Implementing an Open Business Model and Open Architecture Approach to Enable Agile Technology Selection

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Overview

- Software technology insertion goals
- Enabling software technology insertion
  - Process
  - Business Models
- Mine Warfare software program technology insertion current initiatives
  - MEDAL
  - PMA
- Importance of systems engineering to support technology insertion

MIW FUTURE

MIW Reachback support

-Data can be provided from a variety of sources.

MIW Information is processed and available via SIPRNET

ONI
NAVO
CMWC

MIWC

-Present in either DESRON or PHIBRON staff

MIWC Staff

- Receive data from all LCS assets IOT maintain COP and determine prosecution sequence of MILCOs.

-Maintain authoritative data set ongoing operation

Enterprise Support

- National assets (LRS) monitor enemy activities

-UAVs (BAMS) provide surveillance data

-Pushes all data of interest to MIWC

Hostile Minelayer

Hostile Mine Storage Facility

Integrated Operations

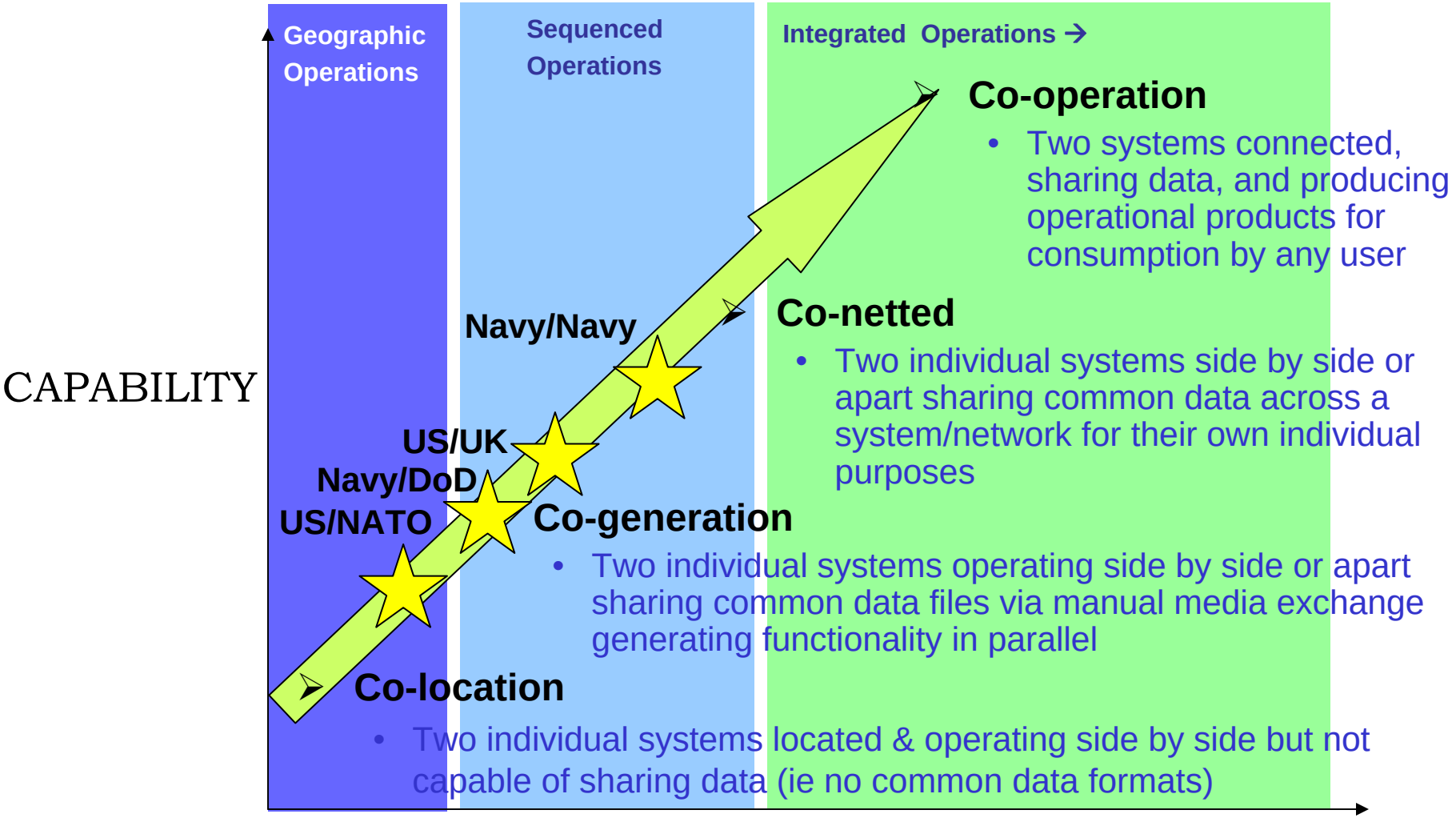
- Each Platform deploys its assets to detect, locate and prosecute any mines.

