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Enabling Software Acquisition Improvement: Government and Industry Software development Teams

Joe Heil

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Enabling Software Acquisition Improvement:

Government and Industry Software development Teams

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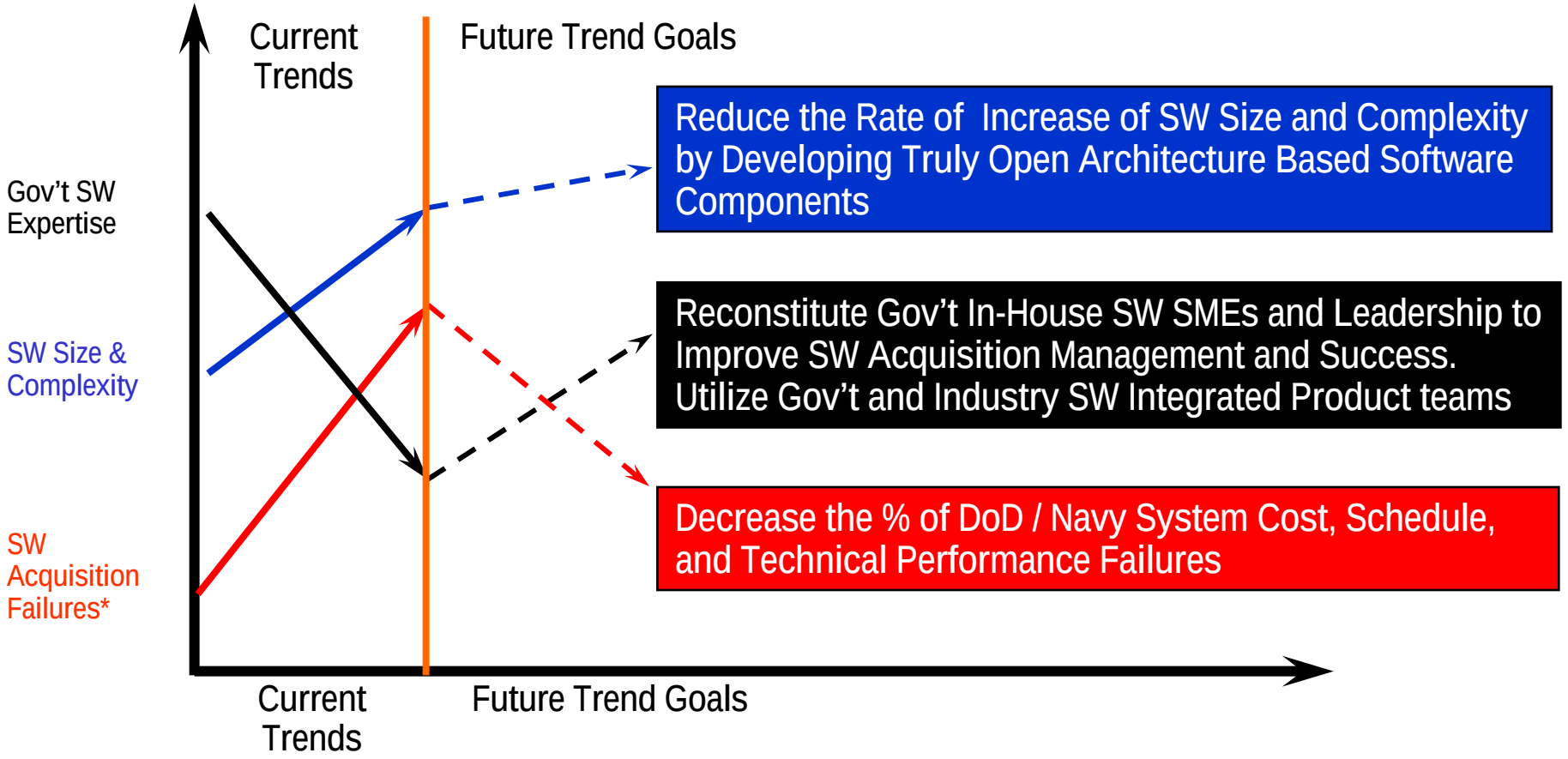
Software Acquisition Improvement

- Executive Summary
- Current State
- Future State
- Recommendation

Enabling Software Acquisition Improvement Executive Summary



*** Failures**

YR 2000: 84% of programs are late and over budget, and deliveries include only 61% of planned capabilities*
YR 2004: 40% ($8 Billion) of DoD RDT&E Budget was spent on reworking software due to quality issues**
YR 2009: DOD's 95 major defense acquisition programs have an average cost growth of 26% and an average schedule delay of almost 2 years***

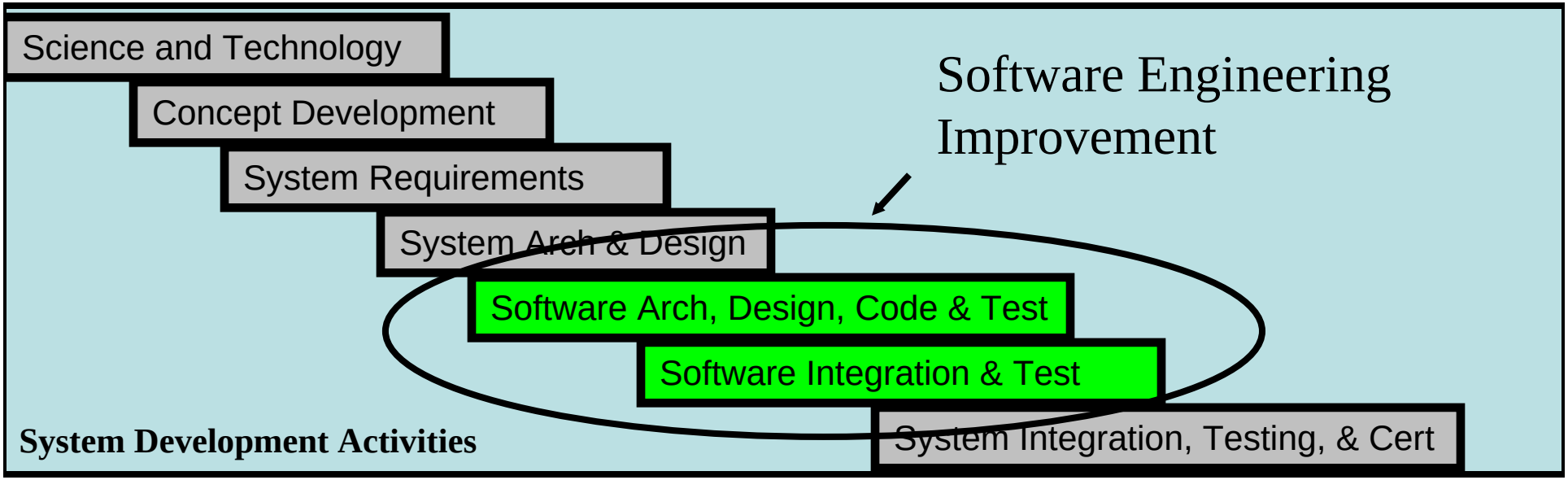
Improvement Recommendations

1. Reconstitute the Navy's in-house applied sw development expertise and Leadership
2. Utilize government and industry software development Integrated Product Teams

CURRENT STATE CHALLENGES

- Designing and implementing truly Open Architected systems
  - standardized interfaces, scalable, reliable, portable, modular
- Assessing, successfully utilizing, and rapidly integrating the most advanced software technologies and methodologies:
  - Model Driven Architectures, Service Oriented Architectures (SOA), multi-core parallel processing, automated code generation, cloud computing, next generation programming languages, and agile development processes.
- Integrating the mix of legacy and modern SW and HW components
  - new Commercial-Off-The-Shelf (COTS) SW & HW components and DoD/Navy developed highly specialized and unique components
  - Achieving integrated net-centric systems composed of hundreds-of-millions (possibly billions) of lines of code that can execute as systems-of-systems and fully meet mission level objectives and Key Performance Parameters (KPPS).
- Achieving Information Assurance (IA) and protection against SW based Cyber-Attacks while maximizing COTS utilization and Net-Centric communications.
- Maintaining government corporate knowledge of the system architecture, design and technology utilization as the responsibility for system and software development transitions among different private industry organizations during the program life-cycle.

