

Cybersecurity for Manufacturing

Software and Supply Chain Assurance Winter Forum

1 December 2015

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Office of Science and Technology Policy*

Take-Aways

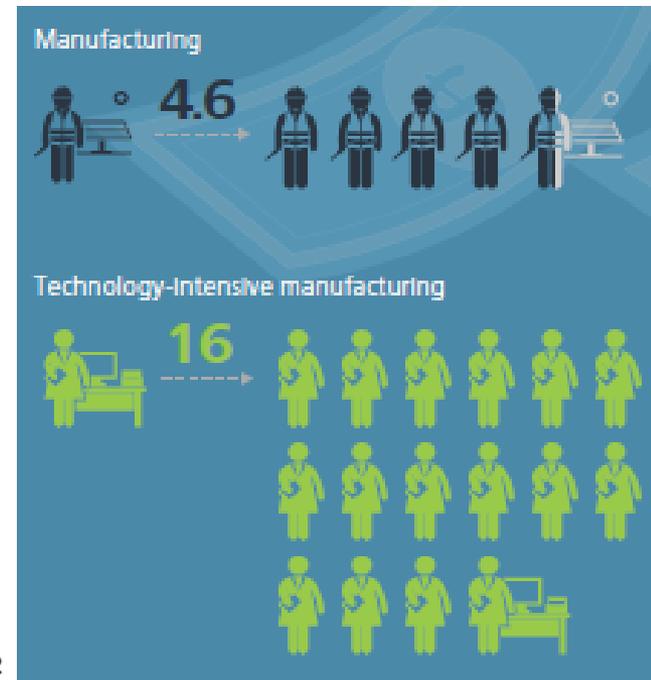
- National Network for Manufacturing Innovation
 - Manufacturing punches above its weight
 - There's innovation in manufacturing
 - 7 Manufacturing Innovation Institutes so far
 - Many topics remain for engagement
 - Some manufacturing mega-trends
- Cybersecurity for Manufacturing
 - Manufacturers received highest volume of spear-phishing attacks
 - Companies of all sizes are at risk
 - Attackers want manufacturers' secrets
 - Malware for industry control systems represent a notable shift in targets and techniques
 - Manufacturers recognize threats, but struggle to respond
 - Some starter resources... equivalent for manufacturers?

Manufacturing Punches Above Its Weight

- Manufacturing: making something that can be “dropped on your foot”
- Advanced Manufacturing: when technology gives competitive advantage
- Manufacturing has the greatest multiplier effect: every \$1 in manufacturing value added, \$1.33 in additional value is created in other sectors
- Manufacturing has one of the highest job multiplier effects



Economic Activity Generated by \$1 of Sector GDP, 2012



Deloitte/Council on Competitiveness

There's Innovation In Manufacturing

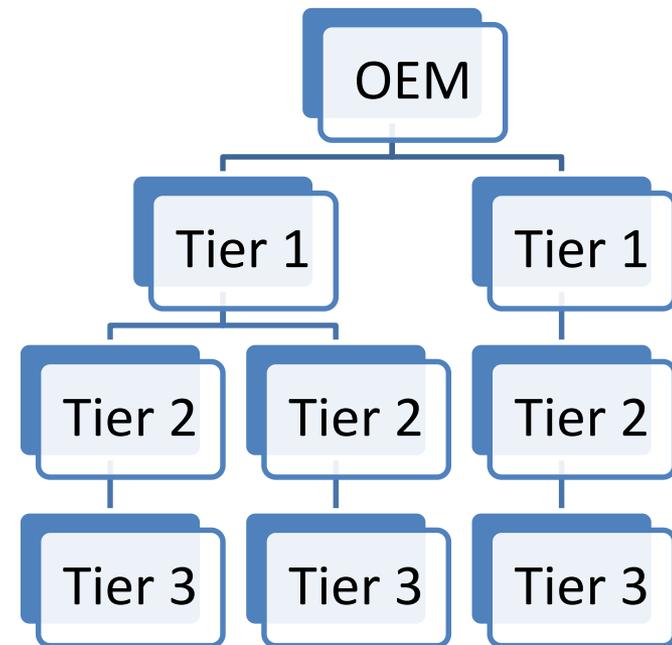
Then-1980s



Ford River Rouge Complex (1920s)

