Challenges for Japanese Universities' Technology Licensing Offices – What Technology Transfer in the United States Can Tell Us[1]

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Abstract

American universities have been transferring their technology to industry since before World War II. This technology is now developed with the more than $35 Billion the universities receive annually from the Federal government and industry, with the latter providing less than 10% of the total. The universities annually receive in total more than $1 Billion in royalty payments, create hundreds of new start-up companies every year, and are the recipients of more than 3400 US patents. Most of the royalties are paid for biomedical and pharmaceutical [“bio” and “pharma”] research, with these funding companies usually insisting on and obtaining exclusive intellectual property [IP] rights. As a pure business model, this process is somewhat questionable for the universities, but the other benefits obtained by the universities and society more than compensate for the costs. This paper will address US technology transfer from the viewpoint of an industrial “customer” – IBM - and from the viewpoint of my consulting company that represents universities and companies in technology transfer. From this experience we will identify some challenges facing newly “privatized” Japanese universities and propose some suggestions to Japanese Technology Licensing Offices [TLO] for what we believe are “best practices” in technology transfer.

Introduction

"Technology Transfer" is a simple term which covers a multitude of processes. In its most basic sense, however, it covers the transfer – intentional or otherwise, for a fee or for free – of patents, trade secrets or other know-how from the owner to another party. Both the sender and the recipient can be an individual, a company or one of its divisions, a government entity, a university, or another owner of technology. In this paper I will focus on transfers from United States universities to private companies. However, because it is less commonly discussed but nevertheless embodies many of the key features of the former, I will also briefly discuss the challenges of technology transfer *within* a large company.

In this context, "technology" is commonly understood to mean patents, although patent applications and know-how – in essence, any relevant information not in the public domain – can also be valuable and the object of transfers. (Ordinarily, patent rights are irrelevant in internal company transfers.) There is an enormous body of literature describing patents and patenting[2] and for the purposes of this paper I will assume the reader has at least a passing familiarity with this field. Most important for my present purpose, a patent is an *exclusionary monopoly.* That is, the only right an issued patent confers on the patentee is the right to prevent another party from practicing the invention, *primarily as defined in the patent claims,* in the *national jurisdiction (country) in which the patent is in force*. In other words, *if no one other than the patentee has an interest in practicing his invention, the patent's value is de minimus.*

[2] For a readable introduction, see *Essentials of Intellectual Property,* by Alexander I. Poltorok and Paul J. Lerner, John Wiley and Sons, New York (2002)

American universities have been transferring their technology to industry for nearly a century. The situation in Japan is quite different. Unlike US institutions, Japanese universities have not been major centers of basic research and their research budgets have been an order of magnitude or so less than in the US[3]. Since April, 2004, however, with the putting into effect of the so-called Privatization Law, Japanese schools have received a major stimulus to change. That is because under the new law any money received from technology transfer can now be spent at the discretion of university management rather than as budgeted by the former Education Ministry [Now part of MEXT, the Ministry of Education, Culture, Sports, Science and Technology]. In anticipation of this event, schools throughout the country have established TLO's, Technology Licensing Offices, whose mission is to manage the transfer process and earn fees. As of this writing, according to the Japan Association for University Intellectual Property Management, JAUIPTM, there are approximately 40 TLO's[4]. My objective here is to describe the salient features of US university technology transfer and from them to extract some messages which can be profitably employed by the newly "privatized" Japanese universities.

US University Environment

The basic source for information covering US university technology transfer is found in the annual surveys of AUTM, the Association of University Technology Managers[5]. In brief, a large majority of US institutions have a licensing office. Their main function is

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[3] Getting a clear figure for Japanese government research expense is not easy, since most university research is carried out in national universities, and they do not break out "research" expenses from other recurring expenses such as faculty salaries

[4] http://www.jauiptm.jp/en/member/member.html]

[5] See http://www.autm.net/memberConnect/survey_summary.cfm#2003Summary for the 2003 summary report

normally to negotiate research contracts with foundations, industrial companies and the government. Depending on the quality of the results of this research, however, the offices also negotiate licensing deals. According to AUTM, approximately 70% of all licensing income (from a total of approximately $1B in 2003) is received by the top ten schools, leaving perhaps $300M to be spread – thinly - around hundreds of research institutions.

Responding to concerns that the US was losing its technological leadership, Congress in 1980 passed the Bayh-Dole Law, which mandates that university and government researchers share in any licensing payments received by their institutions, typically about one-third[6]. Although intended to motivate researchers to engage in commercially important work, its results are, in my opinion[7] mixed. Its basic limitation is that it is a trailing incentive, and a slow one at that. There is no direct positive feedback to researchers anywhere in the process as envisioned by Bayh-Dole until there has been a successful, paid transfer. This is ordinarily years after the initial work, even for industrial researchers. The delay is much longer in universities, where the emphasis is on more basic work. Ultimately a few successful transfers, almost all in the medical or pharma fields[8], have greatly enriched a handful of inventors.

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[6] See Morrison and Foerster LLP, http://www.mofo.com/news/news/files/article827.html for much more than you need to know about the Act.
[7] and of others, as well. See, for example, David C. Mowery, at http://www.biopharm.org.tw/srb/07232002/Dr._Mowery.pdf],
[8] See Mowery, *op. cit*

Association of University Technology Managers (USA) 2003 Survey Data

Licensing FTEs in Technology Transfer Office	654.15
Other FTEs in Technology Transfer Office	664.93
Research Expenditures: Industrial Sources	$2,537,020,737
Research Expenditures: Federal Govt. Sources	$23,062,609,472
Total Sponsored Research Expenditures	**$34,826,920,266**
Licenses/Options Executed	3,846
Start-up Companies Formed	**348**
Gross License Income Received	**$1,029,158,110**
License Income Paid to Other Institutions	$65,489,154
Legal Fees Expended	$176,278,483
Legal Fees Reimbursed	$74,971,227
Licenses/Options Yielding License Income	8,976
Invention Disclosures Received	13,718
Total U.S. Patent Applications Filed	11,755
New U.S. Patent Applications Filed	7,203
U.S. Patents Issued	**3,450**

Japan, in parallel with the privatization law, has also enacted its own version of the Bayh-Dole Law. I leave it to motivational psychologists to show that this is a strong motivator to others. It is far too early to judge the impact of the Japanese law. Recent Japanese court rulings favorable to inventors in several cases where the inventors have sued their employers for a share in royalties[9] indicate a shift in the Japanese environment, but in general the payments for licenses and patent infringement in Japan are barely a tenth of those in the US, so it is difficult to see much of a stimulus to Japanese inventors from a fraction of a small royalty.

