Program Executive Office Littoral Combat Ships (PEO LCS) Science &Technology Overview

31 August 2011

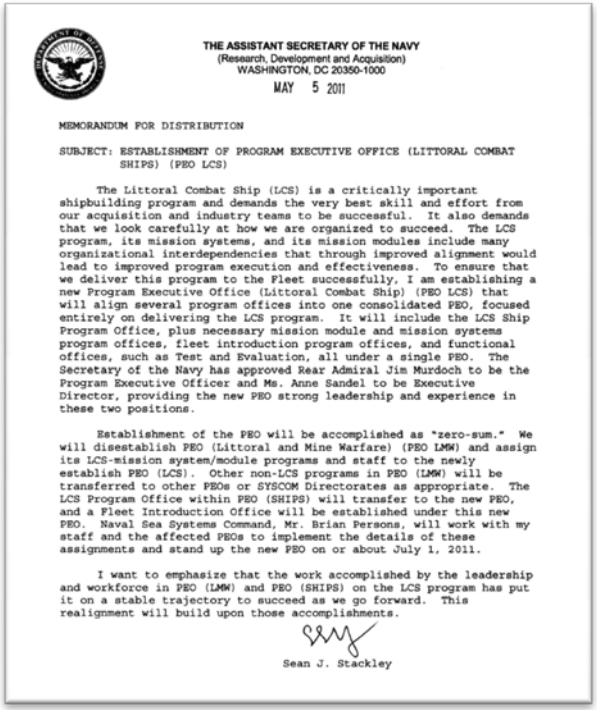
Megan Cramer, PhD | PEO LCS S&T Lead

Purpose

- **Introduce PEO LCS**
  - Stood up on 11 July 2011 at the direction of ASN RDA
  - Focused on delivery of the LCS Program
    - Sea Frames
    - Mission Packages
    - Fleet Introduction

- **Present PEO Science & Technology Initiatives**
  - Rapid Technology Insertion Process
  - Open Architecture
  - Advanced Modeling

- **Benefits**
  - Enhanced capabilities
  - Close Gaps
  - Reduce Costs



THE ASSISTANT SECRETARY OF THE NAVY
(Research, Development and Acquisition)
WASHINGTON, DC 20350-1000

MAY 5 2011

MEMORANDUM FOR DISTRIBUTION

SUBJECT: ESTABLISHMENT OF PROGRAM EXECUTIVE OFFICE (LITTORAL COMBAT SHIPS) (PEO LCS)

The Littoral Combat Ship (LCS) is a critically important shipbuilding program and demands the very best skill and effort from our acquisition and industry teams to be successful. It also demands that we look carefully at how we are organized to succeed. The LCS program, its mission systems, and its mission modules include many organizational interdependencies that through improved alignment would lead to improved program execution and effectiveness. To ensure that we deliver this program to the Fleet successfully, I am establishing a new Program Executive Office (Littoral Combat Ship) (PEO LCS) that will align several program offices into one consolidated PEO, focused entirely on delivering the LCS program. It will include the LCS Ship Program Office, plus necessary mission module and mission systems program offices, fleet introduction program offices, and functional offices, such as Test and Evaluation, all under a single PEO. The Secretary of the Navy has approved Rear Admiral Jim Murdoch to be the Program Executive Officer and Ms. Anne Sandel to be Executive Director, providing the new PEO strong leadership and experience in these two positions.

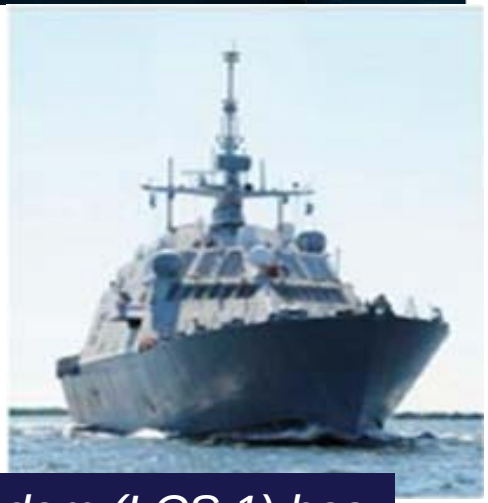
Establishment of the PEO will be accomplished as "zero-sum." We will disestablish PEO (Littoral and Mine Warfare) (PEO LMW) and assign its LCS-mission system/module programs and staff to the newly establish PEO (LCS). Other non-LCS programs in PEO (LMW) will be transferred to other PEOs or SYSCOM Directorates as appropriate. The LCS Program Office within PEO (SHIPS) will transfer to the new PEO, and a Fleet Introduction Office will be established under this new PEO. Naval Sea Systems Command, Mr. Brian Persons, will work with my staff and the affected PEOs to implement the details of these assignments and stand up the new PEO on or about July 1, 2011.

I want to emphasize that the work accomplished by the leadership and workforce in PEO (LMW) and PEO (SHIPS) on the LCS program has put it on a stable trajectory to succeed as we go forward. This realignment will build upon those accomplishments.

Sean J. Stackley

Littoral Combat Ships

- **Modular open systems architecture**
  - Flexible system for dynamic battle space
  - Advanced unmanned air, surface, and underwater vehicles
  - Onboard sensors, weapons, command & control
  - Mission modules interchangeable
  - Maximizing interchangeable components within modules
- **Optimized for warfighting in the littoral**
  - Unique designs for unique environment
  - Fast, maneuverable, shallow draft
- **Targeted at critical capability gaps**
  - Reconfigurable single mission focus
  - Mines, small fast surface craft, diesel submarines
- **Joint Force multiplier**
  - Fully netted with battle force



USS Freedom (LCS 1) has participated in counter-drug operations and RIMPAC Fleet Exercise

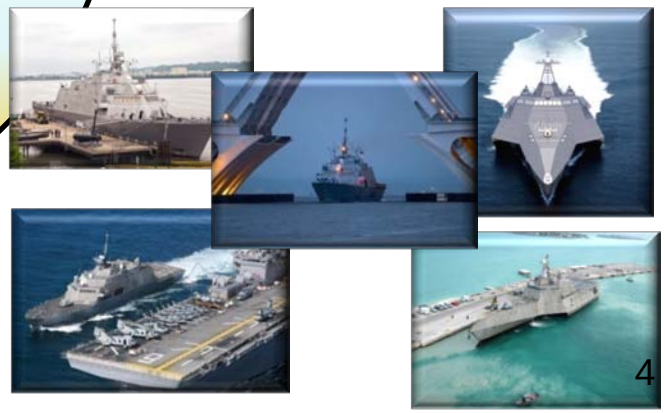
The Business of PEO LCS

LCS Seaframes

Mission Modules

Accelerating Innovation through Open Architecture!