Library of Congress

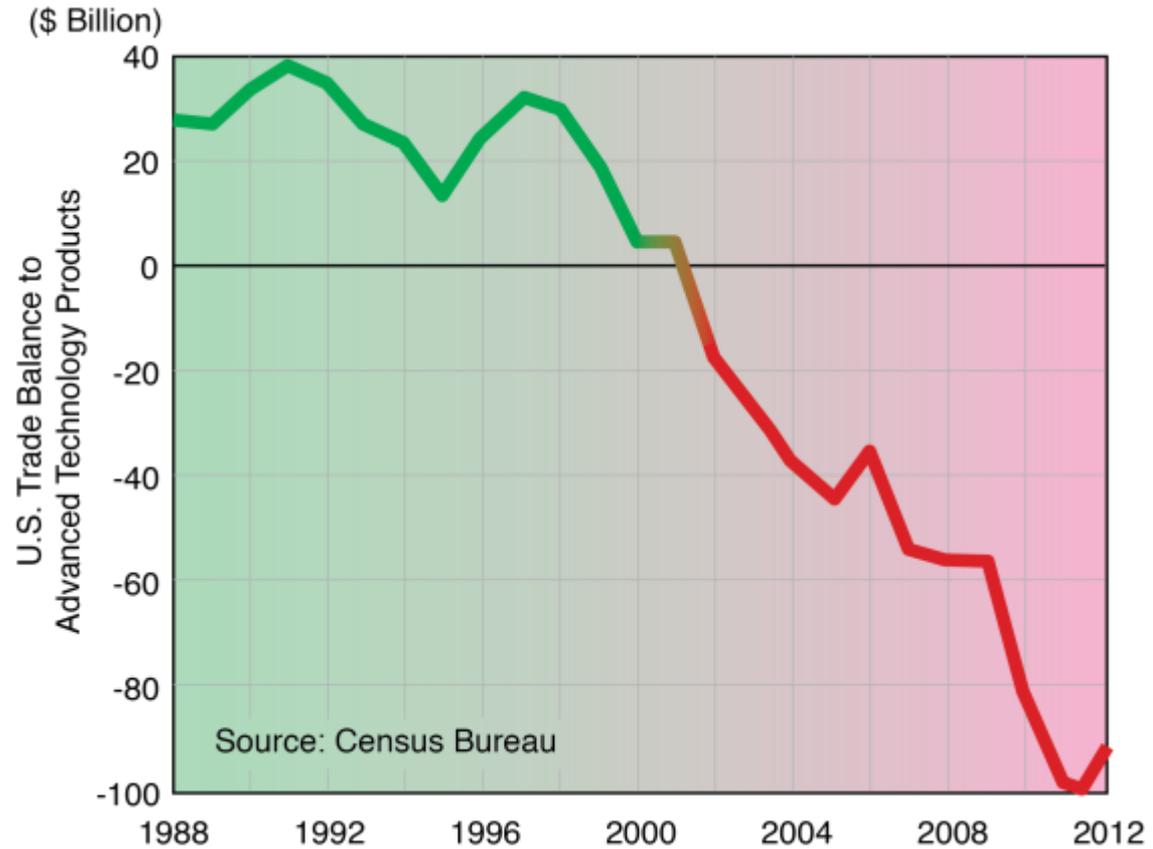
1980s-Now



There's Innovation In Manufacturing



Shutterstock

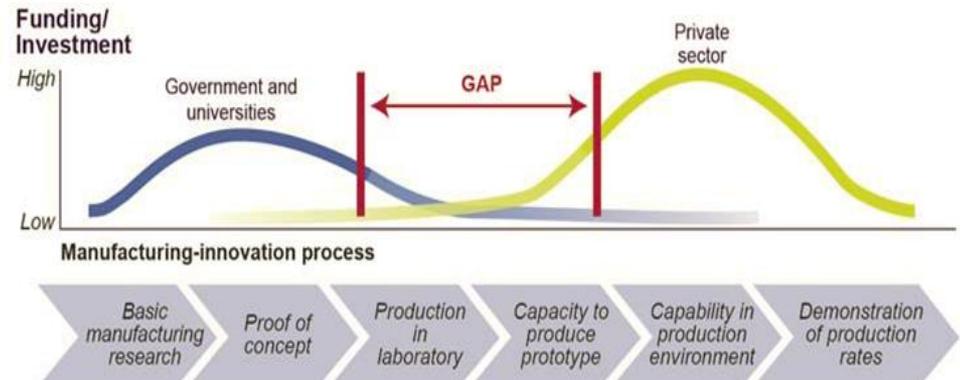


There's Innovation In Manufacturing

President's Council of Advisors on Science and Technology



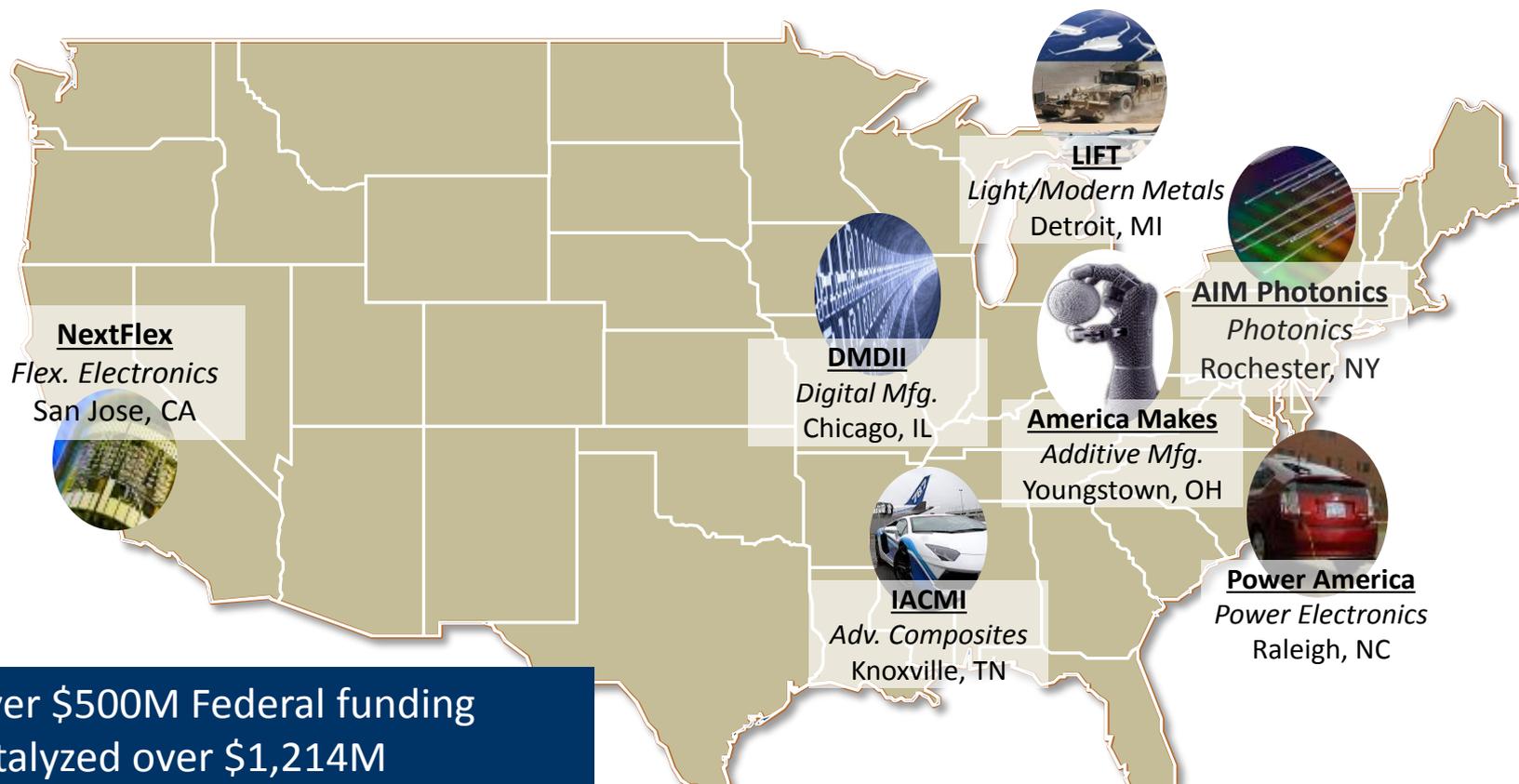
Market Failure in Pre-Competitive Applied Manufacturing R&D



National Network for Manufacturing Innovation creates the space for industry and academia to work on industry-relevant problems

- Addresses the market failure of industry underinvestment in “pre-competitive” applied R&D
- Focuses on “de-risking” new technologies and materials to scale-up for U.S. manufacturers

7 Manufacturing Innovation Institutes So Far



- Over \$500M Federal funding catalyzed over \$1,214M from consortia
- Institutes have attracted hundreds of companies and universities as active partners from across the country

