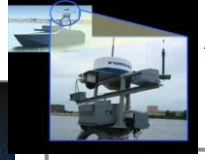
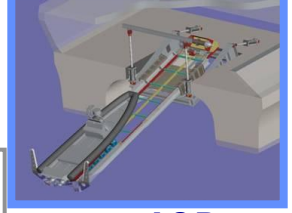
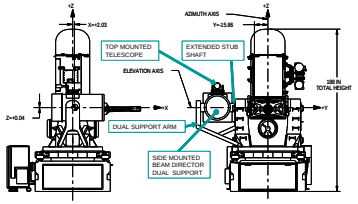
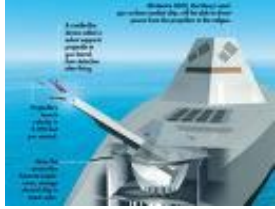








Transition Interface with Early Systems Engineering: SEALION and Open Systems Case Studies

13th Annual Systems Engineering Conference

25-28 October 2010

Michael L. Bosworth, NAVSEA 05TB

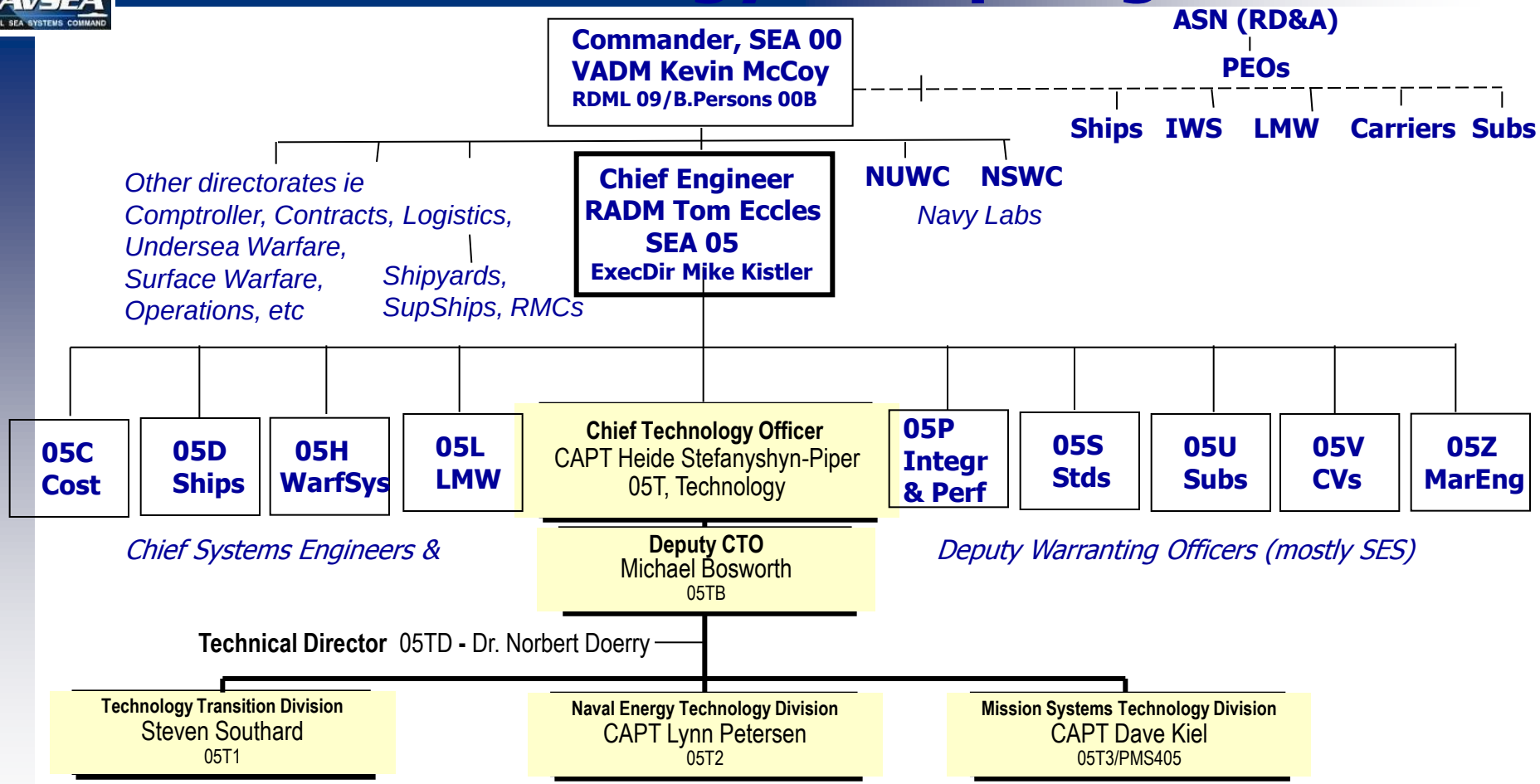
Deputy Chief Technology Officer

Technology Group in NAVSEA

- Naval Sea Systems Command (NAVSEA) Headquarters R&D
- In NAVSEA Ship Engineering Directorate (SEA 05)
- Domain: Pre-Milestone A through Milestone B
- Focus: R&D Adv. Development: Transition to Acquisition
- Manage six R&D programs; interface with any more
- NAVSEA in-house "skunk works" for Adv. Ship Technologies
- Less than one year in existence; emerging roles as:
  - NAVSEA Technology Readiness Assessment (TRA) coordinator
  - Broader NAVSEA R&D portfolio insight (non-05T, non-hdqrtrs; ie PEOs, labs)
  - NAVSEA Technology Database developer/maintainer (transition oriented).

Ship, boat and associated systems Technology Transition for Current Navy, Next Navy & Navy After Next

NAVSEA 05 (Naval Systems Engineering) & its Technology Group Organization



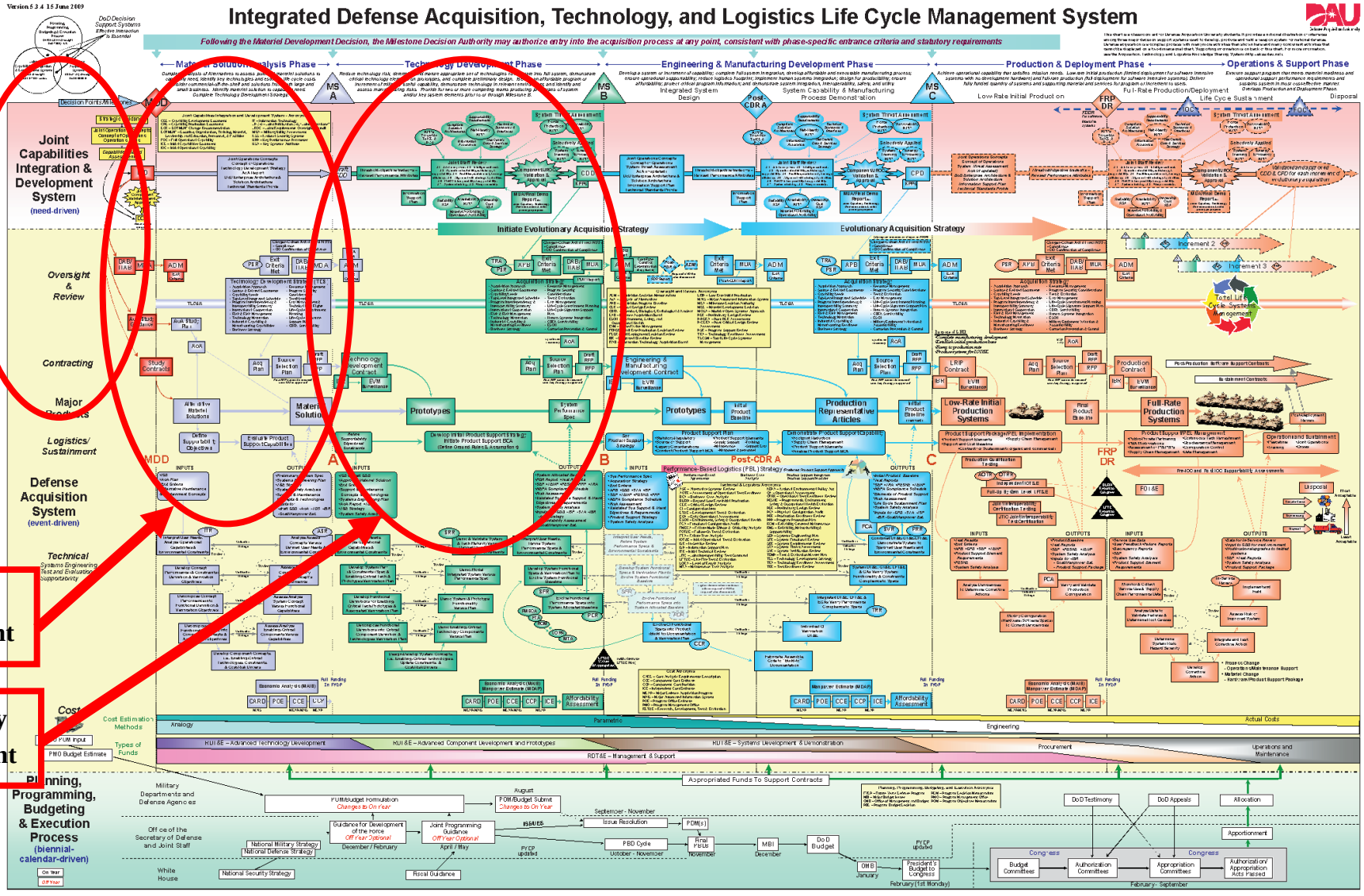
Five R&D programs in ship design, cross-platform, small business, logistics and modularity

