V&V Summit Wrap-up

Dr. Felder

1. Tight integration with NextGen
   - T&E can’t be discussed as a Standalone Concept
2. Systemized & ISO’d
   - ISO 9000, CMMI,…..
3. Networked Org / can’t work individually
   - Complex adaptive (the people)
   - Ownership of: $, Mission, People, Facilities

UNDERSTANDING the Battlefield

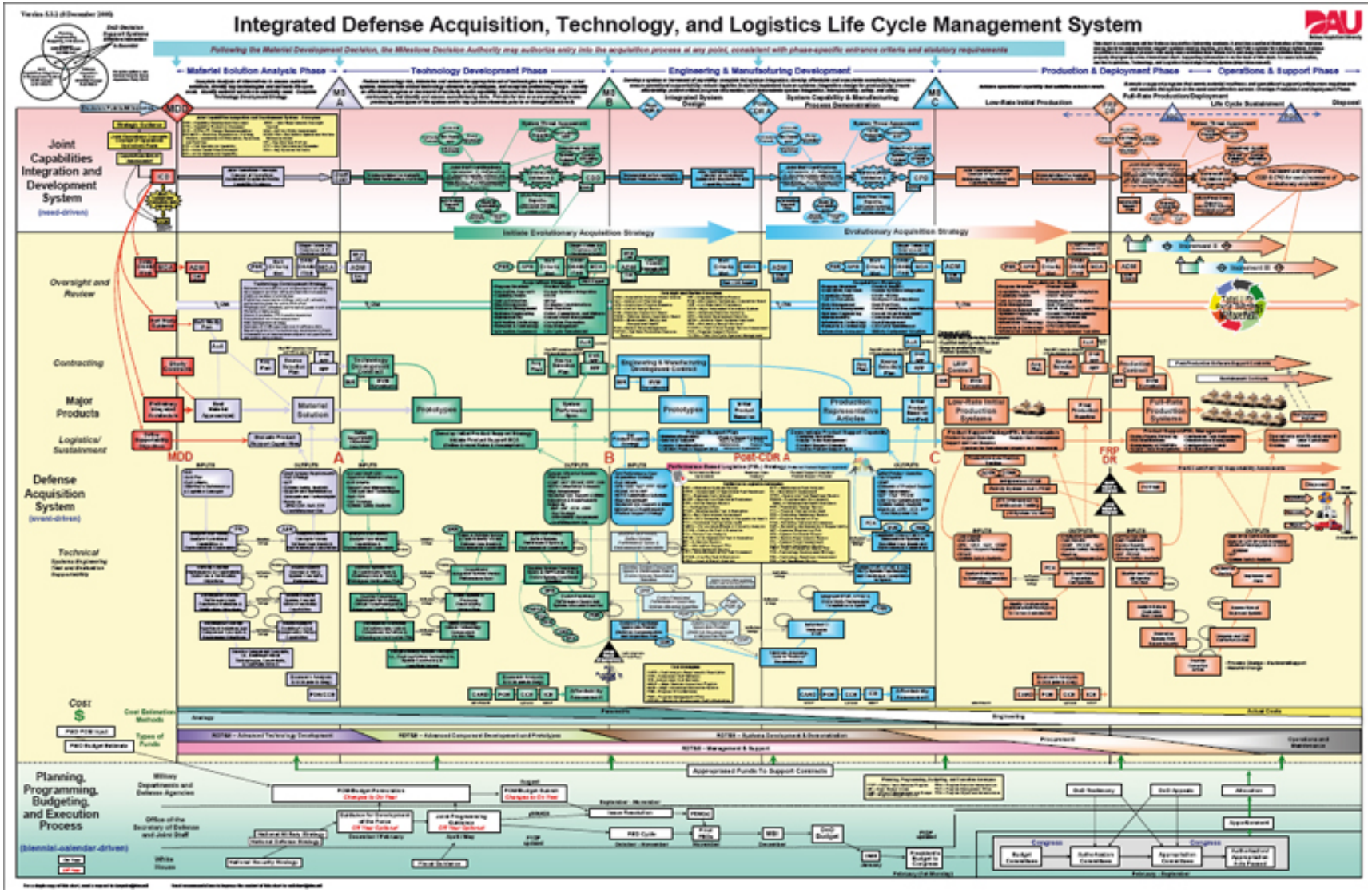
PEO IEW&S

Verification and Validation Summit 2010

System Engineering in DoD

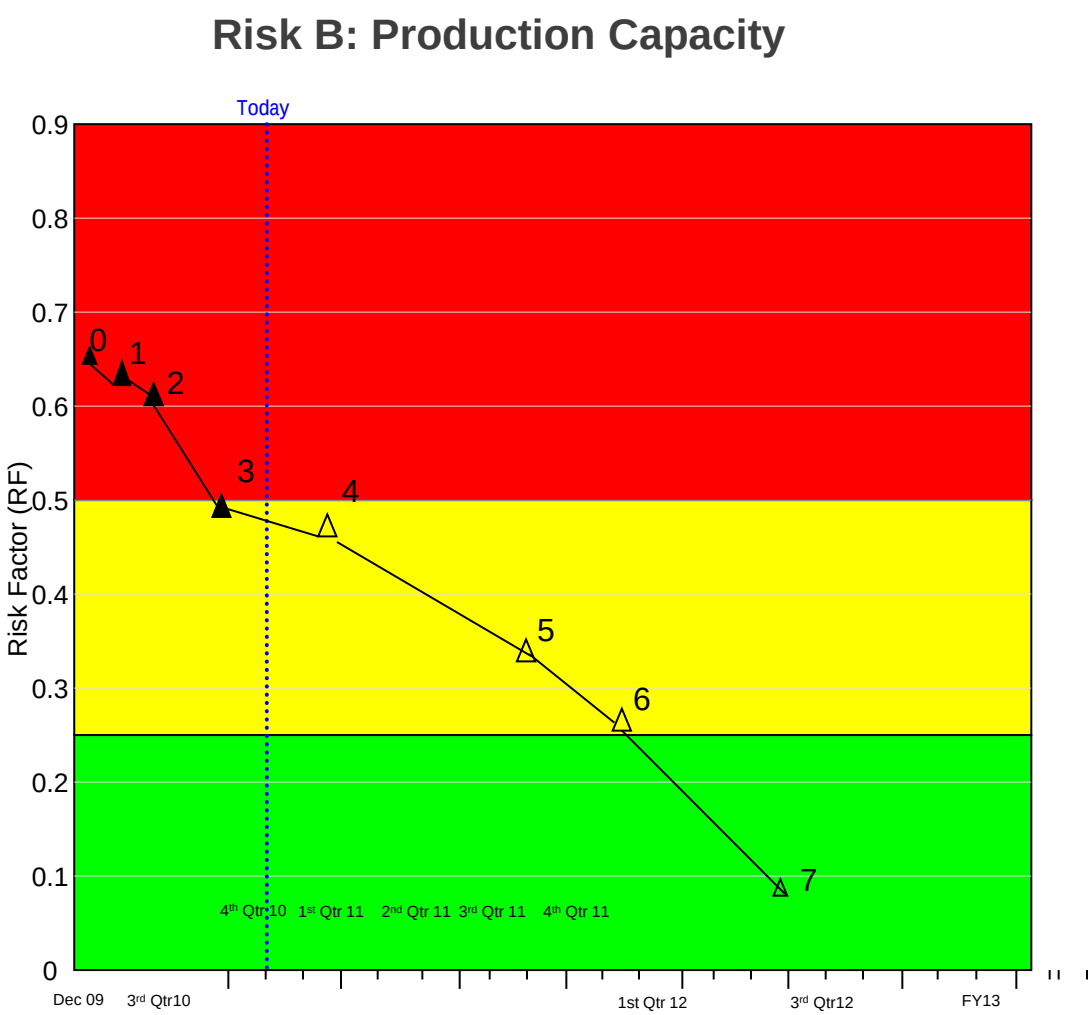
Dr. Rich Wittstruck, *Director SoSE*
PEO IEWS, US Army

