Digitalization and U.S. Competitiveness in the Global Economy

MAPI June 2018 Board Meeting

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About ITIF

- The world's leading science and technology policy think tank.
- 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

MFG Reports



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 tremendo. economic and consumer benefit: while changing the global landscape of manufacturing

Smart manufacturing—the application of information and communication technologies (ICTs) to every facet of modern manufacturing processes—is in the midst of transforming the manufacturing economy. The digitalization of manufacturing transform how products are designed, fabricated, used, ope serviced post-sale, as much as it will transform the operation and energy footprint of factories and the management of supply chains. It will also change the global landscape of competition, potentially reducing the relative advantage regions. The countries—and enterprises and industries in embracing smart-manufacturing techniques will gal advantage over global competitors. Public policy will setting the competitive landscape affecting smart maleadership, impacting everything from how quickly will be able to research, develop, adopt, and diffuse how ready their workforces and supply chains will

Just as they have done in the media, publishing, transpor transportation industries, today ICTs are transforming vimanufacturing economy, from the way products are design factories making those products connect, operate, and f.



Ten Principles to Guide the Trump Administration's Manufacturing Strategy

BY ROBERT D. ATKINSON AND STEPHEN EZELL 1 JANUARY 2017





How Cloud Computing Enables Modern Manufacturing

BY STEPHEN EZELL AND BRET SWANSON | JUNE 2017

Cloud computing represents a key platform technology that is playing an essential and foundational role in enabling the next production revolution

Cloud computing—the provision of infinitely scalable computing resources as a service over the Internet—is in the process of transforming virtually every facet of modern manufacturing. Whether it's how manufacturing enterprises operate, how they integrate into supply chains, or how products are designed, fabricated, and used by customers, cloud computing is helping manufacturers innovate, reduce costs, and increase their competitiveness. Critically, cloud computing allows manufacturers to use many forms of new production systems, from 3D printing and high-performance computing (HPC) to the Internet of Things (IoT) and industrial robots. Moreover, cloud computing democratizes access to and use of these technologies by small manufacturers. This report describes how cloud computing enables modern manufacturing, provides real-word case studies of this process in action, and recommends actions policymakers can take to ensure cloud computing continues to transform manufacturing and bolster America's manufacturing competitiveness.

INTRODUCTION TO CLOUD COMPUTING

Cloud computing has been described as an innovation in computing architecture whose central characteristic is the virtualization of computing resources and services. Cloud constant standardate, in the virtualization or computing resources and services. 'Cloud computing allows computing resources to be delivered with five central attributes: as an ondemand service; with infinite and rapid elasticity and scalability; on a measured basis

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ction, it is that Preside ing. But while he has s warning companies deal that led Carrier to riously headed to derision from work," "picking houldn't care about pread pundit opinior ense, or worse, What happens when he consensus on ignorant and

ning administration ould look like. On one and the broader o other than fall back or ing workers, and building has happened to U.S.



Why Manufacturing Digitalization Matters and How Countries Are Supporting It BY STEPHEN EZELL | APRIL 2018

The digitalization of This report explains how digitalization is transforming manufacturing manufacturing is globally, detailing what exactly smart manufacturing (or "Industry 4.0") is changing how and examining the productivity impacts that digitalized manufacturing products are promises to deliver. The report examines the small- to medium-sized designed, fabricated, enterprise (SME) manufacturing support programs and policies of ten used, and serviced, nations—Argentina, Australia, Austria, Canada, China, Germany, Japan, just as it's Korea, the United Kingdom, and the United States—and provides transforming the insights countries can leverage to support the digitalization of their operations, processes, manufacturers. The report further examines how the development of and energy footprint common standards can facilitate technology adoption and proposes a of factories and typology that helps conceptualize different manufacturing production supply chains. systems and strategies, showing how these need to be supported by

The Digitalization of Modern Manufacturing

Whether it's called 'Industry 4.0," as in Europe, the "Industrial Internet of Things (IIoT)," as in the United States, or just "smart manufacturing," the application of information and as in one content states, or past small manufacturing, the apparation or into transform communication technology (ICT) to every facet of manufacturing is in the midst of reshaping modern manufacturing. This digitalization of manufacturing is changing how products are designed, fabricated, used, operated, and serviced post-sale, just as it's transforming the operations, processes, and energy footprint of factories and the management of manufacturing supply chains. This convergence of digital technologies with manufacturing industries also promises to recar the landscape of global