Technical Support to Electric Ships Office (ESO) in PEO (ships) and (Incoming) Energy Coordination

Directed energy, laser and railgun developments as PMS 405 and (developing) non DE warfare systems

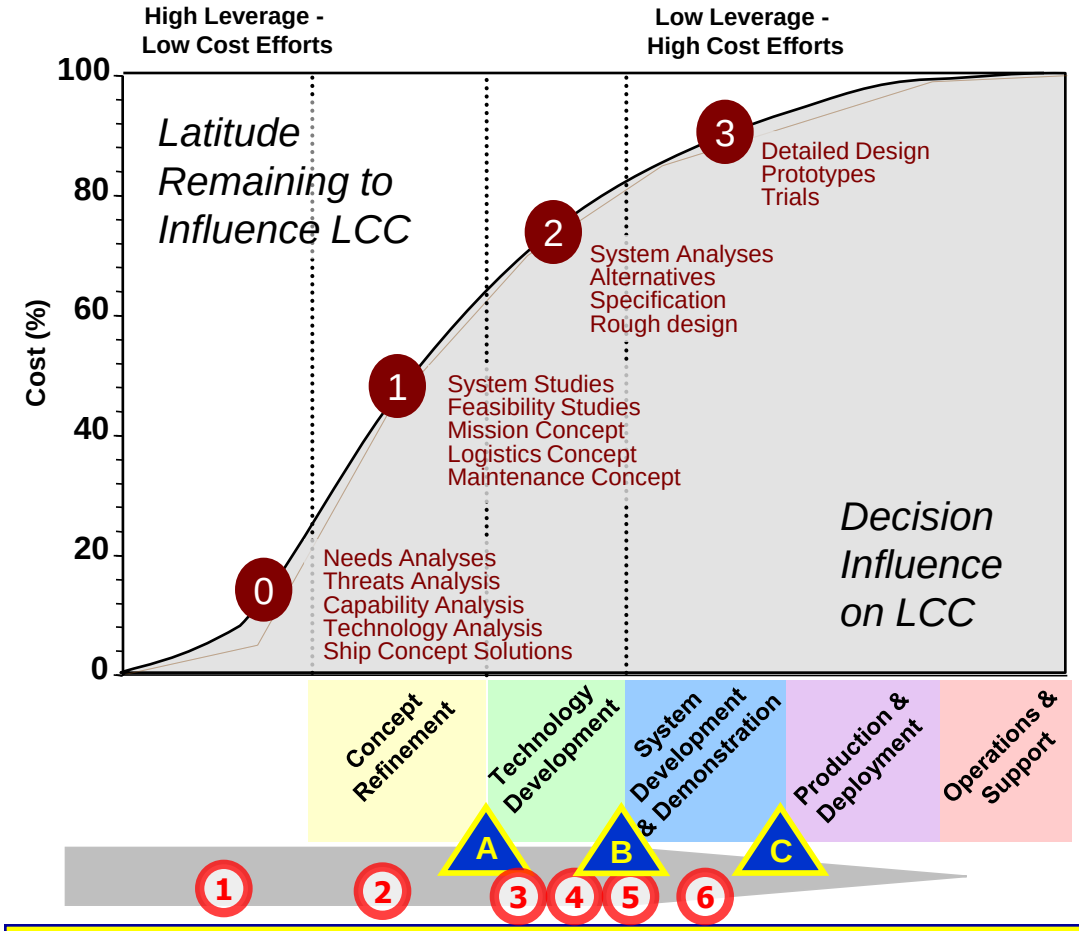
Cadre for: Diverse HM&E/logistics Specialized electrical/propulsion Combat Systems & C4ISR

NAVSEA CTO: Extreme Front End of Ship Acquisition Process

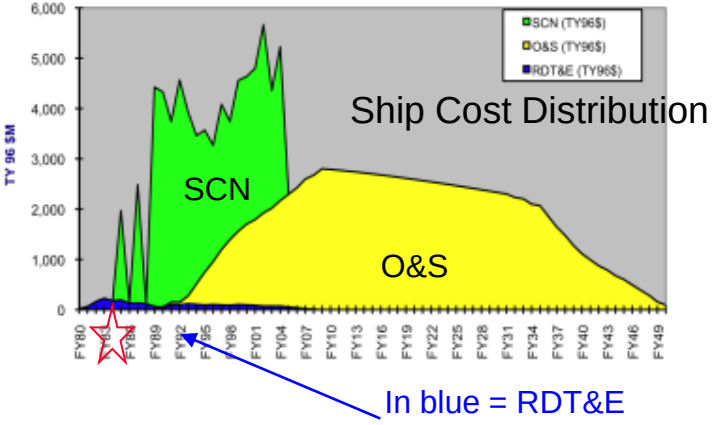


Budget Constraints: Systems Engineering & Total Ownership Cost Management

R&D Influence on Systems Engineering Influence & Total Cost of Ownership



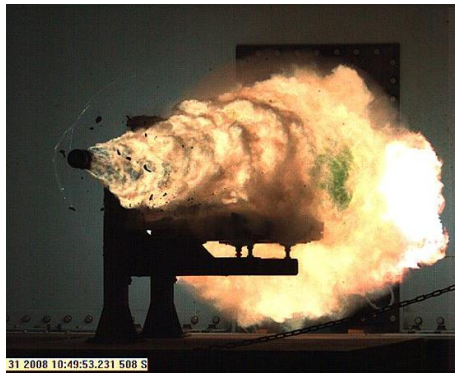
Greatest Influence for Least Cost comes during Pre-CD Phase… 80% or more of ship life cycle cost determined by end of design development phase



