A Revolutionary Technology on an Evolutionary Path

ASEE Presentation
February 9, 2016

Michael Toscano
USZ
(Unmanned Systems Zealot)
Challenge or Tasker

Policy Questions

What should our policies be?

What do we discuss with our legislators and senators?
When do you think unmanned systems will be part of your everyday life?
### Game-Changing Technology

<table>
<thead>
<tr>
<th></th>
<th>Cost</th>
<th>Service</th>
<th>Risk</th>
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What causes policy change?
What Causes Policy Change?

- Human Injustice
- Social Awareness
- Revolutionary Technology
Revolutionary/Disruptive Technology

- Improves Existing Capabilities
- Creates New Jobs
- Eliminates Some Jobs
- Requires New Laws or Policies
Unmanned Aircraft Systems (UAS) or Drones

- Do Two Things Very Well
  - Situational Awareness
  - Delivery
Automated Vehicle Systems (AVS) or Driverless Cars

- Revolutionize Mobility
- Create New Business Model
What are the cyber security policy issues for unmanned systems?
Assumptions

- This is a Revolutionary Technology
  - Technology Always Wins
- Different Level of Autonomy
  - Smart Cars will get Smarter
- There will be a Traffic Management System
Rate of Infusion/Acceptance of UAS and Driverless Cars is Based on SAFETY
Safety of Unmanned Systems Depends on

- Hardware
- Software
Hardware

⚠️ The more you use it, sooner or later
   IT BREAKS

Software

💡 The more you use it, sooner or later
   IT WORKS
Software Will Get Better

- Moore’s Law
- Metcalf’s Law
- Artificial Intelligence
- Learning Machines
What Major Factors Affect Policies and Laws of Unmanned Systems?

- Technology Maturation
- Risk Acceptance
- Leadership
Position on UAS Privacy

All stakeholders can work together to advance UAS technology, while protecting Americans’ safety, as well as their rights.

- **Transparency Measures**
  - Register unmanned aircraft and pilots with the Federal Aviation Administration (FAA)

- **Prohibiting Weaponization**
  - FAA already prohibits the deployment of weapons on civil aircraft

- **Data Retention Policies**
  - Governing the collection, use, storage, sharing, and deletion of data
  - Policies should be available for public review and comment
  - Policies should outline strict accountability
  - Requires government and industry standards

- **Accountability**
  - Fourth Amendment already protects against unreasonable searches
  - People should be prosecuted for violating privacy laws

- **Technology Neutral Laws**
  - Any new laws or regulations should focus on whether the government can collect and use data, not how it is collected
Challenges

- UAS Regulations on Commercial Use of UAS
- Current Privacy Issues in the Civil Market
  - “Lettuce doesn’t care if it’s spied on”
- Solutions Need to Meet the Triple Bottom Line
  - Cost-effective
  - Beneficial to society
  - Good for environment
- Cost-effectiveness of sensors for UAS and UGS
  - Not many available
- Dexterous manipulation
  - Robotic technology can fly a 747 across the country, but is challenged with the simple task of picking a strawberry
Back to Assumptions

- This is a Revolutionary Technology
  - Technology Always Wins
- Different Levels of Autonomy
  - Smart Cars will get Smarter

There will be a Traffic Management System
UAS Traffic Management (UTM) System (same for AVS/DC)

- Federally Created
- Government and Industry
- Works for Manned and Unmanned Systems
Summary

- Unmanned Systems/Robotics has the potential to be a revolutionary technology
  - Major economic drive/job maker
  - Significant improvement to quality of life
  - Improve national security/defense operations
- The White House (OSTP) and Congress are supportive/encouraging unmanned systems/robotics (STEM)
- Unmanned Systems/Robotics will continue to grow and be part of our future
What *Should* Our Policies Be?
I Wish I Was 20 Years Younger!

Michael Toscano
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301-706-2541
Back-up Slides
# What is an Unmanned System?

