Status and Future of the Naval R&D Establishment

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2010 Summer Study

Sponsored by

Hon. Sean Stackley

Assistant Secretary of the Navy (Research, Development, and Acquisition)

NRAC

Terms of Reference

- **Assess** Warfare Centers (and UARCs as feasible)
  - Current technical core competencies
  - Stewardship for core competencies
  - Consider technical quality of workforce and physical infrastructure

- **Identify technical competencies** DoN requires
  - Holds a leadership position
  - Leverages others' expertise
  - Is deficient

- **Identify future technical leadership areas** that DoN will need
  - Indicate likelihood that WCs and UARCs will be able do develop needed capabilities

- **Identify approaches** to maximize likelihood of achieving necessary leadership and effective leveraging (within context of constrained future budgets)

Study Panel

- Dr. John C. Sommerer, Chair
  CTO, JHU Applied Physics Laboratory
- VADM Bill Bowes, USN (Ret), Vice Chair
  Private Consultant
- Dr. Amy E. Alving
  CTO, SAIC
- Dr. A. Michael Andrews II
  VP R&E/CTO, L3 Communications
- Dr. James Bellingham
  Chief Technologist, MBARI
- Dr. Ira M. Blatstein*
  School of Education, JHU
- RADM Daniel R. Bowler, USN (Ret)
  Private Consultant
- RADM Erroll Brown, USCG (Ret)
  IBM
- Prof. Michael S. Bruno
  Dean of Engineering, Stevens Institute
- RADM Walter Cantrell,* USN (Ret)
  Private Consultant
- Dr. Robert S. Carnes, MD
  Director of Internal R&D, Battelle

- LtGen John Castellaw, USMC (Ret)
  Private Consultant
- Dr. Frank L. Fernandez
  Private Consultant
- RADM Millard S. Firebaugh,* USN (Ret)
  Professor, University of Maryland
- MajGen Paul Fratarangelo, USMC (Ret)
  Private Consultant
- CAPT R. Robinson Harris, USN (Ret)
  Director, Adv. Concepts, Lockheed
- Dr. Anna D. Johnson-Winegar
  Private Consultant
- Mr. James H. Korris
  President, Creative Technologies Inc
- Dr. Marv Langston*
  Private Consultant
- Dr. Mark G. Mykityshyn
  Managing Partner, White Oak Group
- Prof. Art Ramirez*
  Dean of Engineering, UCSC
- Mr. Gerald Schiefer*
  Private Consultant

- Mr. Bill Schmitt*
  Private Consultant
- Dr. David Tennenhouse
  Partner, New Venture Partners
- RADM John T. Tozzi, USCG (Ret)
  VP Adv Programs, L3 Communications
- LtGen Joseph F. Weber, USMC (Ret)
  VP Student Affairs, Texas A&M
- Dr. David A. Whelan
  Chief Scientist, Boeing Defense Syst.
- Prof. Patrick H. Winston
  Computer Science, MIT
- RADM Charles B. Young USN (Ret)
 VP Strategic Planning, Oceaneering Intl.

Executive Secretariat

- Mr. Adam P. Nave
  PCDASN (RDA) Staff
- Dr. Steve Pappert, S&T Assoc.
  SPAWAR-SSC-PAC
- Dr. Joe Hoeg, Sr. Scientific Advisor,
  NAWC-AD
- Mr. Scott Boyd, DASN ExW Staff
- Mr. Dave Savillo, NAVSEA UARC Office

