The Future of Work in a Digital Environment

Purdue Spring 2019 Digital Enterprise Symposium

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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

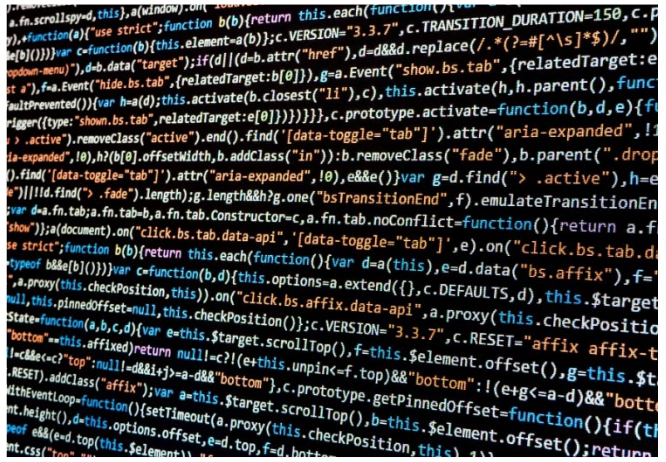
ITIF Mfg. Reports

Today's Presentation

1. Digitalization Transforming Modern Economy & Manufacturing
2. Digital Content of U.S. Jobs Rising; But Digital Skills Lagging
3. Public/Private Approaches to Address the Digital Skills Challenge

What Is Digitalization?

Digitalization is the process of employing digital technology and data to transform business operations and create value.



Source: Mark Muro, "Get With The Program: Digitalizing America's Advanced Manufacturing Sector"

Increasingly Digitalized Global Economy

- Digital economy accounts for 25% of global GDP.
- 50% of all value created in the global economy will be created digitally over the next decade.
- Value of international data flows has surpassed value of international merchandise trade.
- Digital services account for 25% of inputs in U.S. manufacturing; 40% for autos.

Sources: Accenture, "Digital Disruption: The Growth Multiplier"; McKinsey Global Institute, "Digital Globalization: The New Era of Global Flows"

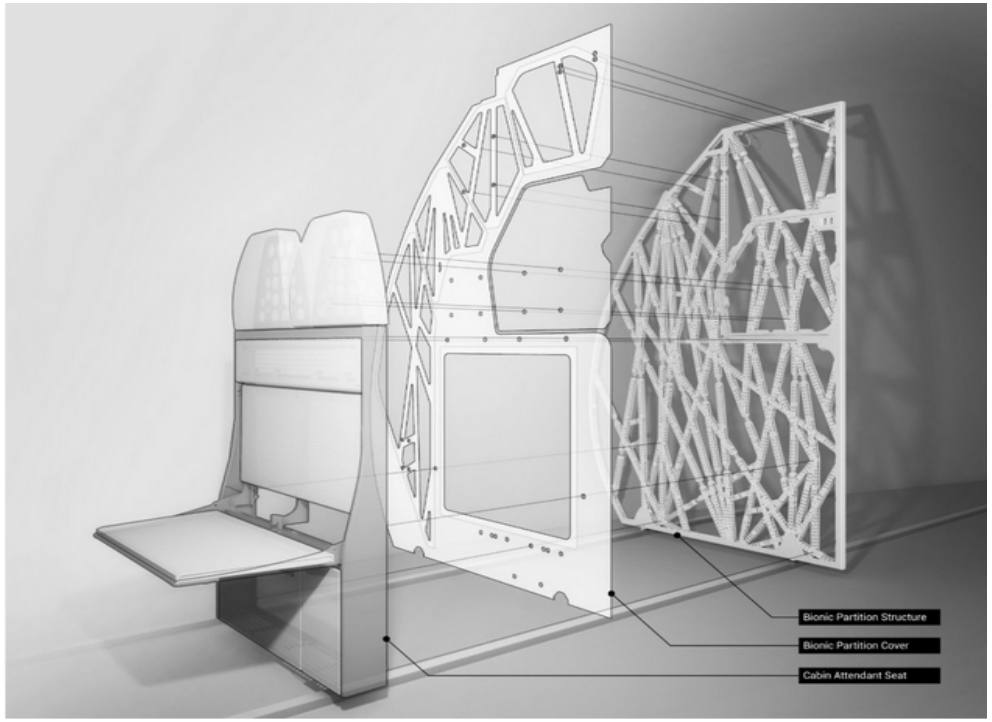
“Digitally Enabled” at Each Step of Modern Manufacturing

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

Source: ITIF, “Why Manufacturing Digitalization Matters and How Countries Are Supporting It”

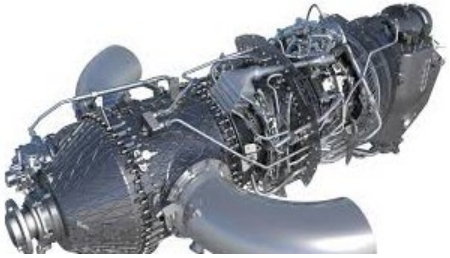
Product Design

- Todays' CAD software leverages generative design techniques to herald a new era of how products get designed.