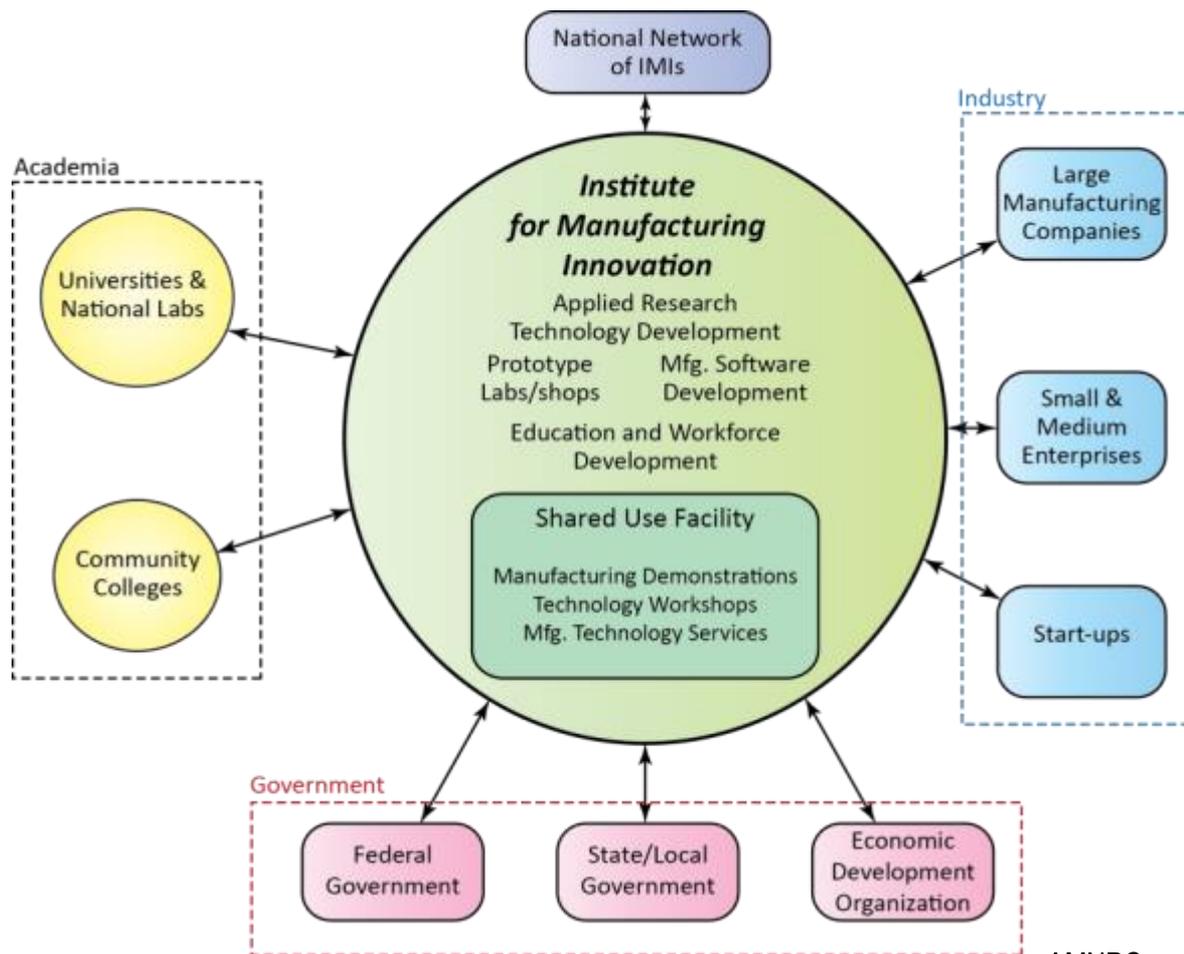
Three more under way...



7 Manufacturing Innovation Institutes So Far

Each institute has:

- 1) Clear, unique institute focus
- 2) Clear industry value proposition
- 3) Strong Partnerships
- 4) Ability to address critical challenges
- 5) A balanced portfolio of projects



AMNPO

Partnership: *Industry – Academia – Government*

Working better, together to create transformational technologies and build new products and industries

Many Topics Remain For Engagement

Enabling Technologies

bio-inspired manufacturing
bioprocessing
cryogenic techniques
cyber security
cyberphysical manufacturing
manufacturing equipment (customizable)
mechatronics
MEMS/NEMS and embedded technologies
nano/bio manufacturing
nano/micro manufacturing
surface engineering
manufacturing facilities/wafer fab

Manufacturing Systems

automation technologies
autonomy
digital manufacturing
digital model-based manufacturing
dynamic machine tool management
manufacturing strategy development
robotics and autonomy
sensors (for diagnosis and control, harsh conditions, remote sensing)
servo technologies
smart/intelligent manufacturing (sensor-integrated manufacturing)

Sustainable Manufacturing

energy efficiency/shortage
repair welding
thermoplastic recycling
reducing greenhouse gases
wastewater reclamation and reuse

Manufacturing Processes

additive manufacturing
assembly and joining (multi-material joining, solid state welding and joining)
coating and deposition (printing, roll-to-roll processing)
composites manufacturing
electron beam processing
laser processing (cutting, marking, sintering, tracking and welding)
machining and precision machining
near-net shape technologies (casting, extrusion, forging, forming, hydroforming, molding, rolling)
polymeric-based web conversion
powder metallurgy
separations and purification
surface finishing and peening
wide bandgap manufacturing

Metrology and Characterization

advanced metrology
in-situ metrology
materials characterization (thin film and bulk stoichiometry)
non-destructive evaluation

Product Development/Manufacturing Software/Tools

"big data"
design tools and informatics
information technology systems
modeling and simulation
rapid prototyping
mass customization/custom electronics

Industry Sectors

chemical
cyber security
electronics (custom, assembly, flexible, nano, organic, printed)
electro-optical devices
energy (clean/renewable/alternative, energy-conversion equipment, biofuels, fuel cells, grid technologies and integration, natural gas, solar cells, wind)
energy storage/batteries
fluid power/pneumatics
food
healthcare (biomedical devices, nanomedicine, personalized medicine, pharmaceuticals, tissue engineering)
high-performance computing
maritime technologies
national security and terrorism
optics and photonics (imaging, photonic integrated circuits)
thermal processing and HVAC
transportation (natural gas vehicles)
water and water distribution

Materials

"smart" materials, advanced magnets, amorphous metals, bio/biomedical, ceramics
Chemicals, coatings, thin films/surface treatments, composites, electro-optical materials, lightweight materials, metamaterials, nanomaterials, next-generation
semiconductors, photovoltaics, powder, superalloys

RFI by AMNPO

Some Manufacturing Mega-Trends

Service models

- Product + service
- Lean/Just-in-time manufacturing
- Supply chain innovation
- Small batches of personalized products
- Democratization of manufacturing equipment
- On-site manufacturing

