

**Biosecurity:  
A Multi-Dimensional Challenge of  
Escalating Complexity and Urgency**

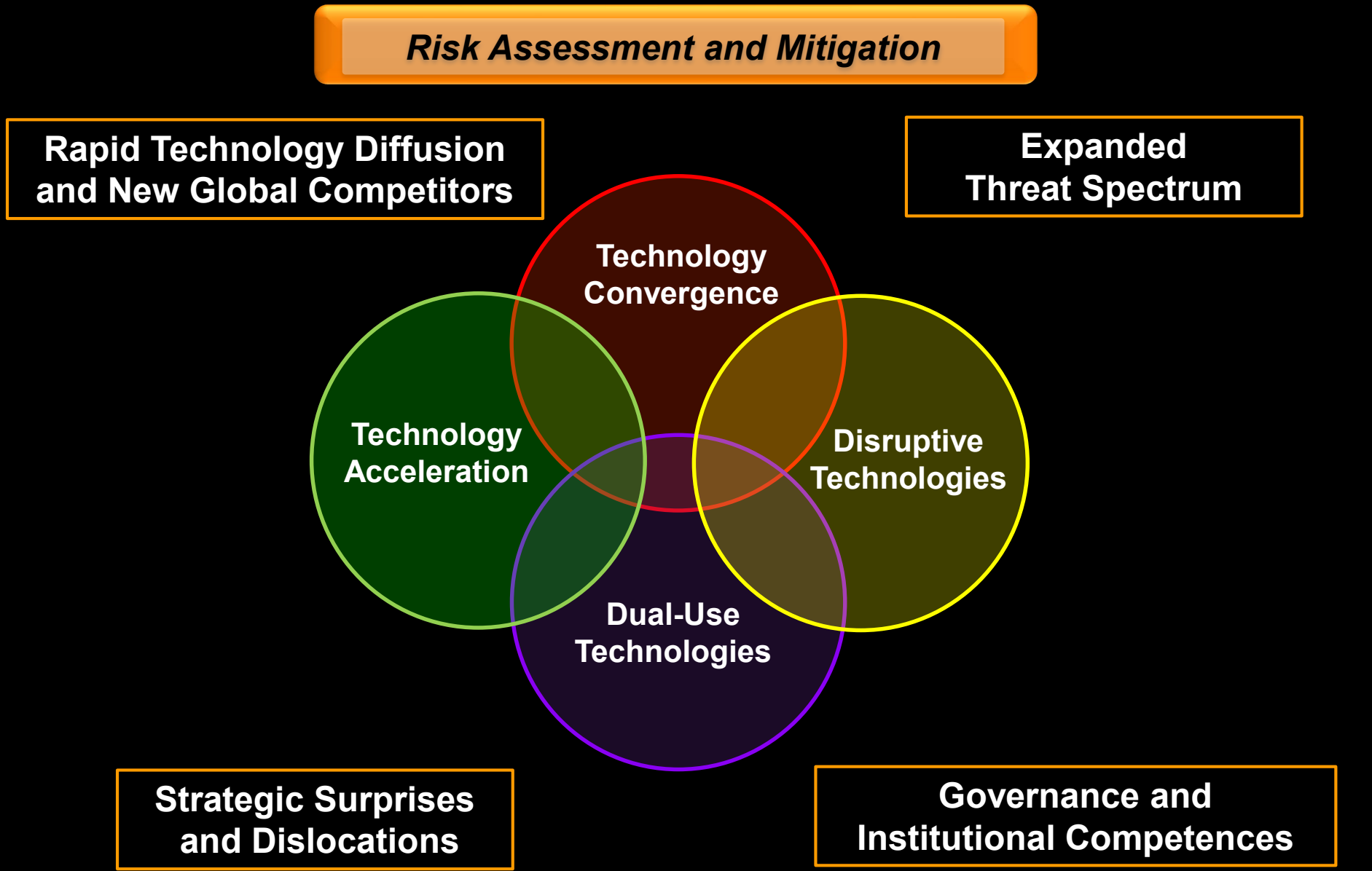
**Dr. George Poste**

Chief Scientist, Complex Adaptive Systems Initiative  
and Regents Professor of Health Innovation

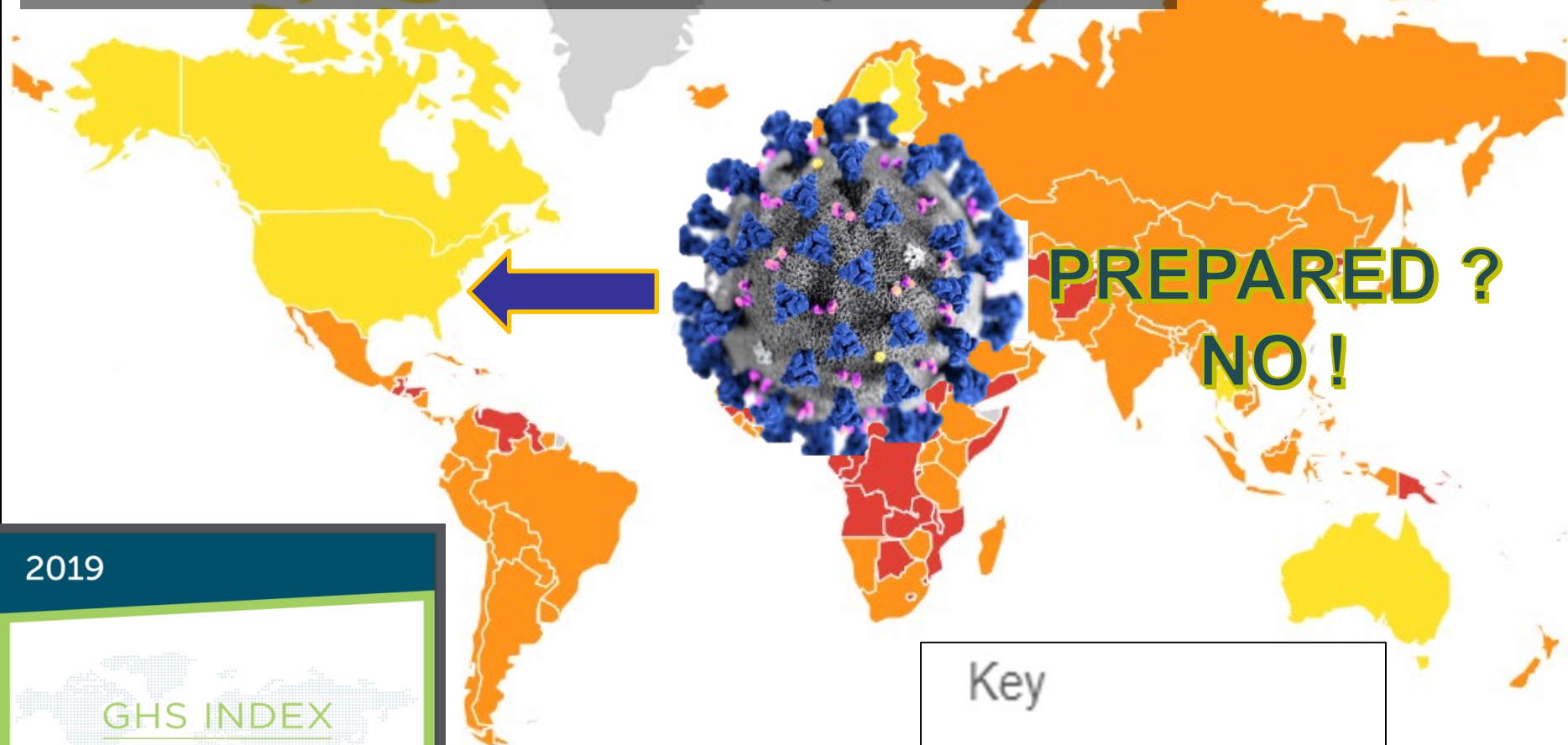
Arizona State University [george.poste@asu.edu](mailto:george.poste@asu.edu) [www.casi.asu.edu](http://www.casi.asu.edu)