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International Benchmarking of Countries' Policies and Programs Supporting SME Manufacturers

BY STEPHEN J. EZELL AND DR. ROBERT D. ATKINSON

SEPTEMBER 2011

Today's Presentation

- 1 Manufacturing Digitalization and Why It Matters
- 2 Government's Roles and Responsibilities

Increasingly Digitalized Global Economy

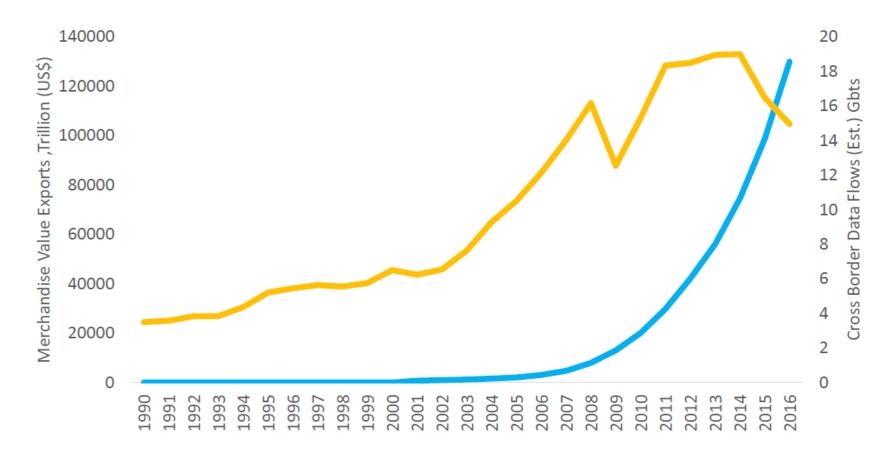
- Digital economy accounts for 25% of global GDP.
- Half of all value created in the global economy over the next decade will be created digitally.
- 75% of the value of data flows over the Internet accrue to traditional industries.



Sources: Accenture, "Digital Disruption: the Growth Multiplier"; McKinsey Global Institute, "Digital globalization: The new era of global flows"



Cross-Border Data Flows Have Surpassed Merchandise Trade



Source: Victor Mulas, The World Bank

Digitalization Transforming Manufacturing

 "Smart manufacturing": The application of information and communications technologies to manufacturing processes.

Enabling technologies: IoT, sensors, wireless, cloud computing, data analytics, CAD/CAE software, robotics.

Digital services account for 25% of manufacturing inputs.

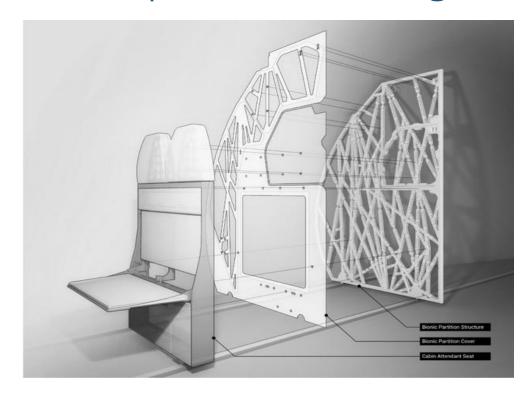
"Digitally Enabled" at Each Step of Manufacturing

- 1. Product Design
- 2. Fabrication and Assembly
- 3. Factory Integration
- 4. Supply Chain Integration
- 5. Product Use and Consumption



Product Design

 CAD leverages generative design techniques to herald a new era of how products are designed.





Fabrication and Assembly

 3-D printing could affect up to 42% of production in aerospace, automotive, industrial, automotive,, and medical device sectors.



 Increasingly capable industrial robots adapt in real-time to support flexible manufacturing systems.



Source: AT Kearney, "3D-Printing and the Future of the U.S. Economy"

Factory Integration

 Sensor-enabling equipment generates a comprehensive, real-time view of the status of machines, work cells, and systems.