SW Acquisition Approach Current State



- **Software size, complexity, and reliance is continuing to grow within DoD/Navy critical systems**
- **DoD/Navy is failing to consistently successfully acquire software intensive systems**
  - **YR 2000: 84% of programs are late and over budget, and deliveries include only 61% of planned capabilities***
  - **YR 2004: 40% ($8 Billion) of DoD RDT&E Budget was spent on reworking software due to quality issues****
  - **YR 2009: DOD's 95 major defense acquisition programs have seen their costs grow by an average of 26% and experienced an average schedule delay of almost 2 years*****
- **DOD/Navy is losing its in-house applied software engineering and development expertise**

*** 2000 Defense Science Board (DSB) Task Force on Defense Software Report**

**** 2004 General Accountability Office Report**

***** 2009 Opening Statement of Senator Carl Levin at Senate Armed Services Committee Hearing, March 3, 2009**

Current System Acquisition Strategy Roles and Responsibilities

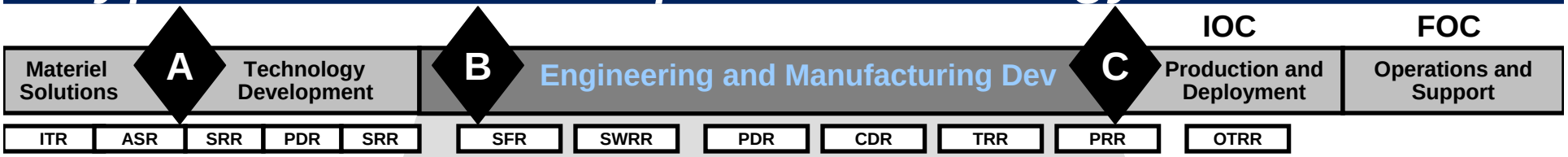
CURRENT STATE CHARACTERISTICS:

- **Government relies primarily on Industry for: System Requirements Definition, System and Software Architecture, System and Software Design and Development.**

- **Non-open systems.**

- **Proprietary system artifacts.**

Current State
Typical Software Acquisition Strategy



DoD/ASN/RDA Policies Call for Gov't SMEs to Define System Req's, Support Milestone Reviews, and Validate the SW Artifacts Developed by Industry

Software Development Activities Conducted Primarily During the System Development and Demo Phase

