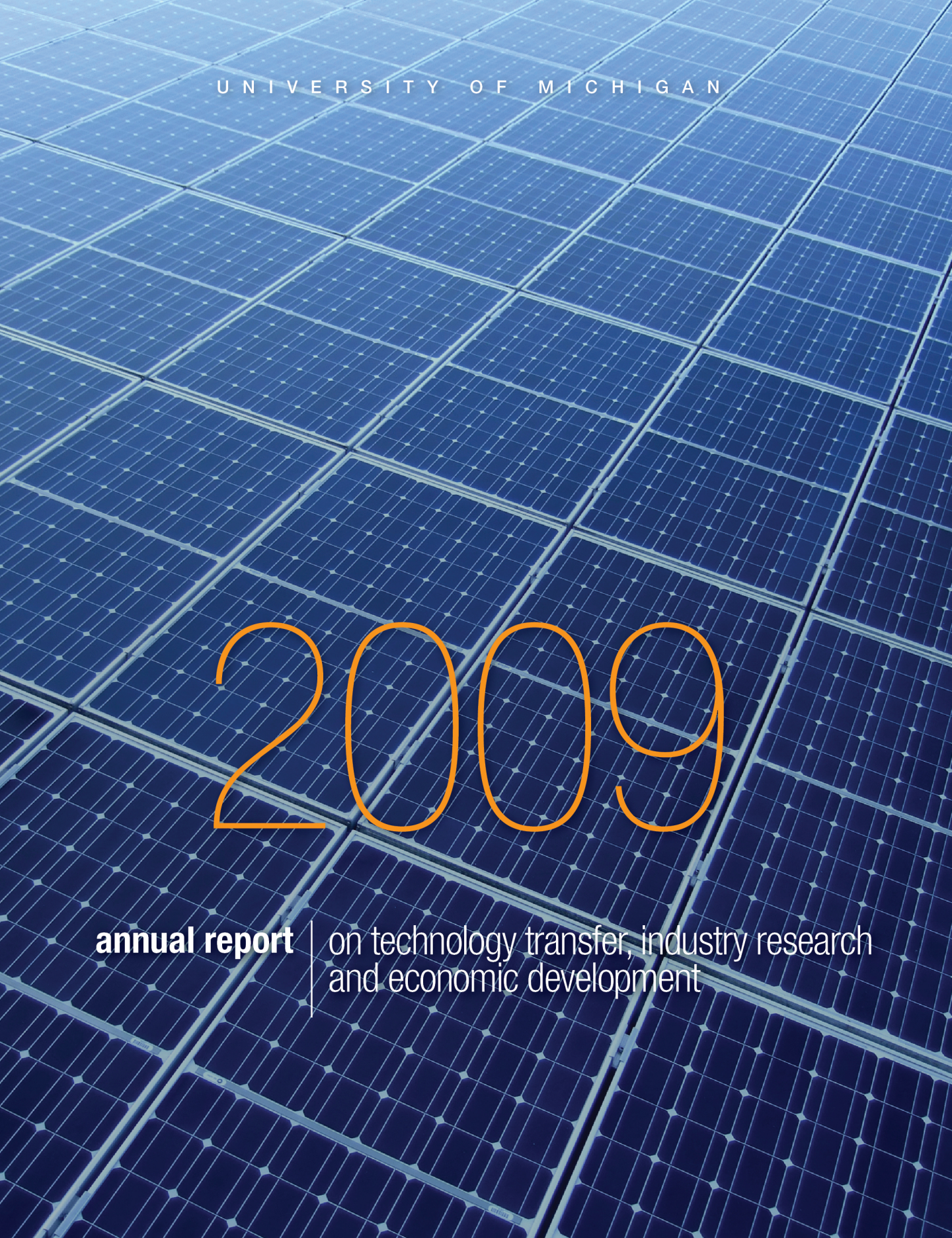


UNIVERSITY OF MICHIGAN

# 2009

**annual report** | on technology transfer, industry research and economic development

University of Michigan Vice President for Research Steve Forrest (right), with the directors of the Institute for Research on Labor, Employment, and the Economy; the Division of Research Development and Administration; U-M Tech Transfer; and the Business Engagement Center: Marian Krzyzowski, Marvin Parnes, Elaine Brock, Robin Rasor, Ken Nisbet, Daryl Weinert

MESSAGE FROM THE VICE PRESIDENT FOR RESEARCH

# The Engaged University

The state of Michigan and the region are going through a transformation that occurs only once or twice in a century. These are times of both enormous uncertainty and opportunity. The University of Michigan can play, and is playing, a significant role in this economic transformation. By leveraging our greater than $1 billion of research volume, and working hand in hand with all of our partners, especially those from industry, we are working every day to reignite the economic power of our region that has long been a source of prosperity for our state and nation.

The Office of Technology Transfer; the Business Engagement Center; the Institute for Research on Labor, Employment, and the Economy; and the Division of Research Development and Administration are taking a leading role, not only at the University of Michigan but also among our peer institutions nationwide, to ensure that our faculty, staff and students are fully supported in their role in helping Michigan to realize its economic potential and leadership. In this annual report you will find a few of the many examples of how U-M is engaged with our partners across the region and the U.S.

STEPHEN R. FORREST
Vice President for Research, University of Michigan

## MESSAGE FROM PRESIDENT COLEMAN

"The University of Michigan's economic contributions are a sharp contrast to the one-dimensional image of Michigan as a troubled state. Our creativity, innovation and discoveries are an economic stimulus package for our community, state and region."

MARY SUE COLEMAN | President, University of Michigan

# Tech Transfer Engagement

Despite the challenging economic climate, U-M's Tech Transfer metrics demonstrate continued progress. For Fiscal Year 2009 (FY 09), we received a record number of new inventions, 350 as compared to 306 last year. We entered into 78 agreements, down from last year but with a higher ratio of high potential exclusive agreements.

Despite constraints on early-stage venture funding, we recorded 8 new start-ups in FY 09. Since 2001 we helped launch 83 new start-up ventures, over 70 percent within the state of Michigan, generating new jobs and opportunities for our communities. We also recorded a 20 percent increase in license royalties in FY 09 that, along with revenue from two equity events, produced $18.3 million in total tech transfer revenue. These revenues allow U-M to reinvest in further research and commercialization for the years ahead.

