

# Relevance for Developing Economies of Technology Transfer from Universities and Government Research Institutes

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# Background: What are the missions of universities and GRIs?

- Education
- Research
- Transferring knowledge to industry [?]
- Helping domestic industry ???
  - To what extent should nationalism & mercantilism intrude into higher education and scientific inquiry?

## Theme of this talk:

- Consistent with any or all of these missions, how should university discoveries be managed so as to maximize social benefit?

## Examples of products or services we use today that were discovered in universities

- Google
  - Stanford
- Method to add Vitamin D to milk & other foods to prevent rickets
  - U Wisconsin
- Recombinant DNA (genetic engineering) technology
  - Stanford, UCSF, Columbia , Harvard, Cambridge
- Oxaliplatin (a commonly used anti-cancer drug)
  - Nagoya U
- Titanium dioxide (TiO<sub>2</sub>) surface coatings/catalysts
  - U Tokyo
- Conductive polymers (plastics)
  - U Pennsylvania & Tokyo Institute of Technology, 2000 Nobel Prize in Chemistry
- Nata de coco
  - U Philippines
- Rural water storage and purification technologies
  - Indian government labs
- Ethernet switchers and routers for low power wireless networks suitable for rural areas in developing countries
  - Midas Communication from IIT Madras

Which of above require companies to make final product or service available to public?

- Most, except for:
- Rural water storage & purification systems
  - Provided by government or NGOs
- Some DNA engineering applications
  - Can be done in university labs
- Nata de coco
  - Basic process known for a long time and can be produced at home on a small scale

# What are characteristics of discoveries that do not require companies for realization of public benefit?

- Suitable for government or NGOs to develop and distribute
  - Rural water purification systems
- No development needed. Ready to use.
  - Nata de coco, recombinant DNA technology

## Summary:

In most cases, in order for the public to benefit from university discoveries, companies need to become involved in

- Further research and development
- Manufacturing or
- Marketing and distribution

How to facilitate such involvement is the theme for remainder of this talk

# How are university discoveries transferred to companies?

- Hiring of graduates
- Open publications
- Consulting by university researchers
- Sponsored research
  - Contract/commissioned research
  - Joint/collaborative research (involves researchers from both sides working together)
- Licensing (of patents, assay systems, etc.)
- Formation of new companies (startups)

# Of previous, which methods are generally most important for industry?

- Probably open publications
- And hiring of graduates
- Consultation (probably #3)

These are all “informal” mechanisms.

- I.e., they do not involve intellectual property (IP).

Very often companies do not need any IP from universities to develop university discoveries.

- They have other ways to maintain a competitive advantage over potential rivals.

## *Digression:* What are the main types of intellectual property (IP) relevant to university research?

- **Patents**
  - Basic right:
    - to prevent others from using the invention without permission
  - Must obtain country by country, max 20 years
- **Copyrights (mainly for software)**
  - Protects only form of expression
  - But automatic and world wide, also long duration
- ***Trade secrets***
  - rarely appropriate for university discoveries!
- **Others** (usually not for university discoveries): trademarks, design patents, plant variety patents, integrated circuit design patents, data base rights (Europe only)

Why not rely only on informal mechanisms to transfer discoveries from universities to companies? After all:

- Nata de coco, TiO<sub>2</sub> catalysts, probably all relied on informal transfer
- Maybe also the IIT Madras inventions
- Universities did obtain patents on the recombinant DNA (e.g., US 4237224) and conducting polymer discoveries (US 4122903), but probably IP rights were not needed for companies to absorb and use these discoveries.

# Consider the following case (1):

- A company is interested in a professor's discoveries but wants more research on feasibility, relevance, etc., and it is willing to pay the university for this research.
  - Need a sponsored research or donation agreement
- Then suppose the company wants to ensure that only it will be able to use the discoveries it “paid” for.
  - The agreement needs to say either that (a) the company will be able to apply for any patents or own any copyrights or
  - (b) the university will apply for patents and then license these *exclusively* to the company.
- Suppose company merely wants to ensure it will be able to use the discoveries it paid for, but others can use too.
  - Either the company must be sure the results will be published (or software made available under an “open source” license) so that no other company can patent or copyright the same discovery or
  - The university must apply for a patent and then license the discovery *non-exclusively* to the company.

## And the following case (2):

A company is interested in university discovery but realizes it will need to do a lot of R&D to develop a commercial product. Let's assume:

- a) the product could be easily copied once it is marketed and
- b) a patent covering the university discovery would also cover the final product.

The company would want to own the university patent or have an exclusive license.

– What industries might fit this scenario?

## And the following case (3):

A startup is established to develop the university discovery. It needs to

- attract investors,
- outsource manufacturing and maybe also marketing,
- attract other companies as customers (alliance partners).

It cannot keep its R&D secret and its investors need assurance that the company will make a profit once it can sell the product.

- It too may want to own the university patent or have an exclusive license.

# What do all the previous 3 scenarios (cases) have in common?

- They all describe scenarios where
  - the university discovery needed more development before it could become a useful commercial product, and
  - The company that developed the discovery needed exclusive rights in order for development to make business sense (i.e., to ensure its R&D investment would not be appropriated by rivals).
- Does this suggest a general principle about when universities should apply for patents and exclusively license (or sell) these patents?