However, American university researchers have another path to wealth. Sometimes called spin-offs, this refers to companies started by entrepreneurial researchers based on their

[9] The case of Dr. Shuji Nakamura and his invention of the blue light emitting diode is most noteworthy, see for example *Inventor Compensation: An Early Spring for Japanese Industry*, John A. Tessensohn and Shusaku Yamamoto, World Intellectual Property Organization Report, Volume 19 Number 03, March 2005 at http://subscript.bna.com/SAMPLES/wipr.nsf/0/a1d549054c42eb5a85256fb800692099?OpenDocument

research. In 2003, according to AUTM, there were almost 350 of these established. Naturally, many of these fail but the payoff for success, in the form of a buyout or an IPO, (Initial Public offering) can be very large and is much more common than a “home run” patent license. In contrast, the Japanese environment for entrepreneurial start-ups is much less favorable.

US universities also receive many patents, over 3000 in 2003. A few major research schools like Stanford and MIT each received well over a hundred, while the California University System received over 300. In contrast, all Japanese universities together received fewer than 100 US patents in 2003, although their Japanese patents were much higher. Later I will explain why the US patents are much more important.

“Top 10” US Universities by Research Expenditure

	Total Sponsored Research Expenditures $Million	Invention Disclosures	New Patent Applications Filed	Licenses and Options Executed	Gross Income $M	**US Patents Issued**	Start-up Companies Formed
Cal System	**2623**	1027	490	208	61	**323**	22
Johns Hopkins	**1461**	330	380	159	6.6	**95**	5
MIT	**994**	452	235	114	24.2	**152**	15
Illinois	**785**	229	118	86	7.6	**39**	6
Washington	**784**	199	73	67	29.1	**46**	3
Michigan	**749**	257	97	76	7.4	**64**	9
Wisconsin	**721**	406	146	177	37.6	**87**	0
Penn.	**650**	321	152	83	10.2	**50**	12
Stanford	**640**	362	290	128	43.1	**117**	12
SUNY	**629**	235	132	34	13.7	**51**	4

Source: AUTM 2003 Survey

Japanese Universities' United States Patents (2004)

Japanese University	US Patents (2004)	US Patents (approx total)
Hokkaido	5	20
Toyama	3	~
Hiroshima	4	23
Nagoya	7	16
Tohoku	2	43
Kyoto	2	21
Tokyo	8	44
Nihon	3	~
Kyushu	2	18
Osaka	3	36
Tokai	4	~
Niigata	2	~
Kanazawa	2	14
Kobe	3	5
Total, all universities	61	

Source: www.uspto.gov

Perhaps the most striking number in the AUTM data is the money spent on sponsored research in US universities: almost $35 Billion. The $1 Billion in gross royalties (before legal and staff expense) is a "return on investment" of less than 3%. If this were the only objective of university research, it would be a poor business indeed. On the other hand, for a university researcher or administrator, the more attractive target is clearly the research support money. As I will discuss later, fortunately, universities for the most part have a more important goal than realizing licensing income. Comparable data for Japanese universities is not readily available but is certainly much smaller.

European Universities

European universities have much in common with Japanese institutions. Most are public, with faculty and researcher government employees and budgets substantially established by bureaucrats. With rare exceptions (such as the Swiss ETH, Swiss Federal Technical Institute, and a few well-known British universities), they are not known for their research results. For example, most French research is carried out in CNRS (National Center for Scientific Research), CEA (Atomic Energy Commission) and other government laboratories, rather than in universities. The Fraunhofer Institute in Germany is well known for its productive research but it is not a university. German universities are not noted for their contributions to research. Not surprisingly, the total amount of royalty payments to all European universities is perhaps of the order of $50M – not much more than that received in 2003 by Stanford alone[10].

Some European countries do allow researchers to own the intellectual property resulting from their work, e.g. Finland, unlike Germany and France where the university is the owner, but there are limited incentives such as Bayh-Dole available and, in any case, relatively few schools have organized technology transfer functions, and socialist traditions and labor laws have not made for a favorable entrepreneurial environment. Recognizing the challenge, the Europeans have started to change their legal environment in the late 1990's so that there is a greater incentive for university researchers to engage in work that contributes to society. It is still too early to say how well this is working

One last characteristic of the European environment relates to the various patent systems. The most significant distinction is the absolute bar against being granted a patent after there has been a divulgation of the invention. Inventors in the US have a one year grace

[10] ***Universities' IP Assets: Are They Transferable to the Private Sector?*** **Pierre-Laurent Joly, Masters Paper, submitted to NDS IP October 2004, Zurich, Switzerland, unpublished.**

period. European university faculty, whose recognition substantially depends on prompt publication of their research results, are thus discouraged from submitting invention disclosures in the first place, since normal review procedures will inevitably delay publication. Even the one year available in the US discourages inventors – even those in industry – from being completely diligent in disclosing all their inventive ideas to the administration. Another topic of active debate is the difficulty in obtaining a European patent on a software invention or a business method. There is little doubt that there have been many questionable US patents issued for software and business methods but it is also true that these are areas where US researchers have been very active because of their great commercial interest.