The DoD 5000.02 Process



Typical Risk Mitigation Plan

Step	Action	Purpose	Date
0	PRR	Confirm ready for production	Complete
1	Response to PRR findings	Addressed process issues	Complete
2	Increase Oversight by DCMA	Provide early insight into production process and procedure problems	Complete
3	Place Final Spec under contract	Resolve SPEC Discrepancies	Complete
4	Begin FRACAS Reporting	Monitor Post-production failures for trend analysis	Nov 10
5	Regression Test	Confirm production compliance with Spec Requirements	Jul 11
6	Physical Configuration Audit	Establish Configuration Baseline	Sep 11
7	Supply Support	Implement strategy that reduces pressure on production capacity	Mar 12



Take Aways

- Systems Engineering has been a focus area for DoD leadership since 2005

- Systems Engineering is a key enabler in managing to complex program success and satisfying Warfighter requirements

- Risk management is a cornerstone of Systems Engineering and Program Management

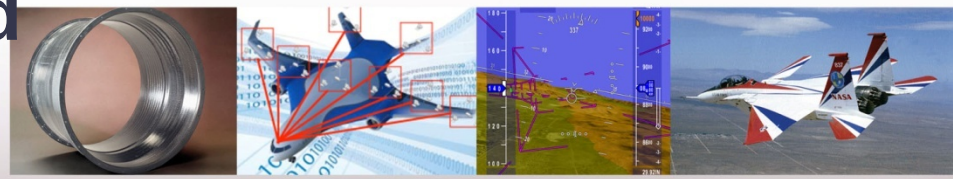
- SoSE is the way of the future for DoD

Enterprise Architecture

Jesse Wijntjes

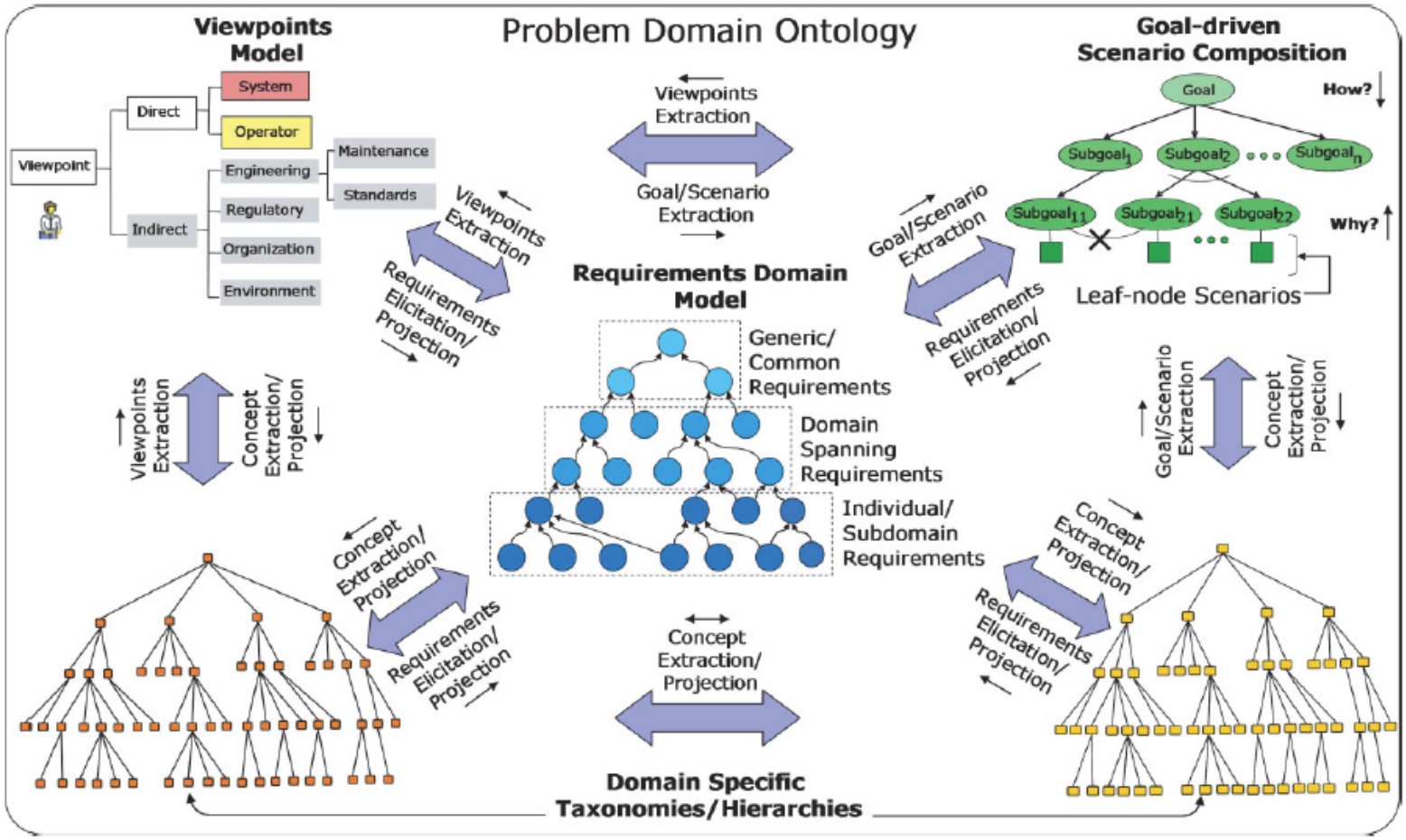
National Aeronautics and Space Administration

NASA Aviation Safety Research Verification & Validation of Flight Critical Systems (VVFCS) – The Way Ahead



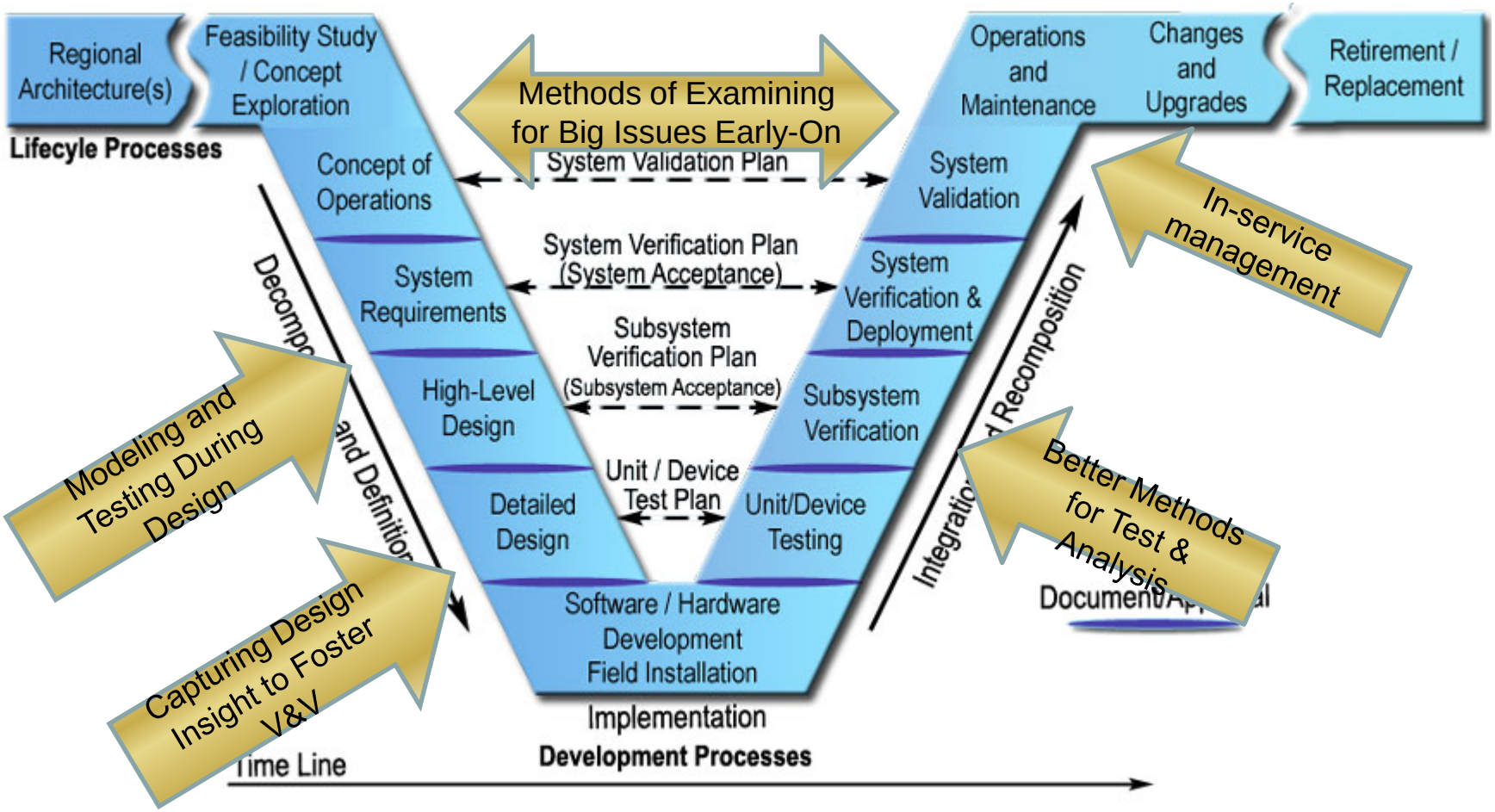
Sharon Graves
NASA Aviation Safety Program
Verification and Validation Summit 2010
October 13-14, 2010

