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Office of the President

TO MEMBERS OF THE COMMITTEE ON FINANCE:

<u>DISCUSSION ITEM</u>

For Meeting of January 19, 2012

UNIVERSITY OF CALIFORNIA TECHNOLOGY LICENSING PROGRAM

EXECUTIVE SUMMARY

A panel of UC faculty and administration members will present to the Regents and share their views on University technology transfer. Statements from panel and UC faculty members are included in Attachment 1.

The University of California's technology transfer program has a 90-year history of patenting and licensing inventions from its researchers to stimulate economic impact directly and return revenue to the University. The bulk of the revenue is earned on a small number of blockbuster inventions. Unfortunately, it is almost impossible to predict which inventions have blockbuster potential at the time they are disclosed to the University. Nevertheless, the University is using a variety of new approaches to enhance entrepreneurship on its campuses and make more of its inventions into useful products, including support of the Gray Davis Institutes, funding a Proof of Concept program to support early-stage inventions to help them attract venture capital, creating "garage" space and providing common support to incubate start-up companies, and working with the business community to bring product experience to the decision-making process around invention support.

UC Licensing Success since 1980 (Bayh-Dole Act Passage)
- 5,000 license agreements
- $2.1 billion in total licensing revenue
- Over 500 companies created to commercialize UC technologies
- 85 percent of companies formed were in California contributing to the state economy

Guiding Tenets of Technology Transfer
- Revenue from licensing is dominated by small fraction of disclosures – less than 0.2 percent make up 80 percent of UC's revenues
- One cannot predict which inventions will result in significant revenue
- It generally takes ten or more years for successful inventions to begin generating revenue

UC's Proactive Approaches to Translation
- Gray Davis Institutes for Science and Innovation

- Proof of Concept funding for early-stage inventions
- Incubation and "Garage Space" for start-up companies with UC technology
- Increased promotion of industry collaborations for research such as the Discovery Program

BACKGROUND

The University of California has one of the oldest technology licensing programs in the country, with the first patent assigned to the Regents of the University of California in the late 1920s, and the first patent policy being adopted in 1943. UC has been at the forefront of universities in its approach to licensing with a long and distinguished record of adopting best practices in technology transfer.

Universities transfer new technological innovations to society through a variety of means, including publication, sharing of research materials, collaborations with industry, and training of students, the majority of whom take their training to industry. With the passage of the Bayh-Dole Act in 1980, the federal government recognized that giving universities ownership of the inventions resulting from federally-sponsored research could accelerate the transfer of useful knowledge to stimulate the economy. The Act greatly expanded the role of universities in producing direct economic benefit from their research programs. In return for allowing federal grantees to retain title to and patent inventions developed under federally-funded research programs, they are required to establish programs to protect and license those inventions for public benefit. Under the Act, universities are allowed to retain any resulting revenue, with the caveat that net income (after expenses and the required payments to inventors) must be used to support research and education.

Licensing University inventions encourages the application of University research results for broad public benefit, addresses the needs of sponsors of University research, generates royalty income for the further support of research and education and builds partnerships with industry to enhance the research and educational experience of researchers and students.

OUTCOMES OF THE UNIVERSITY TECHNOLOGY LICENSING PROGRAMS

Since the Bayh-Dole Act was passed in 1980, UC has entered into over 5,000 license agreements, which have brought in $2.1 billion in total licensing revenue. Over 550 companies have been created to commercialize University technologies, of which approximately 85 percent were formed in California. Many continue to contribute to the California economy.

UC's 90-year experience with patents and licenses is similar to that of all other universities and is useful to put our discussion of revenue generation into perspective. Appendix A provides a comprehensive description of this experience that creates three guiding tenets for the discussion of technology transfer:

1. The revenue from licensing programs is dominated by a very small fraction of invention disclosures. In UC's case, less than 0.2 percent of all inventions make up more than 80 percent of the total revenue.

2. No one knows how to predict which of its inventions will result in very significant revenue.
3. It generally takes ten or more years from the time of disclosure to realize significant income from an invention; many of UC's most successful inventions began generating revenue 15 to 20 years after the inventors first disclosed their idea to the University.

The rarity and unpredictability of very successful inventions combined with the very long timescale pose challenges to consistently returning significant income on licenses.[1] Nevertheless, UC, as with most of its peer institutions, has instituted a variety of programs to stimulate new inventions, to encourage invention disclosures based on university research, and to patent and aggressively market its inventions to companies who will turn them into products. The next section discusses some of the many approaches UC is taking to promote technology transfer and potentially enhance the number of revenue-generating products based on inventions stemming from its research.

ENHANCING TECHNOLOGY TRANSFER AND ENTREPRENEURSHIP AT UC

The Gray Davis Institutes

In the year 2000, UC undertook to better stimulate the economy and encourage entrepreneurship among its faculty when it founded the Gray Davis Institutes for Science and Technology. The initial investment of $400 million from the State combined with the more than $800 million of additional investment raised by UC established four multi-campus Institutes to use UC research to better the lives of Californians. Since then, UC supported the institutes by investing approximately $30 million annually in operating funds, building up strong programs on nine of the ten campuses.

Each Institute has taken a different approach to fulfilling its mission, including emphasis on ties to industry, creation of incubators for new companies, rapid investigation of new product opportunities that address emerging California needs, encouraging (and training) UC researchers to start companies based on the fruits of their research, and bringing in more federal research support for emerging technologies that have commercial potential. The sections below will include examples of how the Institutes have promoted many of these ideas.

Advancing New Technologies: Proof of Concept Funding

University inventions are usually early-stage technologies; unlike industry research, university research often emphasizes novelty and fundamental breakthroughs over incremental advances. Early-stage technologies are often expensive to commercialize and riskier as investments than most industrial product improvements. There is presently limited financial support for these early-stage high-risk investments owing to the poor economic climate, making it more difficult for universities to find investors for many of their inventions.

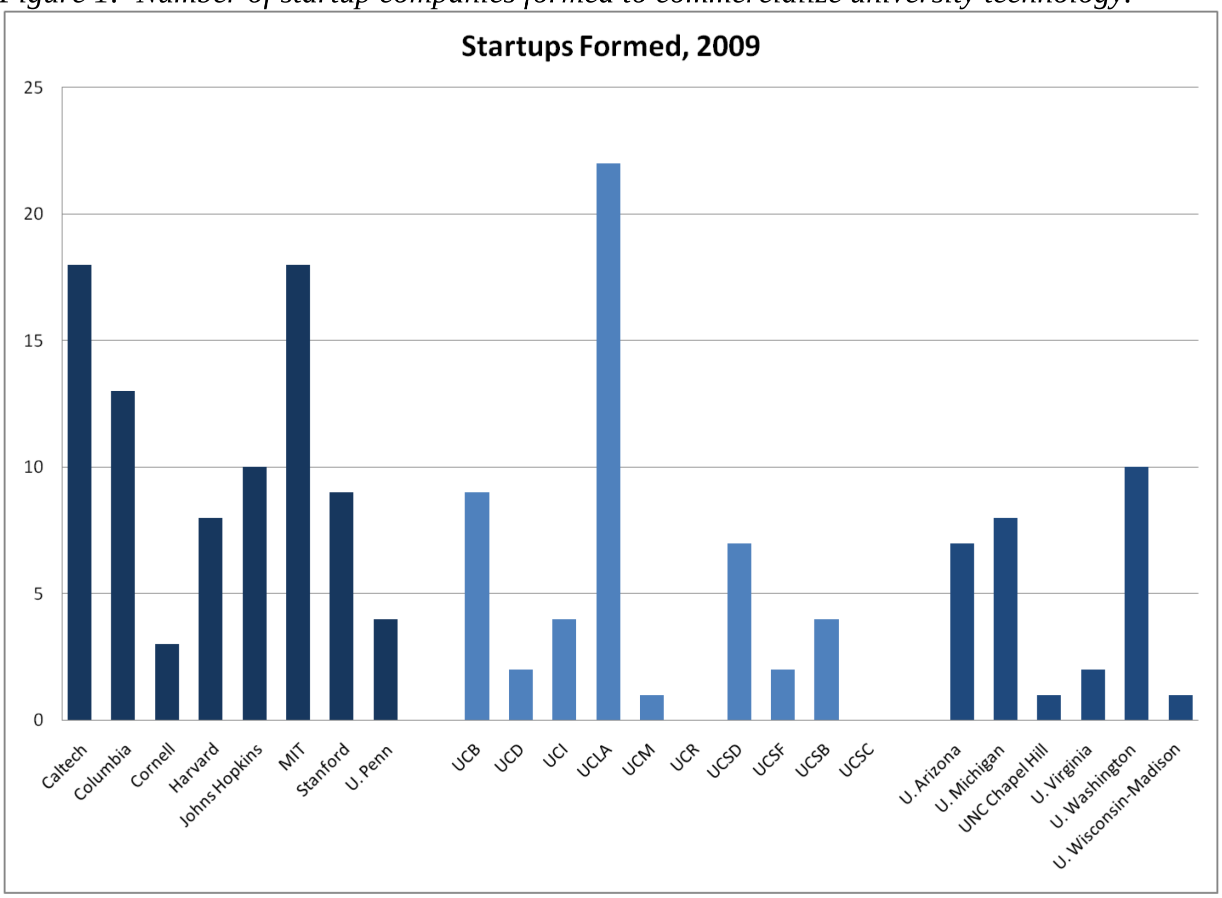
[1] There is some evidence presented in Appendix A that increasing the total number of patented inventions may increase the number of revenue-generating licenses, essentially giving more time for a larger number of inventions to prove their worth.

UC introduced its first systemwide Proof of Concept grant program in 2011 to support early-stage projects that meet both high academic and commercialization standards but otherwise had inadequate funding to demonstrate the viability of a profitable product. The first implementation of this program in July funded 13 one-year programs across the UC system totaling $2.7 million in research funding. This funding also inspired some UC campuses to support their own similar translational research in specific technology areas. The Proof of Concept program addresses the "Valley of Death" faced by many early-stage technologies developed at UC and is one approach to address the problem of scarce venture capital for potentially breakthrough inventions.