Digitization

- Cloud computing
- Internet of things
- **Cybersecurity**
- Artificial intelligence/Robotics/
Virtual

Product Design

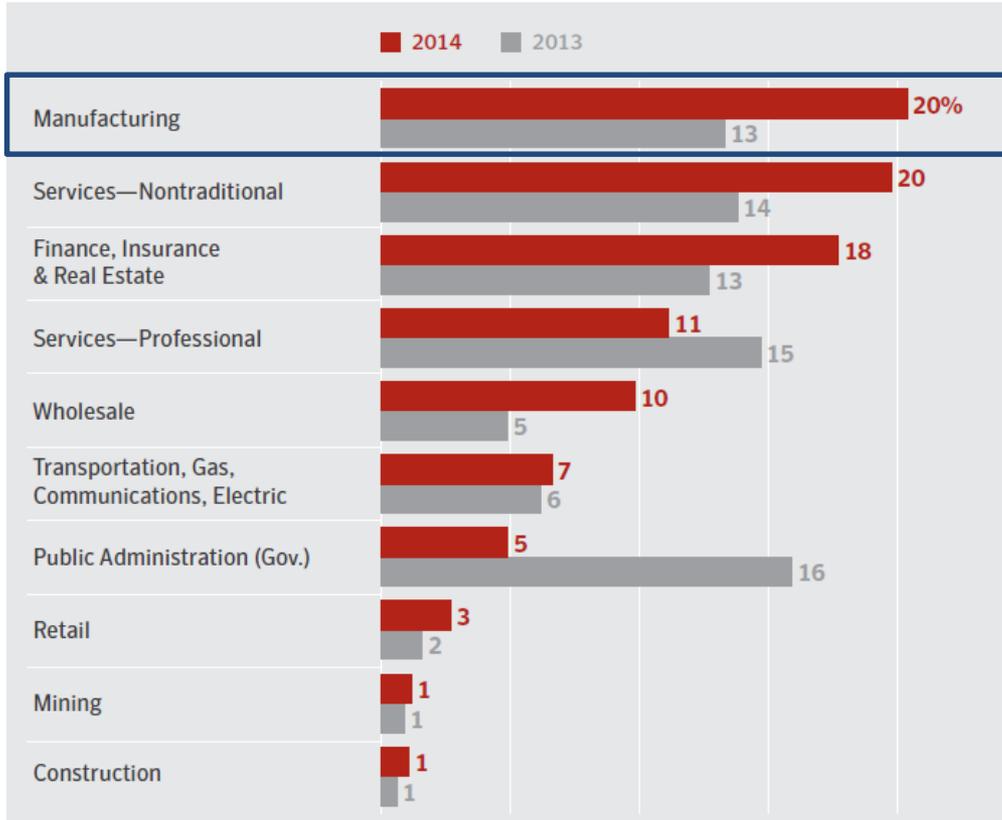
- Advanced materials
- Sustainability

Take-Aways

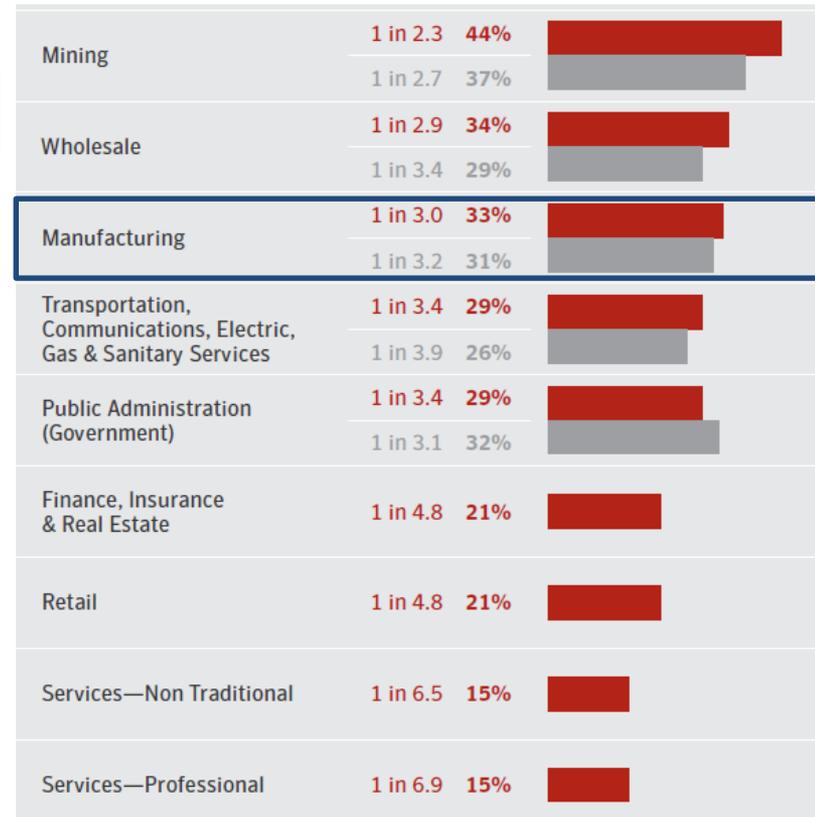
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Mfg'ers received highest volume of spear-phishing attacks

