NAVAL RESEARCH ADVISORY COMMITTEE

Science and Technology for Naval Warfare, 2015--2020

Mark Lister
Chairman, NRAC

NDIA Disruptive Technologies Conference
September 4, 2007

Excerpted from the Final Briefing

Outline

Terms of Reference
Panel Membership
Briefings & Discussions

Global S&T Trends
Military Implications
U.S. Navy-Marine Corps in 2020
Threats to U.S. Forces

Mission+Threats+Technologies Matrix
Counter-Threat Technologies Investments
Mission-Enabling Technologies Investments
Overarching Issues Requirements

Conclusion
Recommendations

Global S&T Trends/1

- Continued asymmetric opposition to U.S. interests
  - Non-state actors
  - Nation states
  - Military actions
  - Against U.S. critical infrastructure
  - Against U.S. civilian population
- <mark>Continued dilution of U.S. S&T base</mark>
  - Foreign students outnumber Americans in advanced engineering and science curricula
  - Technical education losing to business, arts
  - Government laboratory positions less attractive
  - Foreign investment in technical education accelerating

Global S&T Trends/2

- Globalization eroding U.S. technical dominance
- Impending oil availability crisis
  - U.S. dependence on Middle East oil
  - Near-term Chinese demand for oil
  - Mid-term EU, Indian demand for oil
  - Changing situation in Venezuela
- Increasing U.S. dependence on foreign technology
- Worldwide access to advanced technology through foreign and U.S. sales and espionage
- Technological surprise is **probable!**

Military Implications of the World of 2020 for S&T /1

This study makes no attempt to define the future or to draw possible scenarios for what the world will look like in 2015-2020. However, certain trends are obvious:

- Nuclear, chemical, bio weapons continue to proliferate
- Terrorism continues
- Increasing violence and political influence by non-state actors
- Proliferation of primitive (but effective) as well as modern weapons/systems
  - Improvised explosive devices
  - Man-portable air-defense missiles
  - Sea mines
  - Surface-to-surface missiles

Military Implications of the World of 2020 for S&T/2

- Growing foreign economic power and changing politics
  - Rapidly changing demographics
  - Major emphasis on advanced S&T education
  - Advanced weapon development and sales
- Development of significant regional military powers
  - Blue water navies: China, India
  - Regional navies: Iran

Navy-Marine Corps Missions in 2020

Many missions are similar to the Cold War era

BUT with significantly different emphasis

↑ Provide seaborne missile defense

↑ Provide seaborne support for operations against terrorism (including homeland defense)

↑ Protect U.S.-Allied maritime areas of interest (inc. SLOCs)

↑ Project military power (presence/rescue/peacekeeping/ strike/assault)

→ Threaten military forces of potential enemies (especially their WMD capabilities)

↓ Deter nuclear attacks (Trident SSBNs)

Threats Impacting
Navy-Marine Corps Missions/1

- Increased availability of long-range weapons against naval-maritime formations
  - Ballistic missiles with terminal guidance
  - High-speed, sea-skimming cruise missiles
  - EM Guns
- Proliferation of nuclear, chemical, biological weapons
- Proliferation of inexpensive delivery systems and weapons, including
  - Air (UAVs, mini-UAVs)
  - Surface (USVs)
  - Underwater (UUVs, mines, mini-submarines, SDVs)
  - Land mines, IEDs, and other low-tech systems
  - MANPADS, laser devices, and other high-tech systems

Threats Impacting
Navy-Marine Corps Missions/2

- Proliferation of advanced submarine technologies *and concepts of operation*
  - Propulsion
  - Sensors
  - Stealth
  - Weapons
- Proliferation of capabilities for sophisticated information warfare
- Increase in vulnerabilities of U.S. logistics
  - Pipeline
  - Overseas procurement of goods and services

Threats Impacting
Navy-Marine Corps Missions/3

- Near-continuous surveillance of U.S. land and sea forces by opposing military and commercial satellites, "cheap" UAVs, and other means
- "Network centricity" creates vulnerabilities for U.S. forces
    - Interruption/jamming
    - Effective EMCON impossible
    - Information overload
    - Over-dependence on reachback
- Loss of low-observable effectiveness
- Reliance on GPS makes it a major target

Technology Traceability to Navy Marine-Corps Missions

Missions

- Provide Seaborne Missile Defense
- Provide Seaborne Support for GWOT
- Protect Maritime Areas of Interest
- Project Military Power
- Threaten Adversary Military Forces
- Deter Nuclear Attacks