<table>
<thead>
<tr>
<th>UAS</th>
<th>UGV</th>
<th>UMV</th>
<th>Subsystems</th>
<th>Services</th>
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<td><strong>End User</strong>&lt;br&gt;• Military&lt;br&gt;• Civil&lt;br&gt;• Commercial&lt;br&gt;• Academic/Research</td>
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<td><strong>Payloads</strong>&lt;br&gt;• Components&lt;br&gt;• Communications&lt;br&gt;• Command/Control&lt;br&gt;• Navigation&lt;br&gt;• Avionics&lt;br&gt;• Software&lt;br&gt;• Propulsion/Power&lt;br&gt;• Displays&lt;br&gt;• Control Stations&lt;br&gt;• Launch/Recovery</td>
<td><strong>Engineering</strong>&lt;br&gt;• Integration&lt;br&gt;• Logistics&lt;br&gt;• Training&lt;br&gt;• Maintenance&lt;br&gt;• Operational&lt;br&gt;• Consulting&lt;br&gt;• R&amp;D</td>
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<td><strong>Category/Classification</strong>&lt;br&gt;• HALE&lt;br&gt;• MALE&lt;br&gt;• Tactical&lt;br&gt;• Small Tactical&lt;br&gt;• Small&lt;br&gt;• Miniature/Micro&lt;br&gt;• Vertical Takeoff/Landing&lt;br&gt;• Combat&lt;br&gt;• Lighter than Air&lt;br&gt;• Optionally Piloted</td>
<td><strong>Mission (Most Common)</strong>&lt;br&gt;• EOD/Bomb Disposal&lt;br&gt;• Logistics/Transport&lt;br&gt;• Surveillance/Recon&lt;br&gt;• Combat&lt;br&gt;• Medevac&lt;br&gt;• HAZMAT Detection&lt;br&gt;• Combat&lt;br&gt;• Inspection&lt;br&gt;• Communications Relay&lt;br&gt;• Message Broadcast&lt;br&gt;• Firefighting&lt;br&gt;• Search and Rescue&lt;br&gt;• Perimeter Patrol&lt;br&gt;• Archeology&lt;br&gt;• Research</td>
<td><strong>Category</strong>&lt;br&gt;• Unmanned Underwater Vehicles&lt;br&gt;• Unmanned Surface Vehicles&lt;br&gt;• Remotely Operated Vehicles</td>
<td><strong>Payloads</strong>&lt;br&gt;• Components&lt;br&gt;• Communications&lt;br&gt;• Command/Control&lt;br&gt;• Navigation&lt;br&gt;• Avionics&lt;br&gt;• Software&lt;br&gt;• Propulsion/Power&lt;br&gt;• Displays&lt;br&gt;• Control Stations&lt;br&gt;• Launch/Recovery</td>
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<td><strong>Mission (Most Common)</strong>&lt;br&gt;• Surveillance&lt;br&gt;• Precision Strike&lt;br&gt;• Precision Agriculture&lt;br&gt;• Inspection&lt;br&gt;• Communications&lt;br&gt;• Monitoring/Research&lt;br&gt;• Cargo Delivery&lt;br&gt;• Recreation</td>
<td><strong>Category</strong>&lt;br&gt;• Mine Clearance&lt;br&gt;• Surveillance&lt;br&gt;• Environmental Monitoring&lt;br&gt;• Infrastructure Inspection&lt;br&gt;• Marine Life Monitoring&lt;br&gt;• Oil &amp; Gas&lt;br&gt;• Hull Inspection&lt;br&gt;• Search and Rescue&lt;br&gt;• Security/Patrol&lt;br&gt;• Other Inspection&lt;br&gt;• Marine Life Monitoring&lt;br&gt;• Research</td>
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**Unmanned Systems Potential Applications**

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<tr>
<th>Application</th>
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<tbody>
<tr>
<td>Border Security</td>
<td>Industrial Logistics</td>
<td>Search &amp; Rescue</td>
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<tr>
<td>Arctic Research</td>
<td>Pollution Monitoring</td>
<td>Volcanic Research</td>
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<tr>
<td>Firefighting</td>
<td>Storm Research</td>
<td>Pipeline Monitoring</td>
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<td>Flood Monitoring</td>
<td>HAZMAT Detection</td>
<td>Filmmaking</td>
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<tr>
<td>Crop Dusting</td>
<td>Asset Monitoring</td>
<td>Crowd Control</td>
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<tr>
<td>Mining</td>
<td>Event Security</td>
<td>Aerial News Coverage</td>
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<tr>
<td>Farming</td>
<td>Port Security</td>
<td>Wildlife Monitoring</td>
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<tr>
<td>Aerial Photography</td>
<td>Construction</td>
<td>Forensic Photography</td>
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<tr>
<td>Real-estate</td>
<td>Cargo</td>
<td>Power line Surveying</td>
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<tr>
<td>Communications</td>
<td>Broadcasting</td>
<td>Damage Assessment</td>
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Why Automated Vehicles?

- **Safety**
  - 32,719 highway deaths
  - 6,300,000 crashes/year
  - Leading cause of death for ages 4-34

- **Mobility**
  - 4,200,000,000 hours of travel delay
  - $80,000,000,000 cost of urban congestion
  - $242,000,000,000 annual economic cost

- **Environment**
  - 2,900,000,000 gallons of wasted fuel

(2013 Data)
Automated Vehicles by 20XX!

Automated vehicles could be the next transportation revolution:
- Improving driver safety
- Reducing pollution
- Easing traffic congestion
- Aiding mobility of millions of elderly and disabled in the U.S. and around the world

Innovation and technological advancement will be key for the U.S. automotive industry to stay competitive.
Benefits of Automated Vehicles

- Faster reaction time than a human
- Can see 360 degrees and process thousands of vehicle-to-vehicle and vehicle-to-infrastructure information packets a second
- Programmed to follow local traffic laws
- Never gets distracted, tired, or impaired
- Potential to dramatically reduce crashes and car-related injuries and deaths
- Allow for mobility for those who may have difficulty safely driving a vehicle—blind, aging, physically impaired
Challenges for Automated Vehicles

Legal Issues/Liability/Privacy
- Who’s responsible when there is an accident? How do we ensure drivers’ rights to privacy are protected?

Insurance
- How will the insurance industry handle this revolution in transportation? What will the emerging insurance models entail, and how will automated vehicles be covered?

Cultural
- How do we instill trust in the driving public? How do we market a “cool” driverless car to auto and driving enthusiasts? How do we influence consumer behavior and societal acceptance?

