



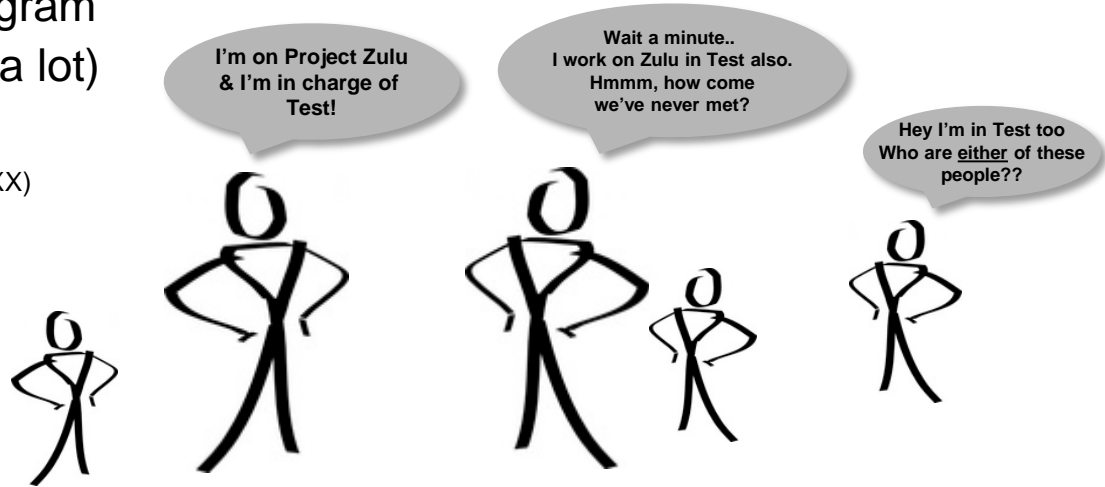
# Raytheon Test Architect – Competency & Certification

## NDIA T&E Division 2016 Conference

Joe Manas, Senior Engineering Fellow  
March 2, 2016

# The Driving Need

- The cost of **Test** on a program is conservatively estimated at 30% of the total cost of a development program
- What is Test? (it encompasses a lot)
  - Prototype Integration & Testing in the lab
  - HW Design Verification Testing
  - Environmental Qualification Testing (MIL-STD-XXX)
  - Testing for simulation validation
  - Field & Flight Testing
  - Cybersecurity Testing
  - Interoperability Testing
  - Software Testing
  - Integrated Testing
  - Factory Acceptance Testing
  - Operational Availability Testing
  - More...

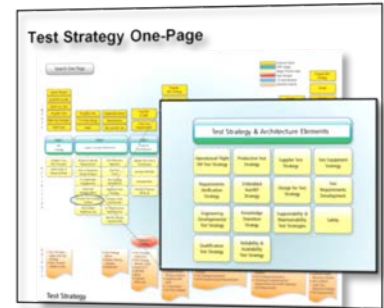


*There are so many elements of “test”. Quite often the test teams may be separated geographically and also by products & discipline – especially on large programs*

**Are You Spending That 30% Wisely?**

# Our Solution

- Life Cycle Test & Evaluation Strategy & Architecture
- Led by the Test Architect
  - Role established in 2011
  - Drives the integration of all test activities across the entire program life cycle consistent with the customer's test and evaluation strategy.
  - Develops the lifecycle test strategy and guides the development of the lower level test strategies.
  - Works w/ System Architects, Chief Engineers and Technical Directors
    - Testability is being driven into design
    - Incremental capabilities are being considered for efficient IV&V
- Key member of the Change Control Board – The persistent conscience of test
- May be thought of as the “Chief Engineer of Test”



