

Systems of Innovation: Building Regional Capabilities to Address Emerging Challenges

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Building Innovation Ecosystems



Boston

*Kendall
Square*

Charles River

MIT

Cambridge

Why Think of Innovation in Terms of Systems?

- Non-linear
- Interactive
- Geographically-mediated
- Requires “local buzz” and “global pipelines”
- Shaped by institutions and culture



Innovation Systems Working at Several Levels

National Innovation System

- National Innovation Systems
 - Legal system, Property rights
 - S and T policies
 - Institutions

Regional Innovation Ecosystem

- Regional Innovation Systems
 - Networks, collaborations, innovation intermediaries

Industry Clusters

- Clusters of related firms
 - Specialization/trade
 - Cluster initiatives/strategies to address specific issues

Individual Firms

- How do firms innovate?
 - Open innovation
 - Learning by doing; absorption

China Has Been Building Capabilities Across Systems

- **National Innovation Systems**

- R&D investments in S&T (2% as a percentage of GDP; on par with EU average)
- Business R&D expenditures (1.4%; 2011 vs. EU 1.3%)
- Higher Education – new doctorate graduates (2.5%; 2011 vs EU 1.7%)
- Strengthened IP regime (34th among 122 indexed countries)
- Worldwide patent applications and scientific publications (surpassed US in 2015 on an absolute basis)

- **Regional Innovation Ecosystems**

- University investments, focus on centers of excellence; patenting
- Cluster-related research institutions associated with industry concentrations
- This week: 31 National Demonstration Centers, 35 provincial Manufacturing Innovation Centers

China Has Been Building Capabilities Across Systems

- **Industry Cluster Strategies**

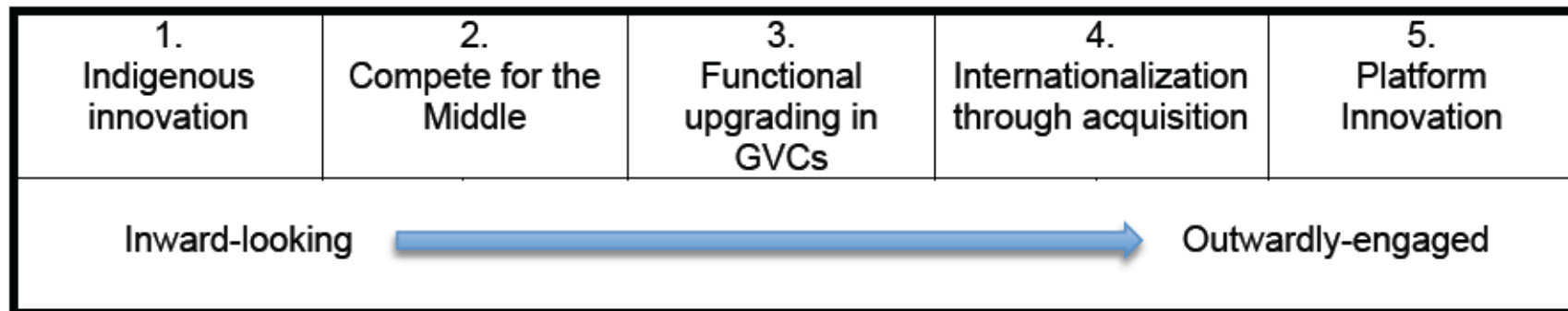
- Significant engagement in Global Value Chains (GVCs)
 - Manufacturing and Export Hub
 - China is world's most important destination for export-oriented FDI
 - 87% of all of China's exports in 2014: autos, ICT, textiles
- Desire to move up the value chain by developing capabilities within higher value-added clusters
- Investments in Key Clusters: advanced manufacturing, biotech, green energy, ITC, new materials, electric vehicles,

- **Firms**

- *Lead firms and Global Suppliers:*
 - Haier, Lenovo, Geely, Lens Technology
- *Platform Innovators:*
 - TenCent, Alibaba



Multiple Pathways for China Going Forward to Drive Economic Growth



- China 2025
- Domestic Market
- Move up value chain
- Lenovo
- Geely
- Midea
- Alibaba
- TenCent
- DJIL

Shifting Sources of Innovation in the U.S.