MIW MM OIC's

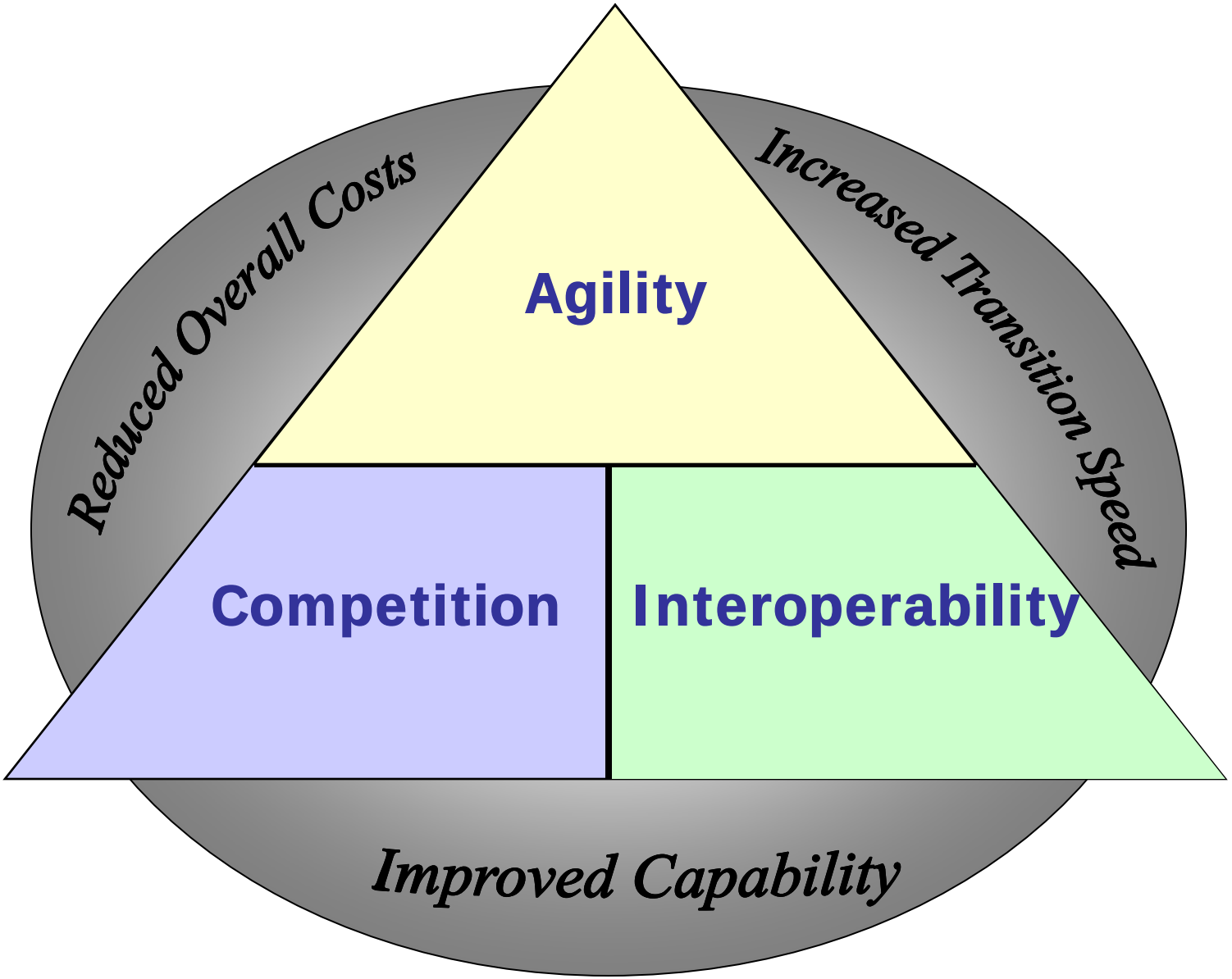
- May be working collaboratively

- Pushes all MILCO, environmental and mine data to MIWC

Levels of Interoperability



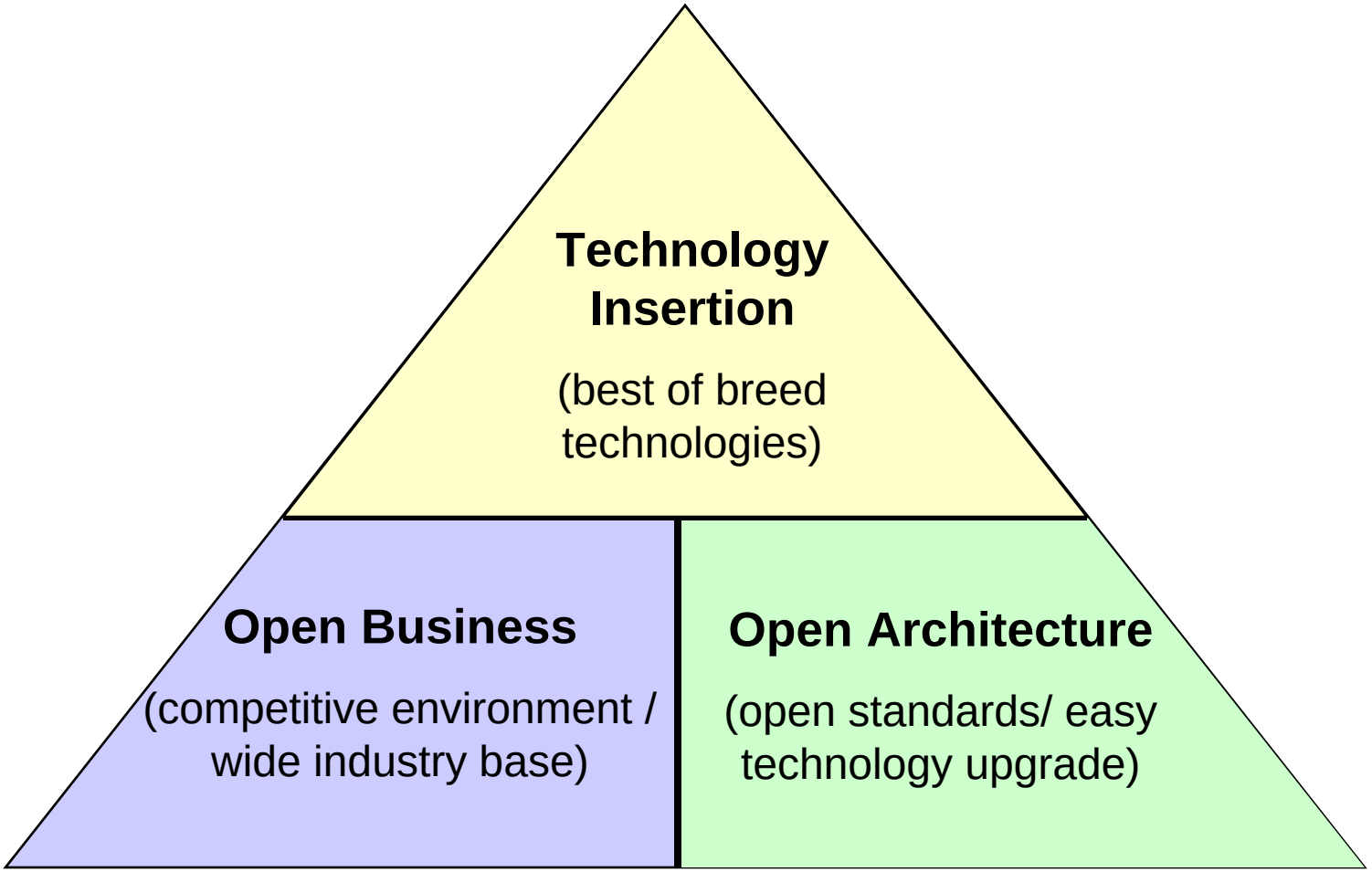
Software Improvement Goals



Introduction

- Through adoption of a common Open Business Model involving scalable Open Architectures with identified Technology Insertions points, it is possible to create an effective government and industry partnership to support rapid capability improvements to software systems and eventual migration of capability to unmanned vehicles.
  - Enabled by reusable services and common standards, which together support a decrease in the required integration time of new technologies and enable the ability for multiple systems to interoperate on the battlefield.
  - Requires industry participation in an inclusive business model and align to a common Service Oriented Architecture (SOA) to achieve an affordable and consistent foundation for the transition of future capability improvements.
- Technology improvements to software capability are required to ultimately migrate capability to sensors to enable autonomous capability

Technology Framework



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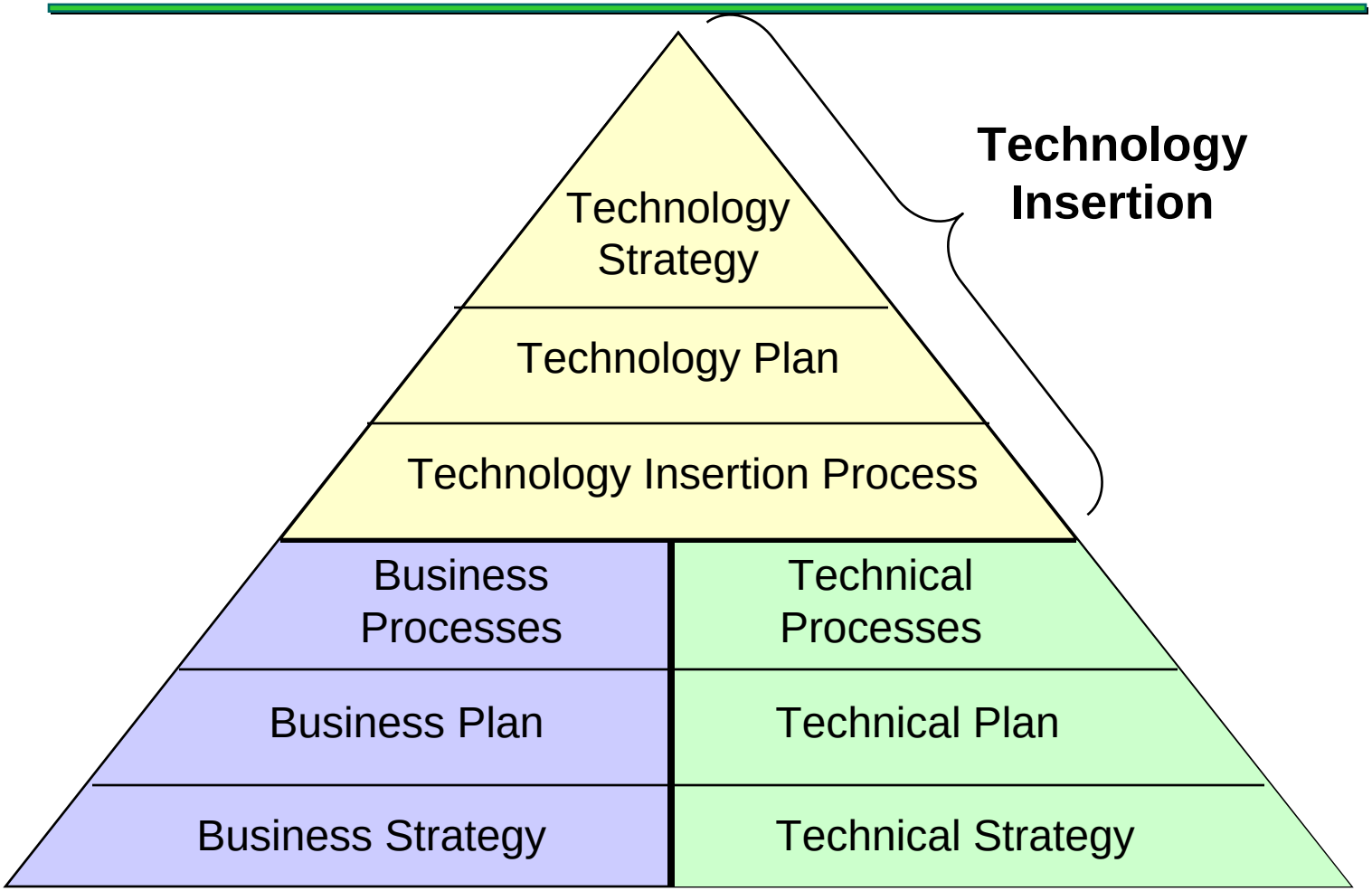

