# Future Trends–The View from DoD

**22 October 2013**


## Al Shaffer

**Acting Assistant Secretary of Defense**
**for Research and Engineering**

**“(Ladies and) Gentlemen, we are out of money.**

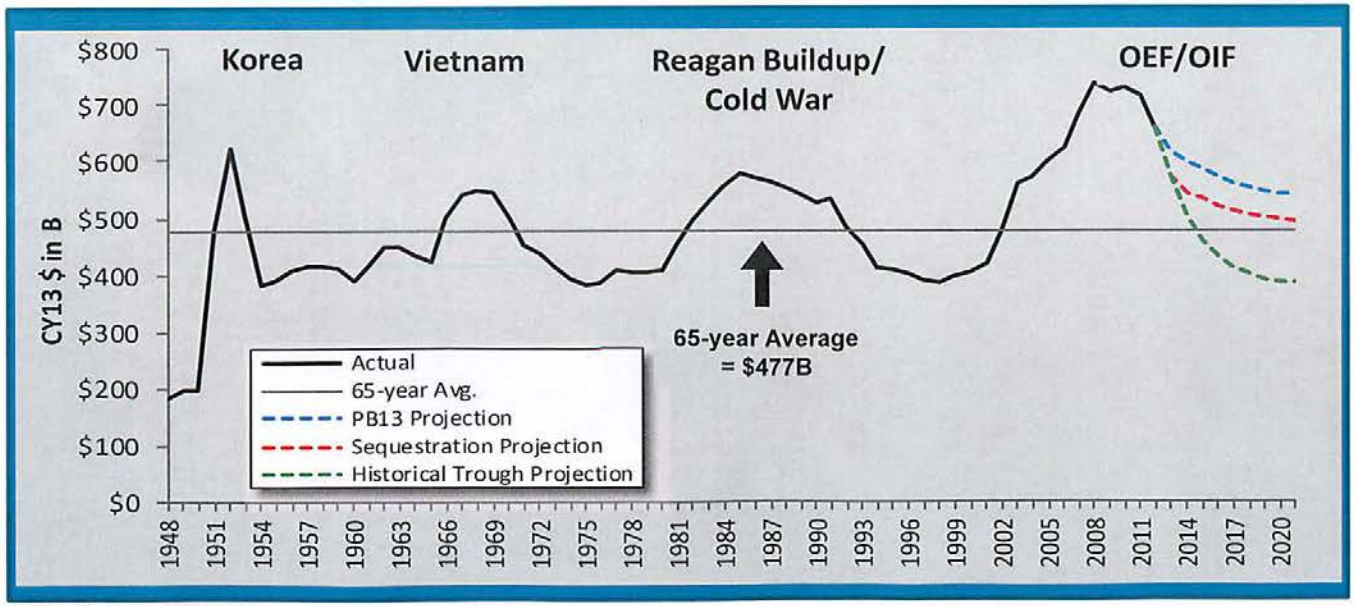
**Now we must think!”**

Winston Churchill to
Parliament during World War II
*(Stolen from Ernest Rutherford)*

# The Reality….

*"Our current security challenges are more formidable and complex than those we faced in downturns following Korea, Vietnam, and the Cold War. There is no foreseeable "peace dividend" on our horizon."*

GEN DEMPSEY, CJCS
Testimony to SASC, 12 Feb 2013

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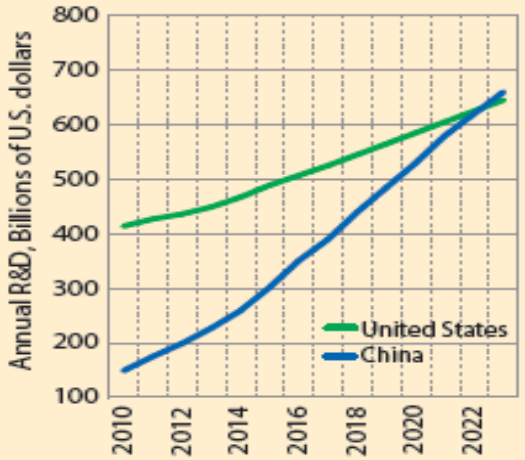
# Global Research Views in R&D

## U.S. - China Annual R&D Spending




Source: Battelle, *R&D Magazine*

China's double-digit growth in R&D spending is expected to match and surpass that of the U.S. by about 2023, if several forecasting criteria are maintained. This forecast is based on continued Chinese R&D growth averaging 11.5% per year and U.S. R&D growth averaging about 4.0% per year for the next 13 years. Present U.S. R&D annual growth is only about 2.1%, but has been more than 6% over the past 15 years. China's R&D growth over the past 15 years has consistently exceeded 10%.