Consultant for this study *

Warfare Centers:
The Only Constant is Change

- **Naval Technical Community experienced many changes before 1992**
  - Labs + field stations
  - SYSCOM, SPAWAR, ONR management
- **BRAC (rounds 2–4)**
  - Four Warfare Centers reporting to SYSCOMS
  - ~50% reduction in staff
  - Overhead reduction
- **WC portfolio expansion**
  - Jointness
  - 9/11, Homeland Security, IEDs, etc.
  - Preserve core technical competencies
  - Overhead amortization
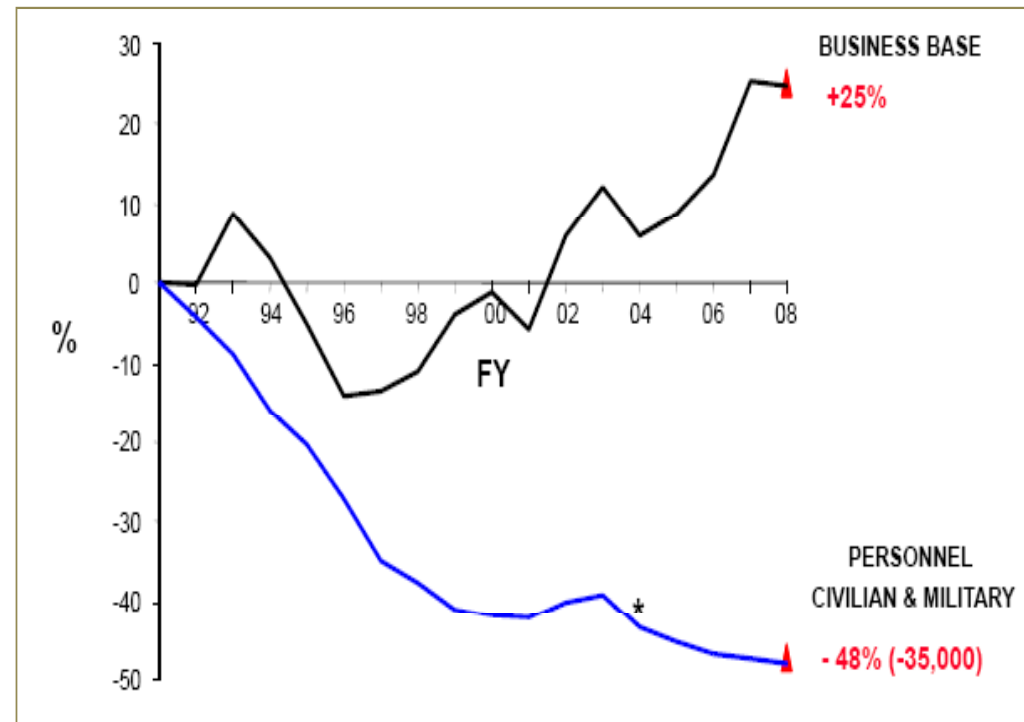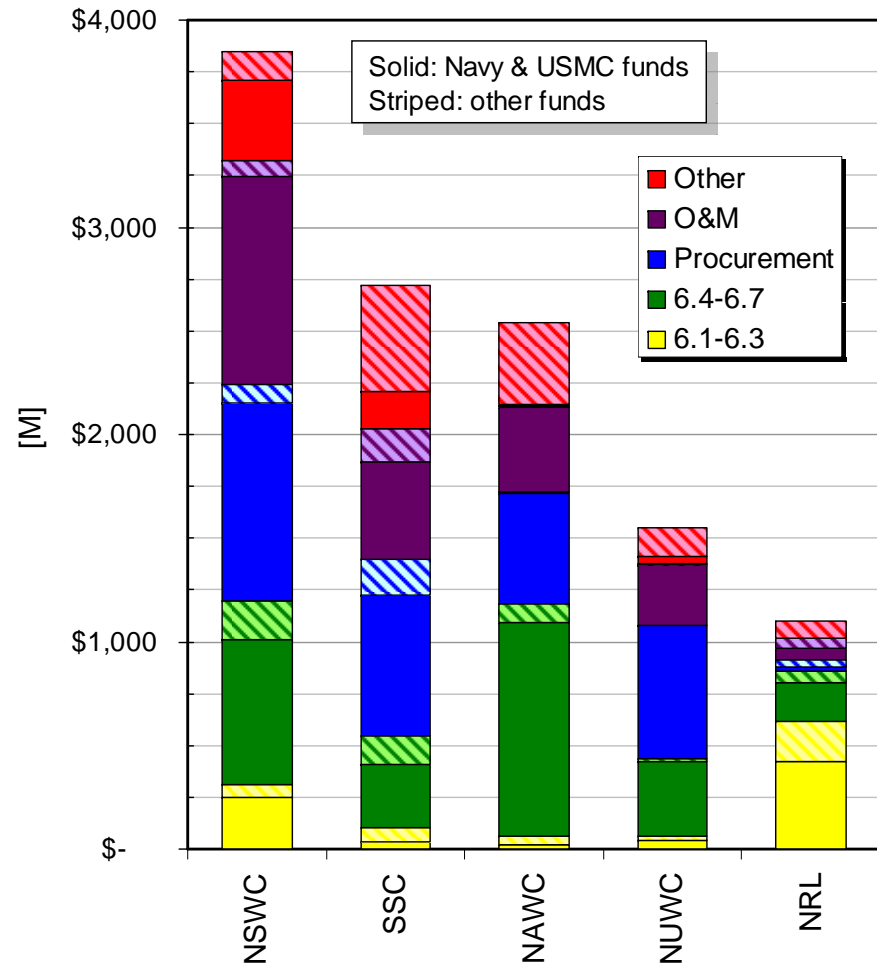
Navy Working Capital Funding

- **Advantages**
  - A good business model for survival of WCs
  - Ensures customer relevance and responsiveness to emerging operational issues
  - Enables joint tasking
- **Issues**
  - Does not incentivize development and sustainment of deep technical competence
  - Relatively short-term focus fosters neglect of planning for the future

Reimbursable Expenditures by Funding Type, GFY09

Solid: Navy & USMC funds
Striped: other funds

Legend:
- Other
- O&M
- Procurement
- 6.4-6.7
- 6.1-6.3

[M]

Y-axis: $4,000 / $3,000 / $2,000 / $1,000 / $-

X-axis: NSWC, SSC, NAWC, NUWC, NRL

Programmatic Context for NRAC Study

- Mandate to increase size of acquisition workforce (in-sourcing and new hires)
- SECNAV goal of "acquisition excellence"

- Likely decreasing DoN RDT&E budget
- SECDEF goal of "reducing overhead and improving business operations"…"to provide the equivalent of roughly 2 to 3 percent real growth"
- Unsustainability of current Federal budget