**Program Consolidated Test Plan (PCTP)**

CONTRACT NUMBER  
XXXXXXXXXXXX  
1000 000000

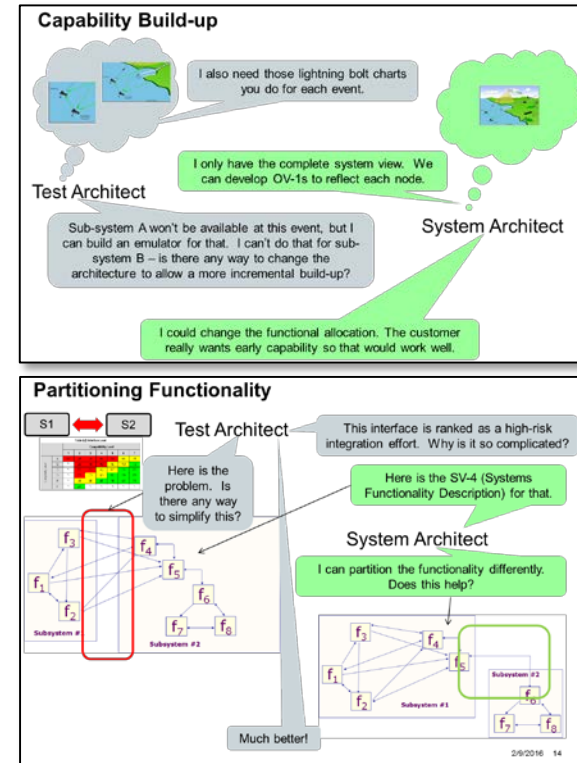
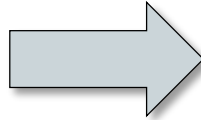
Prepared by:  
Raytheon Missiles Systems

Signature _____	Date _____	System Test _____	Date _____
System Design Center _____	Date _____	Electronics Subsystems _____	Date _____
Mechanical Subsystems _____	Date _____	Software Engineering _____	Date _____
Lifecycle Engineering _____	Date _____	Manufacturing Test Center _____	Date _____
Chief Engineer _____	Date _____	Program Manager _____	Date _____
Customer Representative _____	Date _____		

**A Systems Engineering Approach to Test**

# Test Architect Competency Model Defined

- **Executive Leadership**
  - The ability to lead by influence
- **Technical Abilities**
  - Test & Evaluation – Across the Lifecycle
  - Architecture for Test
    - Influencing the System Architecture for IV&V
    - Influencing the System Architecture for Testability
- **Program Execution**
- **Understanding of DASD (DT&E)**
  - Deputy Assistant Secretary of Defense for Developmental Test & Evaluation
- **Developmental Evaluation Framework**
- **Business Acumen**



**The Ability to Define a Test Strategy & Influence the System Architecture To Realize It**

# Test Architect Driving Implementation

## Test Principles

**Integration Principles**  
 Mitigate risk early  
 Minimize impact of constraints  
 No gaps  
 Minimize duplication  
 Integration not constrained by architectural boundaries  
 Maximize use of vendor expertise  
 Stress test at all levels  
 Introduce operational relevance early  
 Layered approach to integration sequence  
 (Vendor → SEIT)

Verification Principle	Selected Examples of Remedial Application
Early verification	Develop and execute test plan for the integrated subsystem (ICS) before the subsystem is integrated into the system (SIS) or the system (SYS).
Minimize product verification on the AWB	Perform vendor activities in parallel with ICS and ICSU development.
Minimize testing on the AWB	Develop and execute test plan for the integrated subsystem (ICS) before the subsystem is integrated into the system (SIS) or the system (SYS).
Layered verification activities	Develop and execute test plan for the integrated subsystem (ICS) before the subsystem is integrated into the system (SIS) or the system (SYS).
Maximize reuse of procedures	Use test procedures from previous ICS, ICSU, and ICSU development.
Test at the right time (introduce stress)	Develop and execute test plan for the integrated subsystem (ICS) before the subsystem is integrated into the system (SIS) or the system (SYS).
CATC (20%) independent time phasing	Develop and execute test plan for the integrated subsystem (ICS) before the subsystem is integrated into the system (SIS) or the system (SYS).