Fleet Introduction



LCS Mission Packages

MISSION MODULE
LCS MM Program - PMS 420

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CREW & SUPPORT AIRCRAFT

= **MISSION PACKAGE**

Mission Systems + Support Equipment

Weapons
- RMMV
- USV
- 30MM Gun
- AMNS
- SSMM

Vehicles

Sensors
- ALMDS
- AQS-20A
- COBRA

Support Containers
Support Equipment
Standard Interfaces

MPCE/MVCS Software

MPCE/MVCS Hardware

VTUAV

Crew Detachments
- Mission Modules
- Aviation

MH-60S

MP

Ship Hardware

Open Architecture concepts enable delivery of right components LCS based on the mission

LCS Seaframe Status

- **USS FREEDOM (LCS 1) (LM)**
  - Undergoing Post Shakedown Availability
  - Completed maiden deployment and arrival to homeport of San Diego on 23 Apr 10
- **USS INDEPENDENCE (LCS 2) (GD)**
  - Undergoing post delivery, test and trials
  - Successfully launched, towed and recovered the RMMV
- **FORT WORTH (LCS 3) (LM)**
  - Launched December 4, 2010
  - Projected delivery in February 2012
- **CORONADO (LCS 4) (GD)**
  - Projected launch fall 2011
  - Projected delivery in fall 2012
- **MILWAUKEE (LCS 5) and JACKSON (LCS 6) awarded on 29 Dec 10**
  - In various stages of preparation for "start of fabrication" (design reviews, production readiness reviews)
- **DETROIT (LCS 7) and MONTGOMERY (LCS 8) awarded on 17 Mar 11**
- **Options for 8 additional hulls at each shipyard available on the FY10 ship contract**

LCS Mission Modules Status

- **Surface Warfare (SUW)**
  - Mission Package (MP) #1 Deployed to SOUTHCOM on USS Freedom (LCS-1)
    - Mk 50 Gun Weapon System demonstrated high reliability during firing events
    - Maritime Security Module directly supported 4 major drug seizures
- **Mine Warfare (MIW)**
  - MCM MP Support Containers and Watercraft (USV, RMV) successfully embarked on USS Independence (LCS-2) for Shipbuilder ICD Checks
  - MCM MP End to End Phase 3 Integration & at-sea operations on SEA FIGHTER (FSF-1) successfully completed
- **Anti-Submarine Warfare (ASW)**
  - Increment 1 MP Deferred in favor of alternative systems
  - Jointly Testing CAS-VDS Sonar with PEO-IWS

Mission module concept helps provide the capabilities of multiple ship classes (frigates, patrol combatants, and mine countermeasures ships) in one LCS class

Fleet Introduction Status

- **Newly established PMS 505**
  - Dedicated **Fleet Introduction** program office
    - Responsible to coordinate
      - logistics
      - training
      - mission package support
      - lifecycle support & ship maintenance

- **Mission Package Support Facility (MPSF)**
  - Operational
  - Mission Module lifecycle support

- **Innovative Concepts**
  - Traditional O-level maintenance pushed ashore
  - Corrective Maintenance using
    - Distance Support (DS)
    - Fly-Away Teams (FATs)

- **Future Initiatives**
  - Establish Fleet users group in San Diego to evaluate new technologies and provide input to next generation Mission Modules

PEO LCS S&T Vision

Accelerate Technology to Meet the Fleet Needs with Improved Capability at Reduced Cost

OA + TECHNOLOGY = MISSION MODULES

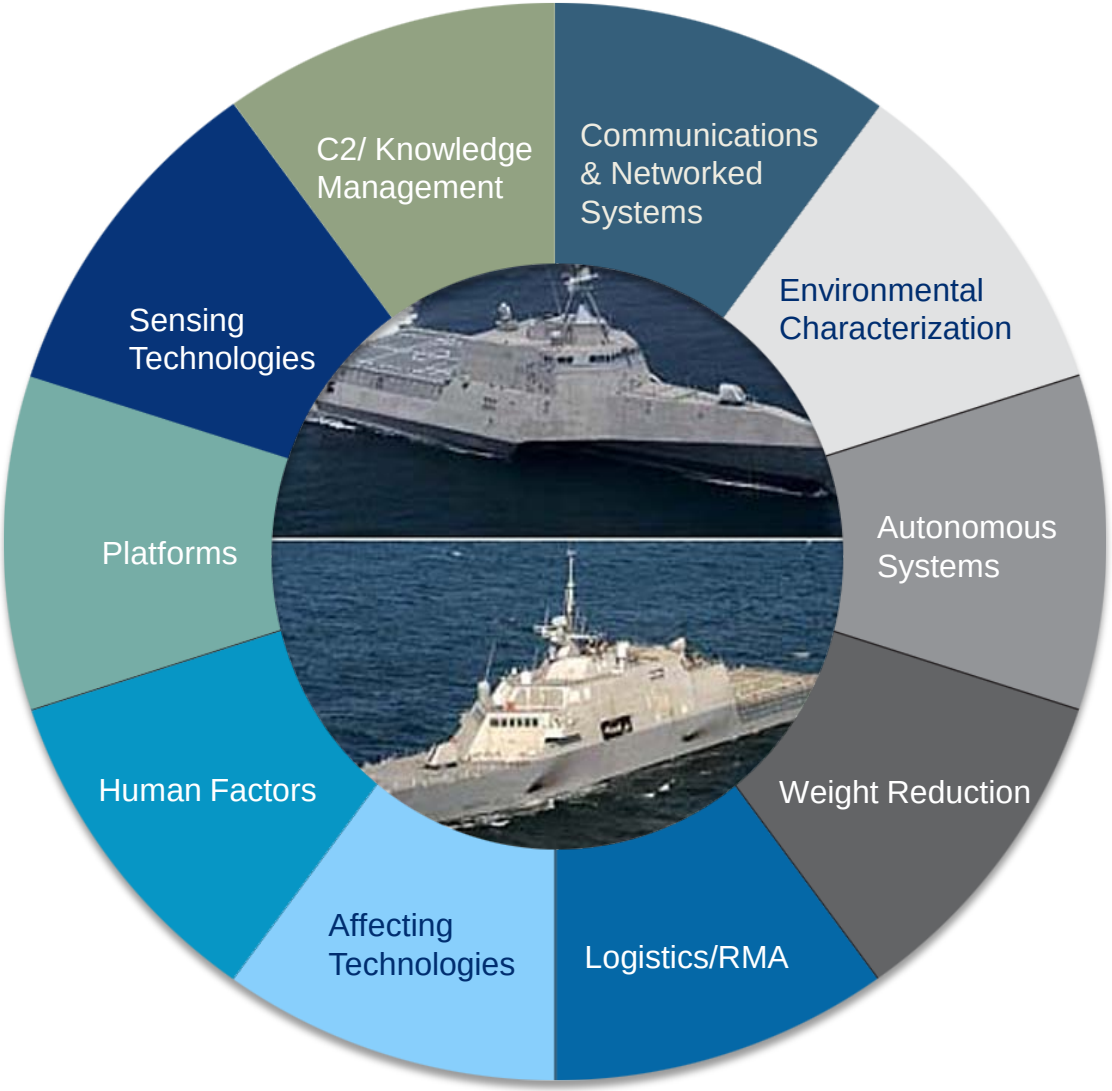
ACCELERATE TECHNOLOGY → **IMPROVED CAPABILTY** → **REDUCED COSTS** → **MEET CUSTOMERS NEEDS**