**Planning for the Future**

# The Strategic Environment for Biosecurity



# Sars-CoV-2 Revealed Major Shortcomings in the US Public Health Capabilities



2019

GHS INDEX  
GLOBAL HEALTH  
SECURITY INDEX

Building Collective Action and Accountability



Index developed with  
the  
Bill & Melinda Gates Foundation

Key

- Most Prepared
- More Prepared
- Least Prepared

# **Building Robust Preparedness to Combat Epidemic and Pandemic Infectious Diseases**

- **shared requirements whether of natural or nefarious origin**
  - **“all-hazards”**
- **major vulnerabilities exist across the entire spectrum of required capabilities**
  - **global biosurveillance, pre-emptive detection and interdiction**
  - **rapid diagnosis, track and trace**
  - **healthcare resources for large scale bioincidents**
  - **drug and vaccine availability supply chain fragilities and mass distribution logistics**
  - **outdated public health laws: national and international**
  - **institutional competences and agility (international: WHO; and national: CDC, NIH, DoD, USDA)**
  - **inadequate proactive engagement of private sector expertise and production scale**



## **COVID-19:**

### **The Past as Prologue and the Continued Present**

- the quest for high levels of ‘herd immunity’ (>60%)
  - vaccination and/or natural infection
- will mutational drift in SARS-CoV-2 render current vaccine strategies ineffective and require constant vaccine redesign (cf. influenza)?
- strengthen diagnostic test, track and trace capabilities for rapid containment of future ‘hot spot’ flaring
- will SARS-CoV-2 show progressive reduction in virulence and become endemic to join the four other low virulence coronaviruses that circulate?

# Global Preparedness to Combat Infectious and Parasitic Disease

- comparable vulnerabilities to shortcoming in human public health preparedness apply to protection of critical agricultural and ecological resources



**Swine Fever**



**Crop diseases**



**Increased famine risk from  
reduced agricultural  
productivity**

# Connectivities: Climate Change and New Diseases Patterns



**Desertification and  
agricultural productivity**



**Deforestation and  
depletion of natural  
resources**



**New vector ranges for  
infectious disease  
transmission**

# Global food system emissions could preclude achieving the 1.5° and 2°C climate change targets

Michael A. Clark<sup>1\*</sup>, Nina G. G. Domingo<sup>2</sup>, Kimberly Colgan<sup>2</sup>, Sumil K. Thakrar<sup>2</sup>, David Tilman<sup>3,4</sup>, John Lynch<sup>5</sup>, Inês L. Azevedo<sup>6,7</sup>, Jason D. Hill<sup>2</sup>

The Paris Agreement's goal of limiting the increase in global temperature to 1.5° or 2°C above preindustrial levels requires rapid reductions in greenhouse gas emissions. Although reducing emissions from fossil fuels is essential for meeting this goal, other sources of emissions may also preclude its attainment. We show that even if fossil fuel emissions were immediately halted, current trends in global food systems would prevent the achievement of the 1.5°C target and, by the end of the century, threaten the achievement of the 2°C target. Meeting the 1.5°C target requires rapid and ambitious changes to food systems as well as to all nonfood sectors. The 2°C target could be achieved with less-ambitious changes to food systems, but only if fossil fuel and other nonfood emissions are eliminated soon.

# **“One Health”**

**the inter- dependencies of human health,  
animal health and ecosystems stability**

**the increased importance of ‘spillover’ of  
animal pathogens as reservoirs of emerging  
infectious diseases with pandemic potential (zoonoses)**

# 'One Health' Biosurveillance: The Need to Rebuild the Front Line in Biopreparedness



- range and physical contact
- environmental factors

- demographics
- cultural, political and economic factors
- health system capacity to detect/respond



**Fast Track Action Committee Report:  
Recommendations on the Select Agent  
Regulations Based on Broad  
Stakeholder Engagement**

**October 2015**

**National Science and Technology Council  
Committee on Homeland and National Security  
Subcommittee on Biological Defense Research and  
Development  
Fast Track Action Committee on the Select Agents  
Regulations**

## Addressing Antibiotic Resistance

A REPORT FROM THE JOINT APLU | AAVMC TASK FORCE  
ON ANTIBIOTIC RESISTANCE IN PRODUCTION AGRICULTURE



## National Quality Partners Playbook™:

ANTIBIOTIC STEWARDSHIP IN  
POST-ACUTE AND LONG-TERM CARE

## ANTIBACTERIAL AGENTS IN CLINICAL DEVELOPMENT

An analysis of the antibacterial clinical development pipeline,  
including tuberculosis



development dialogue paper  
no.26 | december 2018

Antimicrobial resistance and sustainable development:  
**A planetary threat  
but a financing orphan**

Planet Earth faces the very real threat of having to survive and thrive in a 'post-antibiotic' era in which there are few, if any, antibiotics which effectively and affordably cure infections. A world without antibiotics would necessitate radical changes in health care and farming. Despite the severity of this threat, many low- and middle-income countries struggle to identify resources for even basic activities related to antimicrobial resistance (AMR). In this context, the Dag Hammarskjöld Foundation and ReAct - Action on Antibiotic Resistance hosted a meeting to discuss how AMR could become more visible and how more funds to tackle AMR could be mobilised.

