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

IITP Presentation

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ITIF

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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
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%.
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.

- 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”
Today’s Presentation

1  The Digitalization of Manufacturing and Why It Matters

2  Government’s Role and Responsibility For Industry 4.0
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

<table>
<thead>
<tr>
<th>Initiatives launched per country</th>
<th>Declared Funding [EUR Million]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrie 4.0</td>
<td>200</td>
</tr>
<tr>
<td>Advanced Manufacturing Partnership 2.0</td>
<td>2,000</td>
</tr>
<tr>
<td>Catapult centers</td>
<td>370</td>
</tr>
<tr>
<td>Intelligent factories clusters</td>
<td>41</td>
</tr>
<tr>
<td>Revitalization / Robots strategy</td>
<td>8</td>
</tr>
<tr>
<td>Made in China 2025</td>
<td>787</td>
</tr>
<tr>
<td>Industrie du futur</td>
<td>2,200</td>
</tr>
<tr>
<td>Manufacturing Innovation 3.0</td>
<td>1,000</td>
</tr>
<tr>
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<td>1,600</td>
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Source: Roland Berger

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## APEC IIoT Readiness Scores

### IIoT Readiness Score 2016

<table>
<thead>
<tr>
<th>Country</th>
<th>Readiness score</th>
<th>Relative readiness score</th>
<th>Ranking</th>
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<tbody>
<tr>
<td>Singapore</td>
<td>0.182</td>
<td>9.8</td>
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</tr>
<tr>
<td>Taiwan</td>
<td>0.159</td>
<td>8.6</td>
<td>2</td>
</tr>
<tr>
<td>China</td>
<td>0.139</td>
<td>7.5</td>
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<tr>
<td>South Korea</td>
<td>0.122</td>
<td>6.6</td>
<td>4</td>
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<tr>
<td>Japan</td>
<td>0.082</td>
<td>4.4</td>
<td>5</td>
</tr>
<tr>
<td>Malaysia</td>
<td>0.034</td>
<td>1.8</td>
<td>6</td>
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<tr>
<td>Australia</td>
<td>0.019</td>
<td>1.0</td>
<td>7</td>
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<tr>
<td>Thailand</td>
<td>0.019</td>
<td>1.0</td>
<td>8</td>
</tr>
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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

<table>
<thead>
<tr>
<th>Technology</th>
<th>Talent</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Technology Icon" /></td>
<td><img src="image2.png" alt="Talent Icon" /></td>
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<th>Trade</th>
<th>Tax</th>
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<td><img src="image3.png" alt="Trade Icon" /></td>
<td><img src="image4.png" alt="Tax Icon" /></td>
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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
Apprenticeship
Up through the early 19th Century. Characterized by studying the Master, and focused on specific customer needs. Difficult to reproduce.

Education 2.0
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
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
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:

- 70% technology/computer skills
- 69% problem solving skills
- 67% basic technical training
- 60% math skills

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.
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 Institute (DMDII) and Manpower Group, “The Digital Workforce Succession in Manufacturing”
Tax Policy to Support Industry 4.0

Global Comparative R&D Tax Credit Generosity

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

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

Automation lowers prices, which leads to more consumption and job creation. 

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