Distribution of attacks

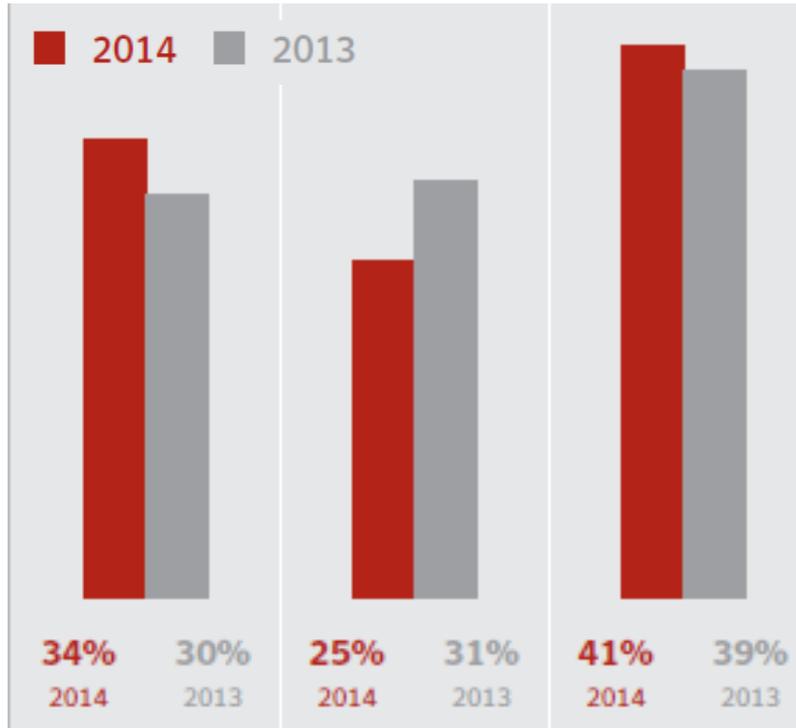


Risk ratio (Of all companies of a given industry)

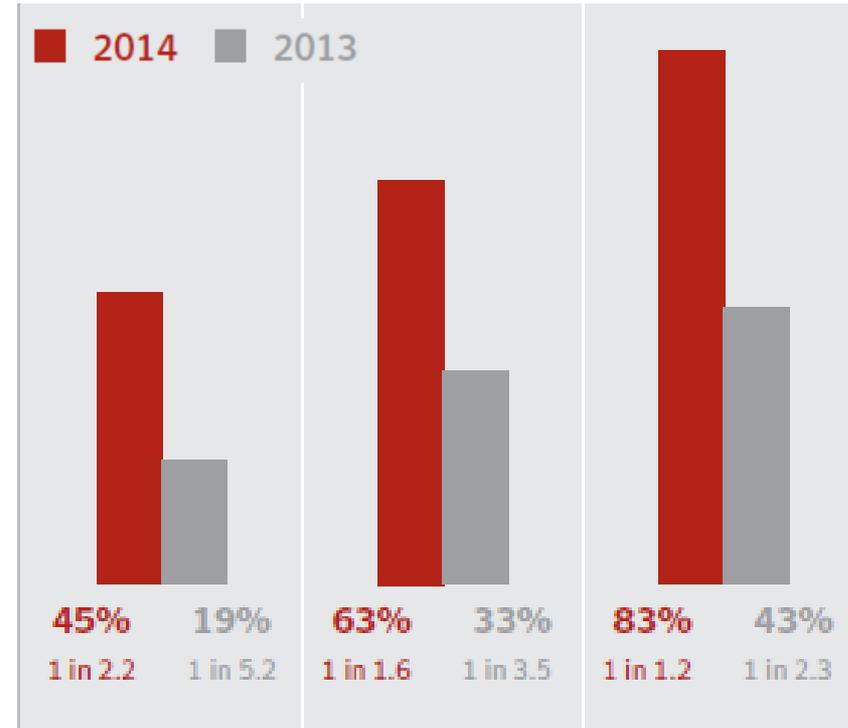


Companies of all sizes are at risk

Distribution of attacks



Risk ratio (Of all companies of a given size)



Small
(1-250 employees)

Medium
(251-2500 employees)

Large
(2500+ employees)

