National Security Implications of the Fourth Industrial Revolution

Linton Wells II
Centre of Excellence for National Security (CENS),
Distinguished Visitor Program (DVP) Lecture
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Overview

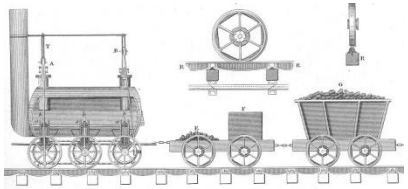
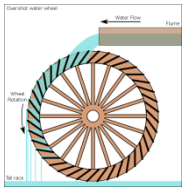
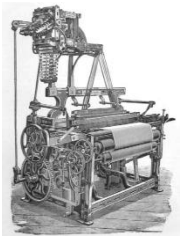
- Four Industrial Revolutions
- Intersections with Current Military Developments
  - High end
  - Civil-Military Convergence
  - Small, Smart, and Many
- International Challenges
  - Why, how, who do we fight? Who pays?
  - Geo-political, strategic, institutional
- Implications of Converging Trends
  - Job-related security issues
  - Complexity lens
  - Reduce pressures for migration & radicalization--BROCADE project
  - Investment strategies
- Challenges for National Security Decision-Makers

Security Definition

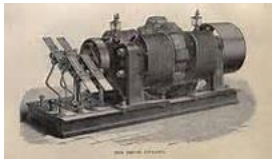
Freedom from want and freedom from fear

Four Industrial Revolutions

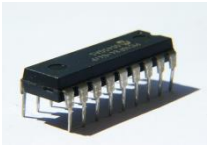
- 1st ~1780s:

- 2nd ~1870:


- 3rd ~1969:



- 4th just beginning: fuse technologies "blur lines between physical, digital and biological spheres"




Source: Klaus Schwab, "The Fourth Industrial Revolution: what it means, how to respond," 14 January 2016 http://www.weforum.org/agenda/2016/01/, accessed February 16, 2016

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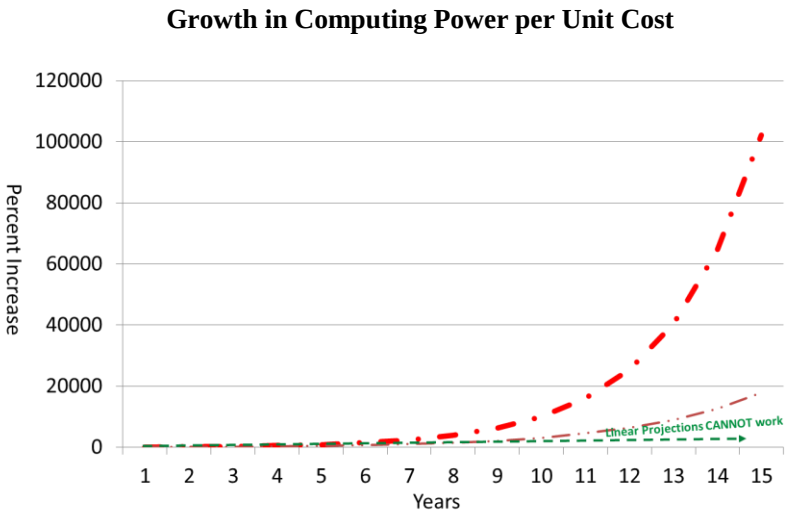
4th Industrial Revolution (4th IR)

- Key distinctions between 3rd & 4th revolutions:
  - Velocity of change, scope, and systems-wide impact
    - Massively disruptive, and accelerating
    - Transforming management, as well as production and distribution
    - Can provide very important collective benefits to society, but also negatively affect many individuals
      - Loss of jobs and pace of social change
      - Machine learning and artificial intelligence

- Responses must engage public-private, whole-of-society, and trans-national stakeholders
  - In comprehensive, integrated ways

Velocity of Tech Change

If a factor, e.g. computing power/unit cost, doubles every 18 mo, 5 yr increase is 900%, 10 yr 10,000%, by 2030 ~100,000%



Biotech even faster, robotics ubiquitous, nano poised breakout, energy impacts are global

