The Opportunities and Challenges Presented by The Fourth Industrial Revolution

The 32\textsuperscript{nd} Pacific Economic Community Seminar
“Quest for Economic Growth Engines”

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VP, Global Innovation Policy
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
ITIF Global Engagement
Today’s Presentation

1. The Digitalization of Manufacturing and Why It Matters

2. Governments’ Role and Responsibilities
“Smart manufacturing”: The application of information and communications technologies to manufacturing processes.

Enabling technologies: IoT, Industrial Sensors, LTE Wireless, cloud computing, data modeling, HPC-enabled CAD software.

Digital services account for 25% of manufacturing inputs.

Source: Sherry Stephenson, “The Linkage Between Services and Manufacturing in the U.S. Economy”
“Digitally Enabled” at Each Step of Manufacturing

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

- Modern CAD software leverages generative design techniques to herald a new era of how products get designed.
Digitally Enabled Fabrication and Assembly

Industrial Robots per 10,000 Workers, 2017

Source: International Federation of Robotics, “Executive Summary World Robotics 2017 Industrial Robots”
Digitally Enabled Factory Integration

- Sensor-enabling production equipment produces a comprehensive, real-time view of the status of machines, work cells, and systems.
Digitally Linked Supply Chain Management

- Real-time visibility into every machine making every component across manufacturing supply chains.
Digitally Enabled Product Use and Consumption

- “Product servicification”: Selling products as services.
  E.g., Rolls Royce’s “Power by the Hour” model.
- “Digital twins” concept a key enabler.
The Benefits of Digital Manufacturing

- Increase manufacturing productivity by 10 to 25%.

- Add as much as $10 trillion to global GDP over next 20 years.

- Anticipated 25% increase in revenues from new products and services at firms using smart manufacturing techniques.

Sources: Peter C. Evans and Marco Annunziata, "Industrial Internet: Pushing the Boundaries of Minds and Machines"; Smart Manufacturing Leadership Coalition, “Economic Benefits”
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 Responsibilities
## Countries Aggressively Implementing Policies to Achieve Digital Manufacturing Leadership

<table>
<thead>
<tr>
<th>Year Launched</th>
<th>Program Name</th>
<th>Declared Funding US Millions</th>
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<tbody>
<tr>
<td>2010</td>
<td>Industry 4.0</td>
<td>$550</td>
</tr>
<tr>
<td>2010</td>
<td>Industry 4.0</td>
<td>$280</td>
</tr>
<tr>
<td>2011</td>
<td>Manufacturing USA</td>
<td>$700</td>
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<tr>
<td>2011</td>
<td>Catapult centers</td>
<td>$430</td>
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<tr>
<td>2012</td>
<td>Intelligent Factories Clusters</td>
<td>$48</td>
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<td>2013</td>
<td>Factories of the Future</td>
<td>$1,120</td>
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<tr>
<td>2014</td>
<td>Revitalization/Robots Strategy</td>
<td>$916</td>
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<tr>
<td>2015</td>
<td>Industrie du futur</td>
<td>$1,800</td>
</tr>
<tr>
<td>2015</td>
<td>Manufacturing Innovation 3.0</td>
<td>$1,160</td>
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<tr>
<td>2015</td>
<td>Productivity 4.0</td>
<td>$1,000</td>
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<tr>
<td>2016</td>
<td>Research Innovation and Enterprise 2020</td>
<td>$2,300</td>
</tr>
<tr>
<td>2017</td>
<td>Made in China 2025</td>
<td>$3,000</td>
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Source: Roland Berger; ITIF Analysis
Singapore and Taiwan Lead APEC in IIoT Readiness

### Frost & Sullivan 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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</thead>
<tbody>
<tr>
<td>Singapore</td>
<td>0.182</td>
<td>9.8</td>
<td>1</td>
</tr>
<tr>
<td>Taiwan</td>
<td>0.159</td>
<td>8.6</td>
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<tr>
<td>China</td>
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<tr>
<td>South Korea</td>
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<td>4</td>
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<tr>
<td>Japan</td>
<td>0.082</td>
<td>4.4</td>
<td>5</td>
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<tr>
<td>Malaysia</td>
<td>0.034</td>
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<tr>
<td>Australia</td>
<td>0.019</td>
<td>1.0</td>
<td>7</td>
</tr>
<tr>
<td>Thailand</td>
<td>0.019</td>
<td>1.0</td>
<td>8</td>
</tr>
</tbody>
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### Hyundai Research Institute “Industrial R&D Readiness” for Industry 4.0

- **United States**: 100.0%
- **Europe**: 90.0%
- **Japan**: 80.0%
- **Korea**: 70.0%
- **China**: 60.0%

Sources: Frost & Sullivan, “Understanding the Role of Governments in Promoting the Industrial Internet of Things”; Hyundai Research Institute
Get the 4 “Ts” Right for Digital Manufacturing Leadership

<table>
<thead>
<tr>
<th>Technology</th>
<th>Talent</th>
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<td><img src="image1.jpg" alt="Technology" /></td>
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<th>Trade</th>
<th>Tax</th>
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<td><img src="image4.jpg" alt="Tax" /></td>
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Invest in ICT Research and Development

ICT R&D/Share Total BERD

ICT BERD, Euros, 2014

Source: European Commission, “The 2017 PREDICT Key Facts Report: An Analysis of ICT R&D in the EU and Beyond”
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

- Manufacturing extension services should provide technical assistance to SMEs, including access to high-performance computing tools.

**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
Talent: “Industry 4.0” Demands “Education 4.0”

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

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.

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.

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 4.0 Workforce

Challenge:

- 80% of U.S. manufacturing sector workforces lack necessary skills to compete in the global smart manufacturing economy.

- Two-thirds of manufacturing MNCs 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:

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

Source: Digital Manufacturing and Design Institute (DMDII) and Manpower Group, “The Digital Workforce Succession in Manufacturing”
Tax Policy to Support Digital Manufacturing

✓ Implement tax credits for enterprise investments in new plant/capital equipment/machinery (e.g., Korea 5% tax credit).

✓ Expand R&D tax credit generosity.

✓ Introduce collaborative R&D tax credit.
Trade Policy to Support Industry 4.0

Manufacturing producing more data than any other economic sector.

✓ In TPP, RCEP, etc. ensure open cross-border data flows.

✓ Eschew data localization provisions, including on cloud computing.
Don’t Fear Job Loss from Digital Manufacturing

The regression line is almost flat, showing little correlation

Source: George Graetz and Guy Michaels, “Robots at Work”; Muro and Andes, “Robots Seem to Be Improving Productivity, Not Costing Jobs"
Join the Global Trade and Innovation Policy Alliance

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- C.D. Howe Institute (Canada)
- The Center for Global Enterprise (U.S.)
- Center for Social and Economic Research (Poland)
- Competere (Italy)
- The Free Market Foundation (South Africa)
- Fundación Idea (Mexico)
- Geneva Network (UK)
- ICRIER (India)
- I-Com (Italy)
- ITIF (U.S.)
- The Legatum Institute (UK)
- The Lisbon Council (Belgium)
- The Macdonald-Laurier Institute (Canada)
- Shanghai Institute of Science and Technology Policy (China)
- Swedish Agency for Growth Policy Analysis (Sweden)
- Taiwan Institute for Economic Research
- Taiwan Research Institute
- Tic Tac de la CCIT (Colombia)
Thank You!

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