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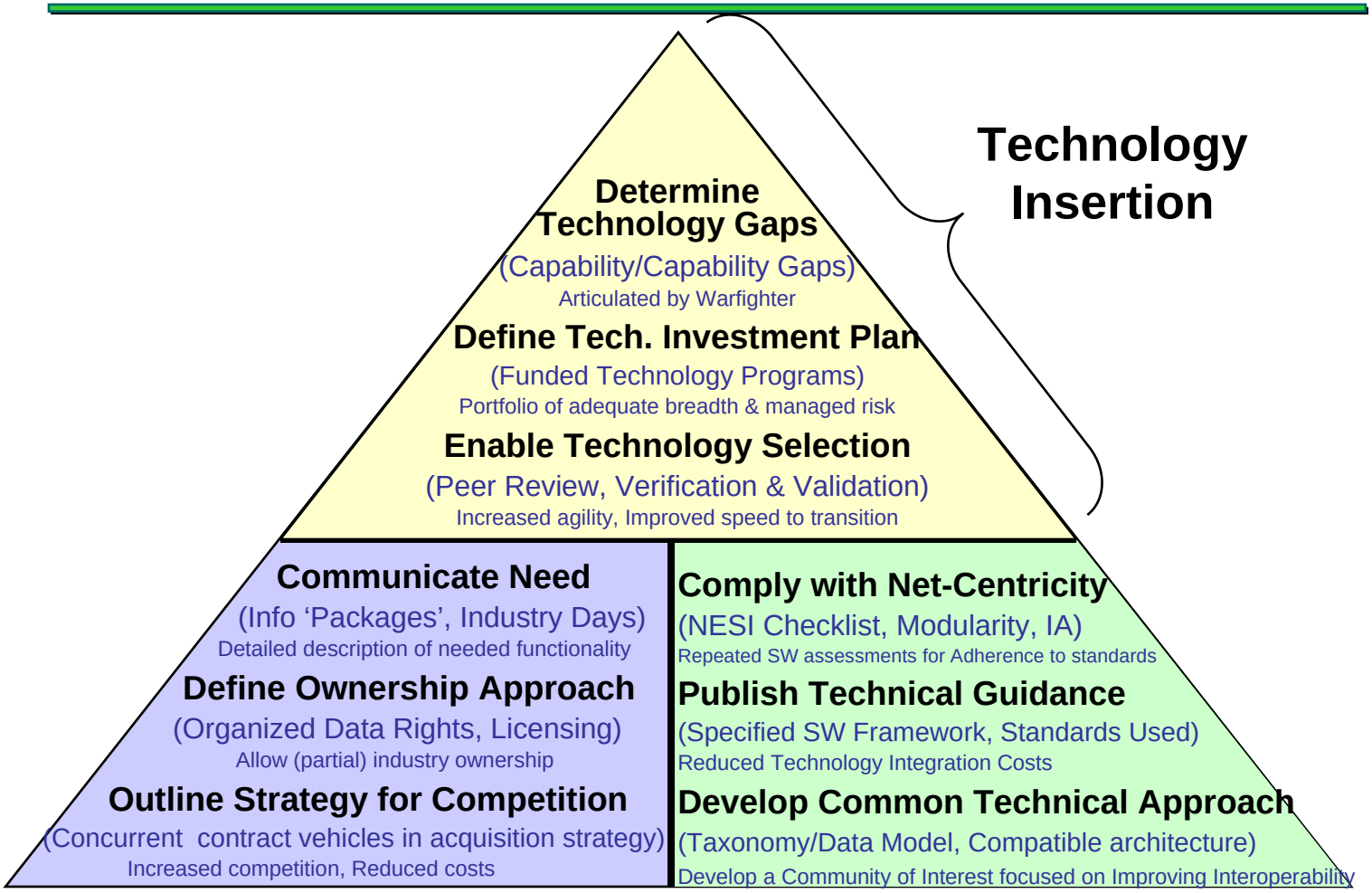
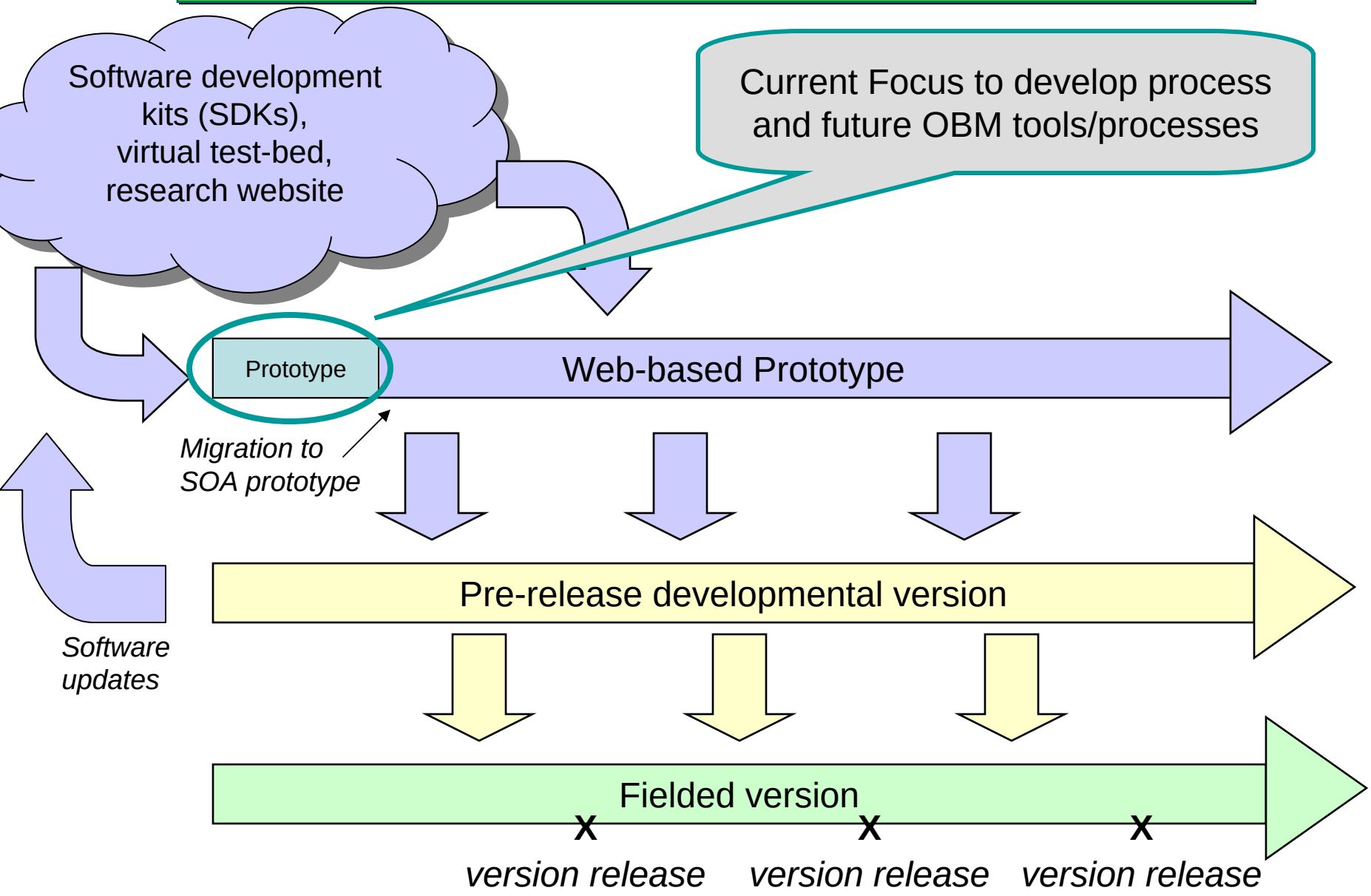


Spiral Technology Development Model

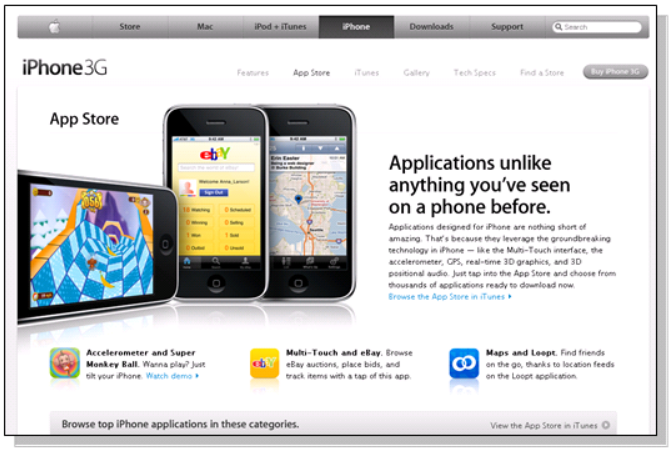


Categories of Software Technologies

- Mr. Robert Gold, the Deputy Under Secretary of Defense for Science and Technology (DUSD (S&T)) categorizes software technologies into five variants:
  1. Unprecedented Functionality,
  2. Off-The-Shelf Components,
  3. Enabling Run-Time,
  4. Aggregation of Components, and
  5. Enabling Development
- Each of these flavors of technologies must be addressed and appropriately managed through the transition process.
- Transparent architectures and well defined business models for software programs must be appropriately ‘open’ to address each of these types of technologies.

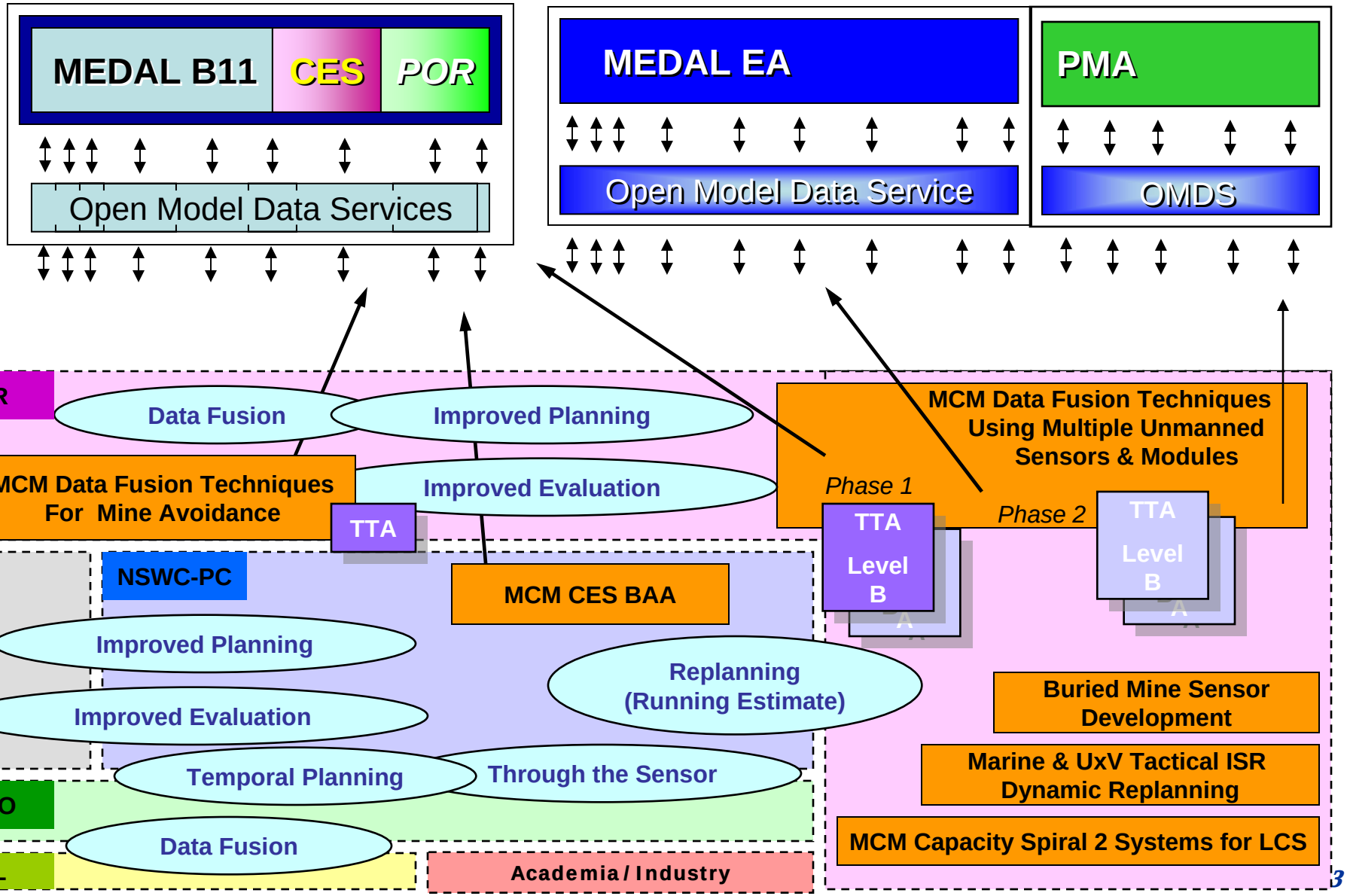
Potential Open Business Models

Very Structured — Middle of the Road — Very Unstructured



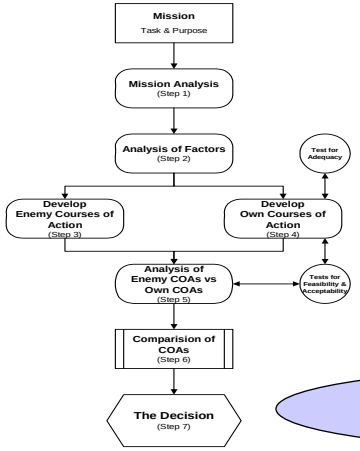
"Living Labs" such as Google, Apple, IBM, or open source software communities such as GNU/Linux etc. recognize the power of a collaborative research community and a structured process for technology maturity

