Engineering for Diplomacy, Development and National Security: U.S. Universities on the Front Lines
Outline of Remarks

“SET for Grand Challenges”
National Security, Foreign Policy Strategies
Hard, Soft and “Smart Power”
State/USAID/PACOM - Pacific and Western Hemisphere
Universities Gone Global on the Front Lines
Recruitment - A Word from Our Sponsor
Strategic Planning/Horizon Scanning - Crystal Ball Darkly
Some Disruptive Technologies and Paradigm Shifts
“Black Swans” and Renaissance Engineers
Who We Are

One of Four Original Executive Branch Departments
Secretary of State Third in Succession to President
First Archive for State Documents
  - Declaration of Independence
  - Constitution
FY12 Budget ~ $47 billion - State, USAID

State - 61,000 employees
  12,500 Foreign Service
    - 7,000 Generalists
    - 5,500 Specialists
  8,500 Civil Service
  40,000 Foreign Service Nationals
HQ, 163 Embassies, 98 Consulates

USAID – 6,000 employees (2,500 in Washington), 90 Missions
SET for Grand Challenges

• Science, engineering and technology (SET) have disruptive (good and bad) impacts on social, cultural, ethical, civil, economic, political and military affairs.

• Disruptive technologies affect institutions, governments, international relations, national security.

• Global knowledge circulation is now the norm and accelerating, powered by ICTs and Internet.

• Nations, urban centers are shaped by, and compete for, SET assets, R&D, education and an innovation ecology.

Global Grand Challenges are increasing - cooperation and pooling of S&T, engineering assets are seminal to meet them, foster international stability and prosperity.
We must first recognize that our strength and influence abroad begins with steps we take at home. We must educate our children to compete in an age where knowledge is capital, and the marketplace is global.

We must develop clean energy that can power new industry and unbound us from foreign oil and preserve our planet.

We have to pursue science and research that unlocks wonders as unforeseen to us today as the microchip and the surface of the moon were a century ago.

“Simply put, we must see American innovation as a foundation of American power.”

Our Armed Forces will always be a cornerstone of our security, but they must be complemented.

Our security also depends upon diplomats who can act in every corner of the world, from grand capitals to dangerous outposts; development experts who can strengthen governance and support human dignity; and intelligence and law enforcement that can unravel plots, strengthen justice systems, and work seamlessly with other countries.”

National Security Strategy, May 2010

“Smart Power” translates into five specific policy priorities:

- Update and create new vehicles for cooperation to address a multi-partner vs multi-polar world (strategic dialogues with BRICs, UN orgs)
- Pursue principled engagement with those who disagree with us (Syria, Iran, North Korea)
- Elevate development as a core pillar of American power and engrain in strategic planning (refurbishing, reforming USAID)
- Ensure that civilian and military efforts operate in a coordinated, complementary fashion (pre- and post-conflict; 100 POLADs at DOD)
- Shore up traditional sources of influence – economics and the power of American example – life, liberty, pursuit of happiness

Secretary Clinton, Council on Foreign Relations, July 15, 2009

Public/private Partnerships; Empowerment of Women
Social Networking and Internet Diplomacy
Science, Engineering, Technology (SET) Support State/USAID Joint Strategic Goals

**Hard Power**
Peace and Security - SET for National Security, Regional Stability, CT

**“Smart” Power**
Good Governance – SET Meritocracy, Transparency, Protection of IPR
Investing in People - K-12 Science and Math, Higher Education, Research
Economic Growth – SET Partnerships Foster Innovation, US Business

**Soft Power**
Humanitarian Assistance – AID and SET for Sustainable Development
Promoting International Understanding – SET for Diplomacy, Outreach

**Intelligent Power or “Enlightened Self-Interest”**
Strengthening Consular and Management Capabilities – SET Literacy
A final critical trend reshaping the global context of U.S. foreign policy is a broad set of technological innovations that have increased the pace of international affairs and facilitated a new era of human connectivity. **Science, engineering, technology and innovation are the engines of modern society and a dominant force in globalization and international economic development.** Despite fierce competition and rapidly increasing parity in science, technology, and engineering assets among nations, the United States remains predominant in most fields and is a world leader in education, research, and innovation.