Navy Programs must provide Cost-Wise Readiness; vice Readiness, at Any Cost…

Reasons to Adopt a new Technology

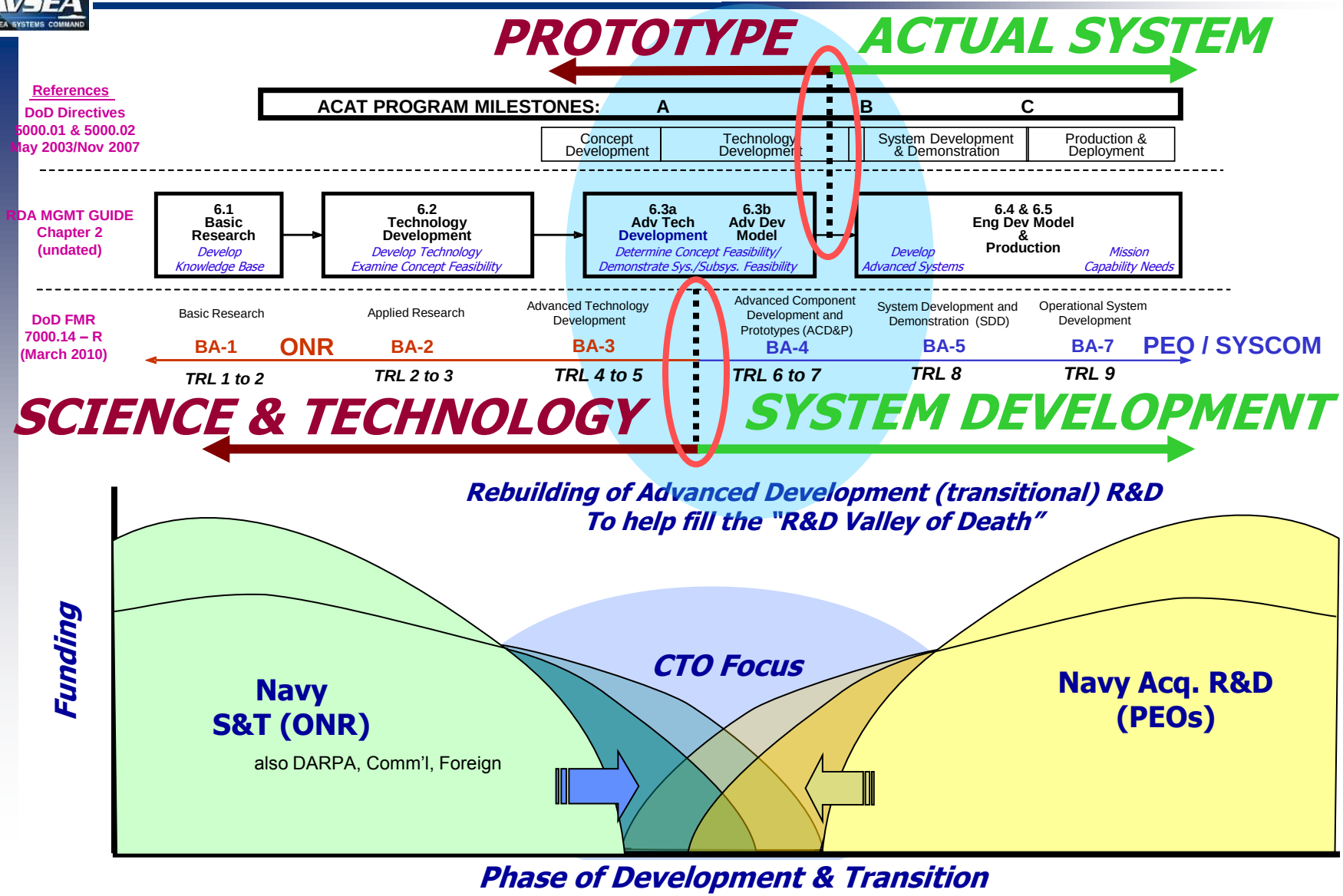
- Gap (Best way to fulfill an unmet operational requirement)
  - **Advances in adversary capabilities**
  - **Changes in CONOPS**
  - **Changes in law and regulations**
  - **Loss of industrial base to reproduce existing system**
- Opportunity (Perceived benefits outweigh the risks)
  - **Acquisition Cost Reduction**
  - **Total Ownership Cost Reduction**
  - **Enable new CONOPS**
- Risk Management
  - **Improve Flexibility to react to potential future gaps (Requirements Risks)**
  - **Mitigate risk of disappearing Industrial Base or source of raw materials**
  - **Mitigate risk of a technology for another more critical program**



Railgun: promise of long range, deep magazines

SACPAS 3rd world patrol boat: Global Fleet Station

How does R&D Transition to Acquisition?



Rebuilding of Advanced Development (transitional) R&D
To help fill the "R&D Valley of Death"

Technology Transition

"Transfer of knowledge from those people that create it, to those people that require the knowledge to impact a change on a ship."

- **People have to be paid**
- **People generally are in different organizations**

- **Two aspects of Technology Transition**
  - **Transfer of Knowledge from one organization to another**
  - **Transfer of Fiscal Responsibility from one organization to another**

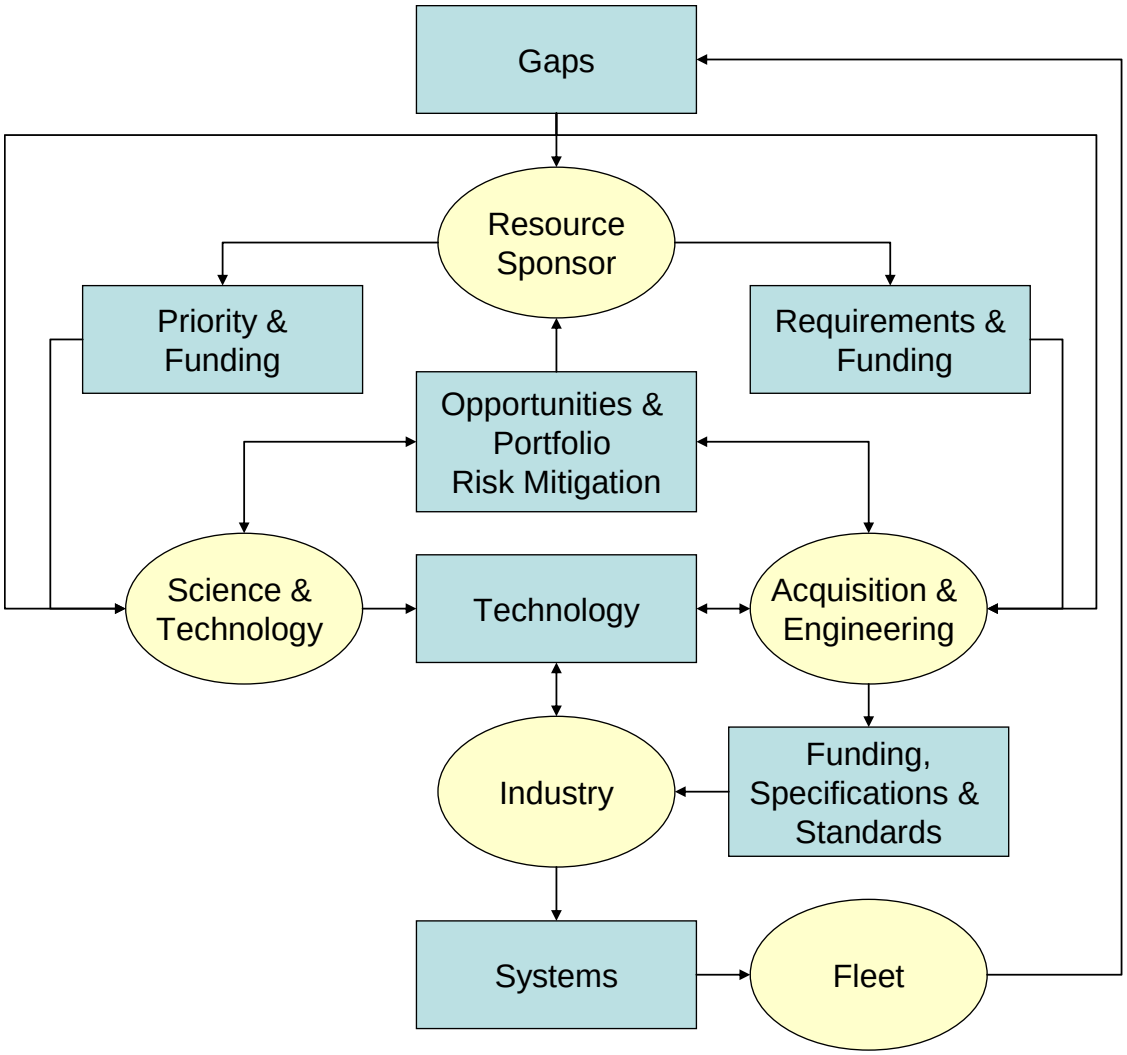
Getting a New Technology Component / (sub-) System on a Ship/Boat/System