Regulatory/Policy
- How will automated vehicles be regulated? What standards will they have to meet? How will regulations and policies differ from state to state? How will these vehicles be vetted, tested, and ultimately integrated onto existing highways with traditional vehicles?
Cybersecurity Policy: Sore Spots and Salves
(some emphasis on connected healthcare systems…)

Dave Kleidermacher, CSO

(all opinions shared herein are my own and not those of BlackBerry)
Background and Agenda

• Who am I and the “new” BlackBerry
  • Disclaimer: not a policy expert
• Theme: national vs. international policy
• Sore spots and salves for:
  • Security and privacy assurance
  • Privacy for non-HIPAA medical devices
  • Vulnerability disclosure
  • Threat and vulnerability information sharing
  • Coordinated incident response
  • The encryption debate
  • Smartphone as an approved Class II/III medical device
  • Deterrence
Theme

- Cybersecurity needs international standards, NGOs, and policies
  - Multi-national enterprises
  - National economies are more tightly tied to world economy and events than ever before
  - Hackers (ethical and non) are all over the world
  - Government lags industry and academia in many aspects of cybersecurity
  - Governments’ historical attempts at cybersecurity standards, entities, and policies are rather dismal
  - Many foreign entities do not trust the U.S. government
Assurance

• Problem: absence of quality assurance standards and policy is the largest cause of the *Crisis of Confidence* in cybersecurity today
  • How are we doing? 2015 healthcare year in review… and those pesky infusion pumps
  • What is ‘security assurance’?
  • Story of snake oil
  • Story of the world’s only software security certification above EAL 6
  • Story of the world’s current EAL 0 software security certifications
  • “*You can’t sell security*” - Schneier
  • “*We can’t raise the cybersecurity bar if we don’t know how to measure its height*” - me
Assurance

• Solution:
  • Scientific approach to security evaluation
  • Efficient (cost and time)
  • Continuous improvement
  • Open and inclusive (international, all stakeholders)

• Example: DTSec
  • [https://diabetestechology.org/dtsec.html](https://diabetestechology.org/dtsec.html)
  • Life-critical connected healthcare devices (current focus: diabetes)
  • General standard leverages ISO 15408
  • Protection Profiles for each type of device
  • Each PP shares an Assurance Package (leverages IEC 62304)
  • FDA, Health Canada, DHS, etc. participants in steering
  • FDA not yet committed to “recommending” standard and mandate is unlikely
  • Need more international regulatory participation
Privacy of Healthcare Things

• Problem: healthcare wearables generally not covered by HIPAA, privacy TBD
  • FitBit example
  • White House - Precision Medicine Initiative (PMI) Privacy and Trust Principles
    • Basic guidance to respect privacy rights of participants
    • We need more than guidance

• Solution:
  • Follow same concept as DTsec
  • Common language for privacy requirements for a product, device, app, system
  • Covers lifecycle (informed consent before disclosure; controls for prevention of unauthorized disclosure; disposal/destruction guarantees)
  • Potential work to be funded by NIH
Vulnerability Disclosure

• Problems:
  • Public disclosure tension between researchers and product vendors
  • Inconsistent rules and regulations (e.g. CERT=45, Google=30)
  • Foreign entities do not want to disclose to CERT
  • No centralized, trusted arbiter
  • Wassenaar Agreement export control ramifications

• Solution:
  • International entity backed by friendly nations and their national policies
  • Researchers and vendors join and agree to its guidelines and decisions (e.g. time-to-disclosure)
  • Obama administration last week: “We agree that keeping these technologies from illegitimate actors must not come at the expense of legitimate cybersecurity activities that are vital to protecting our nation from rapidly evolving cyber threats.”
Threat information sharing

• Problems:
  • Sporadic and ineffective threat information sharing across national and international entities
  • Foreign entities do not want to disclose to US government entities
  • No centralized, trusted distributor (18 US ISACs, few anywhere else)
  • Entities fear PR and legal repercussions from disclosure
  • Wassenaar Agreement export control ramifications

• Solution:
  • International entity funded by friendly nations and supported by national policies
  • Researchers and vendors free to join and agree to its guidelines and decisions
  • Note: DHS is offering to centralized role in the US (not ideal)
  • csis.org 2015:
    • Remove sharing barriers of various sorts
    • Reduce negative ramifications (protect disclosers and privacy)
Coordinated incident response

• **Problem:**
  - Need rapid dissemination of threat and mitigation information

• **Solution:**
  - FIRST (Forum of Incident Response and Security Teams)
    - All relevant stakeholders (government, academia, industry)
    - International
    - Non-profit
  - Nations have cyber incident policies and frameworks in place
The Encryption Debate

• **Problem:**
  • Privacy advocates and government at odds, no productive path forward

• **Solution:**
  • Understand the facts
  • Smart criminals will use end-to-end encryption
  • Every root is a backdoor; vendors are trusted with subjective decisions
  • Managing additional “fair” backdoors is prohibitively expensive
  • Have a productive and balanced conversation
  • International, leaders from all stakeholder communities
  • Additional legislation unlikely to improve either side
Smartphone as Medical Device

• Problem:
  • FDA: life-critical app on standard smartphone = medical device
  • Lack of approval hinders quality of life, e.g. app for insulin pump control

• Solution:
  • Technical: need an assurance standard (step 1)
  • Technical: need smartphone tech to meet standard (step 2)
  • Policy: need FDA to allow assured smartphone+apps (step 3)
  • Example: BlackBerry CHACE working with UVA and Harvard
Deterrence

• **Problem:**
  • $R = f(T, V, C) \Rightarrow$ reducing threat and consequence
  • Offensive strategy fraught with political peril