*Test Lead with Big Picture View  
 Responsible for Test Strategy and  
 Integrated Testing Implementation*

## Test Case Design Integration Information Sheet Verification Information Sheet

1.1 Activity (# and Name)

1.1.1 Summary

1.1.2 Sequence

1.1.3 Objective – Vendor Objective 1

1.1.3.1 Known Issues

1.1.3.2 Expected Outcomes

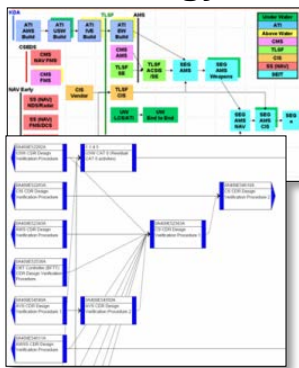
1.1.4 Objective – Vendor Objective 2

Operational Situation Title		Exercises Coverage in Activity	
Task	Purpose	Planning Hours	Execution
Equipment/Tools	Analysis		Total
Facilities			

Task	Purpose	Planning Hours	Execution	Analysis	Total

Exercise	Requirement Coverage

## Strategy



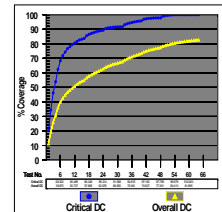
Activity flow that reflects application of principles

## Plan

1. Introduction
2. Applicable Documents
3. Definitions and Acronyms
4. Integration Overview
5. Mission System Integration Activities
- 5.1 Integration Strategy
- 5.2 Integration Strategy Drivers
- 5.3 Integration Activities
- 5.4 Above-Water Sensor Subsystem (AWSS) Integration
- 5.5 Above-Water Weapon Subsystem (AWWS) Integration
- 5.6 Above-Water Support Subsystem (AWSS) Integration
- 5.7 Under-Sensor Subsystem (USS) Integration
- 5.8 Under-Sensor Support Subsystem (USSS) Integration
- 5.9 Electronic Warfare Subsystem (EWS) Integration
- 5.10 Communication and Information Subsystem (CIS) Integration
- 5.11 Avionics Support Subsystem (AS) Integration
- 5.12 Navigation Subsystem (NAV) Integration
- 5.13 On-Rail Targeting Subsystem (ORT) Integration
- 5.14 Australian Tactical Interface
- 5.15 OPERATIONAL SITUATION TITLE FOR THIS INTEGRATION
6. OPERATIONAL SITUATION TITLE FOR THIS INTEGRATION
7. VERIFICATION INFORMATION SHEET
8. VERIFICATION INFORMATION SHEET
9. VERIFICATION INFORMATION SHEET
10. Integration Management
- 10.1 Organizational Responsibility
- 10.2 Integration Roles and Responsibilities
- 10.3 Program Planning
- 10.4 Project Monitoring and Reporting
- 10.5 Integration Risk
- 10.6 Required Support Capability

Schedule and content that reflects activity flow

## Statistical Methods



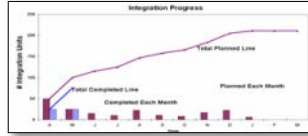
Design and optimize test coverage

## Procedure

1. Introduction
2. Applicable Documents
3. Definitions and Acronyms
4. Integration Overview
5. Mission System Integration Activities
- 5.1 Integration Strategy
- 5.2 Integration Strategy Drivers
- 5.3 Integration Activities
- 5.4 Above-Water Sensor Subsystem (AWSS) Integration
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Detailed description of planned actions and expected outcomes

## Conduct



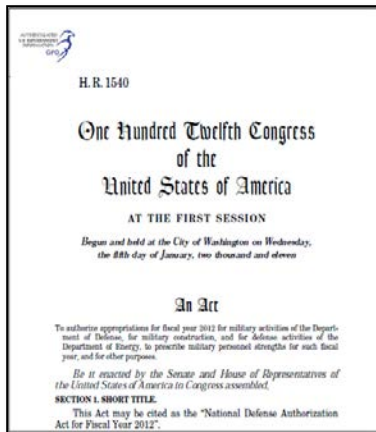
Execute with shared data

## System Test

Operationally Relevant

## Factory Solution





NDAA 2012

- SecDef shall require each major defense acquisition program be supported by a Chief Developmental Tester
  - *“Oversight of all developmental test and evaluation activities for the program maintaining insight into contractor activities under the program and overseeing the test and evaluation activities of other participating government activities under the program; and helping program managers make technically informed, objective judgments about contractor developmental test and evaluation results.”*
- A DoD Key Leadership Position (KLP)

### Chief Developmental Tester Project

**Title 10, Section 139b**  
The Secretary of Defense shall require that each major defense acquisition program be supported by—  
“(A) a **chief developmental tester**; and  
“(B) a governmental test agency, serving as **lead developmental test and evaluation organization** for the program.

