

AUTM

Association of University Technology Managers

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TECHNOLOGY TRANSFER ADDS \$21 BILLION TO ECONOMY AND SUPPORTS 180,000 JOBS A YEAR

San Francisco, CA -- A comprehensive five-year survey released today by the Association of University Technology Managers (AUTM), shows that new innovations are moving from university laboratories to the marketplace faster and more efficiently than ever before -- creating new products, jobs and company start-ups as well as advancing healthcare. An analysis of the 1995 Survey data shows that the licensing of university inventions -- a process known as technology transfer -- adds more than \$21 billion to the economy and supports 180,000 jobs each year.

"These data show that as universities demonstrate growing proficiency to transfer technologies for the public good, academic licensing is increasing the return on the federal government's investment in research," stated Teri Willey, President of AUTM. "A total of 464 companies were started as the result of academic licensing in 1994 and 1995 alone, 28 percent of all start-up companies formed by academic licensing since 1980."

"In the health care arena, technology transfer has brought life-saving new pharmaceuticals and treatments to the American public," she continued. Specific examples include a vaccine for *Haemophilus Influenzae* type B, until recently the leading cause of bacterial disease in children under 5; diagnostic tests for breast cancer and osteoporosis; and new pharmaceuticals for hemophilia, anemia, cystic fibrosis, multiple sclerosis and heart attack patients.

"Technology transfer efforts have risen dramatically as the direct result of the 1980 Bayh-Dole Act which enabled universities and other nonprofits to own and patent inventions resulting from federally funded research programs," added Willey. "As technology transfer programs become established, we are seeing a dramatic increase in patent and licensing activity -- which means that more goods and services are being created for the public," Willey explained.

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Prior to the Bayh-Dole Act fewer than 250 patents were issued to universities each year, and often discoveries were not commercialized for the public's benefit. In the past few years, an average of almost 1,500 patents have been issued to universities annually in this Survey. Furthermore, the 120% increase in U.S. patent applications and the 68% increase in licenses from FY 1991-1995 indicate that the transfer of technology from academic institutions to the private sector will continue to grow in the next decade, generating future economic growth and health benefits.

FY 1995 also saw a continuation in the growth of licensing activity, illustrating the success of partnerships between academic institutions and industry. More than 10,000 licenses and options were executed between 1991 and 1995, of which 2,600 were executed in 1995 alone. "These results must, of course, bring credit to the corporate community, without which little, if any, of the process of technology transfer could have occurred," said Daniel E. Massing, the Chair of AUTM's Survey, Statistics and Metrics Committee, which managed the study.

"The increase in academia-industry partnerships has created a win-win situation: universities are able to attract additional research dollars to develop their technologies and gain access to the expertise of industrial scientists while industry extends the scope of its research and development," he added. Massing also noted, "Relationships with industry also contribute to the placement of university graduates in settings where education and training is effectively used."

The Survey data show how universities have begun to leverage these partnerships. As part of licensing agreements, 76 U.S. universities attracted nearly \$113 million in new industry research support in 1995. This represents a 7 percent increase over 1994, when the data were first collected. In addition, the Survey asked respondents to report the number of licenses negotiated that included equity. Fifty U.S. universities reported that 99 such agreements were made in 1995, and a total of 464 agreements were made prior to 1994.

A further measure of the value of new academic discoveries is the \$424 million in royalties earned by academic institutions in FY 1995. These royalties are reinvested to pay for research and other academic programs, to cover some of the expense of patent protection, to provide incentives for innovation and to support technology transfer operations. "Although the royalty return to the academic community has averaged less than 2 percent of total university research funding, royalty revenue is a direct indicator of the success American industry has had in moving university technology to a worldwide marketplace," stated Willey.

America's university system has long been the envy of the world due to the top-notch educational opportunities it affords its students. Now there is a new angle. In an exciting and constantly evolving partnership with American industry, our higher education system is also creating the tools and innovations fundamental to positive economic growth, improved health and increasing prosperity for countless Americans. The true success of university technology transfer is illustrated by products and services that account for billions of dollars of the U.S. gross domestic product, employ millions of U.S. citizens, and help to improve the quality of life for an immeasurable number of Americans every day.

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Licensing Survey FY 1991 - FY 1995

Executive Summary

About the Survey

The AUTM Licensing Survey is the only survey that gathers technology licensing data from academic institutions, including universities, hospitals, research institutes and patent management organizations from across the United States and Canada.

For FY 1995, the Survey reports on 173 institutions, including: 127 U.S. universities, 27 US hospitals and research institutes, 16 Canadian institutions and 3 patent management firms that manage intellectual property for research institutions. This sample includes information on 87 of the top 100 U.S. research universities ranked according to research dollar volume.