- Think BRINE (bio-robo-info-nano-energy) + Additive Manufacturing

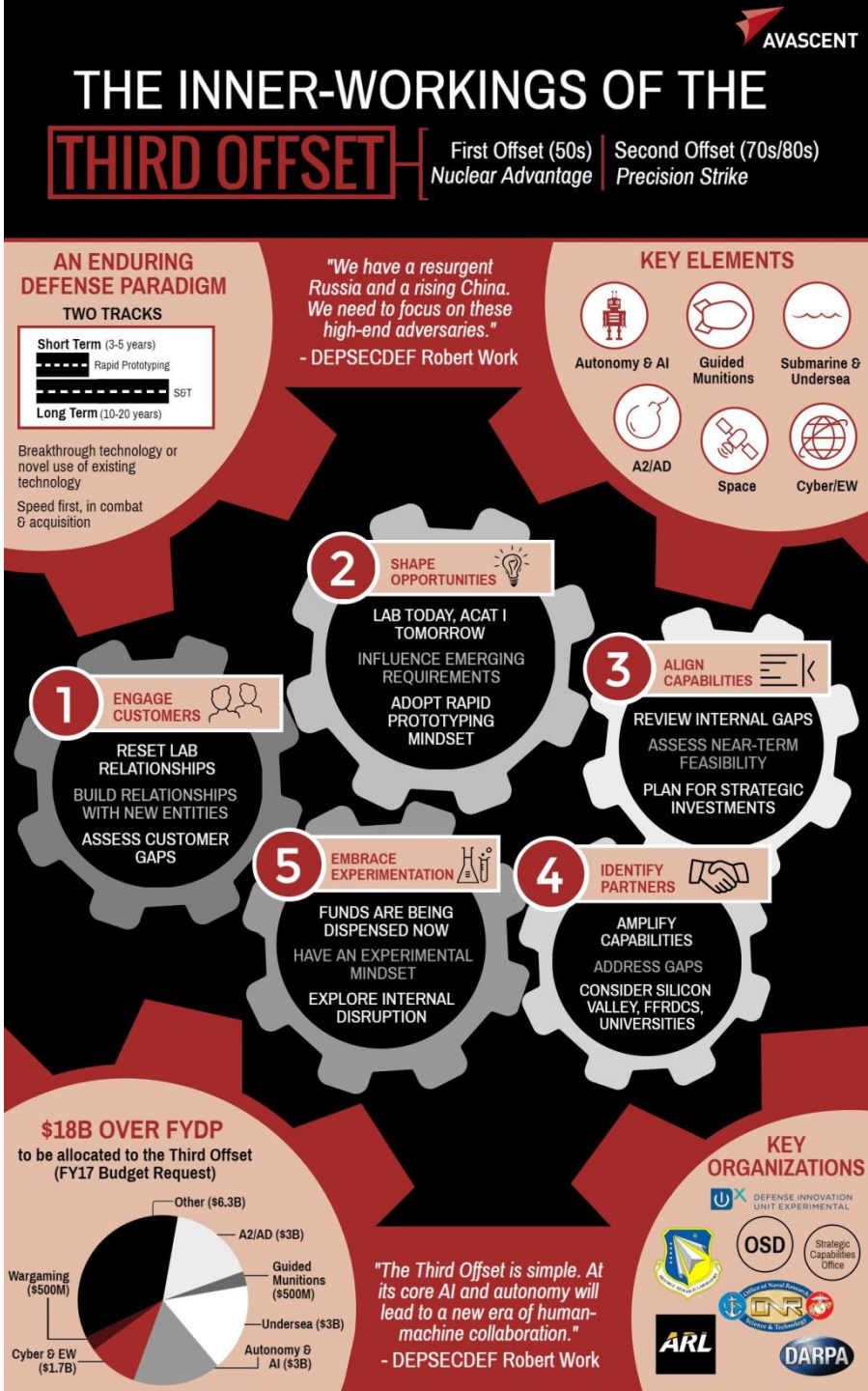
Interactions complicate things

Linear projections CAN'T work

Third Offset Strategy [3rd OS] (1)

- Leverages many similar technologies as 4IR
- Focused on challenges like:
  - "1,000 nautical mile anti-access challenge…
  - Inter-theater area denial
  - Closing the last tactical mile,
  - All while operating under intense cyber & electronic warfare attacks"

All quotes from DepSecDef Robert Work 2015
Infographic from Avascent Analytics, http://www.avascent.com



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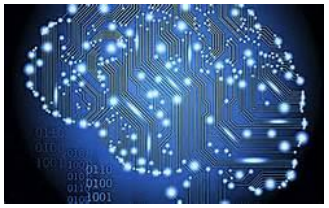
Third Offset Strategy (2)