Threats Impacting Missions

Missions	Advanced Submarines	Continuous Surveillance by Potential Adversaries	GPS as Common Point of Vulnerability	Inexpensive Delivery Systems	Information Warfare Proliferation	Logistics Pipeline Vulnerability	Loss of Low Observable Effectiveness	LR Delivery Systems	Net-centricity Vulnerability	WMD Proliferation
Provide Seaborne Missile Defense	●	●	●	●	●			●	●	
Provide Seaborne Support for GWOT		●			●				●	●
Protect Maritime Areas of Interest	●	●		●	●	●	●	●	●	●
Project Military Power	●	●	●	●	●	●	●	●	●	●
Threaten Adversary Military Forces	●	●	●	●	●		●	●	●	●
Deter Nuclear Attacks		●								

Threats Impacting Missions

		Advanced Submarines	Continuous Surveillance by Potential Adversaries	GPS as Common Point of Vulnerability	Inexpensive Delivery Systems	Information Warfare Proliferation	Logistics Pipeline Vulnerability	Loss of Low Observable Effectiveness	LR Delivery Systems	Net-centricity Vulnerability	WMD Proliferation
Missions	Provide Seaborne Missile Defense	•	•	•	•	•			•	•	
	Provide Seaborne Support for GWOT		•		•					•	•
	Protect Maritime Areas of Interest	•	•		•	•	•	•	•	•	•
	Project Military Power	•	•	•	•	•	•	•	•	•	•
	Threaten Adversary Military Forces	•	•	•	•	•		•	•	•	•
	Deter Nuclear Attacks		•								
Counter-Threat Technologies	Active Acoustic Systems	•				•					
	Discrimination & Clutter Rejection	•				•				•	
	False Target Generation & Deception		•					•		•	
	Foreign S&T Awareness	•	•	•	•	•			•	•	•
	Formal Methods for VVA							•			
	GPS Alternative			•							
	GPS Deep-Fade Technology			•							
	Information Assurance					•				•	
	Overseas Supply Chain Surety						•				

Technology Traceability to Mission-Enabling Technologies

Threats Impacting Missions

	Advanced Submarines	Continuous Surveillance by Potential Adversaries	GPS as Common Point of Vulnerability	Inexpensive Delivery Systems	Information Warfare	Proliferation	Logistics Pipeline Vulnerability	Loss of Low Observable Effectiveness	LR Delivery Systems	Net-centricity Vulnerability	WMD Proliferation
Missions											
Provide Seaborne Missile Defense	●	●	●	●	●				●	●	
Provide Seaborne Support for GWOT		●		●						●	●
Protect Maritime Areas of Interest	●	●		●			●	●	●	●	●
Project Military Power	●	●	●	●		●		●	●	●	●
Threaten Adversary Military Forces	●	●	●	●				●	●	●	●
Deter Nuclear Attacks		●									
Counter-Threat Technologies											
Active Acoustic Systems	●			●							
Discrimination & Clutter Rejection	●			●						●	
False Target Generation & Deception		●							●	●	
Foreign S&T Awareness	●	●	●	●	●				●	●	●
Formal Methods for VVA					●						
GPS Alternative			●								
GPS Deep-Fade Technology			●								
Information Assurance					●					●	
Overseas Supply Chain Surety							●				

Mission-Enabling Technologies

	Advanced AAW	Antenna Technology	Coordinated, Multimode ASW	Effective C2 in EMCON	Environmental Sciences	Lower-Cost Platforms	Offensive Mine Warfare	Pattern Recognition & Anomaly Detection	Robust Offensive Information Warfare	Upstream Information Fusion
Provide Seaborne Missile Defense	●	●	●	●	●					●
Provide Seaborne Support for GWOT	●		●					●		●
Protect Maritime Areas of Interest	●		●	●	●	●		●		●
Project Military Power	●	●	●	●		●	●	●		●
Threaten Adversary Military Forces	●	●	●	●		●	●		●	●
Deter Nuclear Attacks		●	●		●					

Technology Traceability to Missions and Threats

Threats Impacting Missions

Missions	Advanced Submarines	Continuous Surveillance by Potential Adversaries	GPS as Common Point of Vulnerability	Inexpensive Delivery Systems	Information Warfare	Proliferation	Logistics Pipeline Vulnerability	Loss of Low Observable Effectiveness	LR Delivery Systems	Net-centricity Vulnerability	WMD Proliferation
Provide Seaborne Missile Defense	●	●	●	●	●				●	●	
Provide Seaborne Support for GWOT		●								●	●
Protect Maritime Areas of Interest	●	●	●	●	●		●	●	●	●	●
Project Military Power	●	●	●	●	●	●		●	●	●	●
Threaten Adversary Military Forces	●	●	●	●	●			●	●	●	
Deter Nuclear Attacks		●									