PEO LCS S&T Elements

- Future Acquisition Planning
- Transition Funding
- ★ Enabling Technology Transition
- ★ Open Architecture
- Commonality
- Open Business
- ★ Advanced Modeling
- Small Business
- S&T Community Liaison
- ★ Rapid Technology Insertion Process

ENABLING TECHNOLOGY TRANSITION

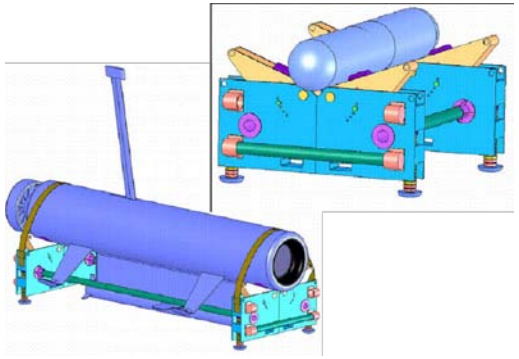
PEO LCS Technology Focus Areas

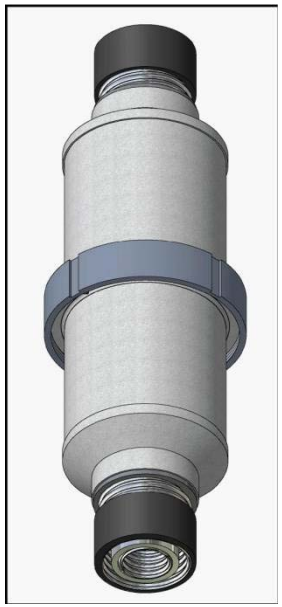


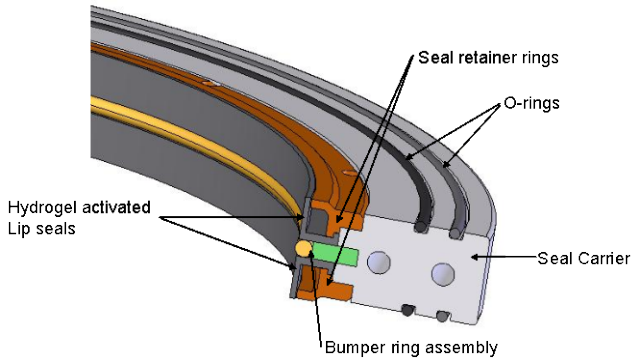
Enabling Seaframe Technology Transition

PEO LCS – consistently leverage Small Businesses to help address technology gaps within the Seaframe

- Common Cradle for Mission Module Vehicles
  - Reduces weight
  - Reduces cost
- Autonomous Shipboard Cleaning
  - Significant reduction in cleaning time
- High Temperature Superconducting Degaussing
  - Reduce weight
  - Reduce number of copper cables
- Autonomous Hull Inspection
  - Provides inspection while in port or at sea
- Bulkhead Seals
  - Prevent excessive flooding







Enabling Mission Module Technology Transition

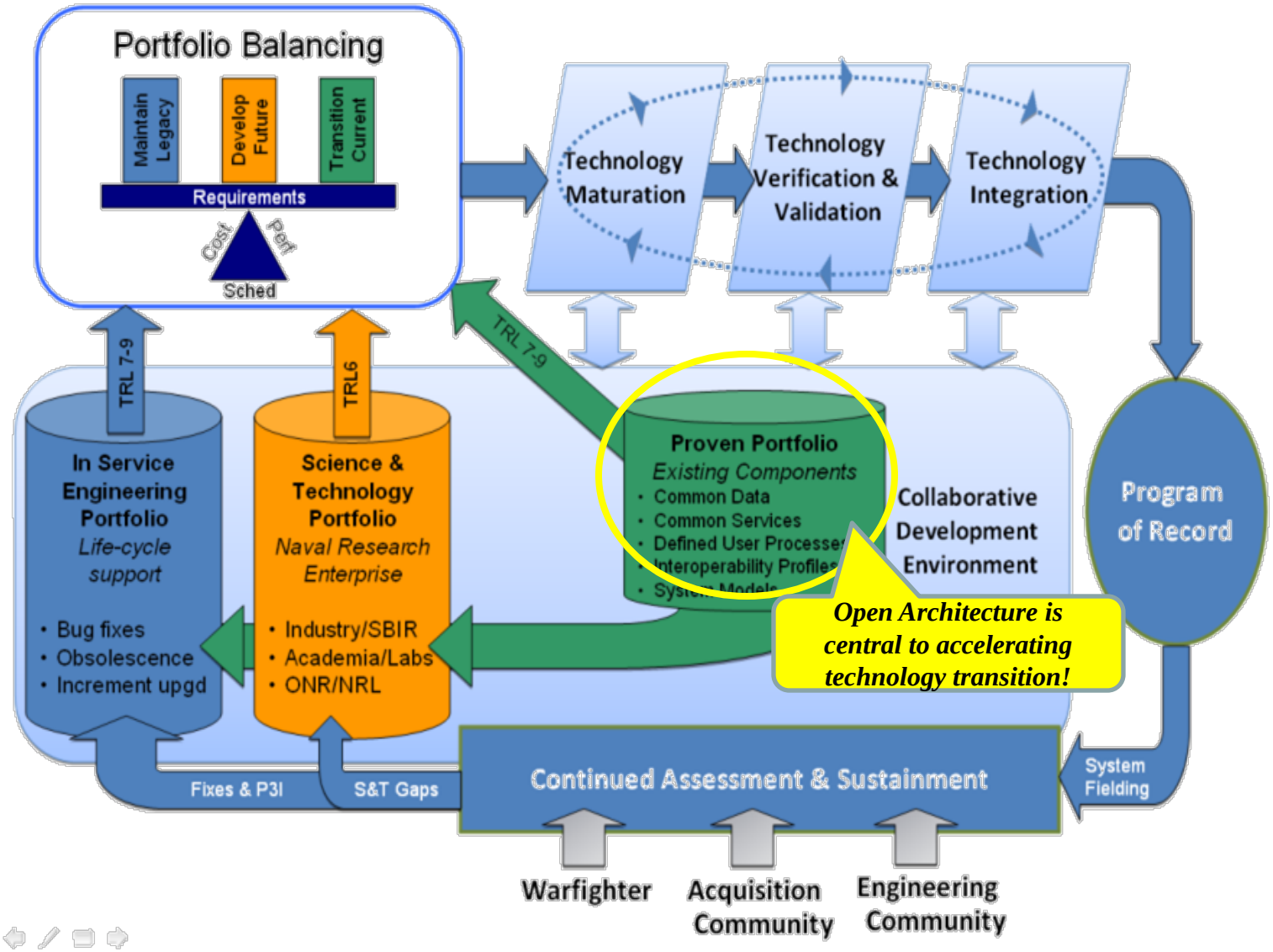
PEO LCS is actively seeking solutions to Mission Module technology gaps