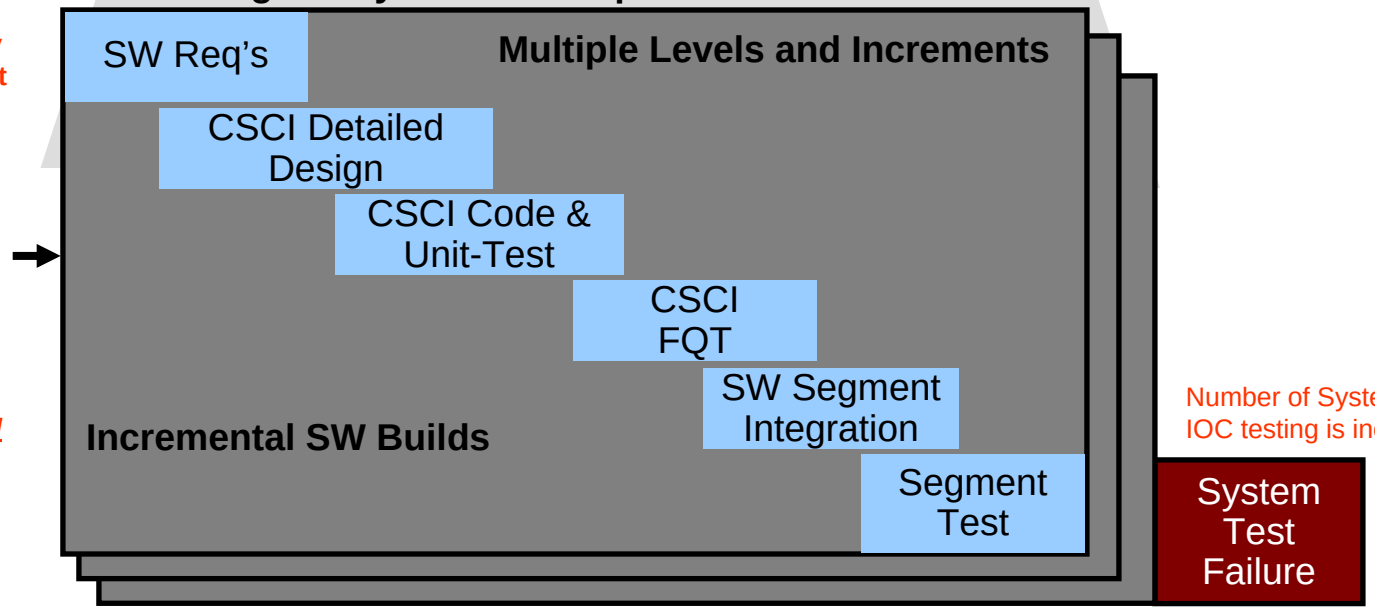
RISKs

Over-reliance on Industry for software Development

Gov't participation primarily via Milestone Reviews is not sufficient

Gov't sw engineer participation during sw development is minimal

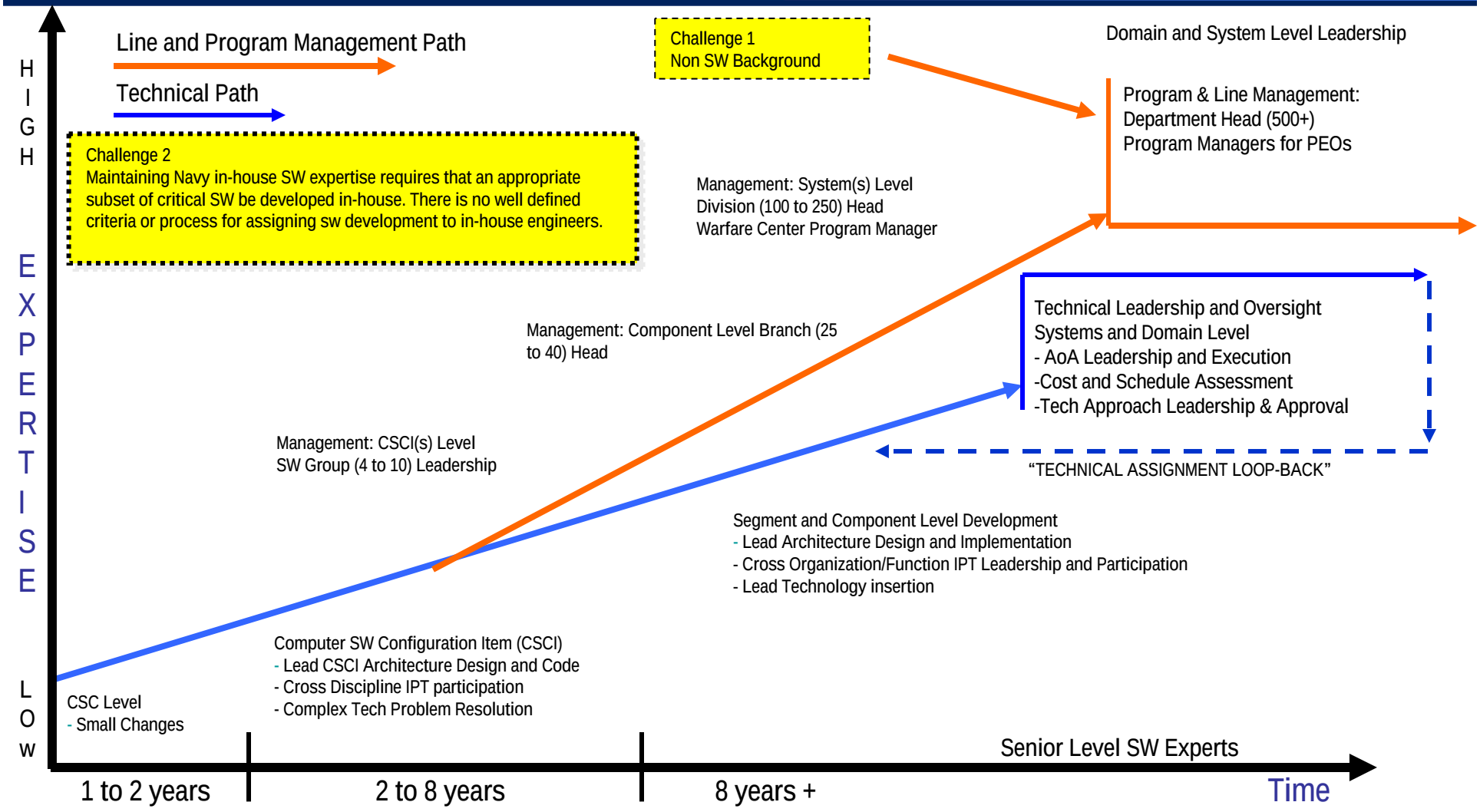
Gov't is losing its *applied* software development expertise



Number of Systems that fail IOC testing is increasing

"The combination of personnel reductions and reduced RDT&E has seriously eroded the Department's domain knowledge and produced an over reliance on contractors to perform core in-house technical functions
-Department of the Navy Acquisition, D. Winter: SECNAV Memo Dated 10 Oct 08

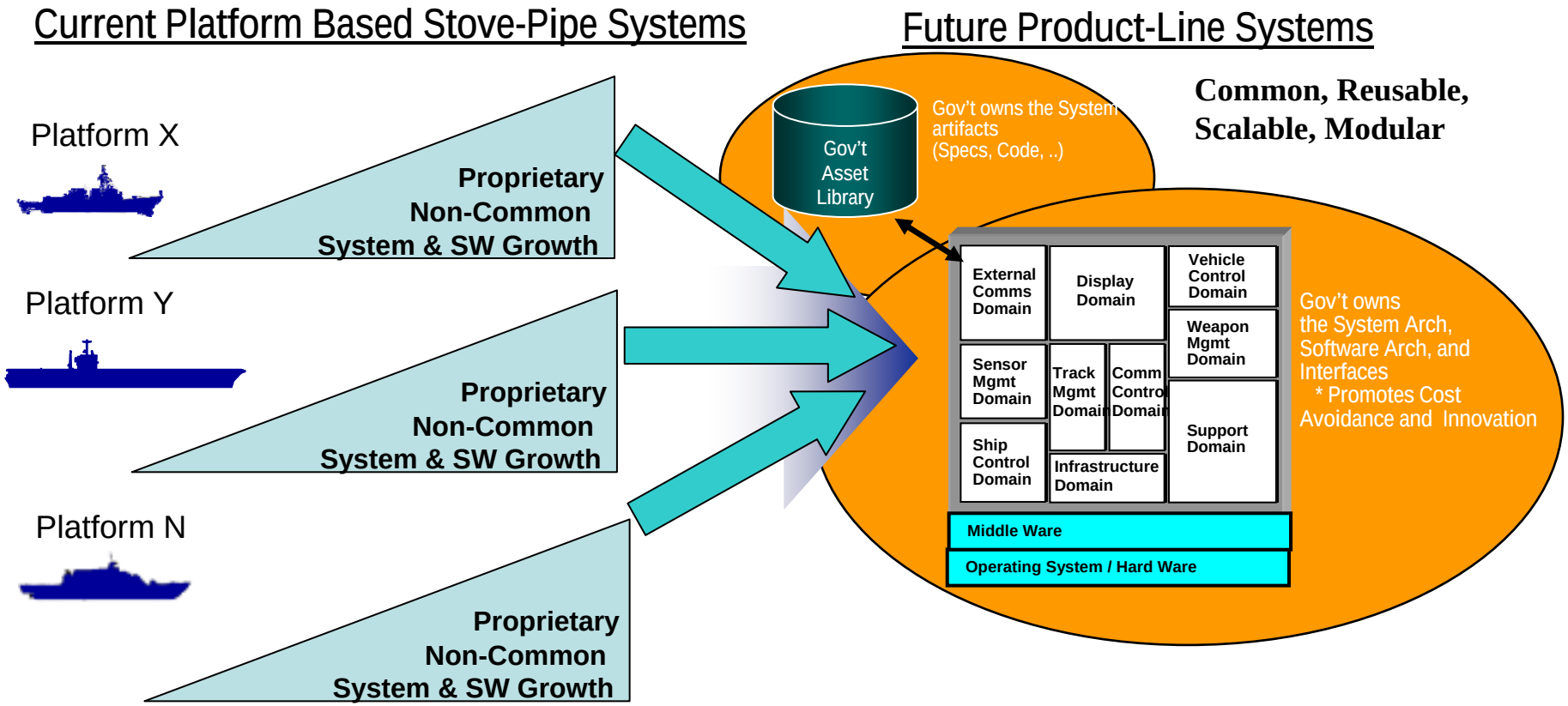
In-House Software Expertise Pipeline



"In order to acquire the DON platforms and weapons systems in a responsible manner, it is imperative the DoN maintain technical domain expertise at all levels of the acquisition infrastructure".

