TECHtransfer

UNIVERSITY OF MICHIGAN

ANNUAL REPORT

YEAR ENDING

JUNE 30, 2002

TECHtransfer
UNIVERSITY OF MICHIGAN

CONTENTS

From the Executive Director

I'm pleased to provide you with this update on our progress in technology transfer at the University of Michigan. We are pleased with our results in commercializing university discoveries for the public good. We attribute this success to excellent technology, the wealth of talent within the University research community, and the diligence and dedication of our staff members and industry partners.

Efforts to encourage wider faculty participation in tech transfer yielded significant results. With leadership from our Medical School and College of Engineering satellite offices, we achieved a 30 percent increase in invention disclosures from faculty over last year. Our revenues, which did not include any equity sales from our portfolio, totaled $5.7 million, a 46 percent increase over the previous year's royalties. Most importantly, we significantly improved our services to researchers and business partners: initiating new protocols for early assessment of technology opportunities, guiding researchers in their choice of commercialization options, and connecting with outside resources to accelerate business start-ups and licensing technology.

But this is only part of the story.

During the past year, we also focused on ways to strengthen our capabilities in technology transfer. In FY02 we completed our Tech Transfer Strategic Plan, developed in conjunction with University leadership. This process produced a consensus on our core mission, objectives and success metrics, along with a focused plan to accelerate our progress.

We also worked hard to expand our business networks by cultivating deeper and broader relationships with outside partners, including venture capital firms, entrepreneurs, consultants, and leading corporations. We continued to enhance our New Business Development team, which provides assistance to start-up companies that license UM technology. And for the third year, our TechStart intern program connected talented graduate students to our technology projects, yielding valuable expertise for us and a rewarding educational experience for the students.

All of us who make up the Tech Transfer team are proud and somewhat in awe of the scope and quality of research underway at this remarkable institution. We are grateful to have a role in furthering the mission of the University by helping to transform academic innovation and discovery into products, services and enterprises that benefit society.

We look forward to the year ahead with optimism and a renewed commitment to those we serve.

Kenneth Nisbet
Executive Director, UM Tech Transfer
University of Michigan

Executive Director Ken Nisbet, with Directors Elaine Brock, Robin Rasor, and Tim Faley

About Tech Transfer

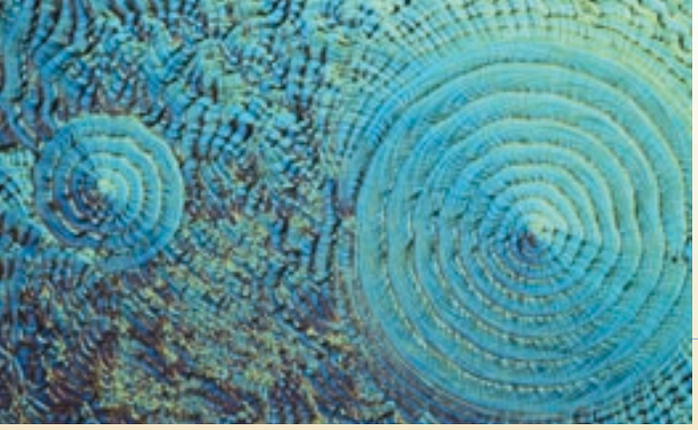
The University of Michigan's continued pursuit of excellence in research inevitably leads to discoveries of great value to society — discoveries that address a broad range of problems and needs. Since 1983, when our first technology transfer office was established, hundreds of inventions and research findings have made their way to waiting and eager markets in the form of new products, services and business ventures. In the last five years, the University of Michigan completed 267 license and option agreements and launched 34 start-up companies.

FULL-SPECTRUM SUPPORT

Our goal is to provide faculty researchers with expertise and guidance throughout the entire technology transfer process—from initial consultations, assessments and disclosures to full-blown commercialization plans, patent protection, development of prototypes and, when needed, additional funding. Through our TechStart student intern program, we provide access to graduate-student consultants in business, engineering, law, medicine, and education. And to facilitate start-ups, our New Business Development team works actively to build relationships with investors and other commercial partners.

"The University of Michigan continues to work diligently to be among the top institutions in the country relative to technology transfer. This year, the State of Michigan and Governor Engler honored UM's outstanding work by awarding its Office of Technology Transfer an award for Exemplary Success in Commercializing Technology and Promoting Entrepreneurship. This prestigious award recognizes the contributions that the University of Michigan has made to the economic vitality of the entire state."

— Doug Rothwell, President and CEO,
Michigan Economic Development Corporation

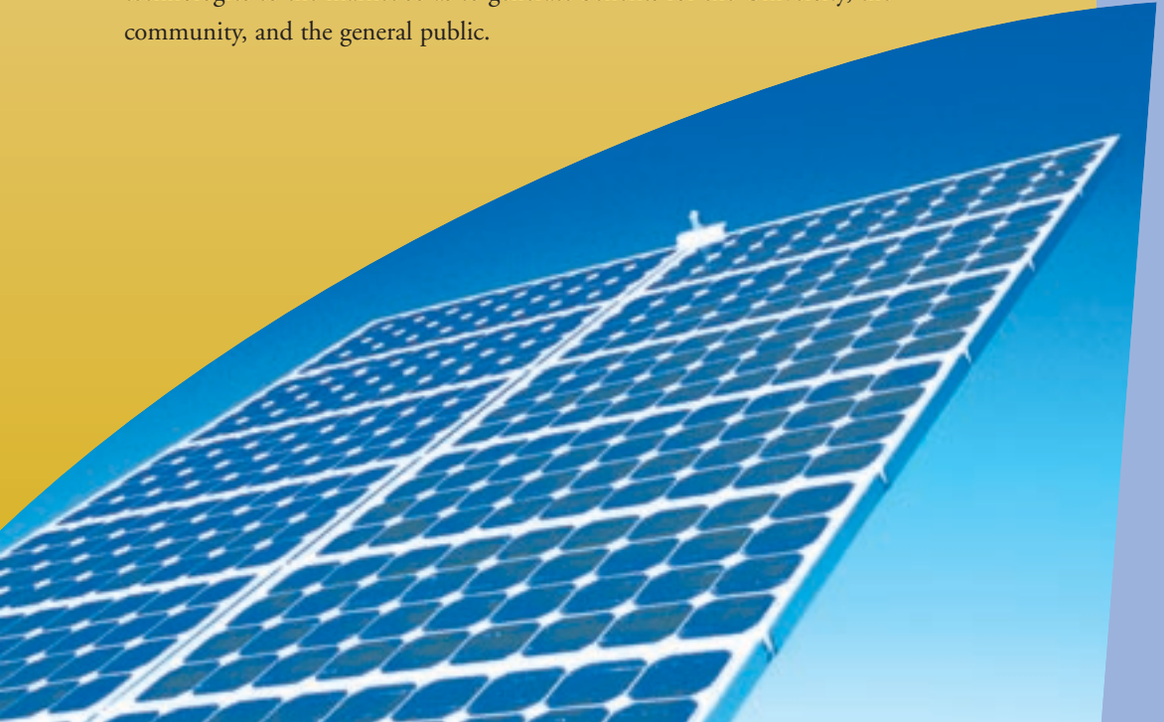


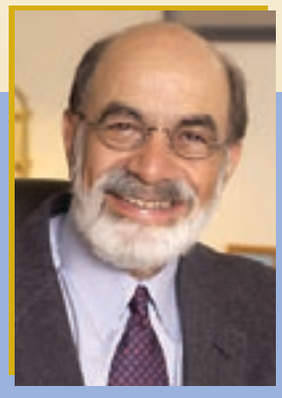
FAR-REACHING IMPACT

UM Tech Transfer supports and furthers the University's mission by:

- Increasing the likelihood that new discoveries and innovations will lead to useful products, processes and services that benefit society.
- Facilitating new research collaborations and resource exchanges with industry, thereby providing unique opportunities for faculty and students.
- Increasing the flow of research dollars and resources to the academic community.
- Providing incentives for faculty to deepen and broaden the scope of their research.
- Helping to attract and retain highly qualified faculty and graduate students.
- Enriching the educational experience through student internships and work-study opportunities.
- Leveraging business partnerships to stimulate local and regional economic development.
- Enhancing the reputation and stature of the University.