We've also embarked on several initiatives to enhance our capabilities and to expand our engagement with entrepreneurial and business partners. These include:

+ The Mentors-in-Residence program, "embedding" seasoned entrepreneurs in U-M Tech Transfer to enhance our ability to assess new opportunities and to launch new start-ups.
+ Working even more closely with the Business Engagement Center in our shared central campus offices to better serve our faculty inventors and business partners.
+ The launch of the Michigan Venture Center (MVC) within U-M Tech Transfer to provide a one-stop hub for faculty and entrepreneurial partners interested in launching new start-up ventures based on U-M technology.

We're proud of our role in linking the technology, talent and resources of this great University to benefit the people in our community, our state and beyond.

KEN NISBET
Executive Director, U-M Tech Transfer



THE MISSION of U-M Tech Transfer is to generate benefits for the University, our community and society through the transfer of University innovations.

# About U-M Tech Transfer

U-M Tech Transfer is comprised of specialists in technology licensing, business formation and intellectual property law—all of whom are focused on providing professional, responsive services to U-M faculty and scientists. We work with inventors in every phase of technology transfer, from initial consultations and technology assessments to marketing, licensing and start-up formation.

We engage volunteers and consultants to more fully develop the commercial potential of our inventions and potential start-up ventures. And we aggressively cultivate a network of business and venture partners to assist us in commercializing technology, improving competitiveness, and launching new ventures to create opportunity and enhance our quality of life.

## WHY DO TECH TRANSFER?

+ To increase the likelihood that new discoveries will provide tangible benefits to the general public.
+ To help create a venue that attracts, develops and retains the very best students, faculty and researchers.
+ To improve the flow of research dollars and resources to the academic community.
+ To enrich the educational experience through student internship programs and other hands-on learning activities.
+ To leverage business partnerships to stimulate regional and national economic development.
+ To enhance the reputation and stature of the University.

## COMPONENTS OF THE TECH TRANSFER PROCESS

RESEARCH
▼
PRE-DISCLOSURE
▼
INVENTION REPORT
▼
ASSESSMENT
▼
PROTECTION
▼
MARKETING TO FIND OR FORM A LICENSEE
▼
LICENSE TO EXISTING BUSINESS { OR } ASSIST FORMATION OF A START-UP BUSINESS
▼
LICENSING
▼
COMMERCIALIZATION
▼
REVENUE
▼
REINVEST IN RESEARCH + EDUCATION

# 2009 Fiscal Year

RESULTS | Traditional measures of success in technology transfer include inventions, agreements, new business start-ups and revenues. But other measures are equally important. The quantity and quality of our engagements—with researchers, students and business and entrepreneurial partners—and the impact on the public of our transferred technologies are important indicators of success. The following pages of metrics and stories illustrate these successes.

## 2009 INVENTION REPORTS

### MEDICAL

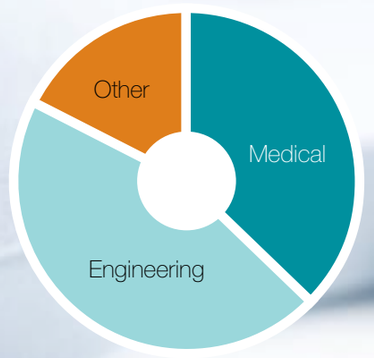
| | |
|---|---|
| Anesthesiology | 2 |
| Biological Chemistry | 2 |
| Cancer Center | 1 |
| Cell and Developmental Biology | 1 |
| Dermatology | 2 |
| Internal Medicine | 49 |
| Microbiology & Immunology | 3 |
| Molecular Physiology | 3 |
| Neurology | 2 |
| Obstetrics & Gynecology | 1 |
| Ophthalmology | 7 |
| Otolaryngology | 1 |
| Pathology | 9 |
| Michigan Center for Translational Pathology | 9 |
| Pediatrics and Comm Diseases | 3 |
| Pharmacology | 1 |
| Radiation Oncology | 6 |
| Radiology | 7 |
| Surgery | 22 |
| **Total** | **131** |

### ENGINEERING

| | |
|---|---|
| Aerospace Engineering | 5 |
| Atmospheric, Oceanic, Space Sci | 2 |
| Biomedical Engineering | 14 |
| Chemical Engineering | 13 |
| Civil & Environmental Eng | 3 |
| Electrical Eng & Computer Sci | 66 |
| Industrial Operations Engineering | 1 |
| Mechanical Engineering | 35 |
| Materials Science & Engineering | 10 |
| Naval Architecture & Marine Eng | 3 |
| Nuclear Eng & Radiological Sci | 6 |
| **Total** | **158** |

### OTHER

| | |
|---|---|
| College of Literature, Science, & the Arts | 22 |
| Dentistry | 9 |
| Information Technology & Computer Science | 1 |
| Life Sciences Institute | 3 |
| Nursing | 4 |
| Pharmacy | 5 |
| School of Public Health | 2 |
| U-M Dearborn | 9 |
| U-M Hospital | 5 |
| U-M Library | 1 |
| **Total** | **61** |

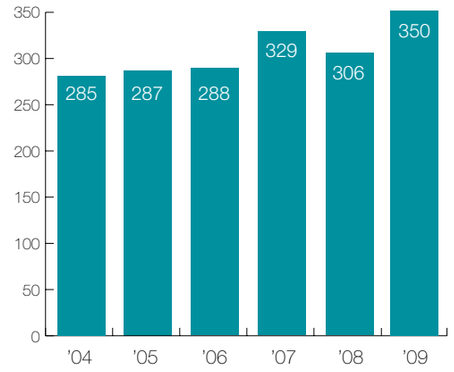



See pages 14–15 for a sampling of inventions, and **www.ttannualreport.umich.edu** for a complete list.

