The Making of Innovation Ecosystems in Modern Research Universities

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Which universities have created the world’s most successful technology innovation ecosystems?
‘Which universities would you identify as having created/supported the world’s most successful technology innovation ecosystems?’

[MIT-Skoltech Study, June 2014: 61 experts from 20 countries]
‘Which universities would you identify as having created/supported the world’s most successful technology innovation ecosystems?’

[adjusted by country of origin]
"I can’t imagine Silicon Valley without Stanford University."

John Doerr, Kleiner Perkins Caufield & Byers venture capital
Models and Examples: Kendall Square
Key Lessons: the role of Universities

• A clear link exists between building indigenous research capacity and economic growth in a post-industrial knowledge economy.

• University-based research is the most effective driver of scientific discovery and economically relevant new technologies.

• World-class Universities provide ideal context for educating students for careers in science, industry, government, and civil society.

• Produce graduates with the intellectual breadth and critical-thinking skills to solve problems, innovate and lead.

R. Levin, “The Rise of Asia’s Universities”. Foreign Affairs, May/June 2010
Some evidence: Stanford

- Stanford’s Office of Technology Licensing (circa 2014)
  - licensed 8000 campus-inspired inventions
  - generated $1.3 billion in royalties for the university
- Five thousand companies “trace their origins to Stanford ideas or to Stanford faculty and students”

Source: “Get Rich U. There are no walls between Stanford and Silicon Valley. Should there be?” Ken Auletta, New Yorker, April 30, 2012
Some evidence: MIT

- 25,800 active companies founded by MIT alumni:
  - employ 3.3 million people
  - generate annual world revenues of $2 trillion
  - producing the equivalent of the 11th-largest economy in the world

Some evidence: US ICT Sector

Source: Continuing Innovation in Information Technology
Technological innovation is the ultimate source of productivity and economic growth

Robert Solow, Nobel Prize in Economics, 1987
Over time, entrepreneurship becomes the principal mechanism through which economies evolve and regenerate.

Both developed and developing economies would stagnate without it.

"I've had dozens of meetings over the years with leaders from around the world who asked how they can build their own Silicon Valley. It never works."

J. Breyer, Breyer Capital & Accel Partners [WEF '14, Bloomberg's GII 2014]

“would be much better to study the early history of Silicon Valley than trying to copy what they are doing now”

MIT-Skoltech Study, June 2014
The Origins

Eric Schmidt, Executive Chairman of Google; US President’s Council of Advisors on Science and Technology; UK Prime Minister’s Advisory Council.


M. Dikaiakos, C4E/UCY
Origin #1: Vannevar Bush

Director, Office of Scientific Research & Development, 1941-1947

• “Science, The Endless Frontier” report to US president Truman (July 1945)
  ‣ Basic research is "the pacemaker of technological progress"
  ‣ Supported federal patronage for the advancement of knowledge in the United States

• National Science Foundation (NSF)

"No American has had greater influence in the growth of science and technology than Vannevar Bush" (Wiesner, Biographical Memoir, National Academy of Sciences)
(btw) Vannevar Bush and MEMEX

“As we may think” Atlantic Monthly, July 1945
Three driving principles

- **Government**: bears primary responsibility for funding basic research and determines the total amount of funding available in different fields.

- **Universities**: primary institutions responsible for carrying out government-funded research.

- **Assessment**: based not on political or commercial grounds but on meritocracy, through an intensely competitive process of peer review by independent experts based on scientific merit alone.

  R. Levin, “The Rise of Asia’s Universities”. Foreign Affairs, May/June 2010
Figure 20. Campus federal funding as a proportion of total research funding, FY1940–FY2013

“Because the full economic benefit of a breakthrough in pure science can rarely be captured by the original inventor, private enterprises will typically have insufficient incentive to make many socially productive investments”

R. Levin, “The Rise of Asia’s Universities”. Foreign Affairs, May/June 2010
(btw) The “short-termism” curse

“Americans think everything had to happen yesterday; they have a very short time frame. My company is 108 years old. Most of my American counterparts are thinking about what’s happening this quarter.