THE MISSION of UM Tech Transfer is to effectively transfer University technologies to the market so as to generate benefits for the University, the community, and the general public.





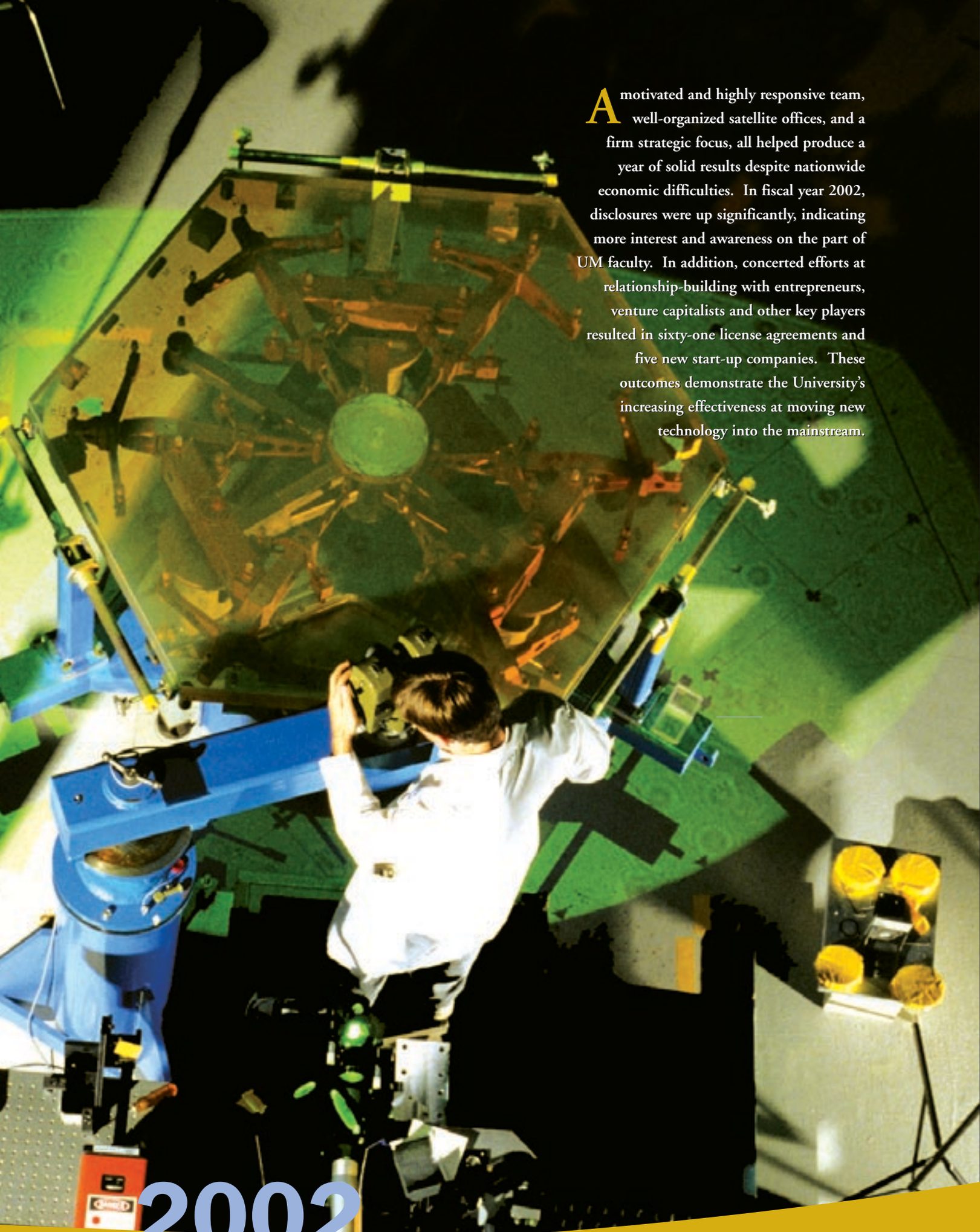
"Our goal is to be among the nation's top five universities in the realm of technology transfer. This objective, which is well within our grasp, reflects the powerful creativity and high prestige of the University of Michigan research community and the dedication and talent of our tech transfer team."

—Fawwaz T. Ulaby
Vice President for Research
University of Michigan

Components of the Technology Transfer Process

- Research
- Invention
- Pre-Disclosure
- Disclosure
- Evaluation
- Patent/Copyright Protection
- Marketing
- Business Development
- Licensing
- Commercialization

Revenue



A motivated and highly responsive team, well-organized satellite offices, and a firm strategic focus, all helped produce a year of solid results despite nationwide economic difficulties. In fiscal year 2002, disclosures were up significantly, indicating more interest and awareness on the part of UM faculty. In addition, concerted efforts at relationship-building with entrepreneurs, venture capitalists and other key players resulted in sixty-one license agreements and five new start-up companies. These outcomes demonstrate the University's increasing effectiveness at moving new technology into the mainstream.

2002 FISCAL YEAR RESULTS

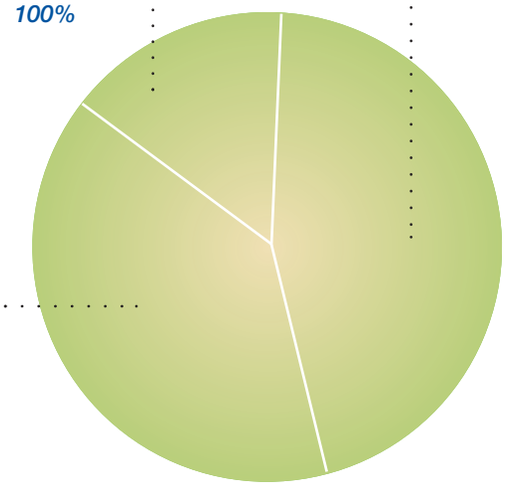
2002 INVENTION DISCLOSURES

OTHER

Dentistry	7	15%
Lit/Sci/Arts	17	37%
Pharmacy	6	13%
Public Health	6	13%
Miscellaneous	10	22%
Total	*46*	*100%*

ENGINEERING

Biomedical Engineering	10	9%
Chemical Engineering	6	5%
Elec. Engin. & Comp. Sci.	58	50%
Indust. Operations Engin.	3	3%
Material Sciences	4	3%
Mechanical Engineering	21	18%
Nuclear Engineering	5	4%
Miscellaneous	10	9%
Total	*117*	*100%*