- 5 main building blocks:
  - **Learning machines**:

  - **Human-machine collaboration**:



  - **Advanced human-machine combat teaming**:

  - **Assisted human operations**:

  - **Autonomous weapons**:

Focused on potential adversary capabilities, not just intentions

Third Offset Strategy (3)

- Goal of 3rd OS is to "make humans more effective in combat" Much in common with 4th IR
  - In both areas people must be empowered to address most serious challenges
  - Tech is important, but both involve adaption and, ideally anticipation, across organizations, people, and processes, as well as technology
- **NOT JUST TECH**

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Convergence of Commercial Trends will Affect C4ISR*

- Velocity of Tech Change
- Explosion of Sensors—many-non-government
- Cyber and EW—Kinetic and Non-Kinetic Fires
- Info Sharing & Security
- Data Visualization/Virtual Reality
- OODA Loop & Decision Cycles

*Command, Control, Communications, Computing, Intelligence, Surveillance, Reconnaissance

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Explosion of Sensors

- Open Source ISR-GIS

- UASs

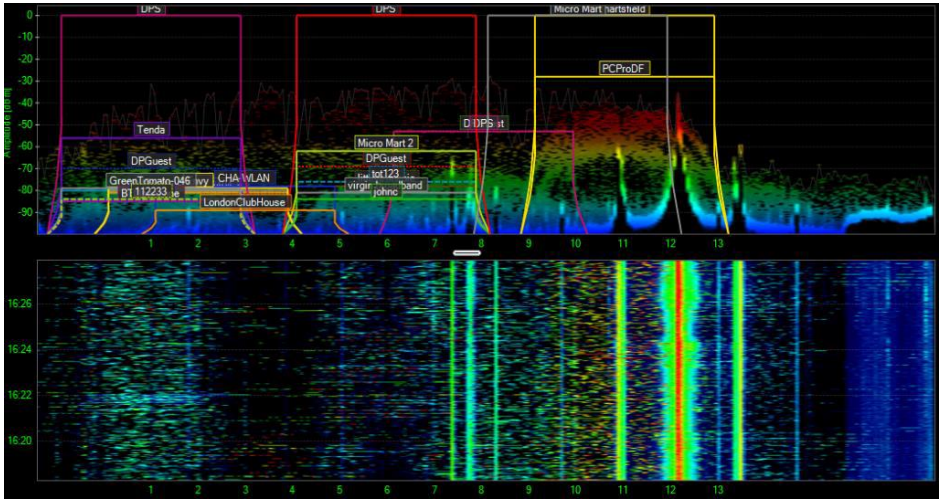
- IV4 (Info Volume, Velocity, Veracity, Value)

- Mobile, Wearable

- Internet of Things (IoT)

Cyber and EW Convergence
Kinetic & Non-Kinetic Fires

- Maneuver in Electromagnetic Spectrum (EMS) Space
  - Navy Electromagnetic Maneuver Warfare (EMW)
  - Army Cyber Electromagnetic Activities (CEMA)
    - EW Planning & Management Tool (EWPMT)
  - Marine Corps Cyber EW Coordination Cell (CEWCC)
  - USAF
- C4ISR Implications