Fabrication and Assembly: 3D Printing & Robotics

- 3D printing expected to impact up to 42% of production in U.S. aerospace, automotive, and medical devices sectors.



- Human-robot interactions in automotive plants are 85% more productive than either humans or robots working on their own.

- "We're moving away from trying to maximize automation, with people taking a bigger part in industrial processes again."
  – Markus Schaefer, Head of Global Production Planning, Mercedes

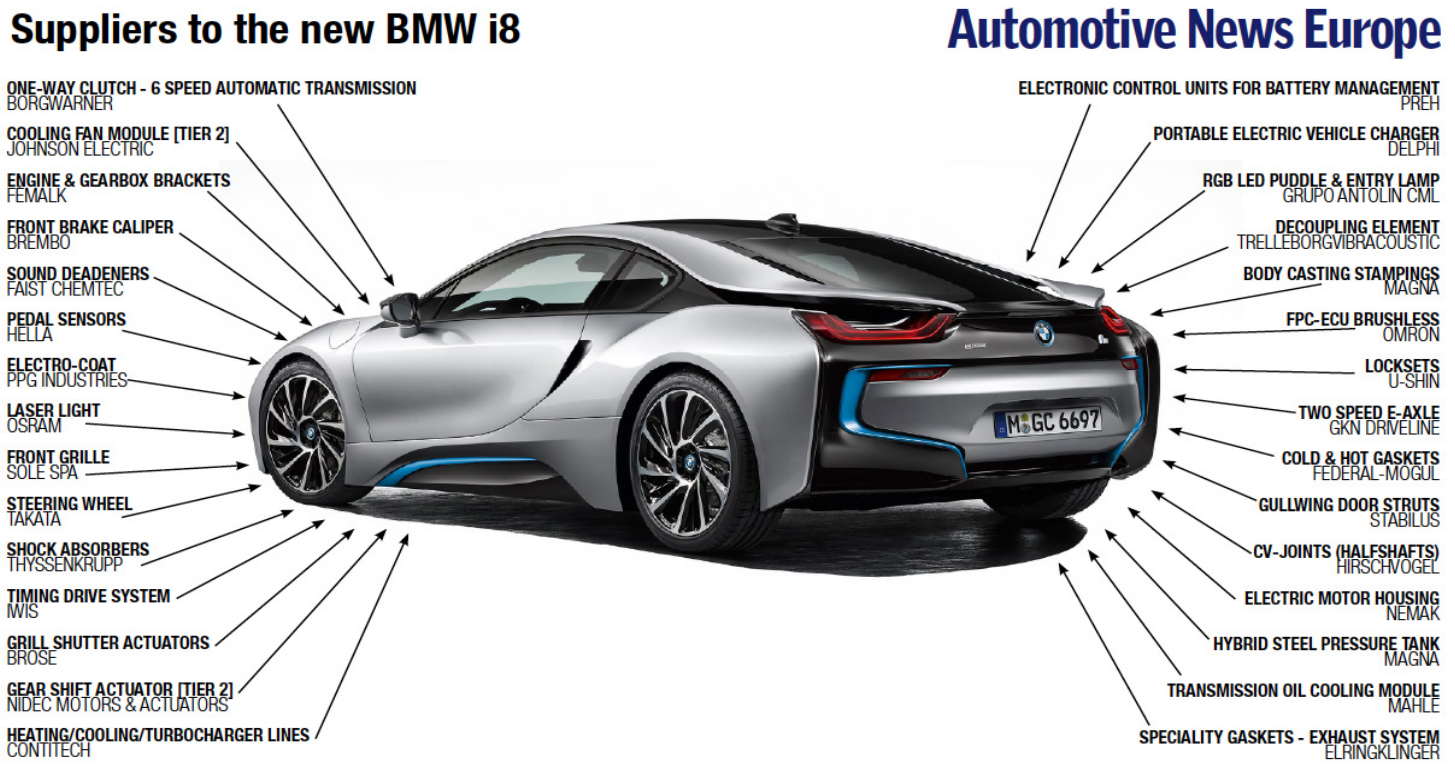
Markus Schaefer

Factory Integration

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

Supply Chain Management

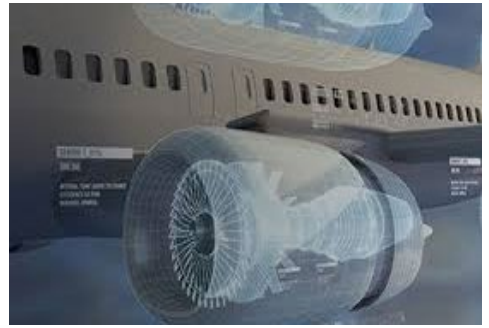
- Real-time visibility into every machine making every component across supply chains.



Digitally Enabled Product Use and Consumption

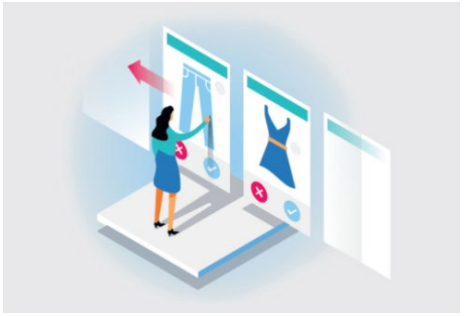
- "Product servicification": Selling products as services.