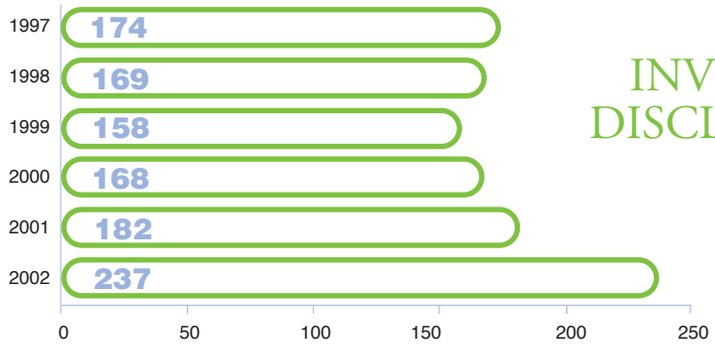


MEDICAL

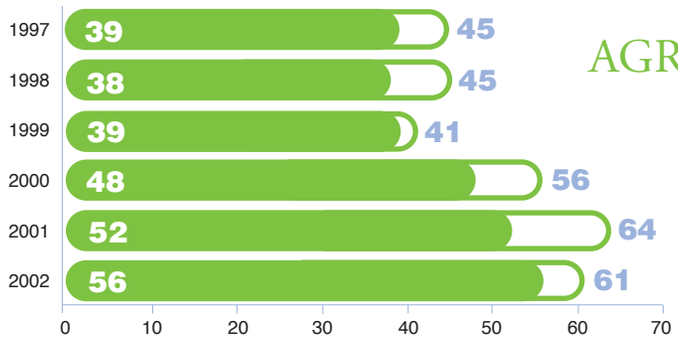
Anesthesiology	3	2%
Biological Chemistry	7	5%
Human Genetics	4	3%
Internal Medicine	30	22%
Mental Health	6	4%
Microbiology	3	2%
Opthalmology	4	3%
Otolaryngology	7	5%
Pathology	16	12%
Pediatrics	7	5%
Pharmacology	7	5%
Psychiatry	4	3%
Radiation Oncology	4	3%
Radiology	5	4%
Surgery	10	7%
Miscellaneous	18	13%
Total	*135*	*100%*

Disclosures with inventors from multiple colleges are credited to each college.

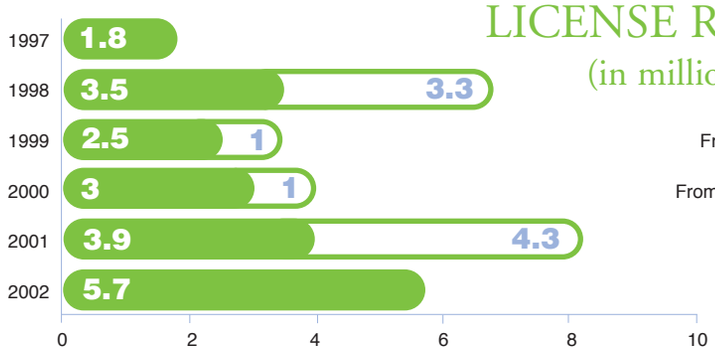
INVENTION DISCLOSURES



LICENSE AGREEMENTS



LICENSE REVENUE
(in millions of dollars)



"Our efforts at encouraging faculty participation in tech transfer were very successful in FY02, as can be seen in our record number of disclosures. We also worked to streamline our processes with the goal of becoming even more responsive to faculty and third parties interested in UM technology."
—Robin Rasor
Director of Licensing,
Office of Technology Transfer,
University of Michigan

Welcome Start-up Class of 2002:

DermaCo
Eprogen
Velcura
Thromgen
Quantum Signal

Target Energy Loss Compensation for Kinematically-collimated Neutron Beams

Dual-rail Static Pulse Clocked Flip-flop

A Device for Measuring and Teaching Fly Casting

Ballast Free Ship

Stiffness-compensated Temperature-insensitive Mechanical Resonators

Collimated Radiation Detector and Array of Collimated Detectors

Defeating TCP/IP Stack Fingerprinting

Method and Apparatus for Non-contact Measurement of Melt Flow Velocity in Laser Materials Processing

Selective Sorbents for Desulfurization of Liquid Fuels

Method and System for Engineered Biological Implants

Circuit Simulator for Quantum and Resonant Tunneling Devices

Ultrahigh Activity Catalysts for Low-temperature Selected Catalytic Oxidation of Ammonia to Nitrogen

Error Correction Method for the Displacement Detector Array of a Past Measurement

Furnace With Increased Energy Efficiency and Reduced Pollutant Formation

Symbolic Structure Representation Algorithm of Human Motion

Fabrication of Out-of-plane Curved Surfaces

A Method to Apply Constraint-based Heuristics in Collaborative Design

Integrated Printed Circuit Board Flow Channel

High Speed Drilling Machine

On-wafer Packaging for RF MEMS

Method for Statistical Reconstruction of X-ray Computed Tomography Images

Region Prefetching Engine

Photo-generated Reagents and Their Reactions

The Store-load Address Table and Its Application to Compiler Optimization

Self-feeding Breadcrumb Trail for Dead-reckoning on Rugged Terrain

Laser-driven Radioactive Flechettes

Enhanced Isotope Enrichment

Fabrication of Thick Silicon Dioxide Layers

Combined Radiation Detector for Neutron Detection and Discrimination

Low-cost Satellite Imaging System

Inductive Biomineral Scaffold for Tissue Regeneration

MEMS-based Voltage Controlled Oscillator

Porous Plug Electro-osmotic Pump

Large Displacement Compliant Joints

Multi-lead Microconnection Device

Low-voltage and Low-power Analog Circuits

Formulation of a Two-component Polymer for Delivery and Endovascular Occlusion of Blood Vessels

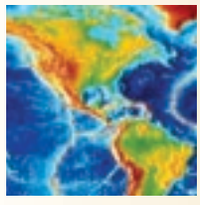
Integrated Electro-thermal Probe

Reconfigurable Slot Antenna for VHF/UHF Applications

Low-power Flip-flop with Energy Recovery and Automatic Clock Gating

Highly Efficient Miniaturized Slot Antenna

High Performance MEMS-based On-chip Clock Generation



Continuous-Wave Ultraviolet Laser

Method to Fabricate Single-crystal Tubes

Vacuum Encapsulation Technique

Microfluidic Device for Separating Motile and Non-motile Particles

A Sensitive and Selective Peptide Sequence for Arsenic (III) Ion Detection in Water

Light Directed Spatial Generation of Acids and Bases from Precursor Molecules in Solution

A Reconfigurable Multispindle Head

Field-assisted Bonding of Insulator to Eutectic Solder

Acoustic Tweezers

Bent-beam Actuated Steerable Microplatform

In-process Sensing and Quality Control of Zinc-coated Steel Welds

Single Phase Resonant Clock Generator for Energy Recovering Systems

Low-power SRAM with Energy Recovery

Technique for Reduced-tag Dynamic Scheduling

Resonant-cavity Magnetic Field Probe for Millimeter Wave Frequency Domain Spatial Field Mapping

Field Tunable Probe for Combined Electric and Magnetic Field Measurements

Detachable Snap Fits for Space Frame Automotive Body Structures

Method of Forming Nanofluidic Channels

Polymer Micro-ring Resonator Devices

Ultra Precise Reconfigurable Inspection Machine

Palm Artifact Manager (PAM)

Combustion Systems of Nanparticles Using a Multi-element Diffusion Burner

Modulation Optimized Spectrum Technology (MOST)

MASSIT Spike Sorter

Purification of Water

MEMS Micropump

A Wide Range Supply Independent CMOS Voltage Reference

Micro Gas Chromatograph

Cochlear Prosthesis Actuated Insertion Tool for Local and Differential Shape Control