MIW Open Business Model Vision



MCM CES – 1st Step into Automation

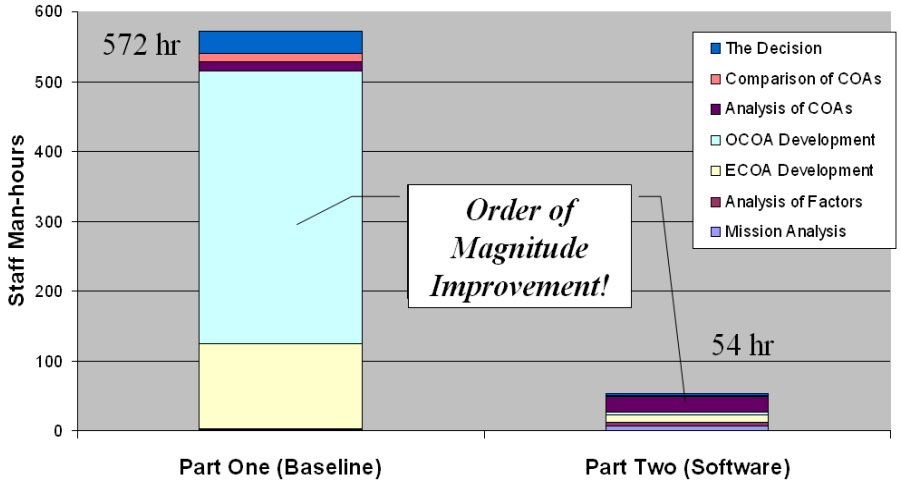
Based on the Commander's Estimate of the Situation process



- **A formal process to ensure the Commander adopts a COA that is:**
  - Adequate
  - Feasible
  - Acceptable
- **Main Features**
  - Task Orientation
  - Enemy Options are carefully considered
  - The decision is based on an analysis of interactions of the enemy's COAs and own COAs.

MCM CES Functionality will be incorporated into MEDAL EA

Overall Planning Timeline



Plan of Action & Milestones

- 3-year OPNAV N852/PMS495 program
  - FY06-FY08
- Build 0 (EDM) → **COMPLETED!**
  - Objective to confirm framework implementation and ROI of CES framework for tactical MCM
    - ✓ Focus future investment
    - ✓ Risk mitigation
  - "Add On" Software with MEDAL Build 10
  - Delivered June 07
- IOC
  - Integrated with MEDAL Enterprise Architecture
  - Delivery FY10 in EA

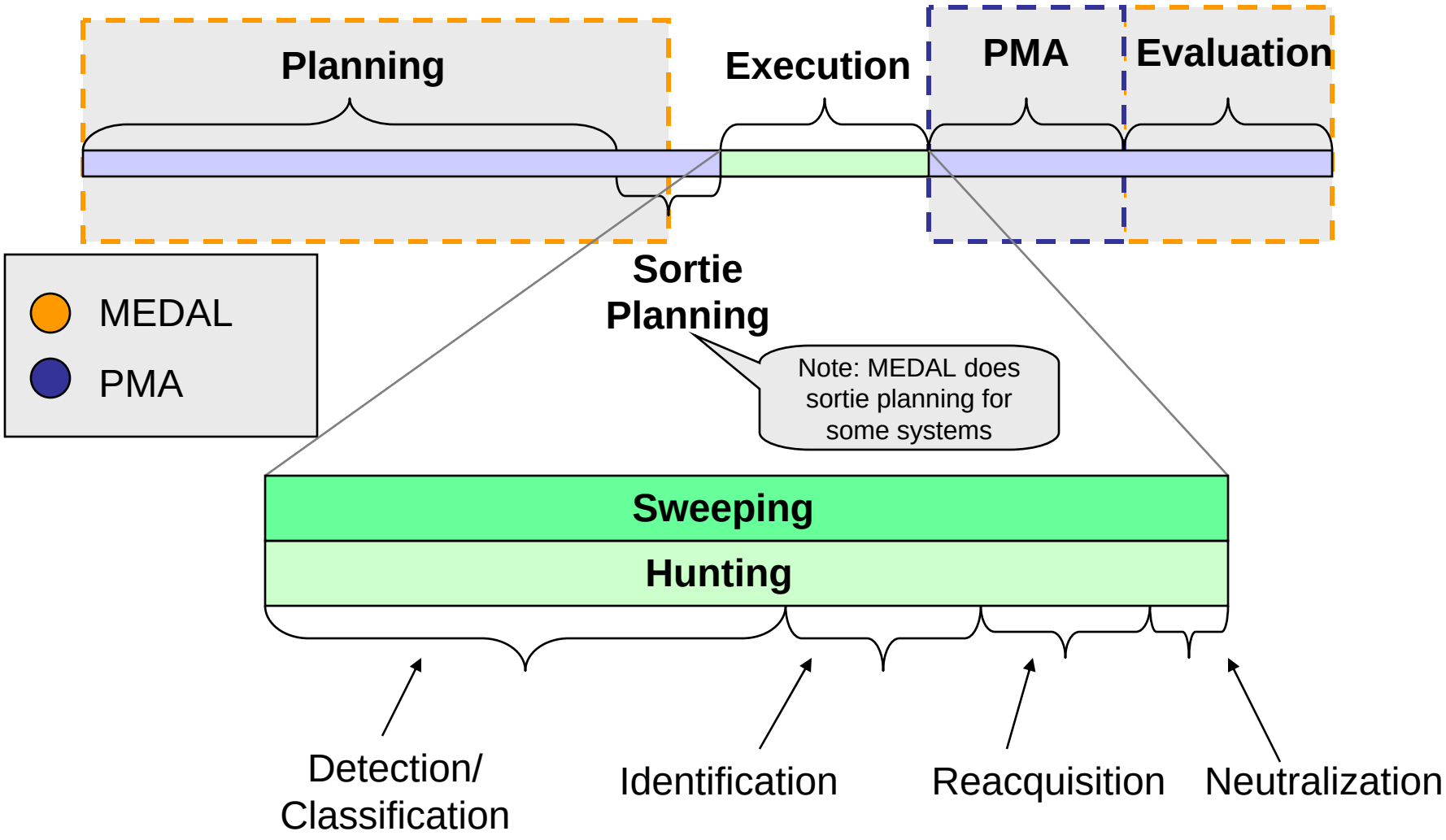
Return on Investment Results

Investment: $1.5 Million (half of total program budget)

Return: 12.9 Planning Days Saved per Operational Plan
(572 staff man-hrs - 53.4 staff man-hrs)/(5 staff x 8 staff man-hrs per staff)

Intangible Returns:
- Ability of smaller staffs to conduct MCM planning through a reduction in training requirements
- Utility for the application of Organic MCM systems, where small and inexperienced staffs must plan their own operations
- Improved staff-to-staff coordination and communications
- Standardized planning process
- Better internal staff collaboration

Mine Warfare C2 Mission Timeline (notional)



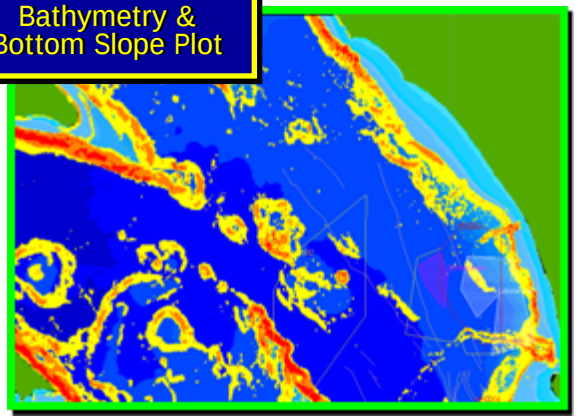
MEDAL

What is MEDAL?

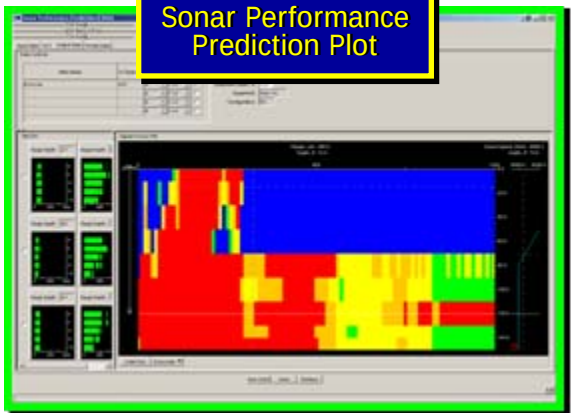
An Integrated Mine Warfare Software Tool Kit providing:

- **Intelligence Preparation of the Environment (IPE)**
  - Access, display, employ, evaluate, update, & fuse extensive databases
  - Environmental, Mine Threat, & Surveyed Contact databases

