The Promise of Technology Transfer from Universities and Research Institutions

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November, 2006

Technology Transfer: What is it?

- Purposeful transfer of the results of fundamental research from universities and research institutions into the economy
  - Often, Intellectual Property (mostly patents) is the currency of exchange between the research institution and industry— through licensing

[short interruption for vocabulary]

- "University"—includes both universities and other government and non-profit research institutions
- "Intellectual Property" (IP)—usually referring to patents, although the term includes copyright, know-how, etc.

Purposes of University Technology Transfer

Research → Invention (and IP) → Development → Innovation

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

What about revenue for the university from technology transfer?

[to be discussed later, but….]

Technology transfer is usually not a substantial source of revenue for the university

– And usually needs some governmental or other support for up to a decade or more

A short history of university technology transfer

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

- Late 1990's: Japan and Taiwan pass "Bayh-Dole-like" Acts. Singapore, Hong Kong, Germany, Finland, Brazil, China, South Africa, and many other countries begin or strengthen their systems for technology transfer from their universities and research institutes.
- 2000-2006: Interest in technology transfer is global. Countries beginning to look to technologies developed at their universities for economic development in the "Knowledge Economy." Intense interest in developing technology transfer capabilities.

U.S. Legislative Basis for tech transfer: Bayh-Dole Act 1980

- >90 % of U.S. University research is funded by the U.S. government 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 inventors.)

Why Bayh-Dole Law was Needed

- U.S. was leading the world in basic research
- But research results were not being translated into industrial innovation
- U.S. government concerned with maintaining economic competitiveness
- Government owned patents from the 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 its feasibility nor market is known
- Development will require high risk investment by industry
- Intellectual property protection can be used as an incentive to make high risk investment
  - motivating the "first mover" by protecting against later competitors

The Tech Transfer Bargain

- University research leads to patent—but technology is unproven
- University is willing to grant exclusive patent license to Company who will commit to the risk of developing the technology
- If development succeeds, the patent 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 patents to induce investment

Examples:

- Superconductors
- High density batteries made by "casting"
- 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 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

University's Financial Benefits of Tech Transfer

- Bring industry support of research into the university
- Revenues from licensing and spin-outs
- Industry and investor philanthropy
- Economic development, locally and nationally

25 years after Bayh-Dole, US Tech Transfer has matured: Fiscal Year 2004 results

- New Issued US Patents: > **4000**
- New Licenses Agreements: >**4900**
- Total Active License Agreements: >**28,000**
- New Startup Companies: >**470**
- Total Startups since 1980: >**5000**

But direct financial income to the universities themselves is still limited: FY 2004

- Licensing revenue from >200 research institutions, FY 2004: $1.4 Billion (U.S.)
- **BUT**…this is on a research base of:
  $ 41 Billion
- Thus, Licensing revenue, after 25 years of experience averages
  only 3.4% of research expenditures

The Societal Impact is much Larger!

- More than 4000 new companies formed 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 (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. and U.K. 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
- Reorganized in 1986 from "Patenting Office" into "Technology Licensing Office"
- Staff change from patent attorneys to technical people with significant business experience
- 1986: 8 licenses/year, Income $3 million

  2006: 100 licenses/year, Income $48 million

Organization and Philosophy

- A department of the university
- Reports to the Vice President of Research (the "Academic ladder")
- Tech transfer is a by-product of the academic process
  - Academic priorities, including freedom of publication, come first
- Emphasis on IMPACT on the community, not primarily income

MIT Statistics

- 4000 undergraduate students
- 6000 graduate students
- >$550 million in research funding—all competitive grants
- 21% of research funding by industry, remainder mostly by Federal Government

TLO Statistics

- Approx. $80 million/year in industrially-sponsored research
- 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(s)

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 research
   - To allow faculty and students to see real-world results of their research
   - For economic development—in Massachusetts and nationally

with other benefits

2. Expose and educate students (and faculty) in how technology moves from laboratory to market, and in entrepreneurship
   - A major player in the MIT Entrepreneurial Ecosystem
3. Participate in a world-wide dialogue (including teaching and publication) on technology transfer and intellectual property—both in developed countries and for the poor
4. Financial return: to inventors, departments, and the General Fund

Strategy: do a lot!