UM
TECH
TRANSFER

Disclos

Transition-aware Global Signaling

Active Shielding of On-chip Global Intercoreaction

Smart Bandage

Rapid Nano Patterning of Multiple Materials on a Substrate

High Performance Nonplanar Inductors

Reversal Imprint Technique

Integrated Surface and Depth Measuring Methods

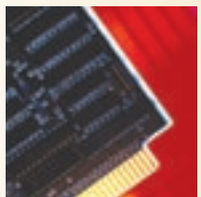
Strain-hardening Cementitious Composites

Radiation-hard Temperature-resistant Neutron Detector

A Three Dimensional Mammalian Fibroid Construct for Clinical Screening and Research

Porous Materials with High Surface Area

Moisture Indicator for Restorative Dentistry



Controls of Mechanical Properties and Degradation Behavior of Alginate Hydrogels

FY02 ures

A Method for the Production of Orthorhombic Acetaminophen

Pulsed Carrier Gas Flow Modulation for Selectivity Enhancements with Gas Chromatography

High Capacity Methane Sorbents

Nitric Oxide Releasing Acrylic Polymers

Stretch Pivot Coordinates for Representing Human Posture

Molecular Targets for Chemotherapy

High Temperature Chemical Crosslinkers

Noninvasive Nonlinear Method for Seizure Prediction

Expression Profile of Prostate Cancer

Multiorgan Gene Expression Profiles of Systemic Inflammation/Sepsis

Novel Methods of Diagnosis of Angiogenesis

Software for Kinematic Assessment of the Shoulder

Transgenic Mouse Model of Elevated Factor IX Causing Myocardial Fibrosis

Targeting and Delivery of Nucleic Acids to Intestinal Cells

Computer-aided Diagnosis (CAD) System for Detection of Lung Cancer

Method of Treating Systemic Inflammatory Response Syndrome

Ultrasound Gating of Cardiac CT Scans

Dynamic Foot Orthosis

Novel Kinases: Sequence and Function

Device for Dentomaxillofacial X-ray Computed Tomography

Mouse-model of Hereditary Spastic Paraplegia

Human Gene Expression Cassettes for Effective Intracellular Delivery of Small Interfering RNA

A Noninvasive Assay for Quantitation of BACE Activity

A Generalized Approach to *In-situ* Formation of Metal-based Pharmaceutics

A Method for Extending the Dynamic Range of Flat Panel Detectors

Instrumentation for Detection and Imaging of Fluorescence Resonance Energy Transfer

Prevention of Noise-induced Hearing Loss

Prevention of Cisplatin-induced Deafness

Interventions to Protect and Regrow the Auditory Nerve

A Microcarrier System for Production of Recombinant Proteins

A New Polyclonal-based (ELISA) Assay for the Detection of Loxoceles Spider Venom

Markers for Pancreatic Cancer Diagnosis

Blood Hemolysis Analyzer

Prospective Identification and Characterization of Breast Cancer Stem Cells

Small RNA Molecules for the Inhibition of Gene Expression in Cells

Microarray Analysis of Gene Expression in the Aging Human Retina

Mouse Eye Gene Microarrays for Investigating Ocular Development and Disease

Histidine-rich Proteins as Targets for Antimalarial Therapy

Genes Preferentially or Exclusively Expressed in Cerebral Cortex or Cerebellum

Quantitative Immuno-Cyto-Chemistry in Tumor Tissues

Methods for the Production of Genetically Modified Animals

Method to Improve Factor VIII Secretion

Sabel Lymph Node Retractor

Agonists for Treatment and Prevention of Alzheimer's Disease

Method of Modulating Inflammatory Response

Bimolecular Fluorescence Complementation Assay for the Analysis of Protein Interactions

ATLAS Method, Amplification Typing of L1 Active Subfamilies

Mouse Model of Respiratory Distress and Pituitary Insufficiency

Inhibitors of Bcl-2 and Its Related Proteins

Antagonist of Bcl-2 and Related Proteins and Therapeutic Methods Based Thereon

Ablation Catheter for Treatment of Atrial Fibrillation

Prevention of Acute Graft Versus Host Disease

Bronchial Blockers

3D Protein Separation

A Human Promoter that Directs Podocyte Specific Transgene Expression

Detection of Quanylyl and Adenylyl Cyclase Activity

Diagnostic Biomarker in Lung Adenocarcinoma

Dopamine Receptor Ligands and Therapeutic Methods Based Thereon

Enhancing Diabetic Wound Healing

Peptide Analogs as Selective Inhibitors of Thrombin Activation

Image Archiving System

Methods of Preventing and Treating Microbial Infections

Antimicrobial Nanoemulsion Compositions and Methods

Methods to Inhibit or Enhance the Binding of Viral DNA to Genomic Host DNA

Surface Transfection and Expression Procedure

Replication Deficient Adenovirus Vectors and Methods for Making and Using Them

Packaging Technique for Microfluidic Elastomer Chips

Stabilization of Tetanus Toxoid Encapsulated in PLGA Microspheres

An Immunoadsorption Device for the Treatment of Immune Thrombocytopenia Purpura (ITP)

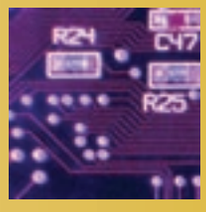
A Universal Delivery System to Achieve Ideal Drug Therapy

Polymer Compositions that Elicit a Strong and Sustained Antibody Response

Magnetically Modulated Chemical Sensors for Background Rejection

Inlet Adaptor for Low Flowrate Version of the IOM Personal Inhalable Aerosol Sampler

Method of Patterning Nanoparticles



Audio Distributor "Sound-Go-Round"

Connections to the Market

As a graduate student in philosophy, Susan Dorr Goold had what she calls "a deep scholarly interest" in theories of justice and the allocation of scarce resources. Medical school intensified that interest, especially as it pertained to health care for the uninsured. And so it was that in 1995, soon after joining the UM Medical Center faculty, Dr. Goold linked up with like-minded colleagues to create an exercise in deliberative democracy, "a method by which individuals could participate in health care planning and rationing decisions." The result of their efforts was Choosing Healthplans All Together™ (CHAT™), an education and research tool in the guise of a board game.

Today, Dr. Goold is director of the Medical School's Bioethics Program, and CHAT has been used for policymaking and research projects from North Carolina to California. "CHAT addresses the major obstacles to individual participation in health care decisions, things like apathy, intimidation, fear, and lack of access to information," says Dr. Goold. "By simplifying the technical aspects, making the process fun and enjoyable, and structuring discussions among 'players,' the game increases awareness and stimulates grass-roots dialogue about the problem of limited resources. It makes people aware that insurance is a group product and that it's important to spread the risks and benefits." She notes that the game has broad applications for consumers, researchers, employers, insurance companies, policy-makers, medical service providers, and community-based organizations.

CHAT

Choosing Healthplans All Together

CHAT continues to evolve. The board game has been transformed into software, and a web-based version is in the works. An inexpensive, portable edition designed for educators (nicknamed CHAT Lite™) is being used at Loyola University and UM.

Dr. Goold is grateful to Tech Transfer for its assistance with licensing and agreements. "Among other things," she says, "they worked to protect the intellectual property so that, for instance, any data collected will be available to researchers." It's likely that, in the future, Tech Transfer could be involved in licensing the game to an outside vendor.