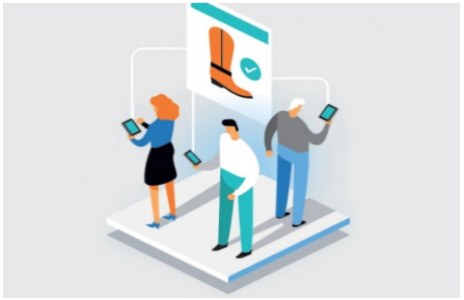
  E.g., Rolls Royce's "Power by the Hour" model.

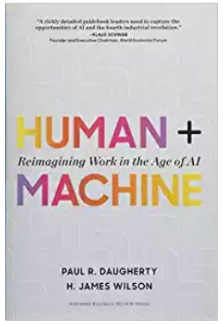


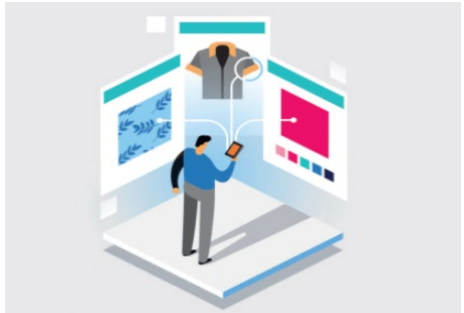
Reimagining Workflows to Leverage Humans & Machines

- StitchFix shows how to combine AI with people to create a powerful new business model.
- Delivers personalized clothing based on recommendations co-generated by human stylist and machine learning.
- Structured data (i.e., measurements/surveys) by machines; unstructured data (i.e., Pinterest posts/customers' notes) by stylists.









Sources: Paul Daugherty and James Wilson, "*Human + Machine; Reimagining Wok in the Age of AI*"; Fast Company, "The 50 Most Innovative Companies of 2019"

Implications for Companies' Digital Transformations

- Digitalization has become a central source of value creation; IT can't be managed as a "cost center" of the business.
- It's not about applying digital to existing processes; it's about using digital to *fundamentally reimagine* existing business processes.
- Companies need formal strategies to get the digital skills they need into their business, and to become "data mature."
- Smart companies build digital platforms allowing partners to make money alongside them.

Policy Implications to Spur U.S. Manufacturing Digitalization

1. Expand MEP's use of its "Digital Manufacturing and Design" assessment tool to benchmark SME mfg. digitalization journeys.

2. Launch a "National Manufacturing Digitalization Fund."

3. Introduce more generous incentives to encourage mfg. digitalization: innovation vouchers; "401Ks" for SME manufacturers.

