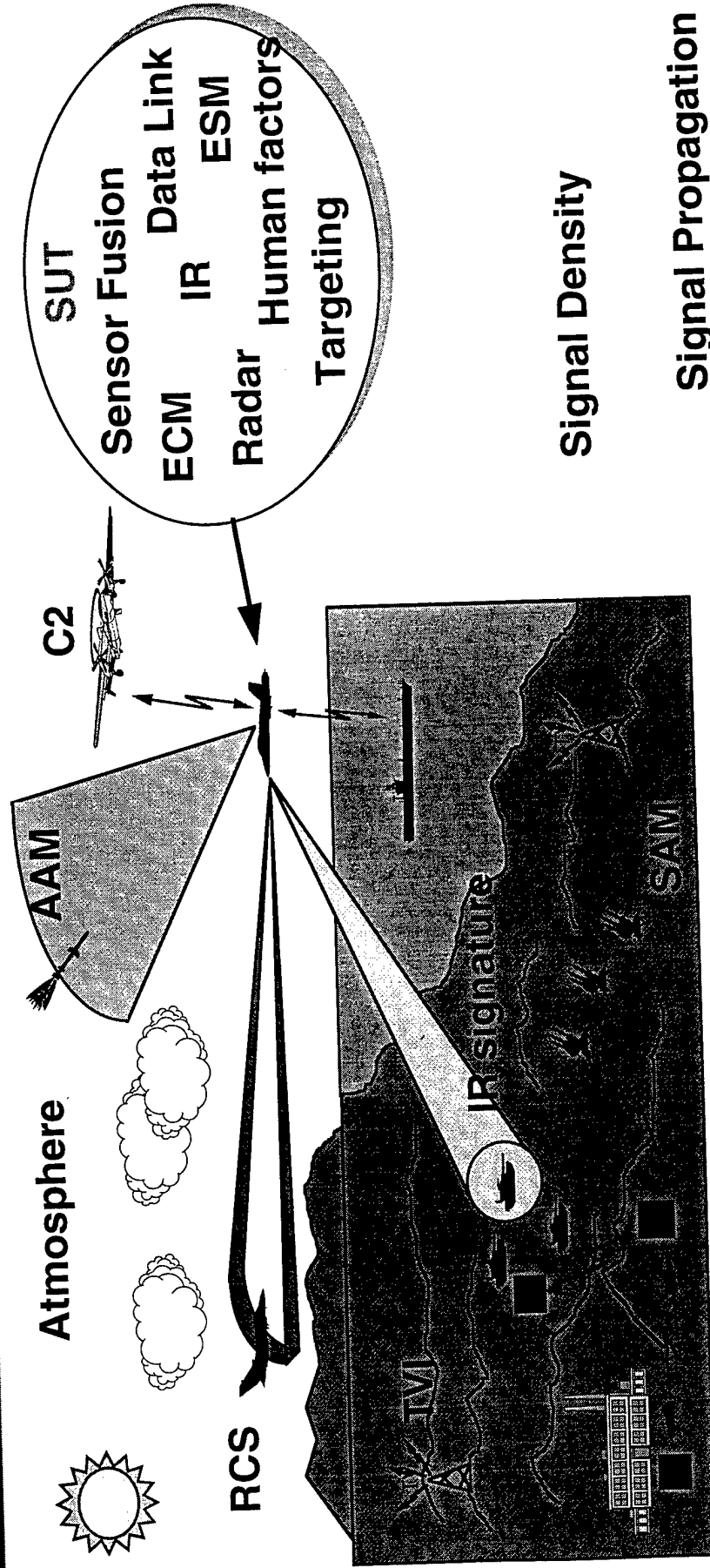
# ACETEF Digital Model



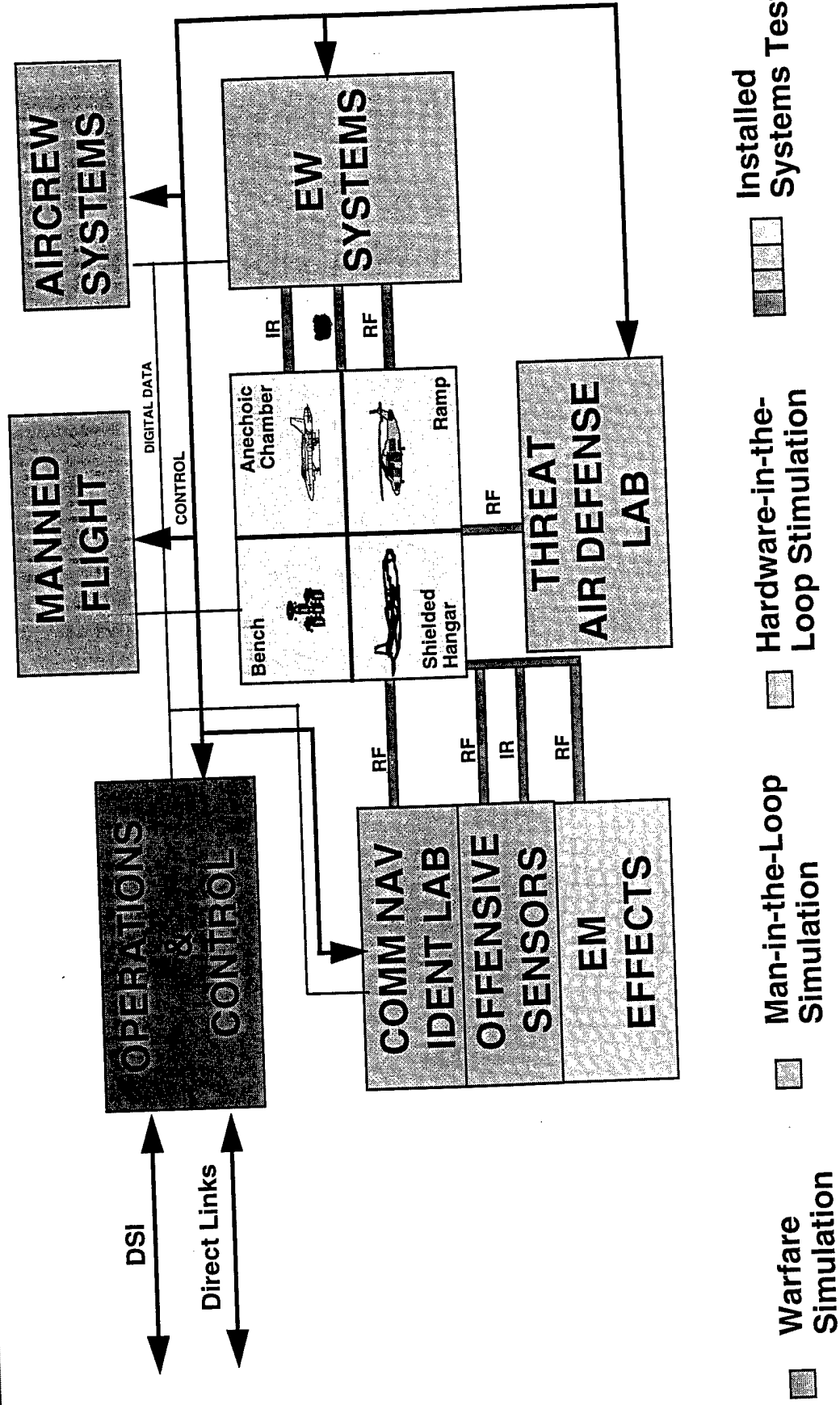
## Simulated Warfare Environment Generator (SWEg)