High-level pharmacy coverage? Long-term care? Fertility treatments? Accupuncture? Dr. Susan Goold (pictured far left) spins the wheel in the game of CHAT where individuals design their own health care plans by choosing from multiple coverage options. Then, working with progressively larger groups, they come to agreement on a health care plan that reflects a consensus in values and priorities.

Handylab

Getting a Sense of the Future

In a birthing suite, a woman goes into labor. The nurse on duty quickly takes a vaginal swab, places it in a syringe containing a small amount of buffer solution, and injects the liquid into a port on a small hand-held instrument. Then, by pressing a single button, she triggers a fully automated DNA analysis. In less than 30 minutes, she'll know whether or not the baby could be exposed to Grade B Streptococcus (GBS), a potentially fatal pathogen—treatable if detected early—that's carried by up to 20 percent of all new mothers.

Thanks to a start-up company known as HandyLab—and the breakthrough research findings of two University of Michigan graduate students—this scenario is being repeated in pre-clinical trials at the UM Medical Center and Baylor College of Medicine in Houston. Within the next three to five years, the same on-site technology may be widely used for diagnosing a whole range of infectious and genetically-based diseases, and for detecting airborne pathogens such as anthrax and smallpox.

The research that drives these remarkable nano-devices was developed over a period of seven years by chemical engineering Ph.D. students Kalyan Handique and Sundaresh Brahmasandra and their faculty advisors, Professors Dr. Mark Burns (Chemical Engineering) and Dr. David Burke (Human Genetics). In 1998, their portable acid- and protein-based analysis systems earned a place on *Science Magazine's* list of Top Inventions of the Year. And in June of 2000, the two former students launched HandyLab with $2.4 million in funding.

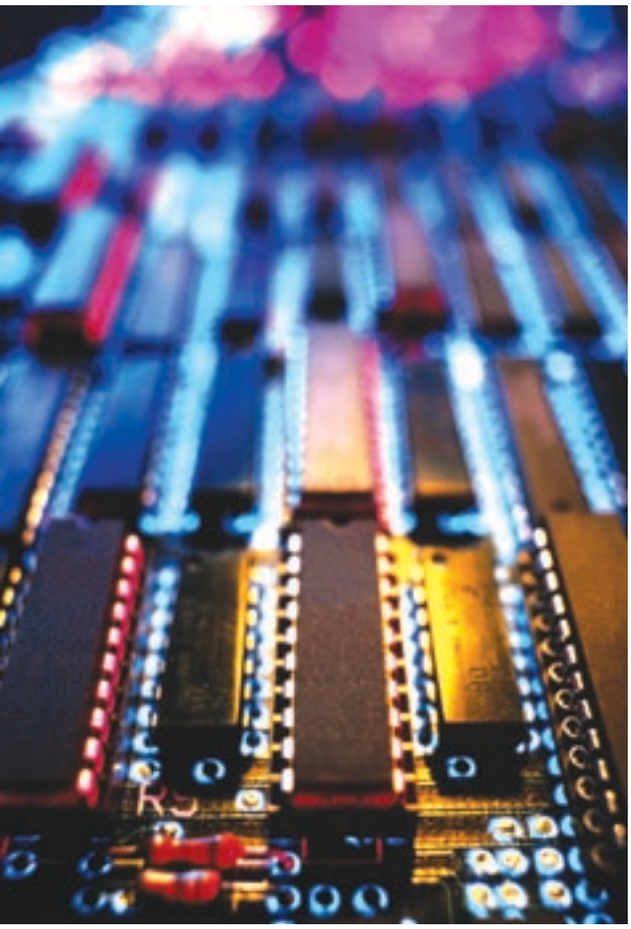
In 2001, the company began seeking $3.5 million in Series B funding, and came away with $5.5 million instead. "To be oversubscribed in this economy is quite an achievement," notes HandyLab President and CEO Michael Farmer. He points out that the company is now receiving significant additional funding in the form of Defense Department and NIH grants and R&D contracts. Among HandyLab investors is the Wolverine Venture Fund, administered by Michigan Business School students.

Developed by HandyLab, a hand-held sensor is programmed to detect the presence of common viruses and bacterial infections within 30 minutes or less. Equipped with the capabilities of a $400,000 laboratory, the disposable cartridge will cost only a few dollars to manufacture and the reader/analyzer will be comparable in cost to low-end PDAs.

"We're very pleased with the business relationship we've had with the University of Michigan," Farmer says, adding that "Tech Transfer was absolutely crucial to the start of the company. Without their contributions, particularly in the areas of patent protection and business planning, there wouldn't be a HandyLab today."

The Sweet Flow of Success

Arbor Networks



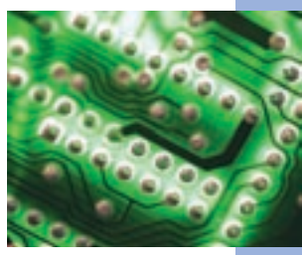
Described by its creators as a distributed, scalable, non-intrusive network availability solution, Peakflow™ enables large enterprises and providers to detect and counter network threats, including denial of service attacks. In 2001, Arbor Networks introduced a new feature that gives Peakflow™ the ability to detect worms and viruses as they propagate through large networks.

Security is a top concern for the operators of critical networks. Government agencies, service providers and large enterprises all face rapidly evolving threats such as denial of service (DoS) attacks, network worms and attacks on the routing infrastructure itself.

According to Arbor Networks' co-founder Dr. G. Robert Malan, "Distributed threats cannot be effectively addressed with perimeter-only solutions such as firewalls and intrusion detection systems." That fact helps to account for the phenomenal success of Arbor Networks' flagship product, Peakflow™, a distributed network anomaly detection system that had its start in the UM research lab of Dr. Farnam Jahanian, professor of electrical engineering and computer science at the College of Engineering, and the thesis work of Malan, his then-graduate student. Peakflow closes the gap between the detection of a threat and its resolution, protecting the availability of critical networks.

In the late 1990s, Jahanian and Malan decided to create a commercial version of their research prototype, originally devised to protect UM's educational network from DoS attacks. With funding from Battery Ventures and Cisco Systems, they officially launched Arbor Networks in February of 2001.

Today, Peakflow is being deployed by a broad range of government agencies, leading service providers and corporations. The past year was filled with milestones. Despite a generally weak economy, Arbor Networks experienced solid growth and won key customer accounts. In August, the company announced that it had raised $22 million in Series B financing from top-tier venture capital firms and strategic investors. Most of the new funding is earmarked for new product development. Arbor Networks has also been recognized as one of *UPSIDE Magazine's* Hot 100 Private Companies in 2002, *Red Herring's* Ten to Watch 2001 and *Network World's* Ten Start-Ups to Watch in 2001.



Co-founders Jahanian and Malan are quick to acknowledge early contributions made by the Office of Technology Transfer. "I credit Tech Transfer with helping us move through the start-up process judiciously and getting our technology to market quickly," says Professor Jahanian. "It would have taken us an additional six months otherwise, and we would have missed important opportunities to raise money and capture emerging markets."

Taking a Sound Approach to Business

Quantum Signal

In the late 1980s, signal processing specialist and UM Engineering Professor William J. Williams (above right) received an unusual request from the Office of Naval Research. Would he be willing to work with biologists at the Woods Hole Oceanographic Institute to create a system for identifying the voice patterns of individual sperm whales? Intrigued, Dr. Williams accepted the challenge and created a successful software program. It was some time later that he learned of the real application for the technology: monitoring Soviet submarines.

