Advanced Manufacturing Innovation: Tested concepts & emerging models

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MIT Advanced Manufacturing Innovation, Provost and MITii
U.S. Manufacturing Foresight Consortium, Leadership Council
U.S. Advanced Manufacturing Partnership 2.0

Key Takeaways

1. Advanced manufacturing innovation is strengthened by public-private partnerships.

2. U.S. Manufacturing Innovation Institutes indicate regional interests, and can include Japanese companies with U.S. HQ.

3. Education and workforce development, and collaborations with MIT on manufacturing outside of these MIIs, are opportunities.
Tested concepts

• U.S. Innovation
• Other national models
  – Germany’s Fraunhofer Institutes
  – Japan’s AIST and AMRI
Innovation remains strong in the U.S., but...

What manufacturing do we need in order to get full value from our innovation?

S. Berger, PIE Study Chair and author, *Making in America*
Spectrum of Innovation

Efficiency gains; market extensions
Customization; Valuable niches
Repurposing
New business models
Patentable disruptive path-breaking “MIT” innovation

Innovation is not only about patents.
There is innovation in process, business organization, and manufacturing technology in firms of all sizes.

S. Berger, PIE Study Chair and author, Making in America
PIE Research

Interviews
United States 179
China 36
Germany 32
Other Countries 18
265

Analysis of Start-Up Trajectories: 150 MIT Licensed Production Firms, 1997-2008

Analysis of Innovation and “Main Street Manufacturers”

Analysis of Strong Scale-Up in Germany and China

Technology Scans and Surveys

Jobs and Skills, Survey of Nationally Representative Sample of 900 Manufacturing Establishments
Critical Case of 150 Production Firms
Started with MIT Licensed Technology (1997-2008)

By Industry
- Advanced Materials and Energy: 17%
- Medical Devices: 21%
- Biopharma: 39%
- Robotics: 10%
- Semiconductors and Electronics: 10%
- Other: 3%

By Current Status
- Operating: 59%
- Closed: 21%
- Merged: 20%

S. Berger, PIE Study Chair and author, Making in America
Holes in the Industrial Ecosystem

1. When innovation grew out of large firms, they had the resources ($$, skills, plants) for scale up. Where do those **resources** come from today? How well do they work at various stages of scale-up?

2. Main Street manufacturers are innovators and critical enablers of innovation. They **used to be able to access complementary capabilities** from the ecosystem. Today they need to generate them internally.

3. Large employers used to provide **skills and training**. There are fewer such firms today; and smaller firms can’t/won’t train. How do we educate the workforce we need?

4. There’s transformative manufacturing technology on the horizon, but how do we **get it into the hands of firms** who might use it?

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S. Berger, PIE Study Chair and author, *Making in America*
Tested concepts: Japan
Tested concepts: Germany

Fraunhofer
Tested concepts: Germany

- Senate appoints Executive Board
- Assembly of Members elects Executive Board
- Group Spokesmen discharges Executive Board
- Executive Board advises Group Spokesmen
- Executive Board advises Scientific and Technical Advisory Board
- Advisory Boards advises Executive Board

67 Fraunhofer Institutes and research units

7 Groups:
- Information and Communication Technology
- Life Sciences
- Microelectronics
- Light & Surfaces
- Production
- Materials and Components
- Defense and Security
Emerging Models

- U.S. Advanced Manufacturing Partnership
- U.S. Manufacturing Innovation Institutes
- UK TICs
Manufacturing at MIT

• Historical strength in “mens et manus”
  – Laboratory for Manufacturing Productivity
  – Industrial Performance Center
  – Industrial Liaison Program
  – MIT Innovation Initiative

• MIT Production in the Innovation Economy (PIE) study, report, books
Key MIT Engagements

• Advanced Manufacturing Partnership 1.0 (MIT Pres. Hockfield, Co-Chair):
  – Advanced Manufacturing National Program Office
  – National Network for Manufacturing Innovation

• AMP2.0 (MIT Pres. Reif, Co-Chair):
  – Action, not reports
  – Public-private partnerships
Advanced Manufacturing Partnership

- Develop and implement actions to accelerate U.S. manufacturing innovation and competitive advantage
- Build on public-private partnerships for manufacturing technology innovation and workforce development

- AMP Steering Committee led by Andrew Liveris (CEO, Dow Chemical) and Rafael Reif (President, MIT)
- Established teams including experts from industry, academia, labor to develop recommendations (2013-2014)
- Coordinated agency engagement via U.S. National Economic Council (NEC) and U.S. Advanced Manufacturing National Program Office (AMNPO)
AMP: Enabling Innovation

1. Developed and tested approach to prioritize manufacturing technology areas of high national priority, which can be distinct from agency mission priorities

