What is value?

Is value best described in dollars and cents? In beneficial outcomes? In meaningful relationships?

THE STANFORD OFFICE OF TECHNOLOGY LICENSING ANNUAL REPORT 2008-2009

value

Creating it, predicting it, measuring it

What is value? Is value best described in dollars and cents? In beneficial outcomes? In meaningful relationships? The monetary value of the human body is about $4.50, but of course we laugh at that valuation of life. Merriam-Webster defines value as "a fair return," but "fair" is often a subjective claim.

At Stanford's Office of Technology Licensing, our charge is to place a value on "potential" – potential for greater good, potential for impact, potential for enhanced relationships, potential for revenue. How, therefore, do we go about valuing the potential of an invention?

creating it.

Stanford inventions theoretically all have potential yet they are typically at the edge of the known, bordering the unknown. The real challenge is that revolutionary inventions have an impact far greater than anyone can predict, but are also often those that are most difficult to recognize. If we could easily identify revolutionary inventions, technological advance would occur much faster.

The problem is that many of the inventions that have had the greatest impact on our lives were not recognized for their value at the time of their discovery. For instance, it was in 1928 that Alexander Fleming noticed that a petri dish containing Staphylococcus culture he had mistakenly left open had been contaminated by blue-green mold, which appeared to inhibit the bacterial growth around it. Yet after preliminary tests, he didn't believe it could live long enough in the human body to destroy bacteria, so it wasn't until many years later that penicillin came into widespread use as a life-saving antibiotic. Closer to home, when Stanford engineering students Larry Page and Sergey Brin brought their new search technology to OTL in hopes of finding a company that would be interested in licensing their invention, we marketed it to every potential licensee we could think of without success, until the inventors decided to form their own company, Google. At OTL, we employ our combined experience and expertise in an attempt to value the potential of hundreds of inventions, and then place bets on those we predict will have the greatest impact.

We also consider the value of our own work – university technology transfer. We believe that while technology transfer through licensing is just one small piece of the university's overall mission to generate and transfer knowledge, it is a valuable piece. Although universities transfer technology in a myriad of ways – typically through educating students and publishing discoveries – technology transfer through a licensing or industry-sponsored research agreement provides a system for ensuring that all parties understand the nature and expectations of the partnership. Each party brings important contributions to the relationship, and together they create enhanced value.

THE VALUE OF THE BAYH-DOLE ACT

There has been controversy about Bayh-Dole, the 1980 law that enables universities to assert rights in federally-funded inventions. In a sound-bite: Bayh-Dole created a system whereby investors, inventors, and companies have a very clear understanding of ownership – they do not have to spend time and effort finding out "who" has rights to an invention made at a university, which can stymie the further development of an innovation. Critics of the law say that university technology transfer offices reduce the value of innovation by being road blocks, hindering the natural transfer of knowledge from the university to the public. Yet advocates of Bayh-Dole believe that the law was "an inspired piece of legislation," as noted by The Economist magazine on the law's 25th anniversary, enabling the U.S. to keep its technological edge by encouraging the commercialization of federally-funded inventions.

Our perspective is that Bayh-Dole has been invaluable, creating an entrepreneurial awareness at universities and encouraging industry and university researchers to work together with a shared understanding that we all benefit when research results are translated quickly from the university to the private sector. It has also helped the public realize how university technology transfer can have far-reaching and invaluable commercial impact, though such benefits may be unforeseeable at the time of discovery.

predicting it.

THE CHALLENGE OF ASSESSING VALUE

So how do we value those potentially impactful inventions arising out of basic research? Some people probably think that we have a big dart board, and that we may be arbitrary in the way we value embryonic ideas. In truth, we know that Stanford inventions – born of smart men and women – have excellent "genetics." Yet we also know that "nurture" plays as critical a role as "nature," so we must find committed licensees to nurture our inventions so that they can reach their full potential. It typically takes 10 to 15 years of development and a significant investment of resources by a licensee for an invention to realize its value. We thus seek licensees who will truly be partners, sharing both the risk and the promise of success.

By definition, each invention is unique – its development path, its role in a product, its importance to a licensee. A core invention for a start-up company's business strategy is more valuable than a research tool used by a multinational company. A new product line for an existing company is more valuable than an added feature to an existing product. A long-term exclusive license can be more valuable than a nonexclusive license. An invention that has a potential market of $1 billion is more valuable than one that has a market of $100,000. And a committed licensee is always more valuable than one who isn't.