But, we think in generational terms.”

W. Fung, Chairman of Li & Fung (world’s largest consumer-goods sourcing and logistics company), 2014
Key factors of success

• Exposes postgraduate scientists-in-training to the most cutting edge techniques and areas of research

• Allows undergraduates to witness meaningful science first-hand, rather than merely reading about last decade’s milestones in textbooks

• Students develop ability to collaborate and assimilate new information, solve problems, and create new knowledge

• Best research gets funded - not research proposed by those who are politically well-connected

R. Levin, “The Rise of Asia’s Universities”. Foreign Affairs, May/June 2010
Witnessing meaningful science first-hand is crucial
The “fractal stain” effect
The “fractal stain” effect

“If you think of technology as something that’s spreading like a sort of fractal stain, every point on the edge represents an interesting problem.

One guaranteed way to turn your mind into the type to start up ideas [...] is to get yourself to the leading edge of some technology.

[...] when you get there, ideas that seem uncannily prescient to other people will seem obvious to you”

Paul Graham, Y Combinator [Source: Course on “How to Start a Start-up” Stanford University, Fall 2014].
The Knowledge Avalanche

- Rapid pace of knowledge creation: available technical knowledge (number of pages published in scientific journals)
  - 2007: doubles every 7 years
  - 2030: doubles every 72 days
- 80% of the knowledge required to perform an advanced technical job is rendered obsolete within 10 years.
- In 25 years from now, the employment landscape will be profoundly different.
The “Onrushing Wave”

Nearly half of 702 professions in the U.S. could be susceptible to elimination due to diminishing costs of ICT and exponential improvements in hardware, algorithms and software.

The role of the private sector

Government-funded Research: transformation of money into knowledge

Innovation: transformation of knowledge into money

[Geoffrey Nicholson, 3M (Inventor of the Post-It Note)]
Origin #2: Arthur Rock

One of America’s first venture capitalists

• He played a key role in launching Fairchild Semiconductor, Teledyne, Intel, Apple, and many other high-tech companies.

• A driving force in the emergence of Silicon Valley as a centre of innovation and entrepreneurship.

• Between 1961 and 1968, invested $3 million and returned $100 million to their investors.

A. Rock: "Success for me is helping to build great companies [...] having created jobs." (Interview with HBS, 2001)
“70% of the US jobs created in the last decade come from fast growing, young companies”

[E. Schmidt, G.S. Beckwith Gilbert ’63 Lecture, Princeton, 30/4/2015]

without start-ups, the net rate of increase in employment in the USA between 1980-2005 would have been negative

How does it work? Start-ups

Research University → Startups

Open Knowledge, Invention → Innovative Products and Services

Small Fraction of startups:
- ~1% for ROI
- ~10% of startups

Investors

Source: prof. Kai Li, Princeton
How does it work? Tech Transfer

University

Businesses, Govt

Small subset

Consumer Demand

Patents

Innovative Processes, Products & Services

Intellectual Property

ROI
Following the US paradigm

“to educate global leaders in innovation, advance scientific knowledge and foster new technologies to address critical issues facing Russia and the world”
[Mission Statement. Skolkovo Institute of Science and Technology (Skoltech). 2011]

“to promote original innovation in scientific research and the innovation and integration of key technologies, so as to scale the heights of world science and technology, and make fundamental, strategic and forward-looking contributions to China's economic reconstruction, national security and sustainable development”
[Guidelines. Chinese Academy of Sciences]
“Four-in-one” management mode

1. Research
   - Research: 6 research institutes & 56 different laboratories

2. Education
   - Education: SAIST

3. Industry
   - Industry: headquarters base and companies
   - Capital: VC fund

4. Capital

Shenzhen Institute for Advanced Technology, China (2015)
A proliferation of “Silicon Valleys”
Signs of success

[“China emerges as a global innovator” T. Stassopoulos, Financial Times blogs, 30/4/2015]
Success in the face of challenges

“Which universities/countries would you identify as having created/supported highly effective technology innovation ecosystems despite a challenging environment?”