WHO GUIDELINES ON  
USE OF MEDICALLY  
IMPORTANT ANTIMICROBIALS  
IN FOOD-PRODUCING ANIMALS





# The Longer-Term Economic Consequences of COVID-19



- **Government and central bank policies**
  - debt, taxation, inflation
- **Business sector recovery**
- **PRC ascendancy ?**

# The Baby Boomers and an Aging US Society An Unrecognized Biosecurity Threat?



- 10,000 boomers turn 65 every day
- 79% projected increase in boomers 80 or older by 2030
- dramatic growth in chronic disease burden
  - the toll of multiple-comorbidities
- \$4 trillion US healthcare economy (c.19% GDP)
  - political reluctance to confront looming unsustainable cost of unlimited care-
- unchecked cost as a potential risk to needed investments in global public health, climate change mitigation, corporate innovation and military competitiveness in advanced technologies

**technology acceleration and convergence**

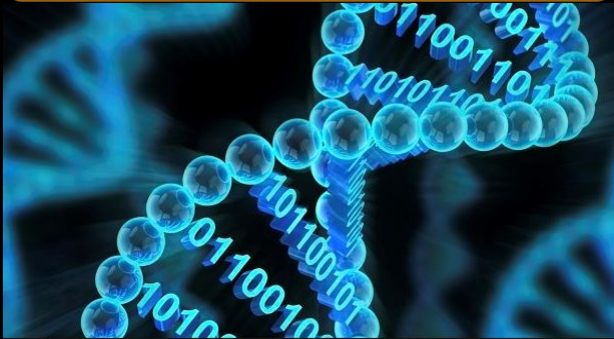
**new great power rivalry for commercial and military  
superiority in next-generation technologies**

**expansion of the dual-use threat dilemma**



# New Technologies and Increased Complexity of Dual-Use Issues in Biosecurity: Synthetic Biology, Genome Editing and Manipulation of Biological Pathways

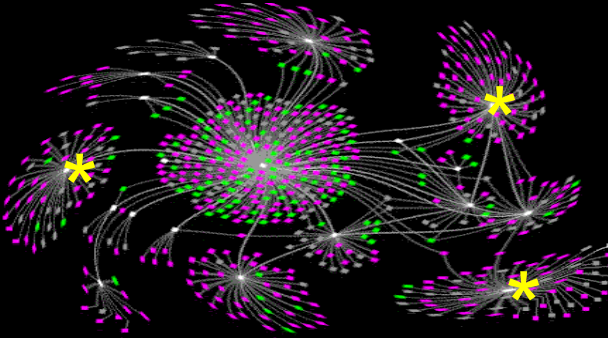
**digital biology:  
“it from bits”**



**de novo  
synthesis of organisms**



**engineered  
virulence**



**targeted modification of any  
biological pathway in any  
organ**

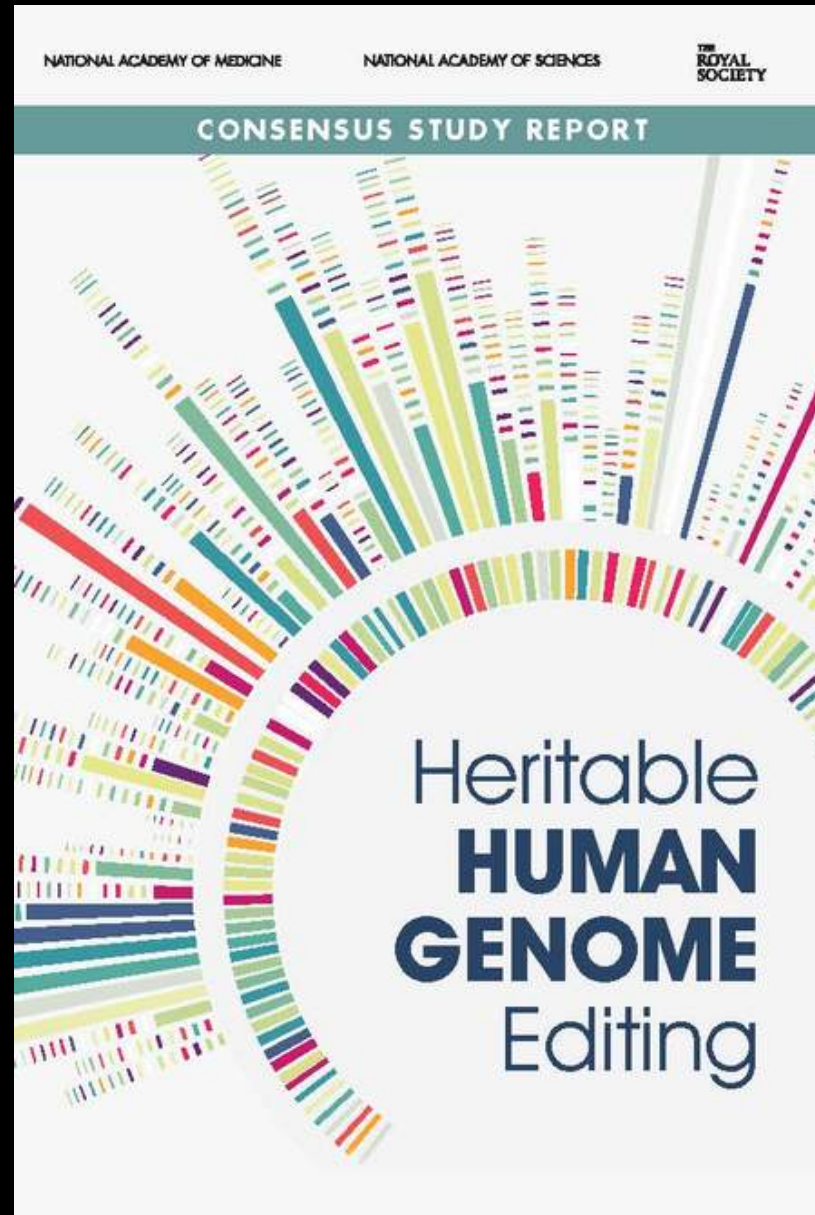


**modulation of neural sensory  
and cognitive pathways**



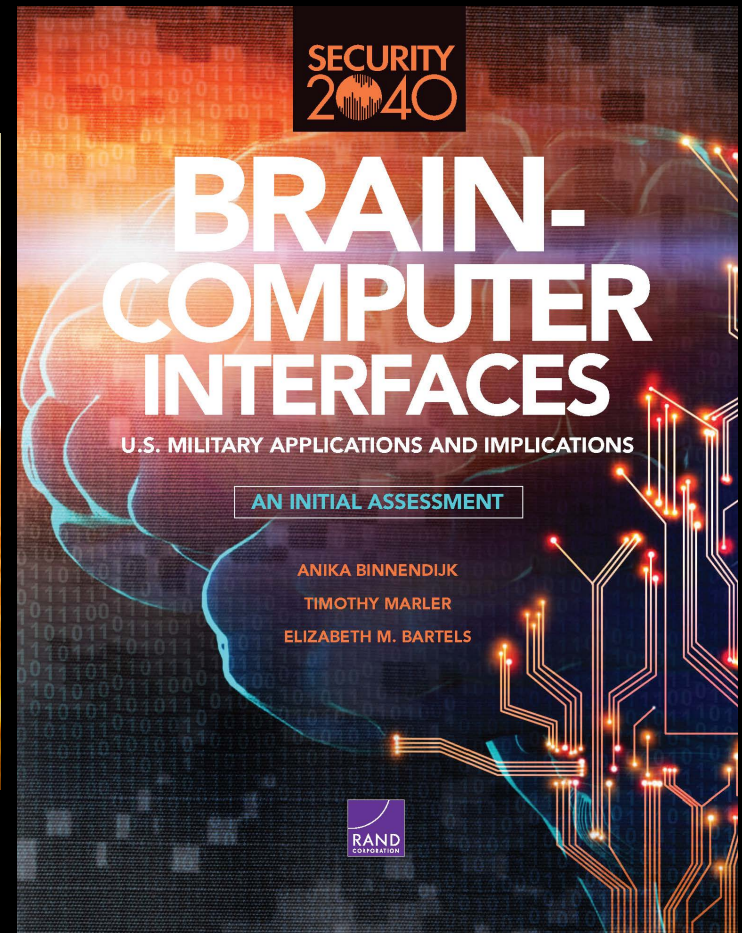
**accelerating technological  
diffusion**

