Integrated Diagnostics and Automated Test Systems (IDATS)

PRESENTED TO:

CBM+ Action Group

PRESENTED BY:

Russell Shannon, Ph.D.
Naval Air Systems Command
Joint Base McGuire-Dix-Lakehurst
russell.shannon@navy.mil, 732-323-4538

3 November 2010

What is IDATS?

- ***IDATS is a NAVAIR strategic initiative to modernize the way we do business in Avionics Support Equipment & ATE Engineering***
- ***IDATS is not a single system, but multiple products to address Warfighter requirements***
  - The IDATS mission: develop and implement advanced diagnostics products that enhance airborne weapons systems supportability and testability.
  - IDATS mission places it firmly at plane side; provides tools and processes for improved avionics maintenance.
  - Integrated diagnostics helps drive up aircraft readiness:
    - Faster, more accurate fault isolation
    - Reduced aircraft downtime and lower life-cycle logistics costs
    - Reduced erroneous component removal, test and repair
    - Reduced spares requirements
    - Reliable test/failure data to improve future systems design
- ***NAVAIR Investment Working Group (IWG) strategic investment to create Avionics Diagnostics Laboratories at Joint Base MDL***

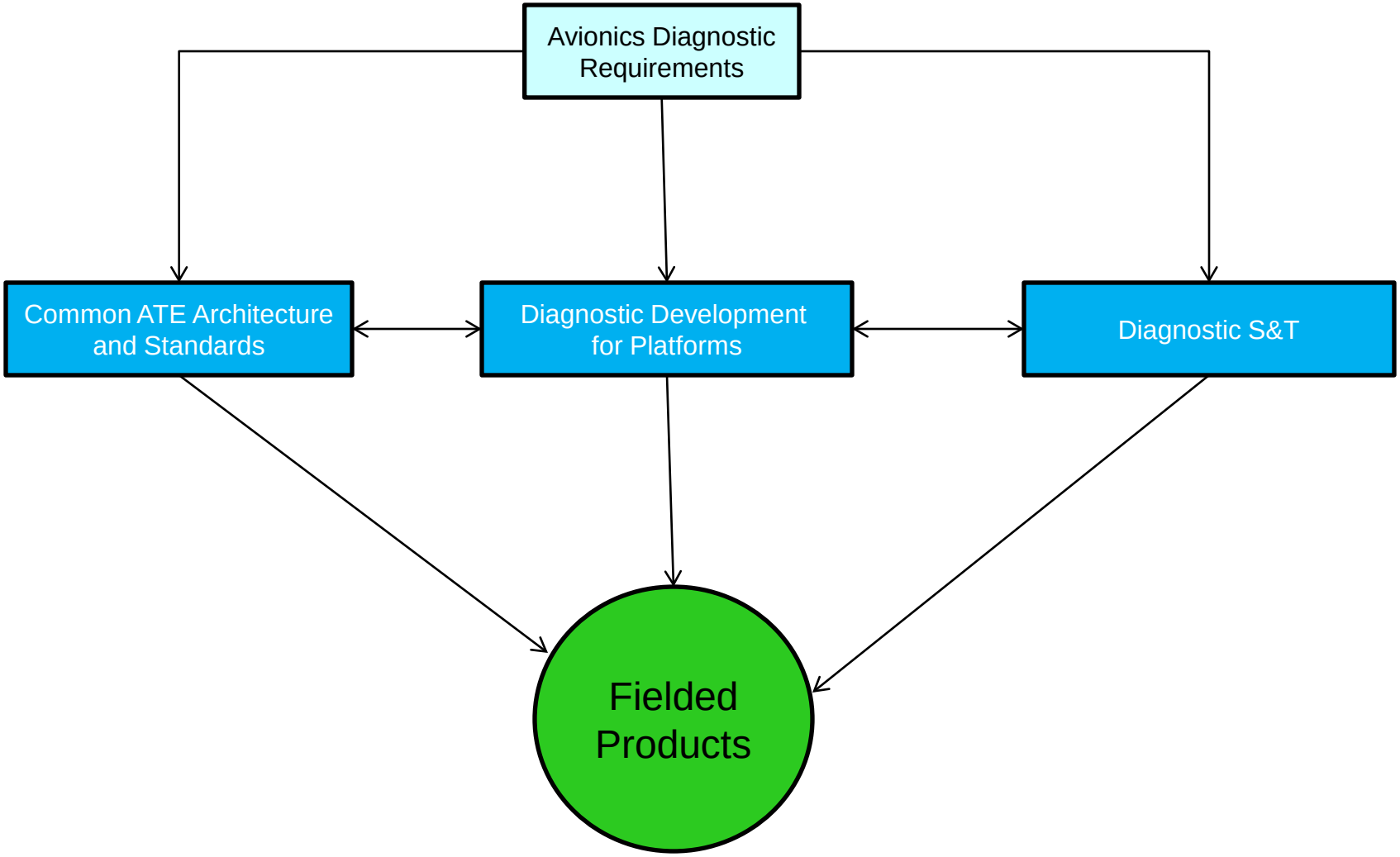
Leadership Endorsements

- **VADM Architzel, Commander NAVAIR:**
  - **"The lab has already had a significant impact on the way the Navy conducts diagnostics and maintenance for the F/A-18 EO program and will benefit countless other programs." -July 16, 2010**
- **NAVAIR-4.8 (SE & ALRE) fully supports IDATS efforts, as they will enhance our capability to perform the NAVAIR mission.**
- **Additional strong support for these efforts have been expressed by:**
  - **OSD Office of Technology Transition**
  - **DoD ATS Management Board**
  - **AIR-6.0A Logistics (SE)**
  - **AIR-1.0 LKE**

The Challenge

- Approximately **72%** of total Navy and Marine Corps aircraft maintenance actions are driven by avionics-related deficiencies.
- Between Aug 08 and Aug 09, false alarms and “cannot duplicate” conditions wasted over **246,000 MMH (140 MMY)**, including aircraft downtime, I-D level testing, and logistics costs associated across six aircraft platforms
- IDATS purpose is to develop opportunities to improve the current situation.
  - Improve Aircraft Operational Availability (Ao)
  - Decrease Beyond Capability of Maintenance (BCM) actions
  - Reduce Aviation Depot Level Repair (AVDLR) costs
  - Reduce Test Program Set (TPS) development costs
  - Develop avionics diagnostics Subject Matter Experts (SME’s) support to NAVAIR programs

The Challenge: Requirements to Products



Capabilities

- Representative maintenance environment incorporating:
  - O-level and I-level test technologies
  - Net-centric connectivity across all levels of maintenance
  - A variety of databases containing flight data and maintenance data

- Developmental environment for new products to augment at-aircraft diagnostics/BIT and allow the Fleet to more effectively and efficiently test, troubleshoot, and repair aircraft.