## Global Researcher Views of Leading Countries in R&D by Technology/Research Area

| Agricul-ture & Food Pro-duction | Automotive & Other Motor Vehicle | Commercial Aerospace, Rail & Other Non-Auto. Transport | Military Aerospace, Defense & Security | Composite, Nanotech, & Other Advanced Materials | Energy Gen-eration & Efficiency | Environ-mental & Sustain-ability | Healthcare, Medical, Life Sci. & Biotech | Informa-tion & Comm. (ICT) | Instru-ments & Other Non-ICT Electronics |
|---|---|---|---|---|---|---|---|---|---|
| U.S. | Japan | U.S. | U.S. | U.S. | U.S. | Germany | U.S. | U.S. | U.S. |
| China | Germany | China | China | Japan | Germany | U.S. | U.K. | Japan | Japan |
| Germany | U.S. | France | Russia | Germany | China | Japan | Germany | China | Germany |
| Brazil | China | Germany | U.K. | China | Japan | U.K. | Japan | India | China |
| Japan | South Korea | Japan | France | U.K. | U.K. | China | China | Germany | U.K. |

Source: Battelle Survey

# Defense R&E Strategy

"*Protect and prioritize key investments in technology and new capabilities, as well as our capacity to grow, adapt and mobilize as needed.*"

-SECDEF, January 2012 Strategic Guidance

**1. Mitigate new and emerging capabilities**

- Electronic Warfare
- Cyber
- Counter Space
- Counter-WMD

**2. Affordably enable new or extended capabilities in existing military systems**

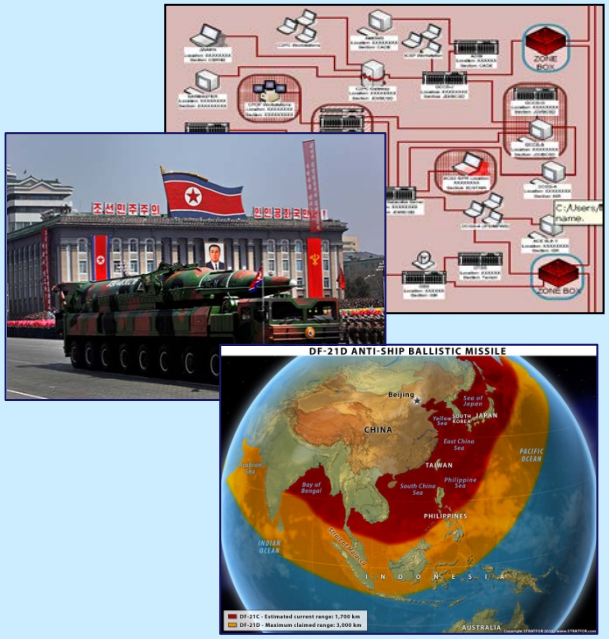
- Systems Engineering
- Data Reuse
- Engineered Resilient Systems
- Developmental Test & Evaluation

**3. Develop technology surprise through science and engineering**

- Autonomy
- Basic Research
- Data-to-Decisions
- Human Systems

**ASD(R&E) Should Lead the Future**

## Technology Needs




- Middle East Instability
- North Korean Nuclear Ambitions
- Anti-Access/Area Denial
- Cyber Attacks
- Electronic Warfare