# Synthetic Biology, Gene Editing and Human Eugenic Modification



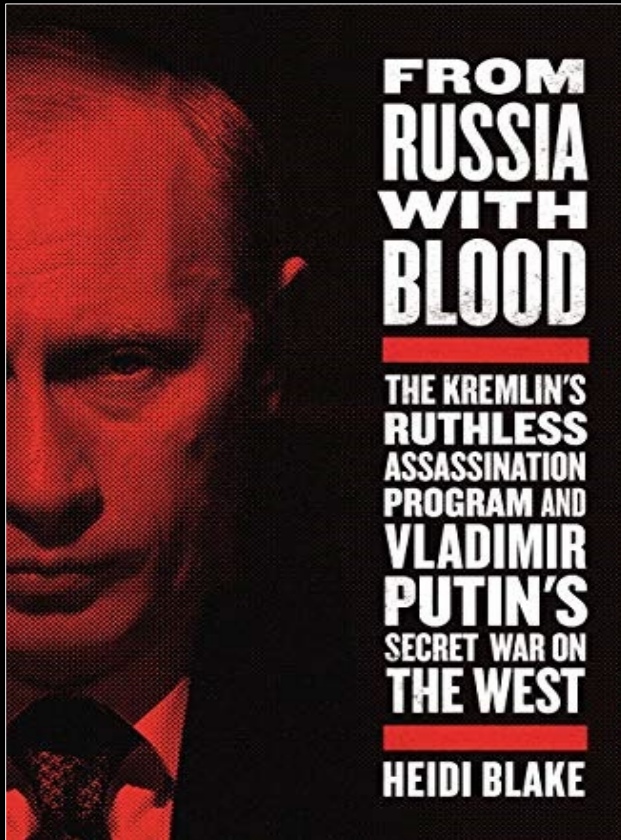


# Cognitive Computing, Brain: Machine Interactions and the Enhanced Warfighter



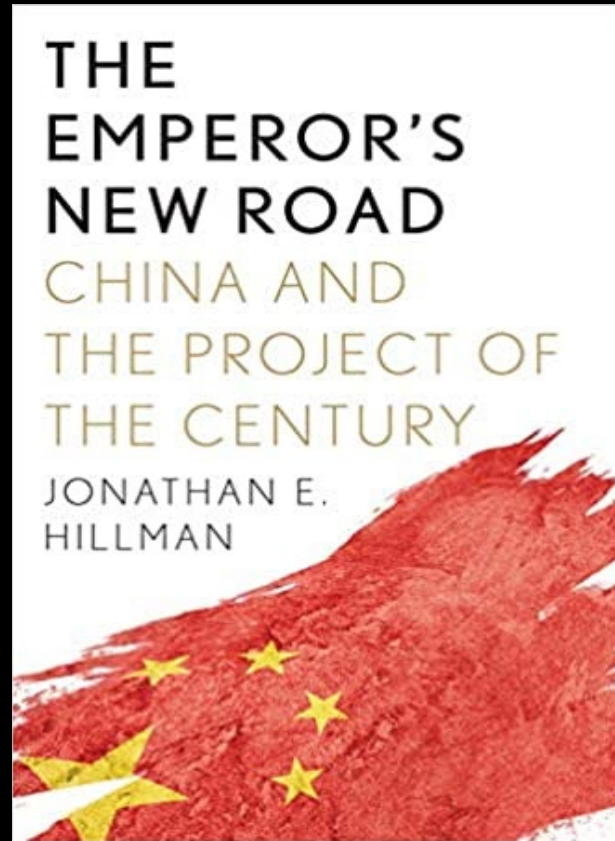
# The Quest for Commercial and Military Dominance in Advanced Technology

## THE NEW COLD WAR?



**Adversary**

- military
- economic fragility



**Adversary**

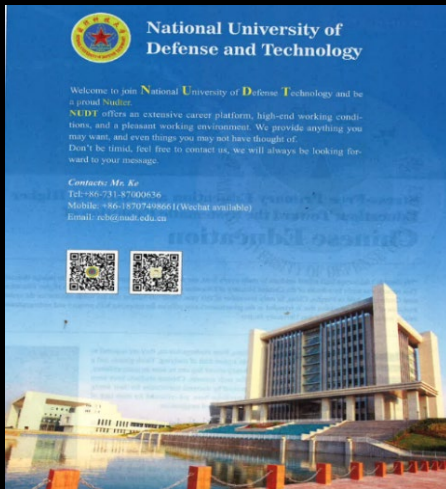
- military
- commercial
- post-COVID ascendancy

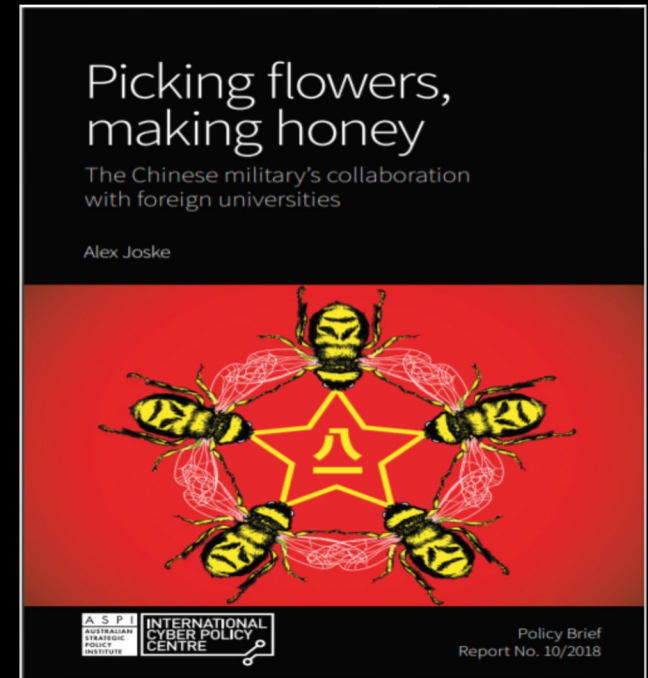


# PRC: The Military-Civil Fusion Plan



- integrate civilian R&D to maximize the capabilities of the People's Liberation Army
- Commission for Military-Civil Fusion Development
  - led by President Xi
- the “Digital Silk Road” as a component of the larger Belt-and-Road initiative
- 2019 China Standardization Development Report
  - 85 cooperation agreements with 49 countries