It is important to remember that in much of Europe and Asia where the majority of universities are state institutions there are sound arguments against their administrations charging a fee for access to their intellectual property, since it is ordinarily developed with public money. Similar arguments can be made in the US for NIH-funded research, as well as for research performed in public universities. This, however, is a matter for another study.

Importance of US Patents

There are a number of reasons why a US patent can be much more valuable than a patent in another country. Indeed, in many fields it is often sufficient to have only the US patent, and eschew foreign counterparts entirely. Most important, the US is of course the largest economy and thus the largest market for products and services in the world. Thus, the odds are that a product utilizing a patented invention will have much higher sales in the US than it would elsewhere – often more than everywhere. As a result, failure to secure the exclusionary monopoly in the US leaves the greater part of revenues and profits available to anyone.

Complementary to this, the US is the country with a legal environment most favorable to patent owners. The "patent court", the Court of Appeals for the Federal Circuit (CAFC), has made considerable progress in ensuring predictability and consistency when a patent matter is litigated. Partly as a result, the majority of litigated patents are now found to be valid. As of April 1, 2005, Japan has opened its own counterpart to the CAFC. At the other end of the process, in spite of many legitimate criticisms, the United States Patent and Trademark Office (USPTO) examination process is widely accepted to be thorough and dependable, although much improvement is needed in such areas as discovering prior art for software and business method patents. Moreover, US patent owners who believe that their patent is being infringed abroad have access to the International Trade Commission (ITC). This body has no jurisdiction outside the US but it does have the power to stop importation of infringing goods, and it can do so in much less time than would be needed to get an injunction in Federal Courts for infringement based on similar evidence. Here, too, Japan has established its own version of the US institution.

Finally, the US is "where the money is". Not only are judgments and settlements in the case of infringement assertions much higher than in the rest of the world (hundreds of millions of dollars are not extraordinary[11]), but even license payments between willing parties are much higher.

In order to obtain a US counterpart patent for an application filed in another country, the cost is reasonable. Since the application or patent has been prepared by competent counsel in the original country, all that is needed is an English translation and a review by a US attorney to be sure the application conforms to US requirements. The filing fee (and subsequent maintenance fees, if desired) are nominal by international standards. Failure to file for a US patent is almost always an indication of a lack of faith in the commercial viability of the invention. Many multinationals, in fact, make their initial filing in the US before they decide in what other countries protection is warranted. The only exception would be a patent for an invention that would almost never be manufactured, purchased, or used in the US.[12]

In summary, the US is the "major league" for intellectual property protection.

The University's Mission

Economists well understand that the missions of a private business are to survive and grow profitably. Public and not-for-profit institutions have different goals. One could argue that they are therefore not "businesses" at all. Universities, in particular, have a unique pair of complementary goals. Their primary goal is to provide their students with the best education they can. Those universities which carry out research (whether or not it

[11] Microsoft has appealed a $520M judgment for infringing patents owned by Eolas Technologies and the University of California, see http://www.siliconvalley.com/mld/siliconvalley/6511953.htm

[12] See R. A. Myers, *Foreign Filing: Beyond the US Patent (Part 1 and 2),* Patent Strategy and Management, March, 2003, page 5 and February, 2003, page 1

is scientific) have the further goal of contributing to society, of performing socially productive research. Neither of these goals has an explicit financial component. It is only to the extent that money earned from transferring technology helps support the primary goals that technology transfer has a financial element. The only exception I accept to this assertion is for those universities that are, in fact, for-profit businesses. However, since research is almost always a bad standalone business[13], such institutions are most unlikely to do any, much less to have any royalties to play with.

Thus, the goals of a university and the goals of business are almost always quite different. It can in fact be quite dangerous for either party to misjudge its purposes. For example, a company that invests major resources in contributing to society is seldom an investment favorite if it survives at all (*pace* Ben and Jerry who, after all, sell ice cream for profit). Such a company very quickly finds out it has erred. Universities, however, are often free to carry on a research-oriented business in parallel with their education and research missions. They may establish research programs with the distinct goal of commercializing the research. These are sometimes married to business incubators. They may well operate their TLO (or Technology Transfer Office) on a business-like basis. This is acceptable, until the university faculty neglects its students for the royalty mirage.

A university can be great if it never makes a dollar from transferring its technology. Indeed, some great universities intentionally disown an interest in the faculty-developed

[13] R. A. Myers, *Patents and Patent Licensing in Independent Research Laboratories.* Workshop at Licensing Executives Society Meeting, Salt Lake City, UT, February 15, 2003

intellectual property. Princeton offers a good example[14]. In contrast, regardless of how much revenue its technology transfer generates, a university will never be recognized as "great" for its research unless there are recognized contributions to the scientific literature and the improvement of life. And none of this counts unless the students receive a great education.

University-Generated Patents

Even a cursory review of university patent portfolios simply confirms the generalization that most patents, perhaps more than 95%, are worthless, neither used nor licensed. Among the small fraction of valuable university patents, nearly all those with significant royalty payments are biomedical or pharmaceutical related patents. Of the universities earning notable royalty payments, nearly all have medical schools, and it is the patents generated in those schools which are profitably licensed. Even MIT, which earns relatively high royalties without a medical school, has a major research program in biotech-related fields.

In this paper, I have not considered non-technical licensing activities, such as the university's brand or mascot. One of the single most profitable technology transfers has been Florida University's "Gatorade" brand, arguably a non-technical innovation.

University technology transfer professionals also recognize that even the most successful university licensing programs are at best marginally profitable after accounting for staff

[14] See http://www.princeton.edu/patents/intelprop.htm for the Princeton policy. Item 1 is "*To maintain the University's policy of encouraging research and scholarship without regard to potential gain from royalties or other such income*."

and legal expenses. In fact, schools like MIT tend to view their patenting and licensing programs as a perquisite for the faculty and their industrial research sponsors rather than as a profit-generating activity. Schools which have a single-minded focus on licensing revenue are fated to be disappointed. As a result of Bayh-Dole, faculty inventors routinely receive a significant share of royalties, but those who do are a very small minority.