Starting New Companies and Incubators

Start-up companies and other small businesses create most of the new jobs in the U.S. and contribute to the economic development of the regions surrounding universities that spawn them. UC's record of creating start-ups is excellent as is illustrated by Figure 1; in fact, UCLA created the most new companies of all universities in our sample in 2009 with 22 start-ups. In 2010, UC created 75 start-ups with UCLA contributing 27. Start-up companies are also strong drivers of new technologies and business concepts.

Figure 1: Number of startup companies formed to commercialize university technology.



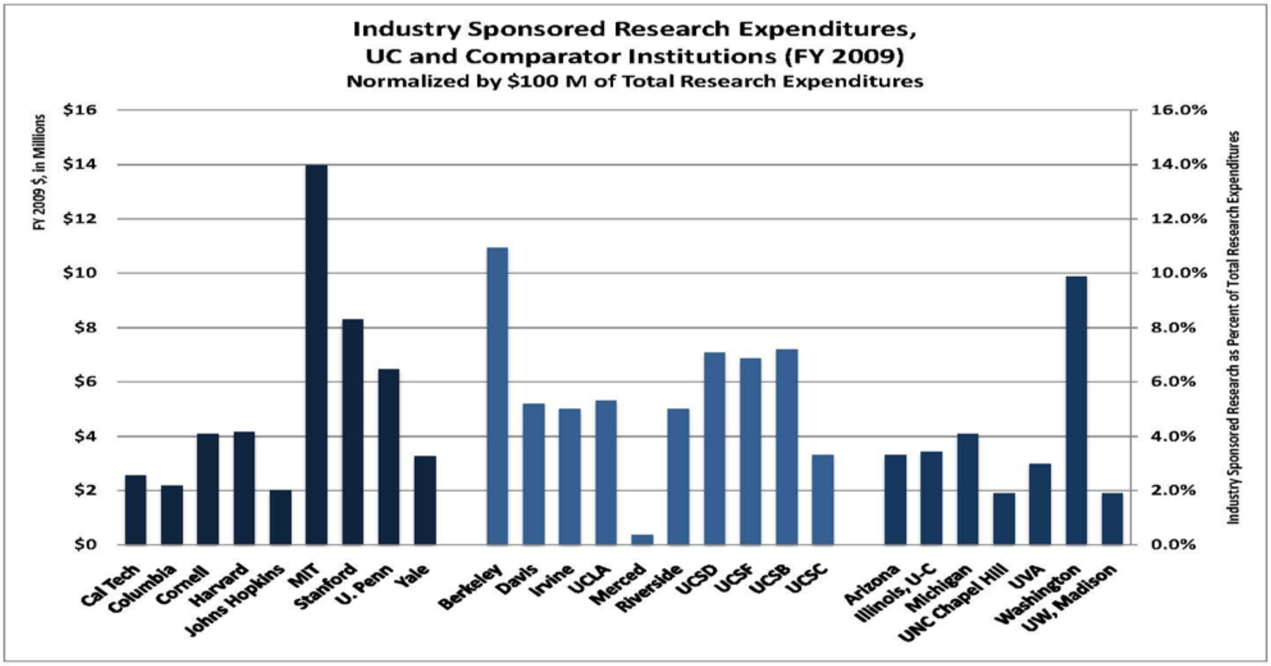
UC contributes to the commercial success of some of its inventions by providing the physical infrastructure that allows faculty and student entrepreneurs to develop their ideas to the point that they are attractive to outside investors. The Von Liebig Center at UCSD is a nationally recognized example of an organized approach to promoting entrepreneurism by incubating nascent research-based commercial opportunities. UC's Gray Davis Institutes for Science and Innovation include several recent examples of investment in incubator space. The "Garage" at the Gray Davis Institute for Quantitative Biosciences (QB3) was the first life science incubator within the UC system. Its success spurred its expansion beyond UCSF facilities into other Mission Bay locations and a small facility at UC Berkeley. The Gray Davis Institute for Telecommunications and Information Technology (Calit2) at UCI has set aside space to support entrepreneurial activities of faculty and staff in the IT and telecommunications arena, and the Gray Davis Nanosciences Institute (CNSI) has an incubator on the UCLA campus. A number of UC campuses are making additional efforts to support incubation at some level.

These incubators are generally comprised of small generic workspaces (100-300 sq. ft.) that allow one or two employees to work on the first steps of product development. These spaces are leased to the company at market rates without long-term contracts. Incubators often allow shared access to expensive equipment that is beyond the reach of fledgling businesses. They may also provide access to other professional services that are needed in the early stages of a company's life. The proximity to the university facilitates communication between the faculty entrepreneur and the company staff, as well as access by the company staff to the enriching academic environment. Most incubators expect their companies to "graduate" to non-university facilities within one to two years.

Industry-Sponsored Research

Technology transfer programs create relationships with industry that can lead to job opportunities for students, gifts to the University, and increased funding for research. Figure 2 shows that the $324 million in industry-sponsored research UC received in 2009 was a higher percent of the total research expenditures than most of its peers. Several campuses, notably UC Berkeley, have well-established relationships with many major companies, have rich portfolios of industry-sponsored research, and host industry researchers on their campuses. The Gray Davis Institutes increased the emphasis on industry-University research in the nine campuses that participate in these institutes.

Figure 2: Industry sponsored research expenditures as a percent of total research expenditures.



<u>Interactions with the business community that enhance innovation</u>

UC uses its talents and relationships in many ways to help identify the commercial potential of new inventions. One of the more common approaches is to engage students and researchers in business plan competitions, which not only helps to evaluate technologies, but provides a very "real-world" educational experience for UC students. These campus-based programs bring together teams to identify the commercial potential around new ideas, and develop the initial rationale for translating the idea into a product or service. Often these programs are run in conjunction with the business school and their programs in entrepreneurship education. Eight UC campuses currently have such programs. The business plans are evaluated by members of the local investor and business community so that the teams benefit from the experience and advice of professionals who understand how successful businesses work. Campuses also may make disclosures available to competing groups for their consideration.

Beyond business plan competitions bringing external advisors onto campus, UC campuses generally seek to engage with their local business communities to assess how best to contribute to the local community. This engagement takes different forms at different campuses based on the perceived need of the local community. UC Merced, as UC's newest campus, is looking to create links to the Central Valley business community to understand how it can evolve strategic partnerships with its community; UC Riverside is engaged with local CEOs; UC Berkeley is an active partner in the East Bay Green Corridor initiative; UCSF is working closely with San Francisco in the transformation of Mission Bay into a booming biotech center; just to name a few. Beyond working with local communities to enhance economic development, various schools and colleges throughout the system have "industry advisory boards" or have established "industry affiliates programs" that create communities of interest that interact with and advise the University about the impact of its research programs, such as Berkeley Sensors and Actuators Consortium (BSAC), UCSD's Center for Wireless Communications, and the Solid State

Lighting Design Center (SSLDC) in Santa Barbara. As mentioned earlier, one of the mandates of the Governor Gray Davis Institutes of Science and Innovation is to develop even deeper ties with their particular industry sectors to inform the direction of the research to investigate the overarching technical challenges facing that sector.

NEW IDEAS TO PROMOTE TECHNOLOGY TRANSFER

Reducing Barriers to Start-up Companies

UC has adapted its licensing practices not only to agreements with larger established companies but also to start-up companies that may be undercapitalized and struggling to survive. For example, UC has a policy that allows it to take an equity interest in a start-up in lieu of the usual upfront fees, an approach that allows those companies to use their cash for other expenses. The University is also exploring means of better addressing the time-critical needs of start-up companies who need rapid response in the licensing process owing to their limited cash reserves. One campus, UCSD, is developing "express licenses" for start-ups created by UC employees by using a template agreement with terms that are largely pre-determined and designed especially for University entrepreneurs. Such programs are now in place at a few other institutions and UC is learning from their experiences as they use this tool to support new company formation.

Campuses usually require licensees to reimburse the University for the full cost of patent protection – patent applications and attorney's fees – at the time of the license, not the time a license returns income. This practice places a much higher burden on a start-up company operating on limited capital than on established companies with steady income from other products. Such practices might dissuade some small companies from reaching agreements to develop some of UC's patents and licenses.

Campuses could consider new practices to promote start-up companies by assuming some of the risk and expense early on, on the assumption that we will reap greater benefits either from licensing income or philanthropy from a larger number of companies that survive and prosper. For example, UC campuses could prioritize the patent and licensing process for start-up companies to ensure they get rapid responses on all aspects of the licensing process. They could delay repayment of the costs of licensing until a young company has had a chance to generate revenue. As noted above, UC already takes equity stakes in start-up companies in lieu of fees, thereby assuming some of the risk while giving the company a chance to gain a foothold in the marketplace.

These practices are not likely to generate immediate returns to UC in revenue, but they would almost certainly aid California's economy and demonstrate a clear commitment by the University to use the results of its research to maximally benefit the state.

Investing in UC Technology Transfer Offices

The University currently protects only a fraction of its inventions due to the costs to file and protect with an uncertain likelihood that the patent will be licensed and then generate royalty income. Of the 23,600 inventions disclosed, only 11.5 percent resulted in an issued U.S. patent.

Many inventions are dropped prior to the time of conversion from a U.S. provisional application to a utility patent application. Without a licensee, most foreign patent applications are allowed to lapse before a full foreign filing is required, since the costs increase dramatically at that point (see Appendix A, Figure A5). The result is that many interesting inventions are not protected long enough to license them to industry and test their commercial viability in the marketplace.

Each campus decides how much to invest in technology transfer operations. At most UC campuses, the amount of financial support for the technology transfer function is linked to the amount of revenue currently generated from previously licensed inventions. This funding model limits the number of licensing officers that can pursue inventions disclosures and market University patents, and it also limits the amount of time the University will maintain a patent before a licensee is found.

Campuses could decide to invest more money in technology transfer with the goal of generating more licenses that may produce revenue. There is some evidence (Appendix A, Figure A7) that more licenses uncover more revenue-producing inventions and ultimately return greater income to the University. If licensing revenue is to become a more important part of the University's budget to support operations, the University may have to invest more in its licensing efforts now to get a future return in the next few decades. Funding such investments will not be easy with the University's current budget shortfalls. Campuses may also try to solicit philanthropy to fund the additional costs of patenting their inventions.