As measured by the 100 most innovative products annually, 1970-2006

- **Decline in the role of the large corporation**
 - Increased reliance on external R&D capabilities
 - Increased investment in university partnerships
 - Increased Corporate Venture Capital (CVC)
- **Increasing collaborations between two or more organizations**
 - Established firms, universities/research institutes, startups
- **Public sector playing an expanded role**
 - Increasing commercialization from universities
 - New institutional models (Manufacturing USA, NSF i8)
 - “Public” entrepreneurship



Regional Innovation Ecosystems: Increasingly Important to Address Core Challenges

Recent Challenges in the US

- 1) From **Startup to Scale Up**
- 2) Building **Manufacturing Capabilities**
- 3) Addressing Increasing **Income Inequality**

The U.S. Has a Robust Innovation Ecosystem at the Early Stages of Scale Up in Select Places

- **Capital Available Over Extended Period of Time**
 - On average \$75m over 8 years
- **Thick Labor Markets**
 - Companies need rapid access to diverse talent pool
 - Easy to find for prototyping and pilot phases
- **Networks Matter**
 - “Visionaries” put company together with funders, potential customers
- **Range of Suppliers**
 - Companies draw from a range of suppliers with an emphasis on speed and quality




However, Ecosystem Falter When at Later Stage Scale Up


Financing and Lack of Capabilities Creates Challenge for Scale Up


- Firms need a **new influx of significant capital** to reach commercial scale
 - Cannot find capital for commercial-scale demonstrations (\$30-\$100m)
- **Strategic partners (large companies) and foreign governments** provide complementary assets in the form of trained workforce, land, capital
- Financing, capabilities and customers/suppliers **pull technology development abroad**
- Leads to a poorer “**industrial commons**” and **loss of capabilities**



Institutions: Institutional Innovations within Five Years

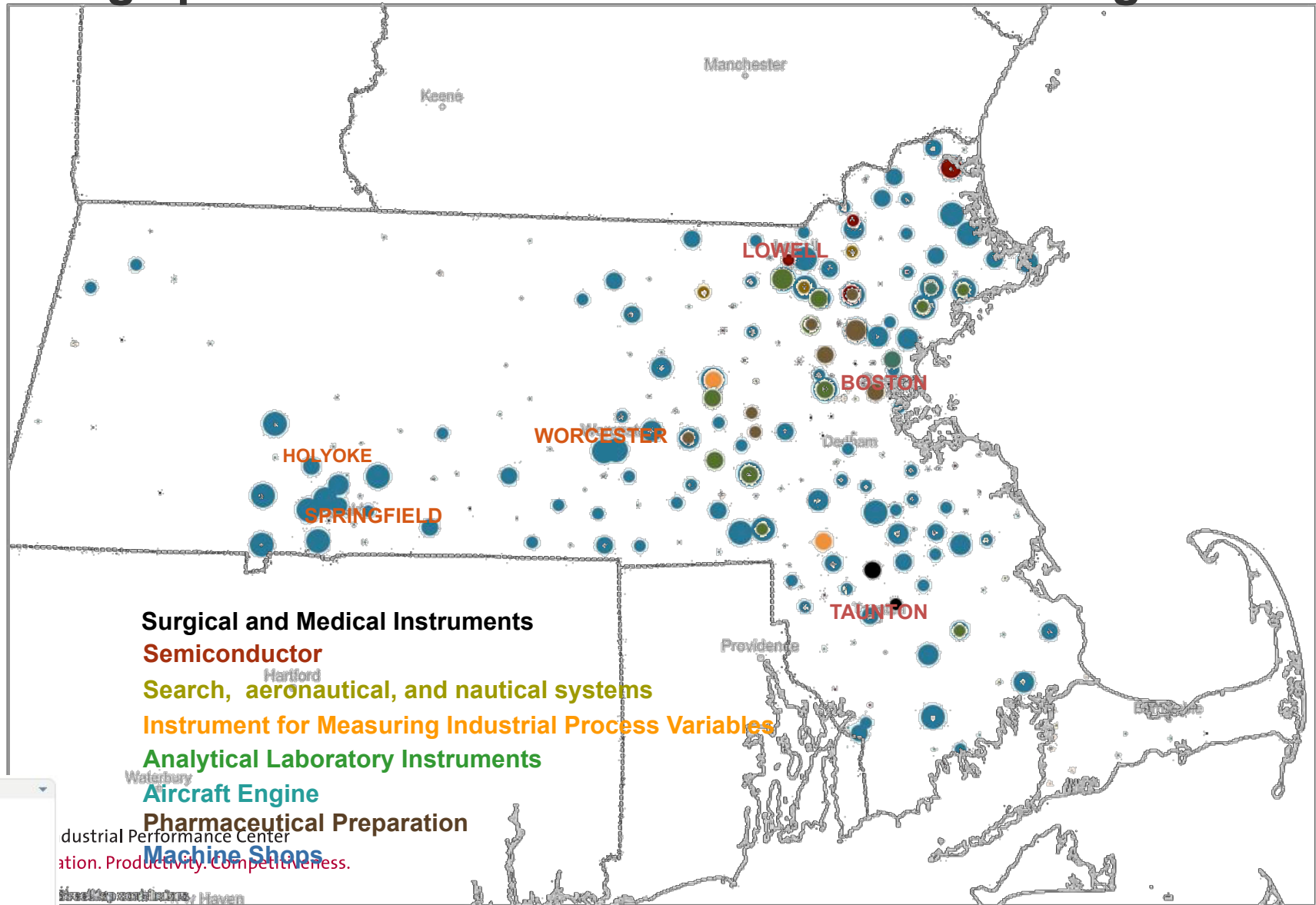
- **Bolt (2013)** 
 - Venture capital/advisory practice designed for hardware startups