Factory Integration



Courtesy: Rold Group, Milan, Italy

Factory Integration







All the data and factory alerts in real-time and ready-to-use

Real-Time Notification to the



Courtesy: Rold Group, Milan, Italy

Timely Problem Solving



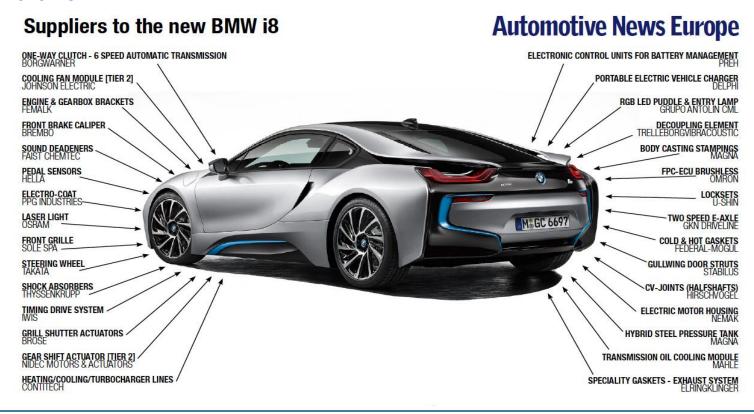
Instant Feedback to the Manager





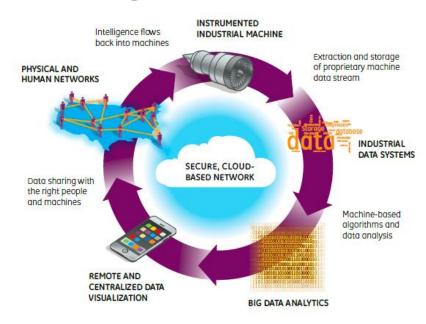
Supply Chain Management

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



Product Use and Consumption

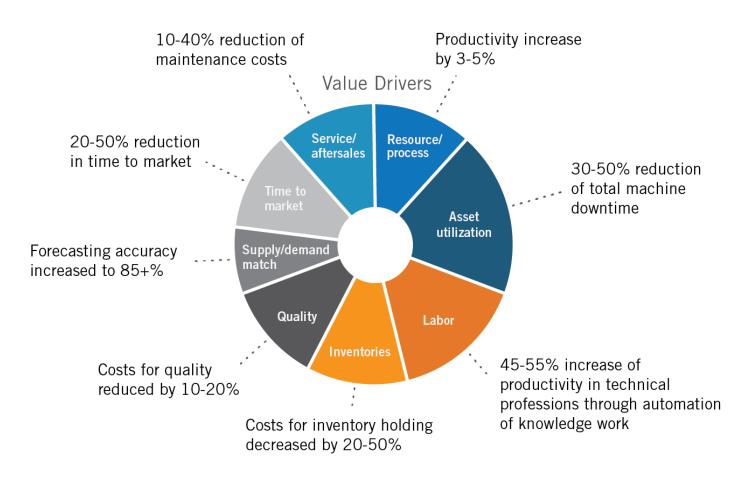
- "Product servicification": Selling products as services.
- Delivering cloud-based, value-added services through products.







Digital Manufacturing Can Drive Productivity Growth



Source: McKinsey Global Institute, "Industry 4.0 How to Navigate Digitization of the Manufacturing Sector"

Digital Manufacturing Can Drive Productivity Growth

- Increase productivity of world's factories by 10 to 25%.
- IoT applications will generate \$1.2 to \$3.7 trillion of economic value annually by 2025.
- Could add 1-1.5% to a nation's annual productivity growth.

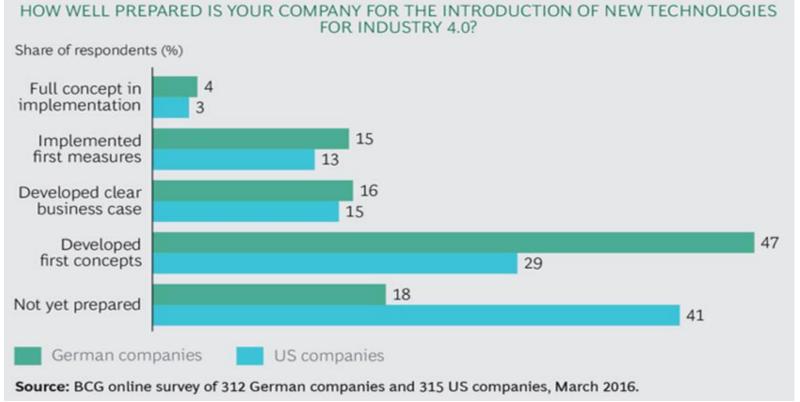


Sources: McKinsey Global Institute, "The Internet of Things: Mapping the Value Beyond the Hype" GE, "Industrial Internet: Pushing the Boundaries of Minds and Machines"



Yet Progress Has Been Slow

■ 77% of U.S. SMEs have no plans to implement IIoT within 3 years.