Licensing Revenue and UC's Budget

UC's severe budget shortfall means that it must look at every source of potential revenue to support its operating budget, including revenue from technology transfer operations. The many approaches that UC is trying show a strong commitment by the University to use its research both for the public benefit and to support its operations. In the next five to ten years, new revenue from UC inventions will necessarily result from licenses that are already in place. New revenue from enhancements in technology transfer practice taken today will take some years to realize, but we should nevertheless consider exploring ways to increase the dissemination of our inventions both for the public good and for increased University income in the future.

(Attachments)

Attachment 1: Statements from Panel Members and UC Faculty

Appendix A: How Technology Transfer Works

Appendix B: Michael Sharer and Timothy L. Faley, "The Strategic Management of the Technology Transfer Function –Aligning Goals with Strategies, Objectives and Tactics."

STATEMENTS FROM PANEL MEMBERS AND UC FACULTY

A panel of UC faculty and administration members will present to the Regents and share their views on University technology transfer. Statements from William Ouchi, Professor at the UCLA Anderson School of Management, Carol Mimura, Assistant Vice Chancellor, Intellectual Property & Industry Research Alliances at UC Berkeley, and Keith R. Yamamoto, Vice Chancellor, Research; Executive Vice Dean, School of Medicine; and Professor, Cellular and Molecular Pharmacology at UC San Francisco, are provided below.

William Ouchi, Professor, UCLA Anderson School of Management

UCLA combines world-class faculties and students with a gold-standard network of hospitals and community medical clinics, all in one compact campus location. UCLA scientists and students can easily walk to one another's laboratories, can access shared large-scale research instruments, and thus can produce the cross-disciplinary work that is necessary to make the major discoveries of today and tomorrow.

UCLA is now engaged in a major effort to enhance its entrepreneurial ecosystem in ways that will nourish the inventive instincts of its students and faculty. New courses are being launched, patenting and licensing procedures are being streamlined, major industry-sponsored research partnerships are being pursued, and existing research policies and procedures are being re-examined. UCLA is developing plans to create a new, non-profit, wholly owned subsidiary that will manage the UCLA patents that are now and will continue to be owned by the Regents. This new entity will enable UCLA scientists to more efficiently move their inventions to commercialization, will build over time the capital necessary to provide proof-of-concept funding for promising inventions, will provide decision-making by experienced business executives along with campus leaders, and will enable UCLA to pursue costly, multi-year and multinational patent applications.

The results of this new Ecosystem for Entrepreneurs will be a campus in which both traditional curiosity-driven research and the increasingly important translational research will flourish. We forecast that annual invention disclosures will double, that campus revenues from industry sponsored research and license royalties will more than double, and that many more students will be able to gain instructional and practical experience in entrepreneurship. With leadership provided by UCLA, the Los Angeles area will become known as a center of technology, with a high technology corridor that generates new jobs, new companies, and new opportunity.

Carol Mimura, Assistant Vice Chancellor, Intellectual Property & Industry Research Alliances, UC Berkeley

In 2004 the UC Berkeley campus restructured its approach to technology transfer. The primary goal of the restructure was to implement an industry "relationship approach" to technology transfer on a holistic, campus-wide level. Implementation of this goal involved:

1) Redefining the traditional definition of technology transfer to include both "push" and "pull" mechanisms;

2) Redefining the definition of success in technology transfer, going beyond the traditional definitions and metrics;

3) Making increased corporate funding for research a campus priority.

To implement change, Berkeley created the Office of Intellectual Property & Industry Research Alliances (IPIRA). New positions and reporting structures were created, and relevant authorities were officially re-delegated. The restructured unit and goals enabled IPIRA to adopt a *spectrum* of intellectual property (IP) management strategies and to develop a number of new business models for implementing the goals of deploying scientific advances for the benefit of society.

Within four years IPIRA increased industry-sponsored research from ~3% to ~10% of total sponsored research, and diversified the number of ways that industry interacts with the campus. Corporate gifts and foundation funding also increased. A number of the business models address the manner in which the University and industry cooperate to address the grand challenges of science and thus represent innovation *on innovation itself*, an activity that is essential if we are to maintain our nation's competitive edge.

Keith R. Yamamoto, Vice Chancellor, Research; Executive Vice Dean, School of Medicine; and Professor, Cellular and Molecular Pharmacology, UC San Francisco

Since the mid-twentieth century, American research in science, engineering and medicine has led the world, making astonishing advances. The endeavor now has the potential to extend fully along two orthogonal axes: (1) a deep conceptual and functional integration of research in life science and medicine with that in physical science and engineering, and (2) a working continuum of open-ended, curiosity-driven discovery and directed, use-inspired application. To fulfill this potential and capitalize on these opportunities in these challenging times, UCSF is building a research and training endeavor that integrates basic biomedical researchers and clinicians with physicists, chemists, computational scientists and engineers, and developing strategies and infrastructure for commerce driven by export of creativity and knowledge, and import of enabling technologies and resources.

One key element in our strategy is the Office of Innovation, Technology & Alliances (ITA) within the Office of the Vice Chancellor, Research, which oversees and coordinates a network of educational, entrepreneurial, business development and project management activities within the UCSF Schools of Medicine and Pharmacy, the California Institute of Quantitative Biosciences (QB3), and the UCSF Clinical and Translational Sciences Institute (CTSI). The ITA network proactively engages both the faculty and private sector entities, facilitating creation of diverse public-private research alliances, transfer of UCSF technologies to commercial entities for development and commercialization, and education on entrepreneurship, intellectual property and alliance-building. Our goal is to train the next generation of innovators, to establish partnerships that facilitate the translation of UCSF-based discoveries for public benefit, to foster and nurture clear-value propositions both for UCSF and for industry partners that produce sustained mutual rewards, and to deliver on our mission of advancing health worldwide.

Two recent examples of novel programs: (1) two major pharmaceutical companies are contributing funds to our Program for Breakthrough Biomedical Research to support selected, high-risk, untargeted discovery research projects and student training in order to help maintain a robust research pipeline; (2) a Masters in Translational Medicine program combines UCSF's clinical and biomedical expertise with UC Berkeley's engineering excellence, training students to apply translational research and engineering approaches to bring innovative treatments and devices into clinical use; program covers bioengineering principles and product design, clinical research methods and trials design, regulatory topics, intellectual property and business/leadership skills, and culminates in an interdisciplinary team design and research experience.

APPENDIX A: HOW TECHNOLOGY TRANSFER WORKS

Licensing revenue and successful new companies result from a small fraction (~10 percent) of the invention disclosures made to the University. The campus licensing offices evaluate each invention for patentability and likely commercial interest, often in consultation with industry contacts. Only about one in five invention disclosures shows sufficient commercial potential to warrant a patent application. These inventions are marketed to industry to attract a licensee that will invest its own resources to develop the technology and bring it to market. Somewhat more than half of these patented inventions are eventually licensed to a company, and it is rare for more than one company to express serious interest in licensing a technology.

Inventions that generate revenue

The vast majority of revenue is generated by a very small number of inventions at UC and at research institutions across the country. In the history of UC's licensing program, only 39 out of about 23,600 inventions disclosed (0.17 percent) have generated more than $5 million each in total income. In any fiscal year, the University's royalty income stream is dominated by a small number of these "blockbuster" licenses. In FY2010, 68 percent of the $104.4 million in royalty and fee income came from the top 25 inventions (two percent of all license agreements; one percent of all licensed inventions) and 41 percent came from the top five inventions alone (0.4 percent of all license agreements; 0.2 percent of all licensed inventions). Figure A1 shows the distribution of revenue from all inventions in the University's database.

Figure A1: Distribution of lifetime revenue from a sample of 3,900 inventions in the UC database. Because the average cost to obtain a patent in the U.S. is of order $20,000, the majority of these inventions do not generate enough revenue to pay for their filing costs.

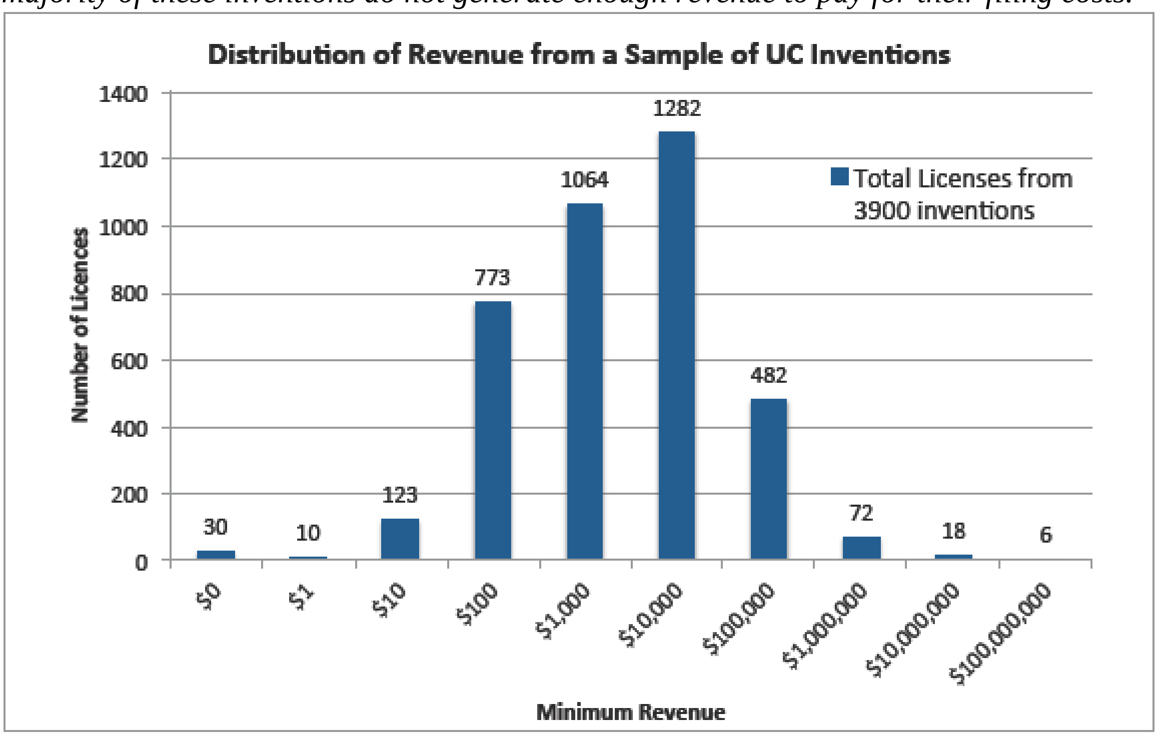


Figure A2 below lists the 39 inventions that have dominated the total revenue stream. These 39 inventions account for $1.65 billion of cumulative revenue, 80 percent of the all the revenue UC has ever earned from technology transfer. As the table shows, the vast majority of the income the University generates through technology licensing comes from the life sciences and agriculture; relatively few are from engineering or the physical sciences.