![Graphs showing the number of recommendations for different countries and universities.](image)
Which challenges?

- National culture that does not support entrepreneurial behaviour and risk-taking.
- Geographical isolation and/or limited local market.
- Lack of venture capital or multinational companies in the region.
- No existing high-ranking research-led university within the ecosystem base.
Identifying Emerging Leaders

• Not simply a result of strong government funding.

• Playing an active role in establishing / growing a vibrant ecosystem.

• Critical entrepreneurial development still in its ‘startup phase’; key E&I components driving change still in place.

• Taken a distinctive path in their E&I policy in response to particular barriers faced in their environment.

• A significant focus on engineering and technology in their entrepreneurship activities.
“Emerging Leaders” Group (ELG)

Aalto University

Imperial College London

The University of Auckland, New Zealand

MIT-Skoltech Study, June 2014
Common key features of ELG

• **Well-connected champions**: Bootstrap and sustain

• **Public endorsement by senior management**: Prominence in regional/national strategies for economic growth

• **Regional, national or government support**: responsive, flexible, sustained, prioritising high-potential players, supporting international strategic partnerships

• **Relationships of trust with the regional E&I community**

• **Mobilisation and drive of student entrepreneurial movement**

• **Creating a market for university entrepreneurship**: Partnerships with alumni entrepreneurs, establishing agency for international industry partnerships, open-access support for entrepreneurial development and start-up creation
Development models

• Model A: ‘bottom-up’ and community-led, catalysed by students, alumni, entrepreneurs in the regional economy with a ‘loose IP control’
  ‣ Strong partnerships of trust with regional entrepreneurial community
  ‣ Investment focused on regional rather than institutional capacity

• Model B: ‘top-down’ and university-led, working through established university structures, with a ‘tight IP control’
  ‣ Driven by and focused on strong TTO
  ‣ Emphasis on university-owned IP - often leaves students and alumni marginalised
Key building blocks of E&I strength

• University senior management - leadership & governance
  ‣ adequate strategy & consistent execution

• University departments - academic culture & research capability
  ‣ excellence in disciplinary and cross-disciplinary research, curricular and co-curricular activities

• University-led E&I activity
  ‣ proper focus and alignment

• Student-led E&I activity
  ‣ enthusiasm and “can-do” attitude

• External E&I community
  ‣ robust relationships of trust, synergies and flow of people & ideas
Ongoing challenges

- Potential conflict between research excellence and entrepreneurial ambitions
- Disconnect between grassroots, community-driven E&I and formal university channels
- Integration of E&I into the university’s mission, policies and incentive systems
- Definition of proper E&I metrics
Balancing critical components

Component 3

University E&I agenda reflected in its policies, mission, budget allocations, incentives and curriculum

Component 1

Inclusive grassroots community of E&I engagement across university populations and regional community

Component 2

Strength in industry-funded research and licensing of university-owned technology

Figure 13. Three critical components in the establishment of an entrepreneurial university.
Figure 15. Timeline for the development of the university E&I components, 2008–2013, showing student-led activities in purple and university-led activities in orange.
Primary instruments for entrepreneurial development at Aalto University

- Low-entry introduction to entrepreneurship and opportunities to form teams
- Education and training on the entrepreneurial process and approach
- Immersive start-up experience (3-12 months)
- Co-working space, intensive mentorship, and support for new start-ups
- Seed financing and pitch support for VC investment

Key: activity participants
- Aalto students only
- Aalto faculty only
- All Aalto staff and students
- Anyone

Figure 17. The E&I support activities at Aalto along the startup pipeline, from initial engagement with the idea of entrepreneurship to funding a new startup company.
universities develop the entrepreneurs of the future **not**
the ventures of today...
“the stable development of a research commercialisation activity, outside a one-off “blockbuster” innovation, would take at least 10-15 years”