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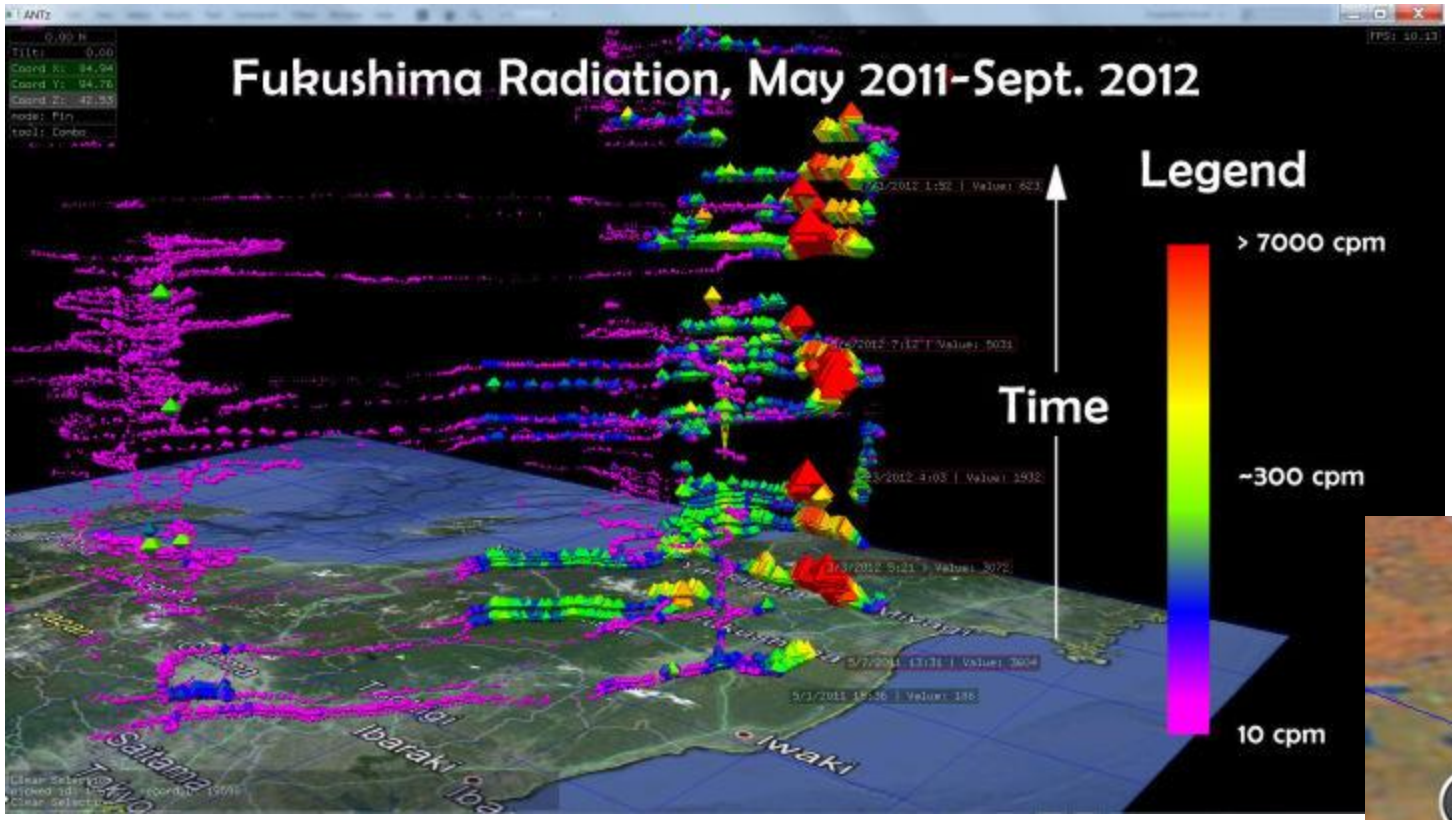
Info Sharing and Security

- Info Sharing Rules
- Alternative approaches to cybersecurity
  - Big data
  - NRT anomaly detection
  - Supply chain, blockchain
- Major policy, legal, moral, ethical, privacy issues

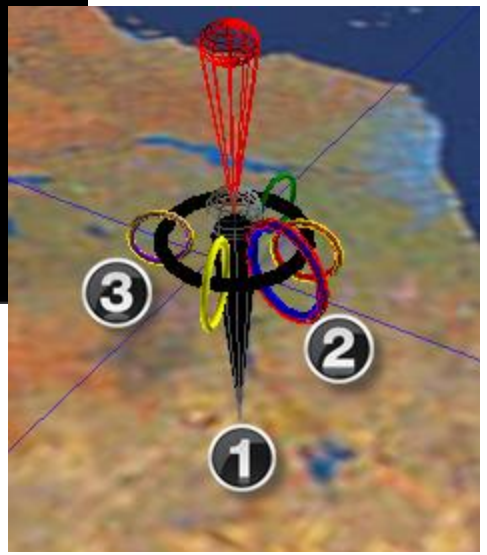
Command and Control/Sensemaking/ Decision Support

How to achieve "Unity of Action" when there's no "Unity of Control?"