Figure A2: These are the 25 highest-earning inventions since the inception of UC's licensing program.

All inventions earning more than $5M in UC's technology licensing program

RANK	TECHNOLOGY DESCRIPTION	CAMPUS	DISCLOSURE	LICENSE	TOTAL REVENUE
1	HUMAN GROWTH HORMONE	SF	1977	1990	$244.9M
2	HEPATITIS-B VACCINE	SF	1981	1985	$211.2M
3	HEPATITIS-B VACCINE	SF	1979	1985	$181.2M
4	1988001-INTRACRANIAL ANEURYSMS	LA	1989	1990	$121.9M
5	BOVINE GROWTH HORMONE	SF	1980	2006	$128.9M
6	PROCESS FOR GENE SPLICING	SF	1974	3rd Party	$107.8M
7	BLOCKING T-LYMPHOCYTE DOWN REGULATION	BK	1996	1999	$87.5M
8	SP54-TAVIN	SD	1980	1993	$62.7M
9	EPIDERMAL FACTOR MONOCLONALS	SD	1983	1993	$47.0M
10	DYNAMIC SKIN COOLING DEVICE	IR	1993	1995	$40.8M
11	STRW- CAMAROSA	DA	1992	1992	$35.0M
12	HYPERMEDIA PROGRAM OBJECTS	SF	1994	1996	$32.3M
13	NICOTINE PATCH-SMOKING CESSATN	LA	1984	1991	$30.1M
14	BIODEGRAD POLY/PROTN BSD COILS	LA	1998	2001	$28.2M
15	ENERGY COUPLED DYES	BK	1994	1996	$23.8M
16	CHROMOSOME PAINTING	LLNL	1985	1990	$19.0M
17	FIREFLY LUCIFERASE	SD	1984	1991	$17.7M
18	RADIOGRAPHIC MEDIASD	SD	1979	1983	$16.2M
19	OPTICAL NETWORK SWITCH	DA	1997	2001	$15.5M
20	FLUORESCENT CONJUGATES/MOLECUL	BK	1981	3rd Party	$14.8M
21	FELINE AIDS RETROVIRUS	DA	1986	1987	$14.0M
22	BIS-ANTHRACYCLINES LIPOSOMES	SF	1977	1986	$13.9M
23	LIPOSOME STORAGE-METHOD	DA	1984	1986	$13.0M
24	ALPHA-FACTOR DNA EXP VECTOR	SF	1982	1985	$12.4M
25	FELINE LEUKEMIA DIAGNOST. TEST	DA	1980	1982	$11.6M
26	LUNG SURFACTANT-SYNTHETIC	SF	1980	1986	$11.6M
27	SPEECH RECOGNITION	SF	1997	1997	$11.0M
28	LASER/WATER ATOMIC MICROSCOPE	SB	1989	1989	$10.5M
29	COCHLEAR IMPLANT DRIVING SYS	SF	1979	1984	$10.4M
30	MAGNETIC RESONANCE IMAGING	SF	1976	1980	$9.0M
31	STRW- CHANDLER	DA	1982	1983	$8.3M
32	MYCOPLASMAS DETECTION	IR	1984	1992	$7.4M
33	STRW- CN220 (ALBION)	DA	2004	2004	$6.7M
34	LOADING LIPID VESICLES	LBNL	1984	1990	$6.0M
35	STRW- VENTANA (C216)	DA	2001	2001	$5.7M
36	REPLACE PHOSPHATE BY PHOSPHITE	RV	1990	1993	$5.4M
37	STRW- PAJARO	DA	1978	1979	$5.1M
38	FLUORESCENT DYES-CALCIUM	BK	1984	1988	$5.1M
39	CITM- W.MURCOTT IR-1/TANGO	RV	2005	2006	$5.1M

Time to License; Time to Revenue

Approximately 50 percent of licenses are executed within three years of disclosure. It takes about 12 years to execute 90 percent of all licenses for typical UC inventions, requiring licensing offices to maintain patents for many years if they want to maximize the number of licenses with industry. Because royalty income is the result of product sales, and it takes companies three to ten years to translate a University idea into a product, significant royalty income lags invention disclosure by about ten years. This long delay between disclosure and revenue return makes it difficult to use revenue return as a measure of the success of any approach to licensing and technology transfer operations.

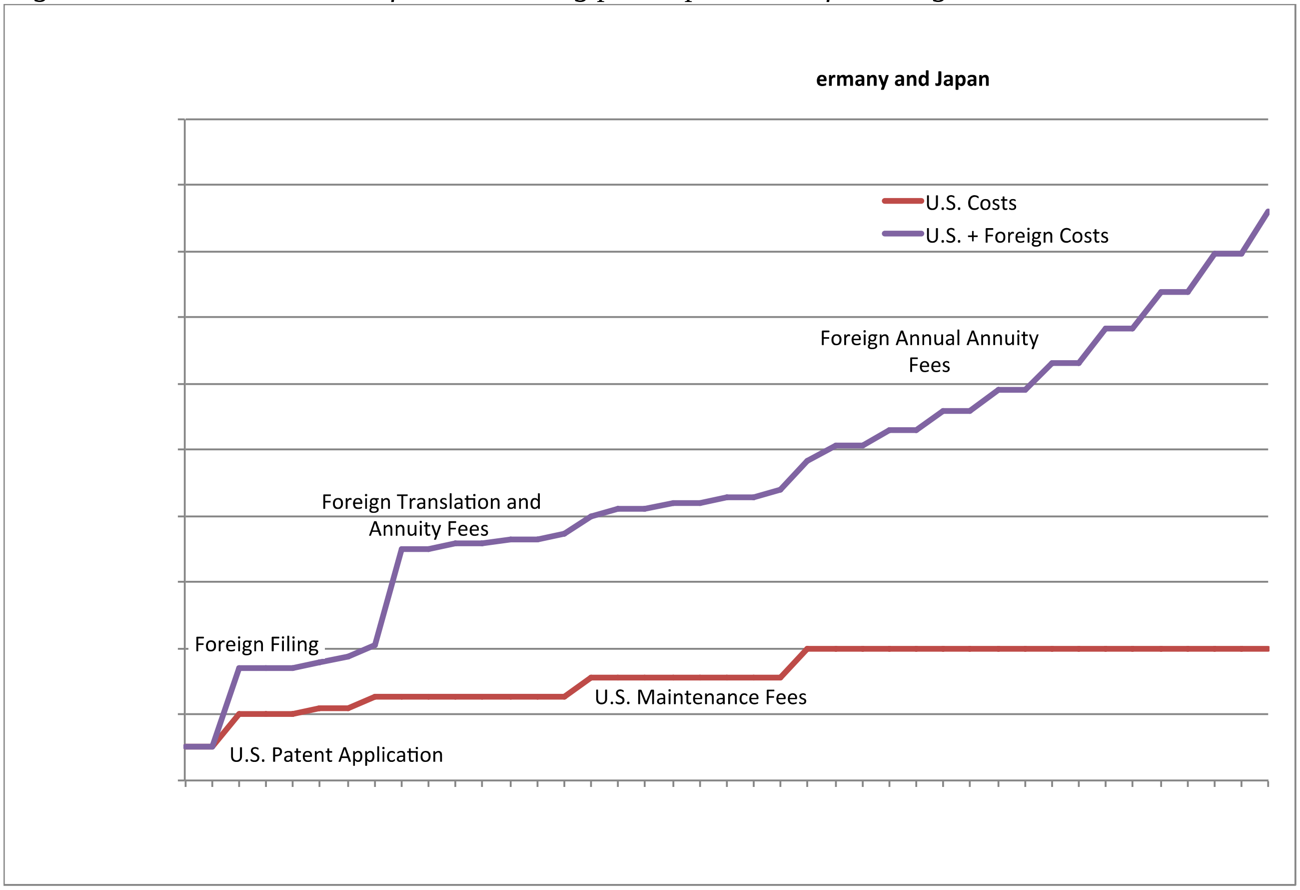
Figure A3 shows the time from disclosure to revenue return for UC's top revenue-producing inventions. The highest money earners, the two Hepatitis-B vaccines patents, required more than 15 years after disclosure to return the majority of their income.

Figure A3: Time from disclosure to revenue generation for 6 of the University's top revenue-earning biomedical inventions that were not the subject of litigation or monetization events.

<u>The Cost of Patent Protection</u>

The typical cost for filing and maintaining U.S. patent protection for an invention is $20,000. U.S. patent law provides a low-cost option to secure provisional patent protection for a one-year period, during which time the University seeks to determine if an invention is of commercial interest. Before the end of the one-year period, a full utility patent application must be filed to continue patent protection. For important inventions, the University may also elect to file for protection in foreign countries, adding significant costs. In fact, each step requires the University to make an increasingly greater financial investment to protect its patent rights. Figure A4 below provides a rough idea of the magnitude and timeline of the cost to maintain patent protection for a single invention.

Figure A4: Timeline and cost for maintaining patent protection for a single invention.