Various dimensions of the Problem Domain



S.-W. Lee, R. A. Gandhi and G.-J. Ahn, Certification Process Artifacts Defined as Measurable Units for Software Assurance, 2007

Seeking Lifecycle Model



Summary

- Four focal research areas
- Partnerships and collaboration with industry, FAA, JPDO, military and academia for coordinated and integrated research & development activities are essential
- Technology transfer at all levels
- Maintain relevancy by on-going communication with key players in community

Melvin Davis

National NextGen Representative

National Air Traffic Controllers Association (NATCA)

This is Complex

Verification and Validation philosophy needs to be applied to Integration and Implementation of NextGen

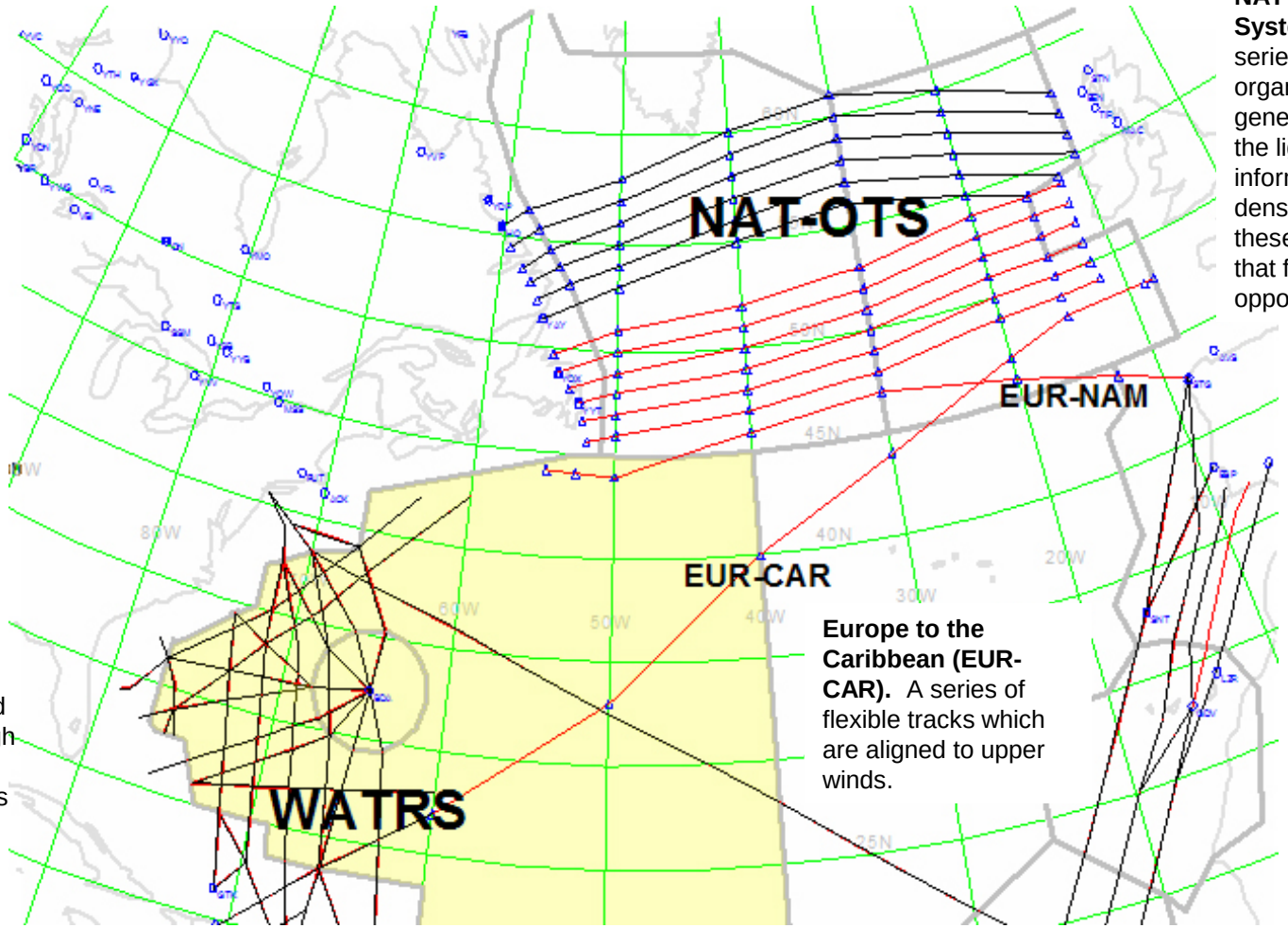
NEXTGEN Now

Ocean21-
The Future of Oceanic
ATC
Today

Atlantic Operations

4 distinct traffic flows affect US Atlantic oceanic operations, controlled from New York Center:

NAT Organized Track System (OTS). A series of highly organized tracks generated twice daily in the light of wind information. The density of traffic on these tracks is such that few crossing opportunities exist.



Europe to North America (EUR-NAM). Random tracks are used which can become more complex due to the random nature of the crossing tracks.

Europe to the Caribbean (EUR-CAR). A series of flexible tracks which are aligned to upper winds.

Western Atlantic Route System (WATRS). A fixed set of tracks of high complexity which experiences peaks of high traffic density.

Ocean21 Evaluation Process

- **Significant insight very early-on of candidate systems**
  - Thousands of staff hours of hands-on operational and proposal evaluation by controllers, technicians, automation specialists and subject matter experts resulted in:
    - Buy-in from key Unions
    - Definition of Concept of Operations and Use
    - Draft Operational Procedures
    - Identification of customization required for the NAS
    - Common understanding of the scope of the effort

Training

- Complete 180 degree difference between old operation and new operation
- Huge learning curve
- Automated vs manual. AIDC vs manual. More errors introduced with a manual operation.
- Very Lengthy Training Process
  - Seven weeks of training for CPC's
  - Eleven weeks of training for trainees. Same course as CPC's plus three weeks of training on paper strips. One additional week for CBI's and maps/documents
- National Oceanic Training Course being developed
  - Based on generic airspace
  - Easier to maintain and update
- Refresher Training
  - Conducted annually
  - 1-2 days in length
- Software Upgrade Training

AVS View of V&V

- V&V is everyone's responsibility
- V&V is not new- it is vital for our oversight mission and fostered throughout our organizations
  - Certification - Surveillance
  - Inspections and Investigations - Rulemaking and Enforcement
- V&V through oversight of Airline Manufacturers and the Air Traffic Organization
  - Setting regulations and standards
  - Audits and analysis
  - Use of required checklists
  - Discussions with users and user surveys for improvement, etc
- V&V should be performed up front and managed throughout the AMS life cycle
  - Advanced planning and decision support tools ensure that we make informed and better decisions