We consider all these factors in developing a license agreement. A start-up company typically cannot afford much cash; in these cases we will take equity (risky "monopoly money" or "the lottery" to some!) as part of the consideration. We expect a committed licensee to demonstrate its commitment both financially (through annual license maintenance fees) and through development diligence benchmarks throughout the term of the agreement. We are willing to share the risk by lowering fees during the early and riskiest part of the life of the license, to be offset by future milestone payments if the technology proves successful. We recognize the different business models of the life sciences industry compared to the internet-communications-physical sciences industry and are always willing to listen to potential licensees articulate their business reason for advocating a particular financial term. Last but not least, we know that we need to consider precedent and precedence, fairness and reasonableness as we negotiate with our potential licensees. At the end of the day, our goal is that each license agreement reflects the value of the invention as negotiated between two willing parties.

VALUING OUR RELATIONSHIPS WITH OUR LICENSEES

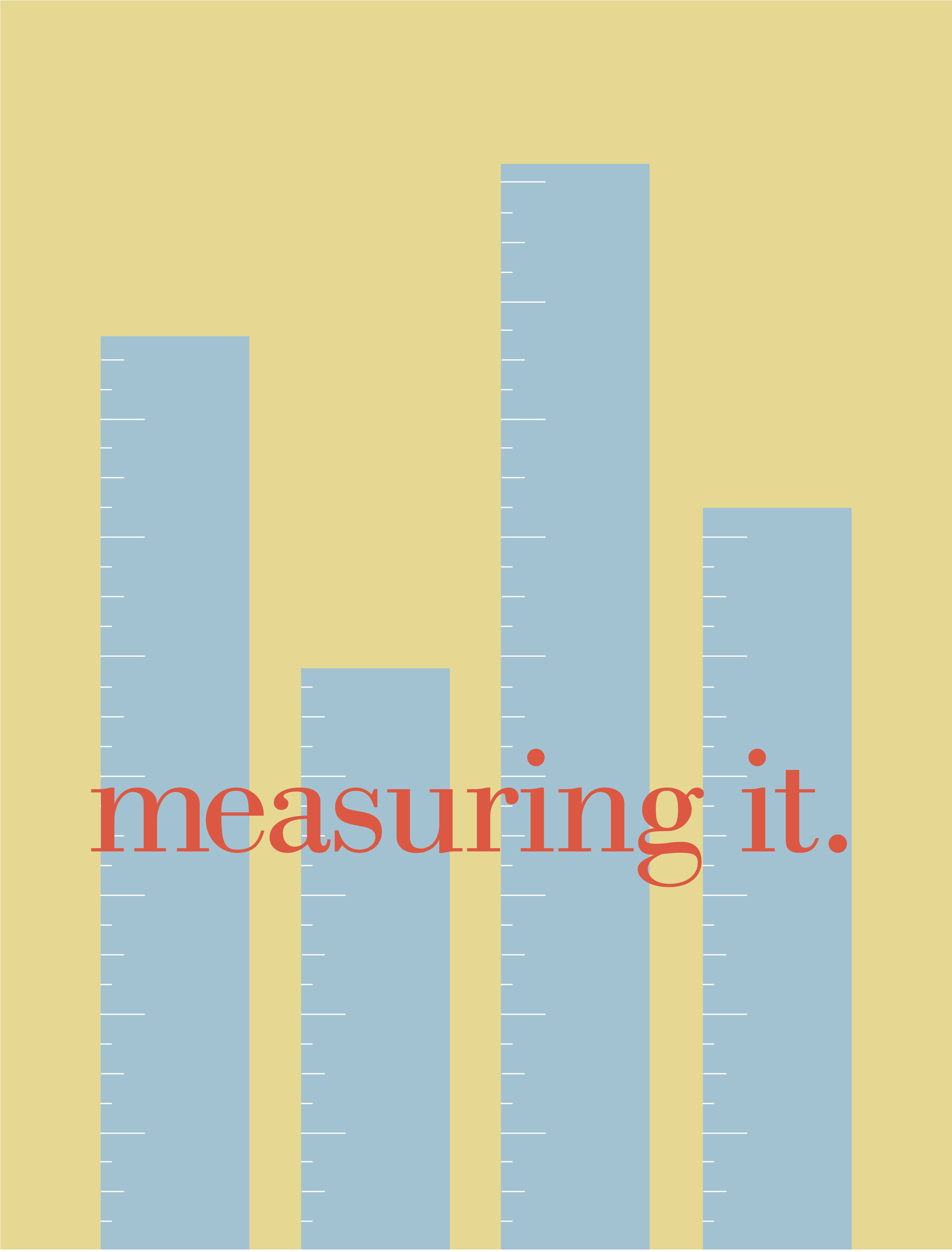
Even more important than the financial considerations of the license is the value of the relationship between Stanford and its licensees and industry partners. Successful licensees are visionaries who recognize that early-stage university innovations can add value to their company's mission and bottom line – bringing important products to the marketplace and contributing to the economy and to the public well-being. Our most successful licensing relationships have been long term – 20-30 years long – with shared experiences and respect for each other's roles in the commercialization process.

