The 4th Industrial Revolution and Government's Roles and Responsibilities

IITP Presentation

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November 1, 2017

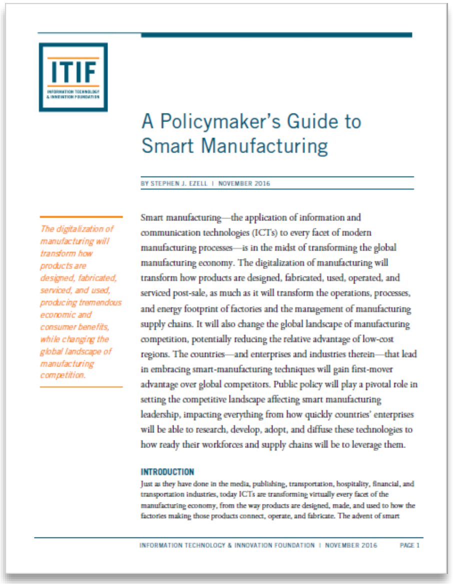
About ITIF

- One of the world's top science and tech policy think tanks.
- Supports policies driving global, innovation-based economic growth.
- Focuses on a host of issues at the intersection of technology innovation and public policy across several sectors:
  - Innovation and competitiveness
  - IT and data
  - Telecommunications
  - Trade and globalization
  - Life sciences, agricultural biotech, and energy

Today’s Presentation

1 The Digitalization of Manufacturing and Why It Matters

2 Government’s Role and Responsibility For Industry 4.0



ITIF INFORMATION TECHNOLOGY & INNOVATION FOUNDATION

A Policymaker’s Guide to Smart Manufacturing

BY STEPHEN J. EZELL | NOVEMBER 2016

The digitalization of manufacturing will transform how products are designed, fabricated, serviced, and used, producing tremendous economic and consumer benefits, while changing the global landscape of manufacturing competition.

Smart manufacturing—the application of information and communication technologies (ICTs) to every facet of modern manufacturing processes—is in the midst of transforming the global manufacturing economy. The digitalization of manufacturing will transform how products are designed, fabricated, used, operated, and serviced post-sale, as much as it will transform the operations, processes, and energy footprint of factories and the management of manufacturing supply chains. It will also change the global landscape of manufacturing competition, potentially reducing the relative advantage of low-cost regions. The countries—and enterprises and industries therein—that lead in embracing smart-manufacturing techniques will gain first-mover advantage over global competitors. Public policy will play a pivotal role in setting the competitive landscape affecting smart manufacturing leadership, impacting everything from how quickly countries' enterprises will be able to research, develop, adopt, and diffuse these technologies to how ready their workforces and supply chains will be to leverage them.

INTRODUCTION

Just as they have done in the media, publishing, transportation, hospitality, financial, and transportation industries, today ICTs are transforming virtually every facet of the manufacturing economy, from the way products are designed, made, and used to how the factories making those products connect, operate, and fabricate. The advent of smart

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Digitalization Transforming Modern Manufacturing

- "Smart manufacturing": The application of a transformative set of ICTs to virtually every facet of modern manufacturing.

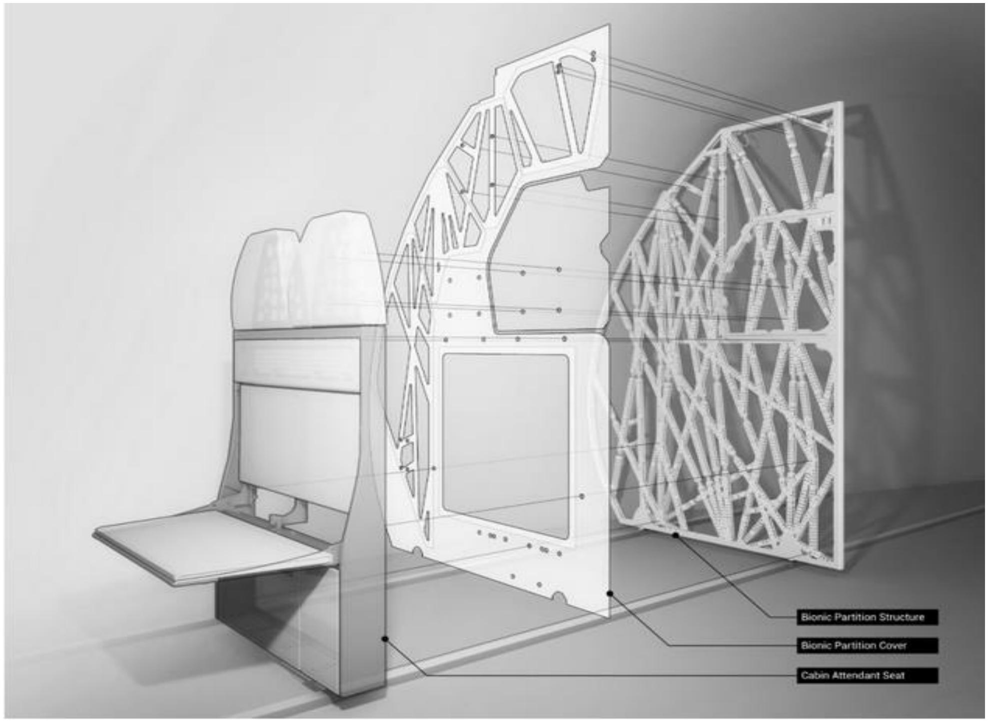
- Digital services account for 25% of total manufacturing inputs.

"Smart" at Each Step of Modern Manufacturing

1. Digitally Enabled Product Design
2. Additive Manufacturing (3D Printing)/Industrial Robots
3. Digitally Empowered Factory Operations
4. Digitally Linked Supply Chains
5. "Smart Products" Beyond the Factory Floor

Digitally Enabled Product Design

- Generative design techniques and modern CAD software herald a new era for how products get designed.