Data Visualization/Virtual Reality



Graphics by SynglyphX



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OODA Loop & Decision Cycles

- "Observe" and "Orient" phases increasingly electromagnetic
- "Decide" and "Act" supported by information processing
- Cyber can dominate OODA loop in any domain
- Tech changes
  - Processing power
  - Machine learning
  - Sensor proliferation
  - Army 2050 battlefield—can you move?
- Speed of decisions
  - "Man-on-the-loop," vice "Man-in-the-loop"

Image courtesy successing.com

Cheap Tech Challenges U.S. Tactical Dominance

- Evolving Tech
  - Additive Manufacturing—drones, EFPs
  - Nanotech—nanoexplosives and nanomaterials
  - Space-like capabilities—GIS, ORS, Aerial Layer
  - AI—convergence of tech to make cheap, widely available, autonomous weapons
- Implications for Modern Battlefield
  - Irregular Warfare, Conventional Warfare (Ground, Sea, Air, Space, Cyber)

- Strategic Implications—cost of intervention rises
  - "Small, smart and many" represent excellent investments for adversaries
  - US may be underinvesting in evolving 4IR tech that's changing nature of warfare

Regulating Radical Leveling Technologies (RLTs)

- RLTs being driven by "power and expertise of online Open Source Communities" (OSC)
  - Additive Manufacturing
  - Synthetic Biology and Biohacking
  - Global effects with little strategic warning

- Existing regulatory mechanisms can't prevent proliferation. Proposals include:
  - Collaborative approaches with OSC participants
  - Cyber bounties, cyber privateering, cyber civilian militia

Maj Jennifer Snow, NPS Thesis Dec 2015

Macro International Security Issues*

- Why, how, who do we fight? Who pays?
- Geo-political disruption
  - Resources, talent, social & political systems
- Strategic de-stabilization
  - Abstraction of war, rapidly changing asymmetries, lack of transparency, destabilizing offensive tech, new domains of conflict, diffusion of capabilities for violence
- Challenges to existing security institutions
  - Weakened state-centric institutions, blurred boundaries, distributed power

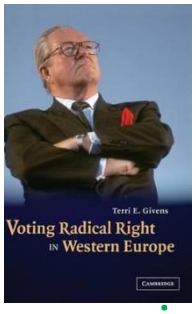
*Formulation from Espen Barth Eide, Anja Kasperson, Philip Shetler Jones, "the 4th Industrial Revolution and International Security," forthcoming

4th IR Job-Related Security Issues

- 4th IR can raise global incomes and improve quality of lives
  - More unequal and disrupted labor markets
  - Loss of jobs, "low-skill/low-pay" and "high-skill/high pay" groups
  - Societal inequalities and social tensions
- Service jobs particularly vulnerable to automation
  - Services are some 80% of developed world employment, growing role in developing economies
  - 2013 Oxford study: "around 47 percent of total US employment is [at high risk for being replaced by "computerization"]…perhaps over the next decade or two."
  - Futurist Thomas Frey has projected disappearance of 2 billion worldwide jobs by 2030, particularly in power industry, transport (Singapore's nuTonomy taxi), education, 3D Printers, and bots

Job-Related Security Implications (2)

- Impacts likely to be more severe in youth bulge areas
  - Parts of Islamic world, South Asia and sub-Saharan Africa, plus megacities and under-served parts of developed world
  - Pressures for migration & radicalization if NO entry level jobs
    - Hence no stake in international system
- Many types of security problems:
  - Impact of a million refugees on Europe in 2015
  - Many times more likely in future
  - High potential for domestic unrest, scapegoat-finding, radical nationalism and protectionism
    - Unless governments and the private sector "are really skillful in managing these changes" -- track record not encouraging



