UNIVERSITY TECHNOLOGY TRANSFER

Questions and Answers

COGR

COUNCIL ON GOVERNMENTAL RELATIONS

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This document, which poses and answers twenty questions, is intended to inform the public about technology transfer at U.S. research universities. The Q&A has a compendium piece, entitled "The Bayh-Dole Act—A Guide to the Law and Implementing Regulations". Although each document fulfills its own purpose, they complement each other. When taken together they present a primer on the subject.

The Council on Governmental Relations is an organization which includes among its members over 135 research intensive universities. This booklet does not claim to be a manual of university technology transfer and licensing activities. Rather, it illustrates the philosophy and processes currently practiced in the university community.

In preparing the material, the COGR Subcommittee on Technology Transfer drew on the assistance of many COGR universities. Their help is gratefully acknowledged.

1. What is the Bayh-Dole Act, what prompted it, and why is it important to university technology transfer?

Enactment of the Bayh-Dole Act (P.L. 96-517), the "Patent and Trademark Act Amendments of 1980" on December 12, 1980 **created a uniform patent policy among the many federal agencies that fund research. Bayh-Dole enables small businesses and nonprofit organizations, including universities, to retain title to materials and products they invent under federal funding.** Amendments to the Act also created uniform licensing guidelines and expanded the law's purview to include all federally-funded contractors. (P.L.98-620)

Critical pressures prompted the Bayh-Dole Act in 1980. Congress perceived the need for reliable technology transfer mechanisms and for a uniform set of federal rules to make the process work. One major impetus for the bill was the lack of a capability on the part of the federal government to transfer technologies for which it had assumed ownership. Hundreds of valuable patents were sitting unused on the shelf because the Government, which sponsored the research that led to the discovery, lacked the resources and links with industry needed for development and marketing of the inventions. Yet the government was unwilling to grant licenses to the private sector. The few federal agencies that could grant patent title to universities, were overregulated with conflicting licensing and patenting policies. Technology transfer under those conditions was operationally prohibitive for universities and made them reluctant to enter the technology arena.

Since U.S. industry also was not inclined to brave government bureaucracy to license patents from universities or from the government, limited technology transfer was accomplished by the publishing of research results, training of students for the workforce and some extension programs established by the land-grant universities. The benefit to U.S. industry of such an unstructured process is undocumented and highly speculative.

The stability provided by the Act, its amendments and clear implementing regulations has spurred universities to become involved in transfer of technology from their laboratories to the marketplace. The ability to retain title to and license their inventions has been a healthy incentive for universities. Such incentive is needed, since participation in patent and licensing activities is time consuming for faculty, and must be done in addition to research and teaching priorities. The number of U.S. patents issued to universities has increased sharply since Bayh Dole was passed.

2. How has the Act influenced university technology transfer over the last decade and what are the results?

Bayh-Dole gave universities control of their inventions. By placing few restrictions on the universities' licensing activities, Congress left the success or failure of patent licensing up to the institutions themselves. That foresight has been rewarded by skillful and committed university professionals who have shown that licensing embryonic inventions can be successful. The keys are inventors motivated to engage in the process and a licensing relationship built on partnerships with industry. This model is now emulated by the federal laboratories.

The success of Bayh-Dole in expediting the commercialization of federally funded university patents is reflected in the statistics. **Prior to 1981, fewer than 250 patents were issued to universities per year. Slightly over a decade later, almost 1,600 were issued each year.** Of those, nearly 80% stemmed from federally funded research. In addition, the number of universities participating in the patenting effort has increased to the point that in 1992, 200 universities had at least one patent issued annually.[1]

Core technologies, likely to spark whole new industries, often result from university patents. This potential makes the contributions of the university sector to the national patent pool so significant. Examples range from the biotechnology to the laser industry. Stanford's Cohen-Boyer patent on basic gene splicing tools is at the heart of the entire biotechnology industry. The Axel patents, from Columbia University, provided a new process for inserting genes into mammalian cells to make protein. A host of new pharmaceutical products resulted from this invention.