The five-year survey summary also includes recurrent respondents that provided data for the survey every year between 1991 and 1995. This sample includes 85 percent of the top 50 U.S. universities.

About AUTM

The Association of University Technology Managers (AUTM) is a professional development organization known worldwide for its achievements in the teaching of successful technology transfer and intellectual property management principles and practices

EXECUTIVE SUMMARY

America's universities provide more than a world-class education system; they create the fundamental knowledge essential to our economic growth, health and prosperity. Advances in science and technology on our nation's campuses spawn new businesses, create jobs, open new markets and lead to products and services that save and improve the lives of all Americans.

As the data in this Survey show, new innovations are moving from the laboratory to the marketplace faster and more efficiently than ever before. New innovations are becoming more accessible and increasingly are being optimized for the public's benefit. Moreover, the return on the federal government's investment in research is rising dramatically as universities demonstrate growing proficiency in transferring new technologies to the private sector through licensing agreements.

The impact of this technology transfer has been astounding. An analysis of the 1995 Survey data show that the licensing of university inventions adds more than \$21 billion to the economy and supports an estimated 180,000 jobs each year. In 1995 alone, academic licensing led to the formation of 223 new companies. And new products such as a synthetic Hepatitis B vaccine and drugs for cancer treatments are saving lives and enhancing Americans' quality of life.

This success in technology transfer -- and the resulting economic and health benefits -- is the direct result of the 1980 Bayh-Dole Act. This legislation, co-sponsored by former Senators Birch Bayh and Robert Dole, enabled universities, nonprofit research institutions and small businesses to own and patent inventions developed under federally-funded research programs. Prior to the Act, fewer than 250 patents were issued to U.S. universities each year and discoveries often were not commercialized for the public's benefit. In the past few years, U.S. universities participating in the Survey have been issued an average of almost 1,500 patents per year.

Furthermore, a 120 percent increase in U.S. patent applications and 68 percent increase in licensing activity from 1991 to 1995 indicate that the transfer of technology from academic institutions to the private sector will continue to grow in the next decade -- generating future economic growth and health benefits.

The Association of University Technology Managers (AUTM) has sponsored this licensing survey to document and measure the impact of universities, hospitals, nonprofits and patent management organizations engaged in technology transfer. As a five-year comprehensive report, this volume contains data for the fifth consecutive year of data collection and combines it with data from the previous years.

Licensing of university inventions adds more than \$21 billion to the economy and supports 180,000 jobs each year

CREATING JOBS, BUSINESSES & INDUSTRIES

As technology transfer efforts continue to increase, new industries, businesses and jobs are being created. Since 1980, academic licensing has helped to form 1,633 new companies. Of this total, 464 companies (28%) were started in 1994 and 1995.

The increasing success of partnerships between academic institutions and industry is illustrated further by the more than 10,000 licenses and options executed between 1991 and 1995, of which 2,600 were executed in 1995 alone.

During this five year time period, the total number of licenses and options increased by 68 percent for all academic institutions and by 66 percent for U.S. universities.

University technology transfer has had a significant economic impact. Based on earlier work performed by Ashley J. Stevens, a revised analysis using the current 1995 Survey data shows that the licensing of university inventions adds more than \$21 billion to the economy and supports an estimated 180,000 jobs each year.

The economic impact estimate includes both pre-production investment (made prior to the sales of licensed products) and post-production sales of products by licensees. Applying a formula developed by the Massachusetts Institute of Technology³ on AUTM's 1995 Survey data, the pre-production investment is calculated to be approximately \$4 billion per year. This total is added to AUTM's own calculation -- developed in previous surveys and applied to the FY 1995 data -- that sales of licensed products generates approximately \$17 billion per year. Thus, the total economic impact is estimated at \$21 billion.

The job impact estimates are calculated by dividing the total economic impact estimate by an average total research and development job cost of \$115,000. The average job cost is derived from U.S. Census Bureau figures which include total salary and benefit costs for high technology positions in large firms and small businesses. This analysis shows that technology transfer by academic institutions supports an estimated 180,000 jobs per year.