-Department of the Navy Acquisition, D. Winter: SECNAV Memo Dated 10 Oct 08

Future State Goal
Open Architecture based Product-Line Initiative

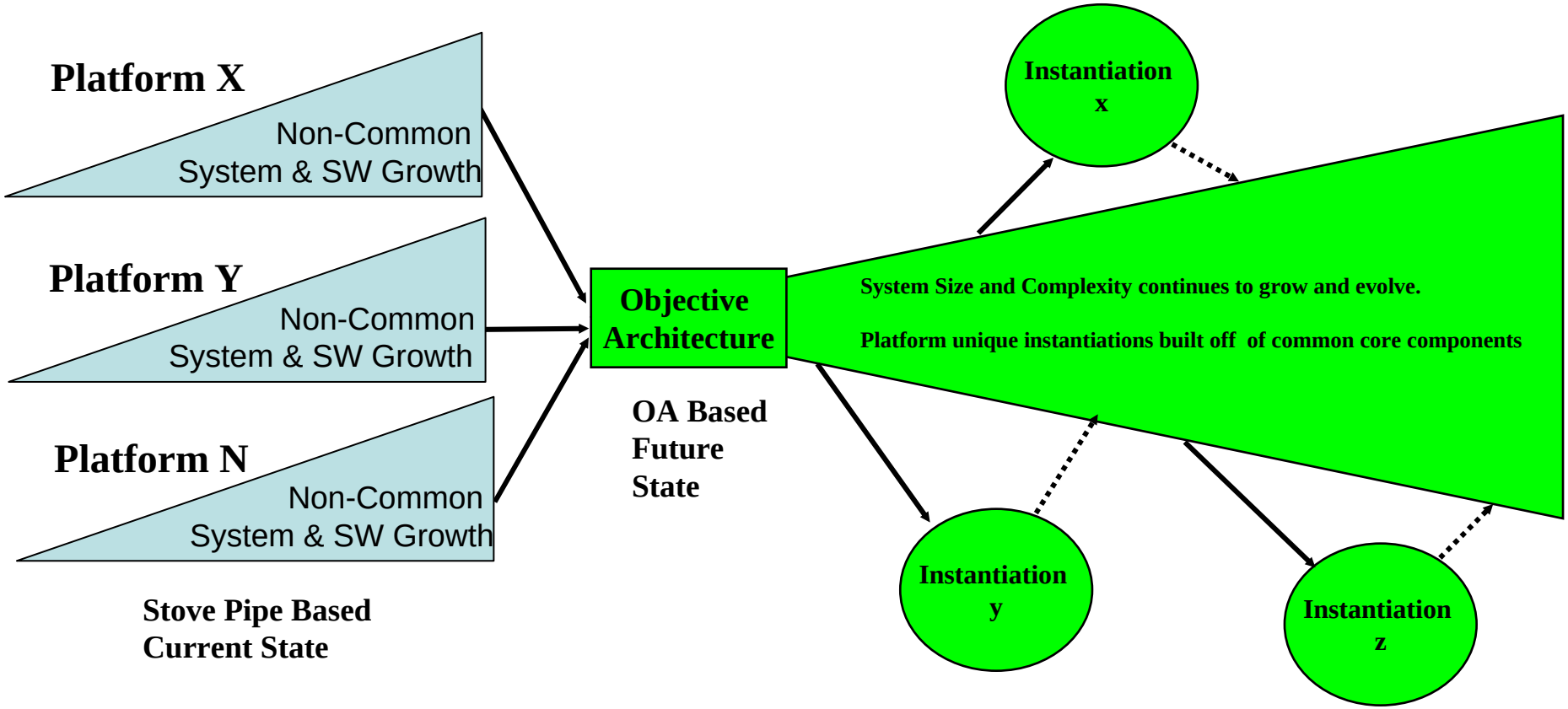


Objectives
- Transition from Stove-Pipes to Product Lines
- Reduce Cost
- Promote Competition & Innovation
- Deliver High Quality Reliable Systems

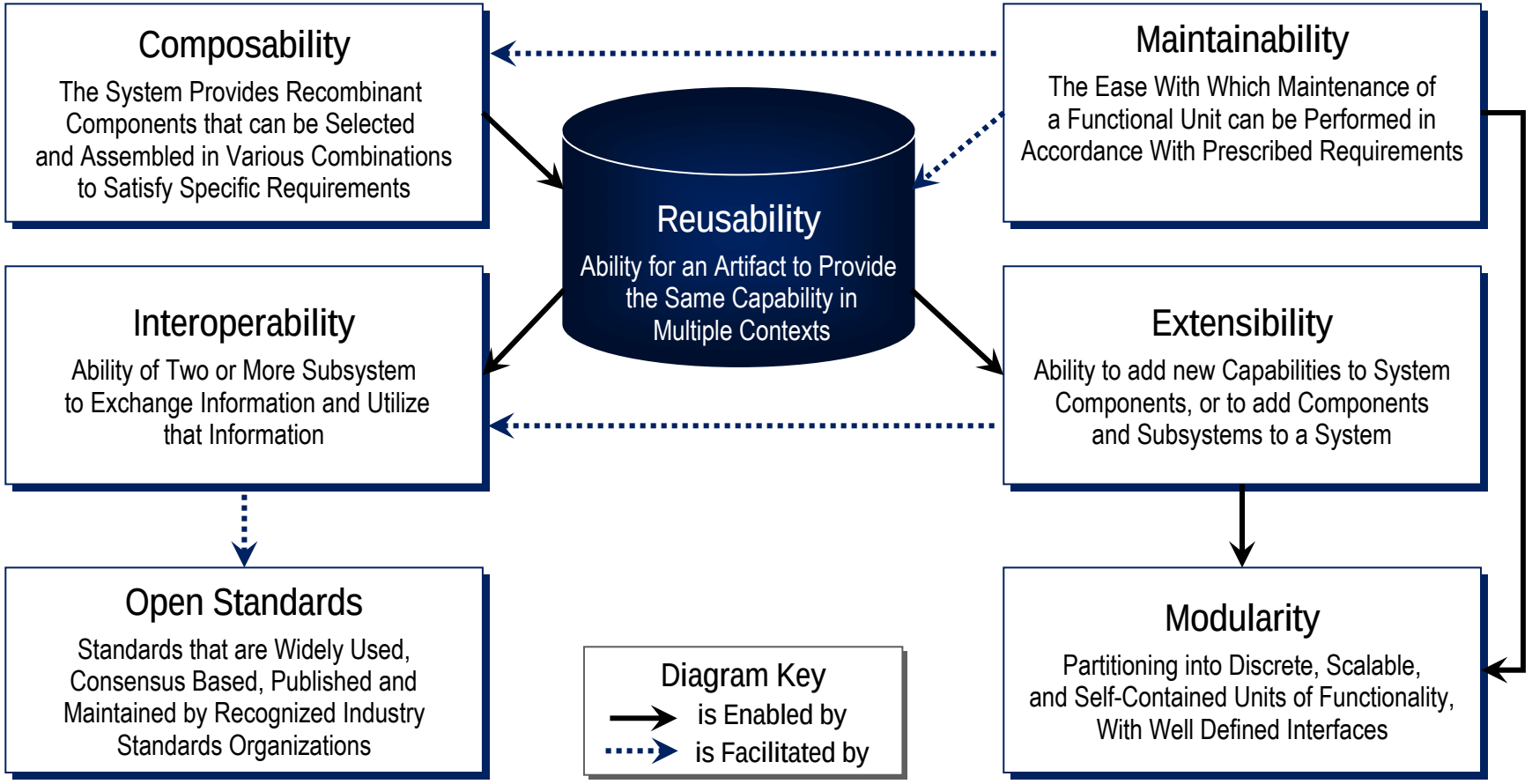
Architecture Characteristics:
- **Decouples Hardware from Software**
- **Utilizes Standards-based Interfaces to Network**
- **Componentizes Software Applications**

Future State Challenge: Maintaining Corporate Knowledge of Objective Architecture

- How does the Navy maintain corporate knowledge and ownership of the Objective Architecture as the system evolves over time and is required to support numerous different platforms?