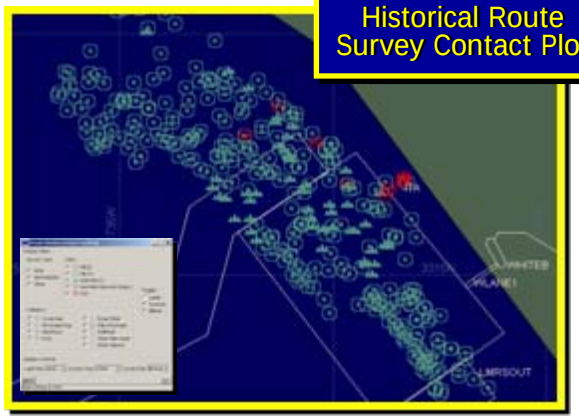
Bathymetry & Bottom Slope Plot



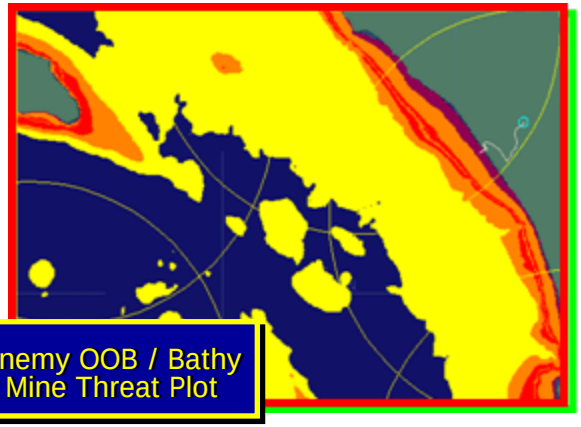
Sonar Performance Prediction Plot



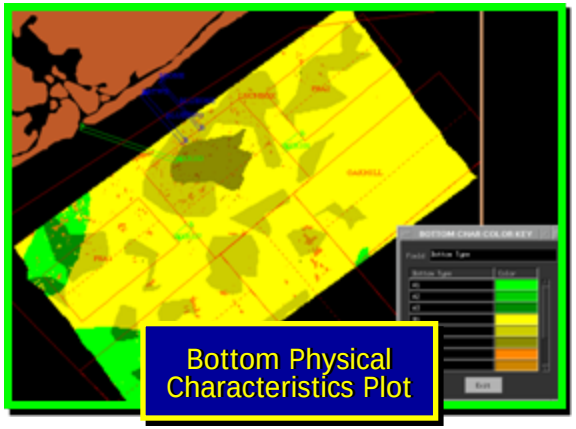
Historical Route Survey Contact Plot



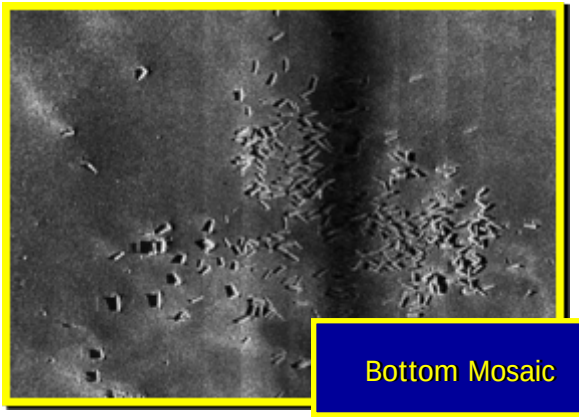
Enemy OOB / Bathy Mine Threat Plot



Bottom Physical Characteristics Plot



Bottom Mosaic

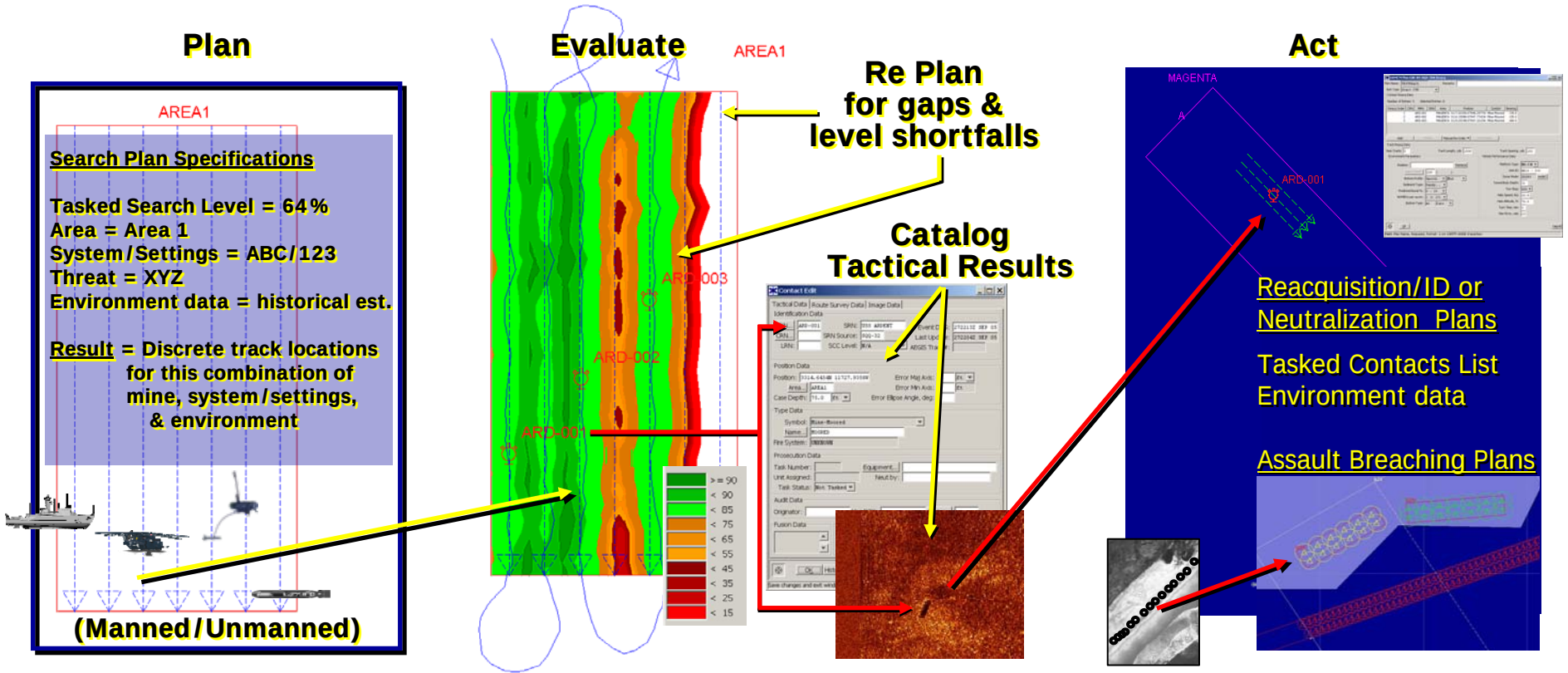


What is MEDAL?

An Integrated Mine Warfare Software Tool Kit providing:

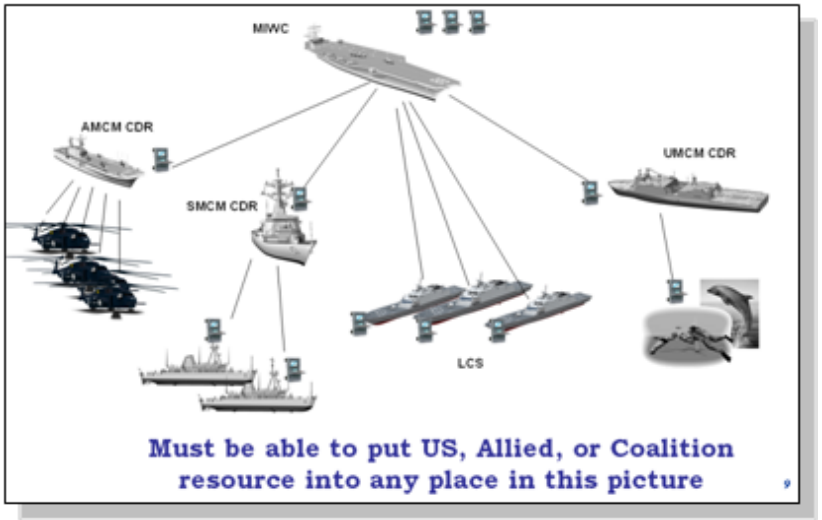
➢ Tactical Planning & Evaluation

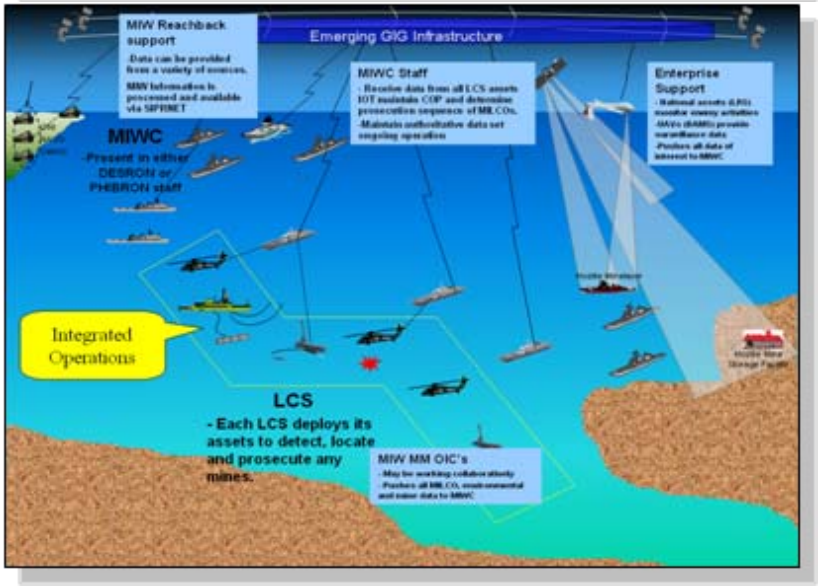
- Create, display, evaluate, optimize, transmit, & store tactical MCM plans for individual manned/unmanned systems, in specific environments, vs specific threats
- Display, evaluate, combine, & store results of actual MCM efforts
- Integrated the plans, effort, & results of all MCM tactical systems



Why Transform?