Although industry only funds a small part of Stanford's research, we recognize that industry-sponsored research has value far beyond its monetary contribution to research. At Stanford, a dedicated group of people within OTL – the Industrial Contracts Office (ICO) – is responsible for facilitating research agreements with industry. University research supported by industry funding brings together researchers from two vastly different cultures – the open environment of the university and the proprietary control of corporations – whose intermingling of perspectives benefits both sides. Since no one has a monopoly on knowledge, each learns from the other. Collaboration and cooperation have proven to be the best way to advance our common goals, and ICO is committed to fostering good research relationships with industry.

We also believe that research collegiality is one of our most important values to foster and maintain. Stanford and several other sister research universities have taken a leadership role with respect to Material Transfer Agreements (MTAs), particularly those between non-profit research colleagues. We are encouraging all universities to minimize the use of MTAs when possible, and to use the NIH's Simple Letter Agreement (SLA) or the Uniform Biological Material Transfer Agreement (UBMTA) when an MTA is required. This effort to

65.1 million
royalty revenue

measuring it.



reduce the use of MTAs will take time to be adopted by the majority of universities but will greatly enhance research cooperation.

77 *new licenses*

VALUING OUR RELATIONSHIPS WITH OUR INVENTORS

Whether created by a Nobel-prize winner or a student, Stanford innovations are kernels of new ideas that could be the beginning of a new product line, a new way of organizing information, a revolutionary therapy for an unmet need, a novel screening method to find new drugs. The breadth of Stanford inventions is amazing and the opportunity to learn about new inventions and their potential is what we find most rewarding about our work in OTL.

VALUING OUR RELATIONSHIPS WITH OUR COLLEAGUES

Lastly, we value each other and our Stanford colleagues. We work closely and cooperatively with the legal office, the conflict of interest group, the research administration staff, the deans, and the dean of research to enable research and technology transfer to happen effectively. The OTL staff is dedicated and diverse in its professional and personal interests and we are always willing to share our individual expertise. We value good judgment, common sense, and contributing to the common good in everything we do.

Our job at OTL is to plant as many licensing seeds as possible so that each valuable seed has a chance to grow and reach its potential.

WHEN THE VALUE OF AN INVENTION REACHES BEYOND THE BOTTOM LINE

Valuing a legacy

Most inventors are eager to get their royalty checks but when one inventor had consistently not cashed his checks, Nancy Fuller on our accounts payable staff was determined to track him down. Sadly, the former genetics post-doc had passed away suddenly, but that did not deter Nancy from trying to find his heirs. After more than a year of searching through newspaper obituaries and making calls to former colleagues (and even an ex-wife), Nancy finally found his mother. His mother wrote: “Your efforts to locate me resulted in a brand new reason to be so very proud of my son.” Because his royalties are now being used to support his five nephews in college, the legacy of this inventor will pass on to the next generation.

Valuing public health and well-being

While university licensing practices are complex and, in our opinion, “neither the problem nor the solution” to accessible global health, we are sensitive to the serious issues of unmet healthcare needs in the developing world. One of our inventions, mycobacterium tuberculosis and BCG Vaccine, invented by Dr. Gary Schoolnik, Dr. Peter Small, Dr. Michael Wilson, and Dr. Marcel Behr in 1998, has been licensed to the Danish Statens Serum Institute (SSI), which is developing a TB vaccine based on Stanford technology. In our efforts to contribute to the greater good, all sales to international organizations, including UNICEF, the World Health Organization, and the Pan American Health Organization, are royalty free.

We have other technology, currently unlicensed, which could be valuable to developing countries as well. Mycobacterial infections account for much morbidity and mortality; worldwide, there are 8 million new cases of mycobacterium tuberculosis every year and 2 million people die from it annually. Similarly, Staphylococcus lugdunesis is a significant cause of bloodstream infections and native valve endocarditis. We have a multiplex, real-time PCR assay that can rapidly and accurately identify both these organisms at less than $1 per test. Our challenge? To find a company that is willing to bring these products to the marketplace for the good of the world.