- **New Construction**
  - In the Competitive Range
  - Written into Ship Specifications
  - Engineering Change Proposal
  - Written into Component Specification / Standard
- **In Service**
  - Ship Change Document (Planned configuration change)
  - Alteration equivalent to Repair (AER)
  - Fit Form Function replacement of a repair part
    - Via Stock System
  - Alteration during Depot Maintenance
  - "Requirements" for consumables (MRCs, TMs, etc.)

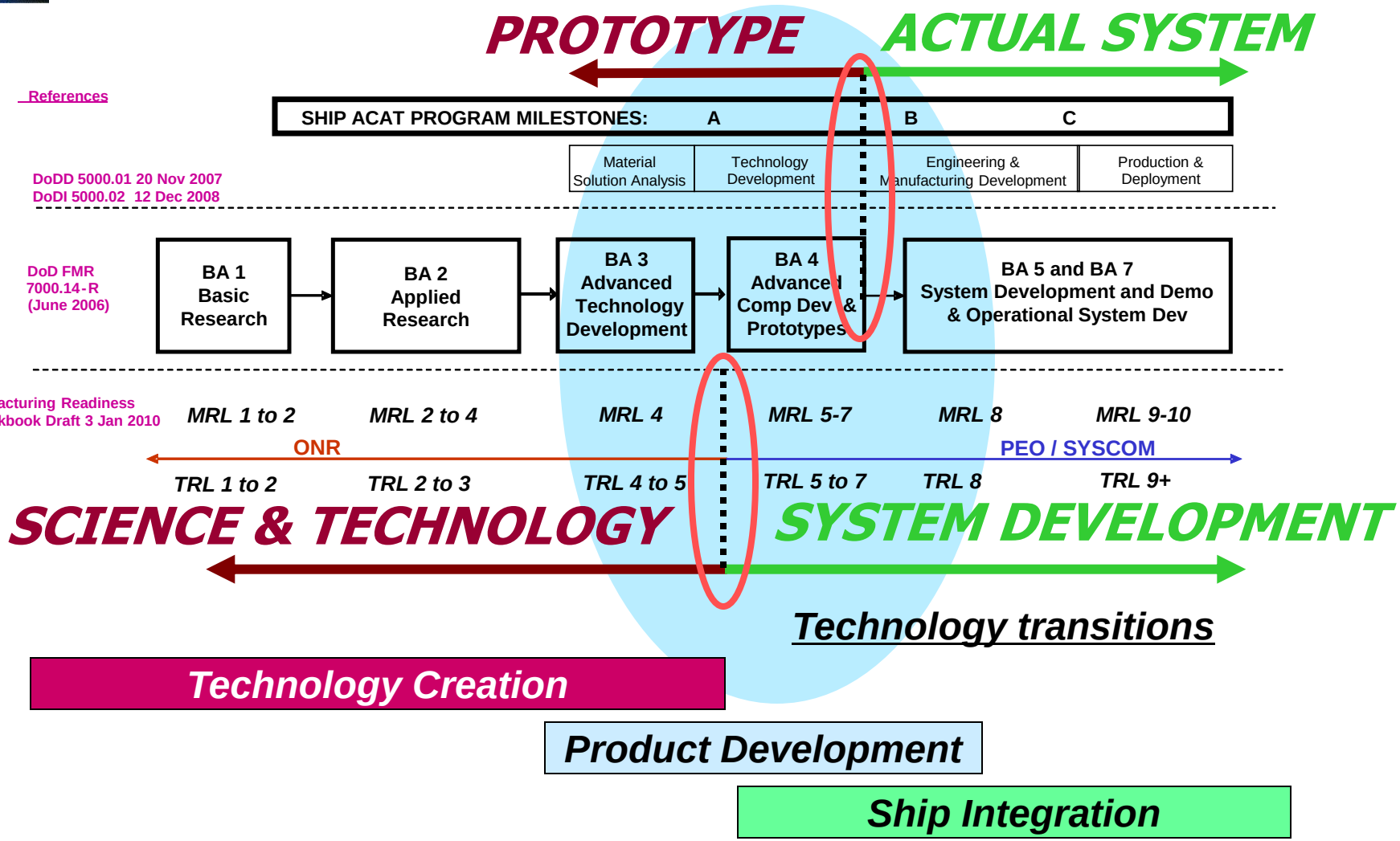
Prototype to Actual System transition

- **Develop Expertise to ensure necessary steps to transition a prototype to an actual system are accomplished:**
  - **Develop Business Case (cost estimates)**
  - **Develop Specifications and Standards**
  - **Manage risk not already mitigated via the prototype**
  - **Modify design processes and design tools (If necessary)**
  - **Develop Procurement Package**
  - **Identify / Create Industrial Base**
  - **Develop Ship Change Document (SCD) or Engineering Change Proposal (ECP)**
  - **Develop ILS**
  - **Modify Concept of Operation (CONOPS) (if necessary)**
  - **Qualify production system**