This new world of patents and licensing has led to a serious change in the attitude of university administration. Traditionally, university faculty have routinely owned the intellectual property they created. Most of this, of course, was limited to textbooks, lectures, and course material. Every so often, however, they were owners of important patents. In particular, the early patents in the field of quantum electronics, such as those of Charles Townes of Columbia, Nicolaas Bloembergen of Harvard, and Gordon Gould, also of Columbia, as I will explain below, were assumed to be the property of the inventors, all of whom realized financial rewards. Gould in particular, then a graduate student, earned many millions of dollars from his patents.

Since the 1980’s, however, university administrators thought they could see a big payoff available from exploiting faculty patents. As a result, their TLO’s were expanded and strengthened, and their licensing practices, formerly rather casual, were infused with the experience of new legal teams, and it became increasingly difficult for companies to establish good licensing relations with the most aggressive universities. Even contracts for sponsored research were loaded with clauses relating to the ownership and disposition of any intellectual property developed during the project.

The major exception here, too, relates to the medical schools and their research. Many biotech and drug companies have found it advantageous to simply outsource some of their research to universities. Their conditions are often strict, in that the sponsor simply owns the IP, and faculty publication is more or less at the discretion of the sponsor. Many schools find this state of affairs quite acceptable, since the sponsor supports numerous graduate students while the overhead charges on the grants are increasingly necessary to maintain the research infrastructure.

Early Examples of University Technology Transfer and Its Hazards

Since 1994 IBM has been by a wide margin the premier recipient of US patents. For decades prior to this the company has been widely acknowledged as a major innovator in business and technology. The history is very well documented[15] but a few points bear repeating here. Thomas J. Watson, Sr. was the man who virtually single-handedly led an amalgam of struggling tabulating businesses, the "Computing-Tabulating-Recording Company" from the 1920's through the 1950's to its success as IBM. A strong-willed man, he was a very strong believer in the importance of patents as a tool for competitive advantage. The company boasted several of America's most prolific inventors, and all were given broad responsibilities and treated well by Watson.

[15] See, for example, Emerson W. Pugh, *Building IBM: Shaping a Technology and an Industry*, MIT Press, Cambridge, (1995),

In addition, Watson was also a believer in universities as a font of knowledge and talent. As long ago as 1937 the company founded the Watson Astronomical Laboratory at Columbia University in New York. In 1938 IBM began to fund Harvard Professor Howard Aiken with whom IBM developed the IBM ASCC, also known as the Mark I. One of the landmarks in commercial data processing, the machine was built in the Endicott, NY IBM plant and completed in 1943. Aiken's key contribution was in the use of paper tape as a program store. All of the many patents filed on the machine were IBM property – an early indication of one extreme of university-industry contractual terms (if, indeed, there was ever any thought given to the matter then). According to one respected historian of science, "Watson's support of academic research helped [IBM] establish itself in the field."[16] Thus, even sixty years ago Harvard was entitled to claim a major success in technology transfer.

Unfortunately, Harvard, at least in Watson's opinion, improperly claimed full credit for the Mark I at the 1944 unveiling. Watson was furious, as were the IBM engineering team members. As a result, Watson virtually forbade IBM from any collaboration with Harvard for many years (although the prohibition did not extend to hiring its graduates). Disappointed with its Harvard collaboration, IBM decided to start its own basic computer laboratory in 1947, the Watson Laboratory – at Columbia University, not Harvard. This incident illustrates another key lesson for university technology transfer managers. Industrial partners, as a rule, have many options. They can choose their partners based on qualification or prejudice; or they can choose to go it alone. The university's bargaining power in transfer negotiations is almost always weaker.

[16] Pugh, *op. cit.*

The history of early maser and laser patents, also dating from the 1950's, provides more examples of successful technology transfer, although it was rarely so represented at the time. Charles Townes, then a Columbia professor, is universally [with the exception of a few Soviet apologists] recognized as the inventor of the maser, which was covered in a patent issued in 1959 after extensive revisions and a resubmission, US patent #2,879,439[17]. Columbia at the time had no mechanism for extracting a share in this patent; all indications are that it could not have cared less. Townes, on the other hand, had worked at Bell Laboratories and was quite familiar with patents and their advantages[18]. The 1959 patent was his personal patent, from which he earned a respectable (for the time) stream of royalties.

Columbia's maser research kicked off decades of active research in quantum electronics. The next major innovation was made by Harvard professor Nicolaas Bloembergen. In that period, as documented in an earlier paper[19], technology transfer was a wide, two-way street, and Bell Labs researchers and university faculty often met and exchanged ideas, with no contracts or agreements. In Bloembergen's case, he came up with the concept of the continuous-wave three level maser, which he, too, patented (with encouragement from others more familiar with the patent system). This invention was the basis for all successive practical masers and lasers. Like Columbia, Harvard had neither a mechanism for nor an interest in patents, and the patent was Bloembergen's personal property, US patent #2,909,654. Interestingly, the patent application was actually drafted by a Bell

[17] For an extended discussion of this topic, see *Who Invented the Laser - An Analysis of the Early Patents.* R. A. Myers and Richard W. Dixon, Historical Studies in the Physical Sciences, vol. 34, part 1, p.115, 2003.
[18] C. H. Townes, *How the Laser Happened,* Oxford University. Press, New York, (1999)
[19] Myers and Dixon, *op. cit*.

Labs attorney, in return for which AT&T received a royalty-free license. Bloembergen himself eventually received enough royalties to pay for his children's college education.

One cannot fail to be impressed by the fact that neither Harvard nor Columbia seems to have suffered in the slightest from their failure to exploit the creativity of their faculty. In this case, of course, both inventors went on to be awarded the Nobel Prize in Physics.