Valuing mobility

In a time when everyone seems focused on the increasing cost of healthcare, Professors Thomas Andriacchi and David Fisher in the department of mechanical engineering developed a way to avoid costly surgical or pharmaceutical options for patients with osteoarthritis. Their solution is a composite material built into a shoe that decreases knee pain by altering how people walk. The number of people with osteoarthritis is increasing every year, and the condition can prevent people from doing everyday activities. The researchers’ innovative and minimal solution could help millions of osteoarthritis sufferers postpone or forego surgery or drugs and continue to do the activities they enjoy most. Stanford has licensed the technology to The Walking Company, which hopes to bring its products to stores in the next few years.

Valuing safety: Two stories

No safe, capable, robust, and affordable platform currently exists for the development of personal robotics applications. Yet the development of such a platform could mean for the robotics industry the equivalent of what the PC meant to the computer industry. Stanford's "Spring Based Force Vectoring System" enables the implementation of robotic arms that are both capable and safe, which is a significant advancement in the field. The student inventors have joined start-up Willow Garage, the exclusive licensee, to further develop the invention for commercial and research uses. The faculty inventor, Professor Ken Salisbury, continues his research at Stanford with a Willow Garage-provided robot. For a brief demonstration, view the QuickTime movie at: otl.stanford.edu/lagan/06324/montage.mov.

Lightning might be exciting when viewed from the ground, but if you are in an airplane, it's not so fun. Professor Umran Inan of electrical engineering and graduate student Ryan Said developed a lightning geo-location network protocol that provides near real-time lightning data. Using a set of algorithms that process data from multiple geographically separated receivers, the system can detect the timing and location lightning strikes as well as characterize the amplitude and polarity of the lightning strikes.

Research sponsor and licensee Vaisala in Finland recently introduced GLD360, the Global Lightning Dataset, which incorporates Professor Inan and Mr. Said's research. GLD360 enables global coverage and timely information about severe weather developments. According to Vaisala, the "network detects over two thirds of all lightning strikes coming to the surface of the earth" and "provides information over oceanic regions where there is a real shortage of real time weather observations." GLD360 can assist in many meteorological areas, including thunderstorm identification, hurricane forecasting, and climate change research. For a brief video, visit www.vaisala.com/newsandmedia/pressreleases/vaisalaintroducesauniqueglobal-lightningdataset.html.

Valuing time-saving technology

If certain biological molecules could be designed and produced faster, the cost of therapeutic protein drugs could come down. Sutro Biopharma has licensed Cell Free Synthesis technology from Stanford, a linear scalable technology invented by researchers in Professor James Swartz' chemical engineering lab that overcomes important limitations associated with mammalian, yeast, and bacterial systems. Open Cell Free Synthesis harnesses the power and productivity of the entire cellular protein synthesis machinery without the requirement to maintain a living cell and focuses all the biochemical processes to make one product. It allows for faster screening and selection of product candidates, and improved control over reaction conditions, all without the need to spend long times developing cell lines. We believe this time-saving technology will become the manufacturing process of choice for therapeutic proteins in the future.

Year in review

2008-2009 will go down in our collective memory as the year of the financial meltdown. With companies cutting back on expenses, with investors too jittery to invest, and with research funding declining, we are honestly amazed that we were still able to negotiate licenses for Stanford inventions. Existing licensees were anxious to modify their agreements, citing funding pressures or the inability to raise more capital as reasons for not meeting their milestones. Stanford continued to be an entrepreneurial culture but it was much harder and took much longer than in previous years for start-up companies to be formed and launched. Not surprisingly all these factors affected OTL's activities for the year.

At the same time, there was optimism that President Barack Obama's administration would fuel a recovery, between stimulus spending and other aggressive actions by the federal government. While it is still early to tell how fast the economy will recover, we hope that companies will start investing in new technologies as the administration moves to encourage infrastructure and environmental investments. Clearly, "cleantech" is going to be an important sector.

Stanford received $65.1M in gross royalty revenue from 517 technologies, with royalties ranging

517 *royalty-producing inventions*

from $3.00 to $38M. Ninety-eight percent of the income came from licenses signed many years ago. We received equity from 9 licensees. Thirty-nine of the 517 inventions generated $100,000 or more in royalties. Three inventions generated $1M or more. We have evaluated over 400 new invention disclosures this calendar year. We spent $6.3M in legal expenses and concluded 77 new licenses. Of the new licenses, 31 were nonexclusive, 31 were exclusive, and 15 were option agreements.

