Technology Transfer from Universities: How it Works (at MIT and worldwide)

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Many forms of "Technology Transfer" from Academia to Industry

- The graduating student
- Publication
- The consulting professor
- Collaborative/sponsored research with industry
- University seminars/courses for industry
- Intellectual Property licensing to
  - **Existing companies**
  - **Spin-Outs**

Formal definition of “technology “technology transfer”

- Purposeful transfer of the results of fundamental research from universities and research institutions institutions into the economy via protection and out-licensing of intellectual property

Purposes of University Technology Transfer

Research → Invention (and IP) →
Development → Innovation

- New products and medicines
- Bring new technology into industry for for economic competitiveness
- Encourage entrepreneurship for local and national economic development

A short world history of university technology transfer

- 1960-1980 Some patent licensing in US and and UK universities; not widespread
- 1980: Bayh-Dole Act in US begins acceleration of tech transfer, and competence competence builds in tech transfer offices
- Early 1990's: Many US universities acquire competence; emphasis on spinouts begin; UK government begins increased emphasis emphasis on technology transfer, particularly particularly spinouts

- Late 1990's: Japan and Taiwan pass "Bayh-Dole-like" Acts.

  Singapore, Hong Kong, Germany, Finland, Brazil, China, South Africa, and and many other countries begin or strengthen their systems for technology technology transfer from their universities and research institutes.

- 2000-2009: Interest in technology transfer is global—including substantial substantial interest in the Gulf States. Countries beginning to look to technologies developed at their universities for economic development development in the “Knowledge Economy.”

  Intense interest in developing technology transfer capabilities and looking for ways to learn it

The Bayh-Dole Act of 1980: changing who owns the IP

- >90 % of U.S. University research is funded by the U.S. government under under competitive grants
- Thus, Federal Government policy on invention ownership dominates U.S. university technology transfer

What the Bayh-Dole Act did…

- Gave universities title to their patents from federally funded research
- Allowed universities to grant licenses
  - enabling tech transfer at the local level!
- Allowed exclusive licenses
- Allowed universities to take royalties (and legislated sharing of royalties with with inventors.)

Why Bayh-Dole Law was Needed Needed

- U.S. was leading the world in basic research research
- But research results were not being translated translated into industrial innovation
- U.S. government concerned with maintaining maintaining economic competitiveness
- Government owned patents from the research research it funded—but very few were licensed out; little impact on industry

Bayh-Dole looked at research and patents in a new way

- University technology is embryonic—neither neither its feasibility nor market is known
- Development will require high risk investment investment by industry
- Intellectual property protection can be used used as an incentive to make high risk investment
  - motivating the "first mover" by protecting protecting against later competitors

The Tech Transfer Bargain

- University research leads to patent—but technology is unproven and high risk
- University is willing to grant exclusive patent patent license to Company who will commit to commit to the risk of developing the technology
- If development succeeds, the patent protects protects the Company from competitors
- University benefits from product being developed and from royalties (shared with inventor)

Patent protection is particularly critical for development of pharmaceuticals

- Development of a new therapeutic or vaccine product is a particularly high risk activity
  - Time frames are long
  - Financial investment is very high
  - Clinical trials are very difficult
  - Probability of failure is high
- Patent protection of the final product is necessary before companies (or biotech investors) will take the risk and make the investment

Other truly innovative technologies requiring substantial investment also need need patents to induce investment

Examples:

- Superconductors
- New materials for solar panels
- High density lithium batteries
- New titanium ore refining methods
- 3-Dimensional printing
- Public key encryption

--and many others

Benefits of tech transfer to the university

- Bring fruits of university research to the the public
  ("Get the technology developed" and "give the public the benefit of the research they fund")
- Allow investigators to "make their findings real"
- Bring real world problems into the laboratory through relationships with industry
- Opportunities for graduates

- But does technology transfer make money for the university?

Fiscal Year 2007: 200 US universities and research hospitals

- New Issued US Patents: > **9800**
- New License Agreements: >**4200**
- Total Licenses yielding income: >**11,000** >**11,000**
- New Startup Companies: >**480**

Even with large number of licenses and and spinouts, income was not large on the average

- Licensing revenue from >200 research institutions in FY 2007: $2.0 Billion (U.S.) (U.S.)