Programmatic Context Contains Mixed Messages

Technological Context for NRAC Study

- US military supremacy has been tightly linked to US technological dominance

- That dominance enabled in part by relative vigor and size of the US economy

- The US economy a decreasing proportion of the global economy

- US S&T is a decreasing proportion of global S&T

- These realities will shape the Navy & Marine Corps

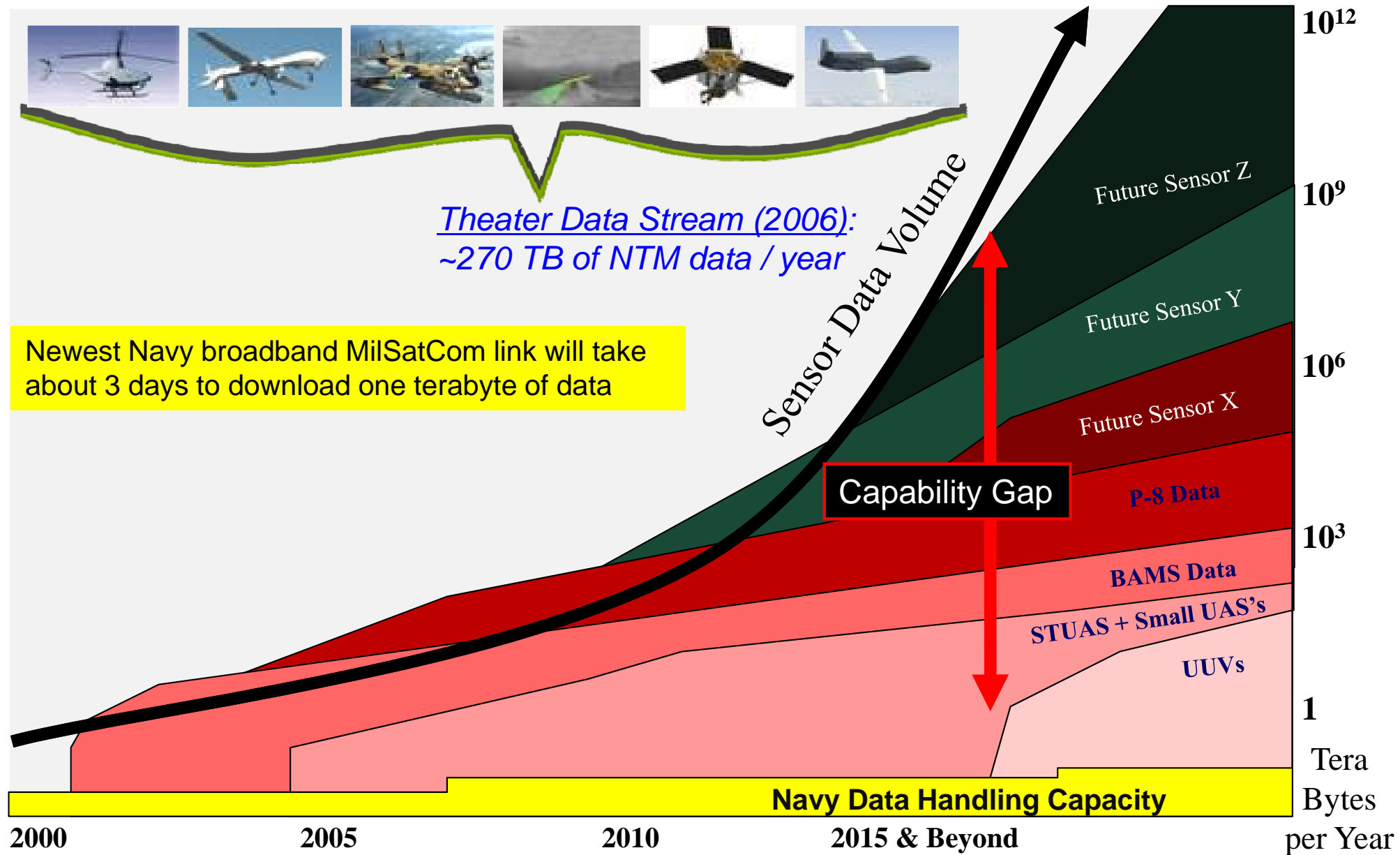**Technology Context is Coherent, Consistent and Inexorable**

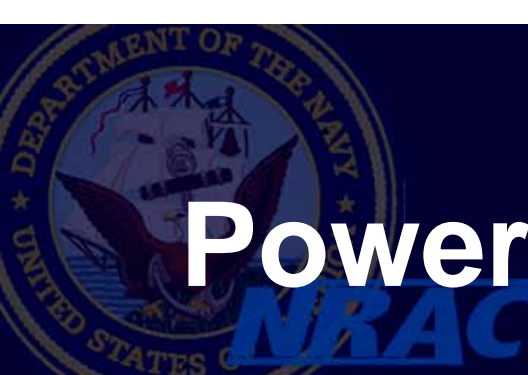# Desired Attributes of DoN Technology Portfolio Management

- Operationally motivated S&T investments
- Self-refreshing
- High quality
- Robust against disruptive innovation
- Informed by global technology landscape
- Vision consistent with resource & infrastructure requirements
- Agile adoption & differentiation of global innovation