- A test bed for integration, V&V, and advancement of off-system maintenance capabilities to reduce maintenance cost.

- Processes and algorithms for mining databases of flight data and maintenance data

➢ ***A new and unique capability, not available in either the Government or Industry.***

Functions and Products

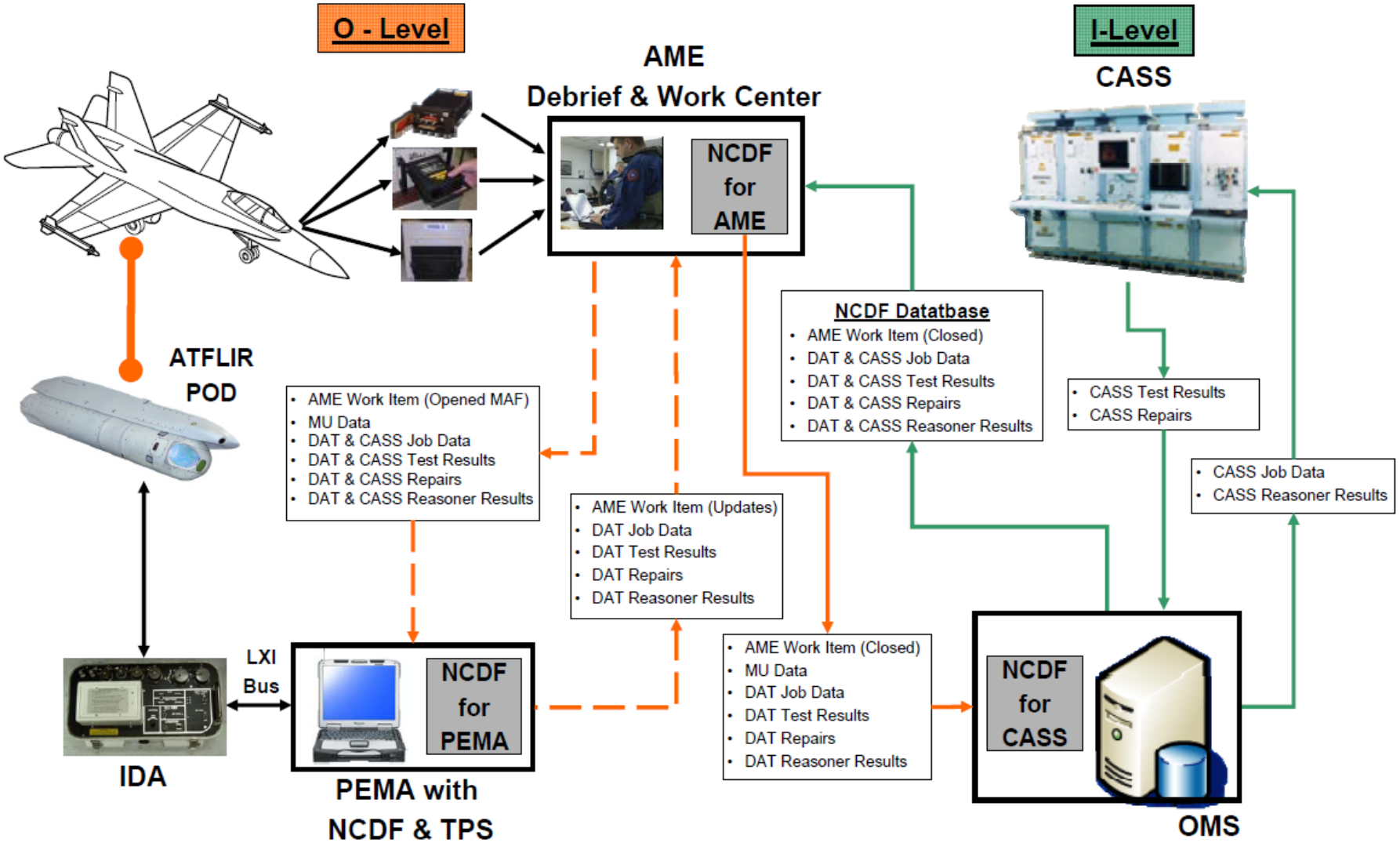
Functions of the IDATS Lab:

- **Supportability & Testability analysis**
  - Establish formal processes and methods analysis for diagnostics development
  - Ambiguity resolution and false removal mitigation
- **ATE integration and development**
  - Hardware emulation
  - Automated testing and data capture
  - Time-domain analysis
  - Frequency domain analysis
  - Network analysis
  - Logic analysis - timing and state
  - Signal processing
  - Printed circuit board creation
- **Data Management**
  - Data mining
  - Metrics generation
  - Custom interface programming; Java, C++
  - ATML parsing and generation
- **Interface to NALCOMIS, Deckplate and other data repositories**
- **Interface to LKE CASS SSA**

Products of the IDATS Lab:

- **F/A-18 Electro-optic Tester (DAT)**
- **The Smart Connector Tester**
- **ALRE Data Mining**
- **Avionics Diagnostics Research and Development**
  - Wireless Diagnostics Data Bus
  - Time Domain Reflectometry
  - Pinless Connector
  - Error Vector Magnitude Measurements for Radio Diagnostics
  - Acoustics for Circuit Card Diagnostics
  - RF Measurements for Circuit Card Diagnostics
  - Electronics Physics of Failure Investigation
  - Network Analysis
  - Radar Systems Diagnostics
  - Diagnostic Dependency Modeling
  - Data mining algorithm development
- **Evaluations of current and emerging technologies**
  - Actuator Power Supply Prognostics

Diagnostics Avionics Tester



The first piece of net-centric support equipment in Navy inventory!

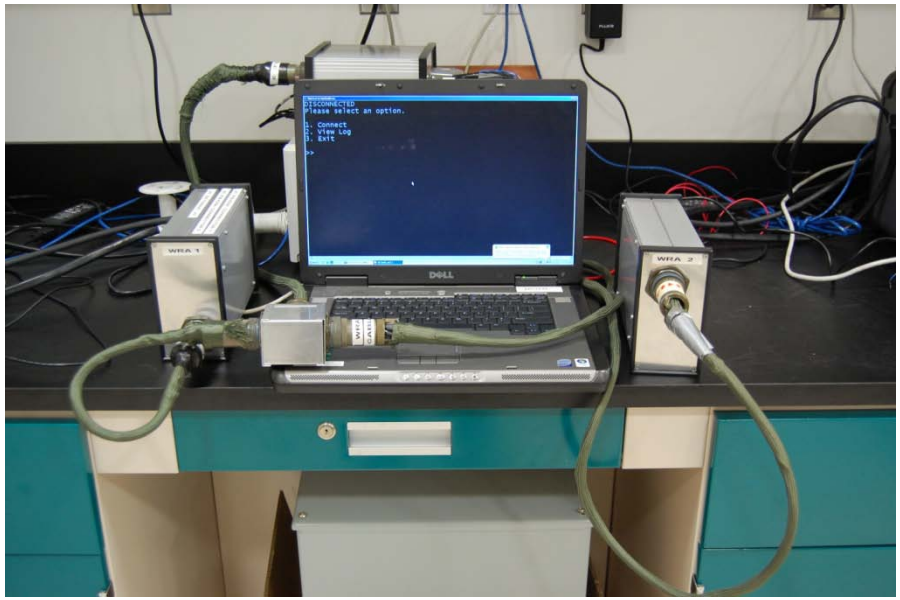
Estimated Avionics Depot Repair cost avoidance: $30M/year

