Overview

• Air Force Integrated Collaborative Environment (AF-ICE) Description
• Systems Engineering Process
• VV&A
• Air-to-Ground Integration Layer Exploration (AGILE) Live, Virtual, and Constructive (LVC) Venue
• AFICE today and tomorrow
AFICE Objectives

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- Thorough testing with credible analysis to deliver better products at reduced costs
- An acquisition lifecycle-assessment approach to leverage resources and expertise at distributed locations
- An analytically based, system engineering process to support traceability of war fighter requirements throughout the acquisition life cycle
- Compose-able, reusable, non-duplicative networked and instrumented infrastructure resources, consisting of LVC assets
- Primary focus: Identify, categorize, assess, and report integration and interoperability gaps and seams
- Secondary mission: Assessment test-bed for risk-reduction activities for any program
Assess the “Seams”

AFICE aids programs in defining and assessing integration and interoperability issues such as NR-KPP*

*Net-Ready Key Performance Parameter

AFICE Support to Test!
AF-ICE Vision: It’s all about the integration

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Horizontal Integration
(USAF single mission/multiple platforms)

Cross Domain Integration
(USAF multiple mission/multiple platforms)

Joint Integration
(joint missions/multiple platforms)

All integration within one distributed live, virtual & constructive range
~~Efficient~~Effective~~Validated~~

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Investment Strategy

Three AFICE Key “Tenets”

1. Customer Need “War-Fighter Gap”

2. Tools built to a set of design standards and principles!

3. Assessments built around analytical objectives using sound system engineering principles to configure the tools to meet customers rqmts!

4. Prove it! Prove the tools and processes below serve real customers needs!

Events
- Repeatable exercise of AFICE infrastructure and processes!

Capability Builds (Infrastructure)
- Modeling, Simulation, and Analytic tools, data, & models

Process
- A repeatable series of related actions to produce a desire outcome
“M&S Battle-space”
Mapping between the real and virtual battle-spaces

Virtual Battlespace:
Computer representation of the actual battle-space!

“Real” Battlespace

Problem of interest is defined from the real battle space and “scoped” within study requirements (inside the LVC battle-space).

End-to-End Approach:
“Constructive” requirements & performance characterization investigation, leading to “Virtual” validation and verification performance assessments (aircrew in the loop)

Analysis results provide insight into the trade space and are applied to the customer’s decision making process to positively impact combat power!

Digital representation of key functional capabilities of the system(s) necessary to support the analytic objectives

“Requirements” for Virtual Battlespace

Analytic Objectives

Analytic Results

Systems Engineering Process

Functional Rqmts CONOPS Use Cases

SOS Context for the Study

System Under Study

Project I

Project II
Organization of Requirements

Functional Requirement Lexicon applied to all Projects

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Key Takeaway: Requirement owners speak in the an organized and consistent language to the software developers! Reduces errors and Requirement Churn!
EAAGLES

Extensible Architecture for Analysis and Generation of Linked Simulations

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- Capability-Based Design
- Electronic combat environment
- Robust air-to-air and air-to-ground
- Designed for hundreds of players
- Proven real-time architecture
- Optimized for the PC, yet platform independent
- Variable and Scalable Fidelity, Object Oriented
- Hardware: Dual to Networked PC “clusters”
- Hardware-in-the-Loop
- Distributed simulation via DIS, HLA, & TENA
- Government owned and managed software

Infrastructure Matters! Environment is engineered for real-time SoS assessments!

The EAAGLES framework is publically released and available via www.openeaagles.org
AFICE Distributed LVC Team
Mapping local processes

AFICE Lead IPT

PARTICIPATING LOCAL SITES IPTs

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**VV&A Problem Statement**

- **The primary role of V&V is to reduce risk.**
  - The greater the risk, the more V&V are required.

- **Requirements and intended use must exist before V&V can be conducted; acceptability criteria must be developed and documented:**
  - Acceptability criteria should be agreed upon between the test manager and the accreditation authority.
  - Acceptability criteria are a measure of the risk the accreditation authority is willing to accept prior to conducting the test.

- **V&V is a never-ending process**
  - V&V continues during test execution. Information may need to be collected during actual test/event execution to ensure that the environment is correct, the simulations are running correctly, and the simulations are interacting with each other correctly.
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**VV&A Process Framework**

**Structuring the Project**

**Step 1. Identify & Categorize VV&A Issues**

**Step 2. V&V Maturity Levels**

- Provide a list of all potential issues identified by category and show the V&V maturity level desired and actually achieved to address each issue:
  - The V&V maturity level must be supported with evidence.
  - Document each potential issue using the "V&V RISK ANALYSIS" outline on the next chart.

- For each risk area identified, provide the chart depicted in Step 4, along with the following information:
  - Specific problem
  - The specific known potential consequences
  - Any additional risk mitigation or V&V activities that may take place before use of the simulation environment
  - A projected schedule and cost to raise the V&V Maturity to the desired level (if possible)

**Step 3. V&V Risk Matrix**

<table>
<thead>
<tr>
<th>Consequence*</th>
<th>Probability that issue will lead to the consequences for the intended use*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Substantial</td>
</tr>
<tr>
<td>Catastrophic</td>
<td>4-5</td>
</tr>
<tr>
<td>Critical</td>
<td>4-5</td>
</tr>
<tr>
<td>Marginal</td>
<td>3</td>
</tr>
<tr>
<td>Negligible</td>
<td>2</td>
</tr>
</tbody>
</table>

*Numbers in boxes indicate desired V&V maturity level to support an accreditation decision.
*Desired V&V maturity levels must be justified based on test objectives.
*See notes page for more information.

