Naval S&T Overview

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Office of Naval Research
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Global R&D Trends

Growth in Global S&T Investment

* UIS S&T database; World Bank - PPP
** OECD 2010 PPP; 2010 Global R&D Report (Battelle)
R&D Investment Trends

Source: National Science Foundation, Division of Science Resource Statistics, Science and Engineering Indicators 2010

Percent

RDT&E 6.1 – 6.7

Then Year $ Billions

DON PBR
RDT&E,N

DON PBR S&T
88 Years of Naval Research
Looking Back .......

Naval S&T Milestones
ACCOMPLISHMENTS ACROSS ALL DOMAINS

- NTS-2 Satellite in NAVSTAR GPS
- Nobel Prize to ONR Scientists for Graphene
- Tactical Microsatellite
- Large Displacement Unmanned Underwater Vehicle
- First Operational Global Ocean Model
- CBR Sensors for Fleet Security
- World Record Setting 33 NM LRMRG Shot
- Anti-Torpedo Torpedo
- Remote Environment Monitoring Units
- 2010 & Beyond

- 1920s
- 1930s
- 1940s
- 1950s
- 1960s
- 1970s
- 1980s
- 1990s
- 2000s

- ENR Commissioned
- First U.S. Radar Patents
- Sound Navigation and Ranging (SONAR)
- Golf-Cage Radiographs
- Principles of Modern Fracture Mechanics
- Synthesis of Organic Molecules
- Unmanned Aerial Vehicle
- FirstまいRadar Indicator
- Plan-Position Indicator
- Synchrotron Radiation Facility
- First Far-Ultraviolet Spectrum of the Sun
- Vanguard I Launched
- Aqueous Flow Forming Forges (AFFT)
- First U.S. Intelligence Satellite
- Far Ultraviolet Lunar Camera
- GAMMA Ray Burst Monitor
- Sounding and II
- Lithium Batteries
- Contributed to Aegis Combat System
- Ultra-high Strength Steel
- 34500 Combat Gauges
- 34500 Combat Gauges
- Remote Environment Monitoring Units
- 2010 & Beyond
..... And Looking Ahead

- Power & Energy
- Directed Energy & Hypersonics
- Information Dominance
- Autonomous Systems
- Total Ownership Cost Reduction
- Naval Warfighter Performance
Power & Energy

1. Sail a “Green Strike Group” by 2016
2. 50% of Navy energy from alternative sources by 2020,

- Fuels
- Power Generation
- Energy Storage
- Efficient Distribution
- Energy Usage
Directed Energy & Hypersonics

- Fight at Hypervelocity & Speed of Light
- Deepen the Magazines
- Increase Depth of Fire
- Broad Range of Missions
Dominating the Electromagnetic Spectrum

Integrated Topside Innovative Naval Prototype Program (INTOP)

Integrated Distributed EW

Wide-Area MOSA CM Technologies
• Changes everything
  – Tactics to strategy
• Hybrid force with manned systems
• Power & Energy implications
• Mission CONOPS development
Total Ownership Cost

Design
- 10%

Acquisition
- 20-30%

Operations & Support
- 60-70%

Modernization

Disposal

- 45 MW Axial Flow Waterjet Desalination System
- Buried Mine Sensor for Detection, Classification and ID of Buried Sea Mines
- Advanced Area Defense Interceptor
- Adaptive Training for CIC Teams
- Naval Interceptor Improvements
- Long Range LFBB sonar (AUV Platform option)
- Anti-Torpedo Torpedo for Surface Ship Defense
- VSW Acoustic Color/Imaging Sonar
- Next Gen Countermeasures for Ship Missile Defense
- Affordable Common Radar Architecture
- ES Detection of LPI Radar
- Low Cost Swimmer Detection
Naval Warfighter Performance

Human Systems Integration
- Manpower & Personnel Management
- Training & Digital Tutors
- User-Centered Design
- C2 Decision Support
- Human, Social, Cultural Sciences
- Safety / Hearing

Bio-Engineered Systems
- Marine Mammal Health
- Bio-Sensors / Materials
- Microbial Fuel Cells
- Bio Robotics
- Human-Autonomy Systems

Undersea & Expeditionary Medicine
- Undersea Medicine (NNR)
- Point of Injury Care
  - “Lighten the Load”
  - Treat hemorrhagic shock
- Automated Medical Care
  - CASEVAC / Patient Movement
Naval S&T Strategic Plan