The Atomic Force Microscope, invented at the University of California, Santa Barbara, is the most advanced atomic microscope in existence. The invention has not only significantly improved our ability to study the structure of molecules important in biology and medicine; it also helps scientists comprehend the subtle details of physiological and chemical processes as they occur in real time.

The field of Magnetic Resonance Imaging, as we know it today, has its roots in research at the University of California, San Francisco. This University-developed technology was first disclosed in the mid 1970s. Later university work in this area and productive partnerships with industry have led to continual advancement in the field. Today, Magnetic Resonance Imaging is a staple in modern medical care.

University gross licensing revenues of approximately $200M in 1991 and $250M in 1992,[2] are a striking indicator of how many university-owned patents have become marketplace products or are in the process of development by industrial companies. Bayh-Dole has enabled laboratory advances to become a significant factor in U.S. industrial growth.

[1] AUTM Survey, compiled annually by Ms. Kathleen Terry, State University of New York at Buffalo

[2] AUTM Licensing Survey, 1993.

3. How many research universities have technology transfer offices and what do they do?

It is not known exactly how many universities are engaged in technology transfer activities. One indicator is that over 230 U.S. universities and nonprofit research institutions are represented in the Association of University Technology Managers (AUTM). Among those universities that are active, one can observe a variety of structures and sizes. More significant than the structure of those offices, however, is their mission.

The mission of university technology transfer/licensing offices is to transfer research results to commercial application for public use and benefit. The office seeks and receives reports of inventions from investigators; reports the inventions to sponsors; decides whether to elect title for inventions developed with external funding; files patent applications; markets those patents to industry, and negotiates and administers license agreements. The technology transfer office is also responsible for oversight of patent prosecution, recording of income and disbursements, and yearly reports to the government.

The major effort of the office is to find companies which have the capability, interest and resources to develop embryonic technologies into useful products. Once a match is found, a license agreement is negotiated to ensure that the company will be diligent in its efforts and will provide a fair financial return to the university—one that reflects a portion of the university's contribution to the return the company receives.

Technology transfer operations are generally also involved in negotiating material transfer agreements. Under such agreements, investigators share research materials (cells, cells lines, reagents, or other organisms) with colleagues in other universities or industry. Technology transfer experts also review the intellectual property terms in sponsored research agreements with industry (in some cases actually negotiating these agreements in conjunction with the university's Contracts and Grants office). Importantly, the professionals in the office are also a resource to the campus on a wide variety of intellectual property matters.

4. How does university technology transfer work and what do universities license?

The major steps in technology transfer are: disclosure of inventions; record keeping and management; evaluation and marketing; patent prosecution; negotiation and drafting of license agreements; and management of active licenses. University technology transfer is mainly a system of disclosure, patenting, licensing and enforcement of patents and licenses.

The disclosure document contains information about the invention, the inventors, the funding sources, anticipated bars to patenting (such as publications), and other data (such as likely candidates for licensing). The disclosure is reviewed by the licensing staff or a university committee, who make a preliminary decision about ownership and the invention's potential commercial value and patentability. The technology transfer office takes action to insure that the newly disclosed intellectual property will be handled in compliance with federal and university policies.

The next step is to seek an opinion on the patentability of the invention or to file a patent outright. The technology transfer office then markets the invention to industry. A nonconfidential summary is sent to companies that are likely to be interested. If a company expresses interest, it will be asked to sign a secrecy agreement (to protect patent rights) prior to receiving confidential information from the university. If the company continues to be interested after reviewing the confidential information, an agreement with the company is negotiated. This can be a letter of intent; an option; or a license.

In conjunction with any one of these options, a research agreement may be negotiated to continue work on the invention at the university. Most university inventions are embryonic and require further research and development before they are ready for the market place. Thus, there is a high level of risk for the licensee—a fact that is taken into account in the licensing negotiation.

Technology transfer offices have many different "customers" with sometimes conflicting objectives. For instance, customers may consist of:

a) the faculty—inventors, who often have expectations of research opportunities, income, public utilization and fame;

b) the private sector, with expectations of securing commercially viable technology at a fair price;

c) the university administration, which expects the office to be self-supporting and wants to prevent conflicts of interest;

d) the governing board, which needs assurance that the university's name and reputation are protected in its industrial relationships;

e) the taxpayers, with expectations that the office will manage state and federal resources in an effective and nondiscriminatory manner; and

f) the sponsoring agency which insists on compliance with provisions of the Bayh-Dole Act.