# ACETEF Stimulations



# ACETEF ARCHITECTURE





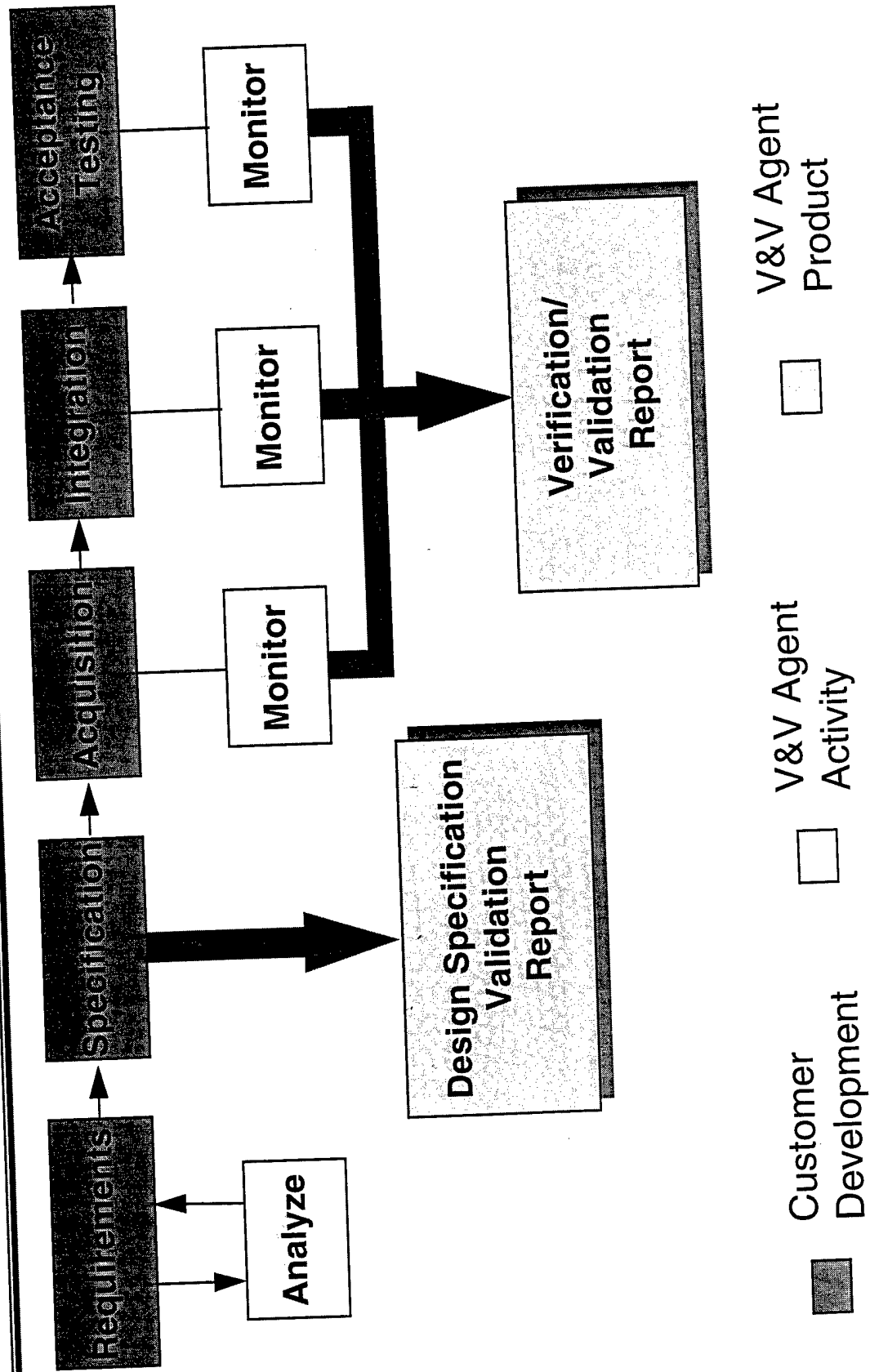
# Testing Issues



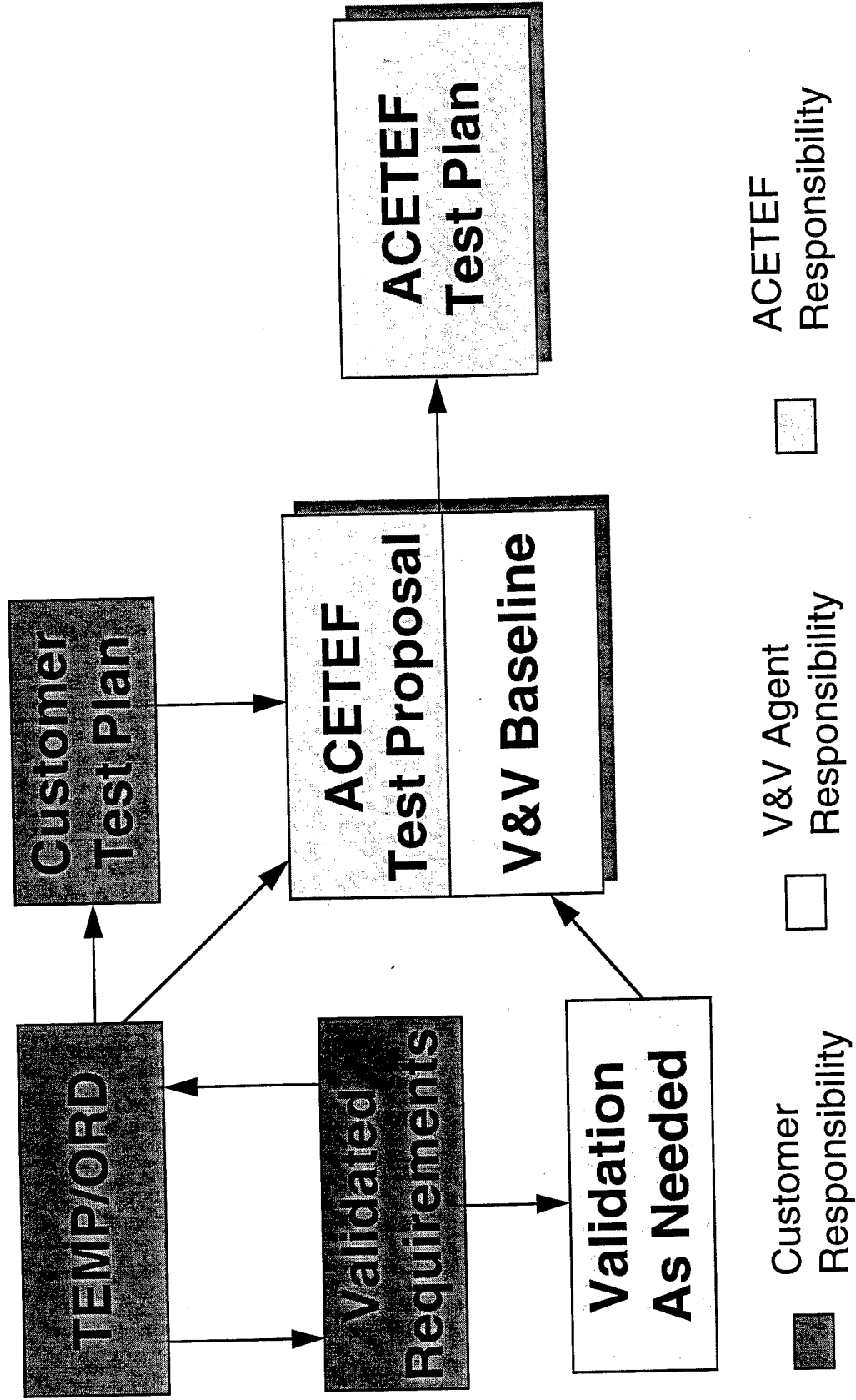
- Realistic system under test loading
- Realistic “test” C4I Architectures/ Loading
- Realistic/varied background
- “Coherent” Scenarios
- Integration of Missile Warning and Countermeasures
- IR and Semi-active Missile Seeker end game testing.
- Highly dynamic scenarios
- Numbers/types of targets
- Coordination of Surveillance Assets
- Training/Calibration of Knowledge Based Algorithms vs testing