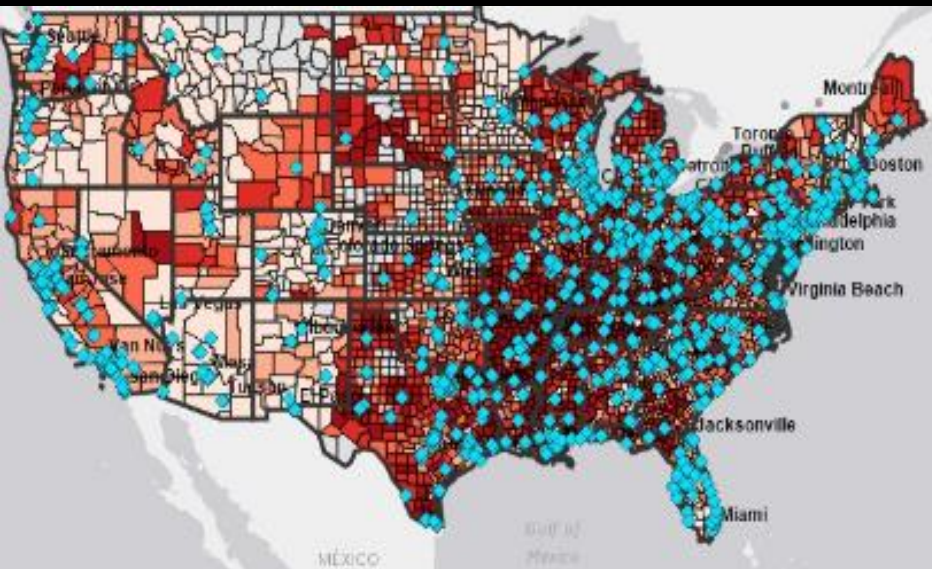


- major R.& D. investments and sophisticated biotechnology/computing expertise
- purposeful creation of large diaspora for training in US/EU universities
- relentless industrial espionage and relentless cyber- exfiltration efforts
- mapping the genetic diversity of human populations



# National Security Implications of Genomic Data on Populations

## Population Databanks



## Individual Profiles



## Foreign Access to Data



## Data Security





OFFICE OF THE SECRETARY OF DEFENSE

1000 DEFENSE PENTAGON  
WASHINGTON, D.C. 20301-1000

DEC 20 2019

MEMORANDUM FOR: SEE DISTRIBUTION

SUBJECT: Direct-to-Consumer Genetic Testing Advisory for Military Members

It has come to the attention of the DoD that some direct-to-consumer (DTC) genetic testing companies are encouraging DoD personnel to purchase genetic ancestry and health information through the offering of military discounts or other incentives. These DTC genetic tests are largely unregulated and could expose personal and genetic information, and potentially create unintended security consequences and increased risk to the joint force and mission.

Exposing sensitive genetic information to outside parties poses personal and operational risks to Service members. DTC genetic tests that provide health information have varying levels of validity, and many are not reviewed by the Food and Drug Administration before they are offered, meaning they may be sold without independent analysis to verify the claims of the seller. Possible inaccuracies pose more risk to DoD military personnel than the public due to Service member requirements to disclose medical information that affects readiness (see DoD Instruction 6025.19, "Individual Medical Readiness"). Testing outside the Military Health System is unlikely to include a clear description of this risk.

Moreover, there is increased concern in the scientific community that outside parties are exploiting the use of genetic data for questionable purposes, including mass surveillance and the ability to track individuals without their authorization or awareness.

Until notified otherwise, DoD military personnel are advised to refrain from the purchase and/or use of DTC genetic services.

Joseph D. Kernan

Under Secretary of Defense for Intelligence

James N. Stewart

Assistant Secretary of Defense for Manpower  
and Reserve Affairs, Performing the Duties  
of the Under Secretary of Defense for  
Personnel and Readiness



# PRC Quest to Dominate AI and Quantum Computing



## Deciphering China's AI Dream

The context, components, capabilities, and consequences of China's strategy to lead the world in AI