Agile Adoption Will Become Increasingly Important

Mismatch Between Vision and Attendant Infrastructure

Theater Data Stream (2006): ~270 TB of NTM data / year

Newest Navy broadband MilSatCom link will take about 3 days to download one terabyte of data

Sensor Data Volume

Future Sensor Z

Future Sensor Y

Future Sensor X

P-8 Data

Capability Gap

BAMS Data

STUAS + Small UAS's

UUVs

Navy Data Handling Capacity

10^{12}

10^9

10^6

10^3

1

Tera Bytes per Year

2000   2005   2010   2015 & Beyond

Power of Agile Adoption

Market Capitalization: Microsoft vs. Apple 1997 to 2010
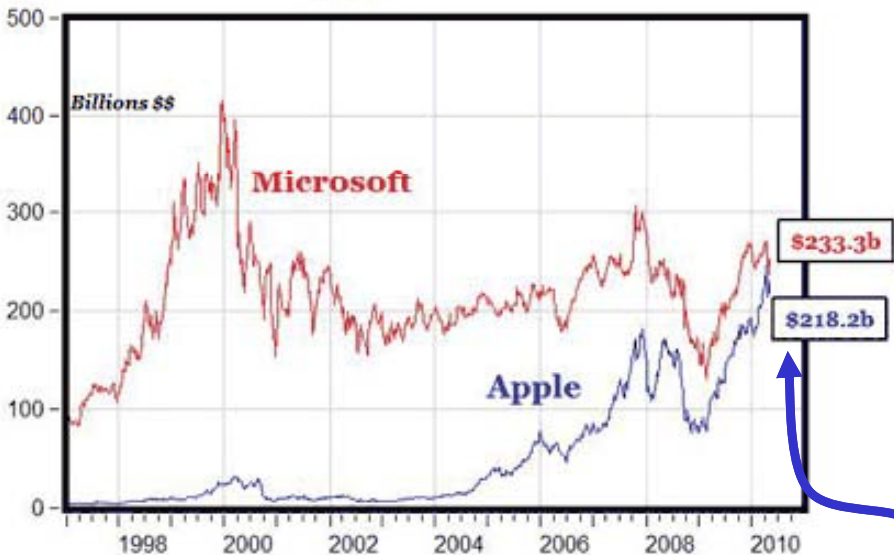
- Add Apple's "secret sauce"
- Apple invests @ ~3.5% sales

Achieved through "smart" investment!

Study Approach

	NAVSEA	NAVAIR	SPAWAR	MARCORSYSCOM	NRL	UARCs	Integration
Panel Chair	Young	Bowes	Fernandez	Fratarangelo	Bellingham	Harris	Sommerer
Vice Chair	Blatstein	Schiefer	Cantrell	Johnson-Winegar	Ramirez	Tozzi	Bowler
Panel	Brown	Castellaw	Langston	Andrews	Andrews	Firebaugh	Alving
Members	Firebaugh	Mykityshyn	Tozzi	Weber	Bowler	Schiefer	Subpanel Chairs
	Harris	Schmitt			Bruno		Selected Panelists
	Schiefer	Whelan			Carnes		
	Schmitt	Winston			Korris		
	Tozzi				Tennenhouse		

> *>600 Staff-days fact-finding*
> *>60 Site visits to:*
> *SYSCOMs & Warfare Centers*
> *NRL*
> *UARCs*
> *PEOs & PMs*
> *Industry*
> *Naval Leadership*

Bottom Line, Up Front (1)

- **Naval R&D Establishment (NRDE) comprises a cadre of dedicated public servants, including many experts in technical competencies needed now and in the future by the DoN**

- **SYSCOMS, supported by the NRDE, are providing essential in-service engineering to the Fleet**

- **NRDE offers significant leverage for the Department's pursuit of Acquisition Excellence ("Smart Buyer")**

but

- **DoN facing evermore technologically intensive and complex future**
  - o **Many critical skill areas are only one or two deep with experienced technologists**
  - o **New areas where the Navy has not been a leader**
  - o **Navy will need to be a leader to enable vision of Naval Leadership**

Future Technology Leadership Areas

- **Integrated C4ISR for combined manned/unmanned (mixed) systems**
- **Infrastructure required to support Information Dominance**
- **Electronic Warfare**
- **Counter Anti-access & Area Denial (A2/AD) and High End Asymmetric Threat (HE/AT)**

> **The uniqueness of the maritime physical and operational environment and the impending integration of unmanned vehicles into the battlespace require technical leadership in these areas**

Bottom Line, Up Front (2)

- **DoN faces this future with a seriously weakened technical workforce**
  - o **DoN must rebuild technical leadership in the uniformed Navy and emphasize quality in revitalizing the civilian R&D workforce**

- **There is a lack of coordination across the NRDE**
  - o **E.g., DoN must assign Technical Authority that cuts across SYSCOMs and platforms**

- **DoN must have a robust S&T program that allows it to effectively extract and differentiate technology from the global marketplace**

- **Navy-After-Next stewardship has been haphazard. DoN needs a champion with continuity of vision**