• **Solution:**
  • Need international coordinated entity and policy for private/public deterrence
    • Similar recommendation by various other cybersecurity thinktanks and leaders
  • Sanctions, attribution, offense, consequence mitigation
  • [http://www.defense.gov/News-Article-View/Article/621018/defense-intel-leaders-cybersecurity-priorities-are-defense-deterrence/]()  
  • At the same time, we must redouble efforts on V!
Summary

• **Problem:**
  • Lack of international, coordinated, multi-stakeholder systems and policies
  • Lack of fundamental understanding (assurance and encryption)
  • All leads to inferior cybersecurity and privacy posture
  • We continue to lose the war of good v. evil

• **Solution:**
  • International, coordinated, multi-stakeholder discussion on fundamental issues
  • International, coordinated, multi-stakeholder standards, systems, and policies
  • Government mandate but not ownership of cybersecurity standards and systems
  • Key areas for improvement: assurance, encryption, information sharing, deterrence
Energy Policy: The Demand Side

ASEE Engineering Deans PPC
February 9, 2016

Lowell Ungar
Senior Policy Advisor
Outline

• Energy demand is as important as energy supply
• Energy efficiency policies are key to national energy strategy
• Current federal actions may help
American Council for an Energy-Efficient Economy (ACEEE)

Nonprofit 501(c)(3) that acts as a catalyst to advance energy efficiency policies, programs, technologies, investments & behaviors

- **Research**: buildings, industry, utilities, transportation, economic analysis & behavior
- **Policy**: national, state, & local
- **Outreach**: conferences and publications
- Nearly 50 staff based in D.C.
Celebrating 20 Years of Achieving Energy Efficiency through Market Transformation

National Symposium on Market Transformation

Baltimore, MD • March 20-22, 2016

Hot Topics:

• Zero Net Energy Buildings
• Combined Heat and Power
• Evaluation, Measurement, & Verification
• Data Analytics
• Connected Lighting & Controls
• Plug Load Management
• Demand Response & Distribution System Grid
• Affordable Housing
• Community Strategies

aceee.org/conferences

For: Policymakers • Contractors • Agencies • Utilities • Researchers • Advocates

@ACEEEEdc #MT16
Energy Efficiency Savings

[Diagram showing energy use (quads) from 1980 to 2013. The chart compares actual energy use with energy use if it grew with GDP. The difference between the two is labeled as "Energy efficiency." The "Structural change" is indicated by an arrow.]
Energy News: Oil Prices

![Oil Price Chart](chart.png)

Source: U.S. Energy Information Administration

ACEEE: American Council for an Energy-Efficient Economy
Vehicle Standards

[Graph showing the percent change in adjusted fuel economy, horsepower, and weight since 1975, with model years from 1975 to 2015.]
Oil Savings from Standards

![Chart showing oil use (million barrels per day) from 2010 to 2040. The chart includes lines for 2011 fuel economy, light-duty standards, and light- and heavy-duty standards. The data shows a decrease in oil use over time.]
Energy News: Utility Angst

Will Solar Cause A 'Death Spiral' For Utilities?

Rate Design & Distributed PV: A Complex Debate That Must Evolve

The End of the Electric Utilities? The Industry Thinks So Too
Real Change is in Demand

Source: EIA
Energy News: Climate Change
Efficiency Key to CO₂ Reductions

U.S. MID-RANGE ABATEMENT CURVE – 2030

Energy Efficiency Potential 40%

Adapted from McKinsey Analysis

Source: McKinsey Analysis
Policies and Programs

Source: Northwest EE Alliance
Research and Development
People-Centered Efficiency
Providing real-time information and management tools that enable users to lower energy consumption in response to changing information.

Technology-Centered Efficiency
Using sensors, controls, and software to automate and optimize energy use.

Service-Oriented Efficiency
Shifting behavior and organizational structures to reduce energy-intensive activities.
Utility Energy Efficiency Programs

Program spending ($ billion)

- Electricity programs
- Natural gas programs

Source: ACEEE, 2015 State EE Scorecard
Building Energy Benchmarking
Appliance and Equipment Efficiency Standards

Appliance Efficiency Trends

Source: ACEEE, EE in US, 2015
Building Energy Codes

Source: ACEEE based on PNNL analysis
Federal Landscape
RDD&D Funding – EE at DOE
House and Senate Energy Bills

![Bar chart showing total savings (in billions NPV) for House bill, Senate bill, and proposed additions. The chart includes categories such as SAVE Act, EERS, Smart manufacturing, Smart buildings, Building energy codes, Federal building standards, and Furnace standard.](chart.png)
Agency Actions

- Clean Power Plan
- Appliance and equipment standards
- Heavy-duty vehicle standards
- Housing finance
Thank you!

Lowell Ungar
American Council for an Energy-Efficient Economy
Phone:  (202) 507-4759
Email:  LUngar@aceee.org
Website:  www.aceee.org
## Electric Program Savings Potential

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<th>Category</th>
<th>Savings Potential</th>
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<tr>
<td>Miscellaneous plug loads</td>
<td>3.4%</td>
</tr>
<tr>
<td>Conservation voltage reduction</td>
<td>2.1%</td>
</tr>
<tr>
<td>New construction programs</td>
<td>1.9%</td>
</tr>
<tr>
<td>Comprehensive commercial retrofits</td>
<td>1.7%</td>
</tr>
<tr>
<td>Smart manufacturing</td>
<td>1.6%</td>
</tr>
<tr>
<td>Residential air conditioners and heat pumps</td>
<td>1.5%</td>
</tr>
<tr>
<td>Combined heat and power systems</td>
<td>1.3%</td>
</tr>
<tr>
<td>Commercial lighting design and controls</td>
<td>1.3%</td>
</tr>
<tr>
<td>Heat pumps replace electric resistance furnaces</td>
<td>1.2%</td>
</tr>
<tr>
<td>Smart commercial buildings</td>
<td>1.2%</td>
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* Savings are percentage of total electricity demand in 2030 *(ACEEE New Horizons study)
Building a new partnership
Progress and Opportunities with the National Network for Manufacturing Innovation

February 9, 2016

Mike Molnar
Advanced Manufacturing
National Program Office
To promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.