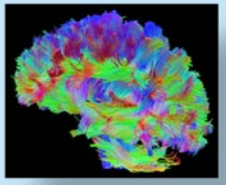
# Basic Science Priorities

**Synthetic Biology**

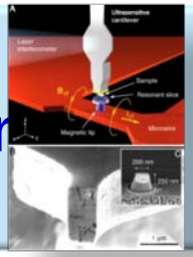

**Modeling of Human Behavior**

**Engineered Materials**

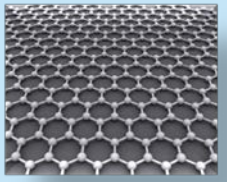

**Cognitive Neuroscience**



**Quantum Information**



**Nano Science and Engineering**



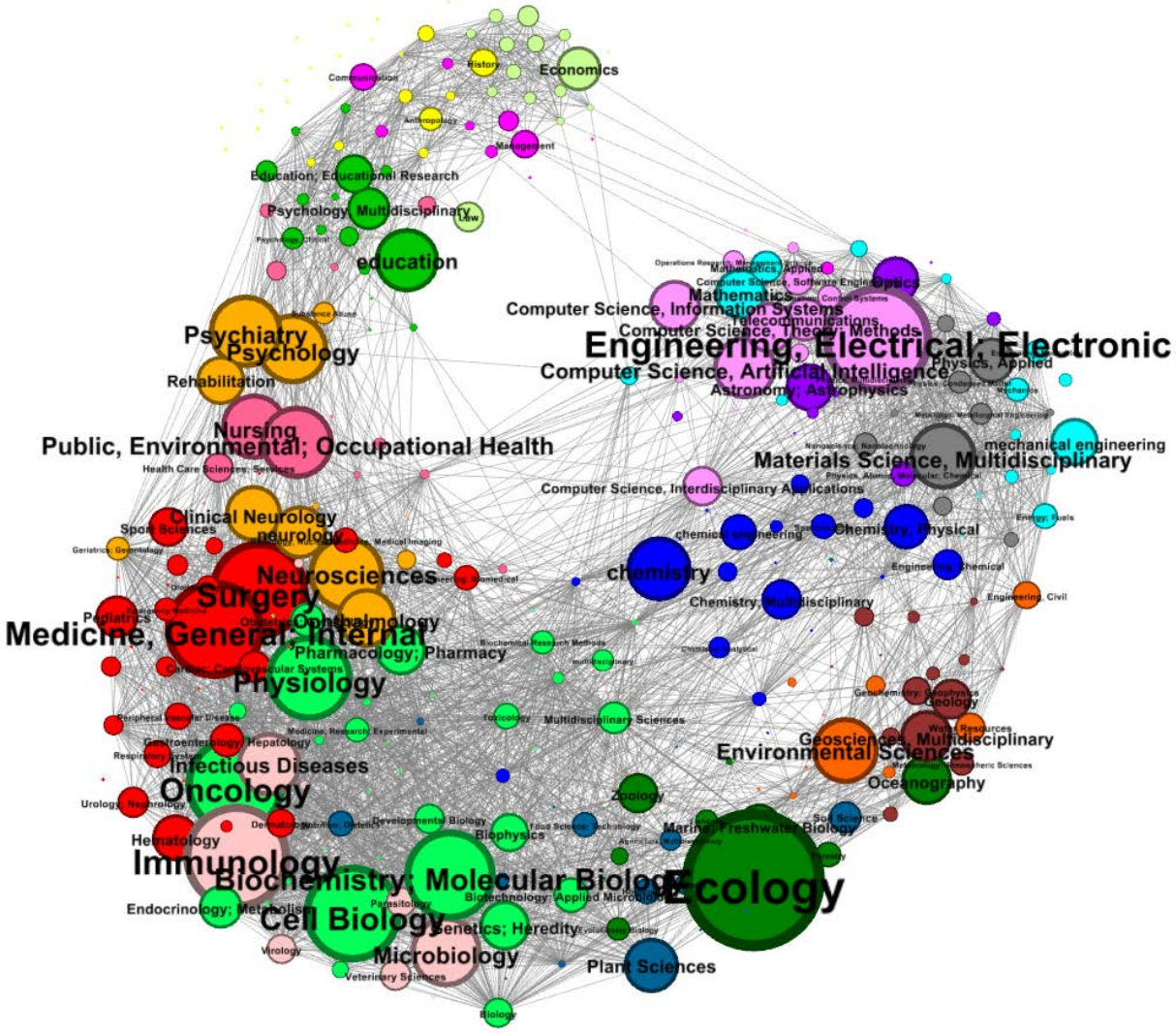
# DoD International Strategy for Research, Development and Acquisition

