

An aerial photograph of the MIT campus in Cambridge, Massachusetts, taken at sunset. The sun is low on the horizon, casting a warm, golden glow over the city and the Charles River. The MIT buildings, including the iconic domes, are silhouetted against the bright sky. The river flows through the city, and a bridge is visible in the distance.

# Universities And the Manufacturing Talent Scaleup Challenge

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# 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)

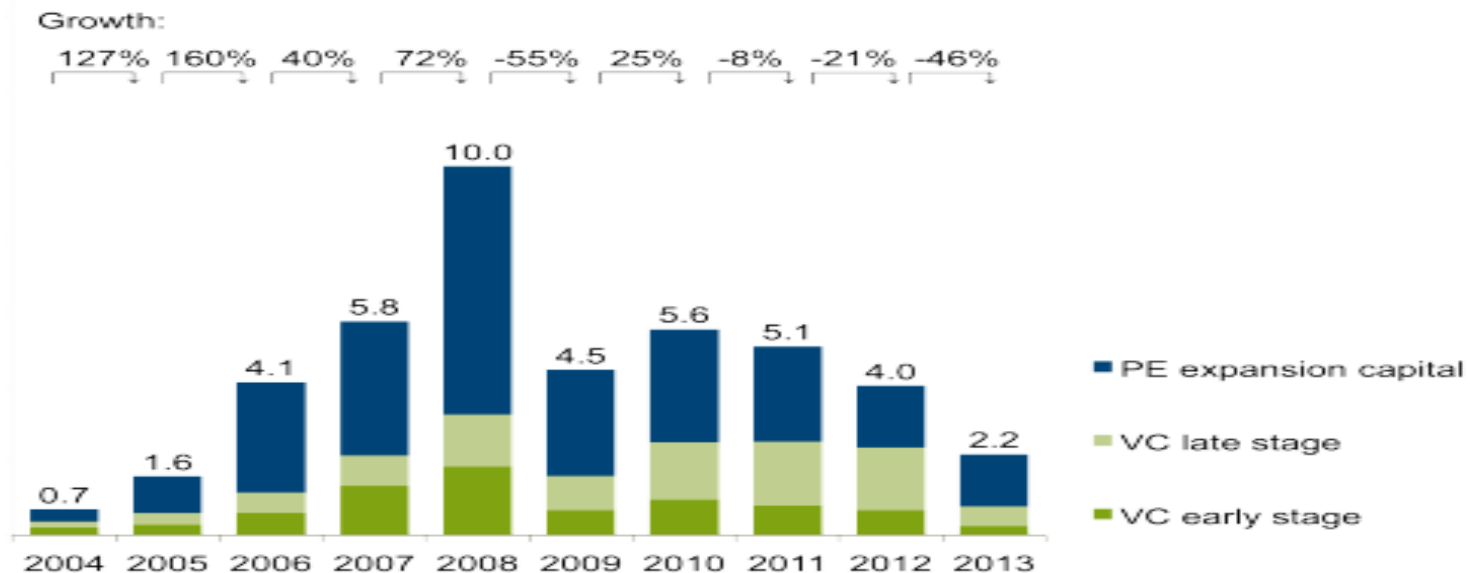
# Story 3: University Role in Startups that Manufacture

- 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 – 10<sup>th</sup> 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**
  - Example: Incubator Greentown Labs in Somerville joined Mass. Manufacturing Extension Program in 1 year pilot program
- **SO: Link scaleup ready startups with labs and small manufacturers**
- Don't have to go to the prototype shops in Shenzhen – 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<sup>10</sup> curriculum

# Wrap-up, con't

- **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