4. **Assist the private sector in solving the digital skills challenge.**

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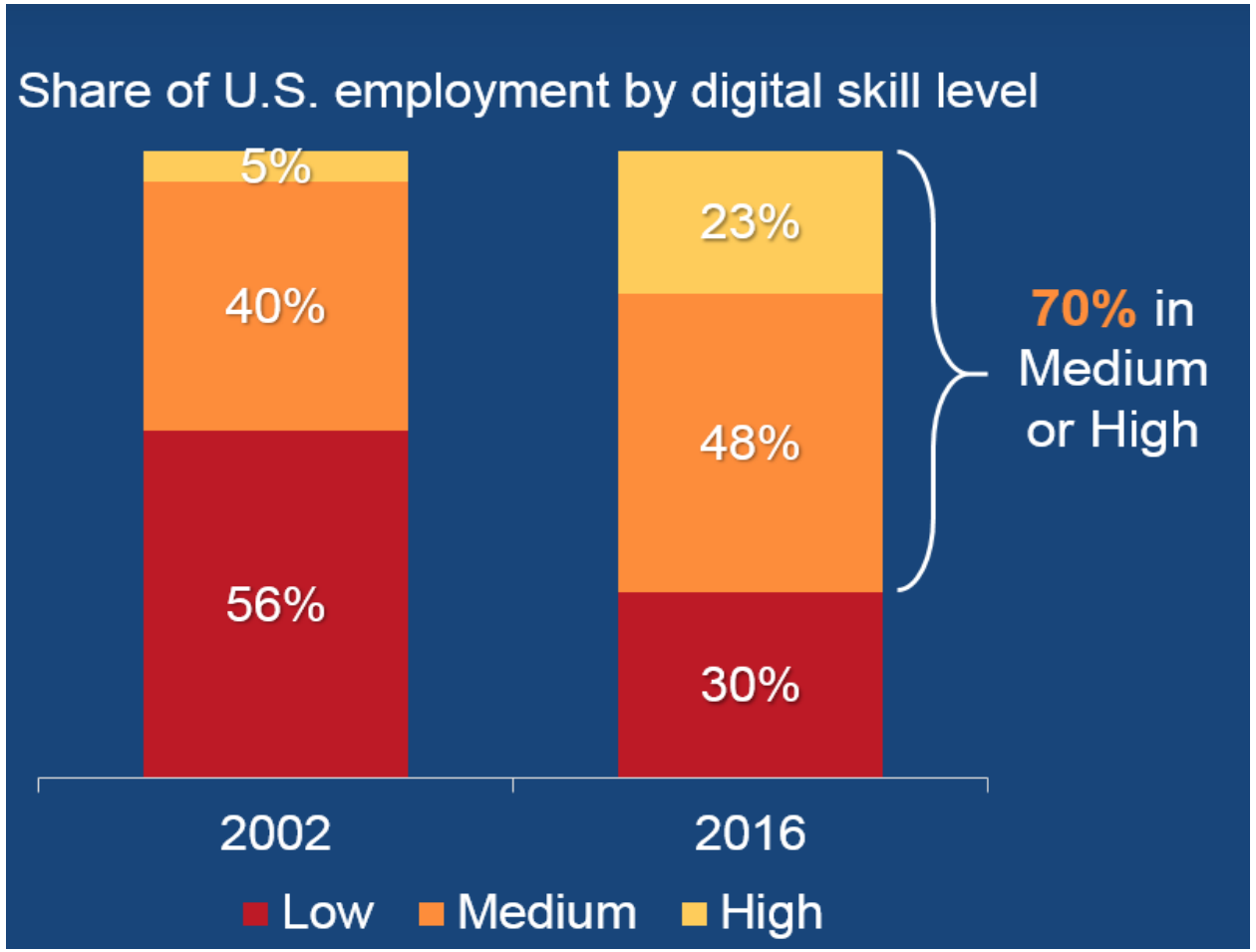
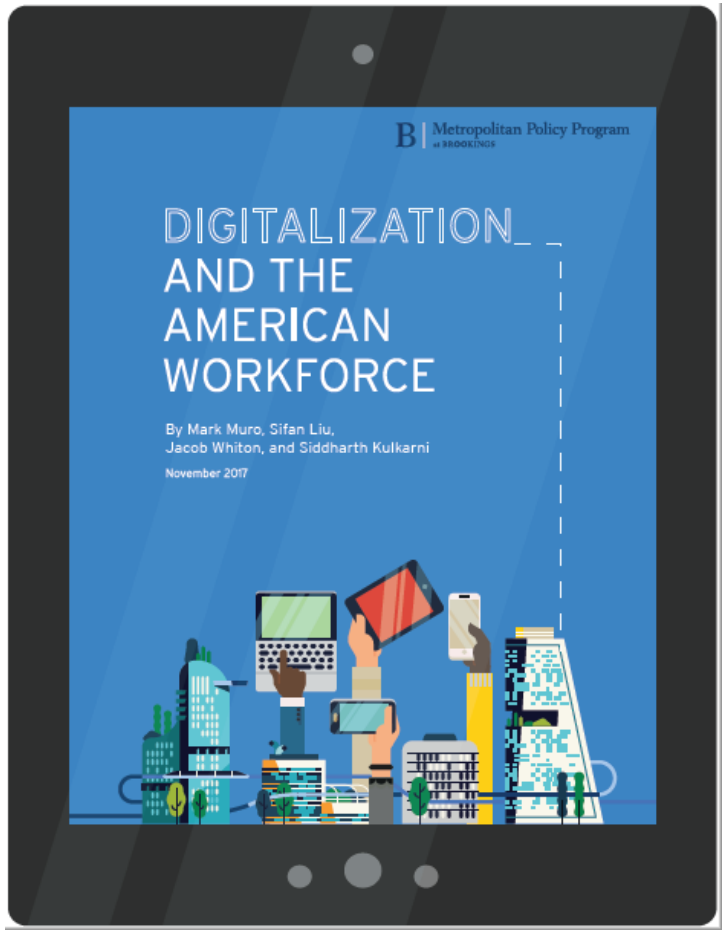
Digital Skills Content of U.S. Employment Rising Rapidly