Operational C2 Requirement ⇒ Technical Approach





- **Better**
  - Provide more capability to users
    - Web services
  - Integration with enterprise-wide services increasing
    - Imagery, VNE-NCS, CJMTK/GO-1
- **Faster**
  - Rapidly transition technology from S&T community
  - Pushing software updates remotely
- **Cheaper**
  - Reduced costs
    - Fielding
    - SW updates
  - Growing number of MIW systems that exchange data
  - Evolving data exchange requirements
  - Platform and language independence
- **Easier**
  - Adoption of technical standards
    - Data format standardization (XML)
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    - Composable (service reuse)
  - Reduce fielded system maintenance by the fleet
- *Plus… fully embraces Dept of Defense initiatives*
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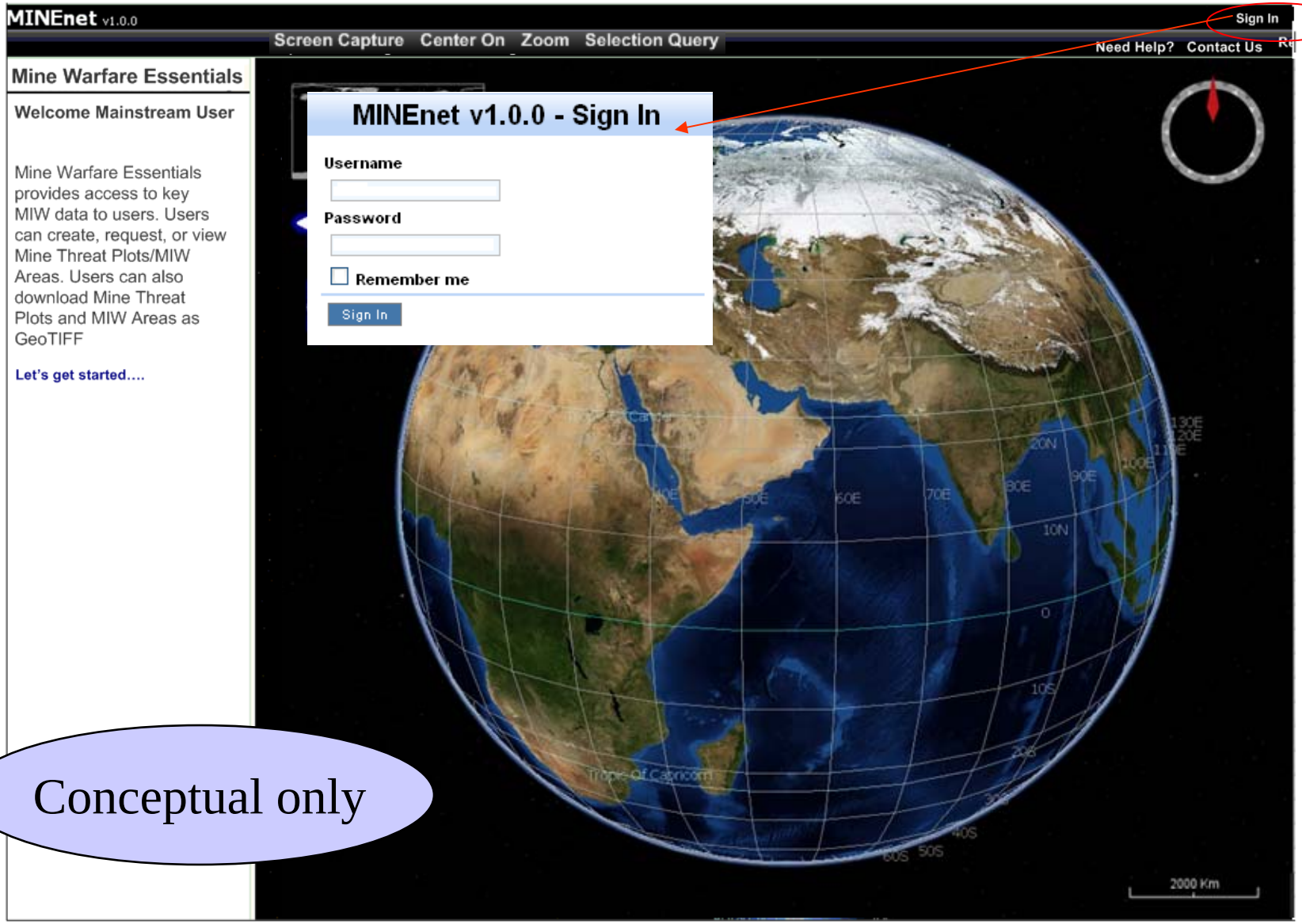
Net-Centric Sign In



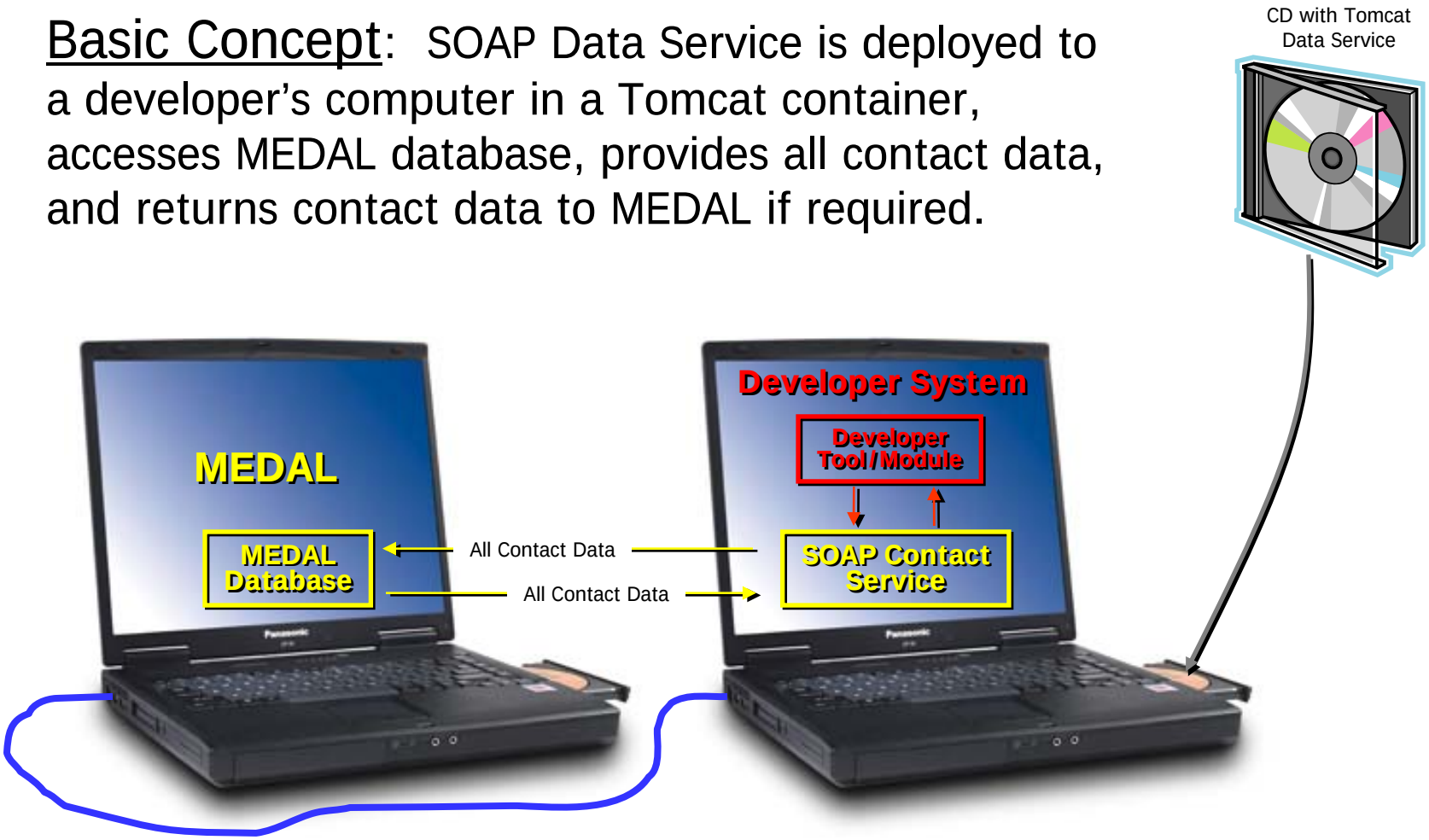
Conceptual only

Expeditionary Operations

Requirement to support expeditionary operations

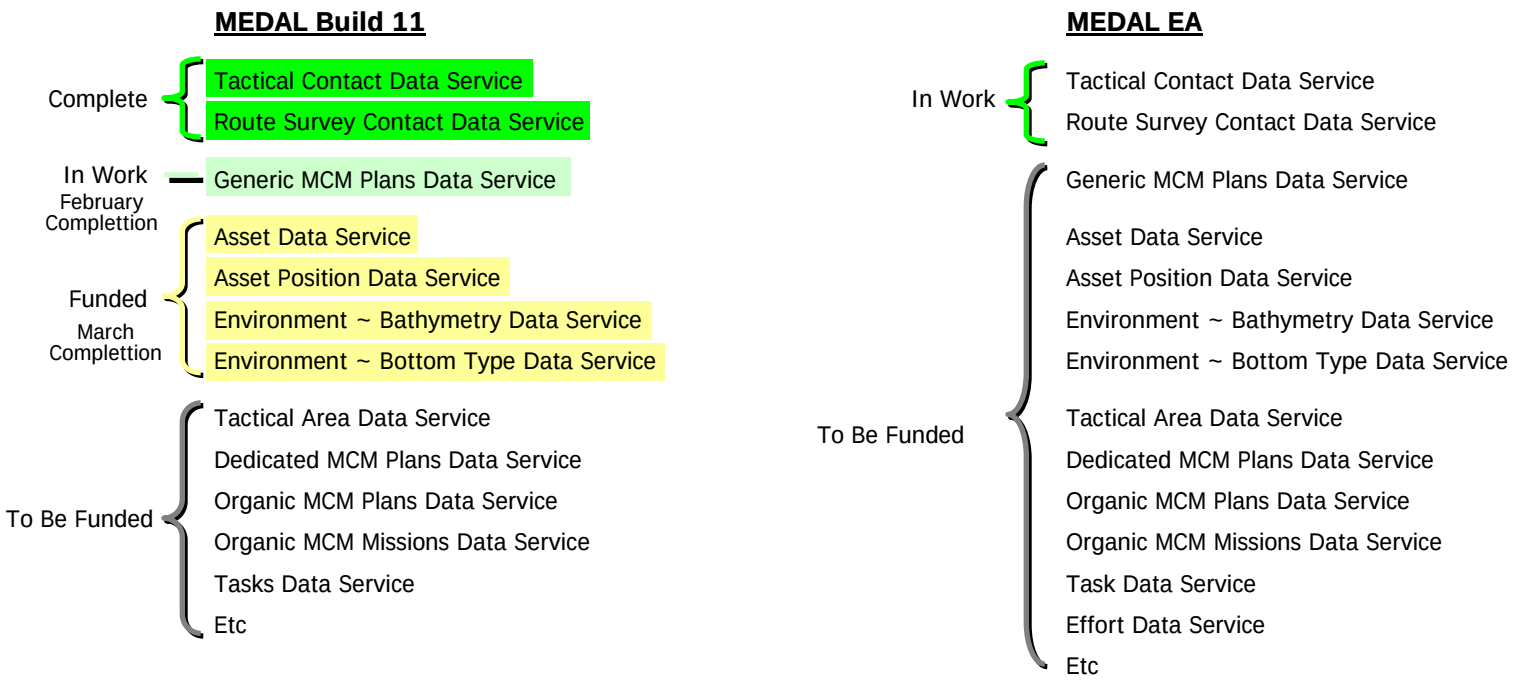
MEDAL Data Services

Basic Concept: SOAP Data Service is deployed to a developer's computer in a Tomcat container, accesses MEDAL database, provides all contact data, and returns contact data to MEDAL if required.