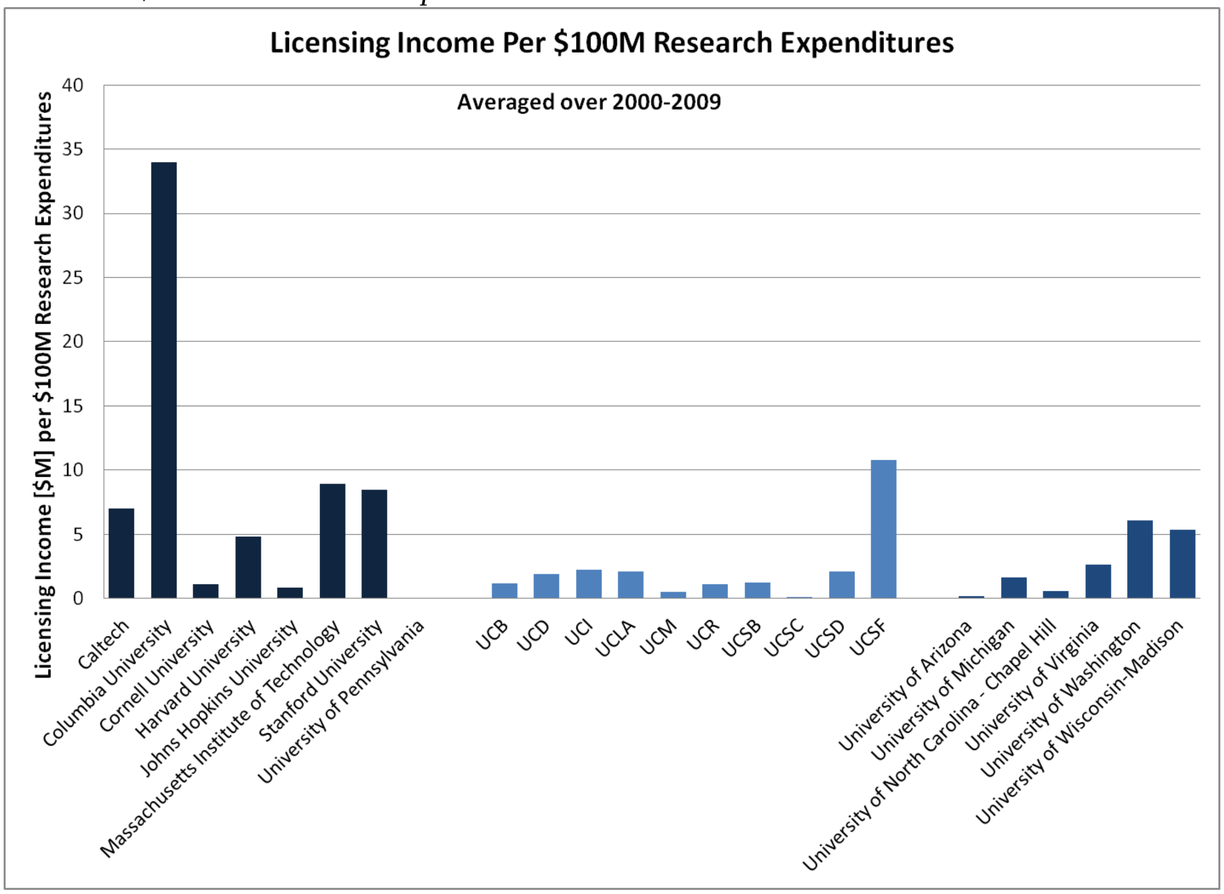
UNIVERSITY OF CALIFORNIA COMPARED TO OTHER INSTITUTIONS

Before 1990, all of the University's technology licensing activities were conducted at the UC Office of the President (UCOP). In 1990, responsibility for management of inventions created at UC Berkeley and UCLA was delegated to these two campuses for local administration. Eventually, each of the remaining campuses assumed responsibility for licensing their inventions ending with UC Merced earlier this year. UCOP now handles accounting services and patent prosecution for those campuses that choose to take advantage of the economy of scale in these business services. UCOP also maintains the systemwide database and provides policy and legal oversight and assistance.

UC's technology licensing programs on the ten campuses are similar to the programs at other research universities around the country. The Association of University Technology Managers (AUTM) statistics on the licensing practices of research institutions in the U.S. show that UC's technology licensing offices have staff sizes within the normal range of its peers. The revenue returns of the licensing efforts vary widely among universities, reflecting that significant revenue results from sporadic blockbuster inventions.

Figure A5 shows the licensing income as a fraction of total research expenditures for UC and its usual comparator institutions over the last decade. The strong variations in this normalized measure of income reflect both the dominance of blockbuster inventions and the varying emphasis on health science research at different institutions.

Figure A5: Licensing income per $100M of research expenditures, for the 10-year period from 2000 to 2009. Note that Columbia's performance results from four blockbuster drugs that generated revenue in this period; UCSF's performance results from three settlements netting more than $335M over the same period.



Blockbuster inventions are not only rare, the likelihood of creating a blockbuster is also highly variable as shown by the poor correlation between the total number of license agreements in an institution's portfolio and the total amount of revenue. Figure A6 plots licensing income versus number of income-generating licensing agreements for UC campuses and other top U.S. research universities by research expenditure, showing little correlation between income and number of agreements. The correlation is even poorer among only the top revenue-earning institutions, consistent with the notion that licensing income bears little relationship to the frequency with which technology is actually licensed.

<u>Cost vs. Revenue</u>

Universities that make licensing a priority, such as Columbia and Stanford, maintain unlicensed patents for the time it takes to execute a license agreement and begin to recoup the out-of-pocket costs of drafting, filing, prosecuting and maintaining patents, typically three to five years. UC does not normally invest in the later, more expensive stages of the patent process absent a licensee, and it might miss opportunities to promote some higher-earning licenses. Institutions like Stanford and Columbia do not require their licensing offices to cover their operational costs each year with licensing revenue. Their licensing offices are allowed to carry patent expenses into the future.

Some universities also make it easier for a company to license their inventions by allowing longer periods for the company to pay back the costs of patenting. UC requires its licensees to reimburse the University for past patent costs and pay future patent costs going forward, one result of the pressure for its licensing offices to cover their operational costs annually. In 2009, UC had 70 percent of its patent expenses reimbursed, whereas Columbia and Stanford were reimbursed for only 40 percent. The latter universities attribute this difference to their willingness to defer reimbursement of costs until the licensee has demonstrated the potential of the technology and raised enough capital such that repaying these costs does not significantly impede the ability of the licensee to advance the technology – they effectively underwrite a portion of the proof of concept costs and share the risk of early stage of technology development.

Figure A6: License income versus income-generating licenses for 161 US universities.

These two approaches require the universities to invest more in their technology licensing offices. They support the staff sizes needed to handle the total case load and allow the offices to file on new inventions that may be too early to generate immediate interest from potential licensees but which may very well become the foundation for the unexpected blockbusters. The approach of UC campuses reduces the risk of losing money by scaling its licensing operations based on income from previous inventions. This approach reduces its impact on local economic activity and carries the risk of losing potentially more licensing income in the future. Campuses who wish to earn more revenue could consider extending their patent protection window, allowing their technology transfer offices to have operational costs in excess of current income requiring investment support from the campus, University or other investors.

Picking the Winners

Universities have experimented with a variety of different approaches to better predict which inventions will produce enough income to justify the cost of patent protection. One approach is to consult with industry representatives who bring business insight to the commercial potential of a technology. UCSD currently does consult with a group of industry advisors on generic technology transfer strategies. However, effective use of industry representatives places added demands on a campus to support the boards and to set up mechanisms to overcome inherent conflicts of interest between industry and the University. One highly regarded peer institution in the field of technology transfer used industry advisors for several years before concluding that their industry representatives often put their own interests ahead of the university's by recommending against patenting technologies that competed with their own products. No university has shown that engaging industry representatives in the decisions surrounding patents has increased revenue or the number of commercially successful inventions.

The consensus among technology licensing officials with experience, including those who have had blockbusters, is that it is currently impossible to predict in advance high revenue-earning inventions for the overwhelming majority of disclosures. The nearly decade lag between the implementation of program changes and impact on revenue means that few institutions have had time to experiment with their approach even over the 30 years since Bayh-Dole.

Infrastructure

Several public universities have created subsidiary organizations to conduct their technology transfer activities, effectively shielding them from State control. Wisconsin, Iowa, SUNY, and even the California State University system have created research foundations that can retain licensing revenue to be used separately from money appropriated by the State legislatures and not counted against the total appropriations for the universities. UC's constitutional autonomy allows it to conduct its licensing business with the same advantages of subsidiary organizations and without the costs of setting up and maintaining independent organizations.

Organizational Values and Approaches to Technology Transfer

Universities use a variety of ways to organize systems to maximize the transfer of inventions with high economic value and a variety of ways to promote faculty engagement with economic development. The approaches depend on the values the organization places on the competing goals for technology transfer: societal benefit, service to faculty, enhanced relations with industry, revenue generation, or economic development. It is impossible to serve all these goals equally well owing to the inherent tension among them. The competing tensions among these goals are nicely summarized in an article by Michael Sharer and Timothy Faley, *The Strategic Management of the Technology Transfer Function–Aligning Goals with Strategies, Objectives and Tactics* (Les Nouvelles, September 2008, p. 170-179, Appendix B).

Faculty members, university administrators, Regents and alumni, venture capitalists and angel investors, large corporations, local government officials and development agencies have quite divergent expectations about the goals of technology transfer, ensuring that some groups (and sometimes all groups) are disappointed with the outcomes of a university's technology transfer program. These divergent goals make it difficult to judge the effectiveness of any one approach as satisfying the University's needs by assessing the satisfaction of the various stakeholders. It is, nevertheless, incumbent upon the University to be innovative in its approaches to technology transfer writ large and seek ways to optimize the balance between competing objectives, including a current need for significant University revenue enhancement.

The Strategic Management Of The Technology Transfer Function—Aligning Goals With Strategies, Objectives And Tactics

By Michael Sharer and Timothy L. Faley

Abstract

The "technology transfer" process is complex in nature, and is made increasingly so due to expectations from internal and external stakeholders. Given this, we believe it is imperative for a technology transfer organization to engage in a comprehensive strategic planning process. It is important for any such organization to identify a specific primary goal, and to then implement strategies, objectives and tactics consistent with the chosen goal. In this paper, we compare and contrast perhaps the four most commonly stated organizational goals for operating a technology transfer function, which are: to provide a service for the organization's researchers, to maximize the societal benefit of the new technologies, to act as an "engine" for economic development (assume local and regional), and to act as a revenue generator for the organization. We then contrast and compare the strategies, operations, and policies for offices operating under each of these four goal scenarios.