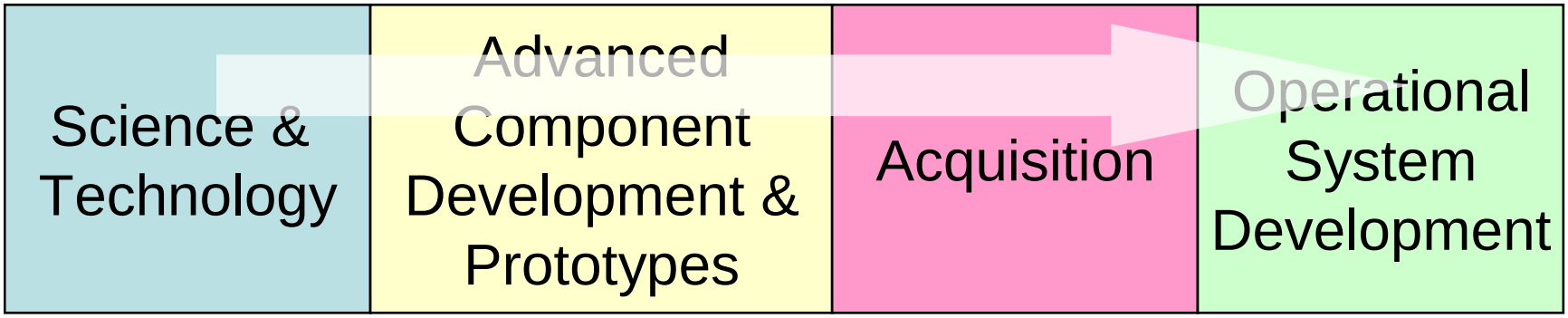
Technology Transition Interactions



Technology Transition

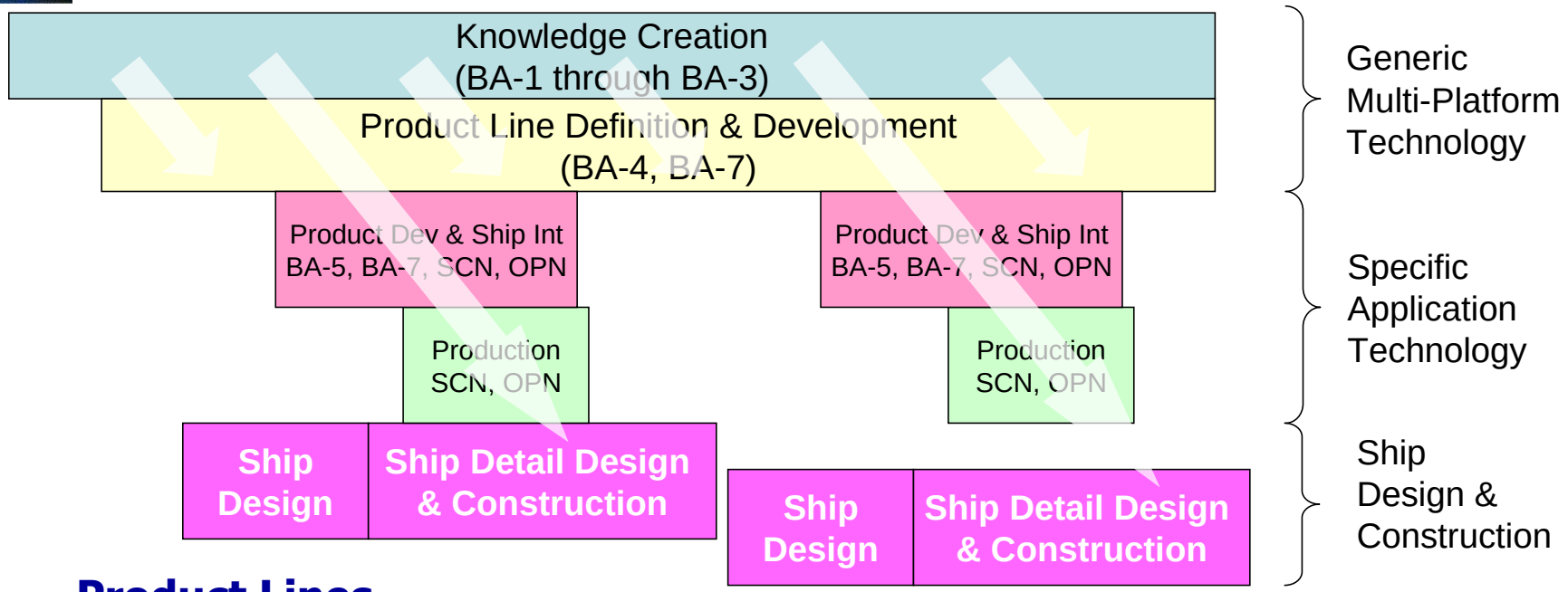


Traditional Technology Transition Model



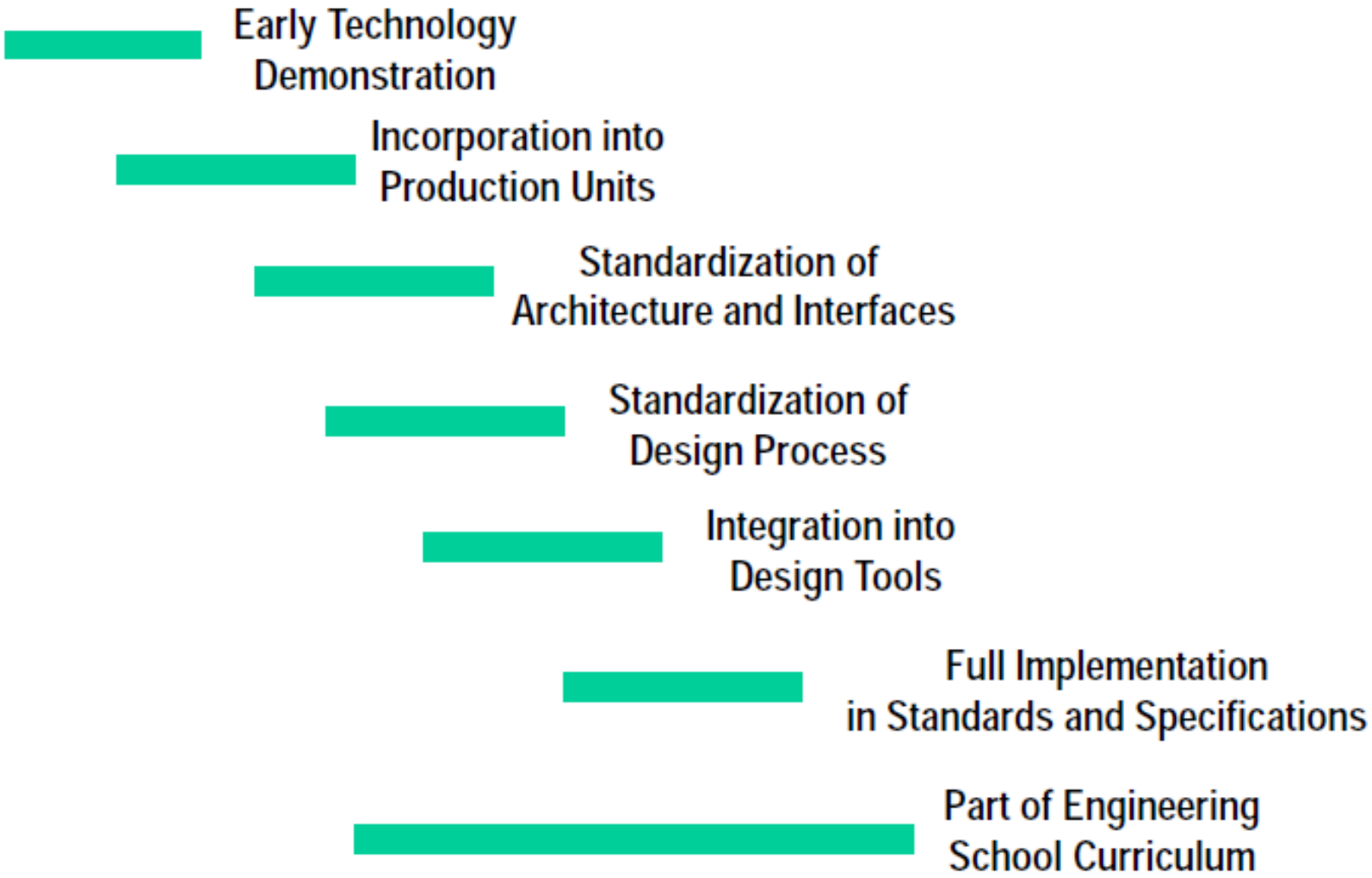
- **Observations**
  - **Serial (long) Process**
  - **Does not promote commonality across platforms**

Alternate Technology Transition Model



- **Product Lines**
  - **Provide capability to create and produce specific applications when needed.**
  - **Promote Commonality across Ship classes.**
  - **Decouple S&T from specific ship applications**
    - **Eliminate churn in aligning S&T and ship acquisition programs.**
  - **Capture knowledge in Specifications, Standards, Handbooks, Design Data Sheets, Rules, etc.**
- **Technology Development Roadmaps facilitate communication**

Institutionalizing Technology



SEALION experimental Special Operations combatant craft (#1 & #2)

SEAL Insertion Observation & Nuetralization

- **Developed in 2001-present**
  - SEALION 1 ’01-’04; SEALION 2 ’05-’07
  - SEALION 1b current work
- **Key Transition Elements**
  - Firm Mk5 replacement (CCH) future acquisition target
  - Clear support/need from SOCOM/WARCOM/NSWG-4
  - IPT of PMs, TPOCs, Prime & Operators…for years
  - Mission-representative demonstrators
  - Lessons learned evolution (mockups>1>2)
- **Transition status**
  - SL2 in NSWG-4 for operational tests
  - SL1b requested for dual craft ops
  - Stealth & seakeeping metrics for CCH
  - Prime a contender for CCM & CCH