US University Faculty and Research Staff

University researchers are only superficially "employees", particularly when it comes to their professional roles. In the case of faculty, this has been primarily a direct result of the western tradition of "tenure", wherein a professor, after a period of apprenticeship, is awarded what is virtually a lifetime appointment. This has naturally promoted a highly independent attitude. This independence is further strengthened in the research sphere as researchers argue that "management" is not competent to judge their output. Rather, it is the mechanism of peer review that is said to determine success or failure.

For whatever reasons, most university administrations have until recently followed a hands-off strategy with respect to intellectual property. Whether it is lecture notes, textbooks, or lecture honoraria, any payments have accrued to the professor or, almost as often, the research staffer.[20]. Needless to say, that has been satisfactory for the faculty and, considering the relatively small amount of money and traditionally low faculty salaries

[20]This is not the place to discuss the many failures of what is for the most part the successful path that universities have followed

(at least in comparison with industrial researchers), for the university administration as well.

It is necessary, however, to emphasize the fact that in US universities tenure is normally granted for excellent research (rarely for teaching). This research is what appears in peer-reviewed journals, and is the substance of the “publish or perish” promotion scheme. [Occasionally tenure will be granted because a junior faculty member has been particularly successful in obtaining research grants, but this success, too, normally starts with a high quality publication record] Thus, tenured faculty have a track record of doing what is recognized to be high quality research. Moreover, in spite of the independence conferred by tenure, there are other material and intangible rewards that continue to depend on a productive research career – salary, laboratory and office space, technical staff assistance, even prestigious endowed chairs. One thing that is hardly ever a factor in a US (much less European) university career is a history of inventing and patenting.

Thus faculty members with commercializeable patents have tended to follow the path of Townes and Bloembergen, procuring patents (often with the aid of university staff) and licensing them for a royalty. Alternatively, the more entrepreneurial faculty may choose to obtain venture capital backing and start their own company, although this path is far more likely to be followed by graduate students such as the founders of Google than it is by tenured faculty. It is only in the last twenty years that the glow of licensing income has tended to dazzle the eyes of university administrators.

Now, the default option has become that “all intellectual property is the property of the university”, with rights to be granted to the inventor or creator limited by the Bayh-Dole Act and by contractual terms of employment as in the traditional model for industrial research staff. Rigorous application of this principle can create endless trouble, not least in the accounting department. A professorial lecture, for an honorarium with travel expenses, requires records and paper shuffling, tax consequences and other headaches. Few faculty are happy with this, in spite of defensible administration arguments that they provide offices, laboratories, equipment, and administrative support at no charge (with the frequent exception of an unconscionable overhead charge on external contracts!).

Unfortunately, again with the pharma and bio exceptions, the amount of money to be retained by the university for intellectual property transfers almost never pays for the administrative overhead involved.

The University Challenge

The challenge for US university technology transfer management is to reconcile the university’s missions of teaching and contributing to society with the requirements of effective technology transfer. Professors expect to publish and get tenure, grants and fame. Students expect to publish and get their degrees, followed by good industrial jobs. The university, on the other hand, dreams of getting a financial return on its research – even though most of the research is funded by the US government or industry, and the returns on the IP have historically been minimal. At a minimum, this requires delay or suppression of publication, possibly combined with a selection of projects which are likely to lead to licensable IP.

The conflict is a major one. Indeed, even many industrial researchers are frustrated and troubled by the restrictions placed on their "academic freedom" by the iron laws of securing patent protection.

The Transfer Agreement – A Necessity to Success

As the Harvard – IBM episode graphically demonstrates, an industrial technology transfer partner has many options, and holds most of the bargaining power. An inflexible university negotiating position is risky. In spite of this, many universities – primarily the most prestigious – have been inclined to adopt a "take it or leave it" stance. This typically starts with insisting on being the owner of any patents resulting from the cooperation or grant. Of course, "ownership" is more a matter of prestige (and, occasionally, statute) than of substance, since an exclusive license generally satisfies most companies. However, for the same reason, it would seem advisable for a university to concede this point if pressed. Much of the rigidity on the part of university negotiators is very likely a result of their lack of familiarity with the industrial environment, a lack which needs to be addressed.

On the other hand, it is often the inventors themselves that are out of touch. Since, thanks to the Bayh-Dole law, they have a monetary interest in any transfer, universities often give them a veto over any deals. We have found that – like most inventors – they often have an inflated idea of the value of their inventions. Hence, they sometimes prevent consummation of a favorable deal by their ambitions. In contrast, their interest in a quick deal can lead university transfer personnel to close a deal prematurely, limiting the payoff – to the benefit of the transferee.

More often, however, the interests of the faculty and of the university are on the surface completely opposed. Faculty members are intent on publishing. They will often avoid disclosing any inventions or, perhaps, minimize their importance when disclosing them. Even after disclosing an invention, they will lobby to prevent filing for a patent or, if that cannot be avoided, will press the attorney to quickly complete the case so they can publish. It is important to note that these attitudes are not unique to university researchers. Many industrial researchers have very similar attitudes, the only differences being that they often have little or no financial interest in any transfer while having much less independence as to how they accomplish their research work. The first “laser” patent was drafted and rushed to the Patent Office by the Bell Labs patent department over the Thanksgiving holiday so that Townes and Arthur Schawlow could submit their paper to the Physical Review[21].

Operationally, these circumstances require that university technology transfer professionals be familiar with the needs and abilities of industry; with the actual market prices for technology transfers; and with the skills needed to persuade researchers to accept the best deal they can negotiate.