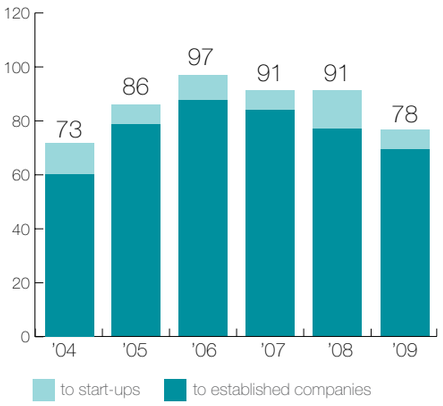


# Tech Transfer Year in Review

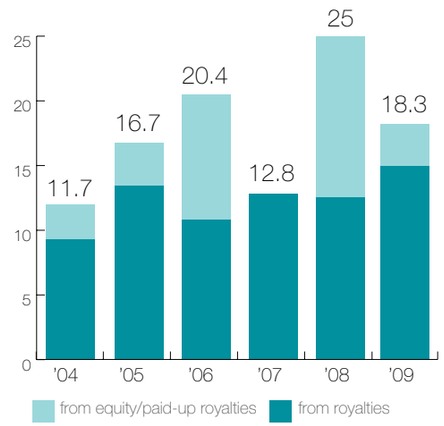
### INVENTION REPORTS




### LICENSE AGREEMENTS




### LICENSE REVENUE (in millions)




### 2009 START-UP CLASS

**ACSI**
Economic indicator based on customer satisfaction

**Biotectix**
Bioactive conductive polymer electrodes and coatings for implantable biomedical devices

**Integrated Sensor Technologies**
Miniature high-speed current probes

**OcuSciences**
Device for early non-invasive detection of retinal and metabolic diseases

**Phrixus Pharmaceuticals**
Treatments for heart failure

**Securus Medical**
Device to prevent esophageal thermal injury during catheter ablation procedures

**Seventh Sense Biosystems**
Health monitoring products that interface directly with human skin

**UMERSE (The Universal Medical Record Search Engine)**
Tools for searching clinical documents

# Developing New Treatments for Immune Diseases

**LYCERA CORPORATION**
**DR. GARY GLICK, CSO | Acting CEO and Werner E. Bachmann Professor of Chemistry**

The technology platforms developed by U-M Chemistry Professor Gary Glick and his research team are now being marketed through Lycera Corporation, a start-up launched in 2006. "From the very beginning," Glick says, "Tech Transfer worked aggressively on our behalf to protect the technology."


As a graduate student at Columbia University and later at Harvard, Gary Glick dreamed of one day founding a drug discovery company. That vision became reality in 2006 with the launch of Lycera Corporation, a University of Michigan start-up focused on developing small-molecule drugs for treating autoimmune diseases such as lupus, inflammatory bowel disease, rheumatoid arthritis, psoriasis and transplant rejection.

Unlike many current treatment modalities, which tend to have limited efficacy and severe—even fatal—side effects, Lycera's technology platforms hold great promise for the development of first-in-class topical and oral pharmaceuticals that are relatively inexpensive, highly effective and far less likely to impair immune function in patients.

In April 2009, the company closed on $36 million of venture capital financing, one of the largest rounds of Series A financing in the nation. Members of the investment syndicate included early investors ARCH Venture Partners and InterWest Partners, as well as Clarus Ventures and Michigan-based EDF Ventures.

The funding should enable Lycera to advance its first drug candidate through Phase II proof-of-concept studies and move a second candidate into Phase I clinical trials.



S2 Yacht officials predict that their diversification strategy could generate as many as 1,000 jobs. According to Product Development Manager Richard Eggerding, "Along with creating new jobs, we want to focus national attention on Michigan's engineering horsepower and the state's resources for rebuilding the U.S. economy."

# Sailing into New Markets

**S2 YACHTS/ENERGETX COMPOSITES**

The Slikkers family has been making waves in the boating world for more than half a century—first with superbly crafted wooden boats and later with innovative composite materials. Since the launch of S2 Yachts in 1974, they've become known for their premier sailboats, powerboats and cruising boats—many of them built at the company's headquarters in Holland, Michigan.

In 2007, the S2 management team made a strategic decision to diversify beyond marine products. Thus was born the company Energetx Composites. "We're still a boat manufacturer and intend to remain so," says S2 Product Design Manager Richard Eggerding. "But we're also a composites company, and our design, engineering and assembly capabilities are especially applicable to the renewable energy industry."

Currently, Energetx is engaged in projects with two U-M start-ups, FlexSys, Inc. and Michigan Aerospace Corporation. In addition, S2 Yachts has licensed the U-M smart buoy technology developed by Professor Guy Meadows, director of the University of Michigan Marine-Hydrodynamics Laboratory.

Through a partnership agreement with U-M, the environmental monitoring buoys produced by Energetx are being deployed as part of the University's Great Lakes Observing System, a component of the National Oceanic and Atmospheric Administration's integrated ocean observing system. "As for the future, there may be additional opportunities to collaborate. We're currently talking with S2 about the commercialization of a marine plug-in hybrid electric boat," says Meadows."

# Giving Start-Ups a Head Start

## THE TECHSTART SUMMER INTERNSHIP PROGRAM

In May, U-M's TechStart program welcomed its newest team of interns: ten graduate students representing business, law, medicine, engineering and information technology. Throughout the summer, the student-consultants teamed up with U-M Tech Transfer staff and industry advisors to help U-M start-ups assess opportunities, identify funding sources, refine strategies and produce viable business plans.

To date, three TechStart alumni have launched their own companies.

Since 2000, when it was founded by U-M Tech Transfer, TechStart has worked with spin-offs in fields ranging from industrial design to the life sciences. "Every year, the University launches eight to ten U-M start-ups," says U-M Tech Transfer Marketing Manager Mark Maynard, who directs the summer internship program. "TechStart is one of several tools we employ to make sure each of those companies is positioned for success."

In 2006, TechStart intern Gus Simiao conducted a market analysis for VIVACE (Vortex Induced Vibrations Aquatic Clean Energy), a technology created by Engineering Professor Michael M. Bernitsas that is capable of harnessing the energy generated by ocean and river currents. This year, Simiao became CEO of Vortex Hydro Energy, the Ann Arbor-based company commercializing the VIVACE technology.

2009 TechStart team members: (front) Hui Li, Naomita Yadav, Qian Wang, Manisha Tayal; (middle) Neelima Patibandla, Erin O'Leary, Antony Chen, Ashish Jain; (back) Frederique Lambers, Sundus Kubba, Mark Maynard

But faculty-entrepreneurs aren't the only beneficiaries. Most TechStart interns find the experience enriching and, in some cases, life transforming. MBA student Antony Chen reports that the program "opened my eyes to a new career strategy." For MBA student Manisha Tayal, another 2009 TechStart intern, the internship made it possible to begin building a career within the entrepreneurial community in Ann Arbor. And TechStart enabled PhD biological chemist Qian "Iris" Wang to transition from laboratory bench work to the commercialization side of science.