SecNav on SEALION June 2007

CCM and CCH are SOCOM acquisitions “Combatant Craft Medium/Heavy”

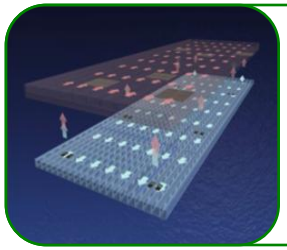
Flexible Infrastructure Ship Modularity Overview

Open Structure
- Deck
- Bulkhead
- Stanchions
- Overhead

Open Power
- PNCC
- Connectorized Power Panel

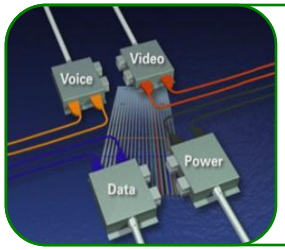
Open Outfitting
- Equipment
- Furniture

Flexible Infrastructure



Open HVAC
- Under Deck Supply
- Overhead Return

Open Lighting
- 110 VAC Plug-in
- Low Voltage DC



Open Data Cable

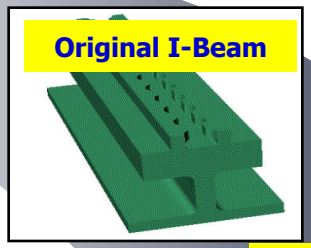
FI State of the Art

- Transitioned to aircraft carrier (CVN) 03 level (1 compartment for CVN 77, 15 20'X60' spaces on CVN 78); working transition to Littoral Combat Ship (LCS…planned 55 ship buy) and amphibious assault ship LHA 6/7
- Fully designed backbone – working through approvals for cross-platform application

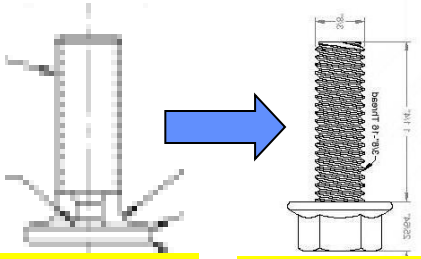
Technical Development of Flexible Infrastructure

FI Design Progression

- Track Redesign
  - 7XA aluminum material vs. steel
  - Profile optimization for reduced weight and cost
- Mounting Hardware
  - Specialized screw vs. standard screw
  - Redesigned fittings for weight and cost

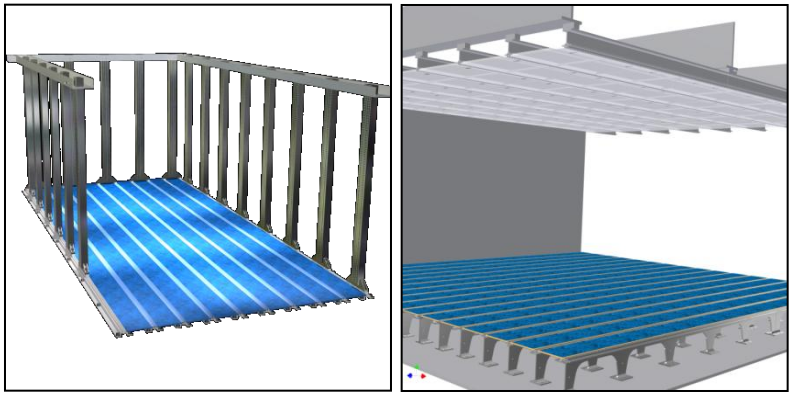


Decreasing Cost and Weight with Increasing Strength

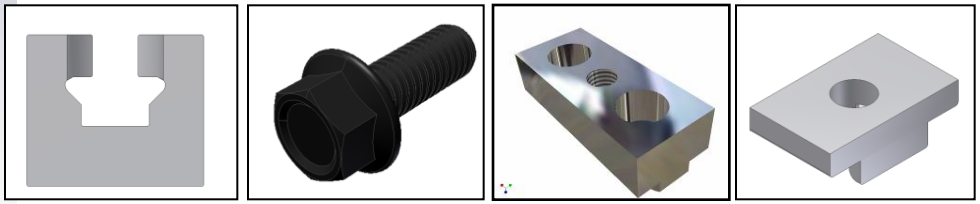


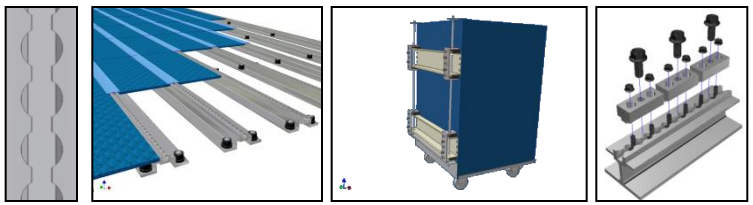
Flexible Infrastructure as an adaptable Standard

- **FI Standardization Highlights**
  - **Government Owned and Controlled**
    - **Responsibility to maintain standards while enabling innovation**
  - **Standard Interfaces**
    - **Deck, bulkhead and overhead tracks designed with a common interface**
    - **Standard bolts and studs used for track and fitting attachments**
    - **Standard attachment methods for equipment**
  - **Standard Tracks**
    - **Track installed in standard grid pattern**
    - **Standard hole spacing for equipment and fitting installation**