[21] Myers and Dixon, *op. cit.*

US Government Research Institutions

The US government spends tens of billions of dollars on research and development, of which the $30+B funneled to university research is only a part. Internal institutions, such as the NIH, Defense, and Energy department laboratories receive the lion's share. The requested total for the 2006 R&D budget is an astonishing $132.3B[22]. By statute, even the DoD laboratories are charged with carrying out a certain amount of so-called "dual-use" research, which is to say research which, in addition to supporting the mission of the laboratory, can also be said to have benefits to society as a whole.[23] Consistent with this, the strictures of the Bayh-Dole law apply as well to these government researchers.

The task of identifying a project with dual-use aspects is not easy and, in practice, technology transfer from dedicated government labs to society, much less to industry for a payment, has not been a raging success, considering the huge investment. This is hardly surprising, if disappointing. It is a rare researcher who can – as it were – serve two masters, and it was a definite stretch for the Congress to so mandate.

IBM Anecdotes

Technology transfer within an enterprise is naturally not the same as transfer from a university to an enterprise. On the other hand, where the company has an internal "research" organization or function, many of the problems are quite similar. A brief look at these problems is, in fact, quite instructive and offers some important messages for

[22] See http://www.whitehouse.gov/omb/budget/fy2006/pdf/spec.pdfreference page 64
[23] See William J. Barattino, *Making Dual-Use Work: Revising Government/Industry Relationships*, National Defense University Research Report, Executive Research Project S3, 1994, for a detailed discussion at http://www.ndu.edu/library/ic6/94-S-03.pdf

university technology transfer professionals. IBM in particular, with its $6B Research and Development budget (and 3000-person worldwide Research Division), is probably the best example. Sadly, Bell Telephone Laboratories, at one time the premier corporate research establishment in the world, has suffered greatly as its parent, AT&T, endured various divestitures and then (now in the form of Lucent) saw its business on a steep downward path.

We have already seen how Thomas Watson Sr. had a high regard for research, university capabilities, and the importance of intellectual property. This eventually led to the establishment of a formal research organization, with an explicit mission of transferring its technology (as well as its people) to the product divisions of the company. This mission was more clearly articulated in the 1970's by then-director Ralph Gomory, as to be "Vital to IBM" while contributing to the scientific community at large. In accomplishing these missions, the Division instituted a formal measurements program, where achieving a high score was directly reflected in the Division's annual incentive pay.[24]

A primary measurement was "Accomplishments", in which both internal transfers and outside recognition were explicitly counted. Other aspects related to patent applications, refereed technical publications, external honors such as fellowships and awards, and a formal customer satisfaction survey of the targeted internal recipients of Research Division results. One of the most important needs in order to achieve the Division goals

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[24] R. A. Myers, *Customer Satisfaction and Quality in the IBM Research Division.* Proceedings of the 1994 R&D Quality Symposium, the Juran Institute, Chicago, IL. June 7, 1994

was for its management and researchers to understand what was important to their customers. This is not as obvious as one might suppose, since many researchers (not to mention university professors!) often believe that they are the sole judges of what is important. Moreover, "knowing" is a continuing process, not an event. As IBM's businesses evolved, and as its customers' requirements developed, the Division's program had to adapt, albeit in less than real time. Consistent with that imperative, in 2005 the Research Division has initiated programs in what it calls "services science" to address the needs of its now dominant services business[25]. Similarly, to achieve recognition from the scientific community at large, it is important to have a deep knowledge of what is deemed to be important. Of course, for both internal and external knowledge, a high quality team of researchers is also expected to help define what is, or will be found to be, important. This kind of leadership is, ultimately, the most important test of success.

Perhaps the biggest obstacle to internal transfers that IBM Research has experienced is the unavoidable fact that its customers are also its competitors. Although they do not carry out "basic" research, they have extensive staffs working to advance the technology underlying their products under development. Moreover, their researchers, too, are very good. The Microelectronics organization has more Ph.D.'s in its fields of expertise than does the Research Division, and many of them have been recognized for their contributions by academics and other industrial researchers around the world. At a Corporate level, too, there is competition for resources, money in particular, from the

[25] See Paul Horn, *Building a Science of Services*, Business Week, June 2, 2005 at http://www.businessweek.com/technology/content/jun2005/tc2005062_0596.htm

parent company. A high degree of tact is essential, combined with the knowledge discussed above.

While it is often possible to identify programs and projects which are important to the developers, the mechanics of a complex enterprise pose serious challenges. In addition to the “competitive” situation, in IBM as in most well-run corporations, budgets are usually fixed for at least the current year, and are often planned for years into the future. If a new project is to be injected into a product organization, the unit either has to find new money from the parent (rarely easy) or else to reallocate its internal people and money, at least cutting and possibly terminating on-going projects. Years of experience has taught that a well-timed “sales campaign” is needed in order to achieve a successful transfer. The prospective transfer recipient needs to be worked with throughout the year to establish and build his receptivity, but the magic time to make the “sale” is when budgets are being prepared. Once the budget is fixed, the transfer is in a “wait until next year” status.

There are several approaches to smoothing a transfer, most of which also apply to university transfers. Perhaps the most successful was the creation of “joint projects”, partnerships between Research Division and product division teams – and budgets[26]. Since these programs are jointly planned and executed, the “transfer” is somewhat automatic, although a successful transfer naturally depends on the completion of the project’s goals. One difficulty with such projects is that, since their goals and plans are

[26] See Ralph E. Gomory, *Moving IBM’s Technology from Research to Development*, Research - Technology Management, November-December, 1989, pp. 27-32, *Turning Ideas Into Products*, The Bridge, official journal of the National Academy of Engineering, Spring, 1988, and *From the “Ladder of Science” to the Product Development Cycle*, Harvard Business Review, November-December 1989, page 99.

primarily established at the start, they are less likely to be dedicated to highly innovative (i.e., risky) initiatives, and they would seem to work best where the project is complex, with multiple sub-projects that must proceed in parallel.

Another important tactic adopted by the Research Division was to designate an experienced manager in most departments whose job was "customer relations and satisfaction". His or her key assignment is to "know" the customer division's plans, needs, and challenges, and to work with the Research team to see that their work addresses these. On an individual level, his or her personal advancement and pay depend to a major degree on how well the unit achieves its transfer targets.