The National Security Strategy and Presidential Policy Directive on Global Development recognize the power of innovation and modern technology to transform lives around the world and our development policy. **Innovation is a key engine of long-term economic growth. History shows how science and engineering open the door to revolutions in development.**
Operational Imperatives for SET Education and Outreach

1. Expand people-to-people-exchanges in S&T and engineering research cooperation, STEM education and publicize them as good news

2. Leverage platforms and spaces through more public/private partnerships to broaden our reach with SET programs and information

3. Ensure content resonates with diverse audiences and captures their imagination, inspires youth and engages women

4. Strengthen institutional mechanisms to facilitate deeper, more diverse SET collaboration, capacity-building and innovation
State, USAID, PACOM Partnering for Humanitarian Assistance, Disaster Relief

State Office of the Geographer and Global Issues, Humanitarian Information Unit (HIU) - civil servants, foreign service, DOD, IC experts

HIU works with PACOM to address real-time information gaps for HA/DR, provide risk assessments of complex humanitarian situations, GIS maps for logistics, command and control for recent events such as:
- Bangladesh Flood Response – November 2007
- Pakistan - 2009-10
- Tohoku Earthquake & Tsunami – 2011

State, USAID Bureau of Conflict and Stabilization Operations, PACOM are also collaborating on a Nepal Interagency Conflict Assessment Framework to address the Himalayas watershed and related, regional hazards to rural and urban populations in South Asia.

PACOM “Promote Cooperation” conference hosted at State April 12-13, 2012, to better integrate civilian agencies and departments into planning efforts for overall military engagement in the Asia-Pacific Region.
PACOM Pacific Operational S&T Conference and Exhibition
March 19-23, 2012, Honolulu

“Theater Shaping with Allies and Partners” with sessions addressing climate, energy, cyber security; HA/DR, human/social/cultural modeling, maritime security, international and long-term perspectives

Themes emphasized by State S&T Adviser to Secretary Clinton Bill Colglazier:

S&T and engineering are critical to war-fighting and key elements of American “smart power” - QDDR has improved State S&T alignment

State (and USAID) are active partners with PACOM, Office of Naval Research, the Air Force Office of Scientific Research, and Army

US National Academies work with counterparts in China, Indonesia, South Korea, Japan, Malaysia, others in Pacific region to encourage NGO communities to advise their governments on S&T and engineering

ONR Global planning conference in Singapore will explore innovation opportunities with government, business and universities
Regional cooperation and capacity building for disaster risk reduction and emergency preparedness
Technology applications for managing disaster risk
Terrestrial and satellite telecommunications applications for emergency response
Meteorological tracking, hazards early warning, mapping, and engineering design for mitigation

This regional workshop will be the inaugural activity of the ASEAN-U.S. Connectivity Cooperation Initiative that was announced by President Obama during the ASEAN-U.S. Leaders Meeting in Bali in November 2011. It will provide an opportunity to demonstrate the potential role of the U.S. private sector in supporting disaster management, mitigation, and recovery efforts throughout ASEAN and to feature U.S. firms with expertise in these areas.

Sponsored by the US Trade and Development Agency in cooperation with the ASEAN Committee on Disaster Management (ACDM) and organized by the Business Council for International Understanding
SET Cooperation - Asia and Latin America: Remember Our Hemisphere

Foundation - bilateral, S&T agreements with Canada, Mexico, Central and South America, including Columbia, Peru and Chile, for basic R&D, personnel exchanges, increasingly with U.S. university partners

APEC fostering collaboration across range of health, environment and natural hazards fields - Earthquake and Tsunami Safety, Risk Reduction and Preparedness with State, USGS, GeoHazards International – Oct 2011

“Engineering for the Americas” (EftA) U.S. initiative through OAS to strengthen engineering curricula cooperation between universities

Sixth Summit of the Americas – Cartagena, April 14-15, 2012

- Communiques on Rio +20, Competitiveness and Innovation for Prosperity; Combatting Transnational Crime and Global Drug Abuse
- USAID “Broadband Partnership of the Americas” for national broadband strategies, expand mobile and broadband to rural communities, improve regional connectivity, Universal Service Funds
Major Changes in World Science - Participation & Cooperation
Higher Education – International Branch Campuses (IBCs)

All nations’ IBCs as of March 2011

Due to Google map restrictions, all IBC locations do not fit on one page. Scroll to the bottom and click on ‘pg 2’ for more locations. In addition, in expanded views, multiple locations may collapse to a single icon. Zoom in to see multiple locations for a single area.

Location of home campus (home location)

Location of international branch campus (host location)

Source: Cross-Border Education Research Team (C-BERT), State University of New York at Albany, March 2011
http://www.globalhighered.org/index.php  Slide courtesy of Dr. Elizabeth Lyons, NSF, on detail to DOS
Major Changes in World Science - Participation & Cooperation
Higher Education (cont.)