Bottom Line, Up Front (3)

- **ASN(RDA) is responsible for managing all Naval R&D investments and for supervising the Chief of Naval Research (SECNAVINST 5430.7Q)**

- **ASN(RDA) needs a full-time civilian (3 star-equivalent) delegate, *with long-term continuity of vision,***

  - **to provide stewardship for all BA1-3(4?) funds across the DoN to align investments that sustain critical Naval technology areas and that support future and ongoing acquisition programs**

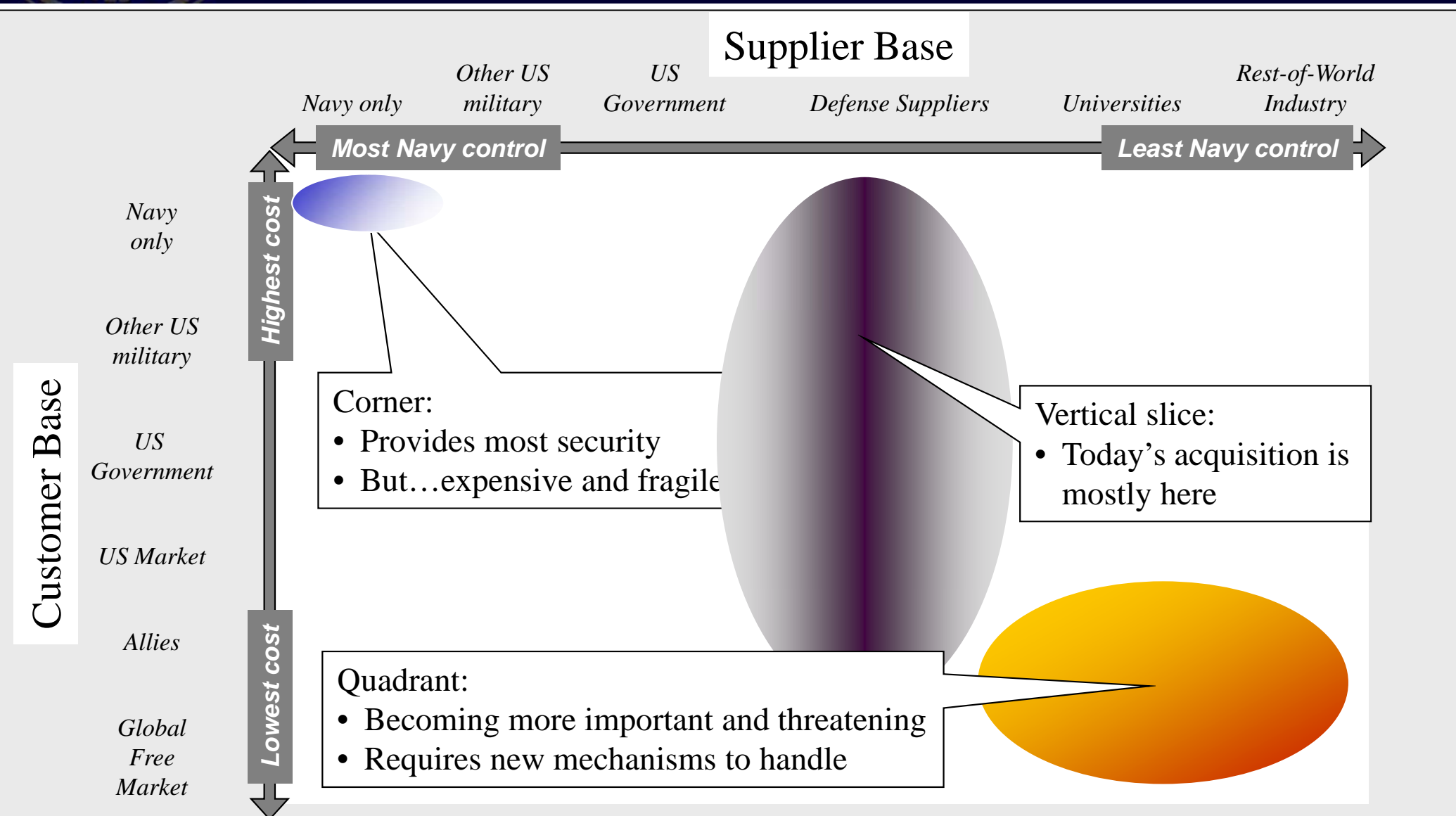 - **to provide essential stewardship for the NRDE**
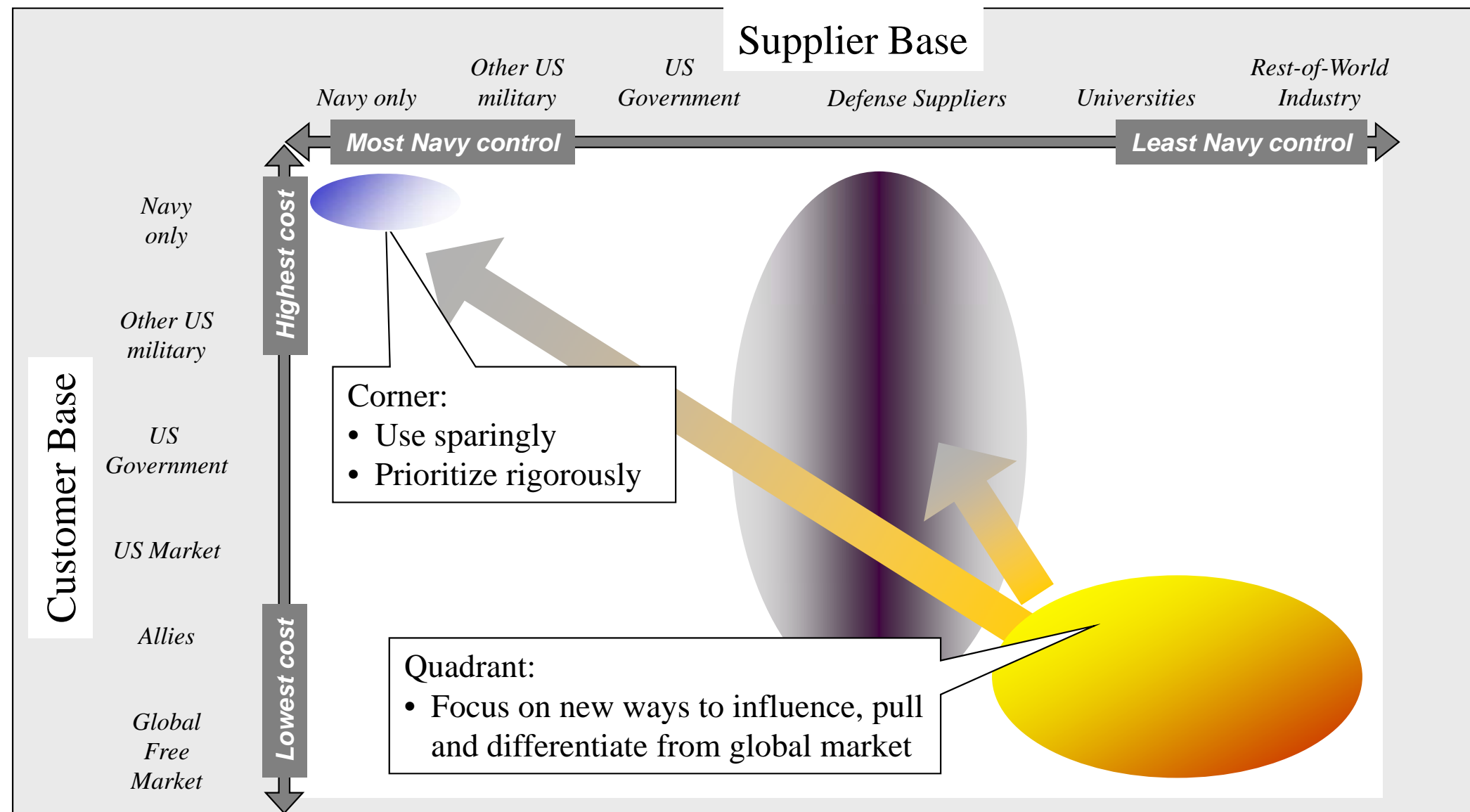
Assessment of NRDE Technical Capabilities