## Vision

Enhanced interoperability and acceleration of developmental acquisition programs - gaining economic efficiencies and mitigating risk of technology surprise

- **Benefits from R&D Collaboration**
  - Improve interoperability and support to current and contingency ops
  - Supporting bi- / multi-lateral acquisition programs
  - Cost reduction and burden sharing through co-funding programs
  - Take advantage of different views
  - Opening access to global markets for US industry

# Australian Science Map WoS (2002-2012)

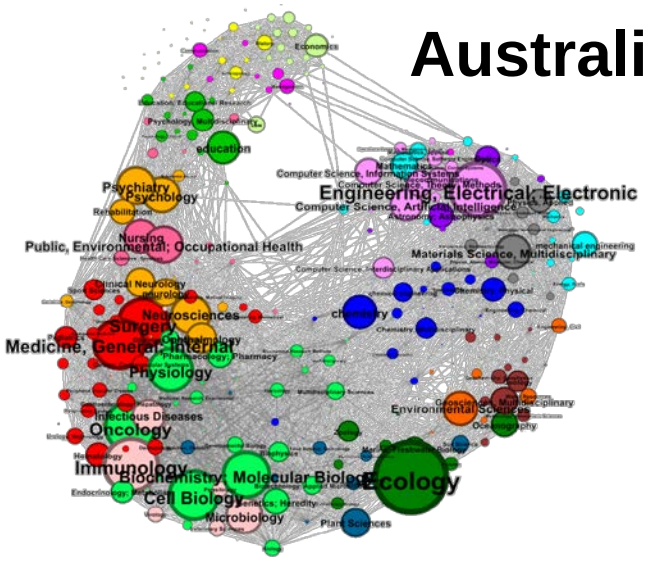



| Top 20 Subjects | Articles |
|---|---|
| Ecology | 25081 |
| Engineering, Electrical; Electronic | 18996 |
| Immunology | 18558 |
| Oncology | 17358 |
| Medicine, General; Internal | 17261 |
| Surgery | 17155 |
| Cell Biology | 16982 |
| Biochemistry; Molecular Biology | 15800 |
| Physiology | 14890 |
| Neurosciences | 13077 |
| Psychiatry | 12668 |
| Public, Environmental; Occupational Health | 12640 |
| Microbiology | 12214 |
| Psychology | 12205 |
| Materials Science, Multidisciplinary | 11526 |
| Environmental Sciences | 11442 |
| Nursing | 11375 |
| chemistry | 11127 |
| Education | 10989 |
| Infectious Diseases | 10966 |

# Comparative WoS Science Maps (2002-2012)

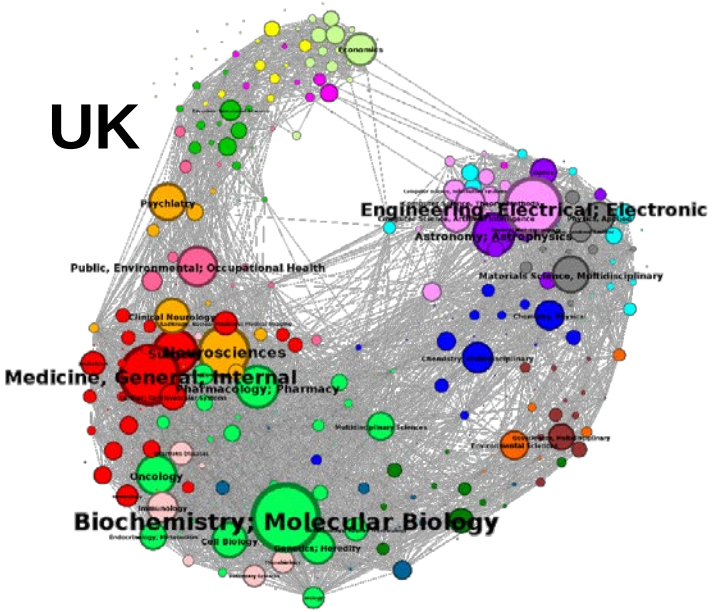
| Top 10 UK Subjects | Articles |
|---|---|
| Biochemistry Molecular Biology | 50052 |
| Medicine General Internal | 43757 |
| Engineering Electrical Electronic | 42427 |
| Neurosciences | 37311 |
| Surgery | 32549 |
| Pharmacology Pharmacy | 31093 |
| Astronomy Astrophysics | 30509 |
| Oncology | 29062 |
| Public Environmental Occupational Health | 28963 |
| Psychiatry | 26827 |