Also, in a combination of US and Japanese cultures, the Division – as mentioned above – has a formal measurements system to track its effectiveness. This measurement system is combined with an ambitious set of incentives, starting with relatively high financial "awards", salary increases, and promotions which to a significant extent depend on successful technology transfers or on achieving high external technical and scientific recognition. Possibly most important, management is seen as accountable for success.

IBM as a Technology Transfer "Customer"

IBM routinely leads the world in the number of US patents granted annually. IBM income from licensing its intellectual property portfolio, at one time over $1.6B, is still more than a billion dollars a year. All of this is managed by a centralized corporate organization, and all patents are "owned" by the Corporation, rather than by any units, although the units receive essentially all of the income earned by patents that they generated. With this great store of its own intellectual property, IBM needs very little – and thinks it needs even less. Therefore, any outsider hoping to make a sale of his intellectual property to IBM must complete an extremely challenging obstacle course. Few do. In practice, almost the only patents that IBM elects to license-in are patents which the company is very likely to infringe with planned products. Or is already infringing.

On the other hand, IBM and its business units routinely support universities and university research. There are many reasons for this. Perhaps foremost is their contribution to public relations, wherein IBM will make grants for various purposes to institutions of higher education in the vicinity of its major plants and laboratories. Almost as important, and in tandem with this, are IBM's recruiting objectives. In particular, supporting graduate students' research (either directly or by means of fellowships) is a very efficient and cost-effective recruiting mechanism. Less often, the company will propose a partnership with a university in which a faculty member is an authority in a field of interest or importance to the company. Sometimes, too, the university may have a laboratory facility that IBM researchers would like to use, but which is too expensive to duplicate.

Where university research is supported, IBM – recognizing the publishing imperative of faculty – rarely insists on confidentiality or exclusive patent rights. The company has generally been relatively easy to do this kind of business with, so long as the university adopts a reasonable path. Of course, what is “reasonable” to IBM may not always be reasonable to the institution. As one example, IBM would not ordinarily fund research if, after completion, it would then have to pay a royalty for the right to use the results. In the language of the street, they will take their business elsewhere. As already noted, valuing a patent is a highly subjective process but experience has shown that one rarely errs in assuming that patent rights are not worth very much.

Fairfield Resources International (FRI) Experience

FRI is an intellectual property licensing and consulting group whose principals have almost 100 years of relevant experience as executives with major corporations, senior officers of the Licensing Executives Society, and as consultants to some of the largest corporations in the world, including Boeing, Siemens, Ricoh and many others. One recurring task assigned to us occurs when a major industrial corporation is building a defensive patent portfolio. Possible reasons for this include entering a new business or a change in the product mix when the company may face new competitors with existing patent positions. We take on the task of locating and procuring patents in the target field, taking advantage of our anonymity to minimize the risk that a seller will ask an unreasonable price.

We ordinarily search – almost exclusively -- for US patents, assigned to universities and to industrial companies as well as to individuals. The universities are a very promising place to look, as they often have many patents which are not exploited. Of course, many are “sleeping” because no one would be interested in licensing or purchasing them.

However, others are not used because, in our experience, patent licensing and sale is a pro-active endeavor which is quite challenging for a university's licensing staff. IBM is typical in not being very interested in obtaining rights to other's patents (unless forced to do so); a patent owner must ordinarily mount a campaign, which can take several years, to interest a prospect in taking out rights to a patent. In contrast, university transfer or licensing offices have many other things to do – mainly, negotiating research contracts. They don't ordinarily have the time and interest to invest a lot of time in a few patents.

Their job is, in some ways, complicated by the Bayh-Dole law. Inventors who anticipate a big payday are impatient and, as pointed out in several places above, rarely appreciate the value of their patent to a third party. We have recently reached a tentative agreement with a major US university for the purchase of a few patents which would add to a client's defensive portfolio. The institution gives the inventor a role in the negotiation, however, and he has implied that the price (agreed to by the licensing office) is not high enough. In another instance, we represented a university on licensing a forward-looking Internet patent which, however, was (and still is) of minimal use to anyone. After two years of marketing, we had only made small progress. Prodded by the impatient (if brilliant) inventor, the university reclaimed the licensing program, unfortunately with no more success than we had.

Nevertheless, we believe that universities can recoup at least a modest portion of their patenting investment by being open to reasonable offers for sale of or an exclusive license to their otherwise sleeping patents. Here, as in most of the preceding discussion, pharmaceutical and biomedical patents are a major exception. A major reason for this is that companies in this industry have found it profitable to literally outsource their research, so the resulting intellectual property is relatively valuable, sometimes immensely valuable. Since the companies pay for the research, they will not enter into a relationship unless they obtain exclusive rights in advance. Normally, however, a portion of resulting royalties – if any – would be returned to the university.

It cannot be repeated too often that the major reason for obtaining a patent is in anticipation that another party will want to use it, and be willing to pay for that right. University research, by its very nature, is far from the marketplace. Considerable time and money are almost always needed in order to commercialize a university patent. Persuading a company to sign up for a license is difficult at best. If the university further insists on an up-front payment, it becomes difficult indeed other than for a sale, as outlined above.

Choosing Transferable Research

Clearly, outstanding researchers don't need any help in this matter. Their choices in a real way are ordinarily, by definition, transferable. Unfortunately, such leaders are rare. Others can benefit from adopting some "best practices" from industrial transfer experience. The biggest challenge, we believe, is simply the normal inflexibility of plans and budgets in a complex organization. A direct approach to this is to be an active participant in setting the plans and budgets. That includes setting long term goals and strategies, as well as working with customer personnel in the annual planning cycle.

However, success in these processes demands that the researchers have credibility. They need to have good interpersonal relations with the customer, and they absolutely must understand, perhaps even better than the customer, his business and needs.

