Raytheon

Shift Test Left

SI&T Involvement in Early Engineering

Integrated Defense System (IDS)

Patrick Sessions
Peter Fontana
March 2, 2016

Shift Test Left –
SI&T Involvement in Early Engineering

Raytheon
Integrated Defense Systems

NON-EXPORT-CONTROLLED TECHNICAL INFORMATION

This document does not contain technology or technical data controlled under either the U.S. International Traffic in Arms Regulations or the U.S. Export Administration Regulations.

Agenda

Raytheon
Integrated Defense Systems

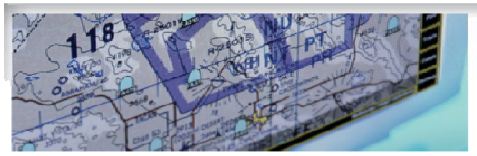
- Who we are
- Introduction - A Shift Test Left Philosophy
- Test Planning and the Agile Process
- System Requirements Development
- System Architecture Development and SysML Modeling
- Conclusion

Raytheon Company Overview

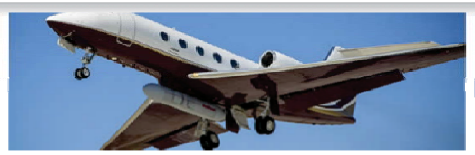
Raytheon
Integrated Defense Systems

A technology and innovation leader specializing in defense, civil government and cybersecurity markets throughout the world.

- 2014 NET SALES: $23 BILLION
- 61,000 EMPLOYEES WORLDWIDE
- HEADQUARTERS: WALTHAM, MASSACHUSETTS



C5ISR



ELECTRONIC WARFARE

MISSILE DEFENSE

PRECISION WEAPONS

TRAINING & SERVICES

CYBER

Introduction to IDS - SVTAD

Raytheon
Integrated Defense Systems

- Integrated Defense Systems:
  - Specializes in air and missile defense, large land- and sea-based radars and systems for managing command, control, communications, computers, cyber, intelligence, surveillance and reconnaissance (C5ISR)
  - Produces air traffic management systems, sonars, torpedoes and electronic systems for ships
- System Verification Test & Analysis Directorate (SVTAD):
  - Responsible for the Integration, Verification, and Validation (V&V) of all IDS products
  - Develops the processes, standards, and expertise to ensure that our customers products are taken from subsystems to integrated deployed systems

Introduction
– A *Shift Test Left* philosophy

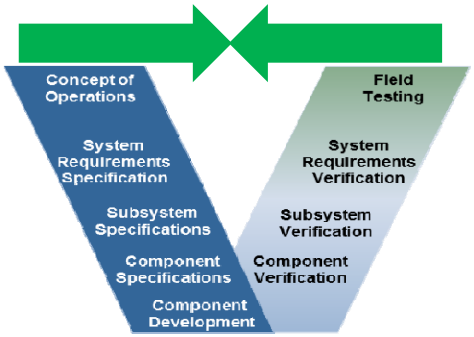
Raytheon
Integrated Defense Systems

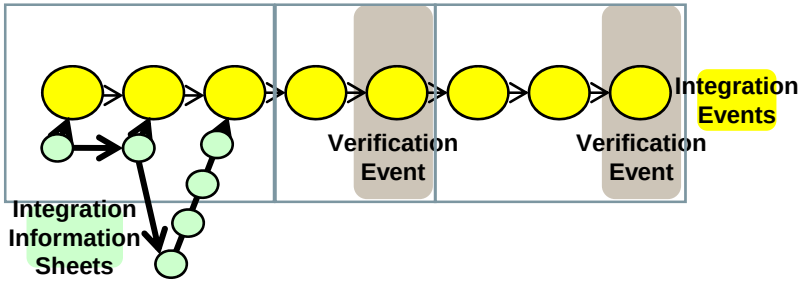
- Our current test approach is to shift System Integration and Test Engineering earlier into the program lifecycle
- Some strategies included in this approach:
  - Expansion of Agile development
  - Adoption of Acceptance Test-Driven Development (ATDD) concepts
  - System modeling for Test
  - The “Test Runway”
- Key benefits and challenges from the shift seen in:
  - Test Planning and the Agile Process
  - System Requirements Development
  - Involvement in System Architecture Development and SysML Modeling