2893 *active inventions*

ROYALTY DISTRIBUTION

Stanford's royalty-sharing policy provides for the distribution of cash net royalties (gross royalties less 15% for OTL's administrative expenses, minus direct expenses) to inventors, their departments, and their schools. In 2008-09, inventors received personal income of $17.4M, departments received $15.6M, and schools received $15.4M. The University assessed an 8-13% infrastructure charge on the department and school shares of royalty income.

We contributed $1M to the University General Fund and $1.7M to the OTL Research Incentive Fund, which is administered by the dean of research for the support of early-stage, innovative research ideas, novel interdisciplinary research, cost sharing of shared instrumentation, and other research facilitation needs. In addition, we contributed $83,622 to the dean of research and vice provost for graduate education. This amount represents their portion of liquidated equity. Stanford also paid the University of California and other organizations $993,244 for jointly-owned technologies for which Stanford has licensing responsibility.

EXPENSES

OTL spent $6.3M on patent and other legal expenses, of which $2.7M was reimbursed by licensees. We have an inventory of $15.3M, which represents patent expenses for unlicensed inventions. Our operating budget for the year (excluding patent expenses) was $4.9M.

We take a financial risk each time we decide whether or not to file for a patent. In this period of tremendous change in the intellectual property landscape as court cases determine new patent law, we will have to weigh the likelihood of licensing a technology versus the expense of patenting or litigation.

EQUITY

As of August 31, 2009, Stanford held equity in 97 companies as a result of license agreements. The market for initial public offerings was slow this year and share prices were down. For institutional conflict-of-interest reasons and insider trading concerns, the Stanford Management Company sells our public equities as soon as Stanford is allowed to liquidate rather than holding equity to maximize return. This year, we received equity from 9 start-up companies. We also received $165,631 in liquidated equity from 9 other companies.

START-UPS

While Stanford entrepreneurs are still starting companies, the uncertain economy clearly affects the Silicon Valley entrepreneurial ecosystem. Venture capital investors are generally shying away from early stage technology. Yet we licensed these companies: Akrotome, Animotion, Eiger Biopharmaceuticals, InMotion, MazorX, Netcrystal, Inc., Solar Junction, T2 Pharmaceuticals, and Vector Magic.

NEW DISCLOSURES

In calendar year 2009, we received over 400 new technology disclosures. Approximately 40% were in the life sciences and 60% were in the physical sciences, including computer science technologies and medical devices.

STANFORD TRADEMARK ENFORCEMENT FUND

The chief financial officer and general counsel of Stanford recommended that Stanford provide a permanent source of funding for extraordinary cases associated with the protection of the Stanford name and associated logos and trademarks. Based on their recommendation, the president and provost approved the creation of the Stanford Trademark Enforcement Fund (STEF). Funding for the STEF comes from 1% of the department and school shares of net revenue OTL receives. In 2008-09, we transferred $355,716 to STEF for a total to date of $2,265,503.

BIRDSEED FUND

The OTL Birdseed Fund, administered by the dean of research, has provided small amounts of money (typically up to $25,000) to fund prototype development or modest reduction-to-practice experiments for unlicensed technologies. This year, the Birdseed Fund funded four new projects, for a total of 85 projects funded to date. The rate of licensing of Birdseed funded inventions is about the

660 *inventor checks*

same as unfunded inventions (20-30%) but without this funding, many of these inventions would likely have remained unlicensed.

THE LITTON PROJECT

In 2000, Stanford's licensee Northop Grumman filed suit against several companies for infringement of Stanford's optical fiber amplifier patent. In 2008-09, all the remaining defendants settled with Northrop.

The genesis for the Litton Project, initiated three decades ago, was the replacement of microwave waveguides and components with optical waveguides and components. Over 400 patents have been issued worldwide from this pioneering research, which has led to a wide array of applications in communications, sensors, data processing, and systems. Litton is now Northrop Grumman Guidance and Electronics Company, Inc., a wholly owned subsidiary of Northrop Grumman Corporation, and its cooperative research venture with Stanford's applied physics department and Edward L. Ginzton Laboratory researchers has elevated Stanford as the preeminent fiber optics research entity in the world.