Diagnostic Avionics Tester

- **Diagnostic Avionics Tester Technology Transition Initiative:**
  - Funded by OSD and F/A-18 Program Office
  - Production contract signed March 2010, 93 units fielded by 2012
  - A cost avoidance is $30M per year in ATFLIR pod repair costs when fully fielded in FY12
  - First fully net-centric O-level support equipment in Navy inventory
  - First LXI-based SE in Navy inventory
    - LXI = protocol to control instruments over Ethernet
  - Successful open-architecture SE implementation
  - DAT is 40 lbs lighter, 4.1 cubic ft smaller, and costs $26K less per unit than current tester
  - Added 3 ATFLIR WRAs to Smart TPS
  - APG-73 Potential

The Smart Connector Tester

- Tester placed between two *running* WRAs to perform fault isolation
- US Patent issued December 1, 2009
- Awarded $500K transition funding in FY10
- Currently developing Smart Connector for MIDS-LVT fault isolation
- Interest in ARINC 429 version for Army helos

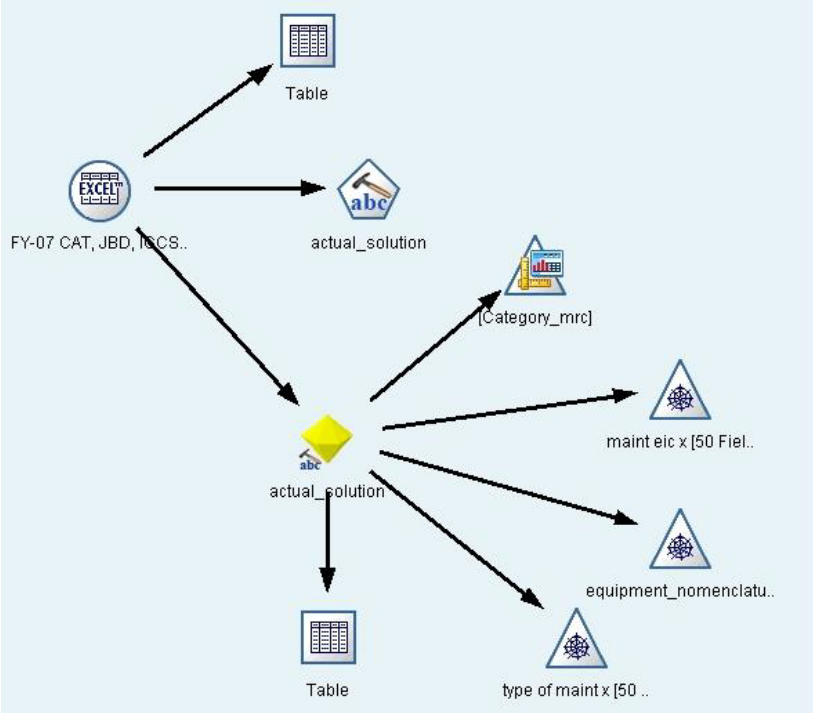


Prototype Smart Connector, developed in IDATS Hardware Lab

Opportunity to impact maintenance across DoD and NATO

Data Mining

- Discovering patterns in data from disparate sources
  - Performance
  - Supply
  - Maintenance
- Correlating data to identify patterns leading to system failure
  - Identify conditions which lead to increased maintenance
  - Identify preventative maintenance opportunities
  - Identify correlations across systems, e.g., between aircraft and corrective maintenance on arresting gear
- Models to assist SMEs in decision-making
- Text mining maintainer comments in MAFs
  - Correlating verbage to preventative and corrective maintenance
  - Identifying other useful information in comment fields



Data Mining Model for ALRE

Data Mining: ALRE Metrics

- Supports PMA251 Carrier Readiness Team
- Coordinate and assure current and future Carrier Fleet ALRE materiel readiness
  - Proactive identification of maintenance and modernization requirements
  - Increase readiness and removal of material barriers
- Increased data acurracy
  - Corrected 16% of 3M records, Increased data accuracy to 94%
  - Data "cleaning" process time reduced from 3 months to minutes
- Results of providing ALRE metrics:
  - The Catapult Water Brake Stand Pipe Program was cancelled this past year because the cost of ownership metrics did not support cost to implement a change.
  - The Embarked Aircraft Tracking System (EATS) Program was re-evaluated in relation to total cost of ownership to PMA251.

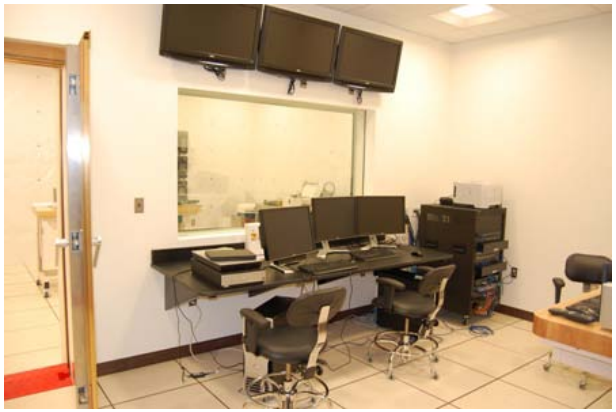
Single Focal Point for ALRE Maintenance and Modernization

IDATS Lab Facilities

IDATS Hardware Lab: Prototype Development Room

Unique features

- Three adjacent independently EMI-shielded rooms: DC to 10 GHz
- Noise suppression
- Anti-electro static discharge benches and floor tiles
- LED lighting
- FM-200 fire suppression system
- Emergency ventilation capability
- 60KVA UPS power: capable of powering an aircraft avionics suite
- 400Hz power



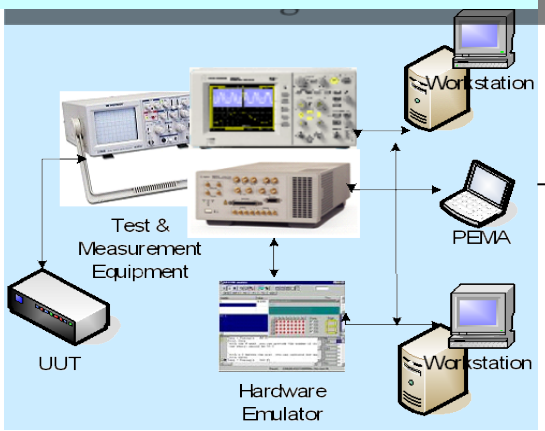
IDATS Hardware Lab: Control Room

IDATS Hardware Lab: Secure Avionics Test Room

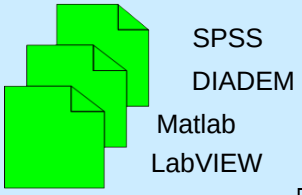
IDATS Software Lab

Laboratory Connectivity

Avionics Diagnostics Lab



Diagnostic Software Development Lab



SPSS
DIADEM
Matlab
LabVIEW
Multisim

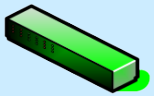
Cyberpower T9000 Workstations

Data Parser (In-house dev.)