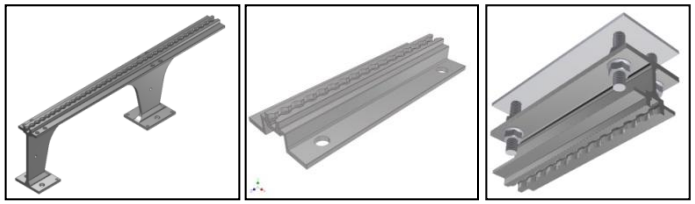


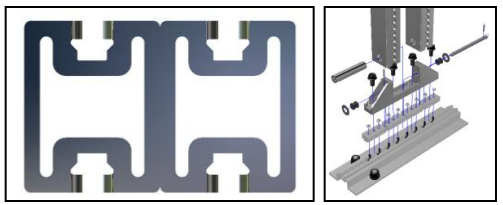
FI-Enabled Space





Standard Interfaces

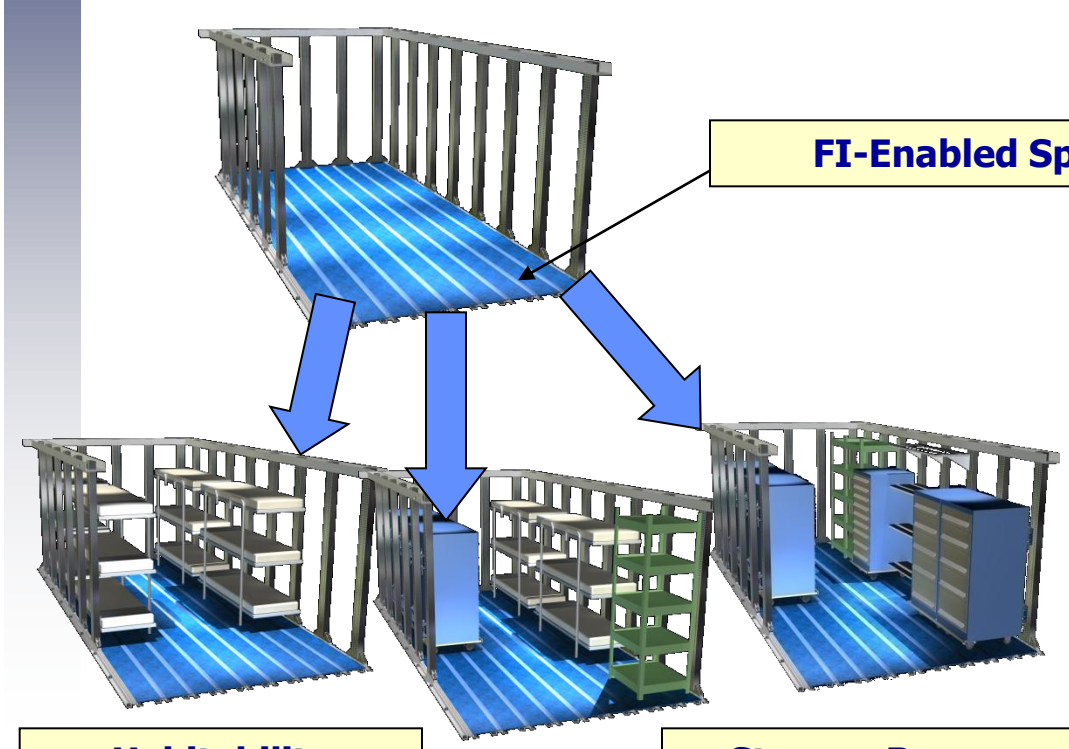




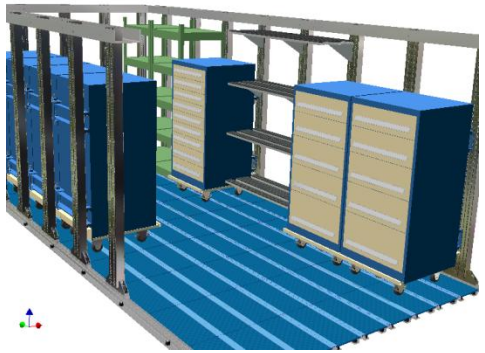
Standard Tracks

Flexible Infrastructure
Mission Reconfigurability

- Allows for maximum flexibility and easy technology insertion and upgrades
- Minimal Hot-Work required and no deck foundation re-work
- Spaces can be partitioned using Integrated Joiner Bulkhead System



Open Structure
Storeroom Configurations



Full Deck Track Installation

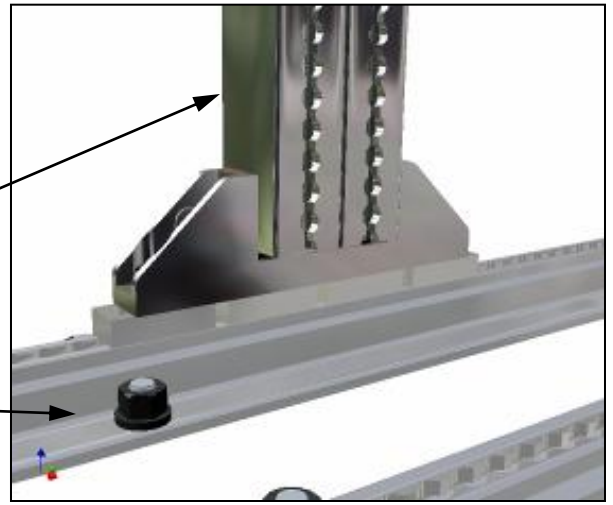
- Allows variable stanchion spacing
- Allows mounting equipment in the middle and around perimeter of the space
- Allows complete reconfiguration of space (change of functionality)

Perimeter Deck Track Installation

- Allows variable stanchion spacing
- Allows reconfiguration of space

Deck Installation

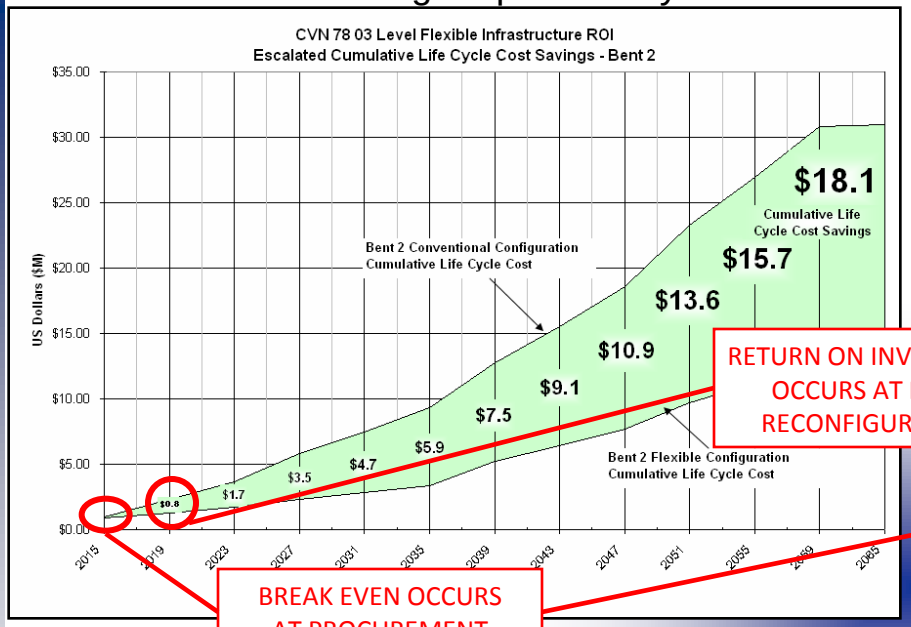
- Fixed Stanchion Spacing
- Allows limited reconfiguration of space



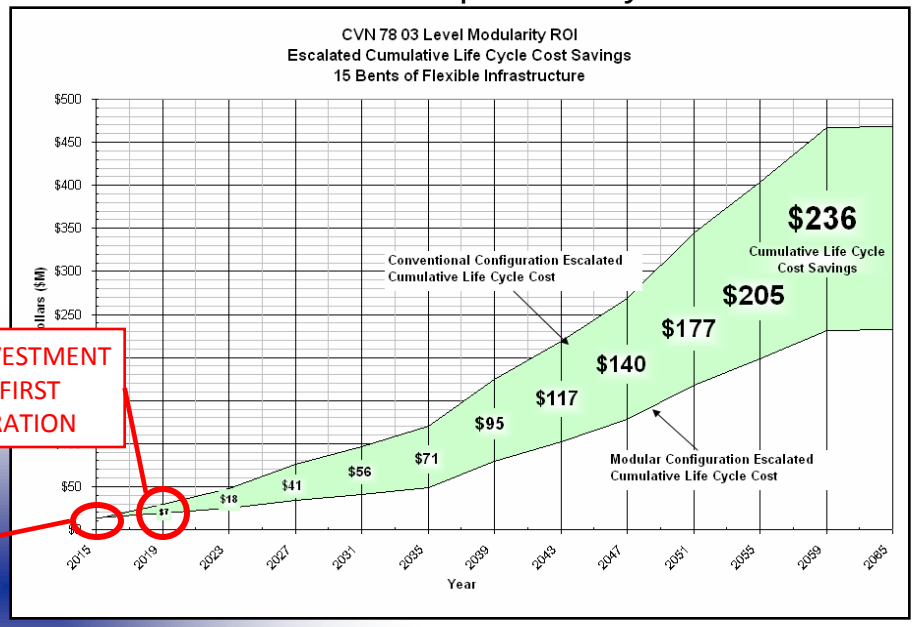
Return on Investment Potential*
Electronics Compartment Analysis

NAVSEA
NAVAL SEA SYSTEMS COMMAND

CVN - Single Space Analysis



CVN - 15 Space Analysis



Life Cycle Cost for One Space with FI vs. Conventional Install	
Procurement Cost	$ 0
Life Cycle Savings	$ 8.4 Million
Escalated Life Cycle Savings	$ 18.1 Million

Life Cycle Cost for Fifteen Spaces with FI vs. Conventional Install	
Procurement Cost	$ 0
Life Cycle Savings	$ 109 Million
Escalated Life Cycle Savings	$ 236 Million

***"CVN-78 Flexible Infrastructure Business Case Analysis" – Jan 2007; AMSEC LLC.**

Robust Business Case/ Return on Investment Analyses Enable Decisions

Flexible Infrastructure Savings*

- **New Build Installation**
  - **Labor Cost Savings up to 50%**
    - **Reduced "Hot Work" (Grinding, Welding, Fire Watches, Painting, Insulation Patches)**
    - **Reduced HVAC Ducting installation and fabrication**
    - **Repetitive Track Installation Process**
  - **Material Cost Increase is offset by labor cost savings**
- **Mid Life Modernization and Availability Savings**
  - **Significant Labor Savings up to 90%**
    - **Elimination of "Hot Work"**
    - **Elimination of HVAC Duct rework**
    - **Simple bolting and unbolting of equipment**
  - **Material Cost are Approximately Equal**

*"CVN-78 Flexible Infrastructure Business Case Analysis" – Jan 2007; AMSEC LLC.

