A Personal Perspective on the IT R&D Ecosystem

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Deputy Under Secretary of Defense (Science & Technology)
November 2, 2006
Questions to Consider

• What are your agency’s investment philosophy, strategy, and interests for IT research?

• From your perspective, what is the state of the IT R&D ecosystem? Has this changed or do you see it changing?

• What aspects of the ecosystem do you think are working well and where are you looking to make improvements?

• What do you think could be done to maintain/improve the health and vitality of the ecosystem? Who can do this? Who should do this?

• What studies and data, including funding data, do you think the Committee should take into account (please provide these or provide links).
Backdrop of DoD S&T

• All DoD research agencies focus on DoD missions.
• Military Service research agencies focus on Service-unique science and technology.
• As a “generic” science/technology, Computer Science/IT is often seen as being the responsibility of others.
• Some novel computing research (e.g., quantum, bio, molecular) primarily takes place outside conventional Computer Science bookkeeping lanes.
• DoD research agencies face intense pressure to demonstrate impact in on-going military operations.
Capabilities for a Joint and Expeditionary Army

Current Force

- Advanced Armor
- LtWt 120mm Gun
- Micro Air Vehicle (Backpacked)
- ~100 lb. load
- 70+ tons
- < 10 mph

Future Force

- < 40 lb. load
- Fully networked
- < 30 tons
- > 40 mph

Enabling the Future Force

Science and Technology—develop and mature technology to enable transformational capabilities for the Future Modular Force while seeking opportunities to accelerate technology directly into the Current Modular Force.
AF Technology Vision

Anticipate, Find, Fix, Track, Target, Engage, Assess – Anything, Anytime, Anywhere

Integrity - Service - Excellence
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<tr>
<th>Naval Focus Area</th>
<th>Naval Warfighting or Support Functions</th>
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<tbody>
<tr>
<td>Maritime Domain Awareness</td>
<td>ISR, CBRNE (IED, WMD Detection), port/base security, swimmer detection, MW and ASW (Surveillance part),</td>
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<tr>
<td>Operational Environment Assurance</td>
<td>Oceanography &amp; Survey (Ocean/Hydro/River), Meteorology, Tactical use of space, Undersea Surveillance</td>
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<tr>
<td>Assure Access and Hold at Risk</td>
<td>Persistent Monitoring, Information Verification, vessel/vehicle-stopping, MCM/Boarding, Hold-at-Risk</td>
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<tr>
<td>Strike</td>
<td>Precise targeting, Time-sensitive strike, Neutralization (lethal/non-lethal), Effect-scaled weapons, Naval fires, Maneuver Battle Damage Assessment</td>
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<tr>
<td>Survivability and Self-Defense</td>
<td>Weapon-Defense (Torpedo &amp; Missile), LO/CL/O, Tactical EW, Counter IED/Snipers, Damage Control/Prevention, MCM Interdiction, ASW, Force Protection,</td>
</tr>
<tr>
<td>Irregular and Asymmetric Warfare</td>
<td>Tagging, Urban Operations, Enhance Maritime Interdiction Operations, Non-lethal systems, Biometrics, Forensics</td>
</tr>
<tr>
<td>Naval Warrior Performance and Protection</td>
<td>Personal Protection, Endurance, Decision-Making Tools, Training Tools, Casualty Care, Undersea Medicine,</td>
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<tr>
<td>Platform Mobility</td>
<td>Platform Performance &amp; Agility, Power-Dense Propulsion</td>
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<tr>
<td>Fleet/Force Sustainment</td>
<td>Seabasing, Distributed Operations, Logistics, Maneuver</td>
</tr>
<tr>
<td>Affordability, Maintainability, and Reliability</td>
<td>Increased warfighting capacity: Reduced logistics, cost optimization, reduced failure rates, Automate Naval engineering, A/C Propulsion Design</td>
</tr>
<tr>
<td>Power &amp; Energy</td>
<td>Power Generation and Storage, assured energy sources, Personal Power</td>
</tr>
</tbody>
</table>
DARPA’s Strategic Thrusts

Investments Today for Future Capabilities

- Robust, Secure Self-Forming Networks
- Detection, Precision ID, Tracking & Destruction of Elusive Targets
- Networked Manned & Unmanned Systems
- Urban Area Operations
- Location and Characterization of Underground Structures
- Assured Use of Space
- Cognitive Systems
- Bio-Revolution
- Core Technologies (Materials/Electronics/Information Technology)
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The Ecosystem “Then”

- Small number of big fish in a relatively small pond:
  - DARPA, NSF
  - Bell Labs, IBM Watson, DEC, Sun, Xerox PARC
  - CMU, MIT, Stanford, Berkeley
- Small science and technology base (Knuth’s volumes)
- Federal S&T investments able to achieve substantial impact relative to small existing base
- CS and IT considered fresh and exciting
- NSF award success rate >30%
- DARPA block grants
- Primordial Internet and WWW; pre-dot-com mania
- Modest level of international investment; Western Europe, Canada and Japan
- Easy international access to US graduate schools
- Limited opportunities for CS graduate degree holders outside US
Total WWW Sites Across All Domains

From news.netcraft.com, Nov. 1, 2006
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Perceived Ecosystem Today

- Federal resources for extramural CS/IT R&D under-sized for demand and opportunities
- Significant potential R&D innovations un-realized
- Commercial R&D investment weighted towards near term
- R&D workforce not refreshing at adequate scale
- US scientific and technological lead narrowing
- CS/IT R&D mature and/or tapped out
- IT R&D is an internationally available commodity
- US military force-multiplier advantage at risk?
FY06 Defense Technology Areas

- Air Platforms
- Biomedical
- Chemical/Biological Defense
- Ground and Sea Vehicles
- Human Systems
- Information Systems Technology
- Materials/Processes
- Nuclear Technology
- Battlespace Environments
- Sensors, Electronics, & Electronic Warfare
- Space Platforms
- Weapons

$ in Thousands

PBR 06

PBR 05

0 200,000 400,000 600,000 800,000 1,000,000 1,200,000 1,400,000 1,600,000 1,800,000 2,000,000
DoD Basic Research Funding by Discipline (varies slightly yearly)

- Cognitive & Neural Sci. 6%
- Physics, 8%
- Biological Sci. 13%
- Atm. & Space Sci. 5%
- Ocean Sci. 10%
- Terrestrial Sci. 2%
- Mechanics, 10%
- Chemistry, 7%
- Mathematics, 5%
- Computer Science, 8%
- Electronics, 16%
- Material Sciences, 11%
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How Can IT R&D Get Its Groove Back?

• Don’t try to “go home again”
• Craft a *National Vision for IT R&D*; generate a sustainable buzz
• Identify challenging, bounded areas for National pre-eminence
• Focus Federal resources strategically on target and avoid diffusion
• Encourage and reward fair and open competition for Federal IT R&D resources
• Explain IT R&D ROI better to decision-makers
• Find mechanisms to increase private-sector long-term R&D
• Inspire youth
• Welcome qualified international students, researchers, and commercial innovators
If I Were King …

- Flawless conversion of intended functionality into digital systems
- Reliable and robust autonomous systems