CASS Lab

ATE/CASS Lab
- OMS
- Smart TPS

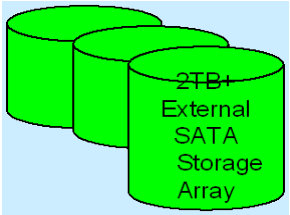
IDATS Lab Connectivity in Bldg 678



Network Switch

RDT&E / NMCI Network Connection

Dell PowerEdge Server



Platform & Maintenance Databases

JTDI

SPRNT

NALCOMIS

MU Data Warehouse

ALE

Current Customer Base

- **Current Sponsors:**
  - PMA260 (Common Support Eq.): PEMA Systems Engineering Support
  - PMA265 (F/A-18): Diagnostic Avionics Tester (DAT)
  - PMA273 (T-45): Leverage DAT concepts to Control Augmentation Test Set (CATS)
  - Navy Innovation Science and Engineering Program: 6 S&T projects: The Smart Connector; Circuit Card Diagnostics Using Acoustics; Circuit Card Diagnostics Using Near-Field Reactive Probing; Electronics Physics of Failure Analysis; The Pinless Connector; Error Vector Magnitude Measurements for Radio Diagnostics

- **Other Partners:**
  - MIDS International Program Office: developing Smart Connector to test MIDS-LVT power supply
  - PMA275 (V-22): Wiring Chafing Detection: Coordinating with V-22 SE Team and AWSIL to meet immediate V-22 program need
  - AIR-4.8 Integrated Support Environment (ISE): ALRE Metrics and data mining for PMA251

Total FY10 funding ≈ $1.3M = 6.3MY Labor + $134K Materials

Moving Forward: Engagement with Programs

- **A structured process:**
  - **Identifying diagnostic requirements**
  - **Mapping solution funding path**
  - ***Eliminating Program surprise***

Requirements	Gap Analysis	Functional Solution Analysis	Proposal Development	Project Execution
• Collect roadmaps • Fleet Input (OAG's, NARG's) • Aircraft/Ship interface	• Gap Analysis • Gap Identification • Prioritize Gaps • Gap/Capability Matrix	• Identify Potential Approaches • Analyze approaches (Tech maturity, risk, supportability, affordability) • Feasibility Alternatives • Evaluate schedule vs. capability need • Evaluate cost to develop, procure and sustain	• Prepare Proposal Template • Quad development • Brief • Letter of recommendation • Detailed cost and Business Case • Market and socialize solution • Briefs • MOA/TTA development	• Resource Allocation • Cost, Schedule, Performance • 3rd Party Coordination • Briefs and reporting to sponsors • Product delivery • Plan out year funding

S&T Process: Tech Gap Matrix (sample)

Only capabilities and needs listed. Not Solutions

Program Capability/Need Matrix

G — Gap or Need mitigated
Y — Gap or Need partially mitigated
R — Gap or Need not mitigated
Not Applicable

System	S/A	Subsystem	Gap/Capability Need Description	Required IOC	SGR	TCO	Safety	Obsolesence	Ship Compatibility	Aircraft Compatibility
Launcher Steam										
	S	Water Brake	Improved inspection		R	R				
	A	Water Brake	Replace Water Brake		R	R		R	R	
	S	JBD	JSF Compatibility	2015					R	
	S	JBD	Remove JBD operator	2015			Y			
	S	Catapult	Reduce Maintenance	2012		Y				
Revovery										
	S		Increase Purchase Cable Life	2012	R	R		R		
	S		Improved RAST							
VLA										

Organized by Program/Subsystem

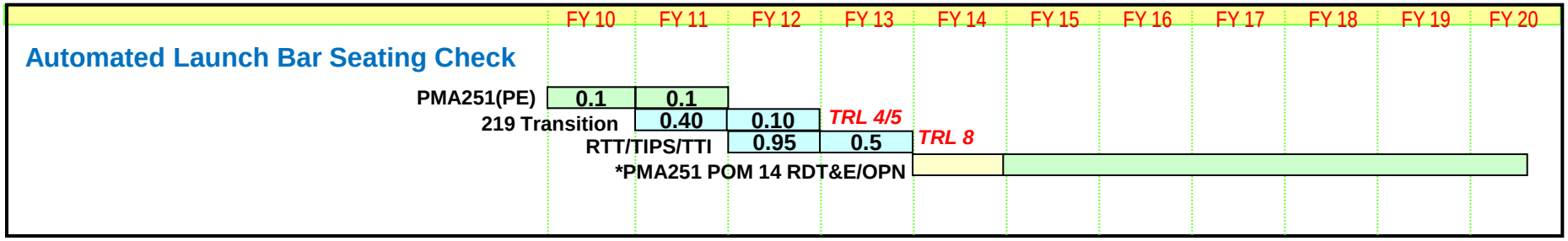
Matrix provides urgency of need

Capture Strategy Matrix (sample)

SBIR/STTR	219 Basic	ONR Swampworks	ONR FNC	219 Transition	RTT/TTI/TIPS	DAC/FCT QRFP
Cable Termination, Synthetic (11-15)	Intelligent Agents (Flight Deck, Weapons)	Synthetic Cable, Cortland (11-13)	Decision Aids (13-16) • Flt Deck/Handler • ALRE Knowledge Base	Improved Ship/Shore Transmission Tools	ALBSC (12-14)	ALRE Test Env.(12)
Adv Purch. Cable, Steel *Ph2.5* (11-13)	Ship Motion Prediction	PM Brake (12-14)	Wireless Mesh Network for Flight Deck (13-16) • Cat Control • SE/weapons Tracking • Recovery	SWOOP	I-RRHB , or 2.5 (12-14)	Steel Cable Inspection/Sensor (12)
ALRE Test Env (11-15)		ALRE Decision Support Knowledge Wall		Wireless Cat Control Hub Design (11-12)	Auto. Weight Board (12-14)	
PM Brake 2.5 (11-12)				ADMACS for Amphibs Air-to-Ground Planning (11-12)	Auto JBD check, or 2.5 (12-14)	
Improved Anchoring System EAF (11-12)				Intelligent Agents (Flight Deck, Weapons) (11-12)	EATS (12-14)	
Environmentally Compatible Cat Lube				Reconfigurable ADMACS Displays (11-12)	Wireless Cat Control (12-14)	
ALRE Decision Support Knowledge Wall					ADMACS for Amphibs (Existing CV functionality) (12-14)	
EAF GPS Mapping (11-15)						
EAF LED Flush Deck Lighting (11-15)						