Mission-Enabling Technologies

Missions	Advanced AAW	Antenna Technology	Coordinated, Multimode ASW	Effective C2 in EMCON	Environmental Sciences	Lower-Cost Platforms	Offensive Mine Warfare	Pattern Recognition & Anomaly Detection	Robust Offensive Information Warfare	Upstream Information Fusion
Provide Seaborne Missile Defense	●	●		●	●		●			●
Provide Seaborne Support for GWOT	●	●		●	●	●		●		●
Protect Maritime Areas of Interest	●	●	●	●	●	●	●	●		●
Project Military Power	●	●	●	●	●	●	●	●	●	●
Threaten Adversary Military Forces	●	●	●	●	●	●	●	●	●	●
Deter Nuclear Attacks		●	●		●					

Counter-Threat Technologies

Counter-Threat Technologies	Advanced Submarines	Continuous Surveillance by Potential Adversaries	GPS as Common Point of Vulnerability	Inexpensive Delivery Systems	Information Warfare	Proliferation	Logistics Pipeline Vulnerability	Loss of Low Observable Effectiveness	LR Delivery Systems	Net-centricity Vulnerability	WMD Proliferation
Active Acoustic Systems	●			●							
Discrimination & Clutter Rejection	●			●						●	
False Target Generation & Deception		●							●	●	
Foreign S&T Awareness	●	●		●	●				●	●	●
Formal Methods for VVA					●						
GPS Alternative			●								
GPS Deep-Fade Technology			●								
Information Assurance					●					●	
Overseas Supply Chain Surety							●				

Overarching Issues

- Formal mechanism for assessing U.S. vulnerabilities
- Fundamental understanding of COTS
- Long-term program to develop S&T workforce
- Improved coordination of R&D programs
- Requirements-linked, long-range planning process for S&T investment strategy
- Long-range S&T review

Findings/1
Counter-Threat Technologies Investments

- Tactical/Operational
  - Active acoustic systems
  - Discrimination and clutter rejection
  - False target generation for deception
  - GPS deep-fade technology
  - GPS alternative

- Logistics
  - Security for overseas supply chain

- Capabilities/Systems Development
  - Foreign S&T awareness
  - Formal, automated methods for Verification, Validation, and Accreditation
  - Information assurance

Mission-Enabling Technologies Investments

- Tactical/Operational
  - Advanced AAW
  - Coordinated, multimode ASW
  - Effective C^2 in EMCON
  - Offensive mine warfare
  - Pattern recognition and anomaly detection
  - Robust offensive information warfare
  - Upstream information fusion

- Capabilities/Systems development
  - Antenna technology
  - Environmental sciences (specific areas)
  - Low-cost platforms technologies

Findings/3
Overarching Issues Requirements

- Formal mechanism for assessing U.S. vulnerabilities
- Fundamental understanding of COTS
  - Business models
  - Technology drivers
  - Standards
  - Internal structure, functionality, vulnerabilities
- Long-term program to develop S&T workforce
- Improved coordination of R&D programs
- Requirements-linked, long-range planning process for S&T investment strategy
- NRAC long-range S&T review should be a continuing responsibility

Conclusion/1

The **bottom line** is that

While the Navy has a productive S&T program today….

The rapidly changing threat and the rate of world technological development demands change in the Navy-Marine Corps investment strategy for S&T over the next 15 years to insure that the naval services can continue to effectively carry out their missions.

Conclusion/2

Failure to change the investment strategy for Navy-Marine Corps S&T will make <mark>technological surprise on the battlefield **likely**</mark>…and success in executing naval missions will be **problematic.**

Recommendations

- **Develop Long-Term S&T Planning Process**

- **Develop Long-Term S&T Workforce Plan**

- **Accelerate Lower-Cost Platform Technologies**

- **Assess and Mitigate Long-Term COTS Vulnerabilities**

"Disruptive Application" Observations

- Christensen: Disruptive Technology to Disruptive Innovation
- Time to migrate to "Disruptive Applications"
  - Not necessarily based on Disruptive Technology
  - Inexpensive, easily accessible, unanticipated asymmetric capabilities
- Know thy enemy
  - Today's and tomorrow's
  - Culturally, mentally, emotionally, technologically
- We have a Disruptive Technologies Office…do we need a Disruptive Applications Office?
  - Proactive vs. reactive