- **Mission focus:** Targeting Investments to **Advance U.S. Innovation and Boost Economic Recovery**
- Deep research expertise underpins technological innovation – e.g. lasers, memory, GPS, wireless
- Non-regulatory status enables important role as a convener that facilitates collaboration between industry, academia and government

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**Cybersecurity:** Improved response to cyber threats

**Nanomanufacturing:** New measurement tools for advanced materials manufacturing

**Energy:** Measurements and standards for energy security
Interagency Advanced Manufacturing National Program Office (AMNPO)

Executive Office of the President

Advanced Manufacturing Partnership (AMP/PCAST)

Advanced Manufacturing National Program Office (hosted by DOC - NIST)

NSTC - Advanced Manufacturing Subcommittee
PCAST 2011
Recommends Advanced Manufacturing Initiative as national innovation policy

PCAST 2012
Recommends Manufacturing Innovation Institutes to address key market failure

PCAST 2014
Recommends strong, collaborative network of Manufacturing Innovation Institutes
NNMI: Addressing the “Scale-up” Gap

Focus is to address market failure of insufficient industry R&D in the “missing middle” or “industrial commons” to de-risk promising new technologies.
Public Engagement on Design
Workshops & Request for Information

Broad & Diverse Stakeholder Input
1,200 voices on the NNMI Design!

- Industry 31%
- Academia 31%
- Economic Development 6%
- Research & non-profits 8%
- Federal State & Local Gov't 14%
- All Other 10%

University of Colorado
Boulder, Colorado

Rensselaer Polytechnic Institute
Troy New York

Cuyahoga Community College
Cleveland Ohio

National Academies Beckman Center
Irvine California

U.S. Space and Rocket Center
Huntsville, Alabama
The Institute Design

Creating the space for Industry & Academia to collaborate

White House Report
NNMI Framework Design
January 2013
The Institute Summary

Applied Research + Education/Workforce Skills + Development of Future “Manufacturing Hubs”

The Federal investment in the National Network for Manufacturing Innovation (NNMI) serves to create an effective manufacturing research infrastructure for U.S. industry and academia to solve industry-relevant problems. The NNMI will consist of linked Institutes for Manufacturing Innovation (IMIs) with common goals, but unique concentrations. In an IMI, industry, academia, and government partners leverage existing resources, collaborate, and co-invest to nurture manufacturing innovation and accelerate commercialization.

As sustainable manufacturing innovation hubs, IMIs will create, showcase, and deploy new capabilities, new products, and new processes that can impact commercial production. They will build workforce skills at all levels and enhance manufacturing capabilities in companies large and small. Institutes will draw together the best talents and capabilities from all the partners to build the proving grounds where innovations flourish and to help advance American domestic manufacturing.

Federal startup investment: $70M - $120M/institute over 5-7 years
Institute Consortium owners must have minimum 1:1 co-investment
The NNMI Mission

“The Network serves the Institutes, the Institutes connect through the Network, and the Program serves the Nation.”

Program Mission (Institutes + Network)
Advance American domestic manufacturing innovation by creating an effective manufacturing research and development infrastructure for U.S. industry and academia to solve industry-relevant problems.

Institute Mission
Create and strengthen American manufacturing hubs through sustainable industry-led innovation institutes that create, showcase, and deploy new capabilities.

Network Mission
Maximize the integrated impact of the manufacturing innovation institutes on U.S. manufacturing competitiveness.
NNMI Authorized:
Revitalize American Manufacturing & Innovation Act

September 15, 2014 – Passed House
100 Cosponsors (51D, 49R)

December 11, 2014 – Passed Senate with 2015 Appropriations
18 Cosponsors (10D, 7R, 1I)

December 16, 2014 – Signed By President Obama

118 Bipartisan RAMI Bill Sponsors
Example Institute: Composites Manufacturing

Institute of Advanced Composites Manufacturing Innovation
IACMI, The Composites Institute
Knoxville, TN
Launched June 16, 2015

Agency sponsor: DOE
Startup funding: $70M public, $159M co-investment

+344,000 square feet in five core regions – composite manufacturing, laboratory, instructional and collaboration space
1) Clear, unique Institute Focus

Each Institute has a clear mission based on a critical Industry need

Opportunity
Lightweight composites offer benefits to energy efficiency and renewable power generation, overcoming limitations through deployment of advanced technologies to make composite lower cost, faster, using less energy that can be readily recycled offer tremendous opportunities for US manufacturers.

Big Idea
The Institute will provide access to world-class resources to partner with industry and develop new low-cost, high-speed, and efficient manufacturing and recycling process technologies that will promote widespread use of advanced fiber-reinforced polymer composites.