Test Left Philosophy
– *A Squeeze of the "V"*

Raytheon
Integrated Defense Systems

- Expansion of Agile development to include all Systems Engineering
- Adoption of Acceptance Test-Driven Development (ATDD) concepts
- Use Case scenarios to drive System Test Cases
- Test Optimization:
  - Partition test cases for alignment to test events
  - Cooperate to share across program and test function
- Defining the "Test Runway"
  - Mapping Integration Strategy to Features, Capabilities, and Scaled Agile Work Items





Test Planning and the Agile Process

Raytheon
Integrated Defense Systems

- Test Leadership involvement in Scaled Agile Planning:
  - Focus on defining a System Integration Flow
  - Drive alignment of the incremental test events and the system development tracked by Scaled Agile work items
- Benefits:
  - Early creation of better test plans
    - Ensure alignment from development and sub-system testing through formal system level verification events
  - Increased team focus and confidence seen when aligned test plans are available to the team early in development
  - Less potential for downstream rework
  - When problems “pop up” it’s easier to assess the impact on Test
- Challenges:
  - Difficult to plan when system architecture and design concepts are not fully fleshed out
  - It’s a Culture Change!

“How do we line this up ?”

System Requirements Development

Raytheon
Integrated Defense Systems

- Early Test Team engagement during Requirements Development
- Benefits:
  - Provides insight into the testability of the system
  - Surfaces issues and influences development promoting overall testability
    - Helps produce verifiable, concise, unambiguous requirements
      - *"The system shall not…"*
  - Opportunity to develop initial test methods and approaches alongside engineering teams writing the requirements
  - Provides an early opportunity to assess applicability of Test Automation
  - Allows for significant "*Get Smart Time*"
- Challenges:
  - Comes with some Churn!
  - Fewer knowledgeable Subject Matter Experts (SMEs) may be available on the program during early phases

System Architecture Development and SysML Modeling

Raytheon
Integrated Defense Systems

- Test Team involvement during the System Architecture and Design
- Benefits:
  - Aids in the development of a test architecture in parallel with the maturing system design
  - Can influence the system architecture and models at the time of development to benefit the Test Teams
    - Identify Test Cases (Shared Products / Multi-Purpose / Reusable)
  - Great training - New SMEs emerge!
  - Can assist with assessment of Test Automation
- Challenges:
  - Required training - Modeling not historically a Test team task
  - Negative reactions to “What’s new”
  - Creating and maintaining SysML models can be costly

Conclusion - A *Shift Test Left* philosophy

Raytheon Integrated Defense Systems

- Our current test approach is to shift System Integration and Test Engineering earlier into the program lifecycle
- Some strategies include:
  - Expansion of Agile development
  - Adoption of Acceptance Test-Driven Development (ATDD) concepts
  - System modeling for Test
  - The “Test Runway”
- Key benefits and challenges from the shift seen in:
  - IV&V Planning and the Agile Process
  - System Requirements Development
  - Involvement in System Architecture Development and SysML Modeling

Benefits outweigh challenges!
Through shared experience and Lessons Learned some challenges can be mitigated

Speaker Info

Raytheon
Integrated Defense Systems

Principal Author:

Patrick M. Sessions
Radar Systems Department
System Validation, Test, & Analysis Directorate (SVTAD)

Presenter and Co-Author:

Peter Fontana
Technical Staff
System Validation, Test, & Analysis Directorate (SVTAD)

Raytheon Company
Integrated Defense Systems
50 Apple Hill Drive
Tewksbury, MA 01876