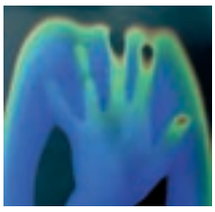
According to Williams' former student, Dr. Mitchell Rohde (above left), that story reflects the core mission of Quantum Signal, a company founded by Williams and Rohde. "Our goal is to take technology out of the ivory tower and bring it into the mainstream," he says. "We do that through consulting and education as well as through the development of core tools and technologies. The beauty of signal processing is that the systems we develop are cross-functional and can be used to solve a huge array of problems." As for example, he notes that an algorithm developed by Quantum Signal for identifying particular words in multiple-format documents is being adapted for use in advanced security systems based on face recognition.

Williams and Rohde are the first to admit that, in the past, relatively few industries realized the potential of signal processing, or understood how the math-based analysis of signals and sensor data could solve their problems. But that's changing quickly. In the past three years, Quantum Signal has worked with clients in manufacturing, health care, power generation, automotive design, and national security. Currently, their superb track record in face recognition, speaker verification and similar biometrics technologies is generating favorable interest in industry and at the National Institute of Science and Technology (NIST), which is reviewing one of their proposals.

"UM Tech Transfer has been a very good partner for us," says Williams. "They encouraged us to create a start-up company. They understand the needs of a small business. They're accommodating about technology licenses." He pauses for a second, then adds, "And they've always seemed genuinely interested in helping us succeed."

"We're fundamentally an innovation center. What we do best is develop good technology and license it to organizations that have the full-scale resources to deploy those solutions."

—Dr. William J. Williams, Quantum Signal



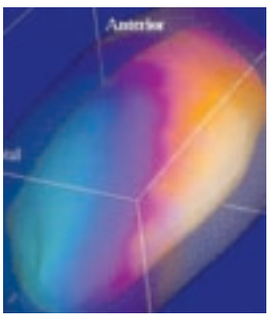
A cardiac patient steps onto a treadmill. The pace and incline periodically increase until, finally, the patient is injected with a compound that traces heart blood flow. Using a technology called SPECT tomographic imaging, a computer then reconstructs and displays the patterns of heart blood flow and contractile function on a screen. These images, along with other data generated by the same software program, will be used to assess the heart and make a diagnosis.

Back in the mid 1980s, when nuclear medicine tomography was in its infancy, there was no way to quantify or display the inherently three-dimensional information. Instead, researchers were forced to work with planar, 2-D images. Nuclear cardiologist Dr. James Corbett and colleague Dr. Tracy Faber at the University of Texas Southwestern Medical Center in Dallas created the first commercially available computer application to generate quantitative 3-D displays of heart blood flow and function. Approximately ten years later, Corbett joined forces with UM colleague and research scientist Dr. Edward Ficaro to develop the next generation of this software program, called 4D-MSPECT.

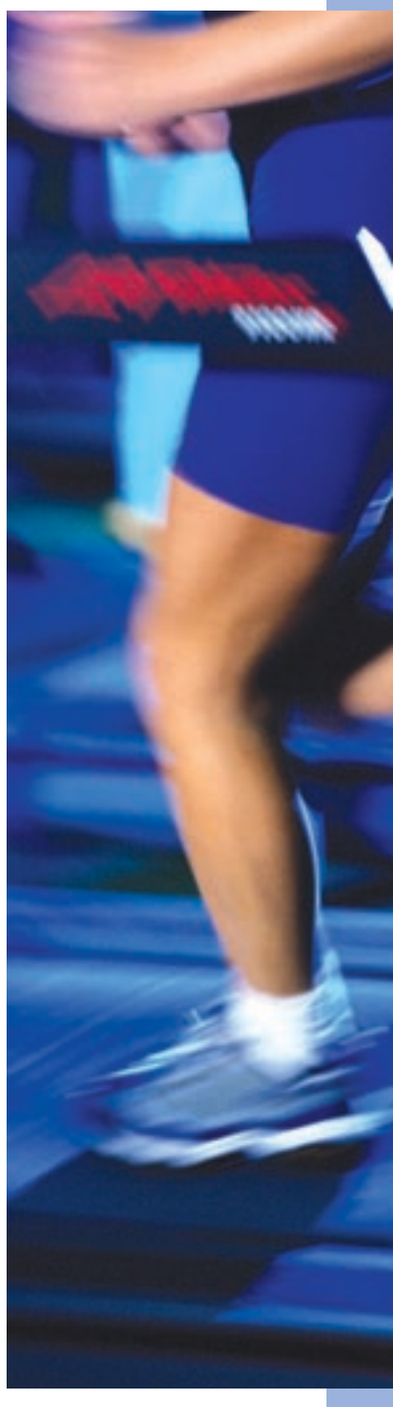
As Dr. Corbett explains, "4D-MSPECT grew out of clinical and research needs for a tool to efficiently and realistically display and quantify gated tomographic studies of heart blood flow and mechanical function. In essence, we needed a technology that would give us access to the wide range of diagnostic information these studies can provide. We ultimately developed a sophisticated computer software application for cardiac nuclear medicine image display and analysis." Corbett and Ficaro have continued to enhance the software, integrating new functions such as automatic report generation and extensions to other imaging techniques such as cardiac PET imaging.

Working with representatives from Tech Transfer, Drs. Corbett and Ficaro licensed 4D-MSPECT to corporate giants such as General Electric, Siemens and Philips. "With assistance from the University, we were able to obtain FDA approval. We are now better able to adapt, develop and extend new technologies within a constantly changing, increasingly competitive environment."

4D-MSPECT



Getting to the Heart of New Imaging Technology



TechStart

Fueling Tech Transfer with Business Expertise

The sign on the glass door reads "LaunchPad." Step inside and you'll find a large, light-filled room where young business consultants are hard at work—coaxing information from computer screens, preparing reports, analyzing data, generating presentations, negotiating with vendors, scheduling meetings.

What makes this scene unusual is that these particular consultants are actually University of Michigan graduate students from the schools of business administration, law, engineering, information, and education. They're part of TechStart, a summer internship program sponsored by UM Tech Transfer. And their clients are faculty entrepreneurs and local start-up firms.

Now in its third year of operation, TechStart is funded in part by UM's Zell-Lurie Institute for Entrepreneurial Studies and the Michigan Economic Development Corporation (MEDC). The program continues to win accolades from both clients—who benefit from the students' wide-ranging, latest-theory expertise—and the interns themselves, who have a rare opportunity to apply their knowledge, hone their consulting skills, and get a firsthand, up-close look at the world of high-tech entrepreneurship.

According to Mark Maynard, who manages TechStart, "The program is special because we recruit from across the UM campus and look to build the most diverse group possible. In doing this, we create cross-functional, multi-disciplinary teams that can understand both the cutting-edge science and the business climate for that technology. It's a powerful combination."

VELCURA THERAPEUTICS: GROWING BONE BECOMES A GROWING BUSINESS

This past year, 10 student consultants—selected from an applicant pool of more than 100—worked on a wide range of projects. One of the three-person teams was assigned to Velcura Therapeutics, a year-old start-up company that won the 2001 Great Lakes Venture Quest Award and generated $3.3 million in first-round funding from the state of Michigan. Located in Ann Arbor, the enterprise was spun out of groundbreaking biotechnology—devised by Medical School faculty member Dr. Michael W. Long—for growing human bone outside the body (*ex vivo*). Unlike other osteoporosis therapies now on the market that inhibit further bone loss, Long's discovery will lead to therapies that actually stimulate bone growth.