- Reduced sensor to shooter timeline
  - Streamline detect-to-engage
  - Net-centric Sensor Analysis for MIW (NSAM)
    - Reduce false alarm rates
    - Multi-sensor data correlation
    - Improve contact confidence
- Very Shallow Water (VSW)
  - Assault Breaching System of Systems, including JABS, COBRA BLK II
- Migration towards unmanned vehicles
  - Improved Automatic Target Recognition (ATR) algorithms
  - Increased Autonomy

PEO LCS Long Term Technology Needs

- Improved hull survivability
- Corrosion mitigation
- Distance training and support
- Enhanced operations at night
- Real-time processing
- Efficient management and transmission of large data sets
- Decreased impact of wave motion on sonar performance
- OTH secure communications for USVs
- Improved detection and classification through the water column
- Improved Automatic Target Recognition (ATR)
- Intuitive human/robotic systems interface
- Increased endurance solutions for unmanned vehicles
- Rapid Launch and Handling →off-board refueling, weight saving, autonomy
- Space-based ISR
- Self-healing structural materials
- Information security

Technology Process



OPEN ARCHITECTURE

Benefits of Open Architecture

- Naval Open Architecture is the confluence of business and technical practices yielding modular, interoperable systems that adhere to open standards with published interfaces.
  - Increases opportunities for innovation
  - Facilitates rapid technology insertion
  - Reduces maintenance constraints

- Current constrained budget environment requires move to OA in order to provide rapid capability to the warfighter

OA enables Better Buying Power!

How PEO LCS Evaluates OA

- Methodology:
  - Analysis at subcomponent and sub-function level to look for opportunities for openness within systems, focusing on:

    (1) Level of documentation

    (2) Widespread use of a standard /architecture/technology/interface

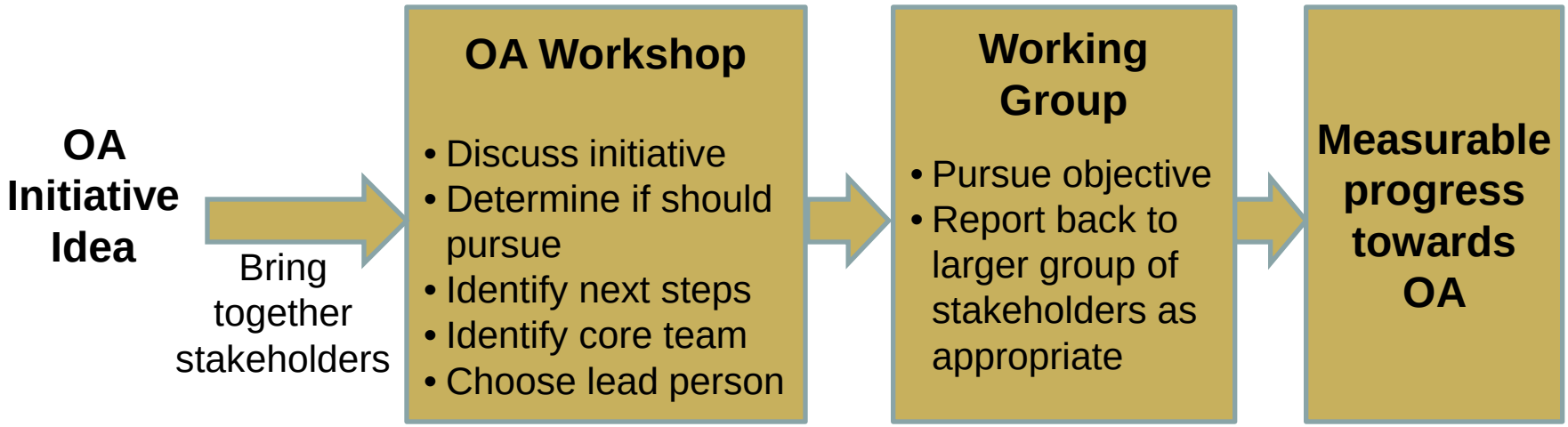
    (3) Ease of making a change

    (4) Ownership to support upgrades

Open Architecture (OA Levels)	
OA Level	**Definition**
1	A **closed** system is a design-specific system that does not support affecting change to the system.
2	A **partially closed** system is a system with limited use of documented interfaces, which inhibits the ability to affect change.
3	A system at this level has a partial ability to enable change due to **supported interfaces**.
4	A system with **open interfaces** uses standards that are considered well-defined, governed, and supported to enable third party development.
5	A **partially open** system has a combination of both open and closed system characteristics and partially supports third party development.
6	An **open architecture** system employs open standards for key interfaces within a system to effect change with minimal development.
7	A system at this level enables **integration-focused development** in order to facilitate third party efforts.
8	System **reconfigurable** to support a change with minimal integration effort.
9	An **open system** fully supports change to enable rapid technology insertion through widespread third party development.

OA Workshop Overview

Typical Process involving PEO LCS OA Workshops



- PEO LCS OA Workshops conducted:
  - ✓ Unmanned Systems Common Control
  - ✓ MIW Software Repository
  - ✓ User Interface Style Guide
  - ✓ Data Services Discovery
  - ❑ More workshops upcoming, including Standard Sensor Payload Interface

OA in PEO LCS

PEO LCS

OA permeates all levels of PEO LCS

PEO LCS OA Initiatives

- Unmanned Systems Common Control ← **Deep Dive #1**
- Mine Warfare (MIW) Data Model Working Group ← **Deep Dive #2**
- MIW Software Repository on Forge.mil
- User Interface Style Guide and others