V&V Strategies and Practices Team

Maureen Molz

Agenda

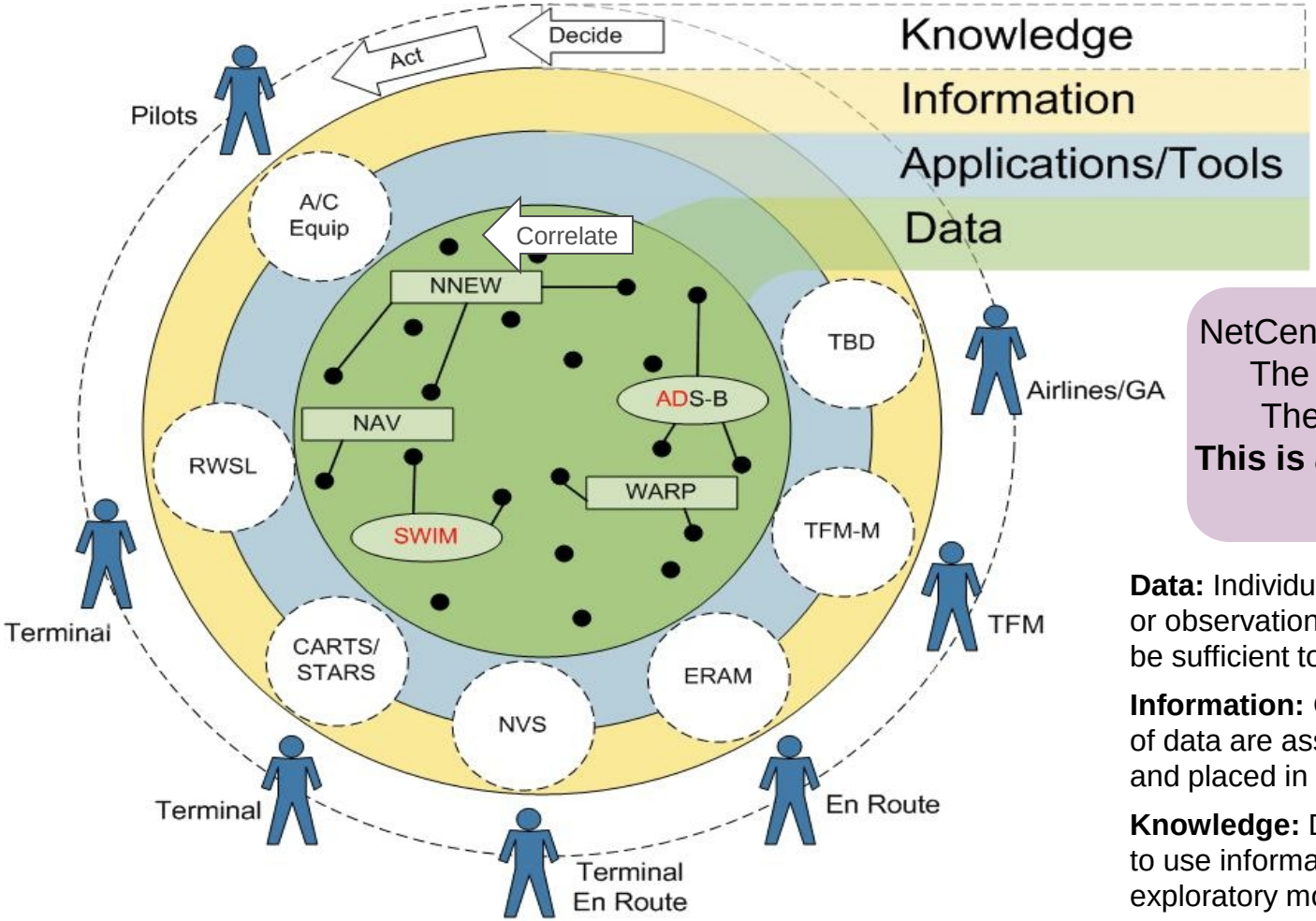
Net-Centric

V&V Strategies and Processes

System of Systems Assessment Platform

Conceptual View of a Net-Centric NAS: NextGen

Net-centric systems that gather, fuse and analyze multiple pieces of data from multiple sources to meet unique user needs



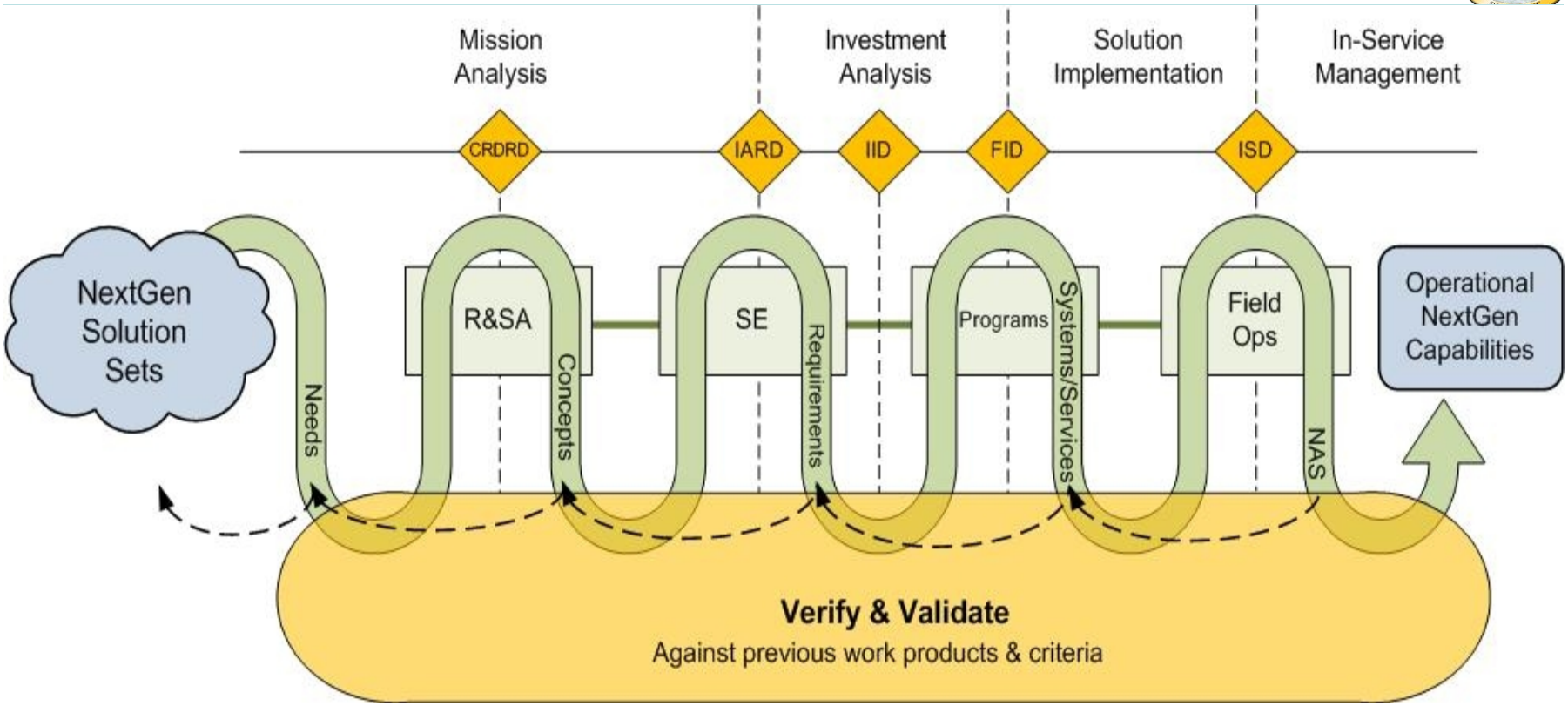
NetCentric has 2 components:
The transport layers and
The information layers.
This is about the <u>information</u> layers