**Step 4. Determine Risk Level**

**Step 5. Report Risk**

**VV&A Process Complete**
VV&A Approach
Applying VV&A to AFICE LVC Distributed Assessments

- Apply template to selected potions of AGILE Fire III
- Report, by project, results to mock Accreditation Authority or Authorities
  - Include Assessed Risk Levels, Ability to mitigate Risk, and Resulting VV&A Risk levels per template
- Report, for entire event, results to mock “Event Accreditation Authority”
- Document lessons learned
- Collect VV&A documentation where applicable
- Provide feedback to further update the template
  - Assess applicability in whole or part (with new upgrades) in preparing for AGILE FIRE IV
- Document entire process as a Use Case
AFICE Venue
Unique Venue to support AFICE Objectives

- Focus on the interoperability within and between space, air and ground communication layers

- Capture the requirements for emerging technologies/interfaces to existing force structure in mission contexts.

- Support the customers by enabling a SOS environment to meet their Net Centric assessment needs!
  - Requirements drive assessments
  - Analysis rooted in mission threads
  - Net Centric Focus to link their system performance to their operational partners
AGILE II/III Description

Air and Ground Integrated Layer Exploration

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- Multifunction Advanced Data Link (MADL)
  - AFMC/Electronic Systems Center (ESC), SAF/A6W
- Gateway
  - AFMC/ESC; Air Force Command and Control Integration Center (AFC2IC)
- AFATDS – TACP CASS
  - PM AFATDS/TACP-CASS/Ft Sill FSC
- Joint Air Ground Integration Cell (JAGIC)
  - ACC/A3D – USAF OPR
  - Joint and Combined Integration (JACI) – USA OPR
- Dynamic Air Space Management
  - AFMC/ESC-PM TBMCS/PM TAIS/PM AFATDS
- Counter – Rocket Artillery and Mortar (C-RAM)
  - PEO C3T/PD- CRAM
- Net-Enabled Weapon (NEW)
  - NEW Interoperability Working Group (NEWIG), SAF/A6W
- Capability Net Centric Test & Training (CNCTT)
  - 505th Command Control Wing (CCW)

AGILE III’s Schedule

- AGILE III’s next planning Conference is 26 to 28 Oct at WPAFB
- First Integration Spiral is December 2010

AGILE FIRE PHASE III adds 5 new projects
• Part of OSD “VV&A Use Case” project tied to M&S Coordination Office High Level Task
• Used Networked-Enabled Weapon (NEW) as notional SUT
• Applied draft “Evaluation and Reporting Framework”
  – Risk-based framework
  – Pragmatic approach designed to achieve confidence in LVC environment while minimizing cost and schedule impacts
  – Focused on Live, Virtual, Constructive Distributed Environment (LVC-DE) for Test and Evaluation
• Reported results to mock Accreditation Authority (SAF/A6W SL) on 17 Aug 10
• Updated draft framework based on feedback
• Reapply as Part of AGILE III, and IV in FY10
• CONOPs signed by Brig Gen Bender (SAF/A6W) on 1 October 2010

• CONOPs establishes AFICE focus on program Integration and Interoperability

• Formalizes AFICE Governance
  - Relationship to WFI GOSG
  - Formation of an O-6/GS15 AFICE Advisory Group (AAG)
  - Formation of an AFICE Users Group (AUG)

• CONOPS identifies a process for nomination of a War Fighter Gap
AFICE and NR-KPP

Present and Future

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• Begin to formalize Interoperability assessments
  - Consistent with existing test
  - Not duplicative
    - Focus on testing the capability in mission threads
      vice message compliance within the System
  - Work with the NR-KPP experts

AFICE Goal: Move beyond finding problems after system release to engaging with programs and supporting primes to discover interoperability problems before system release
Summary

• AFICE uses a robust SE process to establish and maintain requirement traceability from analytic objectives through software development.

• The resulting LVC environment is uniquely "engineered" for each customer based upon their analysis needs - Tied to a War Fighting Requirement.

• AFICE uses these environments to support integration and interoperability assessments based upon War-Fighter capability gaps.
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2011 System of Systems Engineering Collaborators Information Exchange Webinars

- April 12th: **A Game Loop Architecture for the Modeling and Simulation of Mission Threats**, Thomas Tanner, SAIC
- May 10th: **The Role of Enterprise Architecture Updates in Guiding Decentralized Organizations**, John Schatz, SPEC Innovations
- May 24th: **Test and Evaluation Issues for Systems of Systems: Sleepless Nights to Sominex**, Dr. Beth Wilson, Raytheon & Dr. Judith Dahmann, MITRE

For information, email dasd-se@osd.mil or visit our website: http://www.acq.osd.mil/se/outreach/sosecollab.html