Introduction

So called "technology transfer" (TT) is an inherently complex process. The very nature of attempting to commercialize nascent technologies, often ones which have unproven or niche application in the marketplace, can be fraught with complexity and risk. Add to this the expectations of internal stakeholders (senior administrators, researchers, etc.) who may not be aware of the realities of the marketplace nor the realities of the technology development process. It is not uncommon for a university president, vice president of research, or other organizational leaders to have unclear or unrealistic expectations as to the role of TT in their organization. Or, perhaps they have not fully thought through the role that they want TT to play at their organization. This is not to be completely unexpected, given that TT is a relatively new and unfamiliar function to many leaders of non-profit research organizations (NPROs).

In addition, the expectations of external stakeholders, who often have a keen interest in the commercialization of nascent technologies further complicates the picture. These external stakeholders include venture capitalists, angel investors, state and local economic development officials, alumni, and corporations. It is also common that expectations from these groups can be unstated or divergent, making it easy to disappoint or alienate one or more of these groups while satisfying another.

In an earlier publication, we observed that the technology transfer process was complicated by a variety of factors, such as (Faley, Sharer, 2005):

1. NPROs perform different kinds of research in a wide variety of fields of study.

2. NPROs produce different kinds of new knowledge from this research.

3. There are a variety of audiences for the different kinds of new knowledge, each of which may have a different set of needs in order to utilize and maximize the benefit of this new knowledge.

4. Uncertainties exist regarding the appropriate use of intellectual property protection in order to maximize the benefit from new knowledge with commercial application (Rai, et al., 2007).

Given the inherent complexity of the process and the complications posed by diverse stakeholders, it is not surprising that many NPROs seem to be unclear about the primary goal of their TT function. As a result, many TT offices often have unfocused or multiple organizational goal statements, if they have any statement at all. In a survey of the mission/goal* statements of 128 TT offices, there was a 42 percent probability that any individual statement contained all of the three most commonly stated goals (Markman, et al., 2005). Also, in a nationwide sampling of 20 TT offices, these authors found that 65 percent either had no mission/goal* statement or their statement described multiple, possibly competing outcomes rendering the statement unfocused and unclear. In our view, the competing interests of the internal and external stakeholders identified above can cause or exacerbate the problem of having unfocused goals. For any organization, having unfocused goals can lead to conflicting operational objectives and ultimately to operational ineffectiveness ("muddled operations") (Faley, Sharer, 2005). In other words, an organization that attempts to be "all things to all people' is a recipe for strategic mediocrity and below-average performance" (Porter, 1985). Without a focused goal statement, it is extremely difficult to properly prioritize the organization's activities and properly allocate its resources; which can lead to operational dysfunction.

This raises the question of what is the prime goal for which any NPRO should operate their TT function, and how does management of the TT function differ given different primary goals? First, since all NPROs are unique and may experience a different set of conditions and constraints, each may choose to operate a TT function for different reasons. Therefore, each may choose different goals for their TT operation that reflect their specific situation. It should also be clear that the Bayh-Dole Act alone does not necessarily provide the specificity needed to give operational clarity for an organization's TT function (Faley, Sharer, 2005). So, it seems clear that NPROs may choose from a variety of possible goals for their TT function. Anecdotally, these authors have heard all of the following possible goals for TT: to make money for the NPRO (presumably to maximize profit, not necessarily revenue), to provide a service for researchers, to maximize the NPRO's discoveries transferred, to give the technology away as a benefit to the public, to create start-up companies, to act as an "engine" for economic development, to help recruit high quality and/or technology focused researchers, and/or to act as a mechanism to attract more sponsored research to the NPRO.

Given the range of plausible goals for TT, it is the intent of this paper to provide operational and strategic considerations given the assumption of a primary strategic goal. We do not reach the conclusion of whether a particular goal may be better than any other, but rather we attempt to demonstrate how the choice of a primary TT goal should directly impact strategy, and align with operations and policy in order to create an effective TT organization. Further, to make this a useful tool, we will also discuss some advantageous objectives, strategies and tactics to employ to effectively operationalize a chosen goal. It is well-recognized in other domains that a sound IP strategy should align with and support an organization's overall business strategy and goals (Germeraad, Harrison, Lucas, 2003). The key concept is that of alignment: processes, organizational structure, intellectual asset management strategies, hiring strategies, and IP policies should align with the mission and goals. We believe that the type of strategic planning described here and in other publications (such as Germeraad, Harrison, Lucas, 2003) is invaluable for any TT or intellectual property management organization.

In order to simplify the task, we will choose perhaps the four most commonly stated goals for a TT office. The four we have chosen, albeit somewhat subjectively, are:

1. To provide a service for the NPRO's researchers (i.e. service centric).

2. To maximize the societal benefit of the NPRO's technologies (i.e. transfer centric).

3. To act as an engine for economic development (assume local and regional, i.e. job-creation centric).

4. To act as a revenue generator for the NPRO (i.e. revenue centric).

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Strategic Planning Framework

To avoid confusion over the analytical framework, we will define the terms mission, goals, objectives, strategy, and tactics. Mission defines the purpose of the business and should articulate the organization's reason for being. We will assume that the generic mission is roughly the same for most TT offices, which is informed by the Bayh-Dole Act and which is to transfer novel technologies from the research environment to the commercial marketplace.** An organization's strategic goal is an outcome statement that defines what the organization is trying to accomplish both programmatically and organizationally. A goal is typically a collection of related programs and is a reflection of the major action of the organization. This goal should also articulate which internal benefits the NPRO seeks to maximize from its TT operation. Strategy is defined as a long term plan of action, rule, or guideline by which a particular goal will be achieved. An objective is defined as a precise, time-based and measurable action that supports the completion of a goal. Objectives should be "SMART": specific, measureable, achievable, results-oriented, and time-bound. Tactics are the specific actions and processes that will be used to accomplish specific objectives.

Goal-based Strategic Management For TT

Strategic Goal 1: To provide a service for the NPRO's researchers.

Overview: In this case, we assume that the TT office is primarily a service organization that exists in order to aid researchers in their pursuit to "get their stuff out" into the marketplace, presumably to benefit society, but perhaps more directly to help each individual's research program. In meeting this goal, the NPRO may view the TT function as a strategic recruiting tool for the organization to help recruit top researchers with commercially focused research programs

Strategy: Although there may be a number of strategies that can be employed by a TT office to achieve the stated goal, a four pronged strategy is recommended here:

1. Provide prompt service to all faculty who wish to participate in TT activities.

2. Demonstrate an in-depth knowledge of the researchers' technical area.

3. Provide counsel and assistance for business development activities for those researchers interested in starting new companies.

4. Provide prompt transactional support by ensuring that deals are completed quickly to the extent possible given legal and financial constraints.

Objectives: Specific objectives are difficult to provide given that these are often stated relative to historic norms that are specific to the organization, but they may be items such as:

• To respond to all phone calls, emails, and requests for information from researchers in 24 hours or less.

• To provide start-up related education for researchers: one-on-one counseling; short-courses, seminars, webinars, or other materials on new business development.

• To make IP protection decisions for invention disclosures in less than 3 months.

• To complete all licensing transactions in less than 6 months.

As with any "SMART" objective, the objectives for this strategic goal should be calculated based on historic activity and any expected relative increase should be realistic. New objective determination should be based on a realistic estimate of the increase in new resources applied and the expected effectiveness of the new tactics employed to achieve said objective.

Tactics: Obviously, prompt service and a cooperative approach will be key factors for the success of this type of TT organization. Faculty surveys should be used to judge the effectiveness of the organization and to receive input from faculty on new ideas. Whether these ideas are actually implemented, customers will always feel better if they have been heard.

We also recommend establishing a faculty advisory committee that meets regularly (perhaps every other month). This committee can be used for policy development purposes, to help judge the overall satisfaction of researchers, and the committee members can also act as an advocate to other research staff. For the service organization model, such a committee can be invaluable for keeping good relations with researchers.

It will also be necessary to keep good communication between researchers and the TT staff. We recommend letters or emails for each invention disclosure to let the researchers know when the disclosure has been received, and also when an IP protection decision has been made.

IP protection decisions should be made as promptly as possible. If the NPRO does not want to claim ownership, in this model it is advisable to reassign it to the inventor or relevant funding agency.

This type of TT office should not be viewed as getting in the way of deals. Know when to say "no" to deals for legal or policy reasons, but also make sure to do deals whenever possible. It may never be a good idea to decline a deal based on a perceived low royalty rate for this type of TT organization. However, in order to avoid being a resource drain on the NPRO, perhaps the main consideration is to make sure that direct costs are covered for all license and option deals. It should be communicated to faculty that there are minimum, economically break-even terms that are required for licensing, below which the office can no longer afford to function. Alternatives to standard licensing should be proposed for those items that fall below the economic threshold. Since this is a service-centric model, operational efficiency is paramount. As a result, it will also be critical to ensure that MTAs, secrecy agreements and related agreements are handled quickly and effectively.

We also recommend having dedicated new business development counselors (NBDCs) available for this type of TT office. Researchers who wish to have a start-up company should receive ample attention and assistance for these matters. Increasing levels of offerings may be made by the office, depending on its resources. These would increase in cost and intensity from: 1. Providing information (handouts) or educational services (counseling, short-courses, webinars) on new business development; 2. Providing referrals and introductions to other organizations that may assist the faculty (maintain a database of appropriate service providers); to 3. Providing direct start-up business development to the faculty. These services could be provided directly by the NBDCs or indirectly by the hiring of consultants by the TT office to perform these services.

Discussion: Given this goal, the TT organization will want to formulate policies that reflect a need to be service oriented, as well as implementing a hiring strategy that will allow the office to meet the stated strategic objectives. Furthermore, the TT office will want to deploy IP resources on those technologies that will help the office achieve its service goals. This will likely include giving preference to those technologies that are aligned with the organization's research priorities, and may include giving preference to inventions from the most influential researchers.

Strategic Goal 2: To maximize the positive societal impact of the NPRO's technologies.