Professor H. John Shaw provided the first laboratory demonstration of a fiber optic gyroscope (FOG) from this basic research. Today, Northrop is the global leader in the manufacture and deployment of FOG-based inertial navigation systems for air, land, sea and space. In creating the basic building blocks for FOG, other sensors and for all optical communications, Professor Shaw and Professor Michel J. F. Digonnet's optical fiber amplifier (OFA) invention has enabled the bandwidth explosion in optical communications and telecommunications essential to the internet.

The scientific and financial success of this synergistic partnership has added significant value to Stanford University. Litton/Northrop Grumman has supported more than 60 graduate students and has provided in excess of ten million dollars in cumulative research funding over 30 years of this productive research collaboration. In addition, Stanford has received revenue in excess of fifty million dollars for the FOG, OFA, and other Stanford patents. Of this amount approximately 90% is attributed to the pioneering Shaw/Digonnet optical fiber amplifier invention.

AN INVENTION WITH IMMENSE CLINICAL AND FINANCIAL VALUE: FUNCTIONAL ANTIBODIES

The functional antibody invention of Professor Leonard Herzenberg, Dr. Vernon Oi, and Professor Sherie Morrison (formerly of Columbia University, now at UCLA) continues to be Stanford's largest royalty producing invention of recent years, bringing in $38M in 2008-09. Invented in 1984, functional antibodies have led to the development of many valuable medical products including Remicade (Johnson & Johnson, arthritis and other immune ailments), ReoPro (Johnson & Johnson, cardiac problems), Stelara (Johnson & Johnson, psoriasis), Synagis (MedImmune, respiratory syncytial virus), Tysabri (Elan, multiple sclerosis), and Erbitux (ImClone, colorectal cancer) – all of which have been created using the patented process. Exclusive licensee Johnson & Johnson acquired Centocor, our original exclusive licensee, and continues to be the university's partner in managing the patent's sublicensing. Sales are continuing to grow at a modest rate.

EXTENDING OUR VALUE TO OUR SISTER INSTITUTIONS: THE LLC

The Stanford University OTL, LLC has been operating for seven years, established so that Stanford could occasionally handle inventions for sister institutions that cannot support technology licensing offices of their own. For example, since 2001 we have been working with the Monterey Bay Aquarium Research Institute (MBARI); we have received seven disclosures from MBARI during this time and have licensed the institute's "Environmental Sample Processor" to Spyglass. The OTL, LLC acts as an agent for both entities and OTL receives a portion of royalties if the invention is licensed. This year, the LLC received its first royalty payment in excess of patent expenses for a license under the LLC.

The LLC has also begun working with Santa Clara University and has received several invention disclosures from Santa Clara, mostly in the environmental area.

RISING TO NEW AND OLD CHALLENGES

The value of a patent: The value of an issued patent has changed in the past few years. In the past, the Court of Appeals of the Federal Circuit (CAFC) was purported to be "patent owner" friendly, generally presuming patents to be valid when issued by the U.S. Patent Office. The Supreme Court, however, has changed the value of an issued patent in their KSR v. Teleflex ruling where the Supreme Court reaffirmed that "[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." The end result is that there is now uncertainty about the validity of issued patents based on an "obviousness" determination.

THE ROCHE CASE

For only the fifth time in 39 years, Stanford is seeking to enforce its intellectual property through the courts. In the early 1990's, Professors Thomas Merigan, David Katzenstein and Mark Holodniy invented HIV diagnostic technology which enables clinicians to evaluate the efficacy of HIV retroviral therapy. A patent was issued to Stanford for the technology in 1999 and we believe the patent has value. In the same year, Roche began selling a product that Stanford believes infringes the patent. After years of unsuccessfully trying to discuss a license with Roche, in October 2005 Stanford initiated a lawsuit against Roche. In June 2008, the District Court ruled that the inventions that underlie the patents are "obvious" and granted summary judgment in favor of Roche. Stanford appealed to the Court of Appeals of the Federal Circuit (CAFC) and in May, 2009, Stanford and Roche had a hearing before the CAFC. We are now wending our way through the appeal process.

PATENT REFORM

Legislation is pending in Congress to change the patent system in the U.S. from a first-to-invent system to a first-inventor-to-file system more similar to the way other countries operate. In addition, there is momentum around creating more opportunities to challenge a patent without going through expensive litigation (e.g. an opposition period).

In addition to the uncertainty of the value of patents because of recent court decisions, the cost of obtaining patents has risen exponentially. The U.S. Patent Office, in its effort to meet the demands of its increasing workload and worried about criticism of the quality of patent examination, is making it more difficult to obtain meaningful and broad patent protection.