In addition, the technology transfer office has the critical task of insuring that the missions of the university—education, research and service—are not compromised by the business interest emerging from the technology licensing function.

5. How is the licensing value (fees/royalties) of technologies determined, and how is that value protected?

License fees and royalties are determined by arm's length negotiations between licensor and licensee. Fees and royalty rates are rarely large because most of the technology is in early stages and risky, thus requiring considerable investment to transform it into a marketable product. There are, however, a few technologies that have clear commercial applications and have large potential markets. In such cases, the university can negotiate larger fees and higher royalty rates. The deciding factors are: the type of technology, its stage of development, the size of the potential market, the profit margin for the anticipated product, the amount of perceived risk, the strength of the patents, and the projected cost of bringing a product to market.

To place this in perspective, license fees rarely reach into the six figures for a single patent, but more often range from a few thousand to a few tens of thousands of dollars. Royalty rates range from less than one percent (for some process technologies) to perhaps eight percent (for a patented compound with a significant market). The majority of royalty rates are in the 3% to 6% range, based on net sales.

The marketing process itself sets the value of the technology—how interested are the prospective licensees. Other factors that play a role are the estimated dollar value of the research which led to the discovery; the projected cost of development needed to complete the product; the scope of the license (exclusive vs. nonexclusive; US vs. worldwide; narrow vs. multiple fields of use, etc.) and royalty rates for similar products.

Beyond such general considerations, many universities seek to accomplish several basic goals in development of the package of considerations: a) the licensee should fund the patent application either through an up-front fee for reimbursement of costs already incurred by the university or

through a requirement to reimbursement of ongoing expenses of the university; b) the license agreement should include ongoing considerations to the university (a royalty); c) required minimum annual royalties after a specified period of time regardless of actual sales; and d) performance milestones to assure that the university's technology enters the market. This "formula" hopefully assures that the technology is developed to completion and put in the stream of commerce, assures a fair return to the university, and assures that the technology is returned to the university should the licensee not pay the minimums or achieve the specified performance milestones.

6. What factors influence university decisions to license patents either exclusively or non-exclusively?

University decisions on whether to license a patent only to one company or to a number of companies are based on several factors. However, **universities are generally most influenced by two major determinants: (1) what kind of licensing is most likely to lead to rapid commercialization; and (2) what kind of licensing is in the public interest.**

Patents which are broad in scope and can be used in multiple industries, or patents that are so basic that they form the building blocks for new technologies are most likely to be licensed non-exclusively, or by fields of use. An exclusive, "field-of-use" license is a way to protect a market for a company while enabling the university to identify more than one licensee to assure public utilization of the technology in all markets.

Stanford University's Cohen-Boyer patent is an example of a basic patent that was licensed to all companies needing it. Non-exclusive licensing is preferred by universities when the technology can be used to foster product development in many fields of use. For example, if a technology will be of greatest benefit to the public if it becomes an industry standard, the university will make it readily accessible to all interested parties.

Universities most frequently will grant exclusive licenses to patents that require significant private investment to reach the marketplace or are so embryonic that exclusivity is necessary to induce the investment needed to determine utility. Frequently, these are new drugs requiring time-intensive and capital-intensive development or they are technologies that have only a tenuous link between the workbench and production. As such, they require a company willing to dedicate financial backing and the creativity of its own scientists on a long-range basis.

At the final call, the decision to license on an exclusive or non-exclusive basis is inevitably driven by market interest. Not only does the interest relate to the value of the invention, but also to the investment required to develop new products and the risk associated with that technology.

7. To whom do universities license and what role does the start-up company play in technology transfer?

Universities license technology to a broad spectrum of organizations and individuals, ranging from the large for-profit corporation to a small non-profit research institute. For example, a license may be given to a multi-national pharmaceutical company for a new application of a known drug because that company may hold the patent on the compound. A non-exclusive license may be granted to a number of computer hardware and software firms to incrementally improve product lines. A royalty-free license may be granted to another non-profit research institute to enable a researcher to practice the invention for research purposes. Included in these examples must also be a license to a early stage firm whose founding purpose was to commercialize the technology. While these kinds of licenses are probably the riskiest in terms of eventual commercialization and subsequent payoff, those licensee companies are sometimes the most effective at transferring the technology for the public good.