Overview: The goal of TT offices running this scenario is to assist the NPRO in maximizing the commercial potential of its research output in a way that is most advantageous to society as a whole. One of the ways to achieve this goal is by maximizing the number of technologies that are transferred, while minimizing the negative effects of the transfer on society. An office run in this manner could arguably have the greatest positive impact on society by first determining the optimal societal value for each discovery, and then transferring it in a manner consistent with this determination. Operating an office in this mode is not an entirely altruistic goal on the part of the NPRO. While Strategic Goal Scenario number one was focused on maximizing relationships internal to the NPRO (specifically with its researchers), this scenario is principally focused on maximizing the NPRO's external relationships. By taking this approach, the NPRO is anticipating secondary, longer-term, benefits such as increasing collaboration with industry, increasing research contracts in general, increasing gifts/donations to the NPRO from successful commercializers, increasing support (or at least stemming the rate of decrease) from their state or federal government (if they are a government-supported institution) as a result of their economic contributions. In order to achieve these outcomes, this office will not only need to maximize the transfer of the NPRO's technologies for commercialization by others, but to do so in a way that the NPRO gets recognized as being the source of the technology upon which the commercial success was built.

The first task facing an office operating with this strategic goal is to determine how each new invention disclosure can best serve society and determine the transfer mechanism that is consistent with its optimal purpose (Faley and Sharer, 2005). If a discovery has commercial potential, then the next question is, does the discovery represent a sustainable differential competitive advantage for a new product? If so, the licensee is almost always going to be interested in licensing this discovery exclusively. Only with an exclusive license will the licensee likely have the economic incentive necessary to invest in the development and marketing of a new product. In a vast majority of cases, no entity would be willing to invest time and money in new product development only to see their competitors immediately surge into the space once the original developer has created the product and demonstrated a market for its use. It is the temporary monopoly that the exclusive license provides that incents the development of new products. Since differentiated products can command differentiated marketplace margins, costs associated with licensing these types of technologies are consistent with the economic risk/reward of new product development. On the other hand, a discovery that a company would be willing to license non-exclusively suggests that these technologies are not the basis for a competitively advantaged product, but instead are discoveries that grant the company freedom to practice their other differentiating technologies, or benefits them in some general way (to provide a better testing method for the development of new materials, for example, as is the case with many "research tools"). Charging fees for non-exclusive licenses of these non-differentiating technologies ultimately serves to raise the cost for the company's products, without creating any sustainable differentiation for them. This often means that non-exclusive licenses, while generally not directly leading to the development of any new sustainably differentiable products end up eventually costing consumers more as these license costs are ultimately passed on to the consumer. The rather counterintuitive result is that exclusive licenses can directly lead to the optimal benefit to consumers, even when a fee is charged for such licenses, by incenting the development of new differentiable products while non-exclusive licenses, as opposed to making these discoveries available to the licensee at no cost, can be an economic detriment to society by unnecessarily raising the base cost of the production of such products; costs that will be passed along to the consumer. For profit non-exclusive licensing of research that was developed with taxpayer monies can be double jeopardy for consumers—first they pay for the research, then they pay a higher-than-necessary price for the end product. An example of this is the Cohen-Boyer technology that did not need to be patented in order to be adopted in the marketplace (Carroll, Roberts, 2005), and the non-exclusive licensing fees were likely a barrier to commercialization which some may view as an unnecessary tax (Rai, et al., 2007).

Strategy:

1. Effectively sort invention disclosures into their use needs (scientific merit, commercial background/enabling, commercial-differentiating).

2. Determine optimal commercialization route (licensing, startups, partnerships) for each commercial-potential disclosure.

3. Patent those technologies that appear to provide a differentiating commercial advantage, regardless of market size.

4. Generate enough licensing revenue from exclusive licenses to maintain the office and incent faculty to continue to participate in commercialization activities.

5. Maximize the number of technologies transferred.

6. Decrease "transaction" costs for licensing the NPRO's technology by decreasing the negotiation time.

Objectives: These will need to be calculated relative to historic activity in order to make them "SMART" objectives, but may be items such as:

• Increase number of disclosures to office by 15 percent.

• Increase technologies transferred by the office by 20 percent, using the method of Harris, et al. (Harris, 2007) to calculate number of technologies transferred.

• Increase inventor awareness of commercialization strategy and goals.

• Create a Web-based, one-click, no-cost license agreement to maximize technologies transferred through non-exclusive licenses.

Tactics: In this scenario, from an IAM perspective, more time is spent upfront determining how the technology can best be used commercially. If it has no apparent commercial use, it should be put into the public domain using traditional publication methods, as this is the most efficient means of transferring and optimizing the benefit of the new knowledge. If the discovery has apparent commercial potential, it then needs to be determined how this technology may be used in the creation of new products or services. Only potentially product-differentiating discoveries should be patented with the goal of licensing them exclusively, and licensing managers should seek to patent and license these technologies, regardless of apparent market size. All discoveries that have the potential to be licensed non-exclusively should be either put into the public domain via traditional publishing and/or licensed on a no-cost basis, to the extent possible. From a societal perspective, putting these types of discoveries into the public domain so that all commercial entities have access to the information at minimal cost is the most efficient means of transferring these to the martketplace. Assessing whether a technology should be licensed non-exclusively will require an understanding of the market and knowledge of technology benefits (Teece, 1986). The authors acknowledge the difficulty of doing so for early-stage technologies and the role of the customer's preference. It is clear that in some cases, certain technologies may be thought to be "market differentiating," but later information may show the initial assessment to be incorrect. This should be anticipated and should be considered a cost of doing business for this type office. These additional patent (IAM) expenses should therefore be considered as part of the operating costs of the office.

Given that an anticipated outcome for an office operating with this strategic goal is to be recognized externally for their commercialization contributions and to receive other ancillary benefits for its efforts in getting its technologies to commercializers, simply putting discoveries into the public domain will not be enough as the public domain transfer method does not require any recognition of the NPRO as being the source behind the commercial use of the discovery. Beyond the NPRO's expected attribution, the inventor's recognition will also likely be very important in attaining their involvement in the commercialization process. One potential solution that provides for the non-exclusive transfer of these technologies which minimizes transaction costs yet provides attribution to the discoverer and the NPRO is to develop a non-cost non-exclusive license. To be seen as "non-cost" from the licensee's perspective, this license should also have close-to-zero transaction costs. We therefore suggest a standard one-click, Web-based license that describes the invention, terms of its non-exclusive use, provides proper protection for the NPRO (no warranties and no liabilities), and articulates how the licensee is required to provide attribution to the inventor(s) and NPRO. This license will need to be consistent with any policy with respect to use of the NPRO's name by the licensee. Allowing the licensee to use the NPRO's and inventor's name in a defined context as explicitly described by the license (as opposed to not being able to use either without the no-cost license) will give credibility to the invention and provide incentive for the licensee to make that one click.

To increase the market impact of the research, this type of TT office must also use the "start-up" mechanism for commercializing new technologies. There is little doubt that many NPRO technologies will be viewed by many companies as being "too early" and therefore too risky to license. In many cases, the only viable alternative is to commercialize the technology through the formation of a new company. NBDCs should work closely with researchers who have an interest in starting new companies by developing start-up plans, feasibility assessments, and advising them of the start-up company process. This will require the NBDCs to also have good contacts with angel and VC investors. The NBDC staff should be empowered to turn away projects that apparently will not make it as new companies, but they also need to assist as many of these researchers with start-up help as possible in order to maximize the market impact of new technologies produced by the NPRO.

Discussion: Research and IP policies will need to be formulated that support the goal of maximizing the societal impact of new technologies. Further, the IAM strategy employed by the office should allocate resources to those technologies that appear to have the greatest chance for near-term market penetration, independent of market size.

Strategic Goal 3: To act as an "engine" for local/regional economic development.

Overview: This goal is likely to apply mainly to state supported NPROs and/or to those that have close ties to the community. To the extent that some state funding will be, or may appear to be, dependent on the organization leveraging its expertise to help generate economic development, this goal may need to be met in order to receive necessary state funding. Additionally, there may be a real need to cultivate relationships with the local community, for both political and strategic reasons.

For the sake of clarity, we assume that "economic development" in this context essentially means local/regional job creation. Since creating new companies is the way to create the largest number of new jobs, the creation of local start-up companies lies at the heart of any goal for generating local/regional economic development.

Strategy:

1. Maximize the use of a NBD function to get more technologies into the marketplace via the "start-up" company mechanism.

2. Leverage local resources outside the NPRO to optimize the local/regional impact of the NPRO's start-ups.

3. Create strategic partnership arrangements with local economic development agencies.

Objectives: As before, these objectives are simply generic examples, but may be items such as:

• Increase local/regional start-up companies by 15 percent.

• Increase licenses to local/regional companies by 10 percent, particularly those oriented on creating new lines of business for these companies that will create new jobs; or licenses that will allow the company to maintain their competitiveness thereby achieving local job retention.

• Establish or participate in your area's community-based angel network (or VC fund) in partnership with your local economic development agency.

Tactics: This office is heavily oriented towards new business creation—both start-up companies as well as the creation of new lines of business in existing companies. It is therefore imperative that an office with this orientation is heavily staffed with individuals that understand business and business creation—individuals (NBDCs) who can help researchers put their discoveries into the framework of a business, shape those business concepts, assess the feasibility of such a business, including a determination what other complementary assets the business will need [Teece, 1986] and therefore concluding whether such a new business is best suited as a startup or as a new line of business. These individuals should also be skilled in developing start-up plans for new companies. Beyond start-up plans, the NBDCs should assist in the launch of the new business by being able to assist in acquiring the resources (human and capital) that will be necessary to launch the business. In attempting to meet the goal-orientation of this type of office, the default position should be made that the technology will be commercialized by a start-up, and it should be treated as such until there is clear evidence that this goal cannot be achieved; at which point, a license to an existing company is considered. Meanwhile, TT and NPRO leaders should cultivate relationships with alumni groups, local economic development agencies, and local angel/VC groups since these partners will be needed for assisting in generating and launching start-up companies.

We believe it is imperative that this type of TT office attempts to leverage business school and law school resources as much as possible; particularly any entrepreneurship centers that may exist on campus. It would also be advisable to stay connected to local companies to make them aware of technologies produced at the NPRO and also of research opportunities which can help keep them at the cutting edge of the knowledge curve in their industry.