# Launching a Revolution in Cancer Treatment

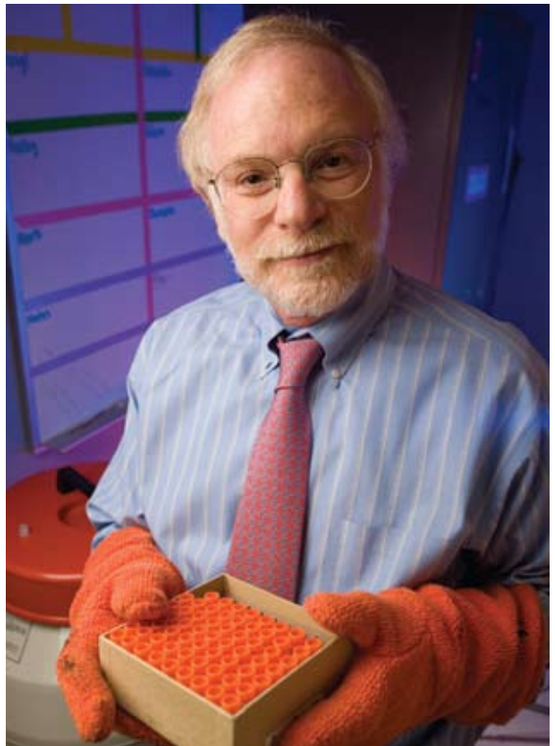
## DR. MAX S. WICHA | Co-founder, OncoMed Pharmaceuticals Director, U-M Comprehensive Cancer Center

In 2000, Drs. Michael F. Clarke, Sean Morrison and Max S. Wicha of the U-M Comprehensive Cancer Center (UMCCC) became the first researchers to identify cancer stem cells in a solid tumor.

According to their findings, stem cells—and only stem cells—were able to generate breast cancer tumors in mice. Those same cells also appeared to be highly resistant to chemotherapy and radiation. As Wicha notes, "The clinical implications are tremendous. Our findings suggest that the way to cure cancer patients is not to shrink the tumors but to attack the stem cells."

With the help of U-M Tech Transfer, the three scientists patented their model for detecting and screening new agents to target cancer stem cells. In 2001, they launched OncoMed Pharmaceuticals, one of eight spin-offs to originate from work at UMCCC.

Since then, the California-based start-up has developed a pipeline of monoclonal antibodies aimed at specific molecules linked to cancer stem cells. Now, with a record-setting $200 million in Stage B funding, two OncoMed compounds are undergoing clinical trials—with more on the way.



U-M Cancer Center Director Dr. Max Wicha is leveraging his experience with OncoMed to encourage a more entrepreneurial research model. "The Center has already spun off eight companies," he notes. "Our challenge is to translate more basic research into clinical trials by engaging venture capitalists and business leaders at the earliest stages."

# MC3

**DR. SCOTT MERZ | Co-founder and President, MC3, Inc.**

While earning his Ph.D., aspiring entrepreneur Scott Merz worked in the lab of U-M Professor of Surgery Dr. Robert Bartlett, where Merz helped develop an advanced blood pump for cardiac surgery. In 1991, he and his mentor spun off the invention into MC3, Inc. Within two years, the technology had been sublicensed to a medical device manufacturer and the start-up was searching for new opportunities.

One of those opportunities took the form of BioLung, an artificial lung developed by MC3 that was later licensed to Novalung, GmbH of Germany. But Merz's business plan was evolving in other directions as well.

"We liked the model of working closely with the University and Tech Transfer, licensing the ideas of faculty-inventors and preparing them for commercialization," Merz explains. "So we created a business accelerator that leverages our U-M connections and our experience in biomedical devices."

In 2008, MC3 spun off venture-backed Accord Biomaterials to commercialize Nogen, a technology for making surfaces biocompatible. Developed by Professor Mark Meyerhoff in Chemistry, Nogen uses nitric oxide, a naturally occurring substance in the body, to prevent clotting and other complications from blood-contacting medical devices. Currently, MC3 is also negotiating a license for a dental enamel compound developed by Professor Brian Clarkson in Dentistry.

Pictured here is the BioLung, one of the first medical device technologies developed and commercialized by Ann Arbor-based MC3. Today the company functions as a concept-to-manufacturing business accelerator, with services that range from feasibility studies and market assessments to business plans and investment financing.




Ann Arbor Business Review/Ann Arbor.com

"Our initial two-year project at the University of Michigan was an excellent proving ground that led us to develop a highly practical, real-world technology," says Tom May (pictured left with Peter Orr). "As a result, MedHub clients report dramatic reductions in redundancy and staff time paired with significant improvements in documentation and audit response."

# MedHub

**PETER ORR AND TOM MAY | Co-founders, MedHub, Inc.**

In 2000, Associate Professor of Endocrine Surgery Paul Gauger, M.D., and the University of Michigan's Department of Surgery, asked IT entrepreneur Peter Orr and mechanical engineer Tom May to develop a web-based call schedule for their 200+ residents, working across 11 programs.

Gradually, project requirements expanded. Capabilities were added. And in 2002, Orr and May deployed an enterprise-wide residency management program that integrated every major function—from physician training and accreditation-related activities to affiliated institutional billing, reimbursement, auditing and reporting.

That same year, they launched MedHub, Inc., to market the technology more broadly. Today, systems are in place at the Cleveland Clinic, Stanford University Hospitals and Clinics, Carolinas Health System, the University of Washington and 12 other major teaching hospitals.

Unlike competing solutions, which address the needs of individual residency departments, MedHub is designed for implementation across an entire organization. Intelligent workflow design makes the system both customizable and user friendly.

"MedHub's biggest strength is its ability to unify the many ad hoc aspects of physician training, Medicare reimbursement and regulatory requirements into a single, collaborative platform," says Orr. "With our best-in-class system, thousands of users can easily communicate, collaborate and retrieve real-time data for a common purpose."

# Engaging Advisory Talent

## U-M TECH TRANSFER NATIONAL ADVISORY BOARD

Since its inception in 2002, the U-M Tech Transfer National Advisory Board (NAB) has played a key role in guiding our strategies and operations. Comprised of representatives from industry, the venture capital and entrepreneurial communities, government and other university tech transfer offices, the NAB provides experience, expertise and diversity for a valued outside perspective. Recent NAB projects included guiding our Catalyst and Mentor-in-Residence talent initiatives and issuing a benchmarking report on public–private university partnerships similar to U-M's new North Campus Research Complex initiative.