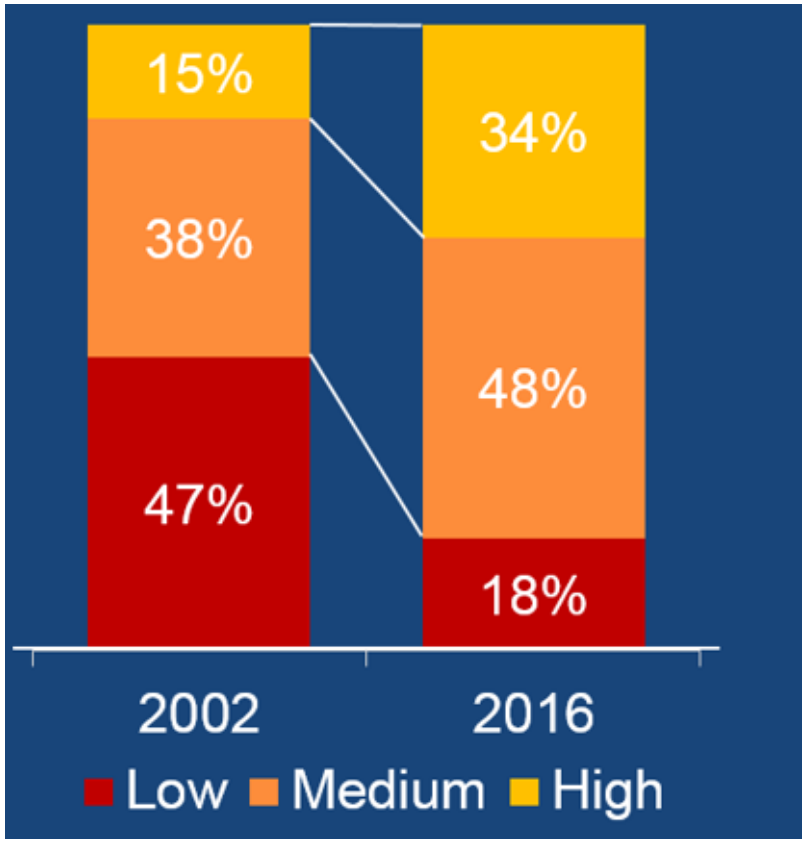




Sources: Mark Muro, Sifan Liu, Jacob Whiton, and Siddharth Kulkarni, Brookings Metropolitan Policy Program, "Digitalization and the American Workforce"

Including for Jobs in Advanced Manufacturing

Employment in Advanced Manufacturing
by Digital Skill Level



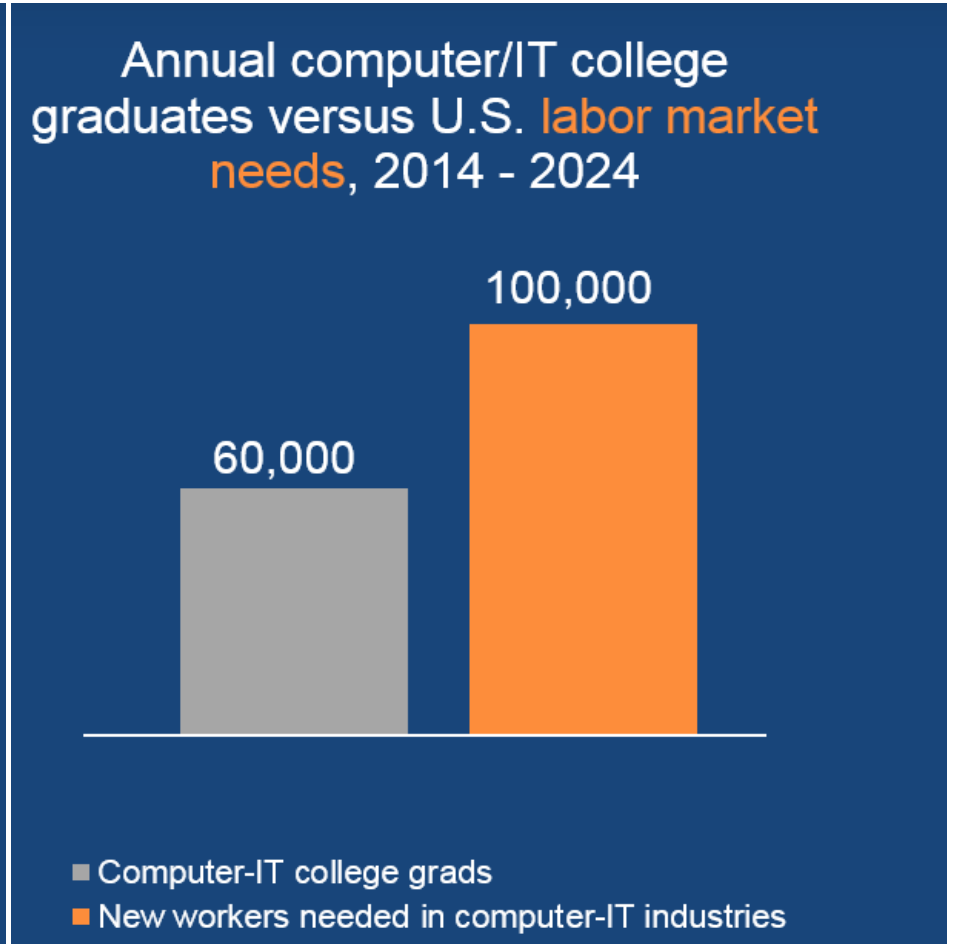
"82% of U.S. manufacturing jobs require a medium to high digital skill level today."

Source: Mark Muro, Sifan Liu, Jacob Whiton, and Siddharth Kulkarni, Brookings Metropolitan Policy Program, "Digitalization and the American Workforce"

Yet U.S. Workforce Faces Critical Digital Skills Gaps

1 in 6

working-age Americans are unable to use email, web search, or other basic online tools



Sources: Mark Muro, Brookings Metropolitan Policy Program "Get With the Program: Digitalizing America's Advanced Manufacturing Sector"; OECD; U.S. Bureau of Labor Statistics, 2016

U.S. Manufacturing Workforce Digital Skills Deficiencies

Skills in which manufacturing employees are most deficient

70%
technology/ computer skills

69%
problem solving skills

67%
basic technical training

60%
math skills

- 80% of U.S. manufacturing workers lack key digital skills.
- Mfg. skills gap may leave 2.4 million positions unfilled between by 2028; a potential economic loss of $2.5 trillion.