PATENT EXPENSES

Rising attorney expenses for filing patent applications have led us to try an experiment – having an in-house patent agent. One of the staff has become a practicing patent agent. She files patent applications at a cost savings for us, often when we are not sure how valuable or patentable an invention is and need more time to evaluate and assess its licensing potential. We have been able to reduce our patent expenses this year, partly because we now have this in-house capability and because we've been more selective in the patents we file.

THE VALUE OF EFFICIENCY AND EFFECTIVENESS

We continue to improve our information technology systems toward more efficient processes. In the past year:

- We launched a new Industrial Contracts Website to provide more information to researchers and companies alike. (ico.stanford.edu)
- We developed a new eMTA (electronic routing of material transfer agreements) system that allows researchers to route agreements and routing forms electronically.
- We now have the capability of receiving credit card payments for transactions such as "ready to sign agreements" (eCommerce) whereby a company can sign the agreement, pay immediately, and be licensed.
- We have enabled visiting researchers to electronically sign the SU-18A Patent and Copyright Agreement for Visiting Researchers. (rph.stanford.edu/su18a)
- We developed a Prior Art Tool for inventors to do their own prior art search.

We would like more inventors to regularly use their personal Researcher Portal account (otlportal.stanford.edu/inventor) where they can see all the patent and licensing activity for their own inventions, and all their Industrial Contract transactions such as Material Transfer Agreements, Sponsored Research Agreements, and Collaborations.

The Industrial Contracts Office (ICO) is an integral part of OTL. Specializing in industry-sponsored research and related agreements, ICO works with industry on a range of research-related agreements. Following is a sampling of those agreements.

During 2008-2009, ICO finalized about 950 new agreements. Of this total, the largest group was material transfers, with both nonprofit and for-profit entities: about 555 were new MTAs for incoming materials, 52 were outgoing MTAs, and another 19 were human tissue transfers. Two-thirds of the MTAs were with nonprofit institutions and the remainder, with companies. ICO also negotiated 117 new industry-sponsored research agreements and an equal number of amendments to existing agreements. Other industry agreements included collaborations, equipment loans, non-disclosure agreements, research licenses and other research-related agreements.

SCHOOL OF MEDICINE

During the year, ICO finalized a master sponsored research agreement with Genentech, under which Genentech is funding a range of projects at the School of Medicine: Professor Jeffrey Glenn (Gastroenterology and Hepatology), Professor Francis Blankenberg (Radiology) and Professor Sandra Horning (Oncology and Blood and Marrow Transplantation).

Professor Glenn also received funding from Roche Palo Alto to study human antiviral responses in patients with hepatitis. Professor Tony Wyss-Coray (Neurology) received funding from Biogen to study beclin 1 deficiency and its impact on neurodegeneration, such as in Alzheimer's disease. Professor Craig Comiter (Urology) received a second year of funding from Advanced Technologies and Regenerative Medicine to study stress urinary incontinence.

Professor Paul Utz (Immunology and Rheumatology) received collaboration funding from Intel to evaluate Intel-designed peptide arrays for biomarker discovery, disease profiling and drug screening applications.

SCHOOL OF ENGINEERING

Honda R&D Company of Japan is continuing its sponsorship of a robotic project under the direction of Professor Oussama Khatib (Computer Science). Building on past successes in Honda-supported robotic projects, this study focuses on sensor-based control to endow the robot with advanced characteristics of agility, interactivity, awareness, and safety. In addition, Honda Research Institute, USA, is sponsoring a study by Professor Khatib that investigates different methods of robotic sensing of the environment and the algorithms to extract needed information about robotic perception. Textron Systems Corporation is sponsoring a study by Professor Andrew Ng (Computer Science) to investigate computer vision in recognizing objects and understanding scenes.

Among other agreements finalized by ICO during the year, Professor John Eaton (Mechanical Engineering) has two projects funded by Siemens Energy, Inc. to explore methods to manage follow separation in high area expansion annular diffusers, to study inlet distortion and swirl distributions, and to design diffusers for application in Siemens power plants. Toyota Motor Corporation is sponsoring the research of Professor Charbel Farhat to study the practical application of Computational Fluid Dynamics in the development of a race car.