Data: Individual facts, measurements or observations which may or may not be sufficient to make a particular decision

Information: Obtained when elements of data are assembled, reconciled, fused and placed in operational context

Knowledge: Derived from being able to use information to construct and use an exploratory model based on understanding of the situation or phenomenon

Acquisition V&V Process



Current:
- Stovepiped
- Limited interdependency issues

NetCentric:
- SoS level performance
- Performance relies on data integration

Advantages

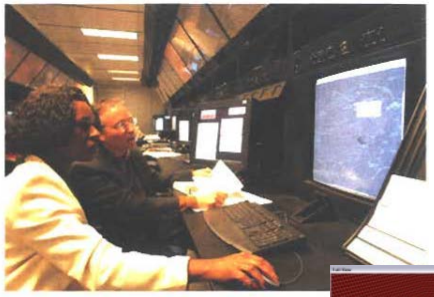
- Provide acquisition decision makers more reliable information
- Ability to track operational improvements through out the lifecycle process
- Ability to mitigate risks associated with the increased system of system complexity
- Common set of tools (data, models, scenarios) to assess system from research through system engineering into test

ARTP Introduction

- Industry, academia, and government collaboration dedicated to the advancement of aviation sciences through private and public research and development activities
- State-of-the-art, high technology, integrated, dynamic research environment
  - Focuses on technologies and innovations for domestic and global aviation
  - Works close with the FAA William J. Hughes Technical Center
  - Integrates with the FAA research facilities and laboratories

Technical Center Campus

- FAA Technical Center is the place where NextGen will come together – integration must be verified and validated, individually and collectively
  - Access to the Technical Center's expertise
  - Access to the Technical Center's systems and air traffic control laboratories



Quality and Standards Team (QST)

In-Service Management Gold Standard ATO Acquisition Practices Approach

V & V Summit
October 13 – 14, 2010
Atlantic City, NJ

Michael Gallagher

AJW-111 QST Manager

Relationship Between: AMS, Acquisition Practices, ISM-GS and V&V

Acquisition Practices:

- Program Management
- Quality Assurance
- Risk Management
- Measurement & Analysis
- Verification & Validation
- Requirements Management
- Contractor Management

AMS Lifecycle

In Service Mgmt. Gold Standard

Summary

- The spirit and integrity of the original T&E Gold Standard was maintained in the development of the In Service Management Gold Standard.
- The ISM-GS provides a value added tool that will assist organizations in managing and maintaining their programs through end of lifecycle.
- The ISM-GS is a time tested product that has been enhanced in response to the survey and/or changes to FAA Policies, Standards and Acquisition Practices.

V&V Needs for NextGen of 2025 and Beyond

A JPDO Perspective

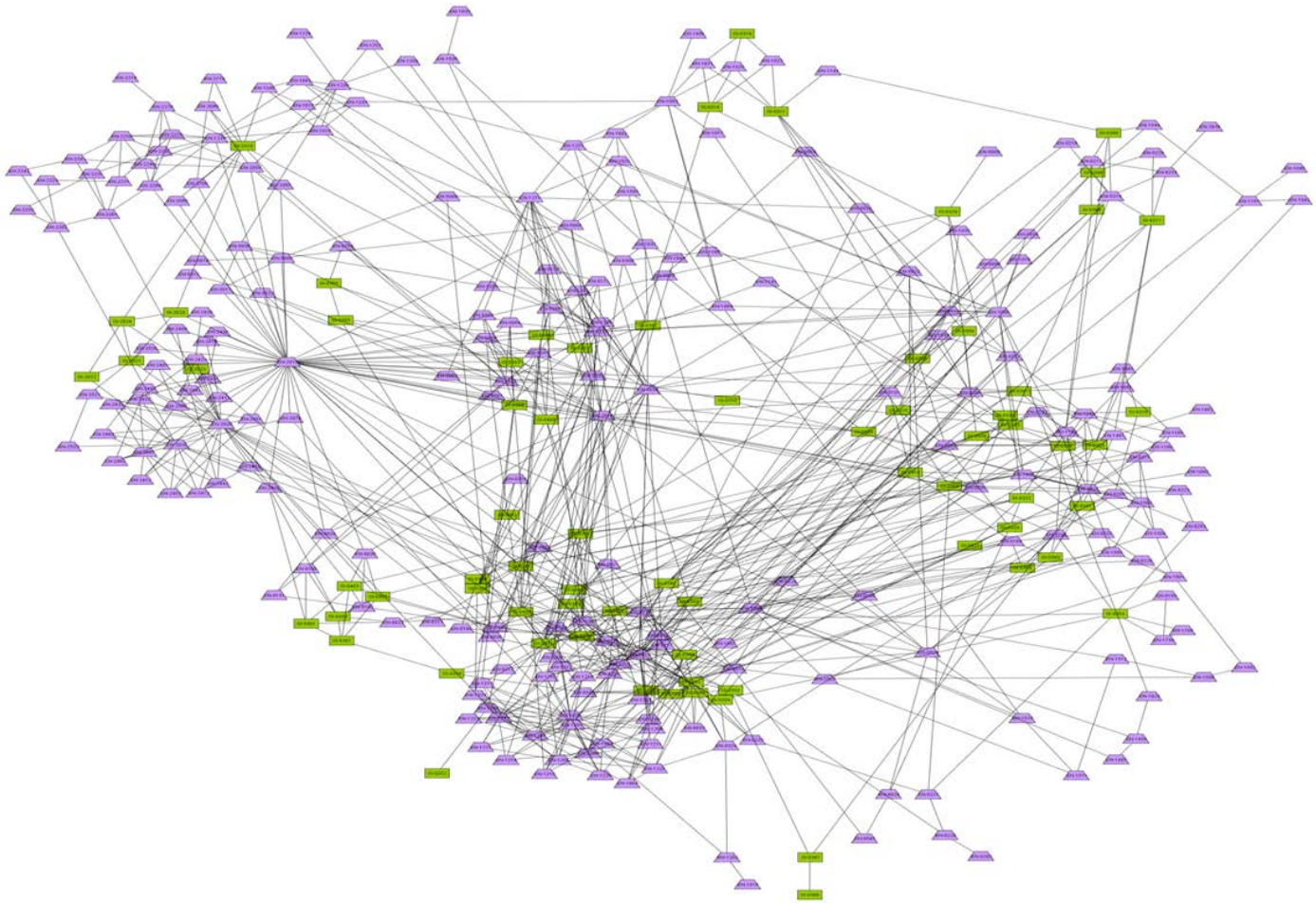
Maureen Keegan
JPDO Integration Manager

October 13, 2010

Where We've Been, Where We're Going

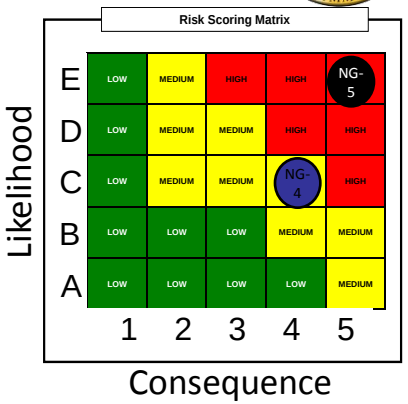
From…	To…
Ground-Based Navigation and Surveillance	Satellite-Based Navigation and Surveillance
Voice Radio Control	Digital Data Exchange
Disconnected Information Systems	Net-Centric Information Access
Human-Centric Air Traffic Control	Automation Assisted Air Traffic Management
Fragmented Weather Forecasting	Probabilistic Weather Decision Tools
Visibility Limited Airfield Operations	Equivalent Visual Operations
Forensic Safety System	Prognostic Safety System
Inefficient Security Screening	Integrated Security Risk Management
Current Aircraft Environmental Footprint	Reduced Aircraft Environmental Footprint