- NRAC WC Sub-panels have received technical capability self assessments from the Warfare Centers and informal feedback from a number of Navy SYSCOMs/PEOs/PMs and Defense Industry Representatives

- NRAC did not have the time nor the resources to do an independent, in-depth, comprehensive assessment of the Naval R&D Establishment

  o A true assessment of the quality of the technical capabilities in the Naval R&D Establishment would require an extensive internal and external evaluation of each technical capability (e.g. there are >133 TCs just in NAVSEA Warfare Centers)

  o NRAC did not assess technical capabilities residing within the SYSCOMs' headquarters program offices and PEOs

- Periodic assessment is nevertheless critical to understanding, building, and improving the Department's technical capabilities

Framework for Assessment
Customers and Suppliers

Supplier Base

	Navy only	Other US military	US Government	Defense Suppliers	Universities	Rest-of-World Industry

Most Navy control ← → *Least Navy control*

Customer Base (vertical axis, top to bottom):
- Navy only
- Other US military
- US Government
- US Market
- Allies
- Global Free Market

Highest cost → *Lowest cost*

Corner:
- Provides most security
- But…expensive and fragile

Vertical slice:
- Today's acquisition is mostly here

Quadrant:
- Becoming more important and threatening
- Requires new mechanisms to handle

Framework for Assessment
Implications

Supplier Base

| | Navy only | Other US military | US Government | Defense Suppliers | Universities | Rest-of-World Industry |

Most Navy control ← → *Least Navy control*

Customer Base

- Navy only
- Other US military
- US Government
- US Market
- Allies
- Global Free Market

Highest cost ↑ — *Lowest cost* ↓

Corner:
- Use sparingly
- Prioritize rigorously

Quadrant:
- Focus on new ways to influence, pull and differentiate from global market

Emerging Agile Adoption Areas

- **Mixed decision making systems (manned and agent-based).** NRDE must acquire the technical competency to shape, adopt, and adapt this capability for the Naval applications