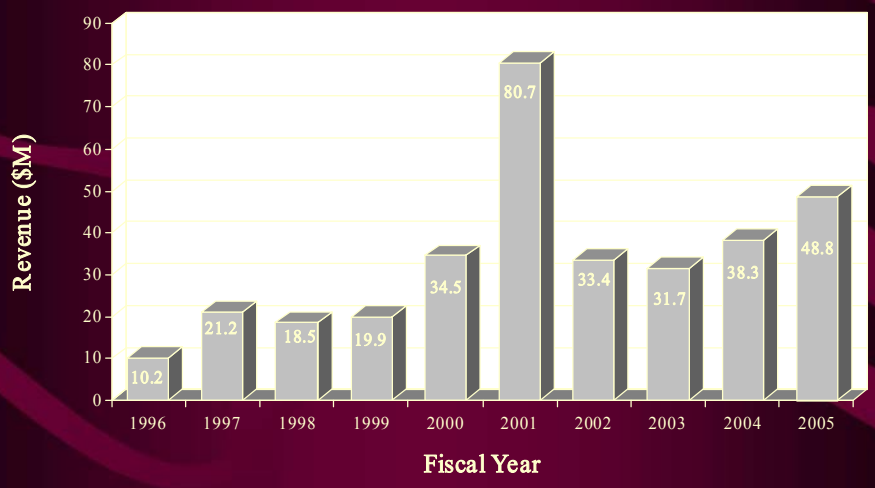
The Volume Strategy

- Aim to maximize the number of technologies being developed
  - Rather than try to pick a few "winners" and concentrate on them

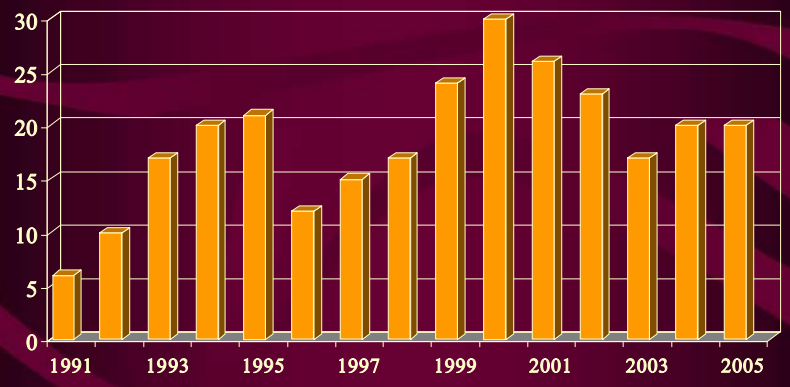
Advantages of the "Volume Strategy"

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

Total Revenue by Fiscal Year, 1996-2005



Companies founded with MIT IP



Impact: Our technology is changing how things are done

- Momenta : “generic biologicals”
  - Carbohydrate drugs; major alliance with Sandoz/Novartis
- Alnylam: RNAi therapeutics
  - First RNAi therapeutic for infectious disease: FDA submission of IND (RSV infections)
  - Alliance with Novartis for flu
- A123: ”printable” lithium batteries
  - Already in consumer products (DeWalt)

More impact

- Omni-Guide: "perfect mirror in a wire"
  - From fiber optic cable to surgical instrument: FDA approval for lung cancer surgery
- Z-Corp: 3-D printing—models and molds
- Cardiomems: sensing of pressure in repaired aneurysms
  - Media Lab signaling invention allows wireless sensing

Why are we able to do so much?

- LOTS of world-class technology—dependent on government support of basic research
- Good IP protection
- Consistent Tech Transfer policies throughout the university
  - It's about Impact, not (primarily) Income
- An experienced Technology Licensing Office
- Well networked in a highly entrepreneurial geographical area with managers, capital, support services

An an entrepreneurial eco-system

- Many activities where the university, its students and faculty mix on a continuing basis with the business community
  - Companies
  - Venture capitalists
  - Angel investors

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
- Student Venture Capital and 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 it too". Changes life-time expectations

Entrepreneurship is in the air!

Key elements in developing a successful university technology transfer system

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

II. A strong, consistently enforced IP system

III. Mission and Expectations

- Does the country know why it is doing it and what it expects to happen?
  - Are time frames realistic?
- Do the research institutions know why they are participating?
  - If they expect to get rich, they're wrong!

IV. Policies

- Clear ownership policies on government-funded inventions
- University policies
  - ownership of IP
  - Sharing of royalties
  - Publication, confidentiality
  - Use of university resources by industry
  - Right of faculty to participate in spin-out companies, consulting to industry, etc.

IV. Investment

- It takes money to build a patent portfolio and to support a technology transfer office
  - where will the funds come from?
  - Is the time frame realistic?

V. Realistic Expectations

- It will take a decade before a tech transfer office is fully functioning
- The university cannot expect that financial returns will ever be a major source of income
  - Unless they get lucky

Key requirements: Talented People!

- Tech transfer is a talent-based business!
- 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
- Experiential learning! It's an apprenticeship

Involvement with Industry and capital

- University must get to know industry and investors—and vice versa
- Many mechanisms:
  - Faculty consulting
  - Collaborative research
  - Seminars, meetings, etc.
  - Volunteer opportunities
  - Networking events (a lot of them!)
  - An "Open Door" policy welcoming

"Technology Transfer is a Contact Sport"

And the Final Requirement: Time!

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

Building a tech transfer system is a long-term societal investment

- To bring the results of basic research to the public in the form of new products, new cures
- To enhance economic competitiveness of industry by incorporating new technology
- To build new industries based on new science and technology
- To build an entrepreneurial culture, bringing new companies, new jobs and new opportunities for a country's people.

Government, Academia and Business working together for a better Society


Thank you!