Focus Areas
- Power and Energy
- Operational Environments
- Maritime Domain Awareness
- Asymmetric & Irregular Warfare
- Information Superiority and Communication
- Power Projection
- Assure Access and Hold at Risk
- Distributed Operations
- Naval Warfighter Performance
- Survivability and Self-Defense
- Platform Mobility
- Fleet/Force Sustainment
- Total Ownership Cost
How We Execute

- 70 Countries
- 50 States
- 1,078 Companies
  - 859 small businesses
- 1,035 Universities & Nonprofit Entities
  - 3,340 principal investigators
  - 3,000 grad students
**Investment Balance**

6.1: Basic Research

- Naval Labs and Centers: 31%
- University & Nonprofit: 62%
- Industry: 7%

6.2: Applied Research

- Naval Labs and Centers: 30%
- University & Nonprofit: 23%
- Industry: 47%

6.3: Advanced Tech Development

- Naval Labs and Centers: 21%
- University & Nonprofit: 14%
- Industry: 65%
First university degrees in natural sciences and engineering, selected countries

China
US
Japan
S Korea
UK

Non-Minority Women
Minority Men
Minority Women
Non-Minority Men

High School Graduates
Total: 3,115,220

First-time Freshmen
Total: 1,903,400

First-time Freshman Interested in S&E
Total: 928,000

S&E Bachelor’s Awarded
Total: 455,441

MS Natural Science & Engineering
Total: 43,104

PhD Natural Science & Engineering
Total: 11,189

PhD Engineering
Total: 2,380

BS Natural Science & Engineering
Total: 225,660

www.STEM2Stern.org
“I never, ever, want to see a Sailor or a Marine in a fair fight!

-Adm. Gary Roughead
Chief of Naval Operations
We Want To Hear From You!

- **ONR Website:**
  [www.onr.navy.mil](http://www.onr.navy.mil)

- **ONR Central Phone Number:**
  703-696-5031
Back-up
Transitions

Successfully delivered 83% of the FNCs to Acquisition

<table>
<thead>
<tr>
<th>FNC Delivery Year</th>
<th>Products Planned to Deliver</th>
<th>Products Delivered to Acquisition</th>
<th>Deployed</th>
<th>On-Track for Deployment</th>
<th>Still With Acquisition Program</th>
<th>Did Not Transition</th>
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</thead>
<tbody>
<tr>
<td>FY10</td>
<td>19</td>
<td>15</td>
<td>1</td>
<td>7</td>
<td>5</td>
<td>2 (13%)</td>
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<tr>
<td>FY09</td>
<td>35</td>
<td>32</td>
<td>2</td>
<td>12</td>
<td>11</td>
<td>7 (22%)</td>
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<tr>
<td>FY08</td>
<td>47</td>
<td>35</td>
<td>8</td>
<td>12</td>
<td>3</td>
<td>12 (34%)</td>
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<tr>
<td>FY07</td>
<td>32</td>
<td>26</td>
<td>7</td>
<td>8</td>
<td>1</td>
<td>10 (38%)</td>
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<tr>
<td>FY06</td>
<td>34</td>
<td>30</td>
<td>7</td>
<td>4</td>
<td>2</td>
<td>17 (57%)</td>
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<tr>
<td>Total</td>
<td>167</td>
<td>138</td>
<td>25</td>
<td>43</td>
<td>22</td>
<td>48 (35%)</td>
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</tbody>
</table>

Forensics

- Did Not Transition
- Still With Acquisition Program
- Deployed or On-Track for Deployment

PMO Lost Interest
- Technology Lost in Acquisition Competition: 22.9%
- Technology did not meet TTA Requirements: 27.1%
- Requirements Changed or not Adequately Specified: 16.7%
- Acquisition Strategy Significantly Modified: 20.8%
ONR Global

- Develop partnerships
- Leverage global S&T advances
- Avoid technology surprise
A Great Place to Work

• #1 “Best Place to Work” in the Navy
  ▪ Partnership for Public Service

• “Most Admired Employer”
  ▪ Black Engineer magazine
  ▪ Hispanic Engineer magazine
  ▪ Women of Color magazine

• #1 Patent Portfolio worldwide among government agencies from IEEE Patent Power Scorecard
  ▪ 232 patents in 2009

• Popular Science Magazine’s 2010 Best of What’s New Winner
  ▪ NEAH Power Systems’ Infinity Fuel Cells

• TIME Magazine’s “Best Inventions of the Year”
  ▪ 2009: Microbial Fuel Cell
  ▪ 2008: NEXI, MEMRISTOR
Naval Research Laboratory (Appropriations Act, 1916)
“[Conduct] exploratory and research work…necessary …for the benefit of Government service, including the construction, equipment, and operation of a laboratory….”