2. Developed detailed vision, gap analysis, and proposed actions for high-priority Manufacturing Technology Areas:
   - Identified common challenges and solutions in top-level recommendations
   - Provided detailed analyses based on national input from industry, academia, labor, and regional governments
   - Identified need for basic research pipeline for NNMI and for workforce training at graduate levels
Transformative Manufacturing Technologies

- Developed process and survey to identify manufacturing technology areas of highest U.S. priority

- Produced detailed recommendations around top four manufacturing technology areas: roadmaps for public-private partnerships closing U.S. gap within 3 and 20 years

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<th>Manufacturing Technology Area (MTA)</th>
<th>Industry Pull</th>
<th>National Security</th>
<th>Cross-cutting in Sector &amp; Size</th>
<th>Leverage US Advantages</th>
<th>TOTAL PTS</th>
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Key AMP outcomes:
Manufacturing Innovation Institutes (MIIs)

– Include technology focus
– Builds sustained innovation ecosystem, with industry and state support
– Includes strong focus on education and workforce training at all stages
Key AMP outcomes:
Manufacturing Innovation Institutes

- Additive Manufacturing (DoD and DOE, OH)
- Power Electronics (DOE, NC)
- Lightweight Metals (DoD, MI)
- Digital Manufacturing (DOE, IL)
- Advanced Composites (DOE, TN)
- Integrated Photonics (DoD, NY)
- Flexible Electronics (DoD, CA)
- Revolutionary Fibers & Textiles (DoD, TBD)
- Smart Manufacturing (DOE, TBD)
- More anticipated in 2016
AMP2.0 Recommendations

Enabling Innovation

1. Establish national manufacturing technology strategy, building on AMP2.0 process, with coordinated implementation across government and private sector

2. Create Advanced Manufacturing Foresight Consortium to provide sustained, coordinated private sector input and partnership

3. Create new manufacturing R&D infrastructure to support innovation pipeline across manufacturing readiness levels (MRLs)
   - Manufacturing Centers of Excellence (MCEs): TRL/MRL 1-3
   - Manufacturing Technology Testbeds (MTTs): MRL 8-10
AMP2.0 Recommendations

Securing the Talent Pipeline

6. Partially fund implementation of nationally recognized, portable and stackable credentials for skill certifications

7. Make online training and accreditation program development eligible for federal support
Emerging Opportunities

1. **U.S. consortium** to provide input on current technical and policy changes

2. **Stronger partnerships** among universities, small-and-medium manufacturers, and large corporations

3. **Increased engagement of U.S. states, governors, and multistate regions** for public-private partnerships

4. Renewed focus on education and workforce training for **manufacturing careers**
How does this impact industry collaborations with MIT?

- Participation with MIT on existing and new MIIs
  - Can accelerate work to at *prototipo to pilot scale production*, and beyond
  - Can position your *US-based company to join MII teams* at early stages, to shape the MII that benefits your industry sector
  - Can initiate new relationships other sponsored projects with MIT, outside the MIIs
How does this impact industry collaborations with MIT?

- Prioritized Manufacturing Technology Areas could spur
  - Increased industry-academia collaboration at lower tech-readiness and manufacturing-readiness levels
  - Increased international funding of related, basic research
  - New Manufacturing Innovation Institutes
  - International collaborations
How does this impact Industry Collaborations with MIT?

- MIT is leading key components of one new MII:
  - **American Institute for Manufacturing Integrated Photonics (AIM Photonics),** HQ in NY
  - **Education & Workforce Development Exec Officer:** Kim Kimerling, MIT
  - **CTO, including roadmap implementation:** Mike Watts, MIT
  - **Technology Roadmapping:** Consortium for Integrated Photonic Systems Manufacturing (CIPSM), a partnership between International Electronics Manufacturing Initiative Inc. (iNEMI) and MIT
How does this impact Industry Collaborations with MIT?

• Upcoming MIIs
  – **Flexible Hybrid Electronics** = NEXTFLEX MII, currently in standup with several MIT faculty participants (Brian Anthony, MIT PI)
  – **Advanced Functional Fabrics of America** consortium, if selected for RFT MII, will have strong focus on MIT innovation in partnership with companies and universities (Yoel Fink, MIT PI)
  – **Smart Manufacturing** (CESMII), with a strong focus on sensors and data analytics (Richard Braatz, MIT PI)

Potential MIIs on Biopharma Manufacturing and Collaborative Robotics Manufacturing
Key Takeaways

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3. Education and workforce development, and collaborations with MIT on manufacturing outside of these MIIs, are opportunities.
What can I do if I am interested?

• Contact ILP and krystyn@mit.edu
• Contact Directors of existing MIls, understanding that currently US HQ are required for MII membership
• Initiate and sustain collaborations with MIT faculty in advanced manufacturing.