## Australia

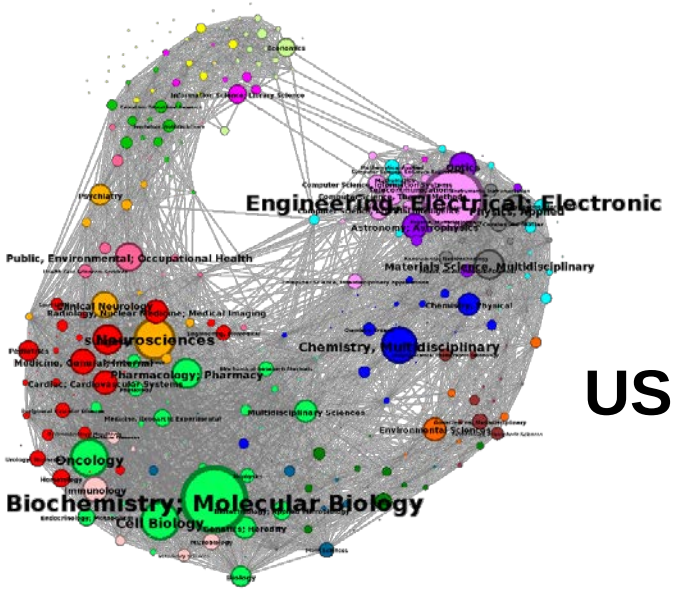



| Top 10 US Subjects | Articles |
|---|---|
| Biochemistry Molecular Biology | 250928 |
| Engineering Electrical Electronic | 235864 |
| Neurosciences | 153337 |
| Cell Biology | 143918 |
| Oncology | 142126 |
| Chemistry Multidisciplinary | 133519 |
| Pharmacology Pharmacy | 110431 |
| Materials Science Multidisciplinary | 109047 |
| Surgery | 108768 |
| Physics Applied | 107872 |