Universities search for the licensee most capable of commercializing the technology. Examples of criteria used in identifying the licensee are: financial and technological resources; "fit" within the company business plans; previous experience, and marketing capabilities. Desire of the licensee to commercialize the technology and the relationship of the inventor to the licensee are also important. Commercialization of technology is not dependent only on intellectual property rights such as patents, but also on the ideas and know-how of the inventor. Therefore, the ability of the inventor to relate to the licensee is often a key factor in a license transaction.

When an entrepreneurial inventor is involved, the licensee may be a early stage company formed around the technology. These entrepreneurial ventures may bring with them a myriad of potential conflict of interest issues which must be resolved before a license is consummated. Nevertheless, they often are the most desirable because they have several of the key licensing components: desire by the licensee to make the product/technology a success, and involvement by the inventor in assuring success. One other factor in licensing to early stage companies is that these companies make that technology their business, whereas in established companies the technology must compete for resources with other development projects.

8. Why is it not feasible to select licensees through a competitive bidding process?

Most university-developed technology is "sold" rather than "bought". This means that considerable investment is required to present, persuade, and tailor specific arrangements to the needs of the licensee. Usually, the task is to find at least one capable and interested company, rather than choosing among several candidates. It is generally impossible to bring the interest of several prospects to a head at the same time, as would be required for a meaningful competitive bidding process. Also, tailoring to special industry needs makes the competitive bidding useless. Yet, such tailoring is especially necessary in the case of small business firms to which universities are required to give preference for technology developed with federal funding.

Additionally, many universities are unable to afford the full expense of the patent application process. They therefore seek prospective licensees to cover such patenting expenses as part of a license agreement. The confidentiality required to prevent loss of rights in pre-filing negotiations makes competitive bidding difficult, especially when loss of patent rights through publication is imminent.

Normally universities contact several prospective licensees and pursue the most promising ones. Should there be more than one, universities will decide in favor of the one best able and diligent to develop the technology, not necessarily the one who will pay the most. Where time and circumstances permit, universities may showcase technology available for licensing, through publications, databases, and technology shows. More satisfactory results probably would not be achieved through a formal competitive bidding process. Because of the extra time and effort required in bidding, together with the inevitable reduction in flexibility, the result almost certainly would be fewer licenses and thus fewer university technologies being productively commercialized.

9. Why do universities sometimes license to foreign companies, and to what extent have federally-assisted technologies been licensed to foreign companies on an exclusive basis?

When universities seek potential licensees, they begin close to home—with companies within the same state or region. This makes sense because the company often needs to have access to the inventor as a consultant to assist in the development process. Such interaction is easier if distant travel is not required. **Universities consider licenses to foreign companies in those instances where all attempts to identify a domestic licensee have failed.** If a thorough investigation of all possible licensees in the United States results in failure, should the university seek foreign licensees or close the file? There are many foreign companies which are leaders in their fields and thus, also, are potential licensees. In some cases, such as in equipment for the paper drying industry, the only prospective licensees may be foreign companies. Many of what appear to be local and U.S. based companies are, in fact, "foreign"; they may have been purchased by a foreign corporation (as is the case with Genentech) or they may be a U.S. based subsidiary (as is the case with Miles, Inc.). The fact is that many companies are multi-national and have U.S. offices and factories.

The choice of licensee is best made on the basis of whether a company has the capability and resources to develop the technology and to bring it to market effectively. Since university technology is not a fully developed product, it is less a question of choosing among various qualified companies than finding any company willing and able to take a license. Thus if a foreign company makes a reasonable proposal and is capable of developing and marketing products based on the invention, the university will generally grant that company a license.

Nevertheless, universities should be extremely cautious in considering foreign licensees, especially if the research was funded by the U.S. government. For those inventions, all exclusive licenses require the licensee, including foreign companies, to manufacture products substantially in the U.S.