# Development Process



# Test Planning Process





# Internal V&V Agent Role



- Perform internal verification and validation of tests
- Ensure repeatability (and document for reproducibility)
- Ensure quality control
- Produce validation reports in the format usable by accreditors
- Assist external validators in understanding and validating ACETEF systems
- Ensure that new ACETEF systems can be validated



# Conclusions

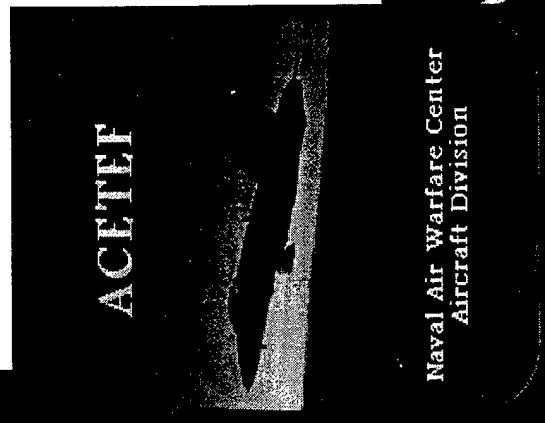


- Modeling and Simulation has a lot to *prove* to the test community
- COST EFFECTIVENESS has two dimensions
  - Can we reduce the cost of testing by supplanting flight tests with M&S tests?
  - Can we test scenarios that would otherwise be *unaffordable* to test?

**A sound ISTF V&V process is critical to the establishment of M&S credibility**

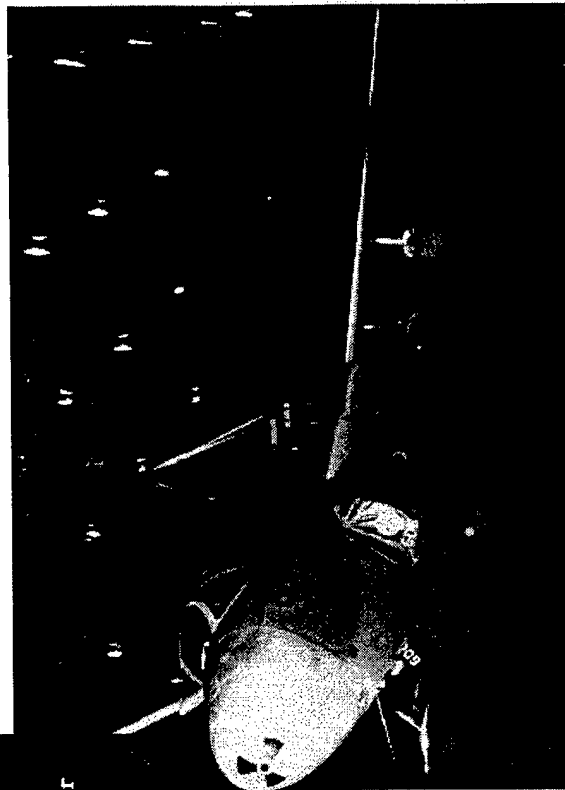


**ACETEF on the WEB**



**ACETEF**

Naval Air Warfare Center  
Aircraft Division



**<http://setd.nawcad.navy.mil>**