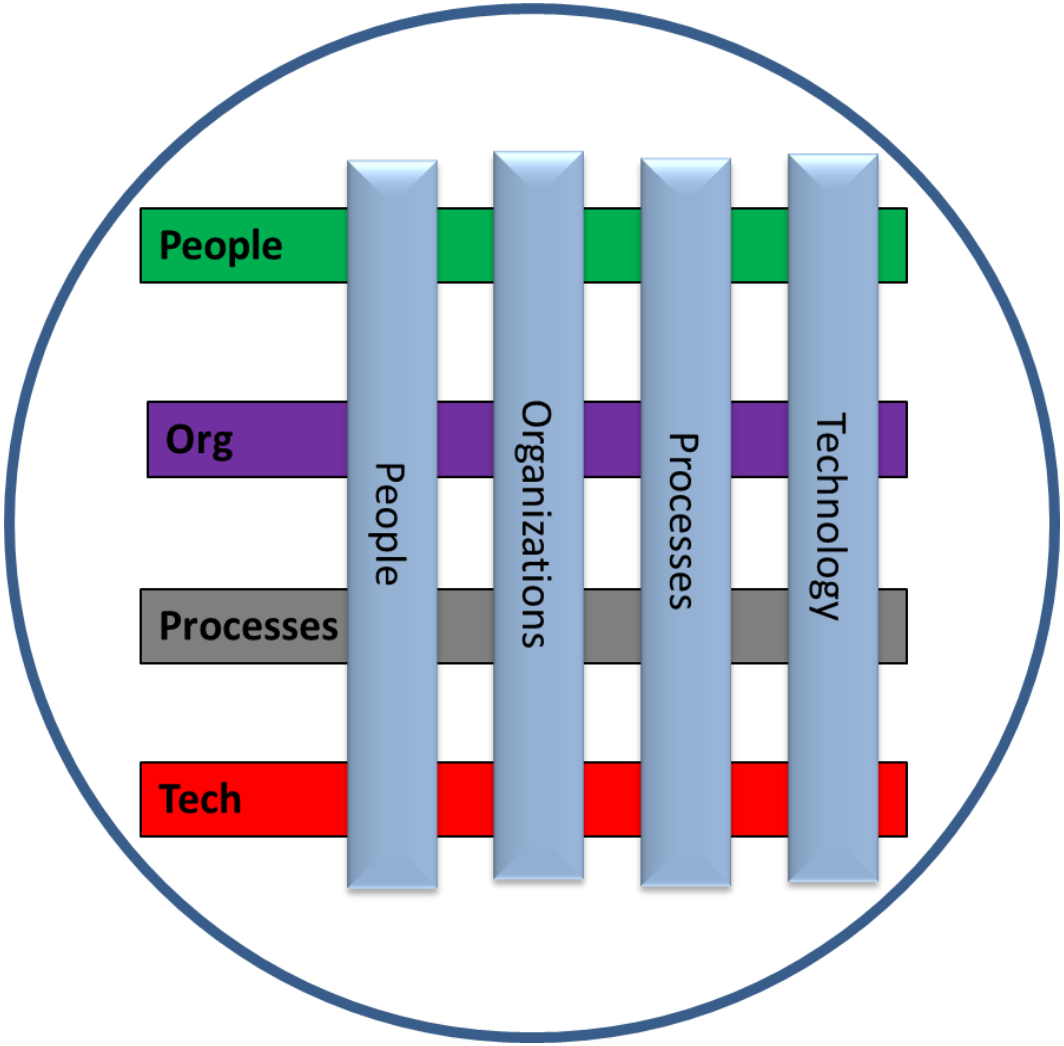
The *Economist* has been especially good in reporting on these topics

Job-Related Security Implications (3)

- 4th IR challenges are beyond 3rd OS's intended focus
  - Unrest in developing (and developed) world
  - Potential threats to Euro-Atlantic security structure
    - Political, social and economic issues threaten true center of gravity of NATO: resilience of populations of member nations
    - Can challenge social compacts
- Also threaten possible de-globalization*
    - Local production of manufacturing and services
    - Installed new energy production is now dominated by local sources -- solar, wind, hydro, and fracked natural gas.
    - Explosion of productivity in urban and indoor agriculture
    - Voter anger over trade pacts
    - Balkanization of Internet