According to MBA student and TechStart consultant Andrew Corr, Velcura relied on the student team "to move the company from a virtual to a physical operation." That included everything from locating and equipping an office to creating a business plan and venture capital proposals. TechStart consultants also devoted considerable time to various kinds of research: providing a detailed analysis of the osteoporosis market, evaluating vendors, and searching out prospective investors. They also assisted with patents and disclosure agreements. Michael Krol, a UM law student with a Ph.D. in molecular and cellular biology, even helped design and plan a bio-informatics structure for what will one day be Velcura's large-scale commercial labs. MBA student Jenny Kempenich researched potential strategic partnerships in Japan (where Velcura is currently negotiating an agreement), and Pacific Rim countries, and provided advice on Japanese business protocol.

"These are absolutely top-notch people," said Long. "Their work was an important component in launching the company this summer. We would have been hard-pressed to do it without them, and the quality of their efforts was excellent."

THE PLAY PROJECT: KEY RESOURCES FOR A SERIOUS ENTERPRISE

Another group of TechStart consultants worked with Dr. Richard Soloman, associate professor of Pediatrics. Soloman is the creator of an innovative and effective therapy for autistic children known as The PLAY Project™. For the past several years, he and his team have been teaching parents throughout Michigan how to use the intensive play therapy at home. Tech Transfer is assisting with legal and potential licensing issues. Currently, the goal is to establish PLAY Project therapy training centers throughout the region.

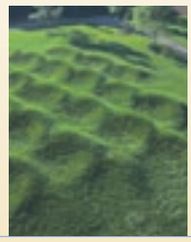
As a first step, the graduate student consultants met with their "client," Dr. Solomon, to evaluate needs and create a work plan. "Our initial challenge," says MBA student Jenny Kempenich, "was to help determine their objectives and find ways to align our services with their changing needs."

After conducting extensive research on autism, the consulting team developed alternative cost/revenue models, devised a quality control strategy, and drafted terms and conditions for PLAY Project therapy centers. According to TechStart consultant Ali Schriberg, who will graduate next year with one of UM's first joint degrees in business and education, "One of our most important contributions was coming up with a quality control strategy that included annual inspections, parent surveys and other metrics for gauging quality and performance. As a next step, we'll try to replicate these same protocols for Michigan public school systems." A therapy center pilot program will be in place by the end of 2003.

"Smart, conscientious, persistent and professional," is how Dr. Soloman describes the TechStart team. "They discovered information on the prevalence of autism that indicated a need for our services and raised important epidemiologic questions about the cause of the enormous increases in the state of Michigan. The team moved our project forward immeasurably. An A+ job!"

"Doing our job well means really understanding the potential of our technologies and fitting those to the needs of our business partners"

—Tim Faley
Director,
Technology Transfer and
Commercialization–Engineering,
University of Michigan



Community Partnerships

In 2002, UM Tech Transfer continued to play a leadership role in organizations dedicated to the strengthening of the entrepreneurial infrastructure in Ann Arbor, and within the state of Michigan.

Here are a few examples of some of the programs and organizations which have benefitted from these collaborations:

"Working with our community partners, we've made great strides in creating an environment to support and foster our research and tech transfer initiatives."

— Elaine Brock
Director,
Office of
Technology Transfer and
Corporate Research—Medical,
University of Michigan

Smart Zone/Accelerator

This year the Ann Arbor /Ypsilanti area was designated a Smart Zone by the Michigan Economic Development Corporation (MEDC). This designation provides for state support to establish resources to accelerate technology business creation within the community. UM Tech Transfer provided leadership for the planning of this proposal, and will play a central role in fostering and receiving the benefits of the resultant expanded entrepreneurial efforts.

MichBio

MichBio, a non-profit organization dedicated to driving the growth of the life sciences industry in Michigan, has played a highly visible role in improving the climate for established and emerging biotechnology companies. UM Tech Transfer representatives have taken leadership roles within MichBio, participating in networking events, collaborating on infrastructure development projects, and providing strategic direction from the Board of Directors.

"UM Tech Transfer has been a wonderful partner for the community. From early endeavors to start the Ann Arbor IT Zone to more recent work with the Smart Zone Business Accelerator Proposal, they have shown the depth of their commitment."

—Chuck Salley,
Ann Arbor IT Zone

Ann Arbor IT Zone

Now nearly three years old, the Ann Arbor IT Zone is recognized as a leading provider of educational content in the areas of entrepreneurship and new business development. UM Tech Transfer has provided board leadership and assisted with several initiatives, including the Smart Zone program, in which the IT Zone is the lead organization. In addition, the IT Boot Camp is an innovative four-day and four-night business development program that has "kick-started" more than a dozen new business ventures with the help of UM planning, course delivery and mentoring.

BioMed Expo

As the founding member of this state-wide networking event, UM Tech Transfer was a driving force in this premier annual showcase of leading-edge biomedical research, education and commercialization. Now in its third year, the BioMed Expo provides face-to-face interactions for hundreds of researchers, entrepreneurs and service providers in an energy-charged setting with industry experts, service providers and established and emerging companies.

Ann Arbor Area Chamber of Commerce

UM Tech Transfer assists with many of the programs of the Ann Arbor Area Chamber of Commerce, including Agenda Ann Arbor, an annual conference exploring the growth and future of our community, and Leadership Ann Arbor, a year-long program introducing individuals to our town and institutions. The University is also well represented on the Chamber Board of Directors.

Michigan Universities Commercialization Initiative

UM Tech Transfer plays a leadership position in a collaboration with Michigan State University, Wayne State University and the VanAndel Research Institute in Grand Rapids. The Michigan Universities Commercialization Initiative (MUCI), sponsored by the State of Michigan, is aimed at enriching and complementing the resources and expertise of our collective technology transfer programs, and improving the deployment of technology from Michigan institutions into our communities.

Great Lakes Entrepreneur's Quest (GLEQ)

The GLEQ (formerly Great Lakes Venture Quest) is an annual business plan competition designed to support technology entrepreneurship in Michigan. UM Tech Transfer, along with the Business School's Zell-Lurie Institute for Entrepreneurial Studies, played a leading role in founding the competition in 2000. UM fosters entrepreneurial activities from positions on the GLEQ board as well as participation in educational events, mentoring and resource assistance.

UM Inventors Recognition Reception

Expanding our traditional event for our UM inventors, we focused on a theme of "Celebrate Invention" to honor the nearly 600 individuals who participated in the Tech Transfer process. This reception featured kiosks showcasing examples of university research and entrepreneurship, a guest speaker reflecting on the life of Thomas Edison, and participation by over 100 community and business partners who paid tribute to the inventors and the inventive spirit at the University of Michigan.

"For entrepreneurs and investors, the 'Celebrate Invention' event is a tremendous opportunity to build and renew relationships with the world-changing inventors at the UM. Events like this will catalyze the next new venture from the UM labs into the market place."

—Kurt Riegger, Venture Partner, North Coast Technology Investors

Future Directions

AN OPTIMISTIC OUTLOOK

Thanks to an academic culture that fosters collaboration and encourages interdisciplinary alliances, the University of Michigan is unique both in the scope and quality of its research. Remarkable strength across disciplines has created an environment ripe for invention in areas such as bioengineering, life and health sciences, manufacturing, environmental science, and information technology.

Looking ahead to the next year and the next decade, current research holds great promise for advances in everything from environmental remediation to public health and safety, and from heavy industry to nanomanufacturing. While it's difficult to predict where major breakthroughs may occur, we expect to see significant advances in fuel cell technology, cancer research and proteomics.