Future State Challenge: Open Architecture Software

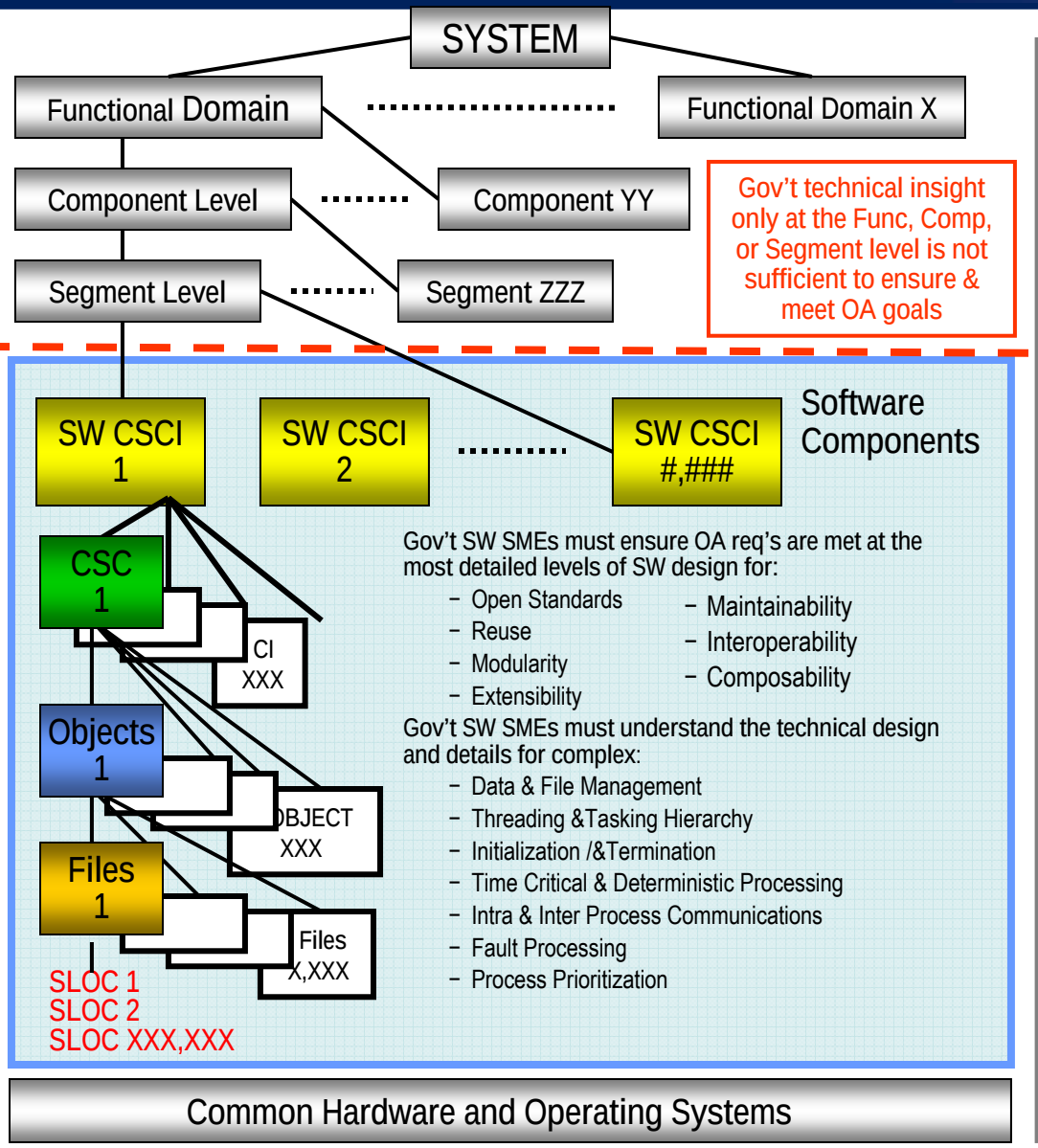


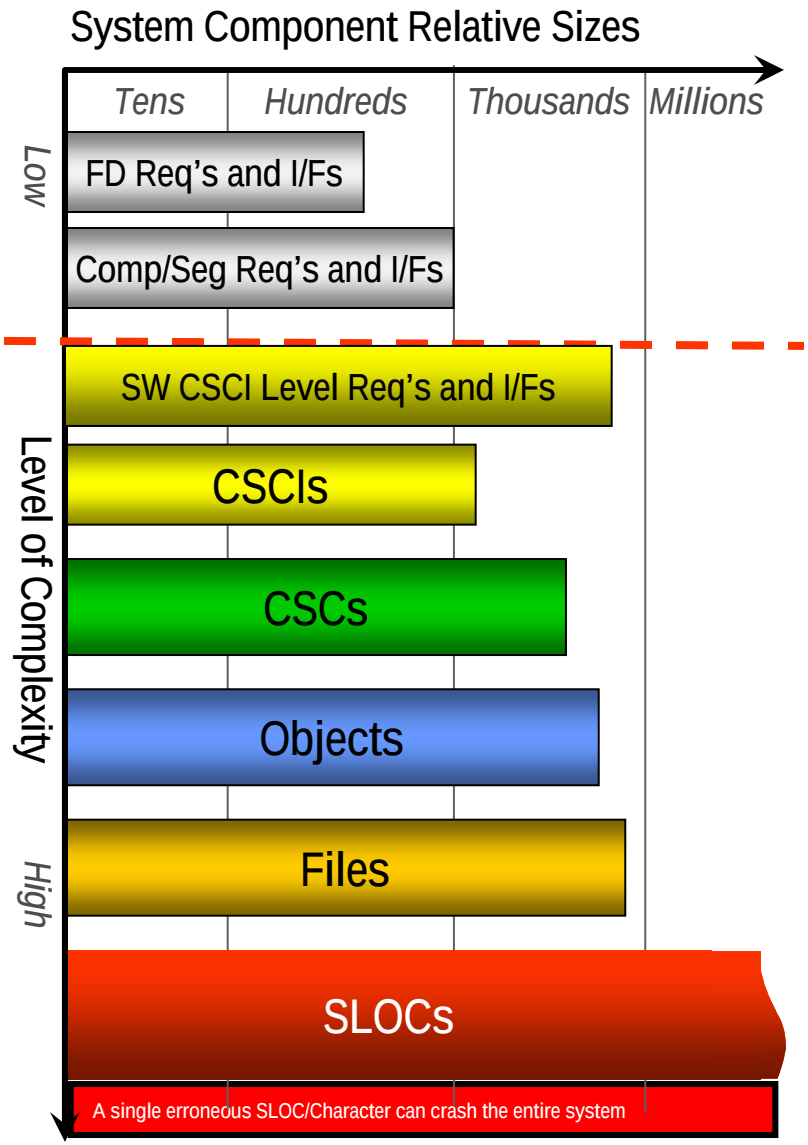
These OA "ILITIES" Cannot be Easily Verified by System Testing….. Government In-House SW Expertise Insight Into Design and Code is Required to Ensure Reusable Software

Designing and Coding for These "ILITIES" is the Key to Saving Significant $$$$$$$