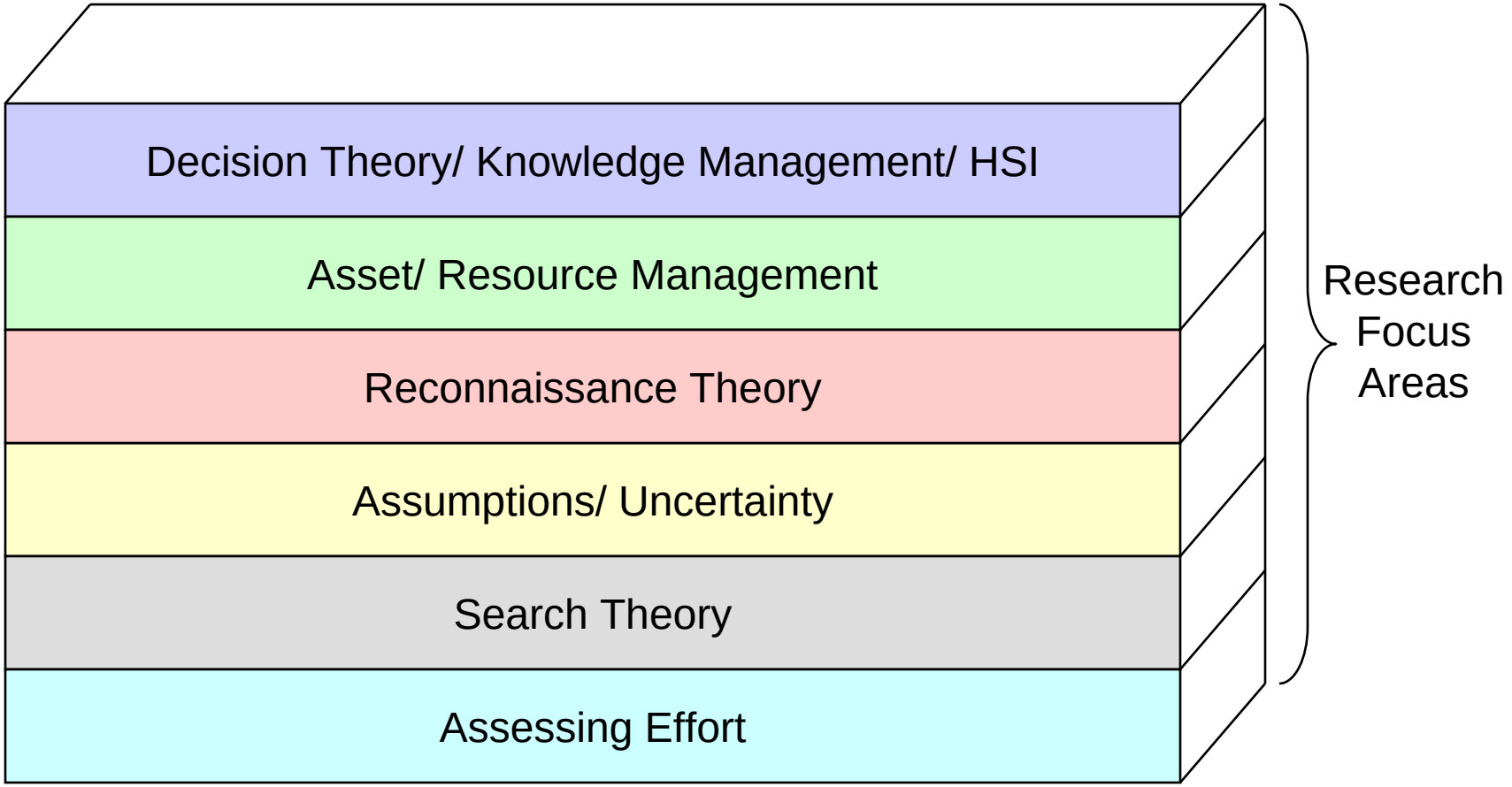


MEDAL Data Services

- Data services are being created for both MEDAL Build 11, the current operational version, and MEDAL EA, the next generation MEDAL
- These services allow easy and complete access to MEDAL data enabling researchers and developers to leverage existing data and capabilities in support of their individual efforts to improve MIW C4I



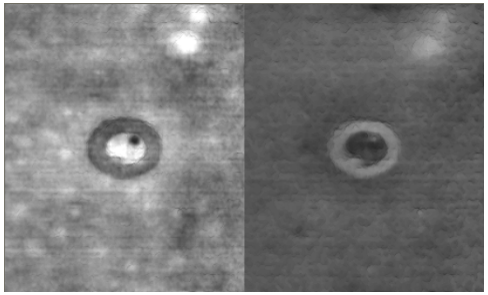
MEDAL Research Framework

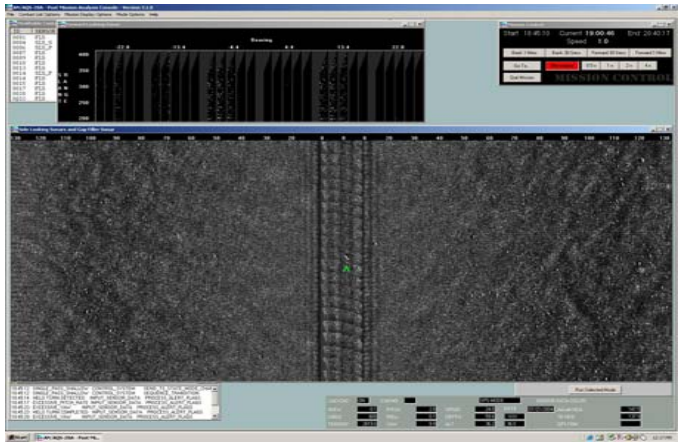


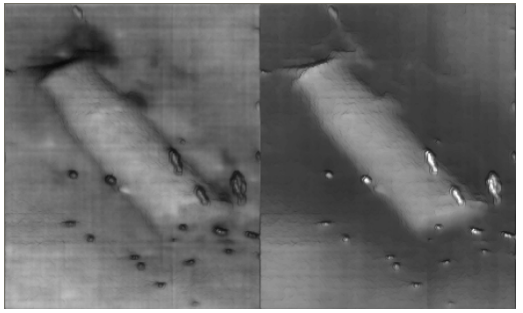
PMA

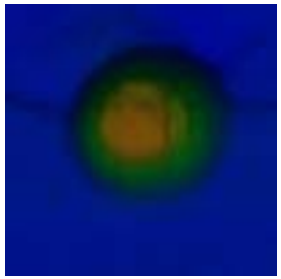
What is PMA?

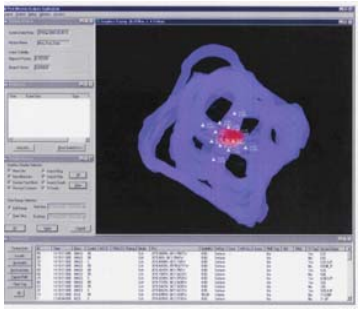
- **Tactical & Environmental Sensor Data Analysis**
  - Display imagery data from MIW tactical & environmental sensors via transferable mass memory devices shared with the sensor vehicle
  - Analyze tactical sensor data to detect & classify mine-like contacts
  - Analyze environmental sensor data to characterize the performance of tactical sensors, provide forecast modeling for MIW planning & enable change detection against historical route surveys

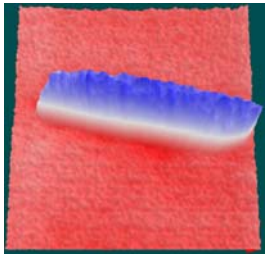












Identified Need for a PMA Strategy

MCM Class

MH-60S AMCM Systems

RMS

COBRA

UUVs

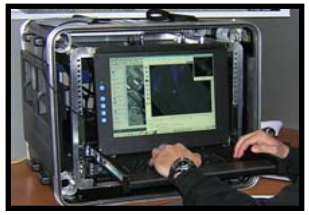
There are currently multiple PMA Systems that are required to management environmental and tactical data

(BPAUV)

Hydroid, Inc. (REMUS)

Bluefin (Sea Lion)

USV Sweep



Environmental PMA

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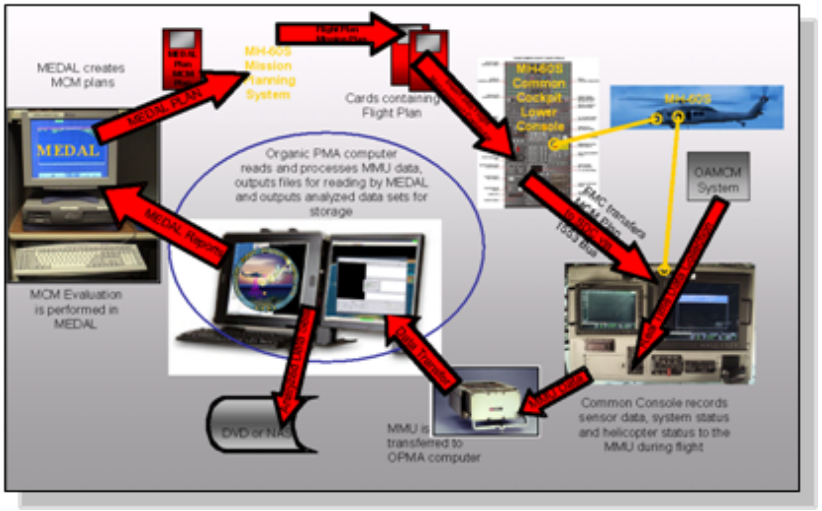
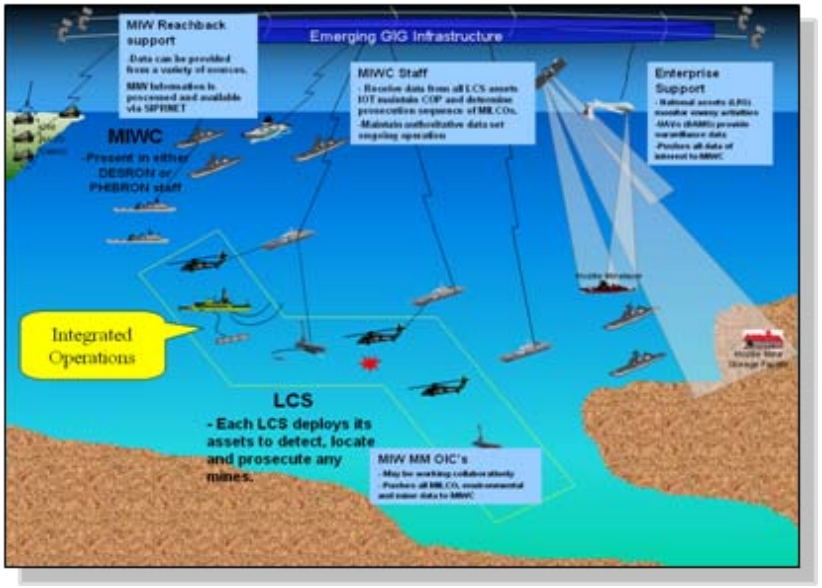
Operational C2 Requirement → Technical Approach