Death Star



Verification and Validation (V&V) of Complex Systems

Risk



- Category
  - Development of higher levels of automation
- Risk Statement
  - If the state of practices for V&V are insufficient for the technologies that NextGen expects to deploy, then performance of NextGen capabilities may be less than planned, resulting in limited benefits for NextGen
- Scoring
  - Likelihood: C. Likely (mid-term) – E. Nearly Certain (far-term)
  - Consequence: 4 – 5
- JPDO Next Steps
  - Inquire about the status of research and development activities relating to validation and verification methods for complex systems
- Partner Agency Mitigation
  - To be proposed by the partner agency

Acquisition Career Certification & Management

Valerie Outlaw Lee

Topics

- Acquisition Career Management Group
  - Functions
- Competency & Certification Business Drivers
  - Certification Programs
- Certification Model Process
- Test & Evaluation Certification Efforts
- Test & Evaluation Schedule and Next Steps
- Contacts & Conclusion

Acquisition Career Management Group

Functions

- Acquisition Workforce
  Data Analysis and Reporting
- Competency and Certification Development
- Certification Management
- Acquisition Workforce Development
- Acquisition Tools and Best Practices support

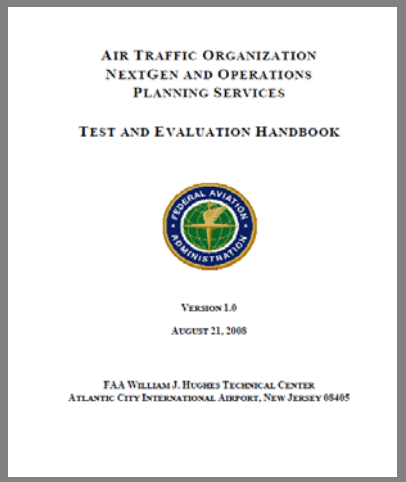
Sample

T & E Competency Model Development

Test and Evaluation Draft Competency Titles			
Technical Competencies			
1	ACQUISTION AND CONTRACTS	9	TECHNICAL WRITING
2	AMS AND ENTERPRISE ARCHITECTURE	10	TEST COST MONITORING AND FAA FINANCIAL MANAGEMENT SYSTEMS
3	DATA COLLECTION AND ANALYSIS	11	TEST MANAGEMENT
4	FAA ORGANIZATIONAL POLICIES AND PROCEDURES	12	TEST REQUIREMENTS ANALYSIS, DEFINITION AND MANAGEMENT
5	HUMAN FACTORS	13	TEST STRATEGY
6	NEGOTIATION	14	TEST THEORY AND METHODS
7	SAFETY AND QUALITY ASSURANCE	15	VERIFICATION AND VALIDATION
8	SYSTEMS THINKING		
Non-Technical Competencies			
1	AGILITY		
2	COMMUNICATION		
3	CUSTOMER FOCUS		
4	INTERPERSONAL RELATIONS AND INFLUENCE		
5	TEAMWORK AND COLLABORATION		

T & E Competency Model Development

FAA ATO NextGen & Ops Planning Services T&E Handbook



AIR TRAFFIC ORGANIZATION
NEXTGEN AND OPERATIONS
PLANNING SERVICES

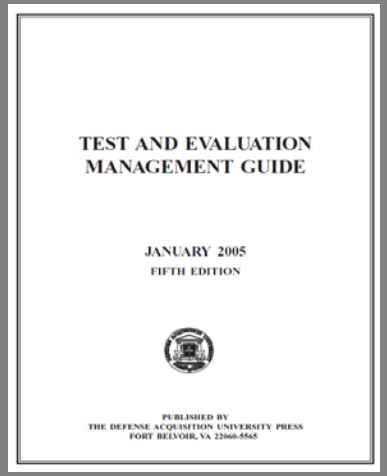
TEST AND EVALUATION HANDBOOK

VERSION 1.0

AUGUST 21, 2008

FAA WILLIAM J. HUGHES TECHNICAL CENTER
ATLANTIC CITY INTERNATIONAL AIRPORT, NEW JERSEY 08405

DAU Test and Evaluation Management Guide



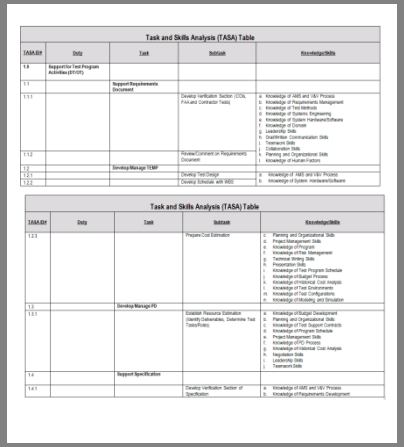
TEST AND EVALUATION
MANAGEMENT GUIDE

JANUARY 2005
FIFTH EDITION

PUBLISHED BY
THE DEFENSE ACQUISITION UNIVERSITY PRESS
FORT BELVOIR, VA 22060-5565

DAU Certification Course for Test & Evaluation Professionals

FAA Test & Evaluation Task and Skills Analysis (TASA) Report



Task and Skills Analysis (TASA) Table

TASA ID#	Duty	Task	Subtask	Knowledge/Skills
1.0	Support for Test Program Activities (STOP)			
1.1		Support Requirements Document		
1.1.1			Develop Verification Section (CDD, Fact and Contractor Tasks)	a. Knowledge of ARS and V&V Process b. Knowledge of Requirements Management c. Knowledge of Test Methods d. Knowledge of Systems Engineering e. Knowledge of System Hardware/Software f. Knowledge of Domain g. Leadership Skills h. Oral/Written Communication Skills i. Teamwork Skills j. Collaboration Skills k. Planning and Organizational Skills l. Knowledge of Human Factors
1.1.2			Review/Comment on Requirements Document	
1.2		Develop/Manage TEMP		
1.2.1			Develop Test Design	a. Knowledge of ARS and V&V Process b. Knowledge of System Hardware/Software
1.2.2			Develop Schedule with WBS	

Task and Skills Analysis (TASA) Table

TASA ID#	Duty	Task	Subtask	Knowledge/Skills
1.2.3			Prepare Cost Estimation	a. Planning and Organizational Skills b. Project Management Skills c. Knowledge of Program d. Knowledge of Risk Management e. Technical Writing Skills f. Presentation Skills g. Knowledge of Test Program Schedule h. Knowledge of Budget Process i. Knowledge of Historical Cost Analysis j. Knowledge of Test Environments k. Knowledge of Test Configurations m. Knowledge of Modeling, and Simulation
1.3		Develop/Manage PD		
1.3.1			Establish Resource Estimation (Identify Deliverables, Determine Test Tasks/Roles)	a. Knowledge of Budget Development b. Planning and Organizational Skills c. Knowledge of Test Support Contracts d. Knowledge of Program Schedule e. Project Management Skills f. Knowledge of PC Process g. Knowledge of Historical Cost Analysis h. Technical Skills i. Leadership Skills j. Teamwork Skills
1.4		Support Specification		
1.4.1			Develop Verification Section of Specification	a. Knowledge of ARS and V&V Process b. Knowledge of Requirements Development