FUEL CELL TECHNOLOGY

Hydrogen, considered the ultimate renewable fuel, can be efficiently converted into electricity by devices called fuel cells. It is possible that hydrogen-based fuel cells, coupled with other power generation systems, could replace gasoline, natural gas and other fossil fuel engines within a generation. Because of this, University of Michigan researchers are focusing a number of research programs on hydrogen energy technologies in general, and on fuel cells in particular. Much of this work is taking place within the College of Engineering. Research activities also exist within the School of Natural Resources and Environment, the Business School and the departments of Chemistry and Physics (LS&A).

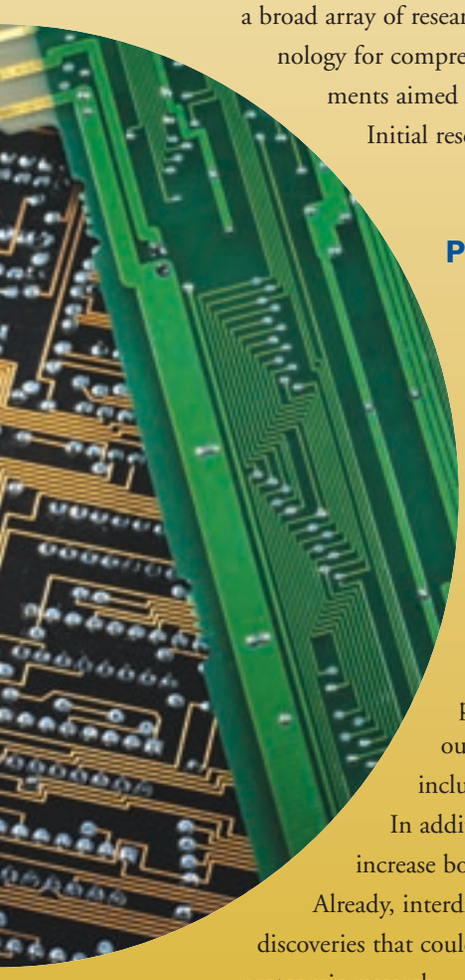
Research is underway to develop more efficient catalysts and better reactor designs for hydrogen generation, improved methods for storing and utilizing hydrogen, and new micro-fuel cells for portable devices. The successes to date are impressive—and the list is growing. Researchers from the College of Engineering are developing high-performance fuel processing catalysts and novel micro-reactors. And in the summer of 2002, the UM demonstrated its commitment to and leadership in hydrogen-based energy research by establishing the Center for Advanced Research at Michigan on Alternative Energies or CARMAe. CARMAe is based within the College of Engineering but will include personnel and projects from other UM units in its research/education portfolio.

CANCER RESEARCH

The University of Michigan has established an impressive record of achievement and earned a place in the top tier of the nation's cancer research centers. Among its numerous facilities is the General Clinical Research Center, the largest and most widely utilized NIH-funded cancer facility of its kind.

A core strength of the University resides in the wide-ranging opportunities for interdisciplinary collaboration. The interface of the Life Sciences Initiative (LSI) with the Medical Center and other units such as Biology, Chemistry and Engineering is creating a research "gestalt" that rivals any other major institution. Within this intellectually rich environment, where research projects run the gamut from nano-devices to tissue engineering and submolecular explorations, the role of Tech Transfer is to make connections between research and business, and to identify new applications for discoveries.

Among its other plans for the near future, the University of Michigan recently received a $3 million grant from the Michigan Life Sciences Corridor Fund (MLSCF) for the Proteomics Alliance for Cancer project. This consortium will bring together a broad array of researchers from inside and outside the university to advance the technology for comprehensively profiling human proteins for proof-of-concept experiments aimed at the prevention, diagnosis, and treatment of cancer. Initial research will focus on lung and breast cancer.



PROTEOMICS

The recently completed Human Genome Project has generated vast amounts of information about the fundamental structure of genes. Scientists are now confronted with the challenge of determining the functions of each gene. The key lies in proteomics—the ability to identify and measure all changes that occur in the proteins of a living cell in response to its environment.

Today, the University of Michigan is poised to become one of the world's premier centers for proteomics research. The UM has assembled outstanding researchers in a vast array of fields—including genomics, molecular biology, and bioinformatics. In addition, the new Life Sciences Institute will significantly increase both the volume and pace of cross-disciplinary research. Already, interdisciplinary teams are producing important, incremental discoveries that could have a major impact on the future of genomic and proteomic research.

"Overall, the prospects for technology transfer at the University of Michigan have never been better. With a strong infrastructure in place, with a notable record of achievement and a growing network of industry contacts, we are well positioned to help move leading-edge research from the University to the marketplace."

—Marvin Parnes
Associate Vice President for
Research and Executive Director
of Research Administration

UM Tech Transfer Staff (left)

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3. Tim Faley
4. Mike Sharer
5. Mike Hallman
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7. Mitch Goodkin
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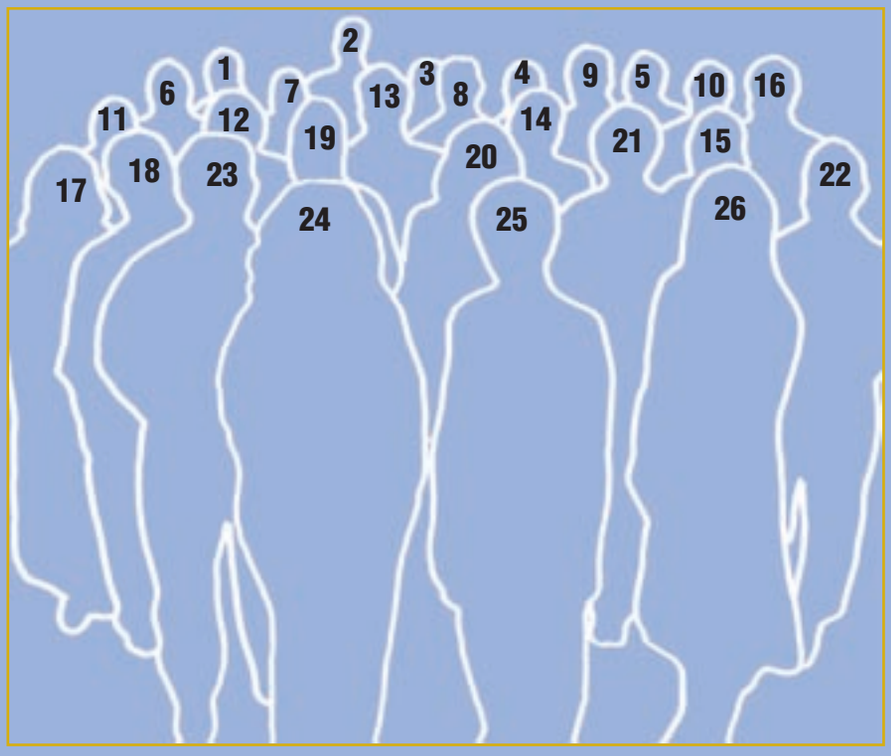

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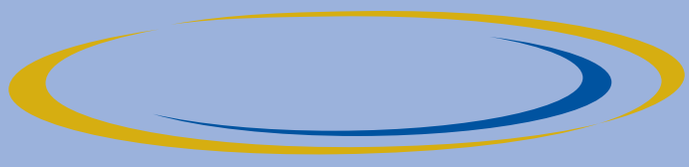

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