At the new Institute, a world-class team of organizations from leading industrial manufacturers, material suppliers, software developers, government and academia will focus on lowering the overall manufacturing costs of advanced composites by 50 percent, reducing the energy used to make composites by 75 percent, and increasing the ability to recycle composites by more than 95 percent within the next decade.
2) Clear Industry Value Proposition

Each Institute creates value for industry participation and funding

- **Access to Shared RD&D Resources**: Leverage and provide access to equipment from lab to full-scale to enable demonstration and reduce risk for industry investment.

- **Applied R&D**: Leverage significant government, industry, and academic investments to develop innovative solutions to member challenges.

- **Composites Virtual Factory**: Provide access to end to end commercial modeling and simulation software for composite designers and manufacturers through a web based platform.

- **Workforce Training**: Provide specialized training to prepare current and future workforces for the latest manufacturing methods and technologies.
3) Strong Private-Public Partnership

Each Institute is operated by a consortium; serving a partnership of Industry, Academia and government.

A partnership of world-class companies including:

- Dow
- Ford
- BASF
- Dassault Systemes
- GE
- Boeing
- Lockheed Martin
- Volkswagen
- DuPont
- Local Motors

Top universities including:

- The University of Tennessee
- Vanderbilt University
- Purdue University
- Colorado State University
- University of Kentucky
- University of Louisville
- Ohio State University

Economic Development Council to leverage state support and investment.
4) Addressing Critical Challenges

By workshops and Technology Roadmaps, Each Institute works on the industry priorities and big challenges only solvable by collaboration

**Five/Ten Year Technical Goals**
- 25/50% lower carbon fiber–reinforced polymer (CFRP) cost
- 50/75% reduction in CFRP embodied energy
- 80/95% composite recyclability into useful products

**Impact Goals**
- Enhanced energy productivity
- Reduced life cycle energy consumption
- Increased domestic production capacity
- Job growth and economic development
## 5) Balanced Portfolio of Projects

*From Technology Roadmaps and Strategic Investment Plan, Each Institute manages a balanced portfolio of real projects for Industry*

<table>
<thead>
<tr>
<th>Activity</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. First Projects</strong>&lt;br&gt;Identified in proposal to DOE</td>
<td>• Strengthen infrastructure capacity:&lt;br&gt;  - Materials and processing  - Modeling and simulation&lt;br&gt;• Innovation and workforce development in strategic areas with national benefit:&lt;br&gt;  - Automotive  - Wind  - Compressed gas storage</td>
</tr>
<tr>
<td><strong>2. Technology Roadmap</strong>&lt;br&gt;Driven by IACMI CTO, Industry and Technology Advisory Board</td>
<td>• Identifies key hurdles to high-impact, large scale advanced composites manufacturing&lt;br&gt;• Prioritizes opportunities across the materials and manufacturing supply chain</td>
</tr>
<tr>
<td><strong>3. Strategic Investment Plan</strong>&lt;br&gt;Driven by IACMI BOD and Technical Advisory Board</td>
<td>• Changing the innovation cycle to enable rapid adoption and scale-up of advanced composites manufacturing</td>
</tr>
<tr>
<td><strong>4. Open Project Call</strong></td>
<td>• Aligns with strategic investment plan and technology roadmap&lt;br&gt;• Emphasis on projects with high near term impact.&lt;br&gt;<strong>Project Call</strong> - open NOW</td>
</tr>
</tbody>
</table>
Building the Network

America Makes
Additive Manufacturing
DOD–Youngstown OH

DMDII
Digital Mfg & Design Innovation
DOD – Chicago IL

LIFT
Lightweight & Modern Metals
DOD – Detroit MI

PowerAmerica
Power Electronics Manufacturing
DOE – Raleigh NC

IACMI
Adv. Composites Manufacturing
DOE – Knoxville TN

Integrated Photonics
DOD–Rochester NY

Flexible Hybrid Electronics
DOD Solicitation

Smart Manufacturing
DOE Solicitation

Revolutionary Fibers & Textiles
DOD Solicitation
DOD RFI for next Institute Topics

Asking for information on selecting next institute topics - *Responses Due February 16th*

• Assistive and Soft Robotics
• Advanced Machine Tools and Control Systems
• Securing the Manufacturing Digital Thread – Cybersecurity for Manufacturing
• Bioengineering for Regenerative Medicine
• Bioprinting across Technology Sectors
• Certification, Assessment and Qualification
• Open topic (RFI responders may suggest)
NIST Advanced Manufacturing Office

The Commerce Sponsored Manufacturing Innovation Institutes
Commerce/NIST Institutes
“Open Topic” Competition

*Uses new authorities under the Revitalize American Manufacturing and Innovation Act (RAMI)* -

Proposals will be accepted on **any topic** not already covered by existing NNMI institutes

- **Key attributes**
  - Open topic competition
  - Up to $70 M federal share per Institute
  - Each institute to serve as a regional hub with well-defined focus area
  - Two-step process, Pre-Applications then Invited Full Applications - each step to be open no less than 60-days
Coming Soon – NNMI Reports

NATIONAL NETWORK FOR MANUFACTURING INNOVATION PROGRAM
ANNUAL REPORT

Executive Office of the President
National Science and Technology Council
Advanced Manufacturing National Program Office

February 2016

First Annual Report on the NNMI Program

NATIONAL NETWORK FOR MANUFACTURING INNOVATION PROGRAM
STRATEGIC PLAN

Executive Office of the President
National Science and Technology Council
Advanced Manufacturing National Program Office

February 2016

First Strategic Plan on the NNMI Program
• Establish a presence, at scale, in the “missing middle” of advanced manufacturing research