3D Printing (Additive Manufacturing)

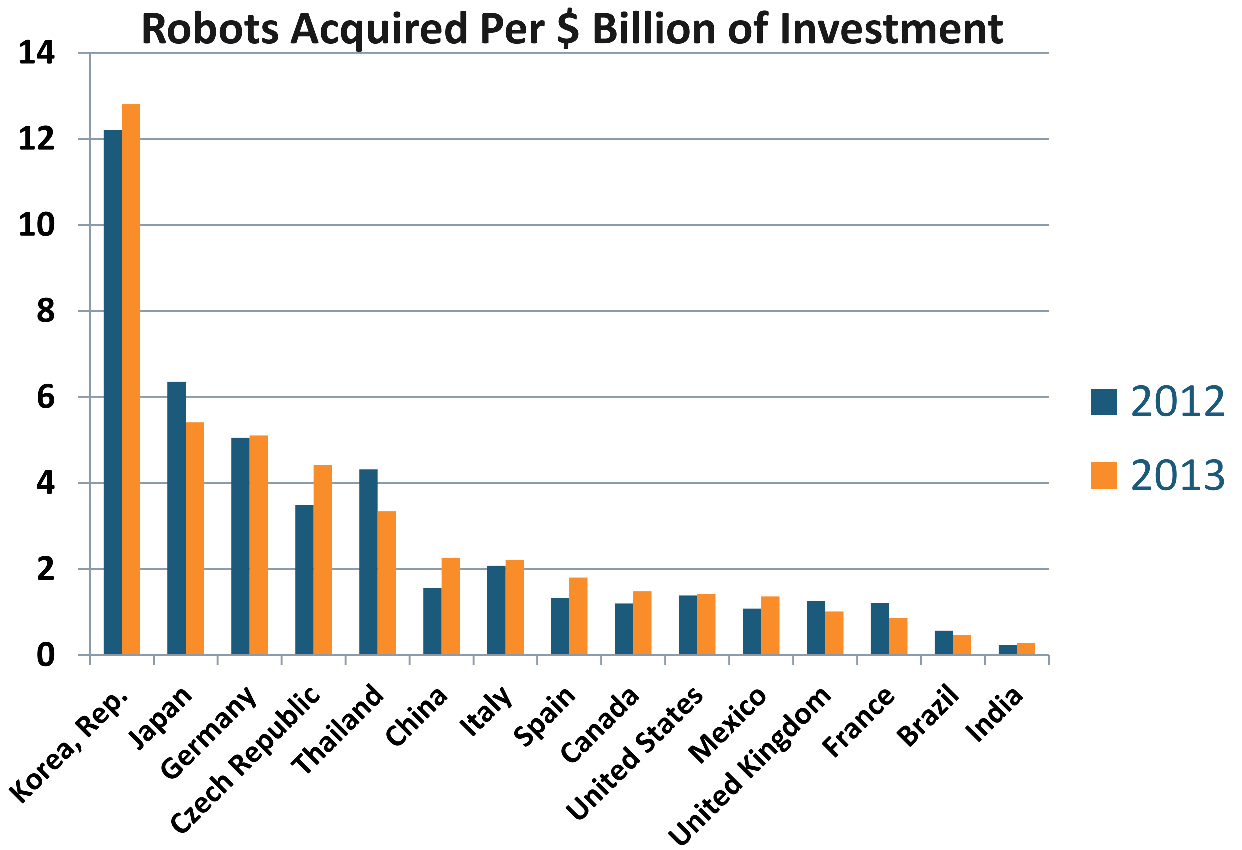
- Particularly suited to producing complex, high-value, lower-volume, highly customizable products.





AI and Industrial Robotics

- Robots in mfg. will add $4.5 trillion to global economy by 2025.



Robots’ Impact on Countries’ Productivity and GDP Growth

- A study of 17 manufacturing industries across 13 countries from 1993 to 2007 found **robots increased the annual growth of labor productivity and GDP by 0.36 and 0.37 percent per year.**
- Robots **accounted for 10% of GDP growth** in studied countries.
- **Productivity in robot-enabled industries increased by 13.6%.**

Robots at Work*

Georg Graetz
Uppsala University†
Guy Michaels
London School of Economics‡

February 27, 2015

Abstract

Despite ubiquitous discussions of robots' potential impact, there is almost no systematic empirical evidence on their economic effects. In this paper we analyze for the first time the economic impact of industrial robots, using new data on a panel of industries in 17 countries from 1993-2007. We find that industrial robots increased both labor productivity and value added. Our panel identification is robust to numerous controls, and we find similar results instrumenting increased robot use with a measure of workers' replaceability by robots, which is based on the tasks prevalent in industries before robots were widely employed. We calculate that the increased use of robots raised countries' average growth rates by about 0.37 percentage points. We also find that robots increased both wages and total factor productivity. While robots had no significant effect on total hours worked, there is some evidence that they reduced the hours of both low-skilled and middle-skilled workers.

Digitally Empowered Factory Operations

- Gives manufacturers a comprehensive, real-time view of status of production equipment, work cells, and systems.

Digitally Empowered Factory Operations

Explosion of low-cost sensor technologies has made every manufacturing process and component a potential data source.

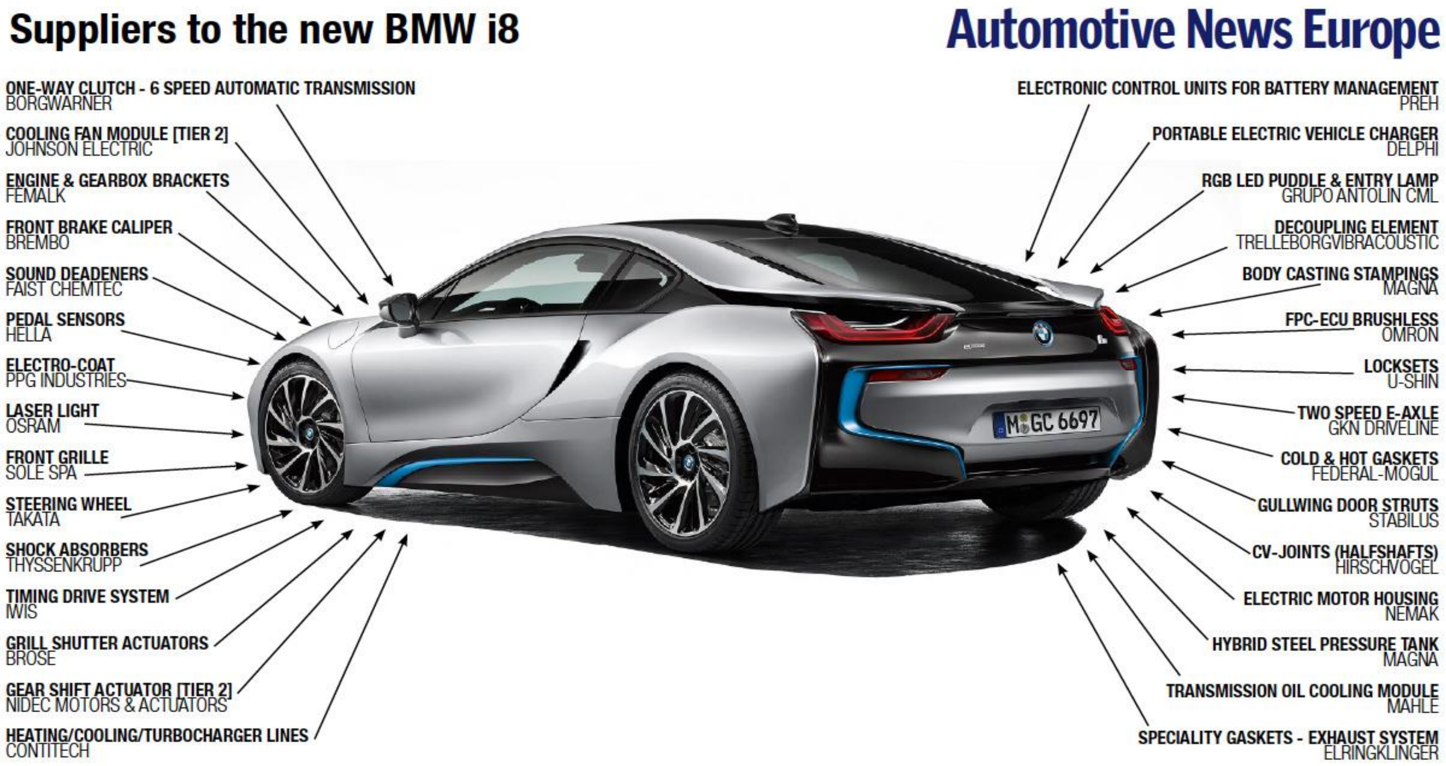
- GM: Uses sensors to monitor humidity conditions during vehicle painting; if unfavorable, the work piece is moved elsewhere or ventilation systems adjusted.