ACADEMIC LICENSING

ACTIVITY	FY 1995 ¹	FY 1991 - FY1995 ²	AVERAGE ANNUAL % CHANGE FY91 -95 ³
Invention Disclosures	9,789	40,795	+ 7%
Total US Patent Applications Filed	6,473	20,065	+30%
New US Patent Applications Filed	2,972	11,328	+12%
Licenses and options executed	2,516	10,346	+17%
New Research Funding Linked to Licenses ⁴	\$147 M	N/A	N/A
Start-ups Formed	223	N/A	N/A
Licenses and options generating royalties	5,336	20,216	+ 19%
Adjusted Gross Royalties	\$424 M	\$1,541 M	+ 32%
Legal Fees Expended	\$79 M	\$297 M	+ 20%
Total Sponsored Research Expenditures	\$19,905 M	\$82,166 M	+ 8%
Research Expenditures: Federal Govt. Funds	\$12,934 M	\$54,964 M	+ 6%

Two specific examples of the success of university licensing are Lycos, Inc., a company which develops and provides on-line guides to the Internet's World Wide Web, and Osteomark[®], a diagnostic test for osteoporosis. Lycos was valued at

US UNIVERSITIES ONLY

ACTIVITY	FY 1995*	CUMULATIVE % CHANGE FY 91-95**
Invention Disclosures	7,427	+29%
Total US Patent Applications Filed	5,100	+127%
New US Patent Applications Filed	2,373	-63%
Licenses and options executed	2,142	+66%
Licenses and options generating royalties	4,272	+72%
Adjusted Gross Royalties	\$274 M	+108%
Legal Fees Expended	\$60 M	+82%
Total Sponsored Research Expenditures	\$17,212 M	+29%
Research Expenditures: Federal Govt. Funds	\$11,381 M	+23%

approximately \$200 million in its initial public offering and now employs more than 100 people. The company . developing Osteomark[®] went public in January 1995 and raised over \$30 million in its initial public offering.

SAVING LIVES, IMPROVING OUR QUALITY OF LIFE

In health care, academic licensing has led to new pharmaceuticals, diagnostic tests and treatments that save lives, reduce suffering and enhance Americans quality of life.

For example, a vaccine for Haemophilus Influenzae type B, until recently the leading cause of bacterial disease in children under 5, was developed through university research. Over 32 million doses have now been distributed. The basic research for BRCA1, a new diagnostic test for breast cancer, was conducted by a university professor. And, after a doctor at an academic institution identified the lung secretion needed for normal breathing, an artificial secretion -- known as Artificial Lung Surfactant -- was created to prevent respiratory distress syndrome in premature babies. The secretion saves 20,000 infants each year.

Other examples of the medical breakthroughs made possible by university research and technology transfer abound. New pharmaceutical products for hemophilia, anemia, heart attack patients, cystic fibrosis and multiple sclerosis are just a few products that have been produced as a result of university research and academic licensing. These products not only save lives and improve our health, they help to fuel the \$100 billion biotechnology and pharmaceutical industries which employ hundreds of thousands of Americans.

Meeting Public Policy Goals

Academic licensing also helps our nation meet a number of other public policy goals, including improving public safety, environmental protection and economic competitiveness. The ET-2000 Guardrail End Treatment, for example, has been installed in over 24,000 locations, saving lives on our nation's highways and reducing the severity of injury. Faster and improved modems for data communications are made possible using precoding technology which was based on university research. And the Fluxless Soldering Method, enables the electronics industry to eliminate the need for

using environmentally hazardous cleaning agents to remove flux residue from lead-tin solders that have been "fluxed" to fuse properly.

PUBLIC REAPS RESEARCH BENEFITS

Technology transfer is a term used to describe a formal transferring of new discoveries and innovations resulting from scientific research conducted at universities to the commercial sector. One way that universities transfer technology is through patenting and licensing new innovations. The major steps in this process include: 1) the disclosure of innovations; 2) patenting the innovation concurrent with publication of scientific research; and, 3) licensing the rights to innovations to industry for commercial development.

The Survey data indicate that transferring new innovations is becoming more cost effective. In FY 1991, 8.5 million total sponsored research expenditures were invested per new patent application. This amount decreased by 18 percent in FY 1995 to 7.2 million total sponsored research expenditures per new patent application.

Total sponsored research dollars per licenses and options executed followed a similar trend. In FY 1991, 10.4 million total sponsored research expenditures were invested per license and option executed compared to 8.1 million per licenses and options in FY 1995.

Universities also have seen a significant increase in patent-related activity, further suggesting that new innovations are moving more actively through the pipeline from the lab to the market. Between FY 1991 and FY 1995, invention disclosures increased by 29 percent, new patent applications increased by 53 percent and licenses and options executed increased by 66 percent.

BAYH-DOLE ACT FACILITATES TECHNOLOGY TRANSFER

The success of the technology transfer program has its roots in bipartisan legislation sponsored by Senators Birch Bayh and Robert Dole. The legislation created a uniform patent policy among the many federal agencies that fund research. Most importantly, it enabled nonprofits, including universities, and small businesses to own and patent inventions developed under federally-funded research programs.