Sources: Sikich, "2017 State of Manufacturing Report"

Markus Lorenz et al., Boston Consulting Group, "Time to Accelerate in the Race Toward Industry 4.0," May 2016

Why Has Digital Manufacturing Progress Been So Slow?

Technology not yet fully mature.Fragmented providers/lack of interoperable standards.

Demand *→*

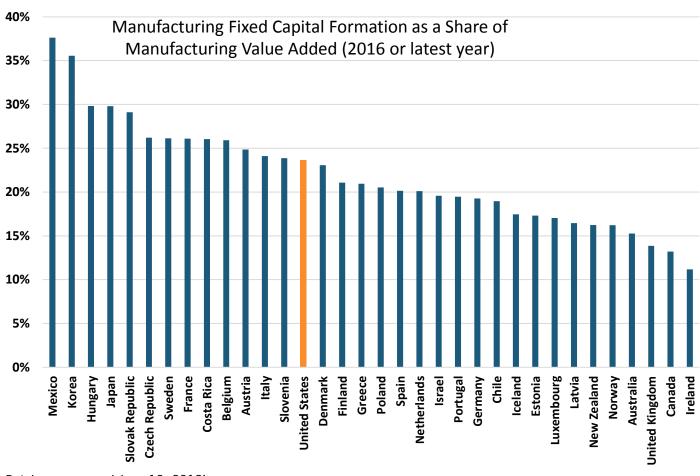
Lack of clarity on how to proceed (especially for SMEs).

Lagging employee skills and competencies.

Underinvestment in capital equipment.

Source: Stephen Ezell, ITIF, "U.S. Manufacturing Digitalization – Extent of Adoption and Recommendations for Increasing Penetration" (Forthcoming July 2018)

U.S. Mfg. Underinvestment Relative to Peer Nations



Source: OECD Stat, (Structural Analysis Database; accessed June 12, 2018)

Today's Presentation

Manufacturing Digitalization and Why It Matters

2 Government's Roles and Responsibilities



reshaping modern manufacturing. 1 This digitalization of manufacturing is changing how

products are designed, fabricated, used, operated, and serviced post-sale, just as it's transforming the operations, processes, and energy footprint of factories and the management of manufacturing supply chains. 2 This convergence of digital technologies

with manufacturing industries also promises to recast the landscape of global

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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

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

how ready their workforces and supply chains will be to leverage them.

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Over 30 Countries Have Introduced "Industry 4.0" Initiatives

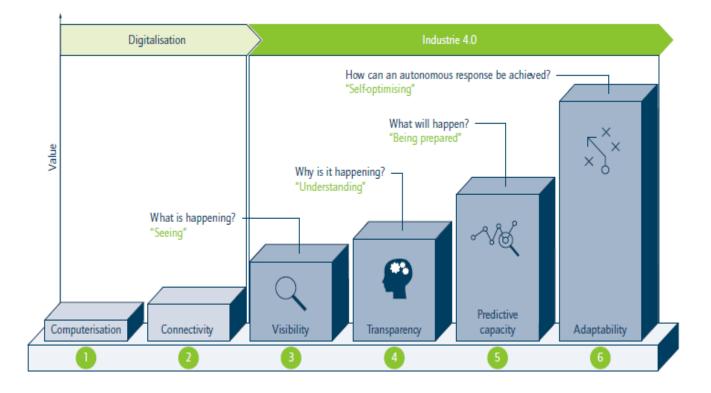


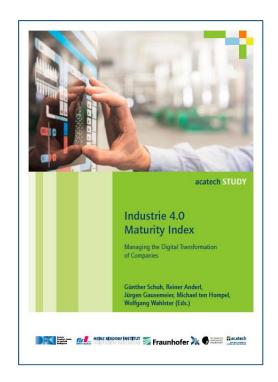
Countries Aggressively Implementing Policies to Achieve Digital Manufacturing Leadership