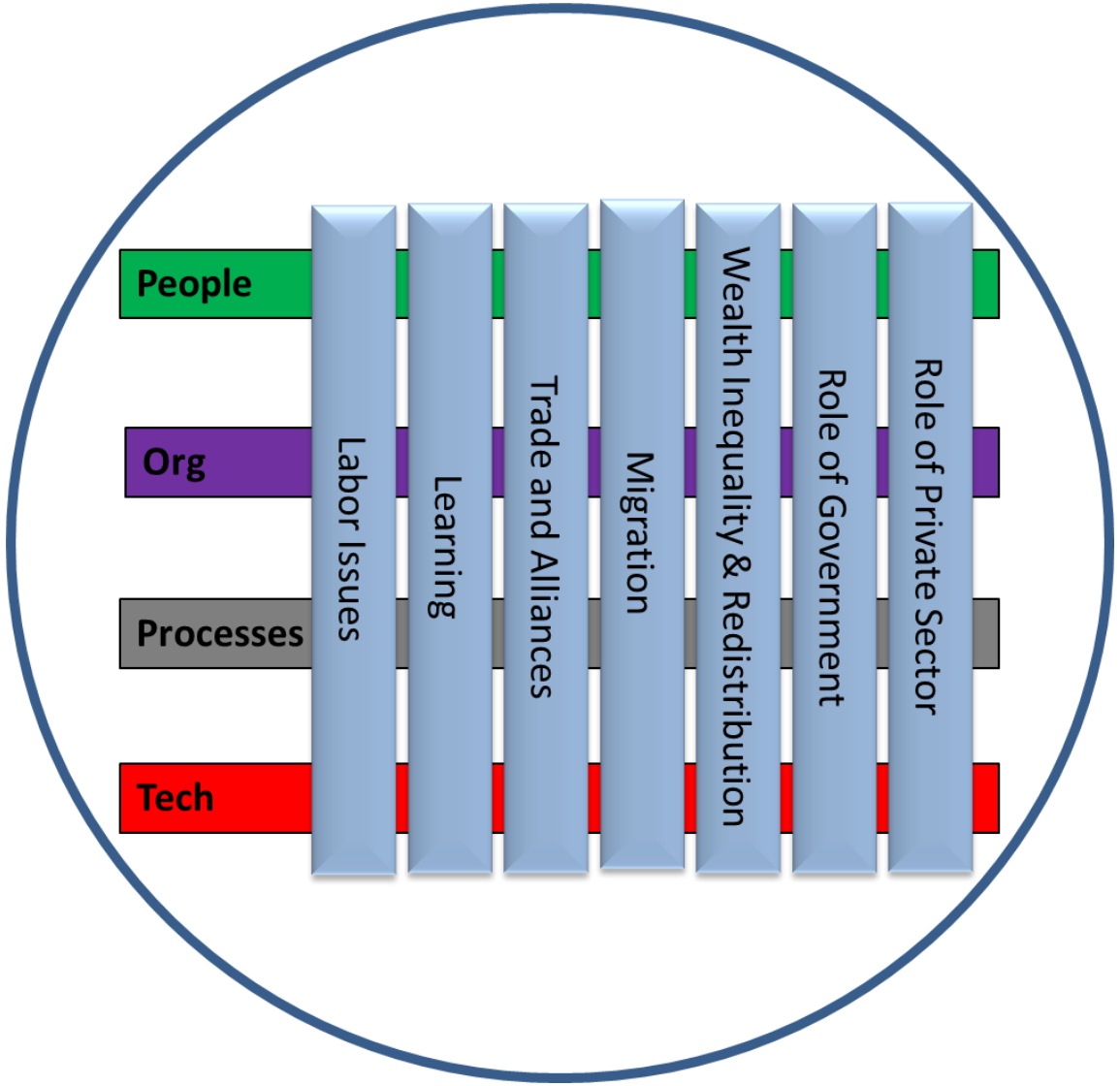
*TX Hammes, "3-D Printing Will Disrupt the World in Ways We Can Barely Imagine," http://warontherocks.com/2015/12/3-d-printing-will-disrupt-the-world-in-ways-we-can-barely-imagine/

Complexity Lens—General*



*Complexity Lens" concept from Jan Vasbinder, Director, Para Limes, NTU

Complexity Lens—Focused on Jobs



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Reducing Pressures for Migration and Radicalization Through "Sharing Economy" Initiatives

The BROCADE Project

Building Resilient Opportunities in Culturally Aligned, Diverse Environments

Peers Progressing

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BROCADE seeks to sift focus from THREAT to Opportunity

Provides a framework to:

- Build economically viable
- Community-based, collaborative ("sharing") economies
- Leverage emerging technologies and other tools, to
- Develop productive, resilient communities, sustainable with local resources

"Make hope possible, rather than fear convincing"-- Raymond Wilson

Use Robin Chase's *Peers, Inc.* construct

- Leverage industrial strength "platforms"
  - *e.g.* the internet, Google search engines ["Inc."]
- To let people ["Peers"] free up "excess capacity"
- To invent a "Collaborative Economy"
  - Airbnb reached 650,000 beds in 4 years

Apply multi-sector approaches, like STAR-TIDES (www.star-tides.net), that integrate changes in people, organizations, processes and technology, plus

- Related ideas like innovative financing and tools like blockchain

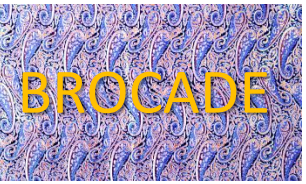
BROCADE

Implementation

- Begin with regional focus
  - Consider governance, sociological concerns, ethnology, etc. for local cultures
  - Look for pilot communities in each region.
  - Some could be rural communities, some refugee camps, some megacities