Members of the National Advisory Board include:

**Thomas Bumol**
*Vice President*
*Eli Lilly*
*San Diego, CA*

**Marshall Cohen**
*DOLCE Technologies*
*Princeton, NJ*

**John Denniston**
*Partner, Kleiner*
*Perkins Caufield & Byers*
*Menlo Park, CA*

**Richard Douglas**
*Senior Vice President of*
*Corporate Development,*
*Genzyme Corporation*
*Cambridge, MA*

**Michael Finney**
*CEO and President*
*Ann Arbor SPARK*
*Ann Arbor, MI*

**Larry Freed**
*CEO and President*
*ForeSee Results*
*Ann Arbor, MI*

**Farnam Jahanian**
*Chair, Computer*
*Science and Engineering,*
*University of Michigan*
*Ann Arbor, MI*

**Edward Pagani**
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*Lumigen, Inc.*
*Southfield, MI*

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**Thomas Porter**
*Trillium Ventures*
*Ann Arbor, MI*

**Rick Snyder**
*Chief Executive*
*Officer, Ardesta*
*Ann Arbor, MI*

**Michael Staebler**
*Partner, Pepper*
*Hamilton LLP*
*Detroit, MI*

**Carl Stjernfeldt**
*Partner*
*Castile Ventures*
*Waltham, MA*

**Jack Turner**
*Associate Director*
*MIT Technology*
*Licensing Office*
*Cambridge, MA*

**Tom Washing**
*Founding Partner*
*Sequel Venture Partners*
*Boulder, CO*

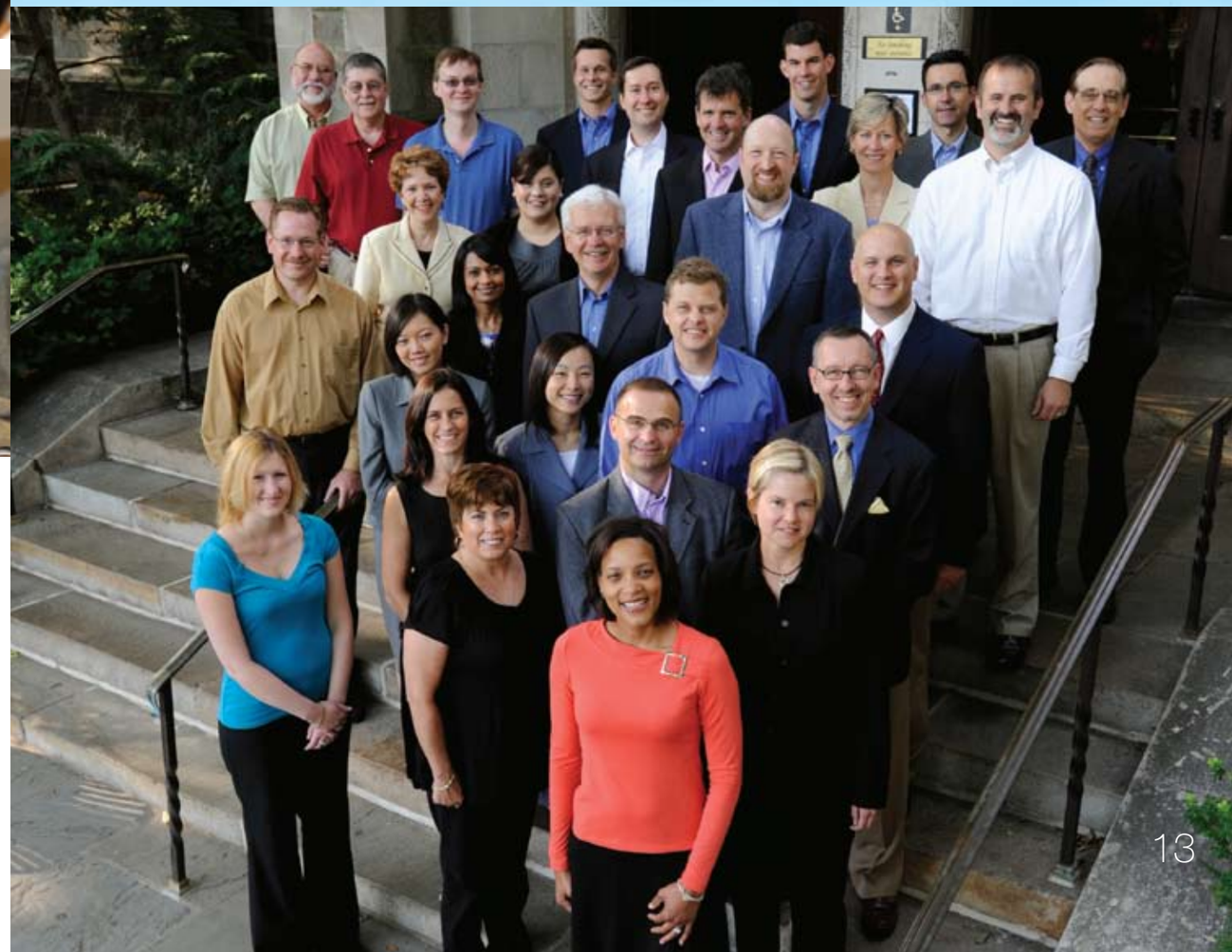
**Jeff Williams**
*President and CEO*
*HandyLab, Inc.*
*Ann Arbor, MI*



# The Staff of Tech Transfer

U-M Tech Transfer staff are actively engaged—often in leadership roles—in community, state and national organizations as well as regional and national events. These involvements help guide operational and policy initiatives and generate valuable resources and connections that directly benefit our work. Equally important, community engagement allows us, as U-M representatives, to contribute to economic vitality and quality of life initiatives that support the core missions of the University.

Tech Transfer staff: (first row) Diane Brown, Sally Ingalls, Carmen Atkins; (second row) Lisa Johnson, Andrew McColm, Debbie Watkins; (third row) Nadine Wong, Mutsumi Yoshida, Mark Maynard, Richard Chylla; (fourth row) Greg Choiniere, Rakhi Juneja, Kenneth Nisbet, Matt Bell; (fifth row) Linda Hamlin, Elizabeth Devlin, Jim Deane; (sixth row) Mike Hallman, Wayne Harvey, Steve Maser, Wesley Huffstutter, Patrick Thornton, Jim O'Connell, Bryce Pilz, Robin Rasor, Rick Brandon, Doug Hockstad, David Ritchie; (not pictured) Dennis Linder



# Fiscal Year 2009 Discoveries

## AEROSPACE ENGINEERING
- Extendible Solar Array System
- GPS Receiver System for Small Satellites
- Passive Boundary Layer Control Elements

## ANATOMY
- Painting Skeletal Muscles in Plastinated Human Anatomical Specimens
- Methods for Painting Neurovascular Pathways of Plastinated Human Anatomical Specimens