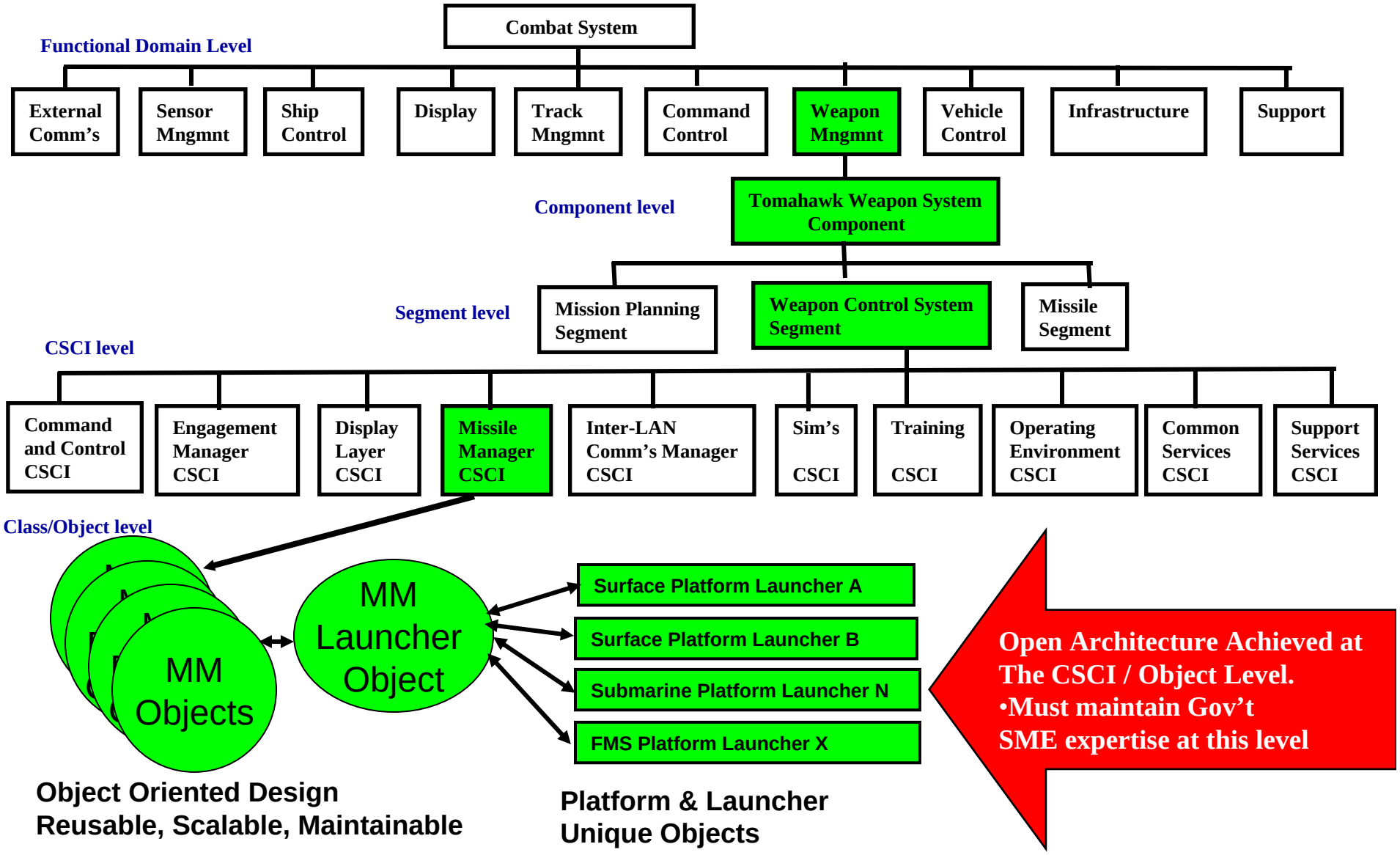
* Reference: OA Architectural Principles and Guidelines v 1.5.6, 2008, IBM, Eric M. Nelson, Acquisition Community Website (ACC) DAU Navy OA Website

Future State Challenge: Components Size and Complexity
Devil is in the Details

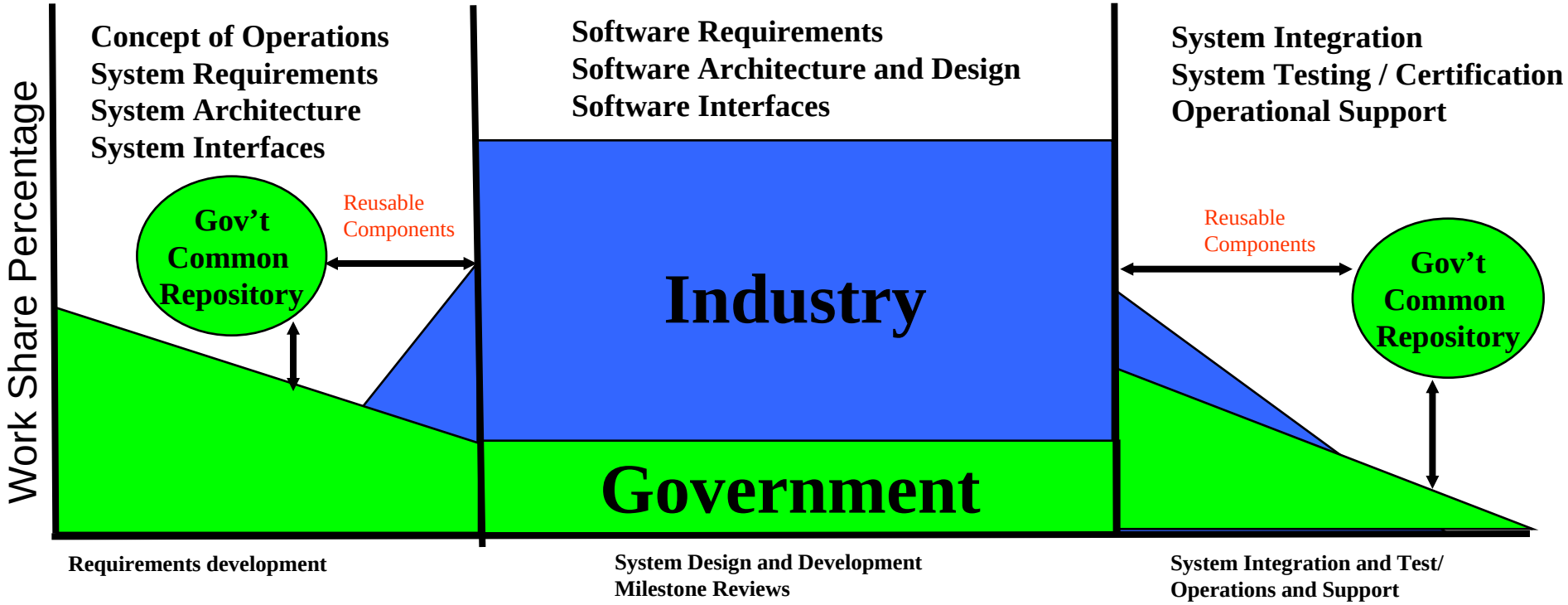




OA Success Example
Open Architecture Achieved at the CSCI and Class Level



Alternative System Acquisition: Integrated Team Roles and Responsibilities



REQUIREMENTS
Majority of Tech Work done by the Gov't
Gov't Leads AOAs / Industry may support.
Gov't Leads Prototyping / Industry may support.
Gov't Defines System Requirements
Gov't Defines System/SW Architectures.
Gov't Defines Interfaces (I/F).
Gov't Determines what system components will be developed by Industry and In-house SMEs.

SYSTEM DEVELOPMENT
Majority of Technical work done by Industry
Gov't controls and manages Architectures and I/Fs
Gov't leads sw design and development.
Industry develops a majority of the sw components.
Gov't develops a small subset of the critical sw.