Licensing staff should aggressively market new technologies, putting the technology in terms of a competitive positioning for local/regional companies. These companies should be viewed as the NPRO's primary customer(s) if the creation of a new company proves infeasible. While it may be okay in this scenario to negotiate aggressively on royalty rates and other terms with companies located out of state or in other areas of the country, it is probably not advisable to do so with local/regional companies. Deals with local industry should be viewed as opportunities to service to the local economy, and while this should not be accomplished at a real cost to the NPRO, a strong argument can once again be made that the NPRO only needs to cover direct costs for licensing such items, potentially forsaking more lucrative deals in favor of local job creation. For example, once patent and marketing costs are covered, and a relatively low royalty rate agreed upon, deals with regional companies should be negotiated quickly. If the goal is local/regional economic development, it is more important that the NPRO be viewed as a cooperative partner in the economic development process rather than as slow and difficult to work with. These tactics will be rewarded by attracting more business opportunities: more local companies and investors will want access to NPRO developed technologies, and more local companies will want to use the NPRO for research projects.

Other tactics to consider include working with the NPRO's lobbying efforts and economic development officials to try to introduce legislation that provides tax breaks or other incentives for sponsoring research at or licensing technologies from NPROs. If a state, city or region is serious about such a partnership, they need to realize that the NPRO will need to have some incentives for working with the local/regional community versus nationally or internationally. It is in a state/region's own best interest to make the most fertile fields for innovation to be those in its own backyard.

Discussion: Research and IP policies that support the goal of creating local/regional economic development need to be implemented. Also, a hiring strategy that takes into account the skill sets needed to foster the creation of start-up companies will help the office meet its stated goal. The IAM strategy in this case should reflect the need to protect those technologies that are the most likely to become start-ups, or which will otherwise create jobs.

Strategic Goal 4: To act as revenue generator for the NPRO.

Overview: In this case, we assume that the TT office will attempt to maximize profit for the NPRO rather than maximizing revenue. Clearly, revenue could be increased by substantially increasing the size and cost of the TT office, but this is not typically an option for NPROs. As a result, maximizing the revenue per fixed amount of cost is the goal. Since the number of patents that can be managed and license agreements that can be consummated will be limited by the number of staff, maximizing the revenue for its existing staff will ultimately mean that the office will want to maximize the revenue received from each deal, while minimizing staffing, marketing and patenting costs. This revenue-goal scenario creates a portfolio management approach to the discoveries, with emphasis on licensing those discoveries that can be monetized in the short-run, but also keeping discoveries in the portfolio that have the potential to generate large revenue potential over a considerably longer time horizon. One way to approach this can be to focus on segmenting invention disclosures into two pools. One pool would include those that are market ready, or can be market ready, in the very near term (apparently 2 years or less). This can often mean software inventions, "research tools," copyrightable materials, and perhaps trademarks. Emphasis would also be on discoveries that could be licensed non-exclusively to multiple parties. The second pool would be those technologies that have the potential to grow very large over a longer time frame—the "home-run" model. Examples of this may include many pharmaceutical inventions and blockbuster start-ups such as Google, Yahoo, etc.

Prima facie, it is often fairly clear on a relative basis when an invention is at a stage that can be licensed in the near term, as opposed to cases where there is several years of development needed before there is a likely licensing or "start-up" company opportunity. The point is, there needs to be an initial assessment about how to classify a new invention disclosure, with the realization that the assessment can be changed as more information is obtained. The clear articulation of an intellectual asset management strategy to faculty in this revenue-generating scenario should reduce a lot of the tension between the faculty and the licensing manager; given that the rational not to patent decision is not a judgment on the researcher's technology, but rather a judgment on the market readiness for it and how large of a market it may serve.

Strategy: Although there are a number of strategies that can be employed by a TT office to achieve this goal, the strategy recommended here is:

1. Maximize the revenue received from existing licensees by an aggressive "collections" program.

2. Maximize revenue from new licensees by negotiating aggressively for high royalty rates and up-front fees.

3. Assert new and existing patents against suspected infringers.

4. Proactively utilize and maximize revenue from non-exclusive licenses for research tools, methods/processes, and related technologies.

Objective(s): As before, specific objectives are difficult to provide given that these are often stated relative to historic norms, but they may be:

• To increase revenue from existing licensees by 15 percent.

• To increase the number of licenses by 10 percent.

• To find 10 potential infringement cases by year end.

• To increase the number of non-exclusive licenses by 15 percent.

Tactics: One approach for maximizing profit from licensing is that licensing staff can focus on quickly "terminating" new invention disclosures with relatively small markets or long technology development timelines. This must be weighed against the need to preserve and invest in certain inventions that appear to have relatively long development timelines, but that also serve large markets. An example of this would be many pharmaceutical inventions. Those invention disclosures that are not terminated immediately are put into two "pools" – ones that appear to be ready for licensing in the near term (less than 2 years) and ones that need substantially more development, on a relative basis, but that appear to serve very large markets – the potential "home-runs." Licensing staff should devote much of their time to actively trying to find licensees for those in "pool 1" (the near term) while spending less time and energy on those in "pool 2" (long-term).

Discussion: Policies and hiring strategies here should reflect a clear desire to generate profit. The hiring strategy should seek to find individuals with the skill sets and experience that can support the key revenue generating tasks of the licensing managers. IAM strategies should focus resources on those technologies that appear to have the greatest chance to generate revenue. This will of course shift the office's focus to those technologies that can be applied to the largest markets, or largest potential markets.

Final Thoughts

As should be clear from the above examples, the intellectual assets that receive the majority of the NPRO's resources are a strict function of the TT office goals. This is summarized in the Tables 1 and 2.

As one would expect, different goals often lead to conflicting operational choices. For example strategic goal scenario #4—maximizing profits—leads to a preference for non-exclusive licensing, while such operational tactics are abhorrent to strategic goal scenario #2—maximizing positive impact of technologies. It is worth noting that there are instances in which although the goals, strategies, and objectives may differ, some of the tactics may end up being the same For example, this is the case for scenarios 1 and 2, which both call for the use of non-cost non-exclusive licenses. In scenario 1, this tactic is used in order to make sure the researcher is given proper commercial attribution for their work, which is presumed will help meet the ends of the service orientation of this office. In scenario 2, this tactic is again used, but in this case it used mainly to allow the institution to more accurately account for the number of technologies it has transferred.

Some may observe that it is the nature of TT to satisfy multiple goals simultaneously, and thus may feel that identifying any single goal may be limiting and

Table 1. Intellectual Asset Management Strategy			
Service Organization Model	**Maximize Positive Impact Of Technologies Model**	**Economic Development Model**	**Maximizing Profit Model**
Protect IP:	Protect IP classified as "product differentiators" regardless of market size that can be either:	Protect IP:	Protect IP that serve the largest markets and:
1. From well-known/ influential researchers.	1. Licensed in the relatively near-term.	1. That can become a start-up.	1. Appear to be license-able in <2 years.
2. That are aligned with organizational research priorities.	2. Become a start-up.	2. That are licenseable to regional business, that could be the basis of a new LOB (to create jobs).	2. Appear to be potential longer-term "home-run" start-ups/licenses (> 2 yrs.).
			3. Can be widely non-exclusively licensed

Table 2. Key Metric			
Service Organization Model	**Maximize Positive Impact Of Technologies Model**	**Economic Development Model**	**Maximizing Profit Model**
Internal researcher survey results.	Number of technologies transferred.	1. No. of start-ups formed.	Total revenue less direct costs.
		2. No. of jobs created.	

perhaps unrealistic. The conflicting objectives and success measures (income versus happy researchers, for example) that can result from multiple goals is precisely why a single primary goal must be identified and elevated in importance above secondary and tertiary goals. In practice, this means aligning strategies, objectives, and tactics with a primary strategic goal and then attempting to also meet other goals opportunistically to the extent possible. Given that the organization is aligned with meeting one goal, it should be recognized that the ability to meet other lesser important goals will necessarily be suboptimal. We hope that the specific-scenario discussion also illustrate the contradictory nature of the objectives and tactics for each of the various goal strategies (a bias for revenue-generating non-exclusive licenses with the revenue-centric goal versus the bias against such licenses with the transfer-centric goal, for example). The operational juxtapositions for the various goals should highlight the implausibility of trying to create sensible policies and operating methodologies for TT offices focused on optimizing multiple office goals.

The authors also recognize that not all of the discoveries of any NPRO will be from research supported by Federal grants and therefore not all will fall under Bayh-Dole guidelines. The ownership position the NPRO may take with respect to non-Federal grant supported discoveries may differ, as may the licensing strategies. If such discoveries are handled separately from their Bayh-Dole counterparts, then the goals, objectives, and success measures for the TT office with respect to those discoveries should be measured separately. Under such considerations, a TT office may have two separate primary goals—one for discoveries pursuant to Bayh-Dole and one for discoveries pursuant to non-federal research grants. But even with the separate measure of these research discoveries and their separate use objectives, the TT office will need to resolve conflicted staffing needs, policies, IAM strategies, objectives, and tactics that may exist with attempting to achieve two primary goals. The differential funding restrictions create even greater complexity and difficulty in managing a TT office, and is why we believe it is especially paramount to choose one primary goal, and to align resources, policies, strategies, and tactics with this goal. In doing so, one must again accept that meeting secondary goals will be necessarily suboptimal, but doing so will simplify the management of a highly complicated working environment, made more complex by differential funding restrictions.

Notes:

* We recognize that some may define the terms "mission," "goals," and "objectives" differently than we have defined them here. The definitions used here are consistent with those proposed by Peter Drucker (Drucker, 1954). However, because of the different organizational uses, and to be as broad as possible in our assessment, we looked for either mission or goal statements, but noting that many office's mission statements are the equivalent to what we are defining here as the primary goal statement. Either way, regardless of nomenclature, we found these statements to be largely unfocused, often describing three or four different and possibly competing outcomes.

** Some NPROs may not be subject to the Bayh-Dole Act, or may be subject to Bayh-Dole for a relatively small fraction of their discoveries and therefore may have formed a TT function for different reasons than many other NPROs. Therefore, their mission (and goals) may be somewhat different than those that receive a large proportion of federal funding, but the process is the same: identify the mission, identify the primary goal, and align the strategies, objectives, and tactics accordingly. ■

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