GM General Motors

- GE's "Brilliant Factories" initiative doubled production of defect-free dishwashers and washing machines.

Digitally Linked Supply Chain Management

- Real-time visibility into every machine making every component across manufacturing supply chains.



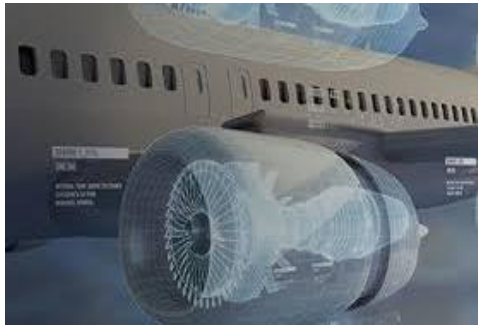
Smart Products Beyond the Factory Floor

- "Product servicification": Selling products as services.

- E.g. Rolls Royce's "Power by the Hour" model.

  50% of Rolls Royce's revenues come from services.

- "Digital twins" concept a key enabler.



The Benefits of Digital Manufacturing

Economic

- Increase global manufacturing productivity by 10 to 25%.
- Industrial Internet could add as much as $10 trillion to global GDP over the next 20 years.
- Anticipated 25% increase in revenues from new products and services at firms using smart manufacturing techniques.

Trade Impact of Digitalized Production Systems

Source: Courtesy Magnus Rentzhog, Swedish National Board of Trade, “Trade, digitalization, and the future of trade policy”

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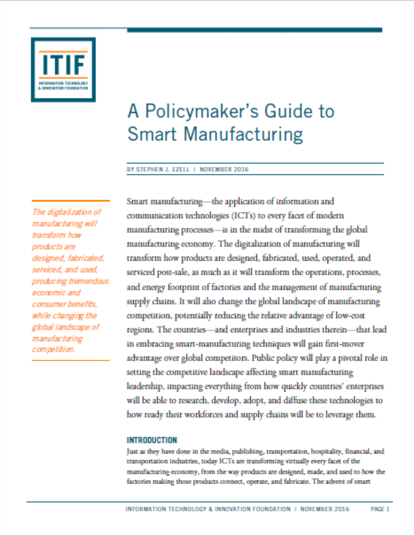

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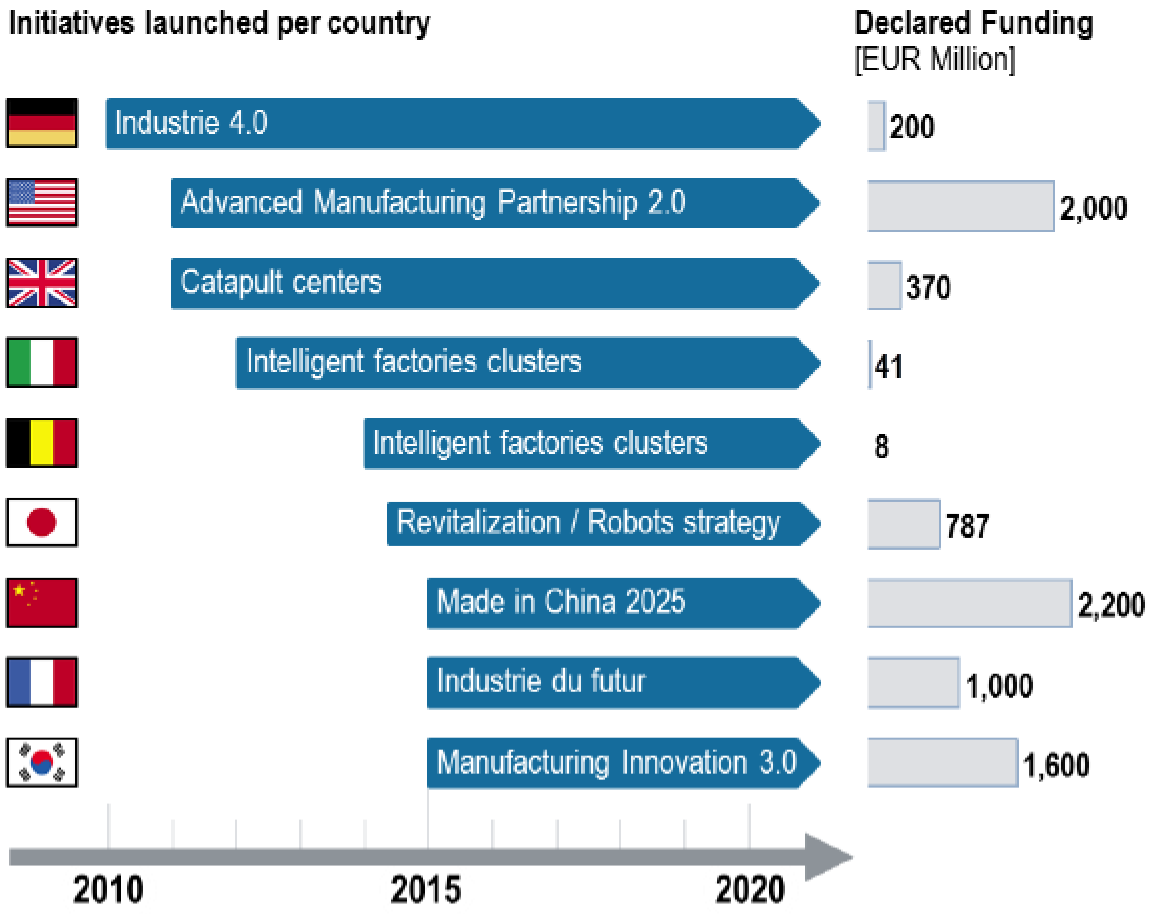
Why Countries Need Industry 4.0 Strategies

- Significant "competitiveness externalities" exist: other mfg. firms in supply chains harmed if peers fail to adopt new technologies.
- Significant investment and firm learning around best practices in technology adoption will be required.
- International competition significantly intensifying.