Development and Testing Status

- **Shock Test – May 2011**
- **Vibration Test – May 2011**
- **Pull Testing – June 2011**
- **Material Testing (Non-Climate Controlled) – January 2012**
- **Standard Drawings – June 2011**
- **Installation Manual – June 2011**
- **Interface Control Document – June 2011**

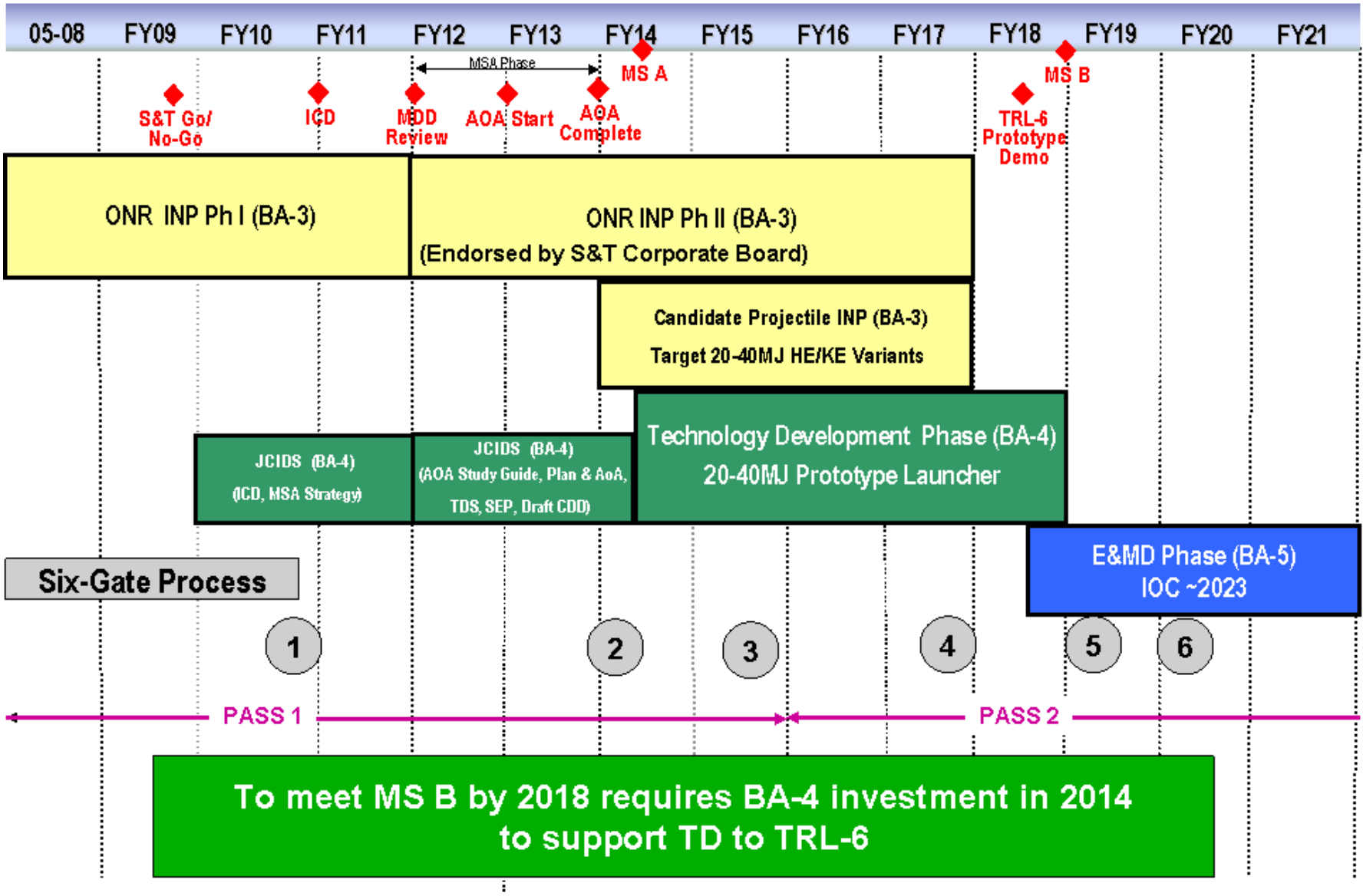
R&D Investment in Qualification Testing Enables Affordable/Timely Decisions

Flexible Infrastructure Transition Take Away

- FI enables space reconfiguration for technology refresh and insertion at a decreased cost
- FI is a mature technology that has been transitioned to CVN 77 and 78 with transition likely to LCS and LHA 7
- Designated Systems Integration Manager for expanded acquisition usage of FI and future, other ship physical open systems is needed
- Transition documents will be completed by the end of FY10

TOC Reduction enabler that needs expanded transition

Electromagnetic Railgun (EMRG) Weapon System Program Plan Overview



Joint Modular Intermodal Container (JMIC)

Technology Description:

- DoD standardized intermodal shipping configuration
- Stackable, interlockable, lockable, and collapsible
- Contents accessible from top or sides (side access when stacked). Capacity: 3000 lbs gross weight
- 43”x52”x44”; 16 JMICs will fit in Twenty-foot Equivalent Unit (TEU)

SEA 05T Role in Technology Transition:

- Finalizing Technical Data Package
- Achieving MIL-STD 3028 approval
- Obtaining NSNs for different color variants
- Improving on design from Extended User Evaluations incorporating lighter weight, improving usability and durability, and lowering cost

Success Metrics:

- JMICs are being used by Navy, USMC, Army, and Air Force
- USMC has existing procurement funding line with plans to purchase 20K over FYDP
- Over 3500 JMICs have been ordered through DLA contracts
- New construction T-AKEs (starting with #9) have been outfitted with JMICs, replacing existing security containers

Summary

- **Transition an art vice a science….**
  - **Wise initial selection of projects with multiple transition targets**
  - **Early collaboration with users/transition targets**
  - **Adaptability to changing acquisition strategies**
  - **Middle R&D funding ('6.3b' or now late 6.3 & early 6.4)**
  - **Teaming of researchers, systems engineers, operators & acquirers.**
- **Recommend use of Product Lines and Associated Technology Development Roadmaps**
- **Recommend modify DOD Financial Management Regulation (DODFMR) to include Technology Transition Activities in BA-3 and to split BA4 into Product Line Development and Advanced Component Development and Prototypes**

Questions? & POCs, resources

- **Michael Bosworth, SEA 05TB dCTO**
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- **Dr. Norbert Doerry, SEA 05TD technical director**
  - Norbert.doerry@navy.mil
- http://doerry.org/norbert/papers/20100618NAStransitioningTechnology-final.pdf **Transition**
- http://findarticles.com/p/articles/mi_qa3738/is_200410/ai_n9426188/?tag=content;col1 **SEALION**