Sources: Deloitte and The Manufacturing Institute, "The Skills Gap in U.S. Manufacturing 2015 and Beyond"; "2018 Skills Gap in Manufacturing Study"; Edy Liongosari et al., "Smart Production: Finding a Way Forward: How Manufacturers Can Make the Most of the Industrial Internet of Things"

Leaving Companies' Digital Transformations Stillborn

Companies are making meaningful investments and commitments…

In 2017, companies will spend **$1.7 trillion** on digital transformation technology alone.

96% of organizations see digital transformation as **critical or important.**

42% of executives **say "digital first" or "digital to the core"** is now their company digital business posture.

…but feel like they're struggling.

75% of organizations are **"not very confident" in their ability to execute** a digital transformation.

84% of executives believe that their organizations **do not have the skills and capabilities** to deliver on its digital ambition.

59% of companies are worried that the **laggard pace** of their digital transformation efforts is causing them to **lose ground competitively**.

The roadblock? People.

63% of executives believe their digital transformation efforts are stalled because of **difficulties in "changing company culture to be agile."**

39% of executives see **"resistance to new ways of working"** as a primary challenge to digital transformation efforts.

One in five executives secretly believes digital transformation projects are a **waste of time.**

Source: Korn Ferry, "Digital Talent Strategy: The Organizational Structures and Roles of the Digital Future" (March 2018)

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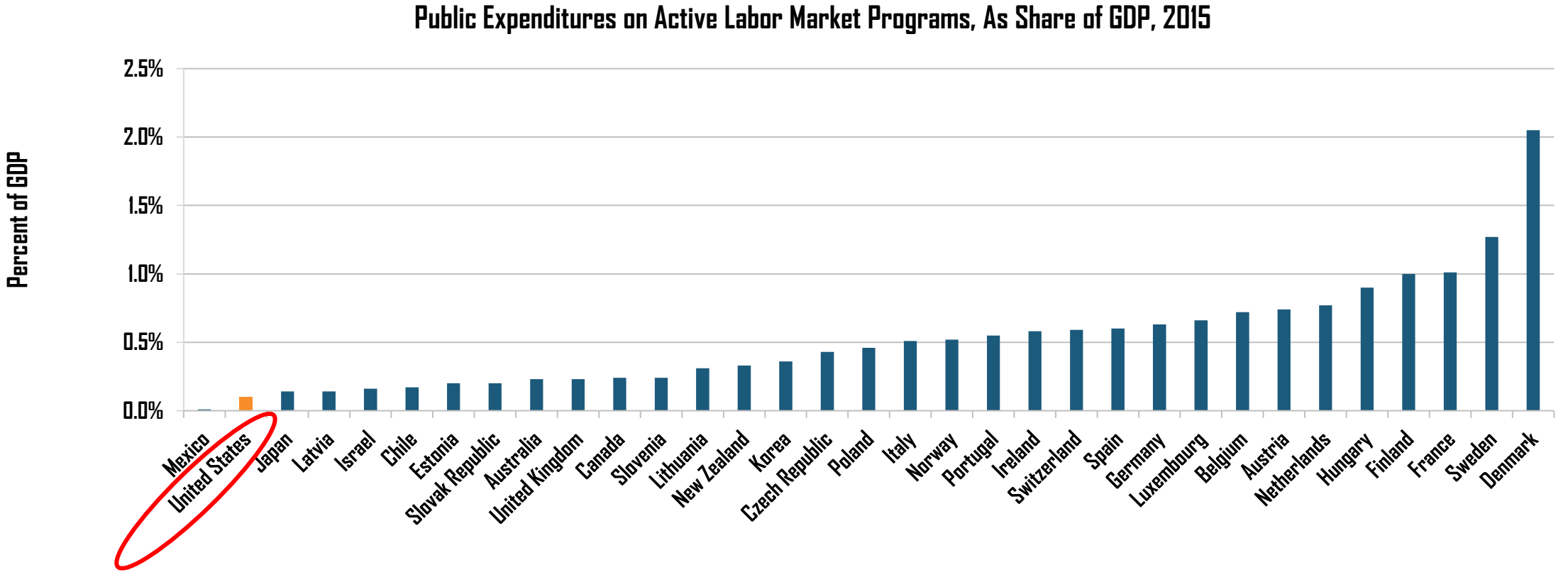
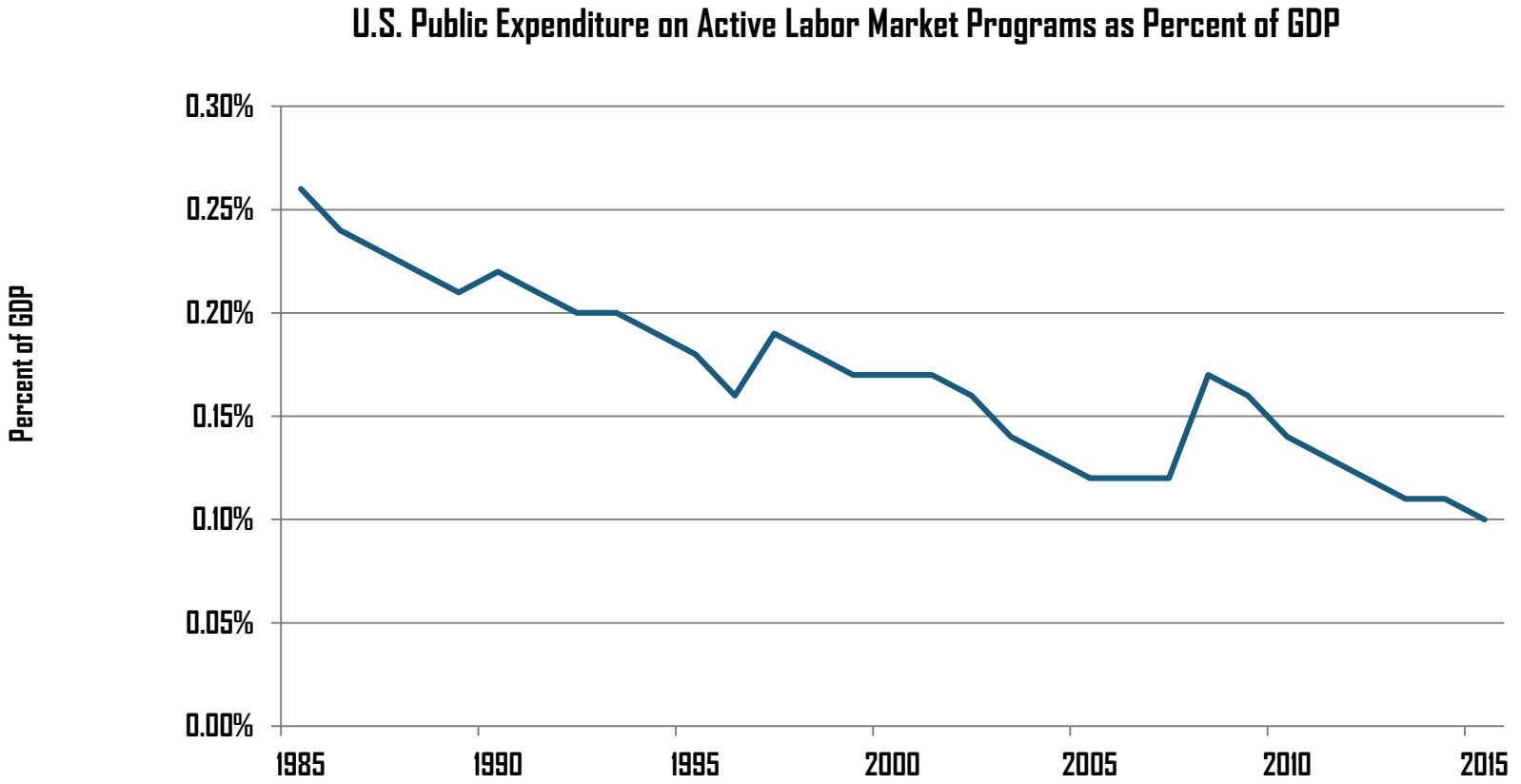
U.S. Underinvesting in Labor Market Skills (Comparatively)