The recent GAO survey of thirty-five top NIH and NSF grantees showed that during 1989 and 1990, only eighteen of the one hundred ninety-seven exclusive licenses for NIH/NSF-funded inventions went to foreign companies (less than 10%). An additional eleven were granted to U.S. subsidiaries of foreign corporations.[3]

[3] "University Research-Controlling Inappropriate Access to Federally Funded Research Results", May 1992.

10. What is the relationship between patents and publications?

In order to obtain a patent, the inventor must fully disclose his/her invention. Thus, in some ways the act of patenting *insures* publication. At the same time, publication of the details of an invention prior to filing a patent application, can result in the loss of patent rights in most countries. The U.S. is an exception since it permits an inventor to obtain a patent if a patent application is filed within one year of the date of publication which first disclosed the invention.

Some scientists are concerned that the desire to obtain protection may cause publication to be delayed for long periods, slowing the exchange of scientific information and thus scientific progress. While this may be true in industry, it does not appear to occur in academia where publication delays for patent purposes are rare. When they do occur, it is usually for less than three months. In fact, if a faculty member starts the patent filing process at the same time as submitting a manuscript for publication, it is likely that the patent application will be filed (in three months) long before the manuscript is published (in six months).

For university scientists, the right of unfettered publication of data—in journals, other written media, through oral presentation at public meetings—is a basic principle of academic life. Patents protect this form of public discourse in science. **It is not a matter of having to chose between patents and publications; both are feasible and frequently desirable.** But if there is a choice, it is the faculty who makes the call.

11. Why is it not desirable to dedicate all federally-assisted inventions to the public via publication, rather than patenting some of them?

An argument has been made that inventions resulting from federally funded research should be dedicated to the public, by publishing the details of the invention in literature available to the public. The thought is that since taxpayers paid for the invention they should have free access to it. In reality, taxpayers could only reap benefit of the invention if they had large financial resources, sophisticated technical skills and the personal interest in practicing the invention. Further, this scenario would require inventions that are ready to go to production stage. In today's complex technological environment, federally funded research is rarely ready to go into production when universities are ready to license it. Such development is often time consuming and costly.

Taxpayers do benefit from inventions by having access to a broad range of products developed by a predominantly competitive marketplace. New drugs are a prime example. If the invention has been dedicated to the public through publication, **no commercial firm would devote extensive resources to developing the first commercial application, knowing that any of their competitors can step in and reap the profits of commercial exploitation once the invention has been proven.** Patents, and the seventeen year exclusive position they provide to the inventor, or to the inventor's designee, are necessary for successful commercial development of inventions.

12. What potential financial conflicts of interest could arise at universities in the technology transfer process, and what steps have universities taken to deal with them?

Universities are concerned about four primary issues in a conflict of interest between the academic researchers' duties to the university and their involvement with industry in technology transfer.

1. **Conflicts of time and commitment**—an over-involvement of the investigator with the company to the detriment of teaching and university research obligations. Most universities have regulations regarding the faculty member's time obligations to the university. For example, some universities state that the "academic year salary" covers 80% of the faculty member's time during the nine months of the academic year. Faculty are free to consult "up to 20% of the time" (usually understood to be one day per week) during the academic year. Payment for the "summer months" is often under a separate, negotiated arrangement. The issue is further controlled by regular reporting of the investigator's consulting and other outside commitments.

2. **Misuse of university resources** on the company's behalf—this includes university facilities, equipment, supplies and involvement of graduate students and other paid researchers. University policies should make it clear that work done at the university must be publishable in the open literature and that any intellectual property such as data, patents and software, developed with university resources belongs to the university. In addition, periodic reports to research sponsors assure that grant money is used for legitimate research ends. Periodic performance review by academic administration and an "appeal path" for employees further controls the process.

3. **Confusion in ownership** of intellectual property—The question: "Who owns Professor X's patent?" could become a common source of dispute, unless there are clear university policies and definitions within research agreements of the sponsor's rights. University policies commonly state that the university owns all patents and software developed using university facilities or developed under a sponsored research agreement. Industrial sponsors are commonly

granted first options to license patents arising from the research, and the federal government is granted a nonexclusive license to patents from federally funded research.