Tying S&T Funding Sources to Technologies to Create a Proposal Generation Plan

Funding Transition Plan (Sample)

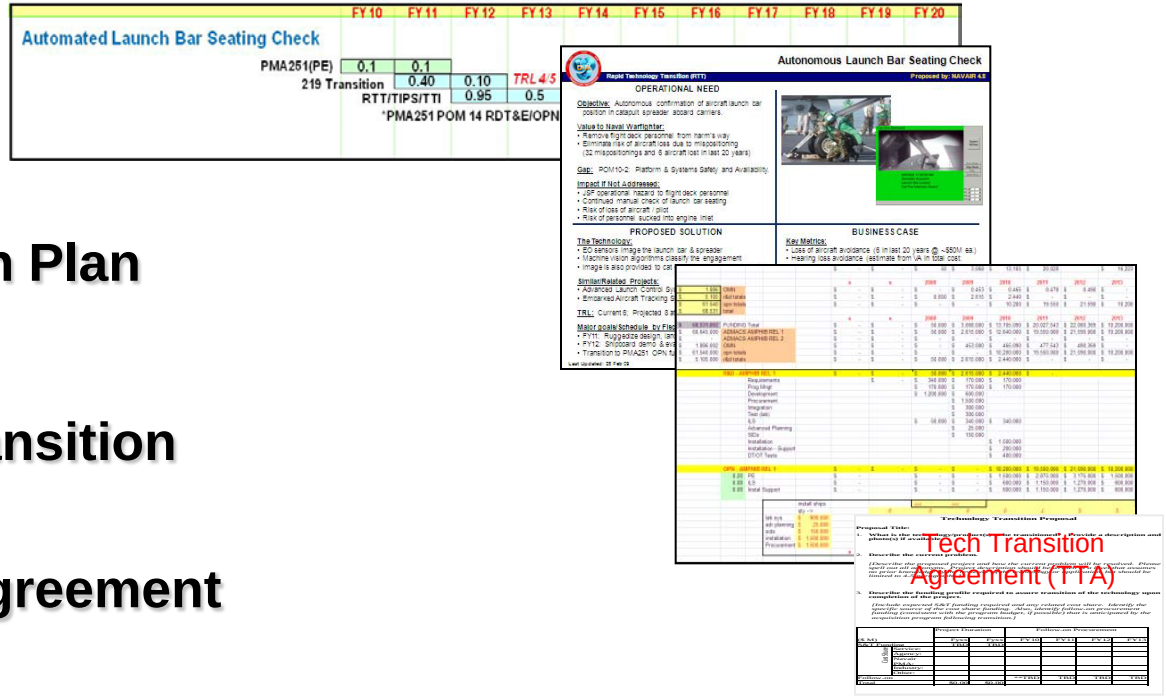


* Note- RDT&E/OPN Funding, 4.2 confirmation to be completed at end of 219 Transition

S&T Funding (6.1 thru 6.3A)
N88 R&D Funding (6.3B, 6.4)
N88 OPN Funding

- **PMA251 PE (example)**
  - Develop system requirements, ROM(4.2)
- **Section 219 Transition Program**
  - Investigate fixture designs, and machine vision approaches from original prototypes. Address (Demo/Prototype) critical performance parameters
  - Refine Requirements
  - Perform Initial Systems Engineering Review, Refine program cost, resource plan, testing requirements
  - In-House funding only. Immediate transition not required. Must transition in 2 years
- **TTI / RTT**
  - Must transition to acquisition in 24 months **or less**. Requested funding not to exceed 2M per project
  - Immediate fleet need (RTT/TIPS) or value to the warfighter (TTI)
  - Deliver shipboard test
- **POM 14**
  - RDT&E/OPN

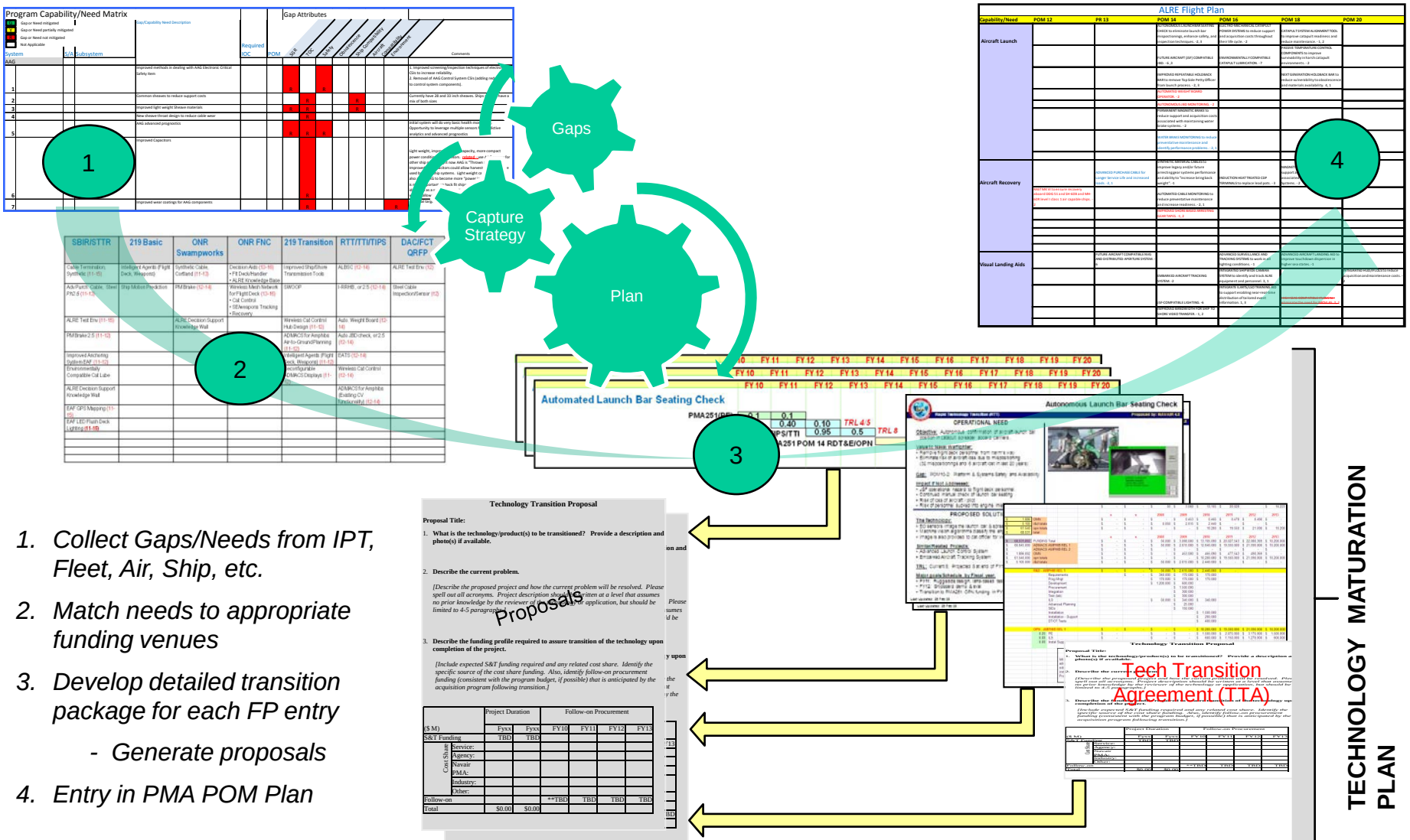
Technology Maturation Plan (TMP)