There is no substitute for participating in the planning process. However, there is a complementary approach that can increase the size of the research payoff. Researchers, often frustrated by the difficulty in making headway against an entrenched product and technology base, choose instead to pursue “alternative technology solutions”. Graduate students, facing well-funded industrial competition in a hot field, are very familiar with this technique, and often are driven to it in order to prevent being “scooped”. Recently, the work of Clayton Christensen at Harvard has even given a name to these alternatives when successful, “disruptive technologies”[27]. One good example is the xerographic printer, which had to contend with the extraordinarily profitable impact printers in the 1970’s.

There have been many others. Some have not made it to the market, such as magnetic bubbles and Josephson junction logic. Others, like the plasma and liquid crystal (LCD) display, have been so successful that they have virtually eliminated the former CRT technology of choice from the marketplace. What I recommend here, however, is not simply choosing to work on “something different”. The chances for success are small enough. It is necessary to understand the weaknesses of the entrenched technology, and the strengths of the proposed alternative, in order to make a good choice. One example is

[27] Clayton M. Christensen, *The Innovator’s Dilemma*, HarperCollins Publishers; 1st HarperBusiness ed edition (May, 2000)

optical storage, now ubiquitous in the Compact Disk (CD) and Digital Versatile Disk (DVD). When first proposed more than thirty years ago, the technology was thought to be a potential replacement for the conventional magnetic hard disk drive. When it finally broke into prominence, however, it was as a write-once medium, most useful because of its high areal storage density. Speed and erasability, still difficult challenges, were not key to this application.

A third approach, perhaps the ideal one insofar as it is a combination of the first two, is to initiate projects which, if successful, will intersect the needs of the marketplace at a reasonably predictable future date without posing a threat to the current products and technologies. Here, too, as in any of these tactics, both knowledge and credibility are vital. Even so, as experienced industrial researchers will agree, success is not guaranteed, and a success rate of ten per cent in research started to research transferred is not too bad.

Recommended Best Practices

We can summarize the key messages from the foregoing as follows.

- Organize to succeed – assign responsibilities for transfer, and be sure the responsible people are measured and held accountable for success.
- In order to do this, effective measurements of success are needed. They can include
    - Royalty income – unfortunately a trailing measurement
    - “Customer satisfaction” surveys, in the university case as a means of ensuring that research partnerships are on track.

  - Publications and awards
  - Citation indexes
  - Patent applications and issued patents
- Promote excitement about commercialization in faculty and students, by techniques such as adjunct faculty from industry, internships, sabbaticals, and frequent seminars from the industrial world.
- Provide financial and other incentives such as research facilities for researchers with successful transfer experiences
- Develop experienced TLO staff, probably starting with staff who already have industrial transfer experience.
- Develop relationships with potential industrial licensees and partners in order to assure that the researchers have suitable credibility. This can be greatly assisted if there is a "customer relation manager" who is responsible and accountable.
  - Understand their needs and situation
  - Select transferable research topics
  - Participate in planning as a regular habit
- Don't be greedy. Demanding too high a price is the surest way to preclude a successful transfer.
- Be patient. Successful transfers take time, often a lot of it. They often also require that the recipient of the technology invest its own people and money. Impatience is another deal killer.
- Persevere. Technology transfer is not easy.

Messages for Japanese TLO Management

Some of the best practices outlined above require little if any change by Japanese TLO's. In particular, the customer focus and quantitative measurements are both embedded in the psyche of Japanese management. However, it is easy to lose sight of the importance of these cultural traditions in the rush to get on the "IP Royalty Bandwagon". That would be unfortunate, since there is nothing automatic about earning a return on one's intellectual property, and these practices can provide Japanese university TLO's with an important competitive advantage in this effort.

On the other hand, there is a lot that could be done to improve incentives. Although there is a "Japanese Bayh-Dole" equivalent, it is a trailing indicator and even then only motivates a small number of the most successful inventors. What is needed is a way to fill the pipeline of patents flowing through the universities. Regular payments for various patenting milestones (such as disclosures, applications, and issued patents), even if small, can provide effective and timely feedback to the university research community. Other forms of recognition, such as recognition in institution publications, personal acknowledgment letters from the university president, and even such basic elements as bulletin board notices and inventor portraits in a central location have been found to be effective in US companies. It is essential that a culture of inventing and patenting be clearly and visibly endorsed by the administration.

Nevertheless, it would be a serious error if the institution of such incentives were allowed to detract from the university's fundamental educational and research missions.

One long term and substantial challenge is to reconcile the lifetime employment and seniority systems as practiced in most universities with the need to generate good, commercializeable technology. Many large global Japanese enterprises are already moving toward a system of pay for performance, and promotions based on ability and actual contributions to the company. Universities have been slow to follow. “Publish or perish” is a tough regime, but it is far superior – at least with regard to technology transfer – to “promotion and salary increases with or without publication”. The current system often encourages highly motivated Japanese researchers to leave academia for Japanese industry or, to the nation’s greater loss, to leave the country for companies and universities abroad with a more favorable environment for researchers.

Japan’s undisputed excellence in establishing processes to ensure the quality of their goods and services is readily applicable to providing for continuous improvement of university technology transfer. In this regard, there is nothing special about technology transfer. However, simply establishing and staffing a TLO can easily be seen as mere *tatemae*. As I suggest in the previous section, the mission and staff of the TLO need to be professional and competent, and recognized as such by the university and industrial research community, in order for them to achieve their objectives.

Today, if measured by the number and quality of US patents, Japanese universities really do not have a substantial inventory of potentially transferable intellectual property. That almost certainly means that there will not be very much royalty income for some time to come. That is unavoidable, and should not be viewed as a major problem. Royalties, in Japan as in the rest of the world, are not what make a great university. A great university need not ever make any money from technology transfer. Its most important missions are educating students and contributing to human knowledge.