Universities And the Manufacturing Talent Scaleup Challenge

William B. Bonvillian
Director, MIT Washington Office

Senate Competitiveness Caucus
The Manufacturing Workforce of Tomorrow
Senate Vis. Cen. 201 - May 17, 2015
Manufacturing – what happened?

- **Postwar - U.S. innovation focus was on R&D**
  - Build a great R&D system
  - U.S. leading science by the end of WW2 - could we capitalize on that?
  - Sputnik, Cold War: built that system out in the post war
  - Created the strongest research universities in the world

- **U.S. had the strongest manufacturing in the world**
  - developed, interchangeable machine made parts, the assembly line, mass production

- **U.S. was production king – what’s to worry?**

- **Then 70s-80s – Japan and the “quality manufacturing” model**
  - new production technologies, processes and business models
  - U.S. lost large parts of auto, electronics sectors
What happened, con’t

• Then 90’s - IT revolution that the U.S. led – so focused on that and dropped manufacturing

• Then 2000’s - China captured a manufacturing output lead, U.S. shut 50,000 factories, lost 1/3 of mfg. workforce

• U.S. now in a catch-up mode

• Manufacturing is PART of the INNOVATION SYSTEM –
  • engineering a new technology for production is very creative process, requires deep engineering and science
  • Need to reconnect R&D to production, see production as part of the innovation continuum
  • Part of that is creating incentives for reconnecting universities to production
Story 1: Universities and Manufacturing Education

**What can Universities do on Manufacturing Education?**

1) **Maker Spaces** – at MIT, 135,000 sq ft, in 35 clusters
   - Beaver Works – equipment/technology rich space for “learning by doing” courses where students making prototype technologies

2) **Manufacturing Masters** – 1 year at MIT and on mfg. site
   - Project and team based, compressed class in advanced manufacturing
   - Intense “launch pad” experience at production firm or startup

3) **MIT Collaboration with community colleges**
   - New training in advanced manufacturing
   - Online features, and “weekend warrior” “learning by doing” on mfg site
   - Note: NSF ATE program: univ’s and community colleges team up for mfg. curriculum
Story 2: Advanced Manufacturing Institutes

**Manufacturing Institutes Driving New Univ. Role:**

- **Idea:** Are there new paradigms of production built around new technologies where U.S. could create a manufacturing edge?
  - Institutes so far: 3D printing, lightweight metals, power electronics, composites, photonics, flexible electronics, revolutionary fibers
  - Collaboration between large/small/midsized firms, universities, gov’t (state and federal) – German Fraunhofer Institute model
  - Applied research, development, testing, **AND** training, education
  - At least 20 univ.’s participating so far with industry in manufacturing institutes
    - Research will drive learning will drive education
    - Univ’s will be creating education modules in the new production technologies and processes
  - (Note: China just announced it will have 20 advanced manufacturing institutes by 2020)
Story 3: University Role in Startups that Manufacture

- MIT researchers create 20 to 25 startups a year coming directly out of its federally funded research –
  - Many universities learning how to do tech transfer to startups founded by their faculty/grad students

- 2015 study: MIT living alumni have founded
  - 30,200 active companies
  - employing 4.6 million people,
  - generating $2 trillion in annual revenues
  - MIT founded co’s – 10th largest economy
  - Universities’ biggest contribution is education, and “startup education” is now part of that

- But its startups that want to make something aren’t getting financing
New Tech: VCs Bailing Out

- Example: VC new energy investment dropped from $5B to $1B between 2008-2014 (B. Gaddy study 2016)
- Energy technology: high risk, low return vs. software low risk, high return

FIGURE 48. VC/PE NEW INVESTMENT IN RENEWABLE ENERGY BY STAGE, 2004-2013, $BN

- Buy-outs are not included as new investment. Total values include estimates for undisclosed deals
- Source: Bloomberg New Energy Finance, UNEP
“Innovation Orchards”

• Rafael Reif, MIT - substitute space for capital

• “Innovation Orchards”
  • technology and equipment rich space for startups
  • full of know-how

• for: advanced prototyping, demonstration, testing - perhaps small lot pilot production

• Gets startup down scaleup curve

• Derisking – get them into range of more traditional financing

• Could accelerate the innovation – better than VC fix
**Idea** – Team Univ. Startups with Federal Labs and Manufacturing Extension Program

- A university can link up to its startups and entrepreneurs.
- A federal lab has technology, equipment, and know-how:
  - It can help provide the technology rich space for startup scaleup.
  - Example: DOE’s LBL and Cyclotron Road.
- Q: But what does a federal lab know about production?
- **Add’l idea** – a missing feature for innovation orchards:
  - Link the state’s Manufacturing Extension Program (MEP), which knows small manufacturers, with Startups.
- SO: Link scaleup ready startups with labs and small manufacturers.
- Don't have to go to the prototype shops in Shenzen – can find capabilities in your own backyard – underutilized assets.
- “Innovation Orchards” → promising model.
Wrap-up: New University roles in Advanced Manufacturing

- **Innovation policy challenge:**
  - Advanced manufacturing needs a supporting talent base or it won’t work

- **1) New university Education models** emerging to fix this?
  - Maker Spaces;
  - **project based courses around making prototypes**;
  - linking to community colleges for training (ATE)

- **2) New Manufacturing Institutes**
  - Universities doing applied research and education with industry on a new generation of manufacturing technologies;
  - involved in training and education around these, will translate back into university curriculum
3) “Innovation Orchards”- financing fading for univ. startups that make something – how to fix?

• “Substitute space for capital”
  • Rich technology, equipment, know-how space for startups
  • For advanced prototype, demo, testing, pilot production stages
  • Cyclotron Road/LBL provides working model for linking startups to a lab
  • Can also link startups to MEPs for access to small manufacturers for scale up to production

• Can this work? – no new money, can’t create new programs
  • But these policy fixes are already authorized, have low capital costs, better utilization of existing assets – labs, MEPs