Professor Mark R. Cutkosky (Civil and Environmental Engineering) is receiving funding from Seabed Rig AS, a Norwegian company, for a project to assist in the design, analysis, fabrication and testing of a sensorized robotic gripper that is capable of intelligently and robustly grasping objects of various size, surface type, and weight. Professor Kay Giesecke (Management Science) received funding from Mizuho-DL Financial Technology Co. of Japan, to develop implement and test computationally efficient methods for the measurement and management of the aggregate credit risk associated with a corporate loan portfolio.

HUMANITIES AND SCIENCES

Professor Brian Wandell (Psychology) received a second year of funding from the HP Labs Innovation Research Program to study high-speed document sensing and imaging in digital presses. Professor Clifford Nass (Communications) received funding from Nokia Research Center for his research on how mobile communication technologies support and enhance social relationships.

INDUSTRIAL AFFILIATE PROGRAMS

Companies also support research through the University's 58 affiliates programs, particularly in the Schools of Earth Sciences and Engineering. Affiliates programs, where groups of companies fund research among several faculty members in an area of interest, provide another type of industry relationship for the university. ICO reviews and signs affiliates agreements. University-wide, the industry affiliates programs brought in $23.5 million in research and educational funds during 2008-2009.

A sampling of new inventions

Nanocrystal-graphene composites

Detecting and classifying body parts and gestures in range images

Solar cell having organic nanowires

Non-invasive diagnosis of graft rejection in organ transplant patients

qPCR assay of six gene biomarker panel can diagnose kidney allograft dysfunctions

Urine 40 peptide biomarkers diagnosing kidney allograft dysfunctions

Velocity sensing in gas flows with optimized wavelength modulation absorption spectroscopy

Cell therapy for muscular dystrophy

Novel subcutaneous implantable defibrillator system

Device and method for endocardial and epicardial ablation

Assay to quantify hepatitis delta virus

Device and method for endocardial and epicardial ablation

Focusing and detection of macromolecules

Method for precise spatial and temporal control of neuronal ensembles

An adjuvant to antibody-based cancer therapies

Increasing the efficiency of reprogramming of mouse and human induced-pluripotent cells (iPS)

Inhibitors of myeloid cell activity

Gyroscopic rotational energy converter

LincRNAs in diagnosis and treatment

Signaling activity on laminin-511

Redox metabolomic biomarkers for disease monitoring

Aberrant cell surface molecule expression in acute myeloid leukemia

Double displacement scaffolds for nucleic acid detection

Use of glypicans

Inhibiting cancer stem cells

Remove teratogenic pluripotent stem cells from therapeutic products

Marker-less motion capture

Method to measure respiration without external physiologic monitoring

High energy storage capacitor

Thermionic energy converter

Automatic determination of effective fluorescence spectra

Non-responsiveness to IFN-beta treatment in multiple sclerosis

Hydroxylated recombinant proteins in E. coli

Novel long-acting analogs

Geodetically accurate InSAR processor

3D vascular geometry for blood flow simulation

Motion control of impedance-type haptic devices

Cell surface marker expression in hematopoietic stem cells

Design process innovation in societies

Nanotextured substrate formation process for solar cells and other optical applications

Management of cognitive transmission in primary spectrum

Method for the identification and isolation of adherent cells

Reciprocating electrolytic pump

Single-piece tube and check valve and method of manufacture

Treatment of inflammatory bowel disease

An algorithm to reduce noise and improve signal quality in near infrared spectroscopy (NIRS) data

Gym organizer

Marker-less tracking of humans and articulated bodies

A method to transform speech sound

Derivation of mature germ cell from human pluripotent stem cells

Dual lumen sheath

Interactive program for episodes of care (IPEC)

Prevention of acetaminophen-induced liver injury

A multimarker bioassay for lymphedema

Whole transcriptome sequencing analysis of rare cell subpopulations

Classification of zones in retinopathy of prematurity

Digital calibration ADC system

Using minicircle DNAs to generate viral-free induced pluripotent stem cells

Carbon nanotube hybrid network films

Human melanoma cancer stem cells

Inactivation of ARF (alternative reading frame)

Esophageal anastomosis device

Assembly of DNA from oligonucleotides

Automated mechanical masking system for blocking atomic layer deposition

Custom petri dish with micro wells

Multijunction nano-structured solar cell

Optogenetic control of neurons

In-situ nanosensors

Concurrent cell-free production of proteins and ribonucleic acids

Method for detecting genetic variations in rare cells

Higher oxygen tolerance

Peptoid-drug conjugates

Whole brain perfusion imaging

Gaussia princeps luciferase mutants

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