Includes:

- Funding Transition Plan
- Quad Chart(s)
- Cost Estimate (Transition Proposals)
- Tech Transition Agreement (TTA)
  - Well defined requirements
  - Accurate cost data
  - <u>Exit Criteria</u>
  - Executable Schedule

S&T Process Products



1. *Collect Gaps/Needs from IPT, Fleet, Air, Ship, etc.*
2. *Match needs to appropriate funding venues*
3. *Develop detailed transition package for each FP entry*
   - *Generate proposals*
4. *Entry in PMA POM Plan*

PMA POM Plan (sample)

ALRE Flight Plan

Capability/Need	POM 12	PR 13	POM 14	POM 16	POM 18	POM 20
Aircraft Launch			AUTONOMOUS LAUNCHBAR SEATING CHECK to eliminate launch bar mispostionings, enhance safety, and inspection techniques. -2, 3	ELECTRO-MECHANICAL CATAPULT POWER SYSTEMS to reduce support and acquisition costs throughout their life cycle. - 2	CATAPULT SYSTEM ALIGNMENT TOOL to improve catapult readiness and reduce maintenance. - 1, 2	
			FUTURE AIRCRAFT (JSF) COMPATIBLE JBD. - 6 ,3	ENVIRONMENTALLY COMPATIBLE CATAPULT LUBRICATION. - 7	PASSIVE TEMPERATURE CONTROL COMPONENTS to improve survivability in harsh catapult environments. - 2	
			IMPROVED REPEATABLE HOLDBACK BAR to remove Top Side Petty Officer from launch process. - 2, 3		NEXT GENERATION HOLDBACK BAR to reduce vulnerability to obsolescence and materials availability. 4, 1	
			AUTOMATED WEIGHT BOARD OPERATOR. - 2			
			AUTONOMOUS JBD MONITORING. - 2			
			PERMANENT MAGNETIC BRAKE to reduce support and acquisition costs associated with maintaining water brake systems. - 2			
		WATER BRAKE MONITORING to reduce preventative maintenance and identify performance problems. - 2, 1	ALCS - 1, 2			
Aircraft Recovery		ADVANCED PURCHASE CABLE for Longer Service Life and increased loads. -2, 1	SYNTHETIC MATERIAL CABLES to improve legacy and/or future arresting gear systems performance and ability to "increase bring back weight". -1		MAGNETIC TAILHOOK to reduce support and acquisition costs associated with maintaining AG Systems. - 2	
			AUTOMATED SYNTHETIC CABLE MONITORING - 3			
			IMPROVED SHORE BASED ARRESTING GEAR TAPES. -1, 2			
			Improved Deck Edge Displays - 1			

Our solutions focus on …..

Test… **isolate the** *real problem*

Repair… *reduce maintenance* **time & costs**

Fly… **increase** *mission readiness*

Questions?

Backup Slides

Acronyms

- ALRE: Aircraft Launch and Recovery Equipment
- AME/ALE: Automated Maintenance/Logistics Environment
- ATE: Automatic Test Equipment
- ATFLIR: Advanced Targeting Forward Looking Infrared
- AVDLR: Aviation Depot Level Repair
- AWSIL: Lakehurst Aircraft Wiring and Support Equipment Integration Laboratory
- BCM: Beyond Capability of Maintenance
- BIT: Built-in Test
- CASS: Consolidated Automated Support System
- CIP: Capital Investment Program
- DAT: Diagnostic Avionics Tester
- DoD: Department of Defense
- IDATS: Integrated Diagnostics and Automated Test Systems
- IDA: Interface Device Assembly
- IOC: Initial Operating Capability
- IWG: Investment Working Group
- JTDI: Joint Technical Data Integration
- LXI: Local area network (LAN) eXtensions for Instrumentation
- MAF: Maintenance Action Form, also called "Work Order"