## UK

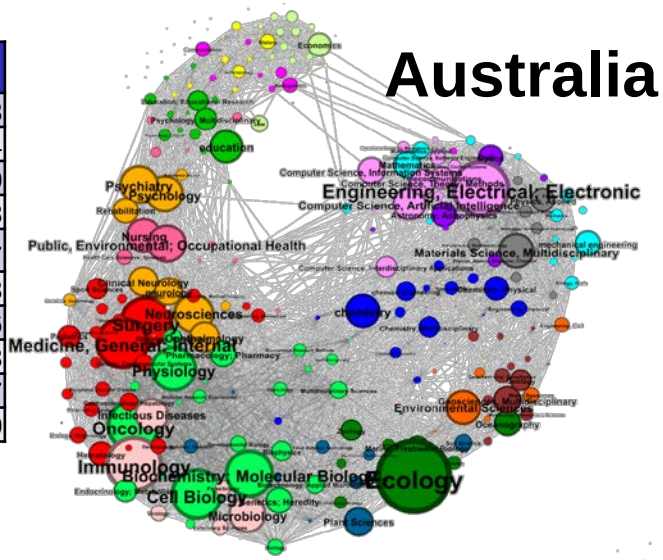



## US

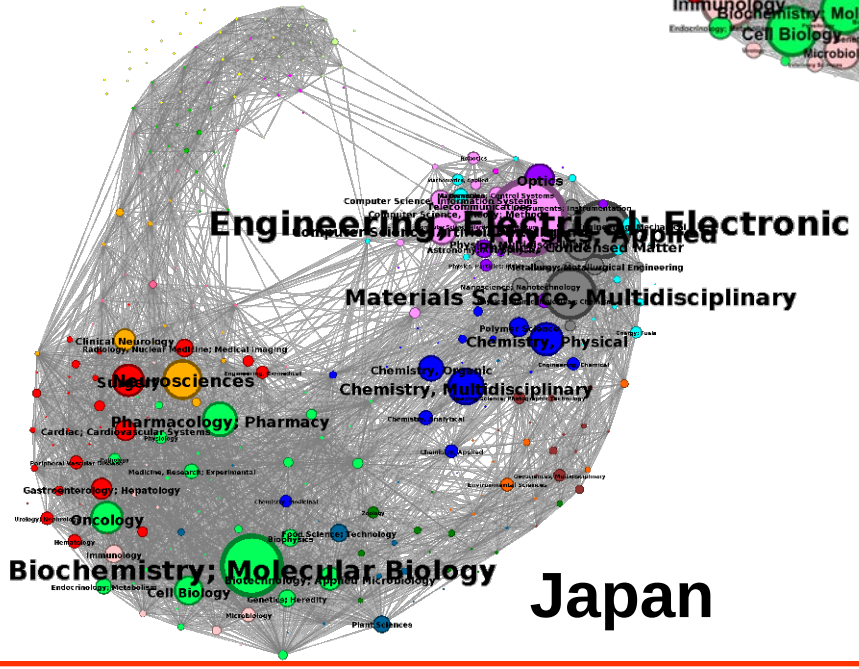


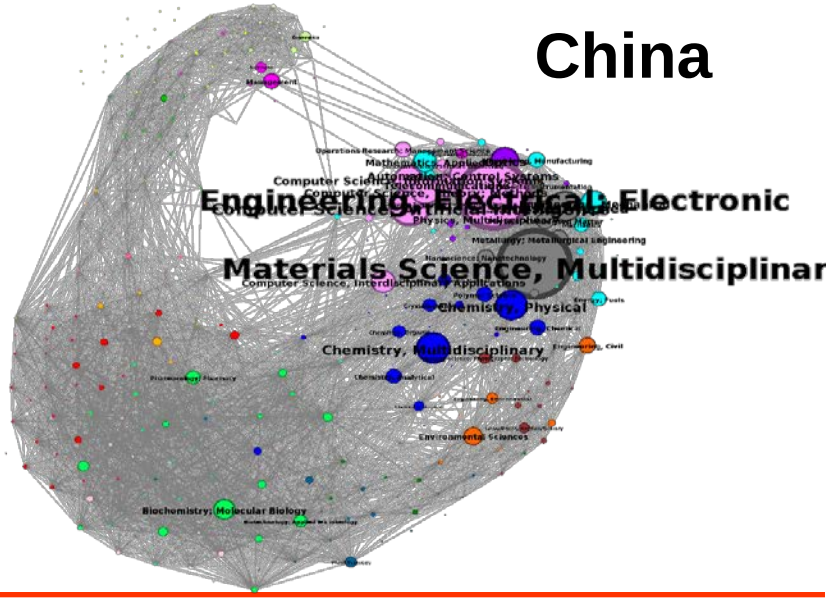
# Comparative WoS Science Maps (2002-2012)

| Top 10 Japan Subjects | Articles |
|---|---|
| Engineering Electrical Electronic | 77933 |
| Biochemistry Molecular Biology | 62564 |
| Physics Applied | 57670 |
| Materials Science Multidisciplinary | 51458 |
| Neurosciences | 38897 |
| Chemistry Multidisciplinary | 35653 |
| Pharmacology Pharmacy | 34006 |
| Chemistry Physical | 32493 |
| Oncology | 31717 |
| Surgery | 31410 |




| Top 10 China Subjects | Articles |
|---|---|
| Materials Science Multidisciplinary | 185538 |
| Engineering Electrical Electronic | 184512 |
| Computer Science Artificial Intelligence | 101552 |
| Chemistry Multidisciplinary | 79761 |
| Physics Applied | 78418 |
| Chemistry Physical | 76225 |
| Computer Science Information Systems | 67379 |
| Optics | 67047 |
| Computer Science Theory Methods | 66992 |
| Automation Control Systems | 65225 |



# Summary

– As funding ***DECREASES*** across the department, the need for International Collaboration ***INCREASES***

– Use both bilateral and multilateral forms

– Seek to increase interoperability and mutual reliance