IBC Hotspots

Middle East Gulf Region

Abu Dhabi

Dubai

Qatar

Ras Al-Khaimah

Other Metropolitan Areas

Hong Kong

London

Singapore

Location of international branch campus (host location)

Location of home campus (home location)

Source: Cross-Border Education Research Team (C-BERT), State University of New York at Albany, March 2011
http://www.globalhighered.org/index.php  Slide courtesy of Dr. Elizabeth Lyons, NSF, on detail to DOS
State Department, national intelligence agencies face critical shortages in strategic areas such as cybersecurity, due to lack of languages and technical expertise.

Three quarters of Americans ages 17-24 lack education to serve in the military.

Panel Recommendations:
- Expand, implement Common Core Standards in science, technology and foreign languages - critical to national security
- Offer more school choices, particularly in low-income areas
- Launch a “national security readiness audit” to determine whether schools are meeting targets and to raise public awareness of the crisis
Enhancing the S&T Literacy and Capacity of State and USAID

Fellowships [http://careers.state.gov/professional-fellowships/pses-fellows]

American Association for the Advancement of Science (AAAS)
Professional Science and Engineering Societies
AIP, ACS, IEEE, ASME
Jefferson Science Fellows – tenured science and engineering professors
Foster Fellows – focusing on arms control, non-proliferation, nuke, chem, bio
Embassy Science Fellows (from the USG writ-large, AAAS and JSF)
S&T Student Internships (in the U.S and abroad)
[http://careers.state.gov/students/programs]
[http://careers.state.gov/students/which-program-is-right-for-you]

Careers

Joining the Department of State and USAID – Foreign and Civil Service
[http://careers.state.gov/]
JEFFERSON SCIENCE FELLOWS (JSF)

Tenured U.S. professors at State and USAID for a one-year assignment and at least five years of consultancy

- Engages U.S. universities in formulation/implementation of U.S. diplomacy, development policies and programs, USG, DOD and IC
- Universities pay salaries and benefits for professors, State and AID pay per diem, administrative, travel costs
- Exemplary public-private partnership piloted by MacArthur Foundation, Carnegie Corporation, U.S. universities and State; administered by the NAS
- Eighth year – 63 alumni from 55 universities; 13 Fellows in current 2011-2012 cohort; 13 new Fellows just selected for 2012-2013 cohort
- Jeffersons are science and engineering “ambassadors” on campus
S&T, Engineering Are Seminal in Foreign Policy


NRC Report “The Pervasive Role of S&T and Health in Foreign Policy” (1999)


RAND “Global Technology Revolution 2020” (2006)


State Department “Project Horizon” at the Year 2025 (2006)

Building the Scenarios

Based on 200 interviews, ‘drivers’ were identified and then distilled into dimensions of broader, more universal scope.

PARTIAL LIST OF DRIVERS
- Level of Stability and Conflict
- Non-traditional actors
- Borders: nature and permeability
- Charismatic leadership (source of)
- Terrorism
- Global Media
- Religion
- Poverty & Development
- International Crime/Illicit Economy
- The Global Commons
- Energy
- Agriculture/Food
- Water & Other Critical Resources
- Global Health
- Environment
- Demographics
- Science and Technology
- Global alliance structures
- Role/structure of transnational business and business organizations
- Dynamics of international debt
- Unemployment/ social fabric
- Global Culture

DIMENSIONS
- Challenge to Nation State Power and Influence
- Gap in Global Standard of Living
- U.S. Economic Competitiveness
- Perception of Serious Threat to U.S. Security and/or Quality of Life
**HORIZON – Forces for Change**

*Most frequently mentioned forces for change expected to drive the landscape of threats and opportunities through 2025*

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The Project Horizon Scenarios: An “Electron Cloud” in 2025

- **Be Careful What You Wish For**
  - Not without its problems to manage, this is a world of opportunity, freedom, and great technological advance. The USG is overstretched operationally and finds a world made up of activist fellow democracies challenging in unexpected ways.

- **Lockdown**
  - This is a multi-threat world marked by persistent terrorism, nuclear proliferation, and the most challenging economics the U.S. – and the world – have faced in more than 50 years – two WMD attacks in 15 years.

- **Congagement**
  - Political and economic power increasingly are organized regionally. It is a vibrant, tense and highly competitive world with multiple points of friction.

- **Profits and Principles**
  - Many have benefited from hyper-capitalism, many others have not. Public institutions are increasingly weak while new, powerful organizations are emerging. The global clash between profits and principles is causing fear that these divergent paths could end up on a collision course.