- **Commercially-available Enterprise Information Systems.** NRDE must develop technical capability to participate in standards and tools development, especially for Naval unique needs

- **Managing software development.** NRDE must develop and implement a comprehensive strategy for revitalizing in-house software engineering competency

- **Power generation and energy storage.** NRDE must be aware of global advances in power generation/control as well as energy efficiency so they can be adapted for Naval-unique uses

- **Biology-based innovation.** NRDE needs sufficient expertise to monitor and exploit new and emerging areas of technology that are based on biological systems

Recommendations & Supporting Findings

- **Technical Competency**
- **Stewardship**
- **Navy-After-Next**
- **Best Business Practices**
- **SYSCOM-specific findings**

- **Summary of Actions**
- **Take-Aways**

Recommendations
Technical Competency

- **Sustain and enhance current NRDE technical competencies to support operational and acquisition needs**
  - Provide additional meaningful "hands on" work
  - Commit to NDAA 2009 Section 219 funding to the limit authorized by law to provide discretionary funding to be applied via disciplined process
  - Provide greater incentives for both military and civilians to achieve technical expertise
  - Allocate a greater number of technical SES and ST billets to the warfare centers
  - Increase number of military billets in the NRDE
  - Conduct periodic, independent assessment of the NRDE technical capabilities led at the ASN (RDA) level

Recommendations
Technical Competency

- **Widen the aperture of the Technical Community**
    - **Establish NRL as a place for development and experimentation of the methods to scout, shape and exploit global technology**
    - **Enhance tools and techniques to expand global technology awareness**
    - **Emphasize workforce mobility, agile adoption**
        - **Develop a pilot program to exchange personnel among industry, academia and the NRDE**
    - **Influence external research agendas & standards to narrow gaps, prepare WCs to close gaps and engage Navy**

Supporting Findings
Technical Competency

- The shortage of discretionary overhead funding for workforce development and innovation is a barrier to technical leadership
- Many critical technical competencies are only one or two deep
- Current prioritization of workforce competencies reflects PEO needs and near-term considerations
- Little evidence of building global technology awareness
- Technical Authority implementation is inconsistent across SYSCOMs
- Too few military are assigned to technical billets in warfare centers and systems commands and less operational exposure among civilian workforce
- Insufficient in-house hands-on work to build experience and maintain essential Navy technical competence

Supporting Findings
Technical Competency

- Perception is that program management offers greater promotion opportunity than technical achievement
- No effective process to exchange experienced technical personnel among industry, academia and NRDE
- Salaries not competitive at senior levels
- Recruiting environment is increasingly challenging
  - Gen-Y less attracted to "jobs for life"
  - Perception that quality and innovation of government work is declining
  - Increasing shortfall in U.S. citizen pool of technical talent

Recommendations
Stewardship

- **Strengthen ASN (RDA) stewardship of the NRDE**
  - **ASN(RDA) designate a *Director of Naval Research and Development Establishment (DNRDE)* responsible for aligning investments across the DON, under the direction of the ASN(RDA):**
    - **Represent the ASN (RDA) in supervising CNR investments of BA1–3(4?) across Navy & Marine Corps**
    - **Support the ASN(RDA) in prioritization issues across BA1–3(4?) investments among CNO, CMC, & CNR**
    - **Coordinate with OPNAV to ensure relevance of ONR investment to Navy-After-Next needs**
    - **Provide continuity in stewardship of NRDE**
- **Establish a Science Advisor to the CNO**
  - **Also serve as liaison to ASN (RDA)**

Recommendations (2)
Stewardship

- **Strengthen ASN (RDA) stewardship of the NRDE (2)**
  - Update/reinstate SECNAV Instructions for governance of NRDE (including NLCCG) and Technical Authority
  - Assign technical authority for systems that cut across SYSCOMs & platforms
  - Increase coordination of the R&D activities that support the Navy-After-Next
  - Establish a process to implement and integrate S&T strategy across the NRDE & SYSCOMs
  - Create a plan to increase the transition of NRL technology and capability into the Warfare Centers and industry

Supporting Findings
Stewardship

- S&T strategy and investment is not uniformly appreciated throughout OPNAV

- Enterprise-wide governance is inconsistent, requires updating, and lacks synergy
  - Stewardship of the Warfare Centers by the System Commands is not a high priority
  - Technical authority for systems that cut across platforms has not been defined or is fractionated
  - Inconsistent use of technical expertise in the acquisition process
  - Coordination of S&T resources and investments among the Warfare Centers is inadequate

- ONR & NRL do not share a common view of how they coordinate their S&T activity

Naval Technology Horizons

- Today's Navy: existing platforms and systems
  - Stewardship role is well defined
  - Technology focus is engineering (ISE)
- Next Navy: POR developmental platforms and systems
  - Stewardship role is well defined
  - Technology role is important – needs "seat at table"

Stewardship:
- Leadership
- Accountability
- Navy-wide view
- Funding
- Facilities
- Execution oversight

Major focus today

- Navy-After-Next: pre-POR capabilities
  - Stewardship role has been undefined, putting execution at risk
    - CNO-00X and CNR roles have been unclear
    - Other elements are missing (CONOPS, experimentation/trials, doctrine…)
  - Technology role provides foundation for developing new capabilities