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Network-Centric PMA Vision

Raw Data

Tactical

Environmental

System Performance

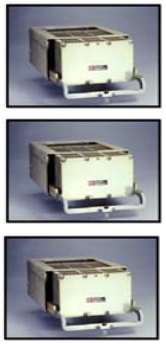
SENSORS

Air-based

Ship-based

Unmanned vehicles

Man-portable

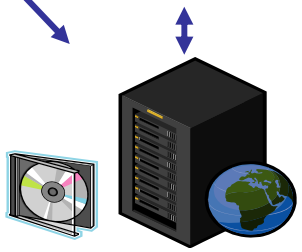


Information Layers

Geographically-Referenced

MEDAL

Mission Evaluation Software



Master Historical Database

Common Processing Architecture

Data Processing Modules

-Contact Correlation Module

-Data Fusion Module

-Training Scenario Generator

Tactical Sensor Modules

-Contact Detection/Classification

-System Specific CAD/CAC

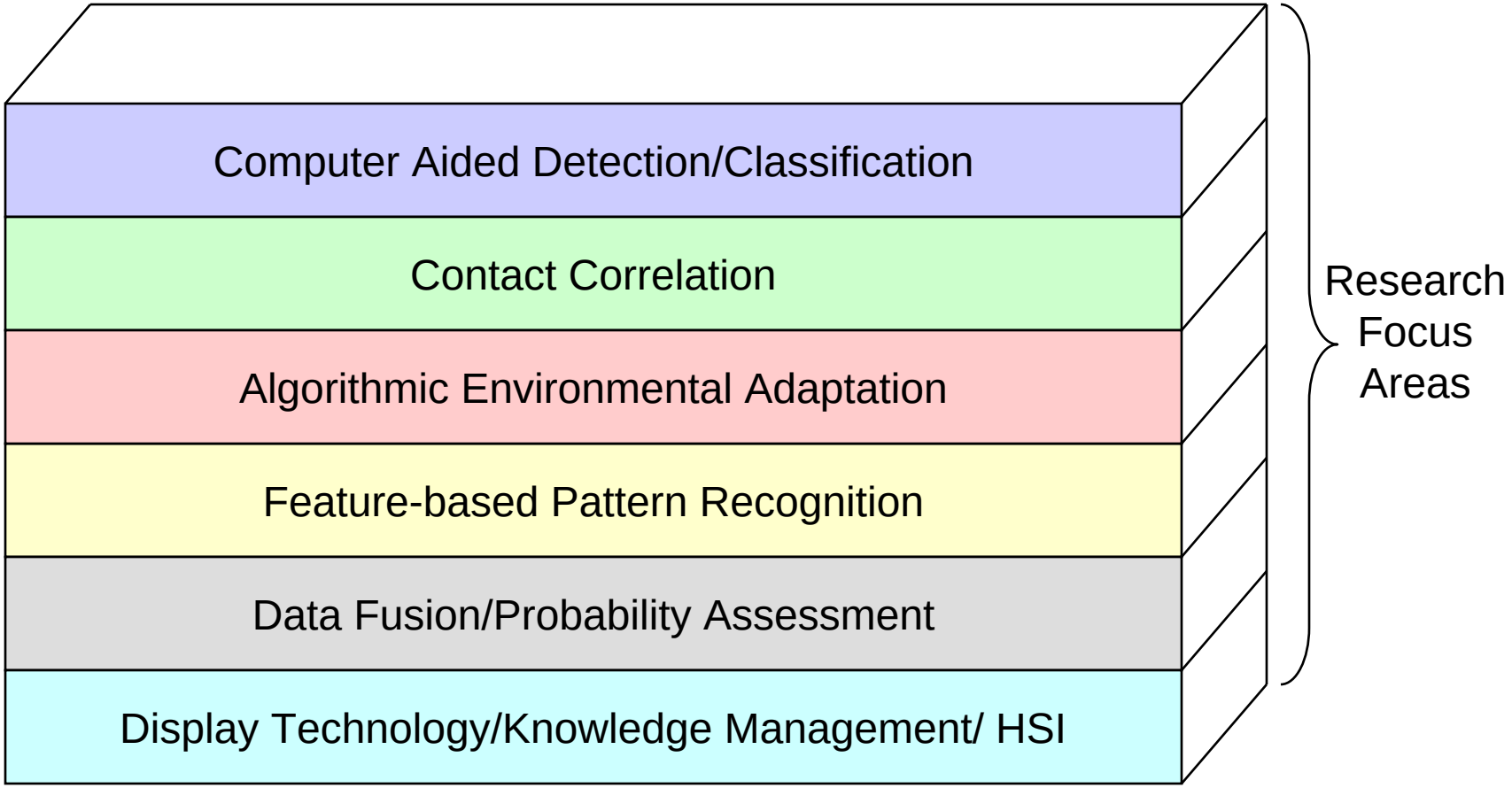
Environmental Sensor Modules

-Change Detection

-Environmental Characterization

EDM in Development!

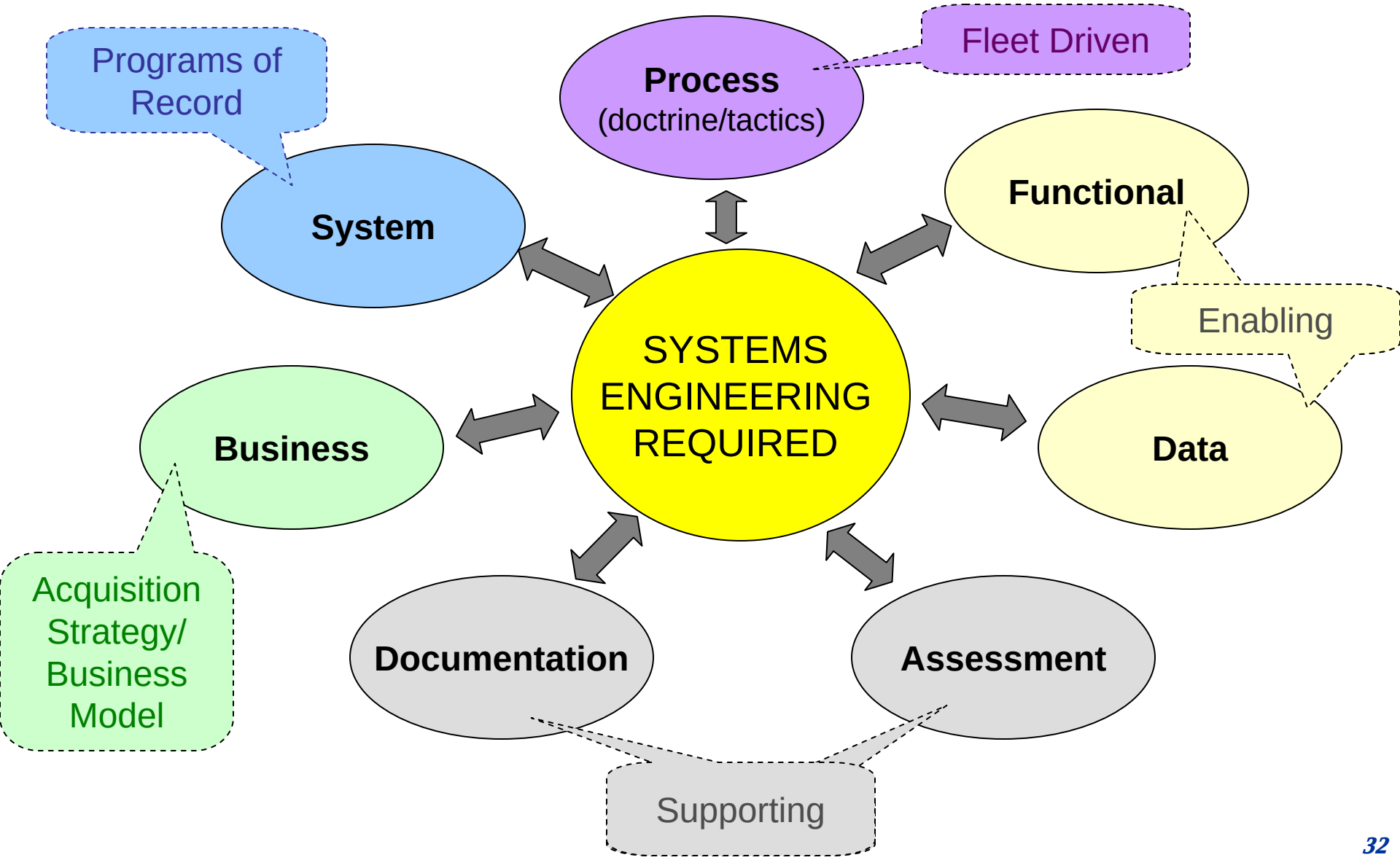
PMA Research Framework



How Industry Can Assist Mine Warfare C2 Improvements

- New techniques for search that are beyond uniform tracks
- New techniques for reconnaissance
- Sampling techniques for environment data collection/ Applying sampling to estimate across the area
- P(y) planning routing that optimally puts tracks where needed
- Exploratory objective planning routine
- Breakthrough objective planning routine
- Reconnaissance objective planning routine
- Non parallel planning versus parallel planning (?) Cross hatching
- Multi-sensor Planning for MCM
  - Asset scheduling
  - Asset allocation
  - Search area participation
  - Adaptive search planning
- Multi-objective/Pareto optimization
- Evaluation of current effectiveness
- Prediction of future effectiveness
- Probabilistic modeling of search event space/ Non-parametric mixture modeling
- (Variational) Bayesian inference
- Transformation of discrete observations to predictive (probabilistic) frameworks
- Tactics/ConOps for LCS using manned & unmanned assets
- Multi-sensor data fusion (e.g. multi-aspect, imaging sonars, broadband sonars, electro-optic, magnetic, etc.)
- Feature selection & optimization
- Detection & Classification (single & multi-sensor)
- Pattern recognition
- Machine learning/ information theory
- In-situ retraining of automatic target recognition
- Human-machine interface for MCM target classification
- Modeling conditional dependence between sensors

Systems Engineering Enablers



Summary

- Processes should be developed to enable technology transition to software programs
- An Open Business Model has been adopted by the Mine Warfare C2 software programs to enable technology insertion
- Information to support MIW research is being compiled
  - Glossary
  - Tactical User Processes
  - Data Standards
  - Information Support Plan
- Access to the MIW COI Website is available for industry partners under contract to DoD