

# **Strategic National Security Impacts of Accelerating Technological Change**

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# Overview

- **Accelerating innovations in science and technology (S&T) are having profound effects on global civilization**
- **These developments will have *strategic* implications for the national and economic security of the U.S. and Allies**
- **We will require a new strategic vision and cultural change to maintain technological preeminence in the coming decades**
- **These are problems of policy, strategy, law, ethics, morals, and governance, not just technology**
- **Reference: Major NDU study on “Policy Challenges of Accelerating Tech Change”, CTNSP #106, Fall 2014**

# Science and Technology Macro-Trends

- **Acceleration of technological innovation due to wide availability of data, information and analytic tools**
- **Convergence of scientific and technological fields as they cross-fertilize → rapid innovations**
- **Globalization of S&T → growing investment by a growing number of countries**
- **Growing investment by private sector, esp. by multinationals → increasingly porous national borders**
- **Birth of Do-It-Yourself (DIY) tech communities**
- **NDU study focused on 5 major S&T areas: Bio-Robo-Info-Nano-Energy (BRINE) and made 12 policy/strategy recomm'ds**

# Biology and Biotechnology

## ➤ Emerging Technologies

- Personalized & regenerative medicine
- Advanced Neuroscience, Brain Mapping
- Bio-manufacturing
- Genetic Modification and Synthetic biology

## ➤ Security Opportunities

- Cheaper, better personnel health care and therapeutics
- Human performance enhancement, cognitive enhancement
- Biofuels, low-cost drug manufacture
- Synthetic organisms for new drugs, biomanufct, materials

## ➤ Security Risks

- Cognitive weapons ?
- Genetically engineered bioweapons ?
- Genetically engineered soldiers ??

# Robotics and Artificial Intelligence

## ➤ Emerging Technologies

- Advanced, cheap, modularized robotics; personal robotics
- Fully autonomous vehicles ( land, sea, air )
- Autonomous manufacturing and logistics
- Human augmentation, DBI, cybernetics, general AI ?

## ➤ Security Opportunities

- Routine tasks replaced by cheap autonomous systems
- Autonomous systems for battlefield, hazardous ops
- Human enhancement ( prosthetics, exoskeletons )
- Advanced AI for battlefield, planning, enhanced cognition ?

## ➤ Security Risks

- Ethics of KillBots ? Fully robotic armies ??
- Legal, ethical frameworks for human / robotic interactions ?
- Replacement of human judgment/accountability with AI ?

# Information, Communication, Computing

## ➤ Emerging Technologies

- Ubiquitous sensing, pervasive networks, big data
- Internet of Things, Operational Technologies
- Social media, virtual reality, telepresence
- Quantum computing

## ➤ Security Opportunities

- C4ISR, total situational awareness, nextgen decision support
- Monitoring / control of all built, mobile, human assets
- Soft power via social media, public diplomacy
- “Almost infinite” computing power for modeling, encryption

## ➤ Security Risks

- Use of open source information by adversaries, bad actors
- Cyber vulnerabilities will skyrocket
- Will there be an “arms race” for computing power and AI ?

# Advanced Materials and Nanotechnology

## ➤ Emerging Technologies

- Smart, multifunctional materials
- Nanomaterials
- Nano-bio-interface
- Nano machines and nanomanufacturing

## ➤ Security Opportunities

- Materials which heat, cool, sense, adapt to environment
- Materials that are ultra strong, light, low friction, wearproof
- Designer drugs and cellular engineering
- Manufacturing materials “atom-by-atom”; nano-sensors

## ➤ Security Risks

- Already becoming globalized and widely available
- May invalidate many conventional weapons / defenses
- New generation of bioweapons or clandestine tools

# Emerging Energy Technologies

## ➤ Emerging Technologies

- Enhanced generation – solar, fuel cells, energy harvesting
- Enhanced storage – ultracapacitors, nano-based batteries
- Smart energy management, smart grids
- Fracking

## ➤ Security Opportunities

- Non-fossil energy sources for small and medium applications
- Large scale storage for facilities, grids, battlefield ops
- Smart energy management of large grids and facilities
- Fracking may change U.S. geopolitical posture !

## ➤ Security Risks

- New energy tech will be widely commercially available
- Cheap oil may kill markets for alternative energy near term
- Fracking will spread globally



# Strategic Tech Challenges for the U.S.

- **Maintaining private R&D and advanced manufact base (e.g. 3D printing) → technological surprise**
- **Shift towards private sector R&D – inability of U.S. government to tap most cutting edge tech**
- **Increasing cyber vulnerabilities ( IoT ) – will grow exponentially in near term**
- **Asymmetric warfare aspects as non-state actors and small groups acquire high tech**
- **Organized Crime / Terrorist nexus**
- **Inability of governments and organizations to anticipate and react to global developments**

# Strategy & Policy Recommendations

- **Create an institutionalized, broad spectrum foresight capacity for tech and future security**
  - Detailed, pervasive monitoring of global S&T enterprise
  - Analytic capabilities to evaluate future tech trends in context of national, economic, societal security
  - Creating *actionable* recommendations for national strategy, policy, & budgeting that are *formally* utilized
  - Emphasize Whole-of-Gov (Society?) Responses
- **Re-engage with international bodies which create or manage tech innovation & infrastructure**
  - International Standards Bodies ( e.g. ISO )
  - Global Tech Governance ( e.g. ICANN, WTC )
  - Global Tech Policy / Ethics ( e.g. IPCC, UN Bioethics )

# Strategy & Policy Recommendations (2)

- **Re-invigorate the U.S. Tech and Industrial Base**
  - Increased R&D funding, esp cross-disciplinary
  - Re-build Federal S&T workforce, esp in Defense
  - Support for Advanced Manufacturing ( e.g. NNMI )
  - Expand Public-Private Partnerships (PPP) with states, industry, academia, financial/venture capital
  - Reform DoD Acquisition and Federal FAR
  - Secure global supply chains; promote high-tech trade
- **Prepare for the Next Generation Workforce**
  - New skills, expectations of the “wired” generation
  - New models for the workplace, and work itself
  - New models for lifelong, digital, personalized learning
  - Tapping the global community ( e.g. crowdsourcing )

# Other Issues of Concern

- **Increasing challenges to personal privacy**
- **Asymmetric global tech markets and trade**
- **Cybersecurity may get worse before it gets better**
- **Dawn of Directed Energy Weapons**
- **Transhumanism**

# Summary

- **Accelerating technological innovation already creating fundamental changes in global civilization and the pace will increase**
- **Changes could create big challenges for the U.S., particularly in terms of national & econ security**
- **“Business as usual” will not work for the U.S. We require new models for governance and investment**
- **Delaying the inevitable is not an option**