- **BUT**…this is on a research base of:

  $ 41 Billion

- Thus, Licensing revenue, after 25 years of of experience averages:

  only 5 % of research expenditures

And the total revenue is very unevenly distributed

- Dominated by a few very large royalties from from fewer than 1% of total patents from research institutions in the U.S.
  - Pharmaceutical royalties are high—but very rare
  - Equity cash-ins from spin-outs are only occasionally large, and are one-time events
- Most universities eventually break even or make a small amount—but very few get rich! rich!

The Societal Impact is much Larger!

- More than 4000 new companies formed from from US university intellectual property
- Estimate over 500,000 jobs in development and production of new products based on university licenses
- Significant tax returns to the government
- Many new medicines developed based on patents from university research

- Significant number of new startups have developed into large, successful companies companies (e.g. Google! from Stanford)
- Biotech and Information Technology (IT) clusters in a number of cities with large research universities (Boston, San Francisco, San Diego, North Carolina, etc.)
  - Majority of new biotech companies spin directly out of university research

Entrepreneurship awareness

- Awareness of spin-outs is now pervasive in many U.S. universities—both in the science and engineering schools and the business schools
- Many successful role models—leading to a multiplying effect
- Business school curriculum changes
- Business plan contests, venture clubs, etc.
- Venture capital and angel investors seeking out new opportunities in universities

MIT Experience

- Patenting activities began before 2nd World War War
- Reorganized in 1986 from “Patenting Office” into into “Technology Licensing Office”
- Staff change from patent attorneys to technical technical people with significant business experience
- 1986: 8 licenses/year, Income $3 million

  2006: 100 licenses/year, Income $48 million

Technology Licensing Office Statistics

- 500 new invention disclosures/year
- 100 new technology licenses/year
- 15-30 new companies/year
- Over 650 active licenses
- About 300 spinout companies total

How we see our mission

1. Bring about commercial investment to develop inventions from MIT research
   - To bring therapies and other products into public use
   - To show the public, Congress, and funding agencies tangible results of basic basic research
   - To allow faculty and students to see real-real-world results of their research
   - For economic development—in Massachusetts and nationally

with other benefits

2. Expose and educate students (and faculty) in in how technology moves from laboratory to to market, and in entrepreneurship
3. Participate in a world-wide dialogue (including teaching and publication) on technology transfer and intellectual property—both in developed countries and and for the poor
4. Financial return to inventors and discretionary funds for the Institute

Strategy: do a lot!