- **Manufacturing USA (2014)** 
 - Federal/State/Industry/University consortium
 - 14 public/private R&D centers in advanced manufacturing
 - AFFOA – Advanced Functional Fabrics

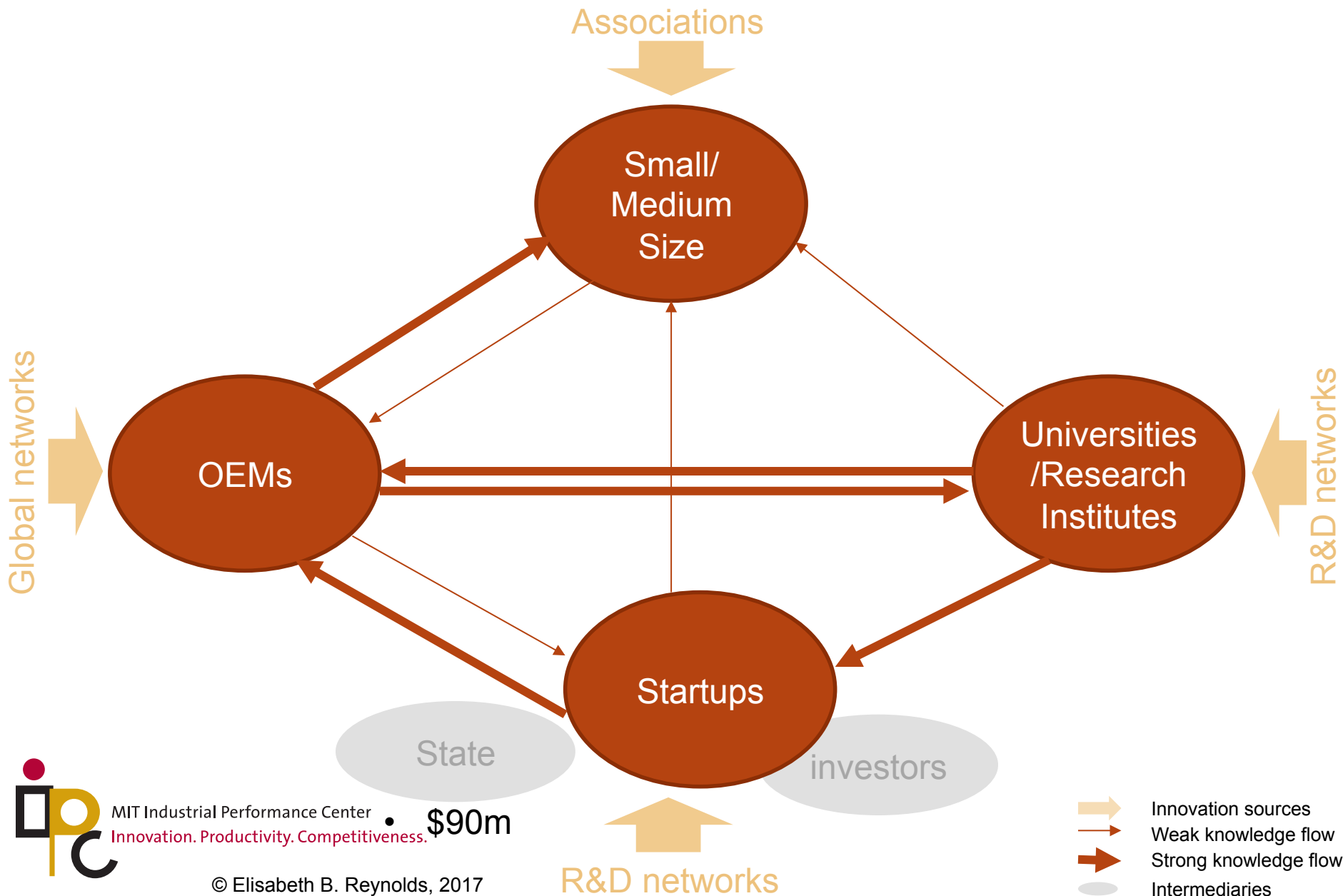
- **MIT The Engine (2016)** 
 - University-driven incubator for “tough technologies”
 - Venture capital arm



Networks: Geographic Distribution of Advanced Manufacturing in MA



Networks: MA Advanced Manufacturing Innovation Ecosystem



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 Innovation. Productivity. Competitiveness.