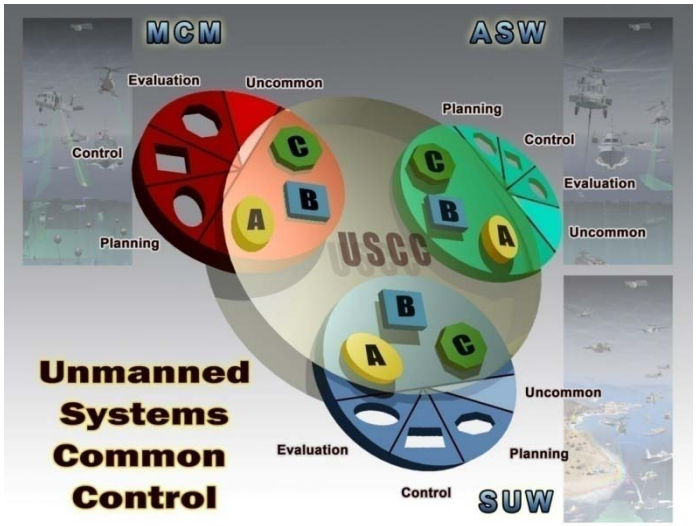
PMS 403 RMS	**PMS 406** Unmanned Systems	**PMS 420** Mission Modules	**PMS 495** Mine Warfare	**PMS 501** Seaframe	**PMS 505** Fleet Introduction

Sampling of OA Initiatives

- Mission Module Open Architecture Strategy
- Open Architecture Levels measuring amount of OA within systems & subsystems
- UUV Open Architecture specification
- Development of Mine Warfare and Environmental Decision Aids Library (MEDAL) Enterprise Architecture (EA)
- Developing Network-Centric Sensor Analysis for Mine Warfare (NSAM) OA prototype to conduct Post Mission Analysis (PMA)

OA Deep Dive #1:

Unmanned Systems Common Control



Description:

- Unmanned Systems Common Control Working Group stood up under the PEO-LCS S&T Working Group to evaluate the current state of the PEO effort to achieve a standard software architecture for unmanned system's C2 and identifying the path forward to gain consensus among all stakeholders on finalization and implementation.
- Stood up in June 2011 bringing together representatives from across the community of interest
- Will deliver a Gap Analysis on the current effort and a White Paper on way forward and recommended transition milestones

Operational Relevance:

- A standard set of software components and interface specifications for communication between components will reduce overall cost and schedule for integration of new unmanned systems and enhancement of existing systems

PEO Objectives:

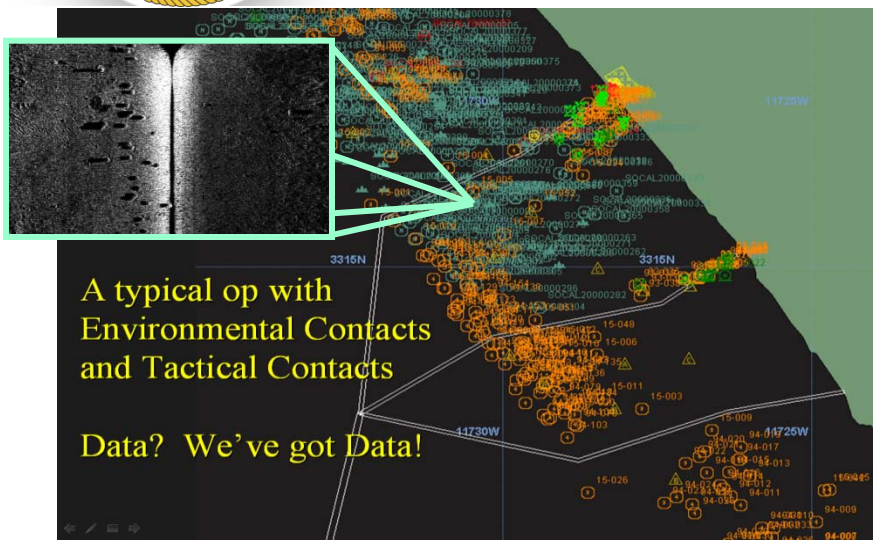
- Lead the working group, conduct a requirements and solution survey, deliver the gap analysis, and recommendations on way ahead.

Major Accomplishments, Products, Deliverables, Future Milestones:

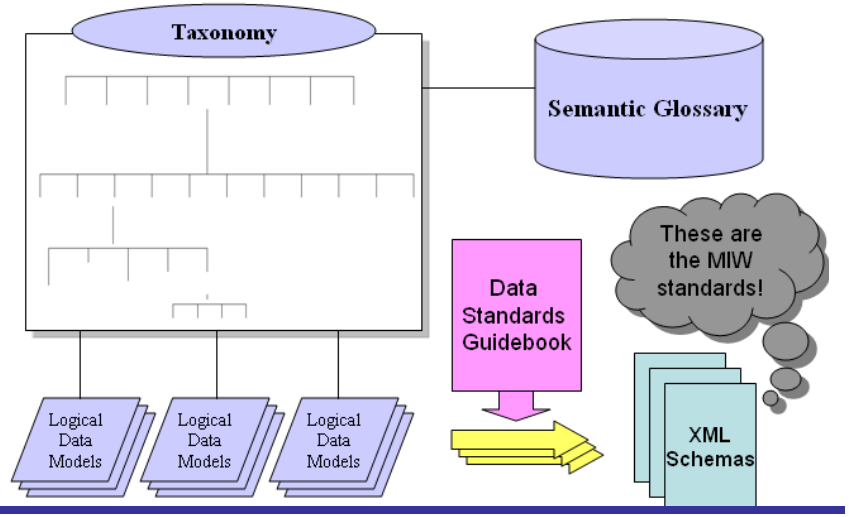
- JUN 2011 – Conducted WG Kickoff meeting in Panama City during ONR Demo event with representation from multiple PEO program/projects and industry partners
- AUG 2011 – Begin requirements and solution survey
- FEB 2012 – Deliver Requirements Gap Analysis
- APR 2012 – Deliver Way Ahead White Paper

OA Deep Dive #2:

MIW Data Standards Effort



MIW Data Model Working Group (DMWG) Process



- **Group Purpose:**
  - Mechanism for oversight of published MIW data standards and semantics development
  - Forum for discussion of program and cross-program data-related questions
- **Group Objectives:**
  - Develop data standards for MIW
  - Develop and manage process to publish MIW data standards
  - Reach out to communities to ensure alignment and interoperability

MIW Data Standards Products:

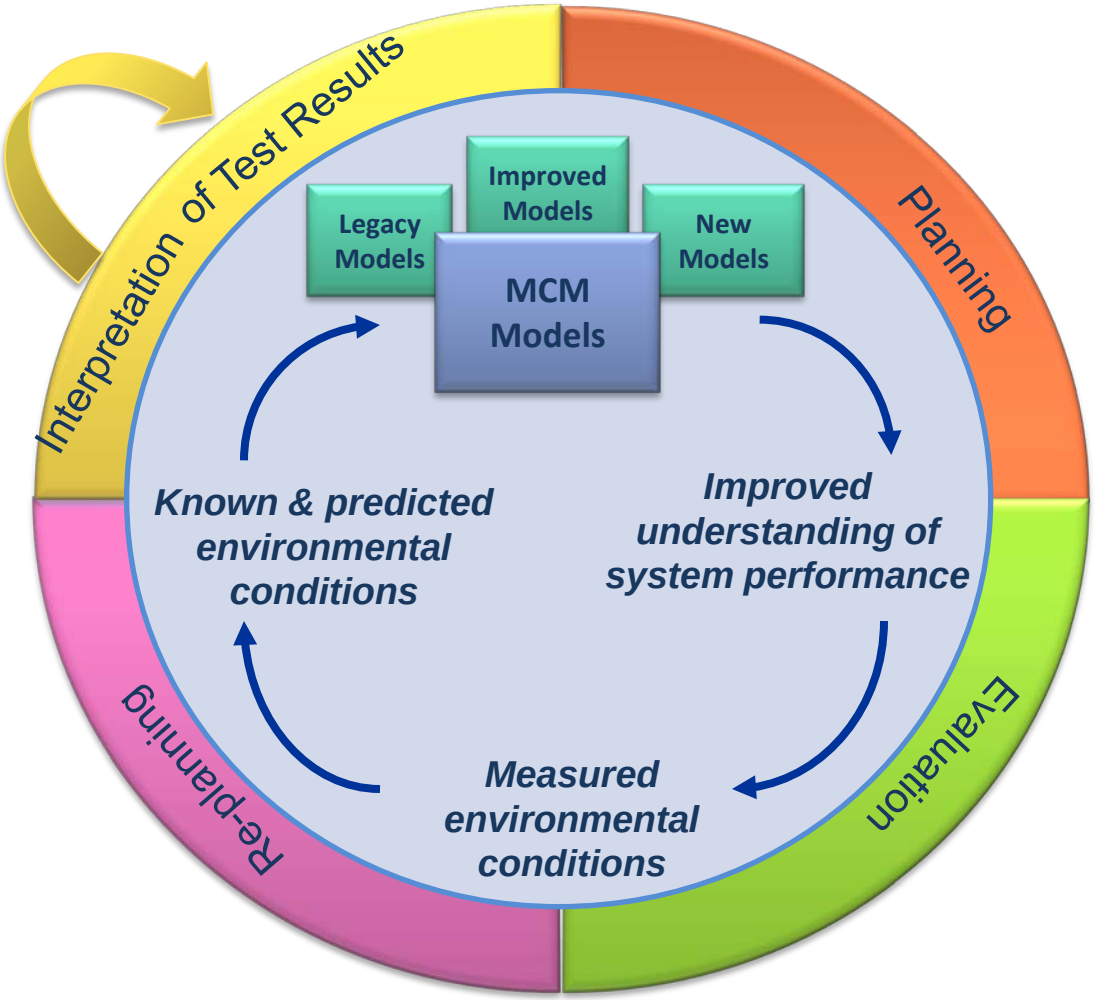
MIW Taxonomy Version 1
MIW Glossary
"Data Standards Guidebook" & associated tool
Data Standards for MIW Contacts, MIW Tasks, MIW Areas
Data Standards for MIW Environmental Data
Data Standard for Sensor Data

MIW DMWG is driven by industry participation!

ADVANCED MODELING

MCM Model Project Vision

Incorporating the complexity of the environment through a model based approach



MCM Model Project Overview

- **Problem Description:**
  - Current set of MCM system performance estimation processes result in unsatisfactory initial performance estimates and expend valuable acquisition testing resources inefficiently.
  - Performance estimates too often result in inefficient, ineffective, and inappropriate test outcomes from associated initial test plans and scenarios.
  - Almost no predictive information is available for use in projecting MCM system performance in test beyond the prescribed environmental and threat context.
- **Effort Description:**
  - Provide advanced MCM system performance models to support improved test evaluation and performance prediction.
    - » Performance estimates more predictive of actual test results

Examining Advanced Modeling

Operational/Tactical Employment

- Planning
- In-situ updates
- System performance Evaluation
- Users: MEDAL operator, NSAM operator (PMA/EPMA)

Resource Sponsors (RDT&E)

- Trade-off analysis
- Predicted System Perf. Evaluation
- System/process improvements
- Users: Program Managers

Assessment

Training

- Fleet (NMAWC)

Testing and Evaluation (T&E)

- System Performance Prediction
- System Performance Evaluation
- Users: OPTEVFOR for OT, Acquisition for DT

Goals

- Deliver enhanced operational capability
- Insight into events and system performance during planning and evaluation
- Migration to Fleet Tools
- Faster reporting and reduction of live T&E

MCM Model Project BAA Opportunity

Advanced Mine Warfare System/Sensor Performance Estimation and Prediction in Test

Topic	Topic Description
(X) MIW Performance Estimation and Prediction Technologies **(a) Physics-based algorithms and system performance models related to MIW sensors/systems** **(b) Environmental algorithms and data collection techniques** **(c) Human-system interaction algorithms** **(d) Multi-system performance aggregation methods** **(e) Services-based architecture for performance algorithms** **(f) Prototype modular system estimation and prediction technologies** **(g) Automation of test design, monitoring, and reporting** **(h) Techniques for system performance representation in complex environments**	*The focus of this topic area will be to provide advanced MIW system performance capability to support improved test evaluation and performance estimation and prediction. A result will be that performance estimates for MCM system testing are more predictive of actual test results.* **The Broad Agency Announcement (BAA) for Net-Centric Systems Test Science and Technology is now accepting proposals for the MCM Model Project.** https://acquisition.army.mil/asfi/solicitation_view.cfm?psolicitationnbr=W900KK08R0018 *Unrestricted Procurement*

RAPID TECHNOLOGY INSERTION PROCESS

Benefits of Rapid Technology Insertion Process

- **Deliver Improved Warfighting Capability**
  - Accelerated Responsiveness to Fleet Needs
  - Flexible and agile as our operational environment and threats change
- **Continuous Coordination with Stakeholders**
  - Proactively Shape and Leverage S&T Technology Investments by ONR, DARPA, & others
  - Provide Technical Information to S&T Organizations and Industry
- **Facilitate PEO LCS Technology Pull**
  - Coordinated Approach to Technology Integration with an emphasis on Technology Transition Exit Criteria
  - Single Oversight Infrastructure & Streamlined Contracting Approach Between S&T and Acquisition

LCS2- USS INDEPENDENCE LCS1 - USS FREEDOM

Accelerate Technology to the Fleet by Leveraging Open Architecture for Enhanced LCS Capabilities!