# But consider the following case (4)

- University discovery is ready to use but university licenses it non-exclusive at a “reasonable price” to any company that wants a license.

- Inventors and universities are happy for the royalty income.

- Probably an incentive for university faculty to participate in the technology transfer process.

(Royalties from licensing usually split 3 ways between university as a whole, inventors’ department(s) or lab(s) and inventor(s) themselves.)

- The genetic engineering patents brought Stanford, U California and Columbia each about \$10-\$50 million annually in royalties, which were shared with the inventors.

# Also consider the following case (5):

- University discovery is “ready to use” but it is only commercially valuable when combined with many other discoveries in a final product.
- Indeed, the final product requires that many patent holders agree to let other companies use their patents – in effect “pooling” them so that the technologies can be combined in a final product. This requirement is not satisfied by the university simply:
  - Letting any company use the discovery for free or
  - Patenting but licensing non-exclusively
- Pro-active leadership by the university might be best, using access to its patent as leverage to get the other patent holders to agree to a patent pool arrangement.
  - This was Columbia’s role in pooling various digital compression and transmission technologies to create in 1997 the MPEG-2 format used for TV and DVD digital storage and transmission.

# In summary: Decisions about how best to ensure university discoveries are developed for the benefit of the public are complex.

Usually they involve deciding how to encourage companies to commercialize the discoveries. Such decisions depend upon:

- Nature of the technology
  - How much additional development is needed
  - Market demand
  - How easy is it to copy
- The type of companies interested in and able to develop the discoveries.
- Whether the companies need exclusive IP rights
- Amount of additional faculty research/consulting needed for development
- Competence of university technology management offices
- Level of business awareness of the inventors and their business networks
- Outside resources and expertise that the university or inventors can draw upon

# Often written agreements are needed to address issues such as:

- Faculty involvement in development,
- Support for additional university research
- IP rights needed by the company
- Incentives for the company to continue with development

# New theme: Ownership of university inventions

- What are the various ownership possibilities? (I.e., who might be able to own university discoveries?)
  - Individual inventor (professor or student)
  - University (as inventor's employer)
  - Government (if it funded the research)
  - Company (if it funded the research)
  - Mixed

# What are the pros and cons of government ownership?

# Advantages of

## Individual inventor ownership

- Fast, non-bureaucratic
- Better alternative if university technology management office is weak or incompetent.
- Companies probably get better deals (lower rent/toll by universities).
- Since inventor does not have to share royalties with university, maybe (??) he has strong incentive to find a good company to develop his discovery.
- **May be more feasible if many technology transfer services exist in community**

## University ownership

- University probably better able to find companies most willing and able to develop discoveries.
  - Prevents professor giving all his discoveries to his favorite company (misappropriation of taxpayer funded discoveries).
- Allows universities to make non-exclusive licensing the preferred option.
- Allows universities to partition exclusive rights among companies in different fields.
- Allows universities to include development incentives in exclusive licenses.
- Allows university to bundle synergistic technologies.
- Allows university to act pro-actively as in **case 5.**

# Japan and USA both have university ownership systems (generally speaking)

- USA since 1980
- Japan since 2004

Nevertheless, the way universities actually manage technology and the “output” of university-industry technology transfer differ greatly between the two countries.

# Main differences between technology transfer in

## USA

- US universities have been entrepreneurial and relatively independent institutions for > 100 years.
  - Used to raising and managing own finances
  - Many established technology management capabilities before WWII.
  - When in 1980, US Gov let univs own government-financed inventions, univs quickly asserted authority over all inventions.
- Supportive environment for startups
- Most exclusive licenses are to startups or other small cos.

## Japan

- Japanese national universities have less financial and administrative independence from gov't,
  - faculty essentially owned their inventions and transferred them directly to large companies that gave donations and hired students
  - Univs began to establish technology management offices only in 1998
  - Only in 2004 could they require that inventions be transferred to them
- Donation system recreated in new joint research system

# More on Japanese system

- Joint research has become the dominant mechanism of formal technology transfer
- About 60-75% of transferred university inventions are transferred by joint patent applications (joint ownership)
  - Almost all to big companies
  - Major transfer decisions determined by professor and company
    - University technology management offices “out of the picture”
- Joint patent owners have exclusive control over inventions in most countries except USA
  - University cannot transfer its share to a 3<sup>rd</sup> party without company’s permission
- Nevertheless, only in Japan are a majority of university patents jointly owned by companies (almost all large)
  - Probably reflects close university-industry relations, but also weak university administrations, weak entrepreneurial inclinations among Japanese faculty, persistence of old patterns of faculty transferring their IP rights directly to large companies.

# Japan-US dichotomy shows that university MOT influenced by many factors:

- Past practices and customs
- Technology transfer legal framework
- Administrative competence of universities
- Degree to which universities and faculty act entrepreneurially
- Overall national innovation system. Including
  - Government R&D funding
  - Labor mobility and preference for jobs in large companies

In turn, a nation's university MOT system can affect its scientific progress and industrial strength, depending upon factors such as

- The innovation potential of new vs established companies
- The degree to which entrepreneurship by universities and professors promotes innovation and good science
- Extent to which joint research with established companies shapes the overall direction of university research

Thank you  
for your  
attention!

Questions  
please!