• Create an Industrial Commons, supporting future “manufacturing hubs”, with active partnering between all stakeholders

• Emphasize/support longer-term investments by industry

• Combine R&D with workforce development and training

• Overarching Objective: Unleash new U.S. advanced manufacturing capabilities and industries – for stronger global competitiveness and U.S. economic & national security
Thank You! – How to connect

Advanced Manufacturing National Program Office

Phone: (301)-975-2830
Email: amnpo@nist.gov
Web: www.manufacturing.gov

DOC Open Topic Competition:

Phone: (301) 975-0404
Email: nnmifund@nist.gov
Website: www.nist.gov/amo/nnmi

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Immigration Reform related to International Students

Moderated by:
Jim Garrett, Carnegie Mellon University
Amr Elnashai, Penn State University

February 9, 2016
Session Objectives

With just under 1 million foreign students in US higher education, we need to:

• Hear and contrast the nuanced pros and cons of mechanisms for retaining foreign STEM graduates
• Have an open-minded, respectful discussion based on data and metrics
• Determine what position (if any) we deans as a group should be promoting related to this issue
Sample of Arguments for Benefits

• “Every foreign-born student who graduates from a U.S. university with an advanced degree and stays to work in STEM has been shown to create on average 2.62 jobs for American workers—often because they help lead in innovation, research, and development.” According to a 2012 report from the Information Technology Industry Council, the Partnership for a New American Economy, and the U.S. Chamber of Commerce

• As of 2010, Immigrants founded 18 percent of all Fortune 500 companies, many of which are high-tech giants, generated $1.7 trillion in annual revenue, employed 3.6 million workers worldwide, and included AT&T, Verizon, P&G, Pfizer, Comcast, Intel, Merck, DuPont, Google, Cigna, Sun, US Steel, Qualcomm, + According to a 2011 report from the Partnership for a New American Economy
Sample of Arguments for Benefits

• ¼ of all engineering and technology-related companies founded in the US from 1995 to 2005 “had at least one immigrant key founder, produced $52 billion in sales and employed 450,000 workers in 2005.” According to a 2007 study by researchers at Duke University and Harvard University

• “Women represent ~45 percent of the total number of international students” and “International students contribute more than $21 billion to the U.S. economy.” According to the U.S. Department of Commerce
Sample of Arguments for Risks

• Giving STEM graduates a green card is a widely popular but misguided policy. Advocates of automatic green cards for STEM graduates base their positions on one or more of a number of suppositions:
  • The U.S. economy is lagging because we don't have enough scientists and engineers to meet industry demand;
  • and/or increasing the supply will directly increase the innovation level in the economy;
  • and/or increases in the number of scientists and engineers in other countries will put the United States at a competitive disadvantage.

• Each argument has the same intuitive appeal as that of motherhood and apple pie yet, when looking at the evidence, we find each of these arguments lacks empirical support.

Hal Salzman Sociologist at the E.J Bloustein School of Planning and Public Policy at Rutgers University.
Sample of Arguments for Risks

• There are more than 5 million native-born Americans with an UG degree in STEM, but not working in STEM with another 1.2 million degree holders not working at all. There are also 1.6 million foreign-born residents with an UG degree in STEM that are also not working in STEM fields or working at all.

Report by Steve Camarota and Karen Zeigler for Center for Immigration Studies
“[US] visa rules are needlessly strict and stress keeping out terrorists rather than wooing talent. It is hard for students to work, either part-time while studying or for a year or two after graduation. The government wants to extend a scheme that allows those with science and technology qualifications to stay for up to 29 months after graduating. But unions oppose it, claiming that foreign students undercut their members’ wages.”

“For a country that wants to recruit talented, productive immigrants, it is hard to think of a better sifting process than a university education. Welcoming foreign students is a policy that costs less than nothing in the short term and brings huge rewards in the long term.”

“Train ’em up. Kick ’em out. It’s a bit shortsighted, isn’t it?”
Speakers for this Session

• Presenting the argument ‘For’:

**Mr. Chad Evans**, Executive Vice President, Council on Competitiveness
  • A recognized expert in global competitiveness and innovation
  • Built and oversees the Council on Competitiveness Technology Leadership and Strategy Initiative (TLSI), engaging more than 50 Fortune 500 chief technology officers.

• Presenting the argument ‘Against’:

**Professor Norman Matloff**, Computer Science, UC Davis
  • Former database software developer in Silicon Valley
  • Conducts research both in computer science and in theoretical and applied statistics.
  • Particularly interested in the use of foreign labor in the U.S. computer industry. His article in the *University of Michigan Journal of Law Reform on the H-1B work visa* is the most comprehensive (99 pages, 300+ footnotes) academic work published on the H-1B issue.
Questions and Answers (two to get started)

1. Are we asking the wrong questions when we ask about STEM degrees?

   Are we lumping over-subscribed topics with topics under great demand? For example, the general impression is that Biology degree holders have a very tough time getting good jobs. At the same time, career fairs in mechanical or biomedical engineering often have more recruiting companies than graduates. Should we talk and think separately about Engineering and STM? Should we delineate between sub-disciplines of engineering?