INTEGRATION / TEST
Majority of Tech work by Gov't
• Gov't leads System Integration
• Gov't leads System Test and cert
• Gov't and Industry fix SW Defects
• Gov't controls the Common Asset Library where final System Products are stored
• Gov't maintains the SW

Integrated Gov't and Industry Development Teams Accountability

- Well defined and documented roles and responsibilities
- Common set of well documented cost, schedule, and performance expectations
  - Cost and schedule Variance (CPI/SPI) Thresholds and Goals
  - Quantified Key Performance Parameters and Software Quality goals
- Common set of well documented system development processes and metrics
  - Business Processes and Technical Processes
- Integrated Master Schedule (IMS) with well defined and agreed to interdependency products and associated delivery dates
- Proactive and attentive integrated team management of cost, schedule and technical performance
  - Frequent regular periodic team communication and risk assessment / management
- Gov't test team is independent from government sw development team
  - Separate management chains
  - Test team has direct line of reporting to the Program Office
- Utilization of Milestone Reviews with Independent Competency Experts

Recommendations Summary

- Reconstitute the government in-house Software Expertise Pipe-line
- Work with Navy senior leaders to define the vision, roles and responsibilities of in-house software development organizations
- Develop and execute the transition plan(s) to accomplish the vision

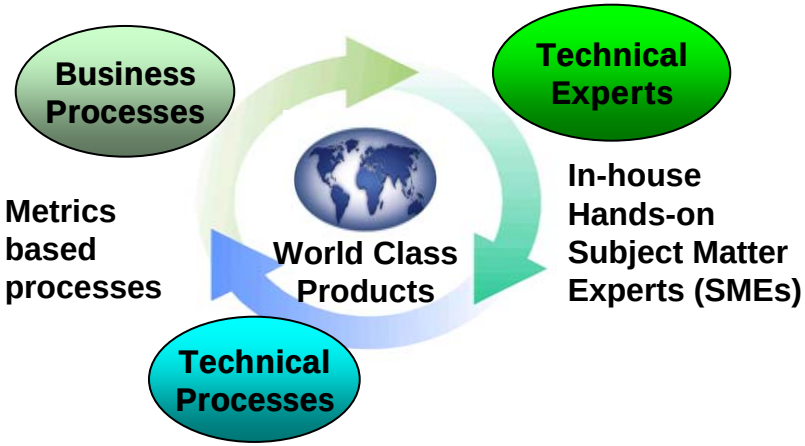
Develop and maintain in-house technical experts who can lead and participate within integrated government and industry software development teams that utilize best-practice based technical and business processes to provide high quality and reliable War-fighter systems that fully meet cost, schedule, and technical performance requirements

Back-Up

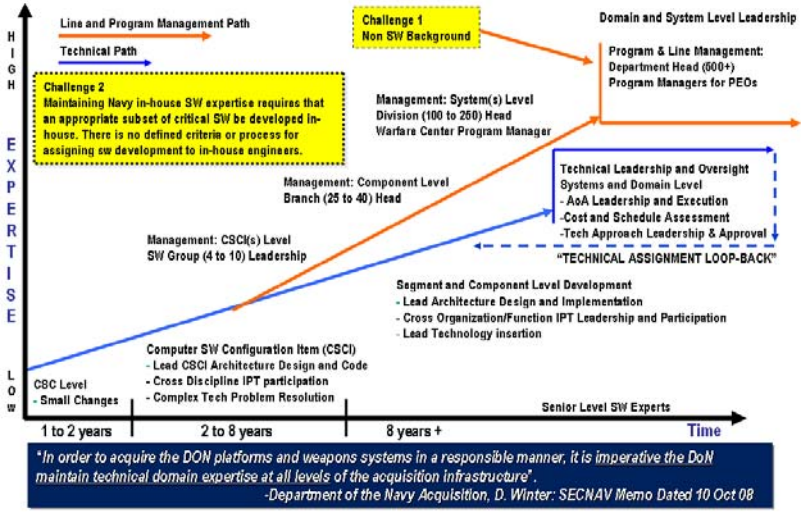
- References
- Open Architecture Characteristics
- Current Typical SW Acquisition Strategy
- Devil is in the Details (System Decomposition)

System Acquisition / Development Key Elements for Success

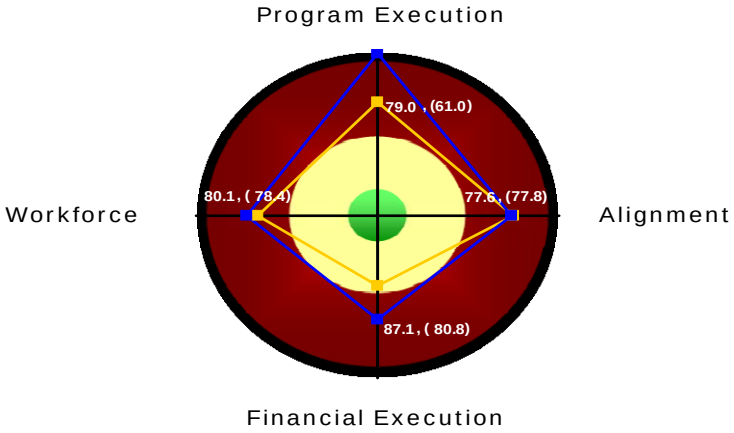
3 Key Execution Elements



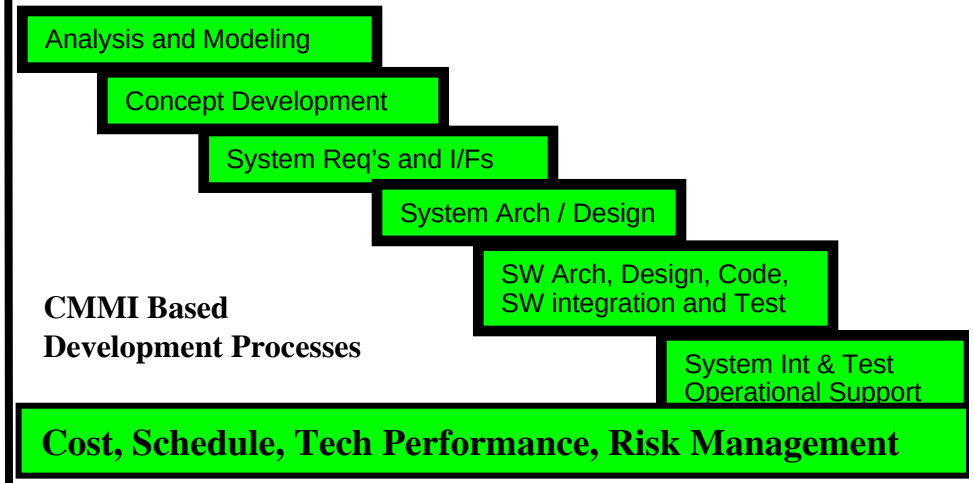
Government In-House Expertise Pipeline



Metrics Based Business Processes



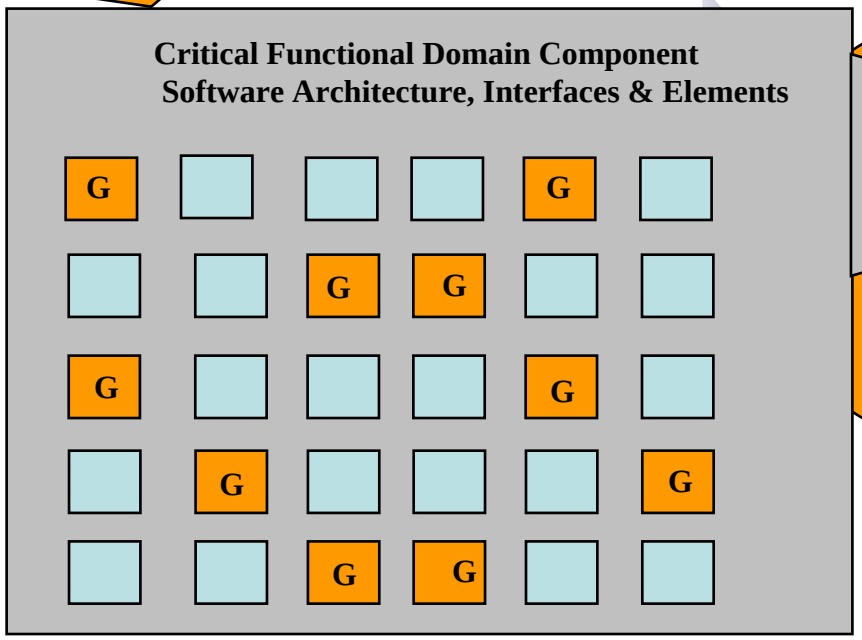
Integrated Gov't and Industry Development Team