Source: OECD, "Public Expenditure and Participant Stocks on LMP"

U.S. Underinvesting in Labor Market Skills (Historically)

- Public investment in U.S. workforce training down 50% as a share of GDP over past 30 years.
- Private investment has fallen 30% over last 10 years.



Source: OECD, "Public Expenditure and Participant Stocks on LMP"

Workers Will Increasingly Need New Skills

"Double-deep" employees: Individuals who know both their job–be it accounting engineering, marketing, and so on–as well as the IT relevant to that job.

David Moschella,
CSC Leading Edge Forum

"Employers want workers with ***strong analytical, creative, and adaptive capabilities.***"

"But the skills employers desire and demand are poorly related to competencies schools teach."

Manuel Trajetnberg,
NBER

Source: David Moschella: "Seeing Digital"; Manuel Trajtenberg, "AI as the Next GPT: A Political-Economy Perspective," Working Paper 24245, (2018, Nation Bureau of Economic Research)

“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

Skills Requirements for a Digitalized Economy

- Built upon the old literacies of reading, writing and mathematics.
- New literacies include:
  - **Data literacy:** read, analyze and apply information
  - **Technological literacy:** coding and engineering principles
  - **Human literacy:** humanities, communication and design

Higher order mental skills – mindsets and ways of thinking about the world.

- **Systems Thinking:** the ability to view an enterprise, machine or subject holistically, making connections between different functions in an integrative way.
- **Entrepreneurship:** applies the creative mind to the economic and social sphere.
- **Cultural Agility:** how to operate deftly in a varied global environment.
- **Critical Thinking:** the habit of disciplined, rational analysis and judgement.

Source: Nathan Hartman, "Transforming The Manufacturing Enterprise for Digitalization; Where Does The Future Take Us?", DEC/IN-MAC

New Institutional Approaches to Education Needed

- **Olin College of Engineering** reimagined engineering education; hands-on, project-based learning; ½ students women/minorities.

  On a per-student graduated basis, graduates launch more start-up businesses than even MIT students.