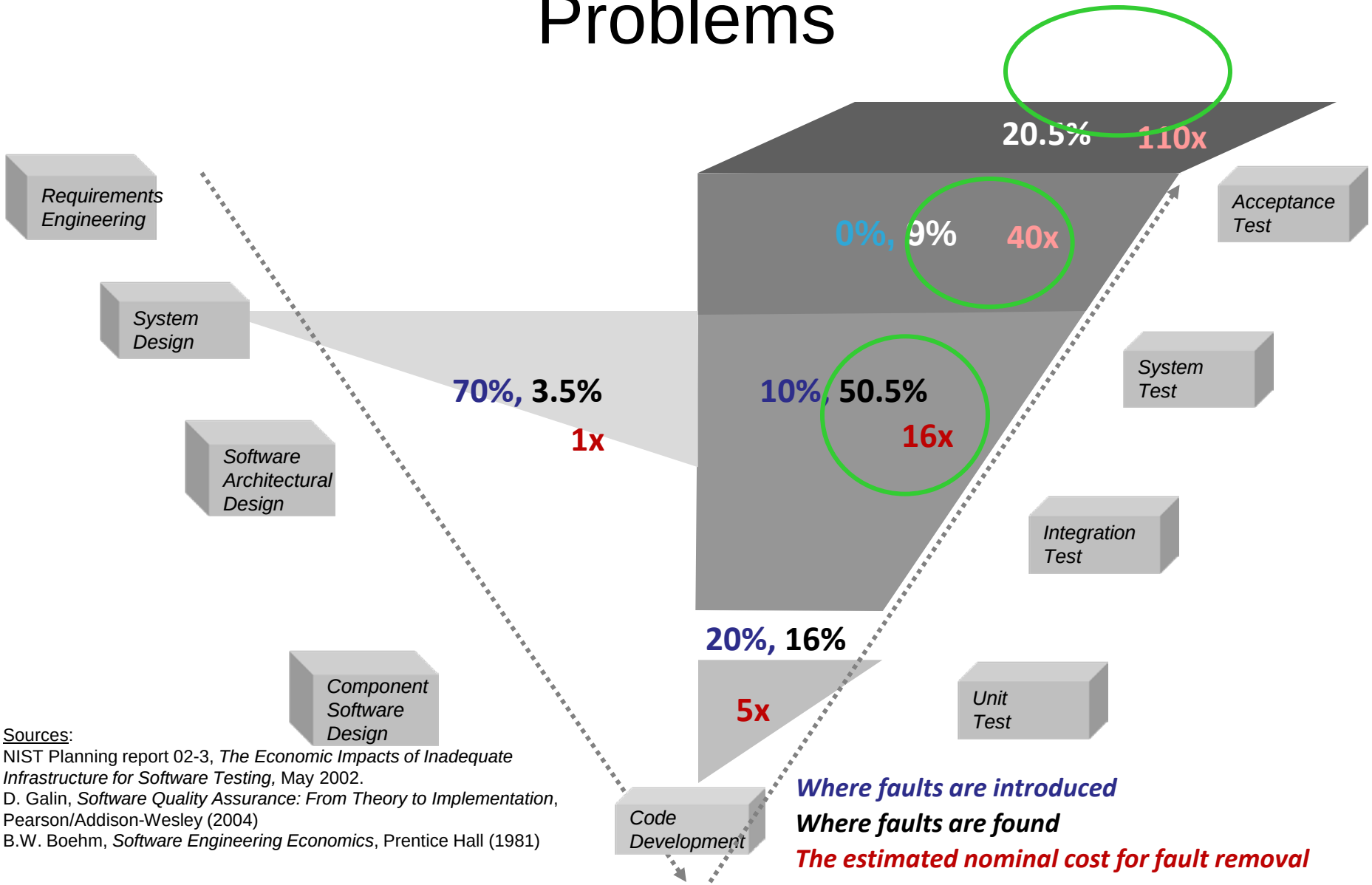
SEI Background

Funded by the U.S. government as a research & development lab; (FFRDC)

Created in 1984 and administered by Carnegie Mellon University

Headquartered in Pittsburgh Pennsylvania; offices and support worldwide

Late Discovery of System-Level Problems



Sources:
NIST Planning report 02-3, *The Economic Impacts of Inadequate Infrastructure for Software Testing,* May 2002.
D. Galin, *Software Quality Assurance: From Theory to Implementation*, Pearson/Addison-Wesley (2004)
B.W. Boehm, *Software Engineering Economics*, Prentice Hall (1981)

Analysis – Test Metrics

Major Defect Save Containment Matrix

Injected → / Detected ↓	Init	Req't	Project Plan	Design	Imp	Int Test	Sys Test	Acc Test	Delivery	Completion
Initiation	0									
Req't	0	9								
Project Plan	0	0	0							
Design	0	2	0	3						
Imp	0	4	0	1	29					
Int Test	0	0	0	0	11	5				
Sys Test	0	1	0	0	3	0	4			
Acc Test	0	0	0	0	2	0	0	1		
Completion	0	0	0	0	0	0	0	0		

Good Containment

Checklists have been updated to address/catch these issues in the future

This project did not accomplish design

Source: ITEA Annual Symposium 2009
presented by 46 Test Wing from Eglin Air Force Base, FL

