Test and Evaluation in a System of Systems Environment

A Case Study of the Air Force Modeling & Simulation Training Toolkit (AFMSTT)

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Notes

► This presentation is an extract of work
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► This presentation has been cleared for
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► The opinions expressed here are solely
those of the principal author
Outline

► What is AFMSTT?
► Why is AFMSTT interesting relative to SoS T&E?
► What has AFMSTT done to make it work?
► Layered T&E Strategy
► Lessons learned that could be applied elsewhere
► Some fortunate circumstances
► Recommendations for further research
► Postscript
What is AFMSTT?

- The Air Force Modeling and Simulation Training Toolkit (pronounced “AFF’ mist”)
- Software program over 15 years old (written mainly in ADA & C++ > 2M SLOC)
- Significant human control/inputs/interaction (approximately ten model controllers)
- Provides a constructive air picture for battle staff training during major exercises and experimentation
AFMSTT Components

► Air Warfare Simulation (AWSIM) – sim engine
► Graphical Interface Aggregate Controller and Data Server (GIAC) – displays air picture
► C2 System Interface (CSI) – external links
► Logistics Simulation (LOGSIM) – injects realistic logistics constraints & behaviors
Why Is AFMSTT Interesting? (relative to T&E in a SoS)

► AFMSTT functions in several complicated federations and interacts with many systems not under a common governance system – the *essence* of System of Systems

► AFMSTT has been undergoing constant evolution since its inception with nearly continual modification
Joint Live Virtual Constructive (JLVC) Environment

Service Combat Simulations

Linkages to Live Systems/Forces

AWSI M
USA
Air Defense

ICE/ FMS-D
USA, USMC, SOCOM

J CATS
USA, USMC, SOCOM

JS AF
Navy, IADS

SELS
Artillery

Intelligence

NWARS/ACE-IOS/TACSI M/MDST

Sensors

ASTi Radios
Voice Comms

Si Mple
USA

BFTT
Navy

Range Integration

Virtual Simulators

CAVSI M
Apache

DVTE
USMC

V MH-53
SOCOM

V B-52
ACC

V AC-130U
SOCOM

EP-3 MAST
Navy

V J STARS
J STARS

TUAV/ MUSE/ AFERS

V MH-53
SOCOM
What has AFMSTT Done to Make It Work?

► Constant attention to federated environment

► Integrated Test Team of Program Office (V&V), Using Command/Representative (AF Agency for Modeling and Simulation), JFCOM & Contractor along with others as required
  - Developer using Agile software development
  - “Test-driven development methodology”

► Intimately close-coupled and “layered” testing almost continuously
Layered Testing

► Contractor Testing
  - Unit & Component QA Testing – nightly/automated
  - System Integration Testing – weekly
  - IA Testing (in-plant & by 46 TS) – every 30 days
  - Extensive shared repertoire of test scripts and cases used to ID critical interfaces/functions (Note: These are constantly evolving/being updated!)

► Government Validation & Verification (V&V) – every 3 months done in C2 Enterprise Integration Facility @ Hanscom AFB
Layered Testing (cont)

External Testing

- Air, Space & Cyber Constructive Environment (ASCCE) – test harness against ACE baseline
- Federation Testing (JLVC & JLCCTC) – every six months but can be done before major exercises
- Formal External IA – Air Force Communications Agency – Note: AFMSTT first legacy system to receive full ATO from AFCA!
- Event Preparation Testing – two-week “rehearsals” (bug fixing) before major events
Layered Testing
Lessons Learned
(with potential for other systems)

► Constant awareness of SoS environment, focus on configuration control (both systems & interfaces)
► Proactive risk management of important interfaces
► Layered, incremental testing can identify most problems early, when easily fixed
► Employment of realistic test environments (fed tests)
► Pre-planned pre-event rehearsal time periods and allotted time for fixing bugs
► Closer user involvement reduces “stuff nobody really wants” which decreases test requirements
Observations

► Increased cost of testing has driven a desire for “the perfect test” and “complete knowledge”

► Complexities of SoS have made this unrealistic and unachievable! (in *both* cost & time)

► AFMSTT has gone in *exactly the opposite direction* with more testing at lower levels = SUCCESS!

► The Certification and Accreditation (C&A) and Test and Evaluation (T&E) processes need to function much more efficiently in concert/combination
Fortunate Circumstances

► The AFMSTT primary mission is to function within a large federated system of systems
  ▪ Not all systems do so regularly

► Small-dollar program, avoided many large formal documentation requirements
  ▪ LCMP incorporates most aspects of SEP, TEMP, etc. into widely used, concise living document

► Popular User Base & linkage to Joint National Training Capability (JNTC) forces incremental delivery
Recommendations for Further Research

► Additional case studies
► Identify and investigate other large system-of-systems federations
► Work towards a set of principles for SoS T&E and develop a methodology
  ▪ Roadmap for SoS/Net-Centric Approaches
  ▪ Likely that a family of approaches will be needed (large/small federations, hardware/software systems)
Postscript

► DoD Exercise budget decreasing

- Fewer dollars for major exercises
- Fewer dollars for programs like AFMSTT
- Modernization on Horizon – funding challenges

► Since no contract lasts forever, AFMSTT is preparing to recompete development

- The “documentation gatekeepers” have struck!
- AFMSTT program office now dedicating personnel to writing documents (that so far have been unnecessary)
Questions?
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