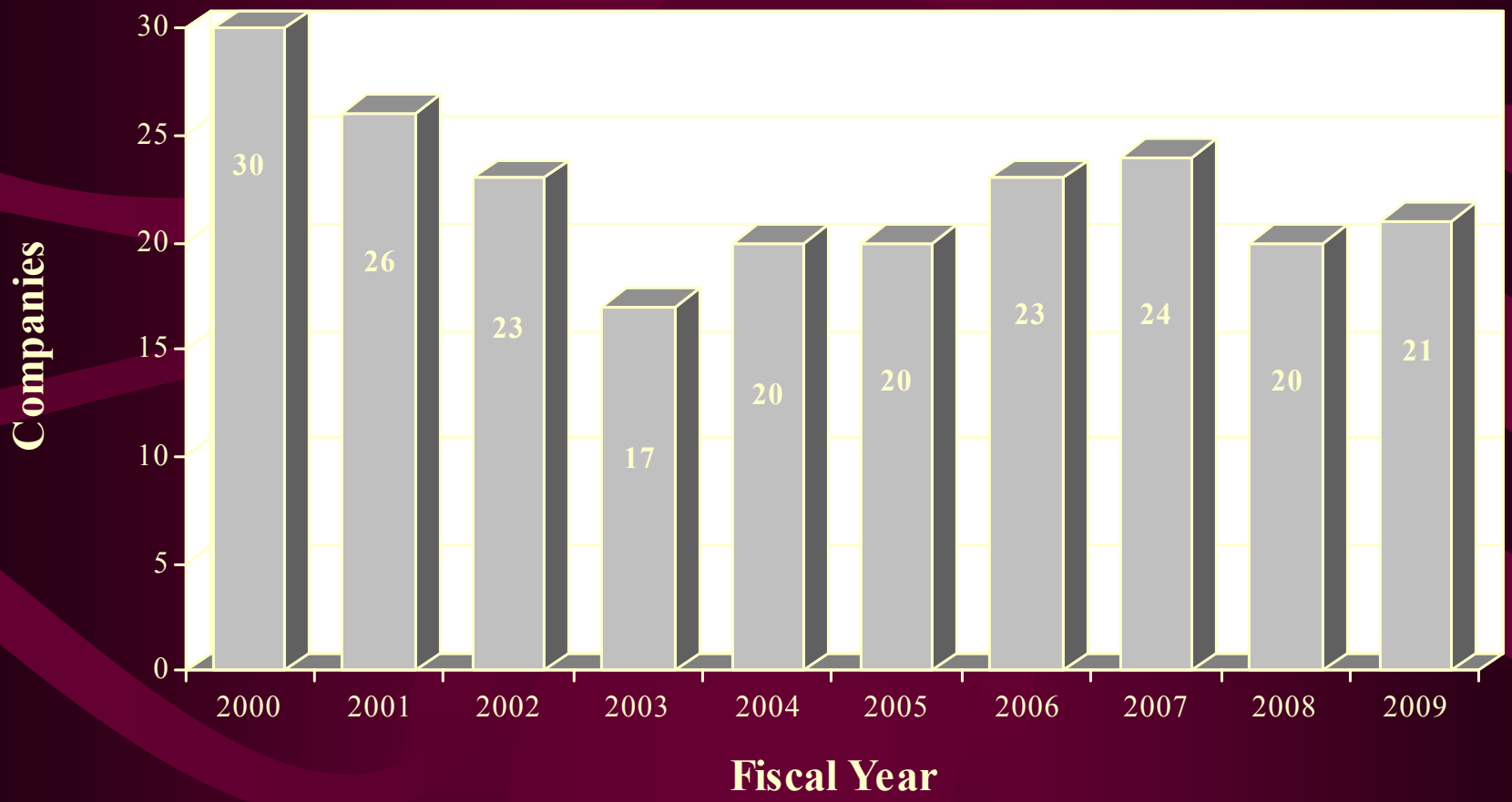
The Volume Strategy

- Aim to maximize the number of technologies being developed
  - Rather than try to pick a few “winners” and and concentrate on them
- 100 license/year—20-30 startups/year

Advantages of the "Volume Strategy"

- Maximizes participation of faculty and and students in the technology transfer transfer process
- Maximizes number of technologies invested in by companies and VC's
- Maximizes probability of hitting a home home run
- **Technology is probably too early to be able to pick the winners!**

Number of Companies Started by Fiscal Year, 2000-2009



Why are we able to do so much?

- LOTS of world-class technology—dependent dependent on government support of basic basic research
- Good IP protection
- Consistent Tech Transfer policies throughout throughout the university
  - It's about Impact, not (primarily) Income
- An experienced Technology Licensing Office Office

A pervasive entrepreneurial eco-eco-system is a key ingredient

- Well networked in a highly entrepreneurial geographical area with managers, capital, support services
- Many activities where the university, its students and faculty mix on a continuing basis with the business community
  - Companies
  - Venture capitalists
  - Angel investors

MIT components of the "entrepreneurial eco-system"

- Deshpande Center: sponsors research "with startup potential"—with business "catalysts"
- $100 K Student Business Plan Contest
- Venture Mentoring Service
- MIT Enterprise Forum
- Entrepreneurship Center at Sloan School of Mgmt.
- Student Venture Capital and Entrepreneurship Entrepreneurship Clubs
- The Technology Licensing Office

- And lots of role models!
  - Both faculty and students
- Students and faculty are continuously exposed to people who have started companies—and to people who fund them
- Students graduate with a sense that “I can do do it too”. Changes life-time expectations

Entrepreneurship is in the air!

Looking worldwide: Key elements in developing a successful university technology transfer system

I. Strong, world-quality research consistently supported over decades decades

II. A strong, consistently enforced IP system

III. Mission and Expectations

- Does the country and each university know why they are doing it and what they expect to to happen?
- Are expectations realistic?