What Countries' Industry 4.0 Policies Are Doing

Building "Maturity Indices" and "Model Use Cases" to facilitate manufacturers' digital transformation journeys. (E.g. Germany)





What Countries' Industry 4.0 Policies Are Doing

- Launching "pilot fabs" that demonstrate smart-manufacturing techniques on active production lines. (Germany/Austria)
- 3. Providing SMEs tax credits to facilitate equipment upgrades. (Austria/Italy)
- 4. Providing SMEs access to cloud-based, HPC-powered design, modeling, and simulation software. (Korea)
- 5. Developing smart manufacturing workforce training/credentialing programs and supporting enterprises' investments therein. (Germany)

U.S. Policy Recommendations

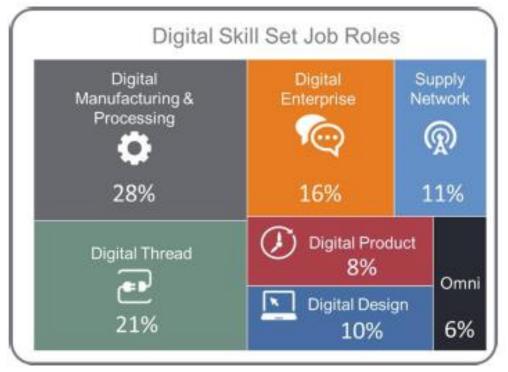
- 1. Leverage DMDII by creating regional digital manufacturing hubs.
- 2. Launch a "Manufacturing Digitalization Fund."
- 3. Incentivize OEMs to launch a "digital supply chain integration initiative" that gets 10,000 SMEs IoT-enabled within five years.
- 4. Provide a permanent share of federal funding for Manufacturing USA Institutes, including DMDII.
- 5. Support investment in digital manufacturing workforce and skills.

Supporting Talent Development

Solutions:

- Expand MOOCs, like Tooling U-SME: Provides 500+ online manufacturing technology classes.
- Leverage the Digital Manufacturing and Design Roles Taxonomy.

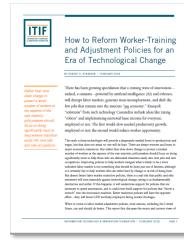




Source: Digital Manufacturing and Design Innovation Institute (DMDII) and Manpower Group, "The Digital Workforce Succession in Manufacturing"

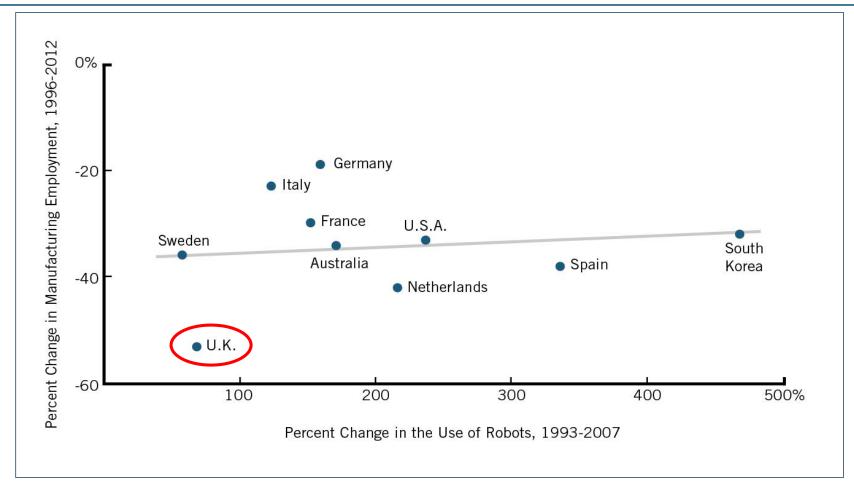
U.S. Policy Recommendations - Talent

- Expand use of industry-defined, nationally portable skills credentialing.
- Increase availability of apprenticeship/on-the-job training programs.
- Broaden the Manufacturing Engineering Education Grant program.
- Expand Section 127 tax benefits for employer-provided tuition assistance.
- Launch a "knowledge tax credit."



Source: Robert D. Atkinson, ITIF, "How to Reform Worker-Training and Adjustment Policies for an Era of Technological Change"

Don't Fear Job Loss from Digital Manufacturing



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

Thank You!

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