Limited attention

Recommendations
Navy-After-Next

- Establish an office of primary responsibility for the management of the necessary competition of ideas attendant to the confluence of concepts with S&T for the Navy-After-Next
  - Empower that office to create and implement a process that incubates and assesses promising concepts across DoN. (Further refine the implementation of OPNAVINST 5401.9)
    - Assign to CNO-N00X
  - Ensure NRDE active participation in concept generation and Concept Development Teams
  - Identify and, where appropriate, champion concepts from other agencies (e.g. DARPA)

Supporting Findings
Navy-After-Next

Stewardship of Navy-After-Next has been haphazard, especially with respect to the engagement of the S&T community

- OPNAVINST 5401.9 is a good starting point for concept development, but does not fully address S&T engagement needs of Navy-After-Next

- Effective stewardship is essential, given global technology context <u>and</u> that Navy-After-Next is point at which U.S. Naval dominance may be challenged

- Current FNC process severely curtails BA 6.3 spending on Navy-After-Next concepts for which there is no Program of Record

- Deep NRDE engagement in both concept generation and in concept development for Navy-After-Next is lacking

- There is no organized process to provide a "landing zone" for innovative S&T-based concepts pioneered by DARPA and/or other agencies

- Long-term guidance on future technical leadership and competency areas is not being provided to the Warfare Centers

Recommendations
Best Business Practices

- **Accelerate physical infrastructure modernization or recapitalization**

- **Consolidate Human Resources, MILCON, and maintenance responsibilities for NRL and warfare centers under a single Regional Commander for MILCON & maintenance, and a single Regional HR Office for HR**
  - **Both must be attuned to needs of technical organizations**

- **Streamline the hiring process for technical personnel and restore local hiring authority**

Supporting Findings
Best Business Practices

- **General physical infrastructure and working conditions do not meet the needs of the quality science/technology work**
- **Some regionalized facilities and HR management offices are not responsive to the special needs of warfare centers and NRL**
  - **Recruiting and hiring qualified people takes too long**
  - **DoN Installation "Regionalization" Support to NRDE is inconsistent**

Recommendations
Technical Leadership and Agile Adoption

- **The DoN must sustain, enhance current NRDE technical competence required to support operational and acquisition needs**
- **R&D is needed in future areas where the DoN will need to exercise technical leadership and where it will be a successful agile adopter**
  - **Internal technical capability to define and help solve Navy-unique problems**
  - **"hands on" expertise to allow Navy representation in shaping and harvesting external innovation**
  - **ONR/NRL/Warfare Centers/UARCs are all involved**

NAVSEA WCs	• WC indirect funds viewed as bill payer, resulting in reduced investment in WC advanced technical equipment and innovation • Capability, competency and skills in offensive mine warfare and energetics are decaying due to lack of sustaining developing work
NAVAIR WCs	• All warfare center personnel are organizationally integrated into the systems command • High turnover of technical personnel assigned to programs
SPAWAR WCs	• Although SPAWAR has specific TA responsibilities, Navy-wide C4ISR TA is not well-defined, disciplined or consistently practiced • Customer opinions regarding warfare center technical competencies highly variable
NRL	• Base funding is primary investment in Naval in-house fundamental research and is critical to sustaining technical competency • Base funding is not fully coordinated with ONR's external research investments
UARCs	• Ingrained culture of independence. Ability to hire technical staff at commercially competitive salaries and benefits ensures quality technical workforce. Ability to capitalize (and amortize) at own discretion results in adequate facilities • Navy funding declining as a percentage of total UARC funding

Technical Support & Overlap in the NRDE
- Issue of "overlap" is exaggerated
- Evaluation of technical support requires in-depth understanding
- Real risk: critical technical capabilities lacking stewardship could be lost

Summary of Actions

CNO
- **Establish a process to coordinate concepts and technology for Navy-After-Next**

- **Establish a Science Advisor to the CNO**

ASN (MRA)
- **Consolidate HR responsibilities**

ASN (EIE)
- **Consolidate MILCON and maintenance responsibilities**

Summary of Actions

ASN (RDA)

- Designate *Director of Naval Research & Development Establishment*
- Ensure SYSCOMs are investing in Navy technology leadership areas
- Ensure future needs are reflected in BA1-BA3 investments
- Commit to maximum NDAA 2009 Section 219 funding
- Update/reinstate SECNAV Instructions
- Conduct biennial assessment of the NRDE technical capabilities
- Allocate a greater number of technical SES and ST billets to WCs
- Accelerate physical infrastructure modernization or recapitalization

CNR

- Enhance tools and techniques to expand global technology awareness

Take-Aways

- The DoN has a seriously weakened technical workforce

- In the future, increased emphasis will be on adapting global technologies to Naval application

- Closer coordination between the operational and technical communities is essential for the Navy-After-Next

- More effective coordination required among OPNAV, ASN (RDA), CNR, SYSCOMs, WCs, NRL and UARCs

- Need a champion with experience and continuity of vision to shape the technological future of the DoN