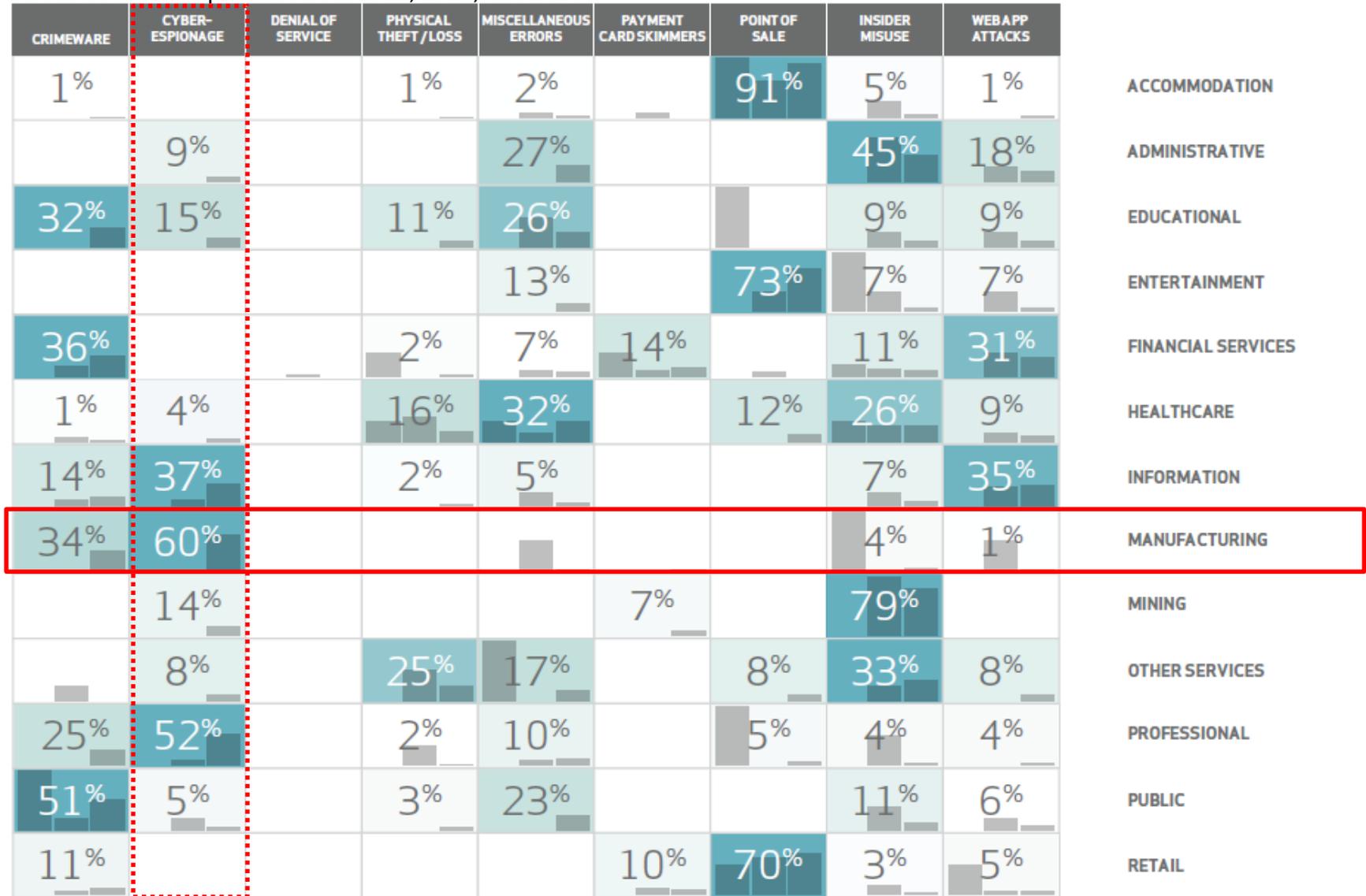
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Attackers Want Manufacturers' Secrets

Bars in each box depict data from 2012, 2013, and 2014



Malware for ICS = Notable Shift in Targets, Techniques

WIND LOGIN | CREATE ACCOUNT

FRONTPAGE WND TV OPINION MONEY DIVERSIONS

FROM JOSEPH FARAH'S G2 BULLETIN

'DRAGONFLY' VIRUS STRIKES U.S. POWER PLANTS

Cyberattacks seek to control or even sabotage America's energy grid

Published: 07/06/2014 at 6:32 PM

PCWorld
Work. Life. Productivity.

Attack campaign infects industrial control systems with BlackEnergy malware

Lucian Constantin

IDG News Service Oct 29 2014 8:05 AM

Symantec Official Blog

+3
3 Votes

Sandworm Windows zero-day vulnerability being actively exploited in targeted attacks

Critical new Windows zero-day has reportedly been used in a limited number of targeted cyberespionage attacks to deliver a back door on to the victim's computer.

By: Symantec Security Response SYMANTEC EMPLOYEE

Created 14 Oct 2014

WIRED An U

KIM ZETTER SECURITY 11.03.14 6:30 AM

AN UNPRECEDENTED LOOK AT STUXNET, THE WORLD'S FIRST DIGITAL WEAPON

BBC Menu

NEWS

Technology

Hack attack causes 'massive damage' at steel works

© 22 December 2014 | Technology

Malware for ICS = Notable Shift in Targets, Techniques

Metric	Information Technology (IT)	Operational Technology (OT)
Role	Supports people	Controls machines
Purpose	Process transactions, provide information	Control/monitor physical process and equipment
Lifetime	~5 years, updated regularly	15-30 years, little/no tolerance for delays or downtime required to update
Architecture	Generic	Custom: event-driven, real-time, embedded hardware/software
Interfaces	GUI, web, keyboard	Electromechanical, sensors, actuators, coded displays, hand-held devices
Ownership	CIO, IT	Engineers, technicians, operators, managers
Connectivity	Corporate network (IP)	Control networks (hard-wired twisted pair and IP)