- Innovation sources
- Weak knowledge flow
- Strong knowledge flow
- Intermediaries

Universities:

Industry Partnerships and Commercialization of Technology

- MIT has one of the highest rates of **industry sponsored research** (over 20%); one of the most successful universities in **commercializing** its research through licensing
- **Incentive system** in place to support this:
 - Discretion for sponsorships lies largely with faculty
 - Additional “research staff” (research scientists, postdocs) to support labs/centers, entrepreneurship
 - Consulting allowed 1 day a week without strings; equity ownership in startups
 - Faculty must raise funds to support their summer salary

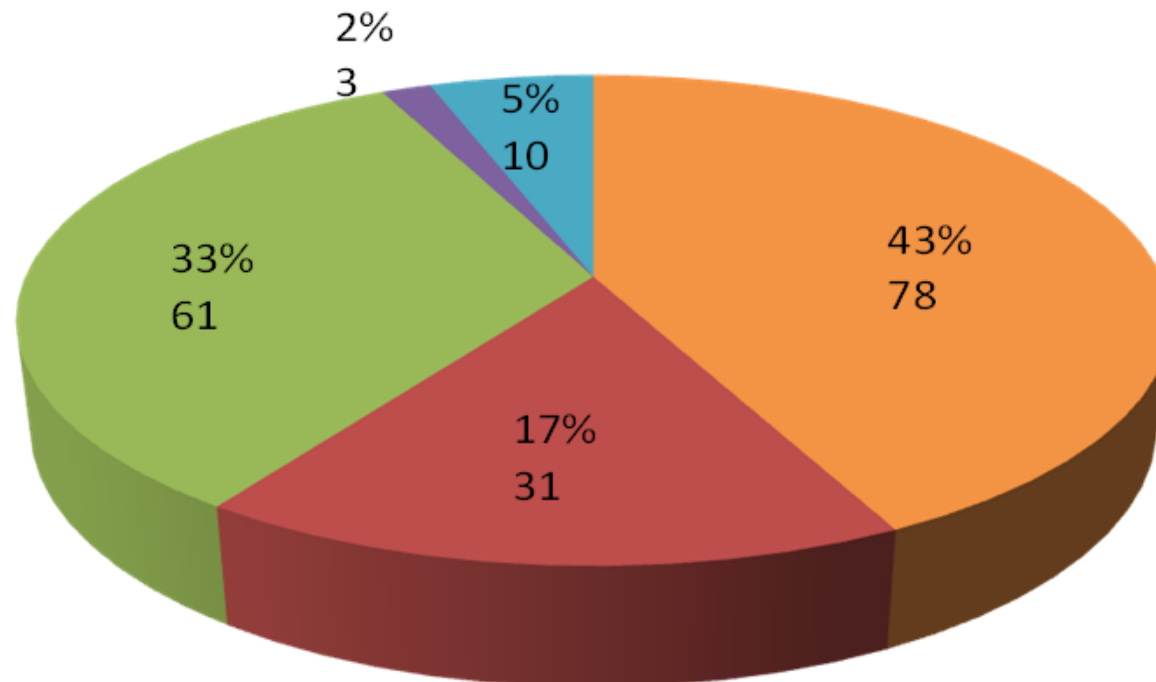
How Will New Technologies Be Taken to the Market?

Large Firms Represent Under 10% of Licensees at MIT

- In any given year, MIT licenses 40% of total number of patents that are issued to MIT in that year; also starts on average 21 new firms through the TLO
- Licensing not a big revenue generator for the university. Goal is *impact on society*

Exclusive Licenses FY 2010-2015

Startups Former Startups Other Small Co. Sponsors Other Large Co.



In Building Innovation-Driven Economies, the U.S. and China Share One Important Challenge in Common: Inequality

	<i>per capita GDP</i>	<i>Gini Coefficient</i>
<i>US</i>	~\$57K	.45
<i>China</i>	~\$8K	.45

- *Innovation-driven growth benefits those at the top the most*
- *Response in the U.S. to date has been limited:*
 - *Public Education*
 - Education for the digital economy: K-12 curriculum in Computer Science, Robotics
 - *Workforce training/Apprenticeships*
 - Community College/ Vocational training partnerships with universities
 - *Technology upgrading* for small and medium-size companies (Industry 4.0)
 - *Increased minimum wage*

Thank you!

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