2. Are there ways of decoupling immigration law and international student recruitment?

   If international students, their supporters (being families, businesses, government, and international agencies) perceive our immigration law as being unduly restrictive, is there not a risk of losing at least part of the currently estimated $21B in tuition and expenses from international students studying in the USA?
Foreign Tech Workers in the U.S.: Failures and Remedies

Norm Matloff
University of California at Davis

ASEE Engineering Deans Council Conference

February 9, 2016

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2 Why Do Employers Hire Foreign Students Instead of Americans?

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5 Conclusions
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- But my foreign students apply to the same firms, and get jobs.
Concrete Example: “Jim”

- Son of Chinese immigrant parents.
- BSEE, MSCS from UCD, mid-1990s.
- At “household name” engineering firm, his innovative work was written up in the Wall Street Journal.
- But was later caught in big layoffs.
- Never got steady engineering work after that.
- Today working as a technician, e.g. installing office PCs.
- The field of engineering lost this highly innovative engineer.
- Meanwhile, lots of foreign students were hired.
- I’ve seen many, many Dans, Ikes and Jims.
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This example highlights the challenges faced by foreign tech workers in the U.S., and the need for appropriate remedies to support their careers.
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Two Central Issues

• Saving on labor costs.
• Having immobile workers.
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Setting the Stage

Why Do Employers Hire Foreign Students Instead of Americans?

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The Wage Factor

• Hard data, consistent with economic theory.

• On average, the foreign tech workers are paid less than comparable (age, education etc.) Americans. This is across the board, not just the "Infosyses" but also the "Intels."

• Young foreign tech workers are paid a lot less than otherwise comparable older Americans (age 35+).

Note: Unless stated otherwise, American means U.S. citizens (native, naturalized) and permanent residents.
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Job opportunities poor for those over age 35. See studies by NRC, American University/IEEE-USA etc.

Wall Street Journal, Feb. 4, 2016: Pete Edwards, EE; age 53; experience with 3-D printing; having big difficulties finding work.

The bottom line: Employers are hiring young foreign tech workers instead of older Americans.
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The Immobility Factor

• Employers don't want engineers to leave for another firm in the midst of an urgent project.
• D. Swaim, former architect of Texas Instruments' immigration policy, now in private practice:
  • hireF-1students.com
  • Don't hire Americans, because they can leave you any time.
  • Instead, hire a foreign student (and sponsor him/her for a green card), because they must stay 7-12 years.

Google!
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• Hard data, consistent with economic theory.
• Various data sources: NRC, GAO, NCSG/NSF, BLS, NACE, etc.
• Easy to lie with data; even easier to innocently misunderstand—Ptolemy's epicycles.
• But I have a "statistical license." :-)
• And I know how engineers are educated, hired and employed. No epicycles. :-)
• Key factors include: age, education, job type, geographic region.
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- Key factors include: age, education, job type, geographic region.
Some Findings

• H-1B tech workers earn less than comparable Americans (Hunt, 2011; Matlo, 2012).
• Employers admit that they pay H-1Bs less than comparable Americans (NRC, 2001; GAO, 2011).
• Immigrants suppress the wages of U.S. PhDs (Borjas, 2006). (Correctly forecast by NSF, 1989.)
• Older tech workers have much more trouble finding jobs (NRC, 2001; Brown, 1998 and Brown, 2009).
• Brown (UCB Econ) attributes this to the influx of young foreign students.
• Foreign workers experience a big spike in earnings when they receive their green cards and become free agents (Mukhopadhyay, 2012).
• No STEM labor shortage, including in CS (Salzman, 2013; Costa, 2012).
• Wages essentially flat, both generally (BLS) and for new grads (NACE).
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- No STEM labor shortage, including in CS (Salzman, 2013; Costa, 2012).
- Wages essentially flat, both generally (BLS) and for new grads (NACE).
Quality of the Foreign Workers

The average quality of the former foreign students now in the U.S. workforce is substantially lower than that of U.S. natives (Bound, 2009; Hunt, 2011; Matlo, 2013).

Compared to U.S. natives of the same age, education etc., the former foreign students
• are less likely to file patents;
• are less likely to be in R&D;
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Given the indirect and direct displacement of Americans, this says we are replacing more-talented people with workers of lesser talent — an alarming situation for our national economy etc.
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• "Ike" was rejected for a job in a group in which the workers (a) all were recent foreign students and (b) all came from very "ordinary" schools, e.g. University of Cincinnatti. Good workers, surely, but likely not "the best and the brightest" — and probably not as good as Ike.

• A 2009 Washington Post column highlighted a worker from India hired by Microsoft, with an MS from the University of North Texas, and working in Quality Assurance. So, likely a person of ordinary talent, doing ordinary work — hardly supporting the column's claim that the foreign workers are "the seeds of tomorrow's innovation."

• The same column profiled another student from India, with an MS from UVa, hired by TI as a test engineer — again, hardly consistent with the "innovation" claim.
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- Most research with findings favorable to the industry are by researchers with financial ties to the industry (e.g. Zavodny “Each H-1B creates 2.62 jobs”), Peri, the Brookings people).
- Much of this research cuts ethical corners, e.g. Zavodny paper.
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Remedies

- Industry claims the H-1Bs are either brilliant or possess rare skills.
- So, require employers to pay more.
- Set the legal wage floor for foreign workers at Level IV (67th percentile).
- Ban ageist practices, e.g., auto rejection of experienced U.S. workers.
- Have OPT revert to the original 12-month "training" period.
- Broaden the "best and brightest" categories (O-1 work visa, National Interest Waiver for green cards).
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• Happened anyway due to big influx of foreign students after H-1B enacted in 1990.
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