Countries Aggressively Implementing Policies to Achieve Digital Manufacturing Leadership



Source: Roland Berger

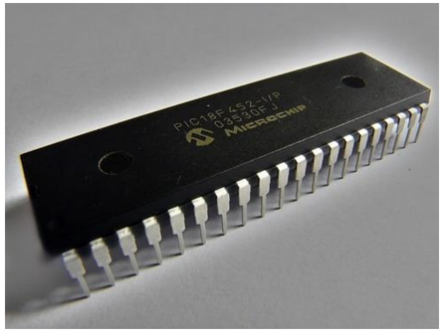
APEC IIoT Readiness Scores

IIoT Readiness Score 2016

Country	Readiness score	Relative readiness score	Ranking
Singapore	0.182	9.8	1
Taiwan	0.159	8.6	2
China	0.139	7.5	3
South Korea	0.122	6.6	4
Japan	0.082	4.4	5
Malaysia	0.034	1.8	6
Australia	0.019	1.0	7
Thailand	0.019	1.0	8

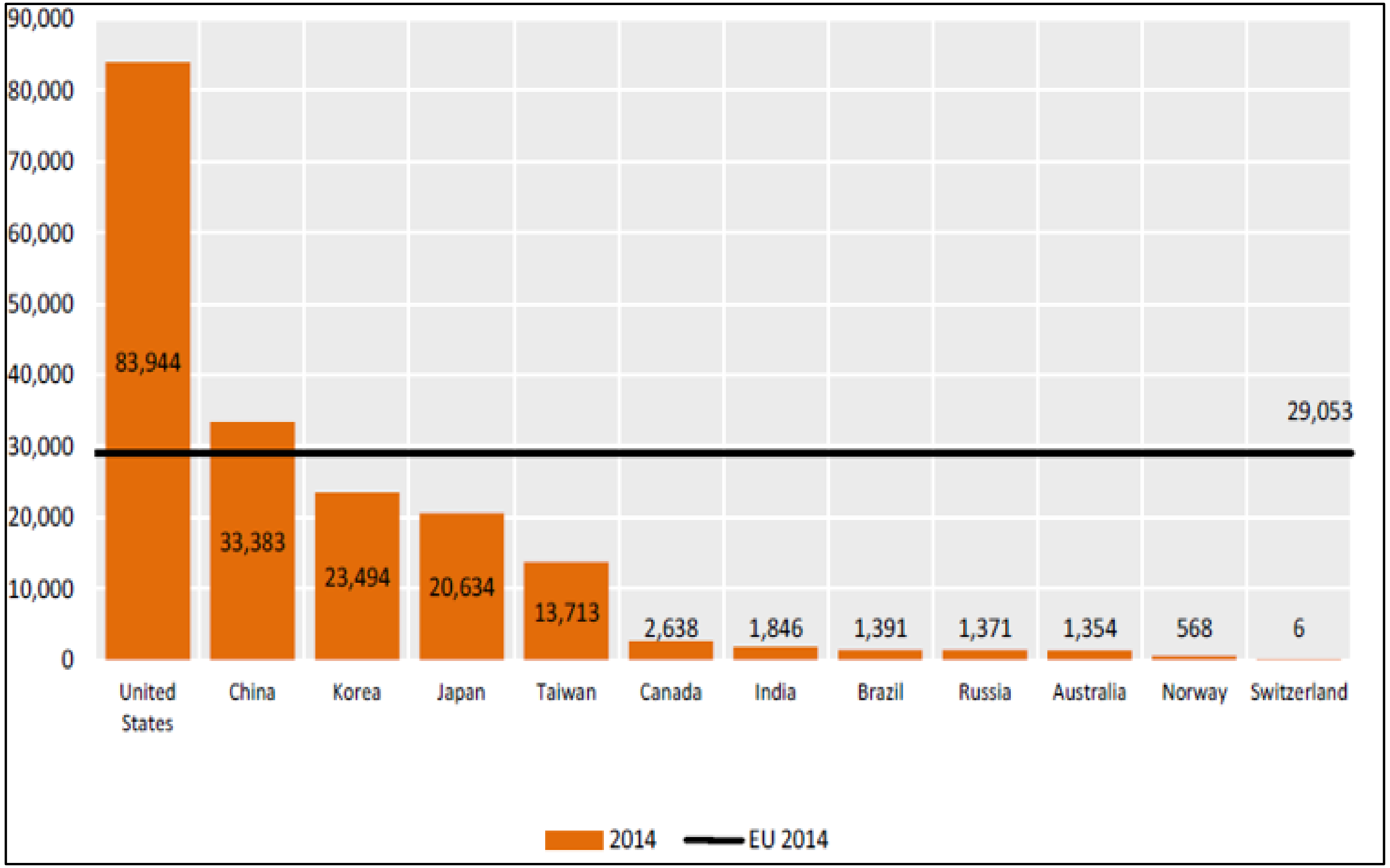
Source: Frost & Sullivan, "Understanding the Role of Governments in Promoting the Industrial Internet of Things"