- **Asian Way**
  - In this world, the global economy increasingly is dominated by Asian mega-corporations that are expanding at the expense of the formerly dominant American and European military and economic powers.
Strategic Interagency Capabilities: Recommendations - All Scenarios

- **Quadrennial Strategic Review**
  - A coordinated interagency strategic planning process for USG global affairs activities that links the President’s National Security Strategy and other National Strategies with agency-level Strategic and Performance Plans, Budget Submissions, and Performance and Accountability Reports.

- **Government-Wide Information Sharing**
  - Transformed government-wide information sharing, including revised doctrine, procedures, and incentive structures for shifting the USG from a “need to know” model to a “need to share” model of information access.

- **Global Domain Foresight**
  - The ability to maintain anticipatory global domain awareness to enable proactive responses to emerging man-made and natural threats.

- **Interagency Fusion Groups**
  - The streamlined ability to create, staff and monitor time-limited interagency organizations specifically focused on emerging strategic issues featuring clear lines of accountability, cross-agency resource control and authority.

- **Global Health Engagement**
  - A strategic approach to the mobilization of interagency and non-governmental public health assets to advance U.S. leadership and public diplomacy efforts.
Global Hazards Planning and Response
- An integrated USG preparedness planning and rapid response function capable of managing the interagency response to significant global hazards in partnership with other nations and non-governmental actors as appropriate

Human Resources Model for Global Affairs
- A revised set of cross-government HR policies, procedures, and incentive structures to enable the rapid assembly of capable, integrated, and trained USG personnel for global affairs activities

Global Affairs Learning Consortium
- A jointly governed network of global affairs training institutions (e.g., FSI, NDU, etc.) that mutually leverages training, exercise, and experimentation offerings to create a rich, coherent curriculum for USG global affairs professionals

USG Public Private Partnership Framework
- USG capacity to partner effectively with universities, private sector entities, state and local governments, and non-government organizations (NGOs), foundations

Science and Technology Incentive Framework
- An S&T, engineering incentive framework that better aligns USG S&T investments with emerging, long-term global priorities and rewards collaborative S&T across the interagency and with academic, private sector and other national partners
Global Trends 2025: A Transformed World

Courtesy of Dr. Mat Burrows
National Intelligence Council
Global Trends 2025: Main Findings

- The international system is transforming.
- Breakdown unlikely but transition will not be smooth.
- Transnational challenges expected: energy security, resource scarcities, economic crisis, climate change, proliferation, terrorism.
- Increasing demand for strategic resources could outstrip easily available supplies in the next decade.
- Maritime security concerns spawning naval modernization and build-ups – e.g. India and China seek blue water navy – that could heighten tensions and regional rivalries.
- Potential for conflict—interstate and intrastate—is likely to grow.
- US remains single most powerful actor, but its influence and leverage will be more constrained.
Global Trends 2030: Alternative Worlds

16 Disruptive Technologies Analyzed Across Three Scenarios:

“Fragmentation”
“Fusion”
“Reverse Engines”

December 2012
Agricultural Water Efficiency
Precision Agriculture
Plant Biotechnologies
Synthetic Biology

Multifunctional Graphene

Affordable Solar Energy
Cost-Competitive Advanced Bio-Based Energy

Data Solutions
Diagnostics
Cyberweapons

Human Augmentation
Human Social Prediction
Social Impacts of Social Networks

Robotics
Remote and Autonomous Vehicles

Urban Technologies
Some Potential Transformational “Show Stoppers”

SRI Consulting Business Intelligence for National Intelligence Council
Selected from 102 Technologies
Evaluated for Potential Geopolitical, Economic, Military and Cultural Impacts on US National Power

Biogerontechnology – improvements in health, lifespan

Energy Storage Materials – impacts on fossil fuel consumption

Biofuels and Bio-Based Chemicals – nearer term alternatives to oil

Clean Coal Technologies – power generation, environmental gains

Service Robotics – civil and military applications

The Internet of Things – ubiquitous nodes, streamlining supply chains

Powering the Next Generation Internet:
Semantic Web 3.0 to Intelligent Web 4.0

The following three slides courtesy of:

Beverly Neale Rush
Center for the Study of Intelligence

"Where Tomorrow Will Take Us:
The Future of Foresight"

Actionable Foresight Conference
National Defense University
June 16, 2010
Today’s rapidly changing digital infrastructure has altered the equation
A world of constant disruption...