Jeffrey Ding\*

Centre for the Governance of AI

Future of Humanity Institute, University of Oxford

March 2018

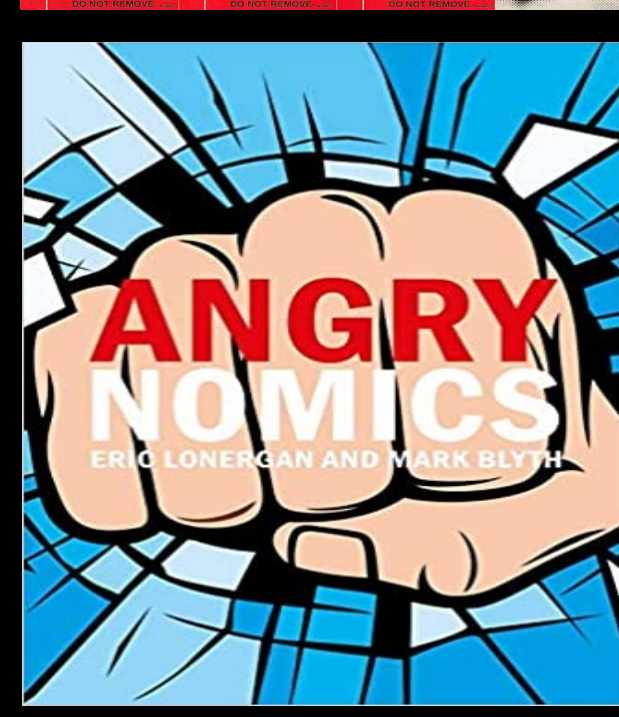
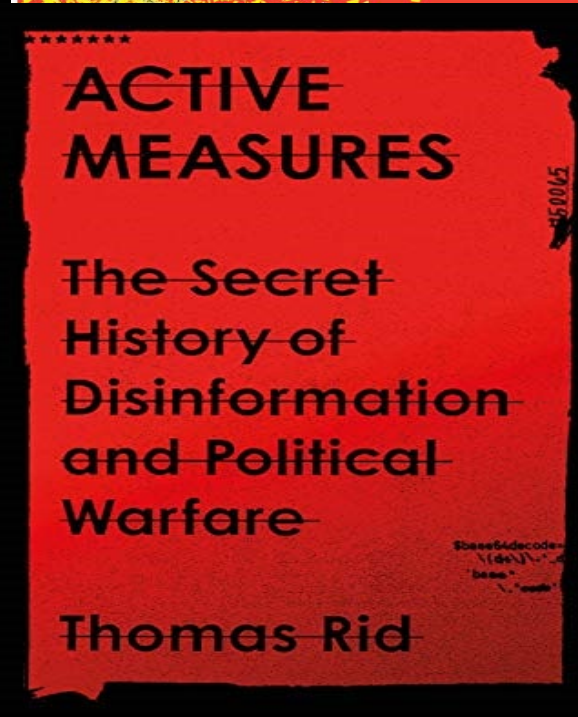
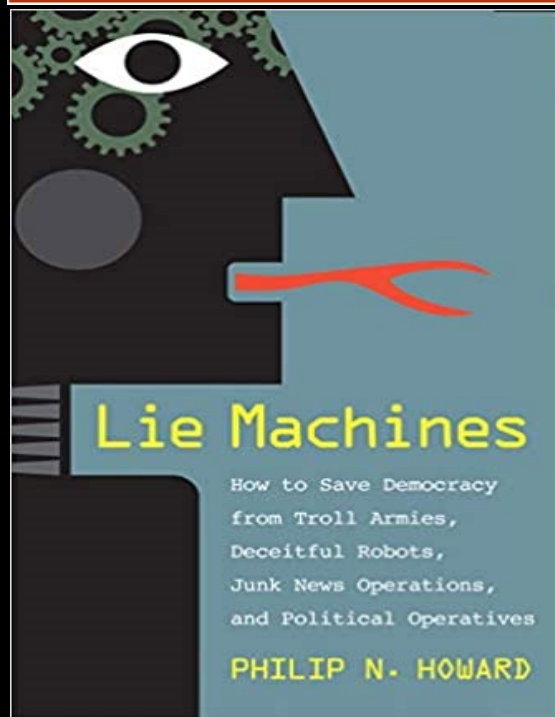
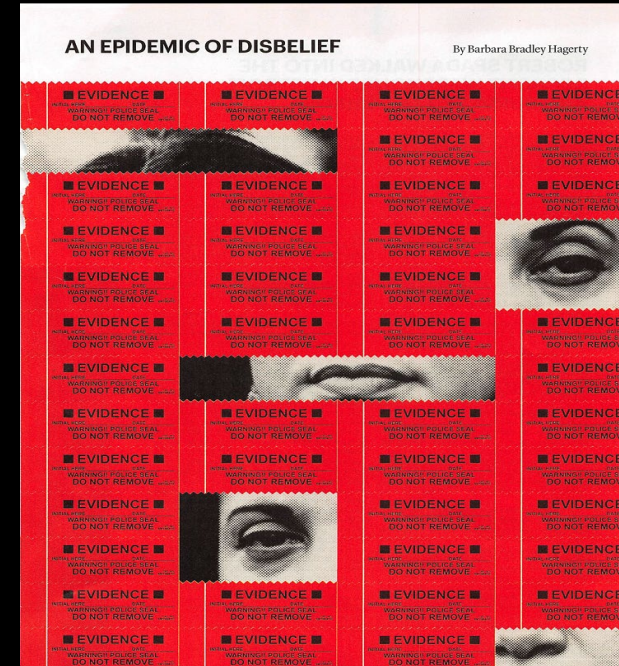
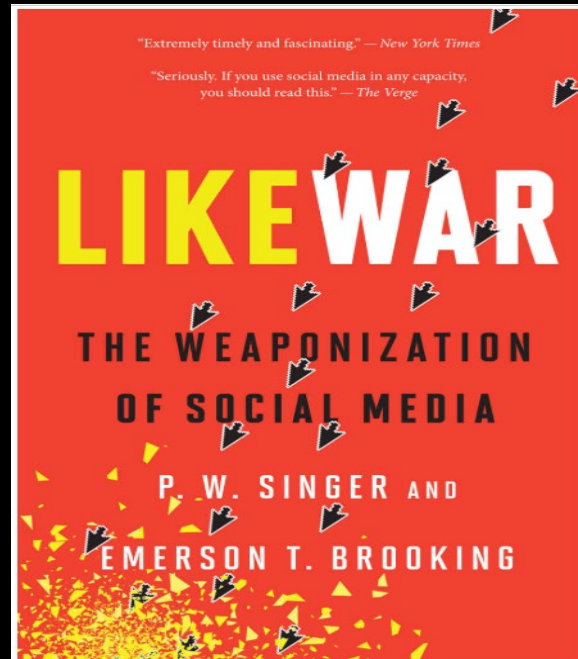
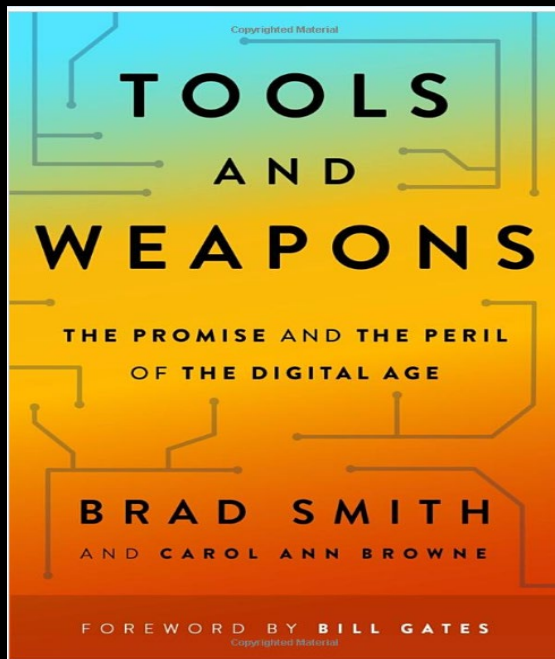


# **Gray Zone Threats**

**An Emerging Dimension of Hybrid Warfare**

**New Risks in the Gray Zone Between  
Peace and Major Conflict**

**Implications for Biosecurity**





## ‘Big Tech’ and the Global Digital Ecosystem

- increasing pervasive reach of data collection on individuals, institutions, societies and governments

amazon

Alphabet



facebook

NETFLIX

Microsoft

LexisNexis

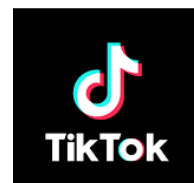
Яндекс

Baidu

Alibaba.com

Tencent 腾讯

ByteDance



HUAWEI

## **Surrender of Personal Privacy and Autonomy For Access to the Conveniences of the Digital Economy**

- **the confessional of social media**
- **click-based commercial and political targeting**
- **opaque data use and distribution by large data companies/governments**
- **anticipate our “wants and needs”**
- **“access to your mental states”**

# Artificial Intelligence: What Algorithms Provide (Want?)



**“I actually think most people don’t want Google to answer their questions. They want Google to tell them what they should be doing next.”**