4. There may be potential or perceived **conflict of interest** where an inventor holds an equity position in a company, which the university has licensed to market and distribute the invention. Most universities believe that bringing such financial holdings into the sunlight, through public disclosure, is preferable to a hard and fast rule prohibiting the taking of equity altogether.

Universities also understand that potential unethical conduct may arise from an investigator's financial interest in a company. Universities have separate rules in place to prevent, discover or sanction fraudulent activities. Scientific misconduct, however, is not to be equated or confused with conflicts of interest.

13. Why is there sometimes joint federal and industrial participation in university research projects?

Increasingly, the federal government encourages the development of collaborative relationships between itself, industry, and academia. New partnerships are fostered through the Defense Reinvestment Act, programs at the National Institutes of Standards and Technology, the Environmental Protection Agency and the Department of Energy. Collaborative relationships are expected to promote economic development, job creation, technology transfer and innovation.

Federally funded projects can indeed benefit from the practical industrial perspective. The research can be enhanced by industry's interest in the application of the research to solving practical problems and creating new or better products. Industry scientists have substantial expertise in many federally funded research areas. Thus, **collaboration between research at the university and development at the company facilitates the transfer of new technologies to the commercial sector.** The resulting leveraging of funds and expertise benefits all parties and the public.

In certain programs, federal agencies require applicants to present a technology transfer plan as part of their funding proposal. In these cases, universities seek potential licensees while the research is in progress. Gaining company participation at that early stage increases the likelihood that the company will grasp the commercial potential of the research and will help move inventions to the marketplace.

Universities increasingly try to foster ties with industry. This can be a win-win situation: industry extends the scope of its R&D, and university investigators extend their limited research dollars and gain access to the expertise of industrial scientists. Bringing industry interests into university projects also contributes to placement of university graduates in industrial settings where their education and training is effectively used.

Some state governments are also promoting industry-university ties. For instance, the Texas Higher Education Coordinating Board makes biannual awards of approximately $60 million to researchers at state universities in the Advanced Technology Program. Receipt of state funds under this program is contingent upon industry participation in the research project.

14. Do universities apply different policies and procedures to inventions assisted by industry funds than to those assisted by federal funds?

Universities generally apply the same policies and procedures to all inventions made at the institution, whether they result from federal or industrial funding. Of course, the university must comply with certain government reporting and licensing requirements of the Bayh-Dole Act for inventions resulting from federally funded research. Nonetheless, university policies emphasize the university's responsibility to manage *all* its inventions for the public benefit.

When an invention results from industrially funded research, the sponsoring company is often granted the first opportunity to obtain a license to commercialize the invention. If joint industrial and federal funding is involved, the company's rights are subject to the institution's obligations to the federal government. Whether or not federal funds are involved, the university insists on license terms that require the company to be diligent in developing the invention. If the company does not comply, the university generally reserves the right to terminate the license or to grant licenses to other companies. In this way, a company can be prevented from "shelving" an invention that might replace or compete with one of its existing products.

15. When is it appropriate for license rights to future federally assisted inventions to be committed to an industrial sponsor?

When both federal and industrial funding support a research program, it is appropriate to grant an industrial sponsor the right to receive licenses to subsequent inventions. The regulations implementing the Bayh-Dole Act specifically recognize this possibility. It is also possible for two separate research projects to contribute to a single invention. If one project is sponsored by industry and one by the federal government, the industrial sponsor can be given rights to the invention.

It is, however, considered inappropriate to grant an industrial sponsor the right to exclusive licenses to future federally assisted inventions which result from research that the company does not fund.

Perhaps the most fundamental boundary is that universities should not grant to a single industrial sponsor the rights to federally assisted inventions from the entire institution or major units such as departments, centers and laboratories. The granting of rights must be specific to the scope of work funded.

University action in the management of inventions is guided in part by their mission: instruction, research, and public service. It is within this mission that universities undertake federally assisted research. The administration of invention rights arising in this research is further bounded by the implementing regulations of the Bayh-Dole Act. For example, the Act specifies that manufacture of products based on the technology should be done substantially in the United States. This is good public policy, but it also makes good business sense. Companies often express a concern about the government's march-in rights under the Act. These rights, again, are appropriate public policy and would likely be applied only when a company's pricing is abusive—a condition which the marketplace is more likely to correct first.