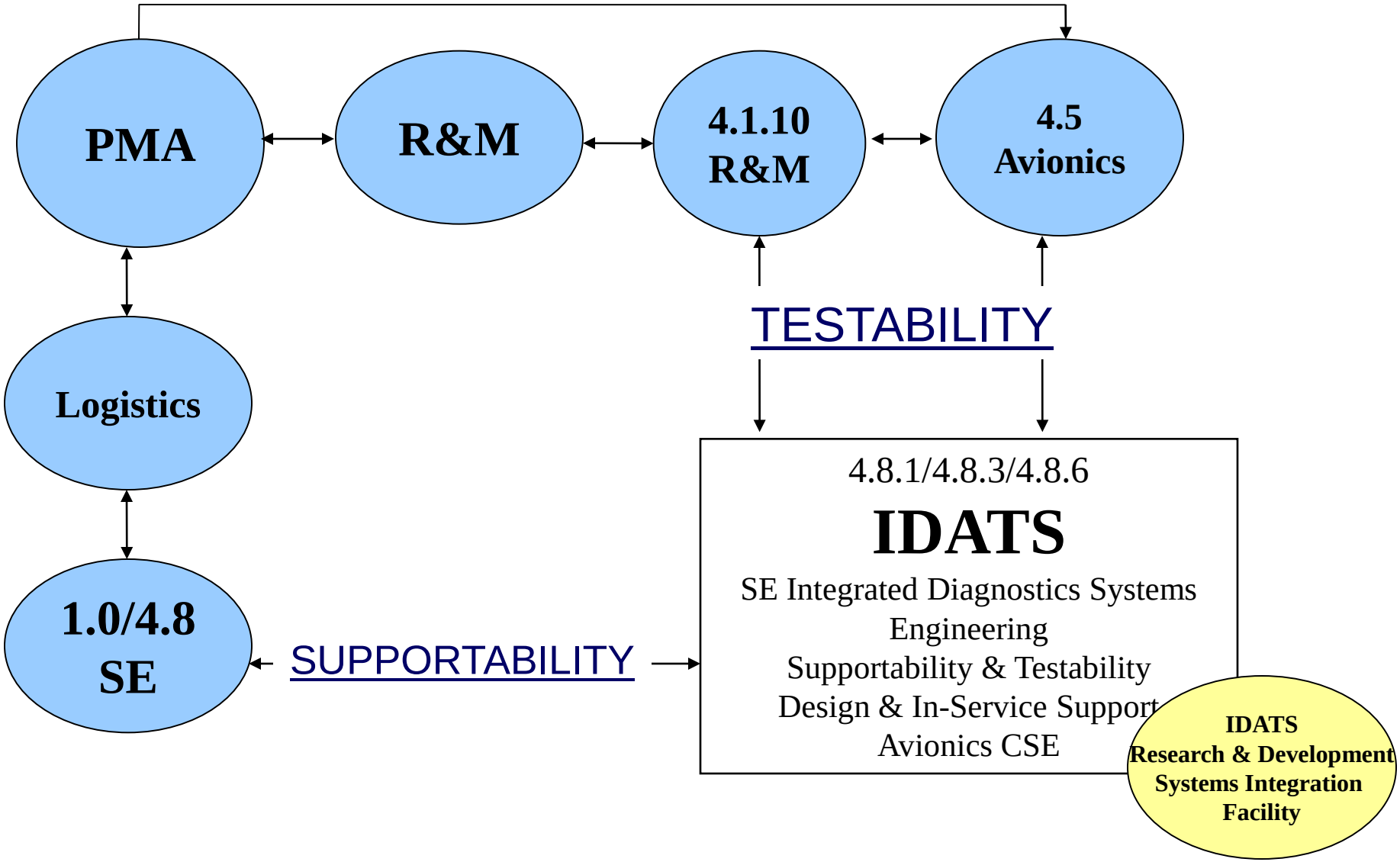
Acronyms (con't)

- MIDS-LVT: Multifunctional Information Distribution System-Low Volume Terminal
- MMH: Maintenance Man-Hours
- MU: Memory Unit (F/A-18 data card)
- NALCOMIS: Naval Aviation Logistics Command/Management Information System
- NATO: North Atlantic Treaty Organization
- NISE: Naval Innovation Science and Engineering, ONR-funded Research Program
- NCDF: Netcentric Diagnostic Framework
- OMS: Operations Management Software
- ONR: Office of Naval Research
- PEMA: Portable Electronic Maintenance Aid (militarized computer)
- PEO: Program Executive Office
- PMA: Program Manager, Air
- POM: Program Objectives Memorandum
- SE: Support Equipment
- SME: Subject Matter Expert(s)
- SSA: Software Support Activity
- TPS: Test Program Set
- V&V: Validation and Verification
- WRA: Weapons Replaceable Assembly (avionics box)

Maintenance Man-Hours Spent on False Alarms

Platform	MMH (August '08 to August '09)	
	799 ("No Fault Found")	127 ("Adjustment")
F/A-18E	10,656.4	14,023.5
F/A-18F	16,364.8	20,928.3
MV-22B	10,284.3	13,622.8
CH-53E	12,384.0	44,340.9
E-2C	7,742.5	29,975.4
T-45A	2,756.0	4,042.8
T-45C	7,019.9	7,801.3
MH-60R	2,255.3	5,966.0
MH-60S	7,849.1	28,339.9
TOTAL:	**77,312.3 (44.4 MY)**	**169,040.9 (96.0 MY)**

IDATS Role in the Acquisition Process



Reference Documents

DoDD 5000.01 *of 12 May 2003*

A central theme of the acquisition process is that the technology employed should be "mature" before system development begins

U.S.C. Title 10, 2366a, Jan 08 TDS for MS-A Statutory

DoDI 5000.02 *of 8 December 2008*

12 May 03 version established the requirement for MS-B & C MDAPs to conduct TRAs
This version established the requirement for MS-A TD Phase programs to conduct TRAs

U.S.C. Title 10, 2366b, Jan 06 TRL6 for MS-B Statutory

Defense Acquisition Guidebook
of Nov 2004

Introduces TRA process highlights, & the use of TRLs

OUSD(S&T) TRA Desk Book
Version 2, of May 2005

Provides TRA process guidelines & includes HW & SW TRLs
Establishes Independent Review Team (IRT)