- **Harrisburg University** set up by regional businesses to train graduates in applied science and technology-related fields.

- **LaunchCode**, a nonprofit group of coding schools in St. Louis, helps firms needing "mid-tech" workers identify prospective employees and upskills them in no-cost coding bootcamps.

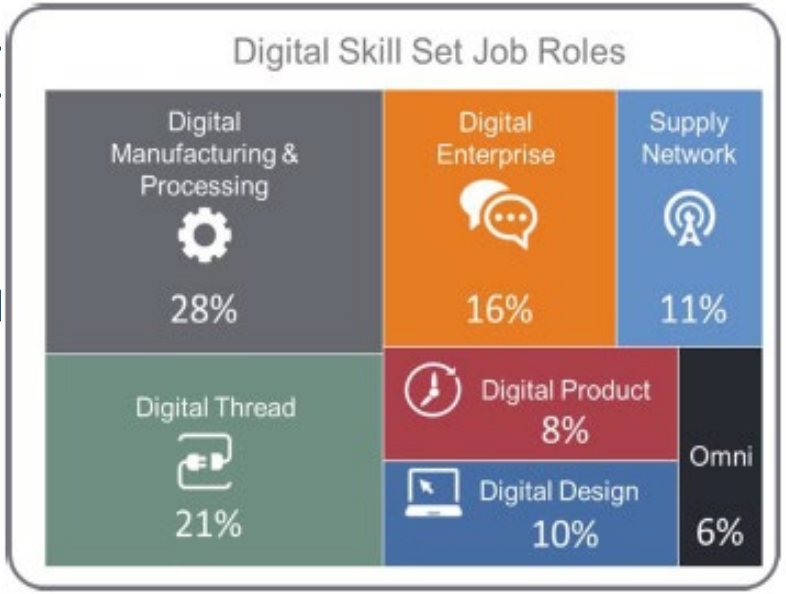
Public/Private Initiatives Tackling the Skills Challenge

- Expand MOOCs, like SME's ToolingU

  Provides 500+ online manufacturing technology classes.

- Leverage DMDII's "Digital Manufacturing and D
  Roles Taxonomy."

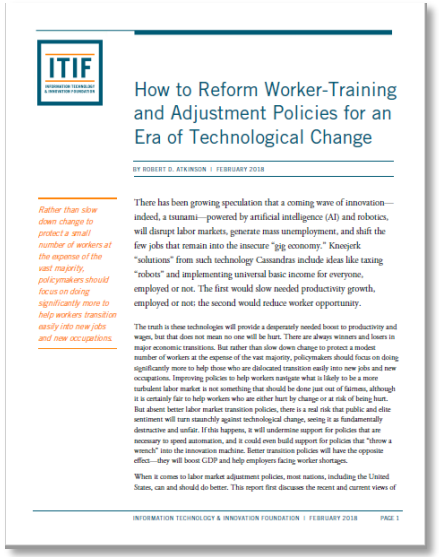
  Identifies 165 distinct digital manufacturing a
  roles.



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

Federal-Level Skills Policy Recommendations

- Expand the Manufacturing Engineering Education Grant (MEEG) program.
- Expand use of industry-defined, nationally portable skills credentialing.
- Expand Section 127 tax benefits for employer-provided tuition assistance.
- Create "LILAs": Lifelong Learning Accounts.
- Establish a "knowledge tax credit."
- Enable students taking short-term courses for occupational credentials to qualify for Pell grants and other financial aid.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How to Reform Worker-Training and Adjustment Policies for an Era of Technological Change

BY ROBERT D. ATKINSON | FEBRUARY 2018

Rather than slow down change to protect a small number of workers at the expense of the vast majority, policymakers should focus on doing significantly more to help workers transition easily into new jobs and new occupations.

There has been growing speculation that a coming wave of innovation—indeed, a tsunami—powered by artificial intelligence (AI) and robotics, will disrupt labor markets, generate mass unemployment, and shift the few jobs that remain into the insecure "gig economy." Kneejerk "solutions" from such technology Cassandras include ideas like taxing "robots" and implementing universal basic income for everyone, employed or not. The first would slow needed productivity growth, employed or not; the second would reduce worker opportunity.

The truth is these technologies will provide a desperately needed boost to productivity and wages, but that does not mean no one will be hurt. There are always winners and losers in major economic transitions. But rather than slow down change to protect a modest number of workers at the expense of the vast majority, policymakers should focus on doing significantly more to help those who are dislocated transition easily into new jobs and new occupations. Improving policies to help workers navigate what is likely to be a more turbulent labor market is not something that should be done just out of fairness, although it is certainly fair to help workers who are either hurt by change or at risk of being hurt. But absent better labor market transition policies, there is a real risk that public and elite sentiment will turn staunchly against technological change, seeing it as fundamentally destructive and unfair. If this happens, it will undermine support for policies that are necessary to speed automation, and it could even build support for policies that "throw a wrench" into the innovation machine. Better transition policies will have the opposite effect—they will boost GDP and help employers facing worker shortages.

When it comes to labor market adjustment policies, most nations, including the United States, can and should do better. This report first discusses the recent and current views of

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

Thank You!

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