## ANESTHESIOLOGY
- Method and System for Signaling Medication Delivery Readiness, Delivery and Effectiveness
- Perineural and Epidural Dexmedetomidine

## ASIAN LANGUAGES & CULTURES
- Sanskrit Primer

## ATMOSPHERIC, OCEANIC & SPACE SCIENCES
- Tornado Detector

## BIOLOGICAL CHEMISTRY
- A Universal Fluorescent Assay for Formaldehyde-Producing Enzymes
- Bacterial Expression Vectors Encoding Chromation Modifying Enzymes

## BIOMEDICAL ENGINEERING
- A Focused Transcranial Magnetic Stimulator Using Electromagnetic Metamaterial Lenses
- A Polymer for Tissue Engineering Applications
- A Point of Care Device to Rapidly Measure Apoprotein Concentration in Blood or Plasma
- An Apparatus and Method for the Generation of Heterogeneity in Cell Cultures Using Magnetic Transfection
- Device for the Endoscopic Treatment of Upper Gastrointestinal Bleeding
- Disposable Transducer to Patient Coupling Medium Container
- Embedded Microfluidic Control System
- Pivot Probe
- Process for Parylene-Based Neural Probes and Biosensors

## CANCER CENTER
- R.E.T.A. (Research Effort Tracking Application)

## CELL & DEVELOPMENTAL BIOLOGY
- Methylketone Synthase 2-Production of Methylketones in Plants and Bacteria
- Treatment of Demyelinating CNS Disease

## CHEMICAL ENGINEERING
- Digital Pneumatic Microprocessors for Microfluidic Large-Scale Integration
- Fixed Output of a Catalytic Reformer Under Variable Feed-Composition
- Microfluidic Assembly Blocks
- Microwave Assisted NOx Abatement
- Nanostructures for Photo-Catalytic Applications
- Neural Prosthetic Applications of Layer-by-Layer Assembled Films of Carbon Nanotubes
- Viscous Solvent-Based Electrified Jetting for Anisotropic Micro/Nano-Sized Composites

## CHEMISTRY
- A Distribution of Type I Collagen Morphologies in Bone
- A Method for Direct Two-Photon Remote Detection of Materials
- Aryl Guanidine F150-Atpase Inhibitors and Related Methods
- Design, Evaluation, and Therapeutic Uses of Selective Threonine/Serine Kinase Inhibitors
- Electrochemical Polyion Sensor for Rapid Detection of High Charge Density Impurities in Heparin Preparations
- Method for Creating Nitric Oxide Surfaces
- Method for the Irreversible Encapsulation of Functional Guests in Microporous Coordination Polymers
- Compounds that Modulate the Mitochondrial ATPase
- Protein Farnesyltransferase Variants with Novel Substrate Preferences
- System for Electrospray and Nanospray Ionization of Discrete Samples in Droplet Format

## CIVIL & ENVIRONMENTAL ENGINEERING
- Augmented Reality Visualization System
- Biologically Mediated Simultaneous Removal of Multiple Oxyanionic Contaminants from Water
- Mobile Augmented Reality Backpack

## CLINICAL INFORMATION & DECISION SUPPORT SERVICES
- Patient Safety Initiative—Case Review System

## DENTISTRY
- Antiviral Phosphonates of 2,2-Bis-(Hydroxymethyl) Methylenecyclopropane Analogues of Nucleosides
- Children's Dental Problems and Management
- Periodontal Diagnostic Assay
- Polymer Compositions and Nanofibrous Spheres
- Synthesis of Flurapatite Nanorods under Ambient Conditions
- Use of Compounds to Stimulate Bone Formation

## DERMATOLOGY
- Methods and Compositions to Prevent Scarring

## ELECTRICAL ENGINEERING & COMPUTER SCIENCE
- A Maskless Laser-Write Lithography Processing of Thin-Film Transistors
- A Method for Pumping a Narrow-Linewidth Optical Resonator with a Broad-Linewidth Source
- Axial Precursor Feeding Plasma Gun Cathode Design for Nanomaterial Synthesis
- BioBolt
- Coaxial Laser Assisted Cold Spray Nozzle
- Complimentary ZnO\ZnTe Polycrystalline Thin Film Transistor Circuits
- DACOTA: Post Silicon Validation of the Memory Subsystem in Multi-Core Designs
- Differential Current Discharge-Based Pressure Sensor
- Dynamic Nano Inscribing Process and Apparatus
- Dynamic Reconfiguration of a Large-Scale Battery System
- Fast and Accurate Three-Dimensional Forward and Back-Projection Methods
- Fast High-Fidelity FPGA-Based Resiliency Analysis Framework
- Hardware Patching for Multi-Core Processors
- Hybrid Plasma Equipment Model (HPEM-UM)
- IC Design Database
- In-Situ Plasma/Laser Hybrid Technology for Solar Cell Fabrication
- Interleaving Constrained Shared-Memory Multi-Processor for Improving Reliability of Parallel Programs
- Maskless Fabrication Method of Thin-Film Transistors on a Hemispherical Surface
- Metal Embedded Antenna
- Method for Packaging Devices
- Methods for Embedding Glass into Silicon Wafers
- New Design and Applications for Nanoparticle Field Extraction Thruster
- Non-Resonant Frequency-Increased Power Scavenger Architecture for Low-Frequency Ambient Vibration
- NonPDPSIM—Software Modeling for Plasma Equipment
- Organic Vapor Phase Deposition (OVPD) Cell
- Photonic Crystal Coupled to Mass Spectrometry
- Post-Silicon Validation System for Modern Microprocessors
- Post-Silicon Verification for Cache Coherence
- Private Pond: Outsourced Management of Web Corpuses
- Proactive Transaction Scheduling for Contention Management Hardware Extensions
- Reval: Automatic Scalable Verification for Hardware Designs at the Register Transfer Level
- Scheduling of Battery Charge and Discharge
- Server Idle Power Elimination
- Solid State Light Source Based on Hybrid Waveguide Downconverter Diffuser
- Spatial-Dispersion-Free Spectral Combining of Pulsed High Peak Power Fiber Laser Beams for EUV Lithography Applications
- Stacked White Organic Light Emitting Devices Consisting of Separate Red, Green and Blue Subelements
- Suppression of Mutual Coupling between Adjacent Miniature Antennas
- Thin-Film Transistor Pixel Circuits for Hemispherical Image Sensors
- Vehicle Drive Cycle Identification and Use in Energy Management
- Wafer-Level Fabrication of MEMS and Solid-State Devices via Solder Bonded or Parylene Bonded and Thinned Bulk Piezoelectric Substrate