Air Force

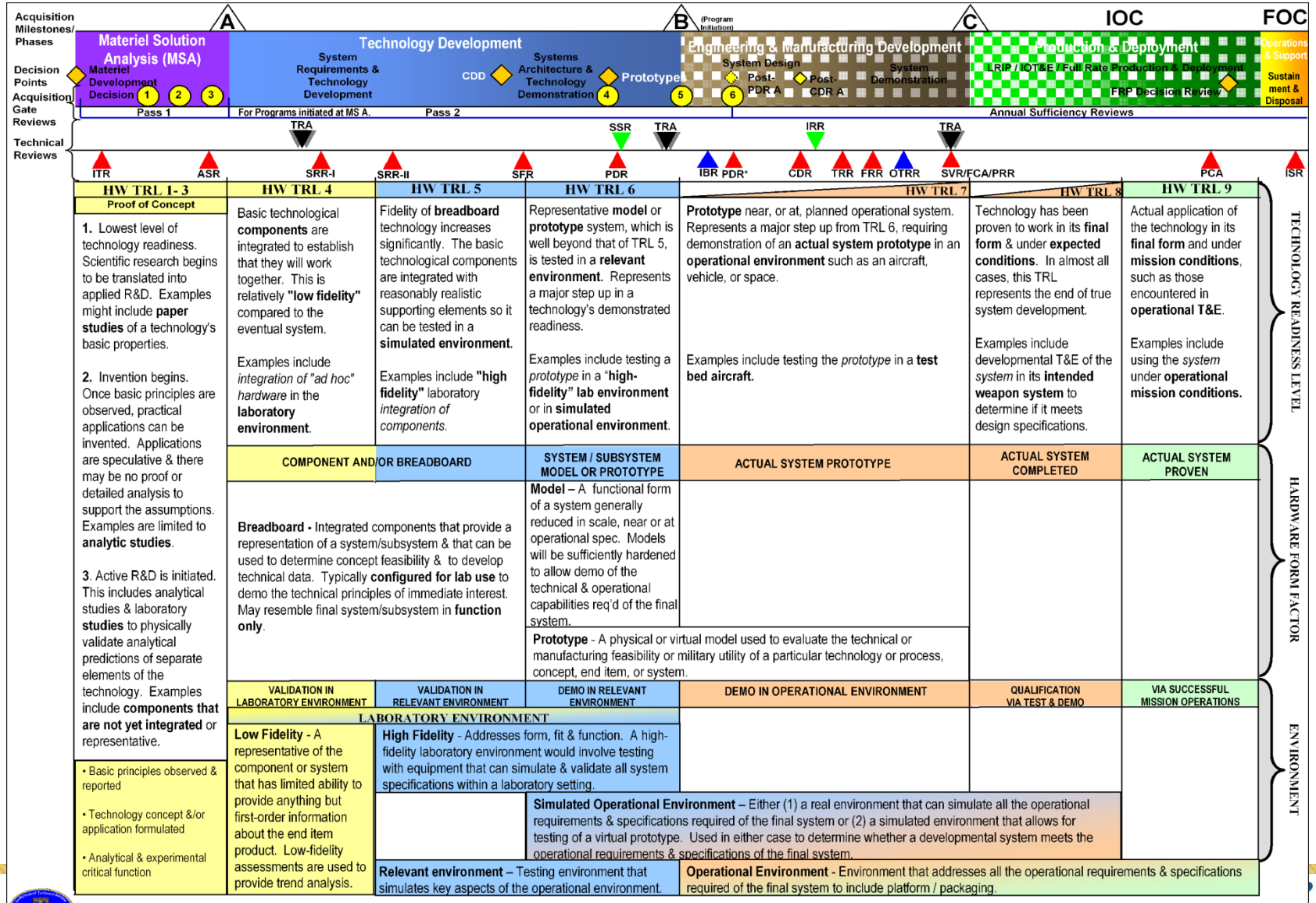
SECNAVINST 5000.2D *of 16 October 2008*

Establishes the requirement for Navy acquisition programs (ACAT I, IA, II, III, IV) to conduct TRAs
Establishes the requirement for "Separation of Functions" – Independent Panels
Establishes the Two-Pass / Six-Gate DON Requirements & Acquisition Governance Process

ARMY

NAVAIRINST 4355.19D
of 17 April 2009
NAVAIR SETR INSTRUCTION
Encl (1) NAVAIR SETR Handbook
Encl (2) NAVAIR SETR Timing

NAVAIRINST 3910
(Final Signature Chain)
NAVAIR TRA INSTRUCTION
Encl (1) NAVAIR TRA Handbook
Documents NAVAIR TRA Process


Acquisition Milestones/ Phases
A
B
(Program Initiation)
C
IOC
FOC
Materiel Solution Analysis (MSA)
Technology Development
Engineering & Manufacturing Development
Production & Deployment
Operations & Support
Sustainment & Disposal
System Requirements & Technology Development
CDD
Systems Architecture & Technology Demonstration
Prototypes
System Design
Post-PDR A
Post-CDR A
System Demonstration
LRIP / IOT&E / Full Rate Production & Deployment
FRP Decision Review
Decision Points
Materiel Development Decision
1
2
3
4
5
6
Acquisition Gate Reviews
Pass 1
For Programs initiated at MS A.
Pass 2
Annual Sufficiency Reviews
Technical Reviews
TRA
SSR
TRA
IRR
TRA
ITR
ASR
SRR-I
SRR-II
SFR
PDR
IBR
PDR*
CDR
TRR
FRR
OTRR
SVR/FCA/PRR
PCA
ISR
HW TRL 1- 3
Proof of Concept
1. Lowest level of technology readiness. Scientific research begins to be translated into applied R&D. Examples might include paper studies of a technology's basic properties.
2. Invention begins. Once basic principles are observed, practical applications can be invented. Applications are speculative & there may be no proof or detailed analysis to support the assumptions. Examples are limited to analytic studies.
3. Active R&D is initiated. This includes analytical studies & laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.
• Basic principles observed & reported
• Technology concept &/or application formulated
• Analytical & experimental critical function
HW TRL 4
Basic technological components are integrated to establish that they will work together. This is relatively "low fidelity" compared to the eventual system.
Examples include integration of "ad hoc" hardware in the laboratory environment.
HW TRL 5
Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so it can be tested in a simulated environment.
Examples include "high fidelity" laboratory integration of components.
HW TRL 6
Representative model or prototype system, which is well beyond that of TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness.
Examples include testing a prototype in a "high-fidelity" lab environment or in simulated operational environment.
HW TRL 7
Prototype near, or at, planned operational system. Represents a major step up from TRL 6, requiring demonstration of an actual system prototype in an operational environment such as an aircraft, vehicle, or space.
Examples include testing the prototype in a test bed aircraft.
HW TRL 8
Technology has been proven to work in its final form & under expected conditions. In almost all cases, this TRL represents the end of true system development.
Examples include developmental T&E of the system in its intended weapon system to determine if it meets design specifications.
HW TRL 9
Actual application of the technology in its final form and under mission conditions, such as those encountered in operational T&E.
Examples include using the system under operational mission conditions.
TECHNOLOGY READINESS LEVEL
COMPONENT AND/OR BREADBOARD
SYSTEM / SUBSYSTEM MODEL OR PROTOTYPE
ACTUAL SYSTEM PROTOTYPE
ACTUAL SYSTEM COMPLETED
ACTUAL SYSTEM PROVEN
Breadboard - Integrated components that provide a representation of a system/subsystem & that can be used to determine concept feasibility & to develop technical data. Typically configured for lab use to demo the technical principles of immediate interest. May resemble final system/subsystem in function only.
Model – A functional form of a system generally reduced in scale, near or at operational spec. Models will be sufficiently hardened to allow demo of the technical & operational capabilities req'd of the final system.
Prototype - A physical or virtual model used to evaluate the technical or manufacturing feasibility or military utility of a particular technology or process, concept, end item, or system.
HARDWARE FORM FACTOR
VALIDATION IN LABORATORY ENVIRONMENT
VALIDATION IN RELEVANT ENVIRONMENT
DEMO IN RELEVANT ENVIRONMENT
DEMO IN OPERATIONAL ENVIRONMENT
QUALIFICATION VIA TEST & DEMO
VIA SUCCESSFUL MISSION OPERATIONS
LABORATORY ENVIRONMENT
Low Fidelity - A representative of the component or system that has limited ability to provide anything but first-order information about the end item product. Low-fidelity assessments are used to provide trend analysis.
High Fidelity - Addresses form, fit & function. A high-fidelity laboratory environment would involve testing with equipment that can simulate & validate all system specifications within a laboratory setting.
Simulated Operational Environment – Either (1) a real environment that can simulate all the operational requirements & specifications required of the final system or (2) a simulated environment that allows for testing of a virtual prototype. Used in either case to determine whether a developmental system meets the operational requirements & specifications of the final system.
Relevant environment – Testing environment that simulates key aspects of the operational environment.
Operational Environment - Environment that addresses all the operational requirements & specifications required of the final system to include platform / packaging.
ENVIRONMENT