Get the 4 "Ts" Right for Industry 4.0 Leadership

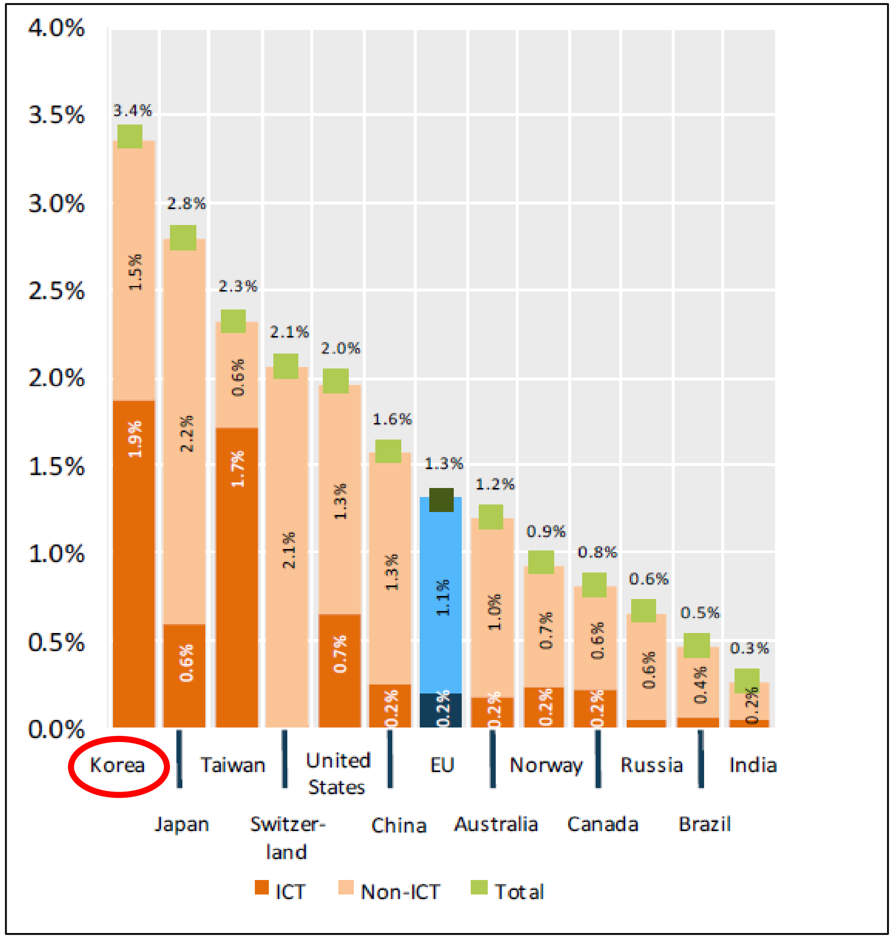
Technology	Talent
	
Trade	**Tax**
	

Invest in ICT Research and Development

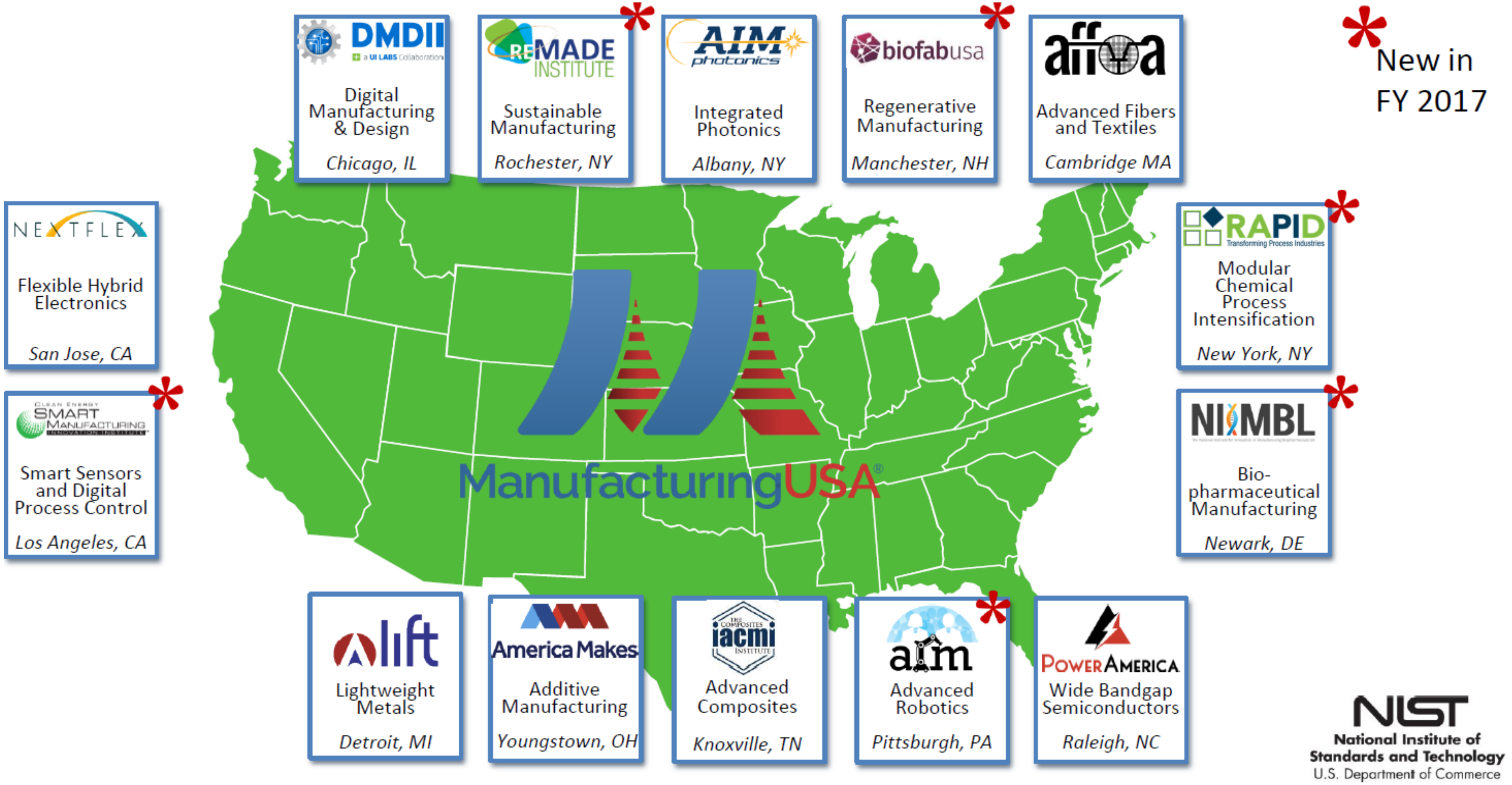
ICT BERD, Euros, 2014



ICT R&D/Share Total R&D



PPPs Supporting Mfg. Product/Process Technologies



Source: Advanced Manufacturing Program Office, NIST, U.S. Department of Commerce

Manufacturing USA's DMDII

- The Digital Manufacturing and Design Innovation Institute (DMDII) was launched in February 2014 in collaboration with the U.S. Department of Defense and is focused on digitizing American manufacturing by helping U.S. manufacturers harness data to make their products better, faster, and more cost-competitively.
- DMDII has the following **technology focus areas**:

Design, Product Development, Systems Engineering: Creating improved design tools and processes, integrating data across the manufacturing lifecycle, and developing automated manufacturing planning

Future Factory: Enabling digital integration and control in the manufacturing environment, and implementing tools to increase flexibility throughout the production cycle

Agile, Resilient Supply Chain: Facilitating access to digital information, supply chain visibility, and design collaborations

Cybersecurity in Manufacturing: Designing and deploying assessment tools, and establishing a collaborative network for sharing best practices

Support SME Adoption of Digital Manufacturing

- Facilitate SME access to high-performance computing (HPC) for design, modeling & simulation, etc.

DIGITAL MANUFACTURING COMMONS

The Digital Manufacturing Commons (DMC) is a leading open-source platform for connecting communities and sharing solutions across the manufacturing product life cycle.