**Eric Schmidt  
Chairman, Google  
Wall Street Journal (2010)**

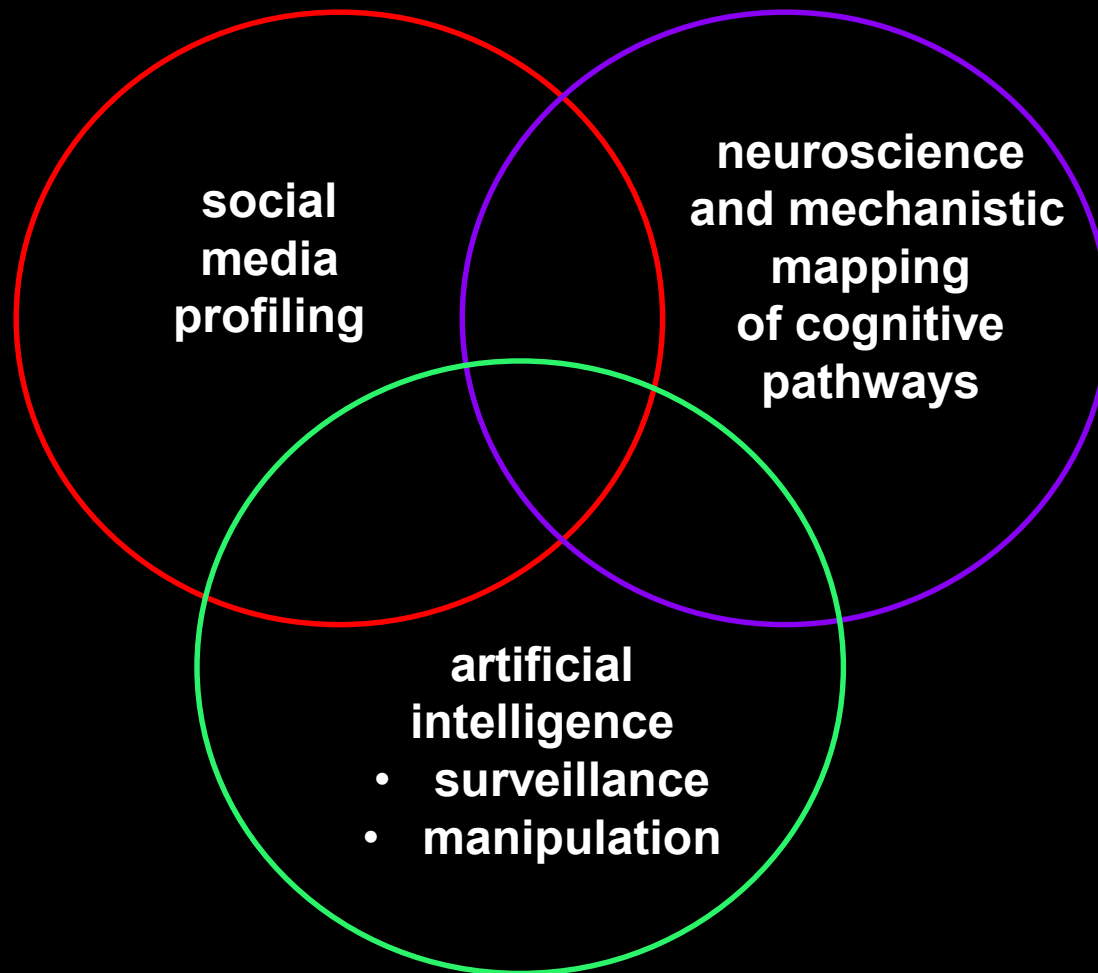
## **Digital Surveillance: Access to Your Mental State(s)**

- **tracking of personal data, use patterns and predictive analytics**
- **insidious erosion of privacy and personal autonomy**
- **monitoring and tracking technologies outpacing regulatory/legislative protections**

# Big Data Analytics: From Consumerism to Control?



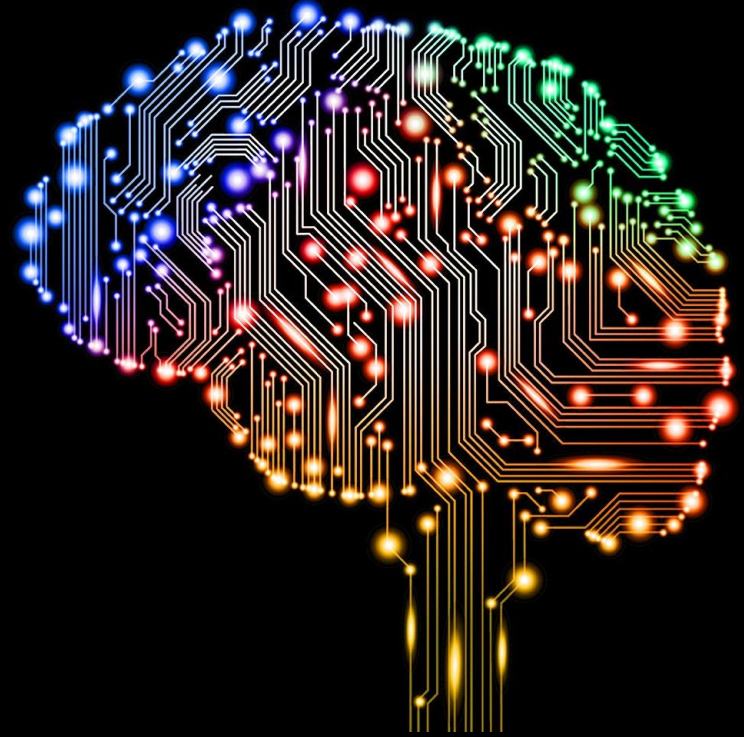
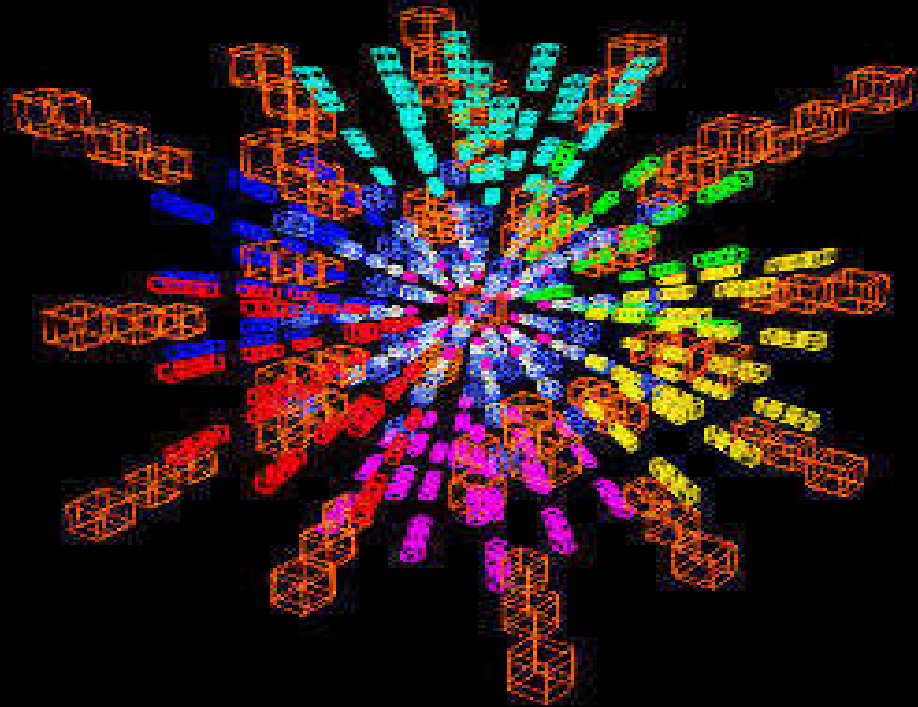
# **Big Data Meets Neuroscience – The Ultimate Technological Triad: Consumerism, Commerce and Control**