It is within this framework of principles, institutional mission and federal regulations that universities determine what rights to grant to industrial sponsors.

16. How much income is derived by universities from licensing federally assisted inventions, and how is that money used?

The 1992 GAO survey of thirty-five top NIH and NSF grantees showed that for the two-year period 1989 and 1990, those universities received a total of $113M from licensing of which $82M was for licenses of NIH/NSF funded inventions. To place these figures in context, the **invention income was less than 1% of the research support provided to universities by NIH and NSF.**

The Association of University Technology Managers (AUTM) gathered 1991–1992 data from U.S. and Canadian institutions engaged in technology transfer. 98 U.S. universities provided gross figures on their royalty income. For 1992, royalties amounted to $172M. This figure needs to be adjusted for legal fees, amounting to $37M. In addition, the survey does not translate into dollar terms the amount of staff time expended to manage the process. Such figures tend to be meaningless in the abstract, lacking the context of institutional, federal and industry funding which provided the basis for the invention disclosures.

In reality, licensing income is small in comparison to the total university budget or even in comparison to the university's sponsored research budget. Even at the schools with the most licensing income those percentages rarely exceed 3–5%, and at most schools the percentage is less than 1–2%.

How do universities use royalty income? The answer is the same at all U.S. universities—income from licenses flows back into research or teaching. According to federal law, the universities must share licensing income from federally funded inventions with the inventors. The balance of income can be used to cover the costs of the technology transfer program and to support teaching and research at the university. While the specific percentages vary from institution to institution, the typical royalty sharing policy provides, after expenses, about 1/3 of net income to the inventor 1/3 to the inventor's department, and the university's general research fund receives the final 1/3.

17. How do universities measure success in technology transfer?

There are many ways to measure success in technology transfer, but since this is a new field, success indicators are not yet uniformly established. Various measures include: the number of inventions disclosed; the number of patent applications filed, patents issued, and licenses consummated; the amount of licensing income, and the number of commercial products produced and sold. Some institutions track the number of industrial interactions and research projects funded as a direct result of marketing initiatives. Others point to spin-off industries and related incubation facilities, which tend to grow next to highly innovative universities. Silicon Valley and Route 128 are well known examples.

More intangible, but nonetheless significant indicators include: a university's capability to retain entrepreneurial faculty and attract outstanding graduate students; its reputation for innovation; the enhancement of university research; and the promotion of the university's name. And **the marketplace impact of university originated products and technology is unquestionably a major component of success.**

Marketplace products are recognized by the public as a tangible outgrowth of its support of basic research. An example of the impact of university technology transfer on the marketplace is found in the biotechnology industry. This entire industry—and ten thousands of new jobs it created—is based upon university research. The Cohen-Boyer patent licensed by Stanford University is used by all biotechnology companies. In addition, many of these companies were founded to develop university inventions, whether related to specific genes, monoclonal antibodies or potential drugs.

18. Why do universities retain title to inventions?

Universities are unique environments. They are the cumulative product of decades of social investment. Their land and physical plant may have been granted or gifted by state governments or individuals. Their tremendous value to the public is exemplified by the fact that they are traditionally tax-exempt. Their activities are supported by a mix of state, federal and private investment. The pact between universities and the public demands accountability for use of resources which have been provided at public expense, and imposes an obligation upon universities to ensure that the public receives benefit for its investment. This is one factor in some universities' reluctance to sell patent title to industry. Other factors also play a role:

- The value of the American research university is in the reservoir of its scientific experience and the accomplishments of its faculty and students. Ensuring continued use of unique discoveries within the classroom and laboratory is indispensable to maintaining the quality of the research university. **By maintaining control of their patents, universities allow both commercial use plus contributions to the universities' collective intellectual experience.**

- By nature the university is a dynamic environment with faculty and students freely interacting with one another. Cross-fertilization of ideas may result in multiple inventions with obligations to different funding sources. By retaining title to patents, universities are in a position to equitably apportion the right to use patents among the contributing organizations.