## HEALTH BEHAVIOR & HEALTH EDUCATION
- Michigan Tailoring System

## INTERNAL MEDICINE
- Anatomically Appropriate Design for Left Atrial Appendage Occlusion Devices
- Antiviral Agents to Treat Alphaviruses
- Arrhythmia Modification or Diagnostic Testing by Nucleotide or Nucleotide Signaling Dissipation
- Bivalent Heteroayl-Substituted Smac Mimetics
- Cell Surface Targets for Neoplastic Barrett's Esophagus
- Drosophila Exercise-Training Device
- Dual Axes Confocal Microscope for Vertical Cross-Sectional Imaging
- Epitope-Targeted Anthrax Vaccine
- HIF-2[alpha]-/- and HIF-2-[alpha]-/-HIF-1[alpha]-/-Cell Lines
- Implantable Leadless and Wireless Devices for Sensing Electrical Activity and Pacing
- Inhibitor for the Treatment of Fibrotic Diseases
- Intra-Atrial Coronary Chemical Ablation of Atrial Fibrillation
- Label Free Protein Detection
- Lung Resident Mesenchymal Stem Cells in Bronchoalveolar Lavage as Biomarkers of Lung Diseases
- Mcomm Medical Communication System
- Method of Screening Patients with Cardiovascular Disease
- Methods for Generating Antigen-Specific T Memory Stem Cells
- Methods to Inhibit the Replication of Endogenous Retroviruses
- Molecular Recognition of Nitrated Fatty Acids
- Mouse Embryonic Stem Cell Line
- Peptides Targeting Neoplastic Barrett's Esophagus
- Plasminogen Activator Inhibitor-1 Inhibitors and Methods of Use Thereof to Modulate Lipid Metabolism
- Polyclonal Rabbit Antiserum against Human FIP200
- Prevention of MMP-9 Activation and Hypoxic-Ischemic Brain Injury in Newborns
- Single Cell PCR
- Small-Molecule Ligands to Target Stat3 Protein
- Stent for Femoral and Popliteal Disease
- Systems for Gastric Volume Reduction to Facilitate Weight Loss
- Target Genes as Predictors of Response to Antiangiogenic Therapy
- Therapeutic siRNAs for Treating Fibrotic Diseases
- Use of Defibrillator Electrograms for Recognition of Clinical Ventricular Tachycardias
- Viral Anthrax Vaccines

## ITCS DEPARTMENTS
- A Method for Extending the Use of Single IPv4 Addresses to Multiple Network End-Hosts

## LIFE SCIENCES INSTITUTE
- Antimicrobial Agents
- MycC1 and MycG, Cytochrome P450 Enzymes from Mycinamicin Macrolide Biosynthetic Pathway

## MATERIALS SCIENCE & ENGINEERING
- A Method and Apparatus for Biaxial Extrusion of Metal Billets to Produce Fine Grain Sheets
- Biosensors Based on Polydiacetylene Liposome Arrays
- Concrete Materials from Coal Char Carbon
- General Concept for Continuous Dissociation of Water to Produce Hydrogen
- Growth of ZnO on Si Substrate
- Methods for Vapor Deposition of Para-Xylylene
- Multi-Spectral Solar Cell
- Properties Tailoring in Silsesquioxanes via Inter-Conversion Processes
- Robust Damage Monitoring/Inspection Systems

## MECHANICAL ENGINEERING
- A Compact Energy-Efficient Biomass Reactor to Produce Liquid Hydrocarbons
- A Device and Method for Measuring Manual Reaction Time
- A Powerless, Optical Microsensor for Monitoring Intracranial Pressure
- An Apparatus and Method for Analyzing the Response to Gait Perturbations Using Convertible Footwear
- Apparatus and Methods for Employing Miniature IMUs for Deducing Forces and Moments on Bodies
- Compliant Structural Support System for Body Support
- Data Portal for MEMS IMU Sports Motion Data
- Dense Horizontally Aligned Carbon Nanotube Assemblies
- Fluorescence Spectroscopy System
- Freeform Carbon Nanotube Structures
- Fuel Composition Recognition and Adaptation System
- High Performance Sandwich Structures
- Manufacturing of Li Ion Battery Electrodes by Plasma/Laser Hybrid Technique
- Metalworking Lubricants Delivered at Low Temperature and High Velocity with Rapidly Expanding Gases and Supercritical Fluids
- Method for Fast Assembly and Disassembly of Battery Cells
- Micro-Engineered Shoes for Walking Over Liquid Surfaces
- Miniature Scanning Two-Photon Optical System for Inflammatory Disease Detection
- Open Surgery Training System Employing MEMS Inertial Sensors and Motion Analysis of Surgical Instruments
- Personal Dead-Reckoning System
- The Method for In-Process Monitoring of Welding
- Wireless Mimic Device for Rehabilitation and Training Applications
- Wireless Tactile Trainer

## MEDICINAL CHEMISTRY
- Inhibitors of RhoA-Mediated Gene Transcription

## MICROBIOLOGY & IMMUNOLOGY
- A Conditional RASA1-Deficient Mouse Model of Lymphangiogenesis
- System Identifying Activated Genetic Switches
- Two-Stage Vaccination Method for Clearance of Infectious Microbes

## MOLECULAR PHYSIOLOGY
- Assay to Detect Keratin-Cross-Linked Liver Inclusions
- Development of a Scaffoldless Three-Dimensional Engineering Nerve Using A Nerve Fibroblast Co-Culture

## NAVAL ARCHITECTURE MARINE ENGINEERING
- Marine Plug-In Hybrid Electric Vehicle (M-PHEV)

## NEUROLOGY
- Methods for Treatment of Inflammatory and Autoimmune Diseases
- Treatment of Inflammatory and Autoimmune Diseases

## NUCLEAR ENGINEERING & RADIOLOGICAL SCIENCES
- Magnetron for Radiation Generation from GHz through THz
- Method and Apparatus for Detection of Explosive Materials
- Methods of Position Sensing for Semiconductor Radiation Detectors
- Neutron Source and Radiation Detector Collimation

## NURSING DEPARTMENTS
- RAAPS—Rapid Assessment for Adolescent Preventive Services

## OBSTETRICS & GYNECOLOGY
- Combinatorial Organic Buffers for Improved Cell Manipulation, Culture and Cryopreservation

## OPHTHALMOLOGY
- Madeline 2.0 Pedigree Drawing Engine
- Small Peptide Inhibitor of Photoreceptor Apoptosis
- The Use of MicroRNA to Regulate Expression of Twist Gene Expression
- Treatments for Carcinoma and Melanoma
- Modulation of a Caspase in Diseases with Inflammation, Endoplasmic Reticulum Stress, and/or Apoptosis