# AI: Data Finding Data- “Intelligence at Ingestion”

## Why Wait for the Slow (Human) Brain to Catch Up?



**Feature  
Extraction  
and  
Classification**



**Context  
Analysis**  
↕  
**Persistent  
Context**



- **Relevance Mapping**
- **Learning Systems**



- **Situational Awareness**
- **Rapid, Robust Decisions**



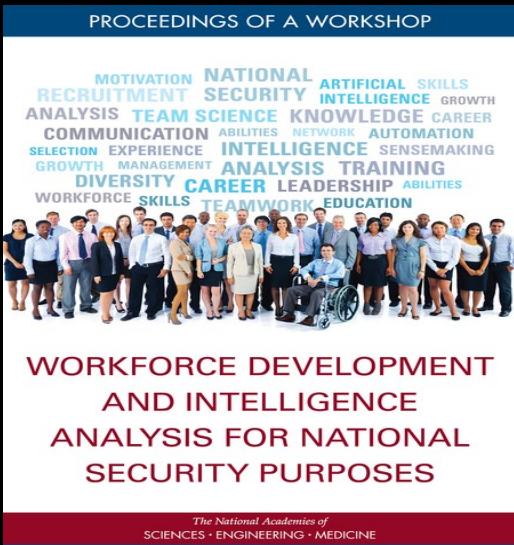
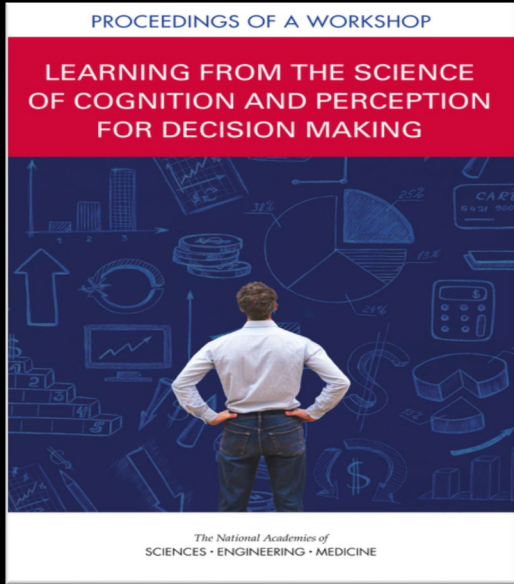
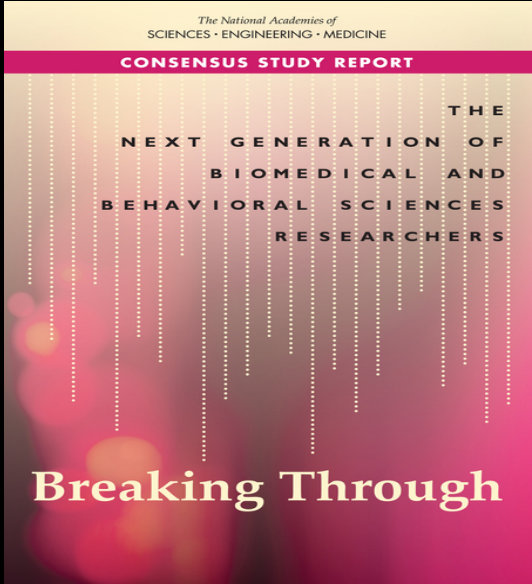
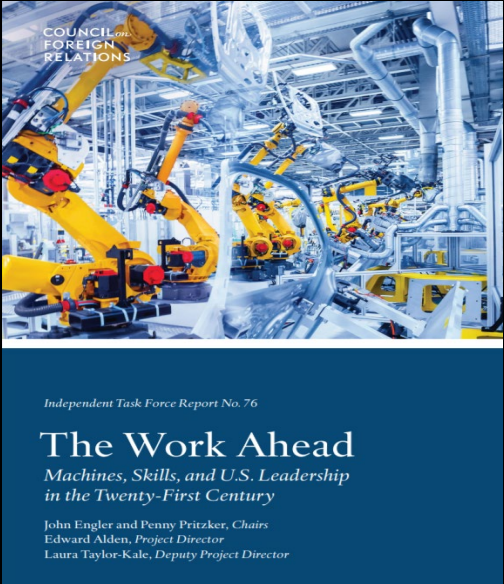
# **“Explainable AI”**

## **Keeping Humans in the Decision Loop**



- **need to better characterize the evolution of decision algorithms**
- **deconvolution of how and why machine learning algorithms reach flawed conclusions**
- **broad national security issues related to data integrity**
- **concern over AI-directed manipulation of social networks, advertising and personal data**
- **corruption of critical military and civilian systems and decision tools**

# Robotics, Automation, AI and Decision-Support: The Future of Work, Education and The Future Workforce



# **Biosecurity**

- **long predicted rude shock of a global pandemic and neglect of preparedness**
- **biosecurity is ‘more than bugs’**

# **Biosecurity:**

## **A Complex System Nested in a Matrix of Multiple Complex Systems**

- **technology**
  - public health, healthcare, agriculture, data science
- **ecosystems**
  - urbanization, natural resources depletion, water, food, climate change
- **socio-economic**
  - haves and have nots
- **governance**
  - domestic and foreign policies, regulation, international cooperation
  - industry and military
  - the quest for superiority in advanced technologies



## **Biosecurity**

- **escalating complexity imposes new challenges on governance and institutions**
- **decision-making in the face of accelerating change and accompanying uncertainties**
- **national leadership, governance and institutional relevance**
  - **integration of multi-dimensional complexity**

# **The Curse of Contemporary Governance: 'Quick Fixes' and the Retreat from Complexity**

- **society increasingly “cocooned” from complexity and risk**
- **pervasive and dangerous scientific illiteracy among legislative and policy makers about biosecurity( and advanced technologies at large)**
- **“quick fixes”, and unidimensional, short term policies**
  - **policy too often defined by length legislative terms**
  - **failure to address long term, multidimensional complexities**
  - **dangerous myopia of national vs global perspectives**



**PREPARE FOR  
TOMORROW'S  
THREAT TODAY**

**“Plus ça change, plus c’est la même chose”**

**“Politics is the art of the possible,  
the calculated science of survival”**

**Prince Otto von Bismarck**



**“Survival owes little to the art of politics,  
but everything to the calculated application  
of science”.**

**Professor Rudolph Virchow  
(in reply)**