MODEL DEVELOPMENT KIT

The tools for building analytical models (apps) for the service marketplace

WEB PLATFORM

The web platform and service marketplace and their source code

MANUFACTURING APPS

Analytical models that live in the service marketplace

DOCUMENTATION

The Quick Start Guide, technical details, and information on contributing

Standards, Interoperability, & Cybersecurity

- Support the development of voluntary, consensus-based, industry-led, globally interoperable standards. Avoid nation-specific standards.
  - UK TSB invested $12B for industry working group to develop an open standard for the Internet of Things called HyperCat.
- Develop cybersecurity frameworks in collaboration with industry, with government communicating insight into cybersecurity threats/defense.

Talent: “Industry 4.0” Demands “Education 4.0”

Education 1.0

1

Apprenticeship
Up through the early 19th Century. Characterized by studying the Master, and focused on specific customer needs. Difficult to reproduce.

Education 2.0

2

Manual Arts
Through the 19th and beginning of the 20th centuries. Focused on work and tools of the day. Discussion of a formal discipline began.

Education 3.0

3

Industrial Arts
Beginning to middle of the 20th centuries. Included a focus on breadth of topics to develop technological literacy, but clinging to its vocational roots. Focused on putting students to work.

Education 4.0

4

Technology Education & the Designed World
Today. Characterized by national movements and formal curriculum standards. The design process and its use as a problem solving method is central.

Source: Nathan Hartman, Purdue University

Talent: Building the Industry 4.0 Workforce

Challenge:

- 80% of countries' manufacturing sector workforces lack necessary skills to compete in the global smart manufacturing economy.
- U.S. skills gap may result in 2M mfg. jobs going unfilled over next decade.
- Two-thirds of businesses report they lack "the human capital needed to effectively use new data."

Skills in which manufacturing employees are most deficient

Source: Deloitte and The Manufacturing Institute, "*The skills gap in U.S. manufacturing 2015 and beyond*"

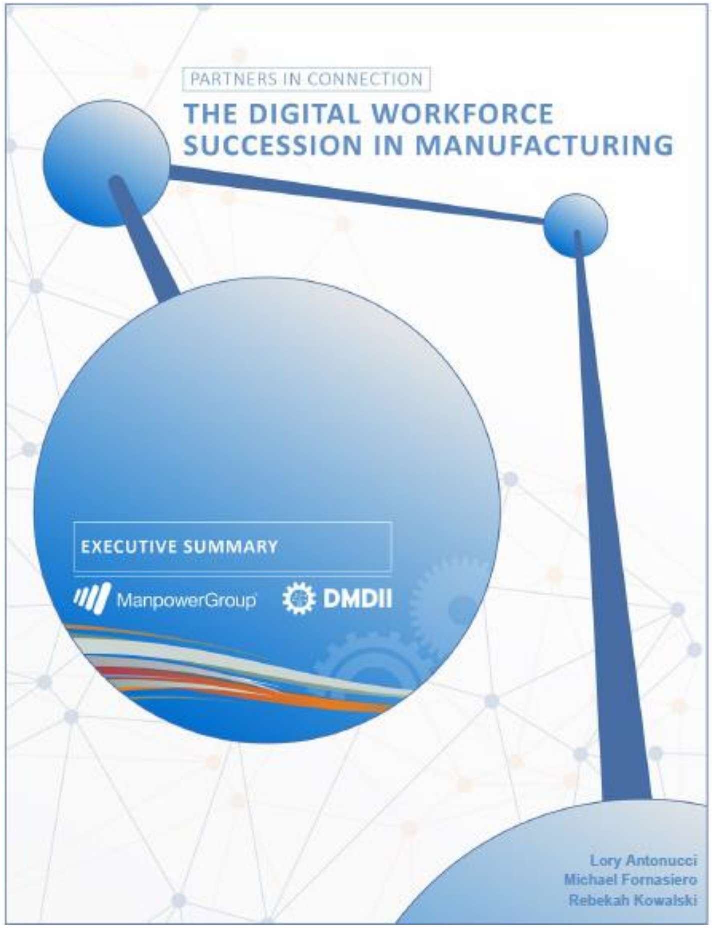
Talent: Building the Industry 4.0 Workforce

Solutions:

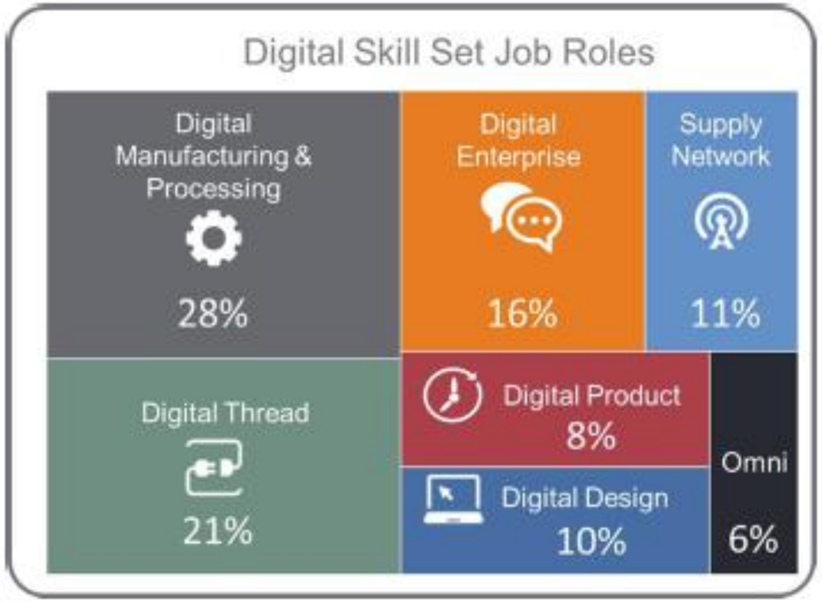
- Prioritize hands on, industry project-based learning at universities.
- Expand industry-recognized, nationally portable skills certifications.
- MOOCs like Tooling U-SME: Provides 500+ online mfg. technology classes; training in nine functional areas and 60 competency models.