**Goal:** Propose a model for industry interaction throughout the phases of a development program with an emphasis on “Shift Left”.

**CDT Project team**

Joe Manas (Lead)	– Raytheon	Brendan Rhatigan	– Lockheed Martin
Sandi Gianotas	– Boeing (BTE)	Steve Scukanec	– Northrop Grumman
Tom Simms	– DASD(DT&E)	Paul Allien	– DAU
Joe Wascavage	– NAVAIR		

NDIA DT&E Committee  
2014

*NDIA 2014 Project helped gain understanding and alignment between Industry & Government Regarding a “Industry Test Lead”*

**CDT Role was a Key Driver in Refining the Raytheon Test Architect Role**

# Why Certify?

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- Improve the professionalism of the T&E discipline
- Establish higher standards for this critical leadership position
- Establish increased professional qualification requirements for the T&E discipline and consistency across Raytheon
- Develop and promote common standards, principles, procedures, processes, and terms for the T&E profession
- Alignment with DASD (DT&E) initiatives for CDT KLP Qualification and Better Buying Power 3.0 professionalism initiative
- Provide a defined career path for our T&E workforce

**Align with Customer Expectations**

# Raytheon Test Architect Certification

- Education & Training Requirements
- Demonstrated:
  - Executive Leadership
  - Technical Abilities
  - Test & Evaluation – Across the Lifecycle
  - Architecture for Test
  - Program Execution
  - Understanding of DASD (DT&E) Developmental Evaluation Framework
  - Business Acumen
- Endorsement



**Required Training combined with Demonstrated Performance on Programs**



# Summarize

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- **Life Cycle Test & Evaluation Strategy & Architecture**
  - A Systems Engineering Approach to Test
- **Led by the Test Architect aka Industry Test Lead**
  - Define a Test Strategy & Influence the System Architecture To Realize It
- **CDT Role was a Key Driver in Refining the Raytheon Test Architect Role**
  - NDIA 2014 CDT Project helped gain understanding and alignment between Industry & Government

# Abstract

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- The Raytheon Test Architect may be thought of the “Chief Engineer for Test” on a program. He/she drives the integration of test activities across the entire program life cycle, ensuring consistency with the customer's Test and Evaluation strategy and defining the test architecture for the production solution. This paper will discuss the evolution of this role at Raytheon, the established competency model and the recently defined certification process.

# Biographies

- **Joe Manas** is a Senior Engineering Fellow with Raytheon Company. Over the last 30 years, he has worked within the defense & aerospace industry, 25 years of which has been with Raytheon. Joe has held leadership positions in the disciplines of System Engineering, Software Development and Test & Evaluation across multiple product lines. He holds a B.S. in Electrical Engineering from Worcester Polytechnic Institute, MA.
- **Martin Leek** is a Senior Principal Systems Engineer who earned his MS from Webster's University of Saint Louis. After a 22 year career in the US Army which included a combat command of a PATRIOT Battalion during Desert Sentry and assignment as Integration Lead for the Cheyenne Mountain NORAD Upgrade, Martin joined Raytheon in 1996 where he has worked as a requirements developer, IPT Lead, operational analyst, functional manager, and directorate learning champion on command and control and radar programs. He is currently the IDS Engineering Integrated Learning Development Program Learning Champion for the Systems Validation Test and Analysis Directorate. Previous assignments have included operational staff functions analyst for the THAAD Command and Control system, Weapon Systems Integration IPT lead, and Raytheon Certified Six Sigma Expert.