Technology Acceleration Challenge

Challenges

- Mission Module Equipment Transition to Production
- Weight Reduction
- Common Support Equipment
- Open Architecture Migration
- Rapid Software Qualification & Certification
- Launch, Handling, & Recovery (LH&R) & off board refueling of Unmanned Off-board Vehicles (USV, RMV)
- Remote Vehicle Communications
- Off Board Systems Autonomy with Reliable Real Time Exploitation

Legacy Solution Process

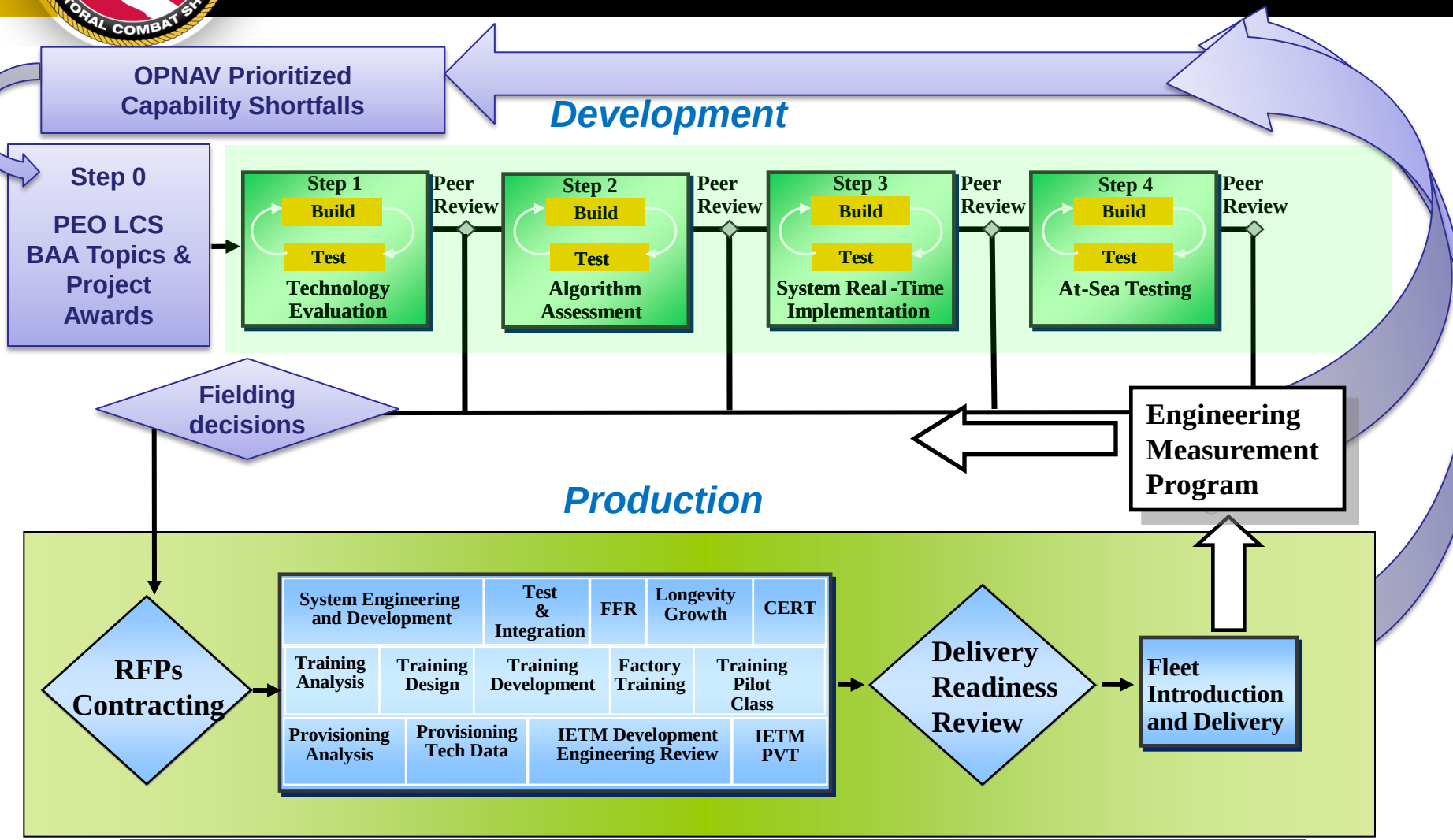
- RFPs: 3+ years to testable solutions.
- ONR FNCs: Appropriate to long term R&D problems.
- SBIRs/STTRs: Exclude large corporations with in-depth solution experience. Good for smaller well defined problems.

Program Managers need a faster solution

Need becomes more pronounced given a dynamic threat

Open Architecture coupled with Rapid Technology Insertion Process will enable Better Buying Power!

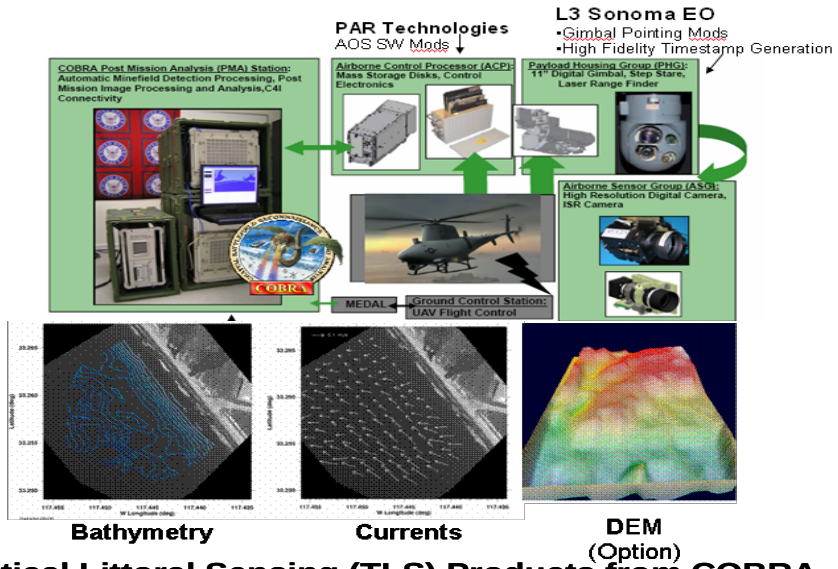
Rapid Tech Insertion Process



Moving Technology from the lab to the Fleet

Rapid Tech Insertion Process Example: COBRA

Coastal Battlefield Reconnaissance and Analysis (COBRA) Capability Enhancement



Tactical Littoral Sensing (TLS) Products from COBRA

Navy/Prog Requirement: Information on bathymetry & currents of the Surf Zone and Very Shallow Water region required for Assault Breaching are acquired with manned assets. Addition of the TLS capability utilizing the COBRA imagery and Post Mission Analysis (PMA) will provide this information without putting divers in harms way. Digital Elevation Data & targeting solutions can also be provided with this asset.

Technology Objective: Fully transition the major Tactical Littoral Sensor (TLS) capability into the Coastal Battlefield Reconnaissance and Analysis (COBRA) Post Mission Analysis (PMA) station and provide a field demonstration of the integrated COBRA capabilities which include imagery of underwater depth contours and surface currents.