It took **two centuries** to fill the US Library of Congress with more than:

- **29 million** Books and periodicals
- **2.4 million** Recordings
- **12 million** Photographs
- **4.8 million** Maps
- **57 million** Manuscripts

Today, it takes **about 5 minutes** for the world to churn the equivalent amount of new digital information
With nearly unlimited space, governments, companies, and individuals are storing – and disseminating – unprecedented amounts of data.
Global Knowledge Circulation: Fuel for S&T and Engineering

“Clouds, Big Data and Smart Assets: Ten Tech-Enabled Trends”

Distributed Co-creation – Open Source software the key
Making the Network the Organization – “in-reach” to build teams
Collaboration at Scale – “organizational capital” for knowledge extraction
The “Internet of Things” – embedded sensors, actuators, “smart” assets
Experimentation and Big Data – data doubles every 18 months
Wiring for a Sustainable World – smart grids, efficiency reduce GHGs
Imagining Anything as a Service – innovate by integrating the end user
Age of the Multisided Business Model – shift from 1/1 to multiple players
Innovating from the Bottom of the Pyramid – “Alibaba” B2B exchange
Producing Public Good on the Grid – e-gov infrastructure and services

McKinsey Global Institute, August 2010
Grand Challenges Demand New Paradigms for Diplomacy, Development and National Security

Strategic Planning and Horizon Scanning

S&T and Engineering Collaborative Framework – strategic cooperation to identify global threats, data gaps, collaborative research

Global Actionable Foresight - promote anticipatory global domain awareness to enable proactive responses to disruptive technologies

Some Mid- and Long-term Issues for Engineers and Educators

Convergence of Life Sciences, Physical Sciences, Engineering (MIT)
Watershed Management Food Security, Natural Resources, Energy
Meteorological, Climate Research and Adaptation Strategies
Advanced and Additive Manufacturing – Dual-Use Implications
Internet of Things and Internet Governance – Camp of “Ordered Chaos”
Megacities and Natural Hazards
**URBANIZATION** By 2008, for the first time in history, half of the world’s population will live in urban areas. By 2030, 4.9 billion people, or 60 percent of the world population, will be urban.

*Source: World Urbanization Prospects, 2005 Revision (United Nations)*
Countries With the Most Slum Dwellers

- China: 38%
- India: 56%
- Brazil: 37%
- Nigeria: 79%
- Pakistan: 74%
- Bangladesh: 85%
- Indonesia: 23%
- Iran: 44%
- Phillipines: 44%
- Turkey: 43%

Slum dwellers as percentage of country’s urban population

Slum dwellers, millions
MEGACITIES

Since 1975 the number of urban agglomerations with a population of 10 million or more—megacities by the United Nations' definition—grew from just three to 20. By 2015 two more cities, Istanbul and Guangzhou, will cross the 10 million mark. Megacities account for 9.4 percent of the world's urban population. The growth of megacities is predicted to slow over the coming decade, and in 2015 they will still account for nearly the same proportion of the urban population that they do now.

SOURCE: WORLD URBANIZATION PROSPECTS, 2005 REVISION (UNITED NATIONS)
Earthquakes in Megacities

By the year 2025 more than 5500 million people will live in cities - more than our entire combined rural and urban population in 1990.

Growth of giant urban super-cities and megacities is a new experiment for life on Earth. Tragically, a significant number of these megacities are located close to regions of known seismic hazard.

With few exceptions (Tokyo 1923; Tangshan, 1976), recent large earthquakes (M>7.5) have spared the world's major urban centers, but this will not persist indefinitely.

In next decades megacities will be damaged by large earthquakes.

We are most certain of the fate of those cities near plate boundaries, however, mid-continent earthquakes also occur, albeit infrequently (c.f. M>7.6 events in eastern US and India, early 18th century)

An intractable problem: saving future lives from earthquakes in developing nations where corruption in building industry is prevalent.

Roger Bilham, University of Colorado – 12th Mallet-Milne Lecture 2009
Black Swan Events

Black Swans (according to Nassim Nicholas Taleb)

Three Attributes:

1) Outlier – i.e., an event outside the realm of regular expectations

2) Extreme Impact

3) Human Nature Concocts “Plausible” Explanations After the Fact

Moreover, “Black Swan logic makes what you don’t know far more relevant than what you do know.”

Linear Domains - Engineering, architecture, astronomy, most physics and common sciences

Complex Domains – social, behavioural, economic sciences, epidemics
Implications for the Future – Taleb’s Bottom Line

Our world is dominated by the extreme, unknown, improbable

We focus on “small talk,” the known and repeated based on current knowledge

In spite of our progress and growth in knowledge (or perhaps because of it), future will be increasingly less predictable;

Human nature and social “science” seem to conspire to hide the idea from us.

Black Swan event should be the starting point, not an exception

My Bottom Line: Educate the “Renaissance Engineer”
S&T and Engineering at State Department and USAID

www.state.gov/oes

www.state.gov/g/stas

www.usaid/scitech/