- The link between technology creator and product developer is crucial for successful commercialization. The product developer most often does not have the knowledge to work with the basic inventions that result from university research. By retaining patent title and licensing those patents to industry, universities establish a partnering relationship that allows ongoing interaction between the source of the idea and those with the expertise to bring it to the marketplace.

- By retaining title to patents, universities can require licensees to make diligent efforts toward commercializing those patents. Patents not used must be surrendered to the university so that an alternative licensee may be found. Universities can ensure that new product opportunities are not wasted by companies without the resources, resolve or capability to achieve commercialization.
- Incentive to invent is as important to the university scientist as it is to the industrial scientist. A technology transfer program structured around royalty-bearing licenses, rather than patent title assignment, helps motivate university scientists to pursue break-through discoveries.

19. Why aré universities a vital link in the chain from creation of knowledge to development of products?

The valuable results of research which provide advances in technology are usually the result of the curiosity of a researcher who is asking "Why is this so?" or "Where could that lead?" What makes universities unique is the fact that they provide a rich diversity bringing together multiple disciplines, with a broader focus than product-specific industries. Most importantly, universities train and nurture the next generation of scientists and engineers which will carry with them to industry the ability to link creative knowledge with product development. The university provides the environment—library, laboratory, resources, equally curious colleagues and students—to nurture the pursuit of knowledge.

However, this **knowledge often needs further work even to begin to determine its usefulness as a contribution to a product or service.** Industry is reluctant to support research which is not directed toward immediate financial return. **The university provides a proving ground on which to take next steps toward commercialization.**

The majority of university research is sponsored by government agencies and is not targeted to specific commercial markets or end products—it is, by definition, basic research. However, since it is the nature of research to identify and test new ideas, its results often lead to the expansion of scientific knowledge as well as to the development of new technologies and products which benefit the public.

20. Why is it important to encourage university inventors to participate in the patenting process and how are they motivated?

Universities make a considerable investment each time they decide to patent an invention. Their resources include the faculty inventor's time and energy, and the outlay of dollars required by the patent application process. Commitment and support from the faculty is essential for successful technology transfer activities by their institution. Beyond the actual patenting stage, however, **the path from an invention to final product or service in the marketplace is usually long and expensive. During this stage, the scientific knowledge of the inventor needs to feed into the process, to assure smooth and continued progress.**

In addition to royalty income, faculty recognition by peers is important. In some schools the preparation of material to obtain a patent and the successful completion is given weight in the tenure and promotion process. This investment in time and money will not be made without incentives. In fact, the Bayh-Dole Act deliberately grants those incentives, to the inventor and the universities. Beyond the gratification of bringing technology to public use, the institution needs to recover its investment. The inventor hopes to generate research funding in the short term and possibly receive license fees to use for future research support. It is important to recognize that without such incentives, many inventions may not get carried through the necessary steps and a commercial opportunity will be wasted. This wasting of ideas is a drain on the economy, irrespective of whether it was public or private funding which led to the initial invention.

Many faculty researchers were not exposed to the idea of intellectual property, patents, copyrights, trademarks, etc., during their early academic careers. They may have misconceptions and apprehension about the patenting process. One common misconception is that the public benefits only when research is rapidly published and provided equally to all interested parties. Another is that patents should be obtained only by industrial researchers.

Many universities provide outreach programs to potential university inventors to dispel these misconceptions and to allow inventors and their laboratories to benefit from their ideas. Encouraging faculty to participate in the process of patenting may increase their understanding of the benefits of protecting the valuable technology. Involving inventors

in the process of marketing the technology is helpful in broadening their outside interests. In this manner, the inventor gains an insight into new potential sources of research funding as well as the benefits of commercialization.

Not all faculty will agree that their involvement in commercialization activities is appropriate. Some contend that commercialization taints the university and detracts from its mission. They believe that technology transfer should be accomplished through more traditional methods, such as the education and training of students and the broadest dissemination of knowledge through publications.

Change is inevitable and change will be effected by success of the commercialization efforts. Yet, participation in such activities should always remain an option, and should remain consistent and focused on the mission of academia.