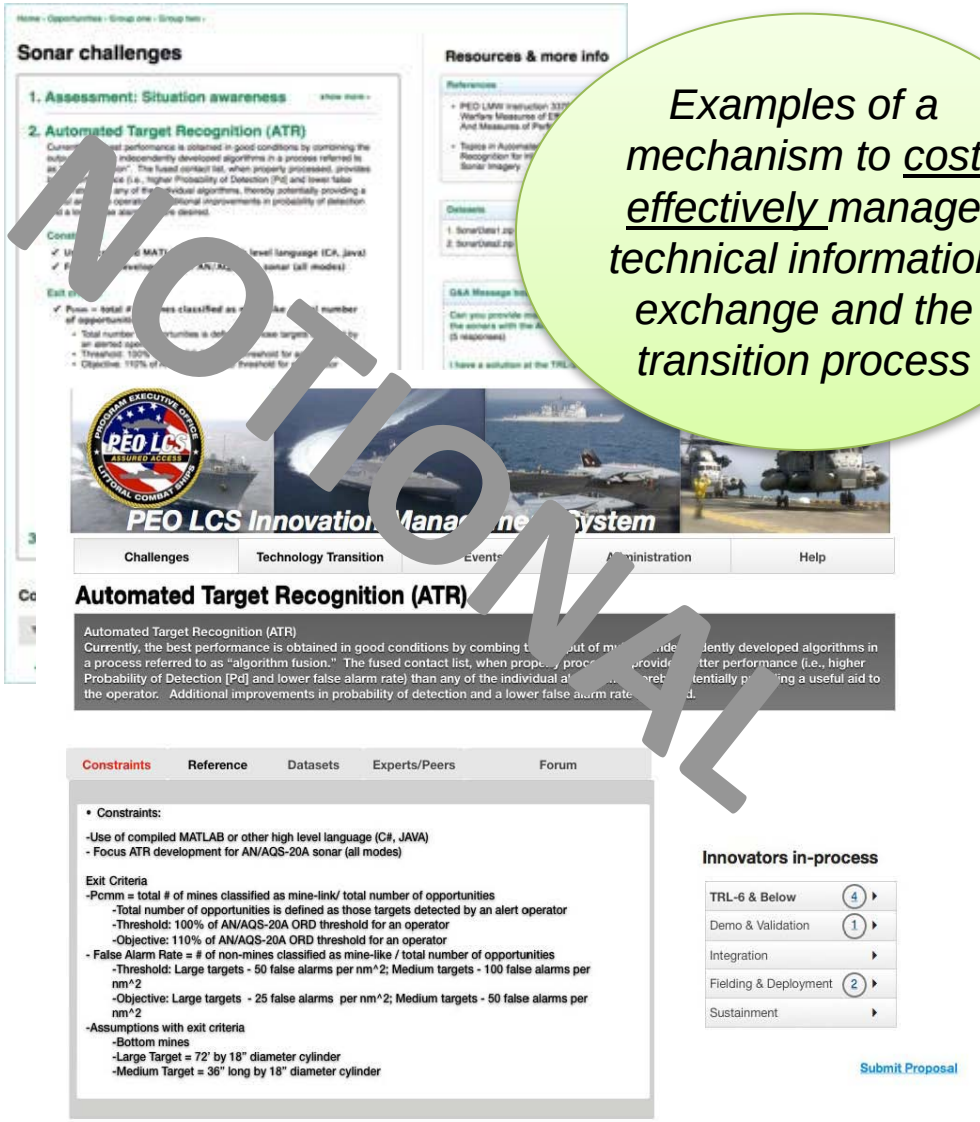
Benefit/Payoff: Estimates of depth contours and current are required for a landing craft diver to approach the beach and make manual corrections. The estimates can be made from data collected by the existing COBRA system.

Deliverables: PMA station documentation; updated PMA Station software COBRA airborne; Payload Subsystem (CAPS) documentation; updated CAPS software

Open Business Portal

- Concept of portal for R&D Contributors will enable Better Buying Power
- Increases throughput of technology, increasing competition and accelerating innovation
- Provides information on systems architecture to innovators, facilitating integration and enabling streamlined technology

Examples of Open Business Portals in Industry:

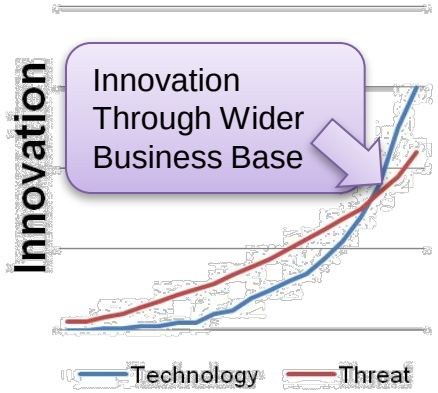


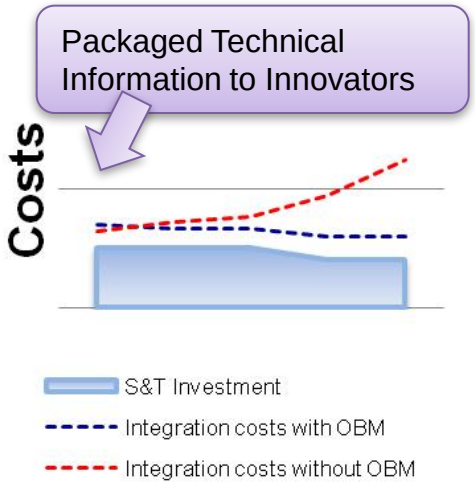
Examples of a mechanism to cost effectively manage technical information exchange and the transition process

NOTIONAL

Projected Benefits of Open Business Model

- Increase industry players in systems innovation base
  - Lower barriers for entry to contributing towards innovation
- Reduce integration costs by approximately 7%, not factoring in improved capability
  - Estimate based upon analysis of literature review
- Leverage more S&T dollars
  - Lower integration costs enable more technologies to be inserted
  - Larger pool of prospective R&D efforts enables improved quality of R&D efforts to be selected
- Enable more revolutionary breakthroughs
  - "Empirical evidence shows that revolutionary breakthroughs are launched mainly by new entrants, while established firms tend to develop marginal changes to existing technologies" from *Radical Innovation and R&D Competition* by Battaggion and Grieco
  - "Because 'second rank' contractors were seldom able to compete successfully against the industry leaders on the basis of their depth of experience in existing technologies, they routinely tried to compete on the basis of their innovative designs" from RAND brief on Innovation and Technological Leadership





Summary

- PEO LCS is developing processes and tools to facilitate technology delivery to the fleet utilizing the powerful mission package concept
  - Acceleration of capability delivery to the warfighter with mission modules
  - Better Buying Power with Open Architecture

- Future efforts include the implementation of mechanisms to make common process and information accessible to stakeholders, particularly small businesses

Help Us Close the Capability Gap | Accelerate technology delivery to the Fleet

THEY *FIGHT* for US

Follow us on
Facebook®
at “PEO LCS”

WE *WORK* for THEM