Critical pressures prompted the Bayh-Dole Act. Prior to this legislation, many of the discoveries that resulted from federally-funded research were not commercialized for the public's benefit. The federal government lacked the resources to market new innovations and industry was reluctant to make high-risk investments without the protection of patent rights. This meant that often valuable new innovations were left to sit on the shelf unused.

The Bayh-Dole Act reversed this trend. The Survey statistics clearly show that the academic community is meeting the Congressional challenge to promote commercial utilization -- through patenting and licensing -- of inventions resulting from federally-funded research programs. In addition to the more than 2,600 licenses granted in 1995, academic institutions filed 6,473 patent applications and were issued 1,833 patents. This single year of activity is a significant increase above the decade of activity pre-Bayh-Dole, from 1975 to 1984, during which universities applied for a total of 4,105 U.S. patents and were issued 2,944 patents.^{viii}

The universities' ability to manage the technology transfer process has also helped streamline the innovation timeline. According to a study conducted by University of Pennsylvania Economist Edwin Mansfield, the mean time interval between academic research results and the first commercial introduction of new products and processes has decreased from approximately 7 years to 6 years.^{ix} This shortened time interval reduces the development costs and speeds new products into the market.

Leveraging Federally Funded Research

Academic discoveries stem from basic research and are often 'embryonic' in nature. At the time researchers are ready to license their innovations, most have not yet reached the prototype stage -- much less demonstrated that they will have a practical application in the marketplace. Consequently, in order to foster commercialization, institutions must attract industry to make a high risk investment.

The increase in partnerships between industry and academic institutions has created a win-win situation: universities are able to attract additional research dollars to develop their technologies and gain access to the expertise of industrial scientists while industry expands the scope of its R&D. Relationships with industry also contribute to the placement of university graduates in industrial settings where education and training is effectively used.

The Survey data show how universities have begun to leverage technology transfer partnerships. As part of licensing agreements, 76 universities reported in the 1995 Survey that they attracted nearly \$113 million in new industry research support. This represents a 7 percent increase over 1994, when these data were first collected. In addition, the Survey asked respondents to report the number of licenses negotiated that included equity. Fifty U.S. universities reported that 99 such agreements were made in 1995, and a total of 464 agreements were made prior to 1994.

Another measure of the value attached to academic research is the \$424 million in adjusted gross royalties^x earned by academic institutions, of which approximately 65% (\$274 million) was earned by U.S. universities. This is an 18 percent increase over FY 1994 for all academic institutions.

Royalties help to advance scientific research and education through reinvestment in the academic enterprise. The royalties are given, in part, to university research departments to provide, among other things, new opportunities for graduate students, buy research

equipment or fund new research. They also are used to help sustain the technology transfer process by paying for the legal fees associated with patenting and licensing as well as funding technology management staff. And finally, as the Bayh Dole Act requires, a portion of the revenues is shared with the inventor.

Although royalties returned to the academic community average less than 2 percent of the total funding for university research, royalty revenue is a direct indicator of the success American industry has had in moving university discoveries to a worldwide marketplace.

Conclusions

The dramatic increase in patent-related activity over the past five years illustrates that transfer of academic research is viable and robust as we prepare to enter the next millennium. But perhaps most importantly, we are seeing that technology transfer helps to move the ideas and innovations that begin in the university laboratory to become the medicines, medical treatments, communications equipment, safety materials and thousands of other products that touch our lives every day. This is the true measure of success of the enterprise.

¹ This includes 173 respondents in FY 1995 survey, including 127 U.S. Universities, 27 Hospitals, & Research Institutes, 16 Canadian Institutions and 3 Third Party Patent Management Firms.

² This is a cumulative total of all participating respondents from FY91-95. The total number of respondents has grown from 130 to 173 over this period.

³ This calculation is based on a representative recurrent sample of survey respondents over the past five years. Recurrent respondents represent 75 - 90 percent of the total aggregate data depending on the year and variable being examined.

⁴ 76 universities gave a greater than zero response. The remainder reported zero or data not available.

⁵ Lori Pressman, Sonia Guterman, Irene Abrams, David E. Geist and Lita Nelson. Pre-production Investment and Jobs Induced by MIT Exclusive Patent Licenses: A Preliminary Model to Measure Economic Impact of University Licensing. 1995

⁶ This includes 127 universities which represent 87 percent of the top 100 research universities.

⁷ These figures are based on a representative sample of approximately 75 universities which have participated in the survey over five years. These universities represent 85 of the top 50 research schools.

⁸ The Council on Government Relations, University Technology Transfer Questions and Answers, November 30, 1993.

⁹ Science and Engineering Indicators 1996, National Science Foundation, page 5-12.

¹⁰ Adjusted gross royalties equal gross royalties minus royalties paid to other institutions to avoid double counting of royalty revenues.