Office of Naval Research (Public Law 588, 1946)
“…plan, foster, and encourage scientific research in recognition of its paramount importance as related to the maintenance of future of naval power, and the preservation of national security…”

Transitioning S&T (Defense Authorization Act, 2001)
“…manage the Navy’s basic, applied, and advanced research to foster transition from science and technology to higher levels of research, development, test, and evaluation.”
Uncertain Future

- New development/Undiscovered technologies (disruptive)
- New development/Known technologies
- Spiral developments/Incremental improvements
- Evolved current systems
- Predicted Future Threats
- Unanticipated Futures

Complexity...Uncertainty...Warfighting Capability

Existing Systems & CONOPS

Time
Uncertain Future

- Discovery & Invention (Basic and Applied Research)
- Predicted Future Threats
- Leap Ahead Innovations (Innovative Naval Prototypes)
- Acquisition Enablers (FNCs, etc.)

- Existing Systems & CONOPS
- Quick Reaction & Other S&T

Complexity...Uncertainty...Warfighting Capability

Time
Quick Reaction S&T
(1-2 Year) Off-The-Shelf Technologies

- Rapid solutions to problems identified by deckplate Sailors and Marines
- 1 year turnaround time
- Video: www.youtube.com/usnavyresearch
- Requests submitted online
  www.onr.navy.mil/techsolutions
Future Naval Capabilities

(3-5 Year) Component Technologies

Secure Networks
<table>
<thead>
<tr>
<th>Program</th>
<th>Lead Agency</th>
<th>TOG Working Group</th>
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<tbody>
<tr>
<td>Sea Shield</td>
<td>MCCDC</td>
<td>0-6/GS-15 reps</td>
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<tr>
<td>Sea Basing</td>
<td>USFF N804</td>
<td></td>
</tr>
<tr>
<td>Sea Strike</td>
<td>USFF N8</td>
<td></td>
</tr>
<tr>
<td>Naval Expeditionary</td>
<td>HQMC PP&amp;O</td>
<td></td>
</tr>
<tr>
<td>Maneuver Warfare</td>
<td>USFF N8</td>
<td></td>
</tr>
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**Technology Oversight Group (TOG) Structure**

**S&T Corporate Board**
- VCNO
- ASN (RDA)
- ACMC
- CNR-Executive Secretary

**Lead Agencies**
- FORCENet
- Power & Energy
- Enterprise & Platform Enablers
- Force Health Protection
- Capable Manpower

**FORCENet**
- N6F
- Dir HQMC C4
- NETWARCOM
- SPAWAR 05
- ONR 31

**Power & Energy**
- N45
- USMC HQ
- USFF N8
- NAVSEA 05
- ONR 03T

**Enterprise & Platform Enablers**
- N8F
- HQMC I&L
- USFF N433
- NAVSEA 05
- ONR 03T

**Force Health Protection**
- N0931
- TMO, USMC
- FFC N02H
- NMSC
- ONR 34

**Capable Manpower**
- N15
- USMC Training/Ed
- USFF N1D
- NAVAIR TSD
- ONR 34
Persistent Littoral Undersea Surveillance

- High Risk / High Payoff
- Innovative and game-changing
- Approved by Corporate Board
- Delivers prototype

Innovative Naval Prototypes
(5-10 Year) Disruptive Technologies

- Tactical Satellite
- EM Railgun
- Persistent Littoral Undersea Surveillance
- Sea Base Enablers
- Free Electron Laser
- Integrated Topside
- Large Displacement UUV
- AACUS
Basic Research
(1-25 Year) Undiscovered & Emerging Technologies

- Diverse portfolio
- Fosters innovation
- Long-term
- Investment in people
  * 56 Nobel laureates

- GPS
- Arctic Research
- Weather Modeling
- Laser Cooling
- Semiconductors: GaAs, GaN, SiC
- Spintronics
The Challenge: “Speed to Fleet”

“I never, ever, want to see a Sailor or a Marine in a fair fight! ... We have to get technology to the Fleet faster.”

- Adm. Gary Roughead, Chief of Naval Operations