TOOLINGU | sme

Talent: Building the Industry 4.0 Workforce

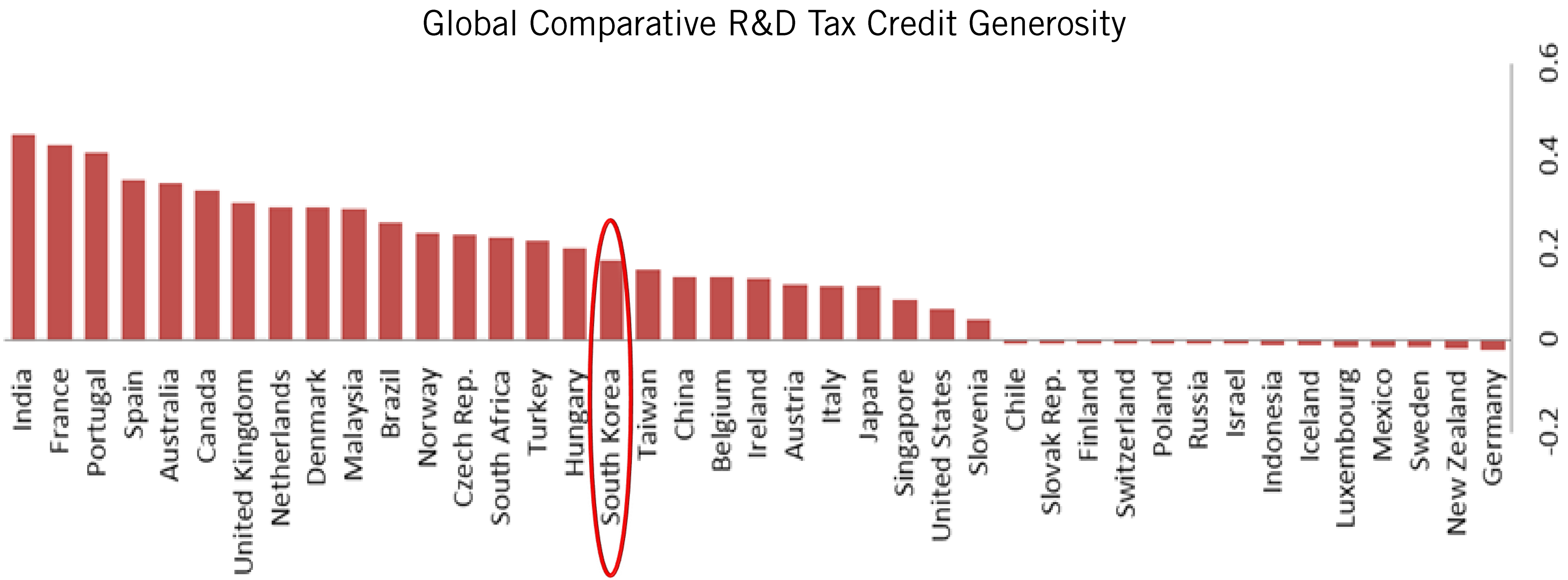


- **Develops a Digital Manufacturing and Design Roles Taxonomy**, identifying 165 potential roles/jobs in digital manufacturing and design.



Source: Digital Manufacturing and Design Innovation Instiute (DMDII) and Manpower Group, “The Digital Workforce Succession in Manufacturing”

Tax Policy to Support Industry 4.0

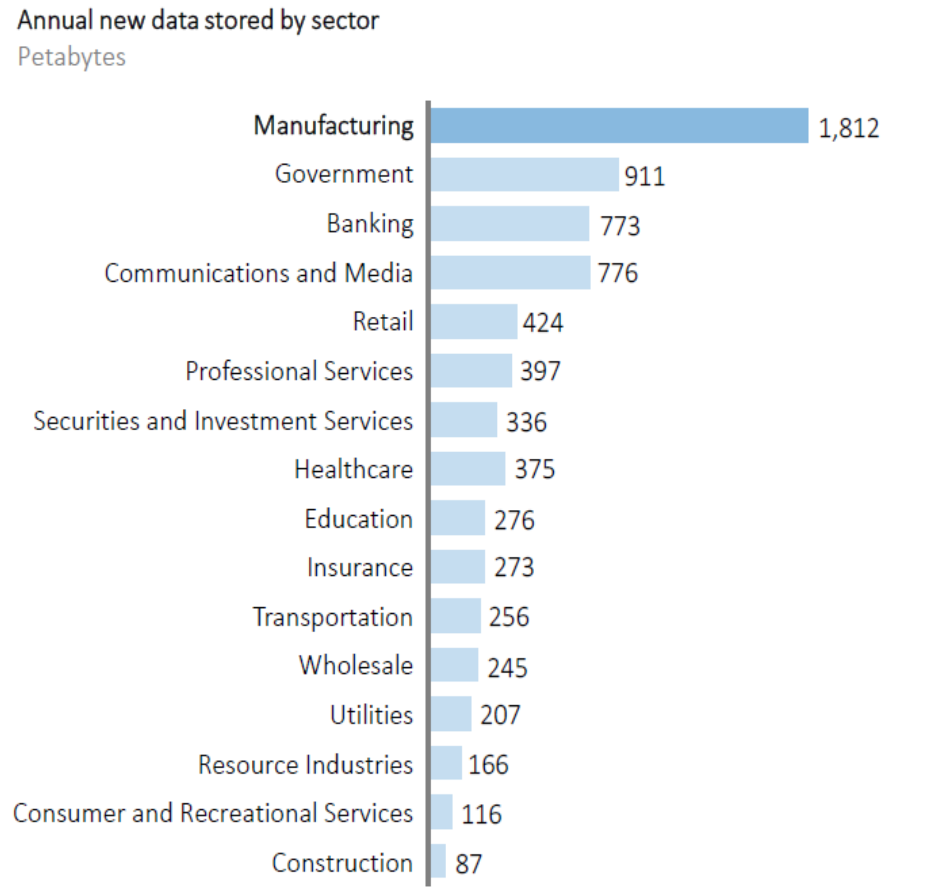


Source: We're 27th! The United States Lags Far Behind in R&D Tax Credit Generosity

Tax Policy to Support Industry 4.0

- ✓ Broaden the eligibility of the 5% tax credit for "industrial equipment or advanced office equipment," to all firms, not just SMEs.
- ✓ Equalize the investment tax credit for R&D equipment: which is 1% for large companies, 3% for medium-sized companies, and 6% for SMEs.
- ✓ Introduce a collaborative R&D tax credit.