Validation & Volcanoes

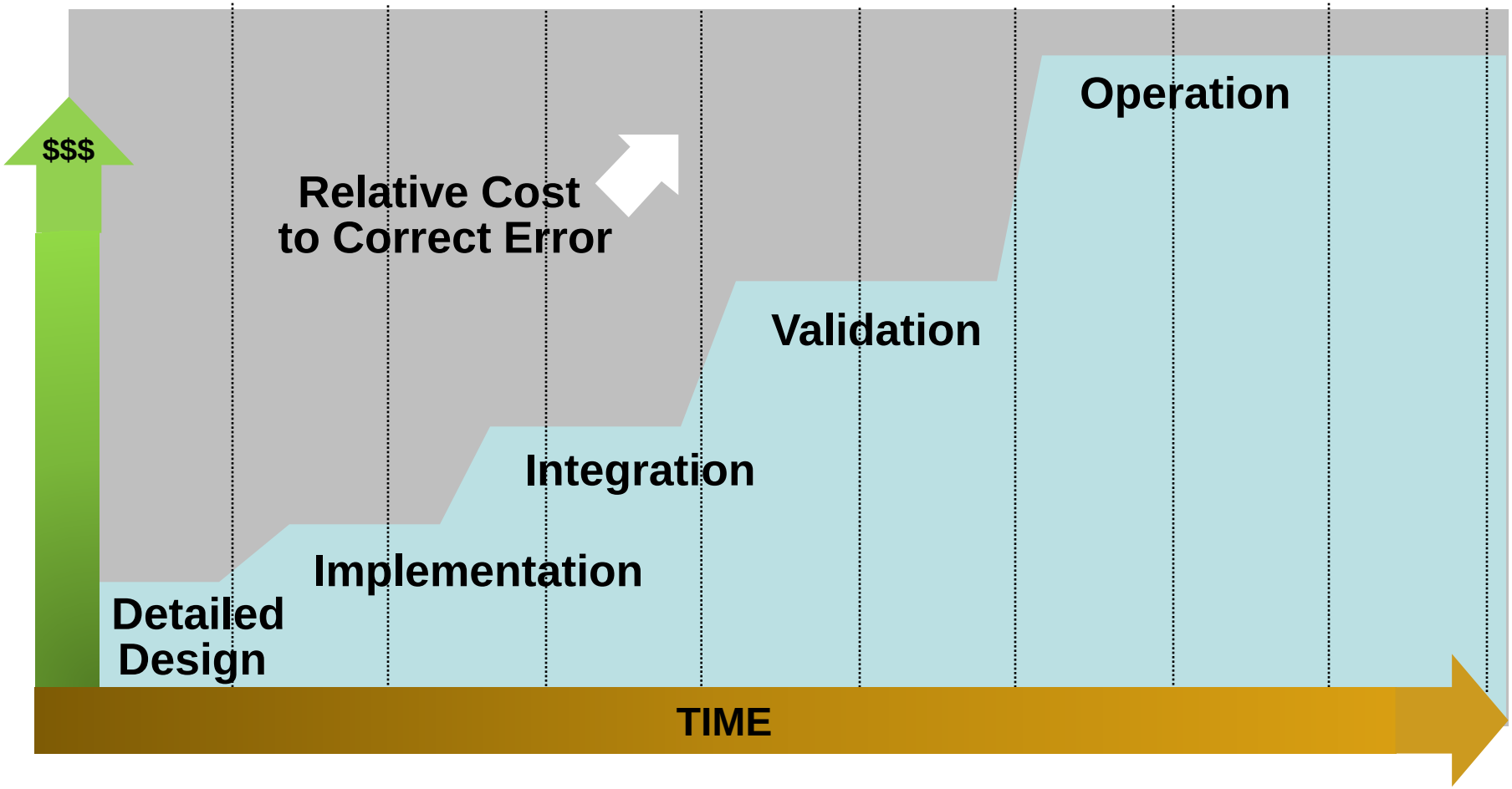
V & V

Some lessons learned in Europe

Nigel Makins nigel.makins@eurocontrol.int

Value of Fixing Defects Early

Error Correction Costs By Phase

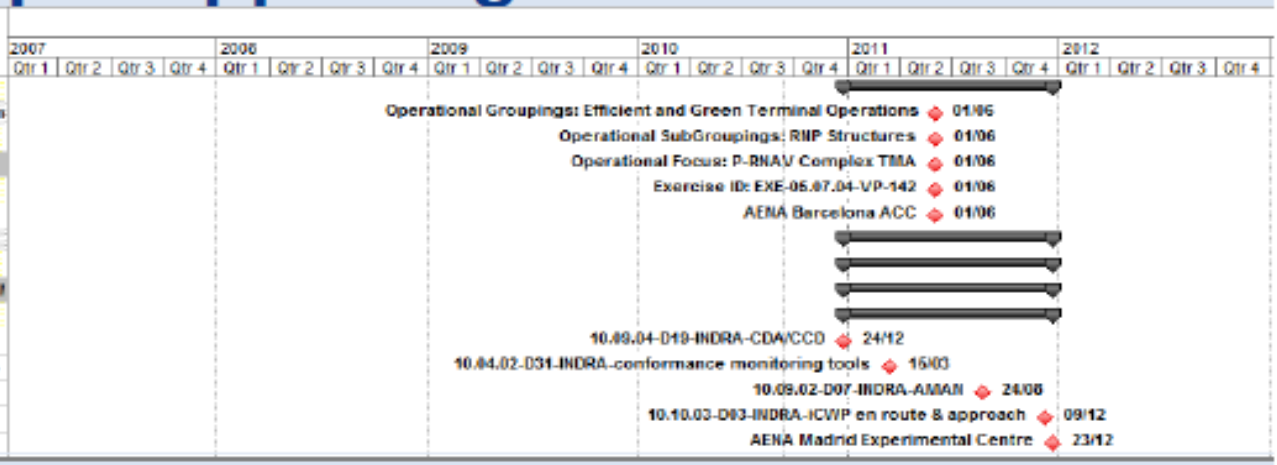


SESAR V&V Planning

V&V Roadmap: Supporting Views

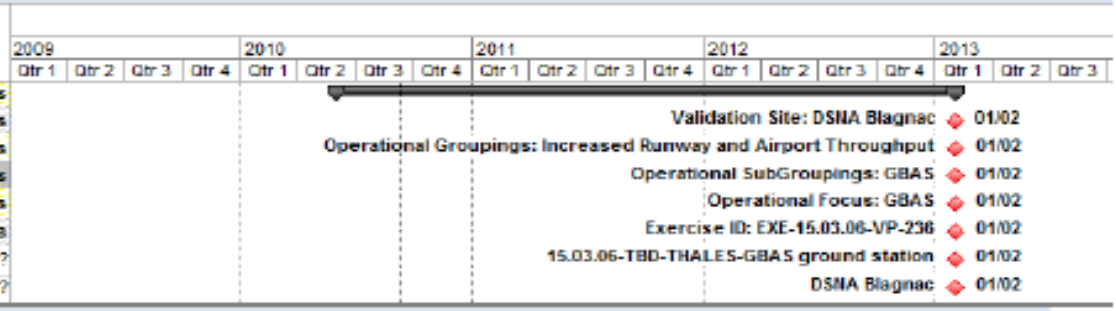
Service Provider View

ID		
	Platform User: AENA	
	Operational Groupings: Efficient and Green Terminal Operation	
	Operational SubGroupings: RNP Structures	
	Operational Focus: P-RNAV Complex TMA	
	Exercise ID: EXE-05.07.04-VP-142	
92	AENA Barcelona ACC	
	Operational Groupings: End to End Traffic Synchronisation	
	Operational SubGroupings: AMAN and DMAN	
	Operational Focus: AMAN + Point Merge in Complex TI	
	Exercise ID: EXE-05.03-VP-034	
99	10.09.04-D19-INDRA-CDA/CCD	
100	10.04.02-D31-INDRA-conformance monitoring tools	
101	10.09.02-D07-INDRA-AMAN	
102	10.10.03-D03-INDRA-ICWP en route & approach	
103	AENA Madrid Experimental Centre	



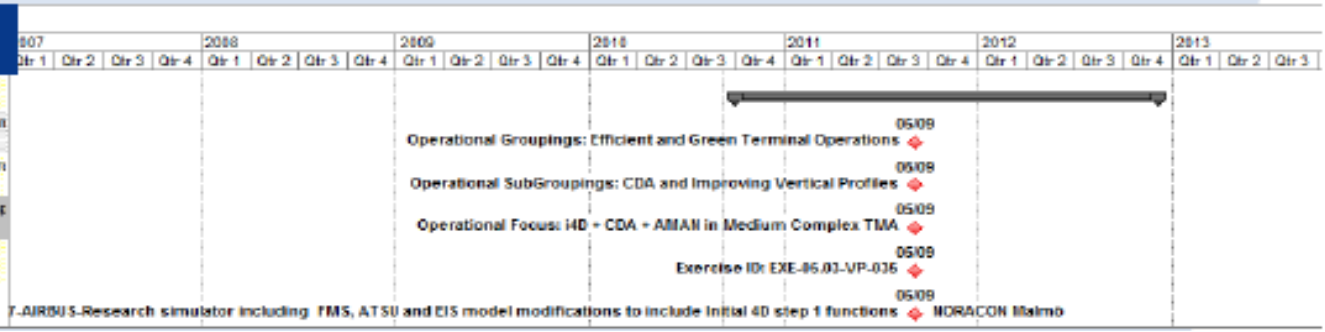
Platform View

ID		Duration
	Platform Owner: DSNA	698 days
	Validation Site: DSNA Blagnac	0 days
	Operational Groupings: Increased Runway and Airport Thr	0 days
	Operational SubGroupings: GBAS	0 days
	Operational Focus: GBAS	0 days
	Exercise ID: EXE-15.03.06-VP-236	0 days
343	15.03.06-TBD-THALES-GBAS ground station	0 days?
344	DSNA Blagnac	0 days?



Industry Partner View

ID		
	Company delivering the SUT: AIRBUS	
	Operational Groupings: Efficient and Green Terminal Operation	
	Operational SubGroupings: CDA and Improving Vertical Pr	
	Operational Focus: HD + CDA + AMAN in Medium Comp	
	Exercise ID: EXE-06.03-VP-036	
58	09.01-D17-AIRBUS-Research simulator including FMS, ATSU and EIS model modifications to include	



Summary

Validation in SESAR

Detailed planning updated after technical pause to work programme

New V&V Roadmap available soon

Joint US-EU work areas to be identified soon under new MoC

www.sesraju.eu for all details

AEB V&V Working Group

Who: FAA V&V experts under the AEB

Mission: Establish a common V&V philosophy

- Across the AMS lifecycle (MA, IA, SI, ISM)

Objectives: Recommend V&V policy changes and improvements

- Identify and define V&V improvement opportunities in MA, IA, SI, and ISM
- Identify and define FAA V&V best practices

<u>Goal:</u> Balanced V&V that Supports the Success of the Programs

Dr. Felder

1. Tight integration with NextGen
   - T&E can’t be discussed as a Standalone Concept
2. Systemized & ISO’d
   - ISO 9000, CMMI,…..
3. Networked Org / can’t work individually
   - Complex adaptive (the people)
   - Ownership of: $, Mission, People, Facilities

How important is it to understand Risk?

<u>Answer</u>: **Important** --- But only if in time to safely and efficiently act on it.

Thank You

Summit Staff

- John Frederick
- Harry Bilicki
- Vy Bui
- Beth Burkett
- Carleen Genna
- Viola Gray
- Adam Greco
- Janet Kinsell
- Wanda Lopez-LaBarbera
- Kristin Snyder
- Stephanie Zvanya

Thank You

VERIFICATION & VALIDATION
V&V
SUMMIT

VERIFICATION & VALIDATION
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