Mfg'ers Recognize Threats, But Struggle To Respond

Manufacturing is behind the curve

- “On a scale of 1 to 100, we are at a 0.0001. It’s why the government is offering us money”
- “Machine shops are still in the dark ages of digitization”
- “Nothing is obvious anymore when compared to pre-cyber security problems”

The threat is significant

- “We need to be successful 100% of the time, but the bad guys only need to be successful once”
- “There are two types of companies - ones that have been hacked and ones that don’t know they have been hacked”
- “Havoc is more easily recognized and responded to but the subtle attacks (e.g., taking over a machine) are what keep people up at night”

Companies underestimate the risks

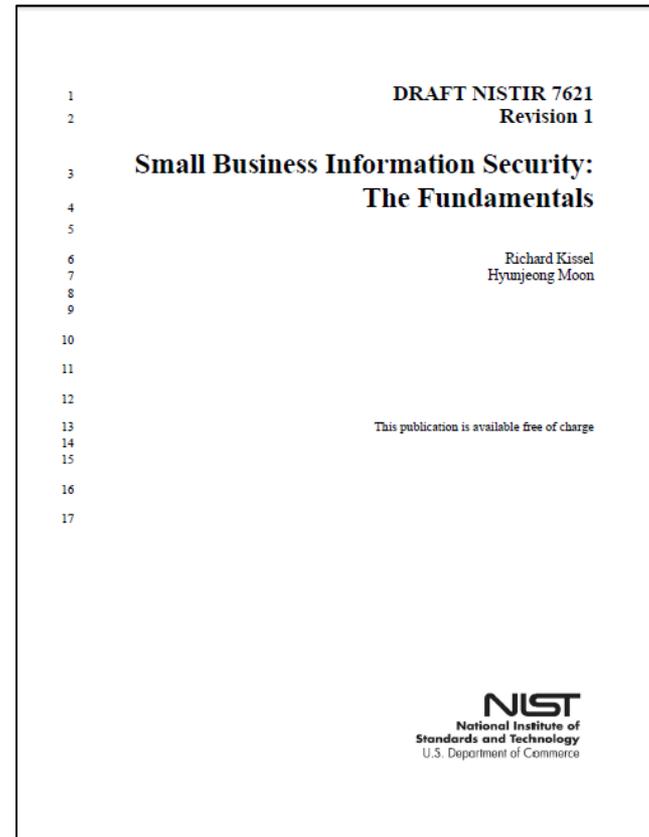
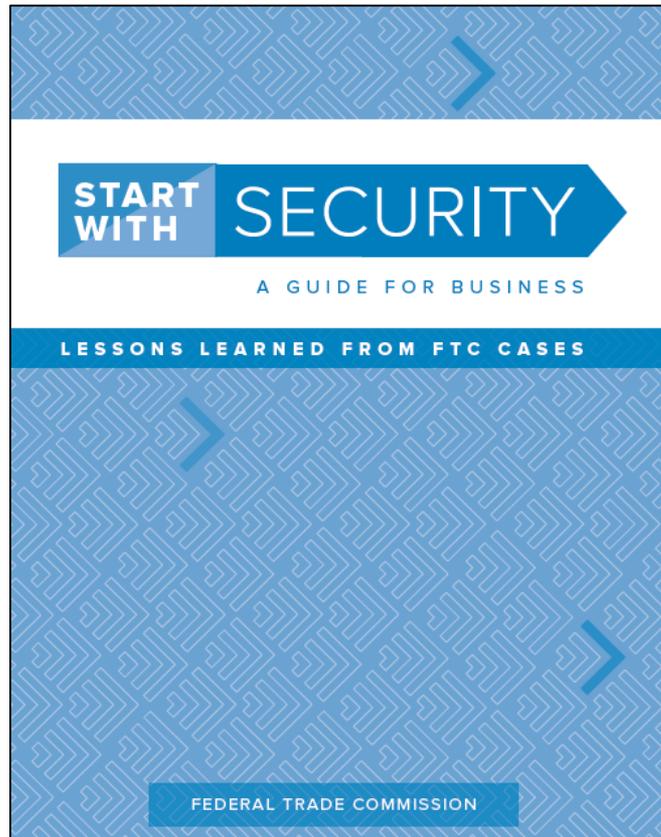
- “Security isn’t going to pay the bills”
- “The mindset is that it’s always someone else who is going to be hacked”
- “There is a constant optimization problem of where to put the next dollar”
- “You don’t think about back door being unlocked”
- “How many people have seen a password taped to a machine tool?”

We need to act quickly

- “Cyber security is the next arms race”
- “How do we position ourselves for excellence that is survivable?”
- “Government can provide the playground for industry and academia”

Some Starter Resources... Equivalent for Manufacturers?

- FTC: Start with Security
- NIST Interagency Report: Small Business Information Security: The Fundamentals (*being updated*)



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