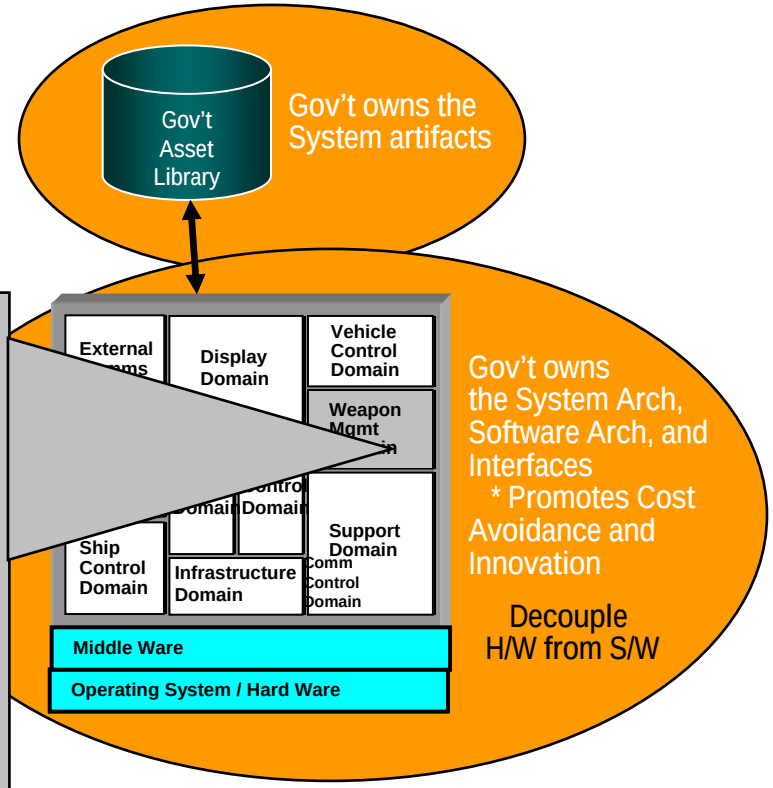


Future State
Gov't and Industry SW Development

Gov't develops a small subset of the sw components to invest in the gov't acquisition workforce at no additional cost to the programs

Gov't contracts out modular components to promote competition between large and small industry partners





Common, Reusable, Scalable, Modular

Government in-house engineers will develop (architect, design, code, test) a subset of the software
Industry software engineers will still develop a majority of the software components

References

REFRENCES FOR SOFTWAR ACQUISITION IMPROVEMENT			
DATE	**REPORT / STUDY / MEMORANDUM / POLICY**	**AUTHOR / SPONSOR**	**KEY QUOTES / POINTS / METRICS**
OCT 10 2008	SECDEF MEMO: Department of the Navy Acquisition	SECDEF Donald. C. Winter	"In order to acquire DON platforms and weapons systems in a responsible manner, it is imperative the DON maintain technical domain expertise at all levels of the acquisition infrastructure." "This combination of personnel reductions and reduced RDT&E has seriously eroded the Department's domain knowledge and produced an over-reliance on contractors to perform core in-house technical functions. This environment has lead to outsourcing the "hands-on" work that is needed in-house, to acquire the Nations best science and engineering talent and to equip them to meet the challenges of the future Navy." "The fraction of RDT&E funding at each warfare Center and Laboratory should be maintained at a level sufficient to develop and sustain the needed technical capabilities of the DON".
NOV 07 2008	Senators Levin and McCain letter to SECDEF	Senator John McCain	Highlights the need for government in-house technical expertise in the acquisition workforce, especially in the technical and business domain
NOV 04 2008	ASN/RDA MEMO: Meeting of the Navy Laboratory/Center Competency Group	ASN/RDA PCD James E. Thomsen	"…strategic imperatives that I have received from the ASN(RDA&A) and SECNAV..." STRATEGIC OBJECTIVE 1: Reverse the over-reliance on contractors performing core Navy acquisition functions. STRATEGIC OBJECTIVE 2: Stewardship of the Navy's Laboraties and Warfare Centers to ensure long term health and effectiveness. STRATEGIC OBJECTIVE 4: Identify and develop skilled Program Managers and their successors
DEC 05 2008	ASN/RDA MEMO: Strategy to Balance Acquisition In-house and Contractor Support Capabilities	ASN/RDA PCD James E. Thomsen	"I expect growth in the organic acquisition workforce, largely offset by a corresponding decrease in outsourced core acquisition (technical and business) functions. I request that each PEO/SYSCOM team submit a time-phased strategy to increase acquisition organic capabilities by reducing dependence on outsourced core acquisition functions."

References

JUL 22 2009	ASN/RDA MEMO: DON Software Measurement Policy for Software Intensive Systems	ASN/RDA John S. Thrackrah	Directs all programs to implement the following core set of metrics: • Software Size • Cost/Schedule (WBS Focus on Software) • Software quality • Software Organization
MAY 2008	Report of the Defense Science Board (DSB) Task Force on Developmental Test and Evaluation	Office of the Under Secretary of Defense for Acquisition, Technology and Logistics	" In recent years, there has been a dramatic increase in the numbers of systems not meeting suitability requirements during IOT&E"." "there was a loss of a large number of the most experienced management and technical personnel ...without an adequate replacement pipeline" "changes in developmental test and evaluation alone could not remedy poor program formulation". "sequential workforce cuts in the last ten years had a significant adverse impact on the DOD acquisition capability". "A significant amount of developmental testing is currently performed without needed degree of government involvement or oversight"
NOV 2000	Report of the Defense Science Board (DSB) Task Force on Defense Software	Office of the Under Secretary of Defense for Acquisition and Technology	KEY FINDINGS/METRICS (from review of 6 major previous DOD-wide studies) • only 16% of programs complete on schedule and within budget • 31% of programs are canceled and the remaining 53% have cost growth greater than 89% • the average final product includes only 61% of original intended features. “..from an analysis of 17 major software intensive systems that the level of team experience with requirements, architecture, and technology, and team processes and communications patterns on similar systems was the dominant reason for a projects success or failure..” "Software is rapidly becoming a significant, if not the most significant, portion of DOD acquisitions." "Technology is changing more rapidly than ever before...the changes make it necessary to stay abreast of the technology, how to apply it, how to develop, field and operate the systems that use it". Recommendations. Improve software skills of acquisition and program management. Strengthen and stabalize the technology base.

References

FEB 2008	Report to Congressional Committees Best Practices: Increased focus on requirements and oversight needed to improve DODs Acquisition Environment and weapon System Quality (GAO-08294)	Government Accounting Office (GAO)	Analyzed 11 major DOD weapon Systems. "defense contractors poor practices for system engineering activities as well as manufacturing and supplier quality problems" contributed to significant failures wit regards to cost, schedule and technical performance. DOD needs to adopt a knowledge based acquisition approach...high levels of knowledge must be demonstrated at critical decision points in the product development process
2007 2008	ASN/RDA Software Process Improvement Initiative (SPII) Software Acquisition Management (SAM) Focus Team "As-Is" and 'To-Be" State Reports.	ASN/RDA Chief Engineer	Assessed numerous previously existing DOD/Navy studies and reports; and found the following 7 common SW Intensive System Acquisition management problems: Lack of effective acquisition management Immature acquirer (program offices) Ineffective requirements management High personnel turnover in the acquiring organizations Unrealistic Cost and Schedule Estimates Ineffective utilization of EVMS for SW Failure to take advantage of lessons learned 'To-Be" report recommendations for each of the 7 critical problems ALL include requiring the government to train and better utilize Subject Matter Experts (SMEs).