IV. Policies

- Clear ownership policies on inventions (may (may involve government policy)
- Clear university policies on:
  - **Sharing of royalties**
  - **Publication, confidentiality**
  - **Use of university resources by industry and particularly spin-outs**
  - **Right of faculty to participate in spin-out companies, consulting to industry, etc.**

V. Investment

- It takes money to build a patent portfolio and and to support a technology transfer office
  - **where will the funds come from?**
  - **Is the time frame realistic? 8-10 years before operating in the black**

VI. Realistic Expectations of Return

- The university cannot expect that financial returns will ever be a major source of income income
  - **Unless they get lucky**

VII: People:Technology Transfer is a talent-based endeavor!

- Requires people who are:
  - Technically trained
  - “Bilingual” in Academia and Industry
  - Can command respect of faculty and business
  - Can handle complexity
  - Good communicators
  - Good negotiators
  - And Dedicated to the mission

VIII: The Final Requirement: Time!

- It takes time (and investment) to build build an IP portfolio
- It takes time and experience to develop develop technology transfer capabilities capabilities in a university
- Developing contacts with industry and and investors—and developing trust—trust—takes time.

Building a region’s technology transfer system system is a long-term societal investment

Worries: As technology transfer transfer becomes pervasive

- Will it change the nature of universities?

Is that good or bad?

The answer will probably vary by country—and and may vary between universities in a given given country--depending on the definition of: of:

THE MISSION OF THE UNIVERSITY

U.S.

- Concern about and emphasis on education, discovery research, and dissemination of knowledge as the core core mission of the university
- Technology transfer defined as a byproduct--not a purpose—of the university
- Technology transfer must not distort the the traditional academic values

Some specific worries

- Will emphasis on tech transfer change change nature of research from “discovery” to “applied”?
- Will need to collaborate with industry be allowed to inhibit publication and dissemination of results?

- Will conflicts of interest (both for professors and for the university itself) itself) lead to the public losing confidence that the university is a source of unbiased knowledge?
- Will “privatization” of research results results retard the progress of science? science?

The leading US universities are still still committed to the traditional academic values in research

- Discovery and dissemination as the primary mission
- Investigator-initiated research (rather (rather than work-for hire)
- Open publication of all research, with with minimal delay

- Free exchange of information within the the university (no “ “confidential” laboratories)
- Free exchange of information and materials with other academic institutions
- Value to society has clear priority over profit

Consequences of the Priority of the Academic Mission

- Increasing emphasis on conflict of interest policies—both for individuals and the institutions
- Strict policies on freedom of publication and and use of university facilities
- Careful oversight of and/or “Chinese Wall” between university and its spin out companies companies
- Growing awareness of obligations to developing countries

A different mission definition in some some other countries: e.g. UK

- Technology transfer from universities is is seen as a key part of the government's economic strategy
- Universities have three co-equal missions: education, research, and contribution to the economy
- Major government financial support of of technology transfer and especially spinouts

Consequences of UK Mission Definition

Increasing blending of university academic mission and technology transfer mission

Leading to different ways of doing things: things:

Some differences in UK practice practice from US

- Embedding of spin-out companies within university research laboratories
- Confidential research with industry
- IP protection of “know-how,” limiting dissemination both within and outside the university
- Equity investment of university funds in spin-spin-out companies

UK Results

- Rapid development of competence in “venturing”—active incubation of spinout spinout companies. A new and vibrant model.

But, in the UK…

- Somewhat unrealistic financial expectations
- Competition for university facilities between the academic and technology transfer activities
- Beginning to worry about conflicts of interest
- Worries beginning about preserving UK competence in basic research

Implications for Technology Transfer Internationally: One size does not fit all!

- Both the government and the universities (in each country) must decide **why** they are doing technology technology transfer
- Must engage in dialogue about **mission mission and priorities** of the university university in that culture

Maximizing the Societal Benefits of Technology Transfer

Balancing:

- Academic and Economic Priorities of the System as a Whole
- Long term research benefits vs. shorter shorter term development
- Local financial benefit to the individual individual university vs. long term objectives

Requires a continuing thoughtful thoughtful dialogue

Among:

- Academia
- Government
- Industry

and Wisdom!

Thank you!