- Continue technical research into rapidly-evolving platforms, recognize that this largely will be stovepiped
  - Academically and organizationally

- Need integration mechanism to tailor platforms to communities



BROCADE "Platforms" (1)

Agriculture/Food: High efficiency urban production

***Local production and logistics*:**

3-D printing, maker spaces, or related techniques, ***Integrated, locally focused logistics***, linked to local, regional international supply chains

***Energy*:** Costs of renewable energy and distributed energy falling rapidly

***Clean water*:** Cheaper energy can produce low-cost clean water

Heating and cooling: e.g. for agricultural produce & medicines, plus heating when necessary

BROCADE "Platforms" (2)

***Information & Communications Technology (ICT)*: global internet**

Expanded access to information: voice interfaces, image recognition

Innovative learning: tailored to local needs, cultures and resources

Telemedicine: "Reach back" telemedicine with improved ICT

Cheap, widely deployable sanitation: Address in value chain framework

Low cost shelters: Culturally appropriate, energy-efficient, local materials

***Governance, Community Design & Management, Security*:**

Rapidly deployable sensors, lighting, GIS, etc.

Blockchains help provide reliable land titles, increase transparency

Public-private partnership/cooperation: Match risk sharing

Innovative financial arrangements, e.g. mobile money such as M-Pesa

Converging 4th IR Trends (1)

- Trends can't be controlled by governments, only influenced
  - May need to "restructure our national security strategy, culture, and organizations accordingly"
    - Failure of US "Project on National Security Reform" (PNSR)
    - Singapore advantage in foresight & strategic futures
- 4th IR will affect business, government, and people
  - Challenge very feasibility of governing by "systems of public policy and decision-making [that] evolved alongside the Second Industrial Revolution"
    - "When decision-makers had time to study a specific issue and develop the necessary response or appropriate regulatory framework"

Converging 4th IR Trends (2)

- Trends support:
  - Hybridization of warfare,
  - Empowerment of individuals and non-state actors (especially through cyber, autonomous and biological weapons), and
  - Further blurring of lines between combatants and non-combatants
- Impact likely to be most profound on people
  - Will change "not only what we do, but also who we are"
  - Privacy issues will be key, but also biotech and AI revolutions

    "which are re-defining what it means to be human by pushing back the current thresholds of life span, health, cognition, and capabilities, will compel us to redefine our moral and ethical boundaries"

4th IR Challenges for Decision-Makers

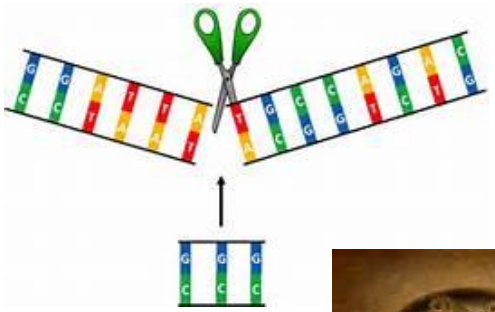
- Projections range from pessimistic ("robotizing humanity") to optimistic ("complement to best parts of human nature—creativity, empathy and stewardship")
  - Insufficient data now for major public policy decisions
- Don't accept passively: shape "a future that reflects our common objectives and values"
- Develop comprehensive and globally shared view of how "tech is affecting our lives and reshaping our economic, social, cultural and human environments"
- Break free of traditional linear thinking
  - "Think strategically about the forces of disruption and innovation shaping the future"
  - Gather data

Questions for Students

What technology will your children use to befuddle you the way you befuddle you parents?

- Cyborgization of the human body

- Trans-generational perception differences
- Genome modification



- Networked minds

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Implications for Research

- Research opportunities in many areas
  - C4I & Cyber, Engineering, Science, Conflict Analysis and Resolution, Public Policy, also Business & Education
  - Focus at Policy-Technology-Sociology-Economy interface
- Promote change in how organizations, people, processes and technology come together
  - Link security and sustainability goals, public-private, trans-national mechanisms & regional cooperation
- Organizations in Europe and the Gulf are building knowledge development resource centers with
  - Analytics & visualization component
  - Training modules and a vibrant community of interest
- All could be tied together. Singapore could play key roles

QUESTIONS?

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