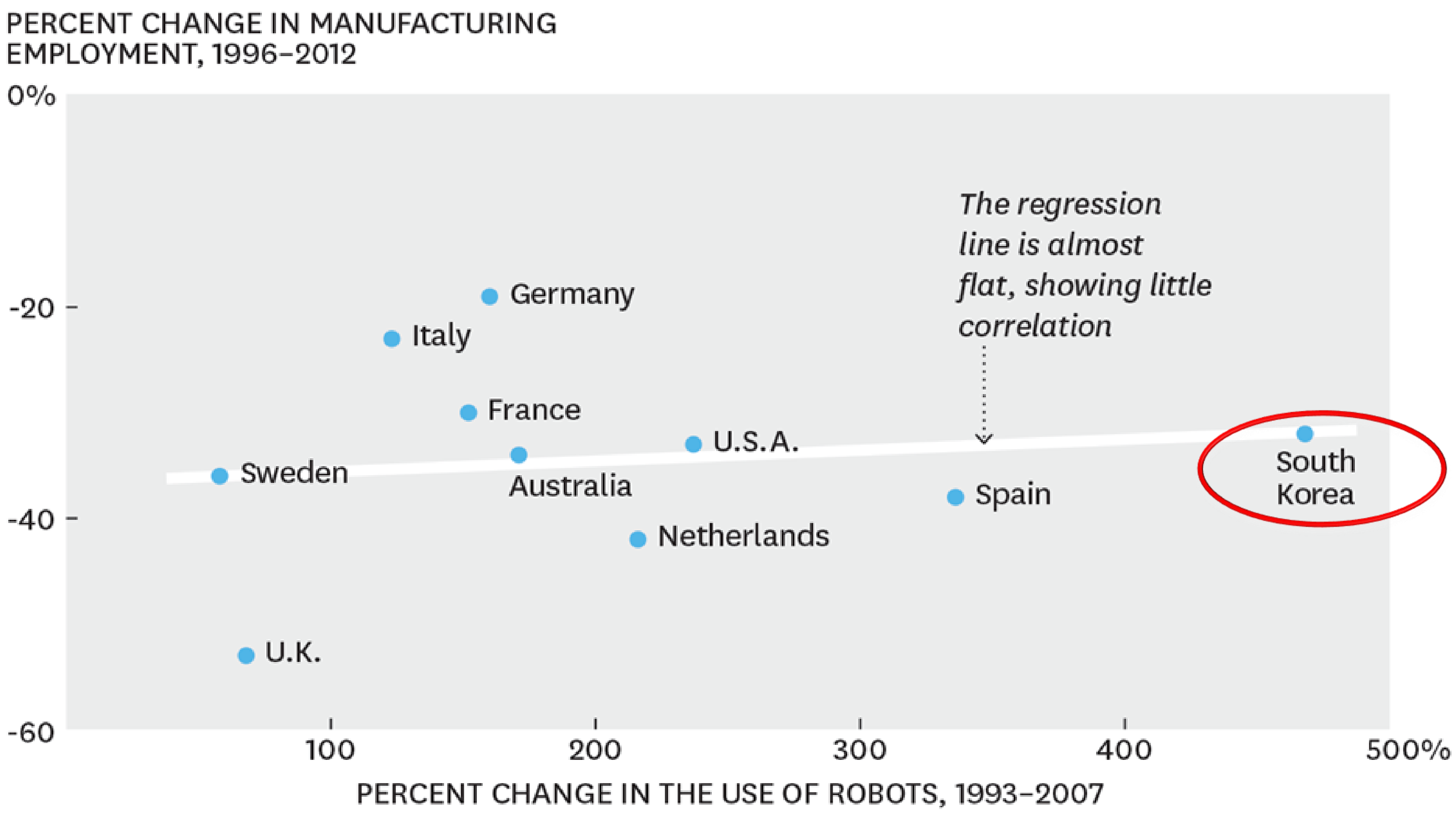
Trade Policy to Support Industry 4.0



SOURCE: IDC; McKinsey Global Institute analysis 2013

- ✓ In KORUS, TPP, RCEP ensure open cross-border data flows.
- ✓ Eschew data localization provisions, including on cloud computing.
- ✓ Contest innovation mercantilism.

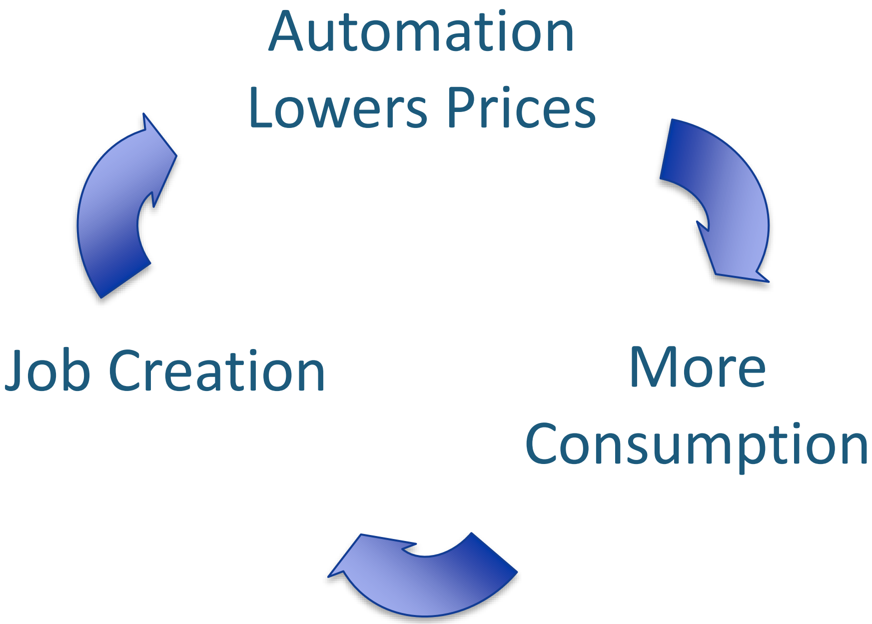
Don't Fear Employment Impact of Automation/Robotization



Source: George Graetz and Guy Michaels, "Robots at Work"; Muro and Andes, "Robots Seem to Be Improving Productivity, Not Costing Jobs

Don’t Fear Employment Impact of Automation/Robotization

Most observers miss the second-order effects from productivity increases.



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Are Robots Taking Our Jobs, or Making Them?

BY BEN MILLER AND ROBERT D. ATKINSON | SEPTEMBER 2013

The view that machines are a problem saps the American spirit of its relentless and aggressive support for innovation and progress. It is time to consign neo-Ludditism and its particular refrain that technology costs jobs once and for all to the dustbin of history.

INTRODUCTION

With U.S. unemployment remaining stubbornly above seven percent and job growth anemic, many have latched on to a compelling explanation: “the robots are taking our jobs.” In other words, a “neo-Luddite” narrative has taken hold. According to this line of thinking, high productivity driven by increasingly powerful IT-enabled machines is the cause of U.S. labor market problems, and accelerating technological change will only make those problems worse. There’s only one flaw in this narrative: it is completely wrong and not supported by data, scholarly evidence or logic.

This report analyzes the “robots are killing our jobs” arguments, shows how they are constructed on faulty analysis, examines the extensive economic literature on the relationship between employment and productivity, and explains the logic of how higher productivity leads to more jobs. We show that more technology benefits not just the economy overall, but also workers: more and better technology is essential to U.S. competitiveness and higher living standards. The claim that increased productivity eliminates jobs is misguided speculation.

These neo-Luddites make a rough and fallacious correlation between today’s high unemployment and the cool technology they see all around them (e.g., their smart phones, the kiosks at airports, Watson on Jeopardy). Clearly, in their minds, there must be a connection. For them, technology is enabling the same amount of work to be done with fewer people and doesn’t lead to a dynamic where these people become reemployed doing other work. In other words, they believe that the jobs are gone and the workers are added to the unemployment rolls.

Source: ITIF, *Are Robots Taking Our Jobs? Or Making Them?*

Thank You!

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