## OTOLARYNGOLOGY
- Methods for Restoring Hearing

## PALEONTOLOGY
- Hyde Park Mastodon

## PATHOLOGY
- Inhibitors of Hsc/Hsp70 as a Therapeutic Strategy for Alzheimer's Disease and Other Tauopathies
- Isotopically Defined Standards
- JMJD3 Mammalian Expression Vector
- Just-in-Time Mobile Clinical Laboratory Analysis Platforms
- Multiplex Quantitative PCR Signature to Predict Progression in Non-Muscle-Invasive Bladder Cancer
- Transcriptome Sequencing to Detect Gene Fusion in Cancer
- Virucidally Assisted Network Asset Validation (VANAV)

## PEDIATRICS & COMMUNICABLE DISEASES
- Co-Culture and Bioengineering of Muscle and Nerves
- Protein Replacement Therapy of Cystinosis

## PHARMACOLOGY
- Recombinant P450 Proteins

## PHARMACY
- A Drug Delivery Composition for Brain Tumor Treatment

## PHARMACEUTICAL SCIENCES
- Polymer Coating Process for Multicomponent Crystalline Particles
- Surfactant and Micellar Systems for Stabilizing Cocrystals

## PHYSICS
- Textured Junction Diode for Neutron Detection
- Time Resolved, Optically Triggered Fast X-Ray Detector

## PSYCHOLOGY
- N-Back Trainer Classic

## RADIATION ONCOLOGY
- Highly Potent Invasion Inhibitors
- MDM2 p53 Luciferase Reporter Mice
- Methods and Compositions Targeting Therapeutics for Glomerular Disease
- Topoligical Uniformilty of Photodiode and Other Sensing Structures in Flat-Panel X-Ray Imagers

## RADIOLOGY
- Contrast Agent Use for Quantitative Measurement of Optical Absorption Spectrum
- Derivatives of Dihydrotetrabenazine
- MRI Knee Positioning Device
- Perfluoro Compounds and Their Application in Dual and Multi Modality Tracers for Diagnostic Molcular Imaging
- Use of Molecularly Imprinted Polymers in Radiopharmaceutical Synthesis, Purification and Utilization

## SURGERY
- A Method to Reconstitute the T Lymphocyte Compartment
- A Mutable Vaccine
- Angio Scope (Thrombectomy Vision) Vascular
- Bench-Top Perfusion System
- Catheter Securement Device
- Easy-Cath 180
- High Output Fistula Management System
- In Vivo Elasticity Measurements of Aortic Walls Using DICOM Computerized Tomography Files
- Measurement of Lymphocyte Receptor Diversity Using a Gene Chip
- Methods and Compositions for the Treatment of Cancer
- Methods for Cancer Treatment by Elimination of Cancer Stem Cells
- Mutable Vaccines
- Nova-Cath
- Pancreatic Cancer Serum Detection Using a Lectin /Glyco-Antibody Array Method
- Quantitative mRNA Predictor of Lung Cancer Prognosis
- Roticulating Laparoscopic Protracker
- Sphynix Catheter Securement Device
- Therapeutic Ultrasound Transducer and Rectal Imaging Transducer Micromanipulator Control Arm for Prostate Ablation
- Treatment of Drug-Related Side Effect and Tissue Damage
- Use of Agonists to Antagonize TLR4

THIS IS JUST A SAMPLING OF THE 350 TECHNOLOGIES DEVELOPED BY U-M RESEARCHERS IN FY '09. FOR A COMPLETE LIST, SEE **WWW.TTANNUALREPORT.UMICH.EDU**

# Industry Engagement

Research partnerships with industry are a cornerstone of our mission, providing expanded learning, opportunities for advanced discoveries and advantages for our students and faculty. The recent economic difficulties made it even more clear that the University must play a key role in revitalizing industry and promoting innovation and growth. The Business Engagement Center (BEC) provides a "front door" for industry with connections to research opportunities and more. In addition, Research Development and Administration (DRDA) partners with the BEC, providing guidance and services to facilitate effective industry research projects.

## BUSINESS ENGAGEMENT CENTER

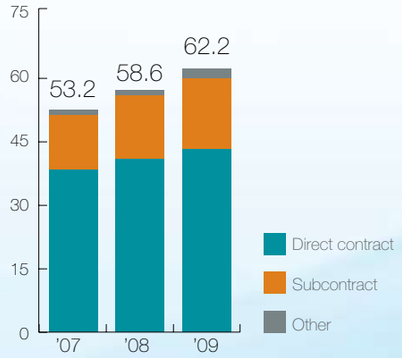
The Business Engagement Center provides the business community with a gateway to the U-M's vast facilities, resources and expertise. Through a central office and satellite offices in the College of Engineering, the Medical School, and the Dearborn campus. The center works closely with the entire university community to assure a welcoming, user-friendly path for prospective industry partners.

These engagements typically include:

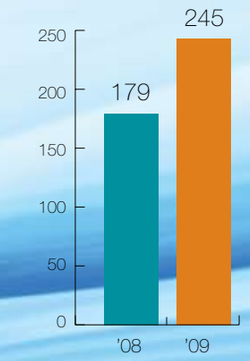
+ Partnering with University faculty on research programs.
+ Contracting with University units to develop and deliver customized training programs for professional-level employees.
+ Recruiting students seeking internships or embarking on full-time careers.
+ Providing licensing leads to U-M Tech Transfer.
+ Developing strategic giving programs that align with company goals.

BEC staff: (standing clockwise from L to R) Nick Miller, Susan Shields, Stella Wixom, Umesh Patel, Deb Mondro; (seated) Nick Glauch, Daryl Weinert, Elizabeth Devlin, Christine Vladu

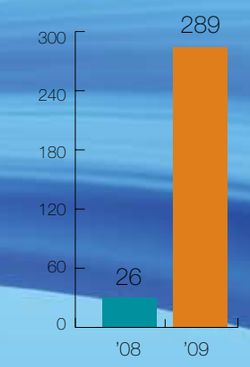
## INDUSTRY RESEARCH
(in millions)




## INDUSTRY VISITS**




## NEW ENGAGEMENTS***




*BEC founded in December 2007. **Includes either company visits to campus involving U-M personnel beyond BEC staff, or visits to a company. ***Interactions with businesses not previously engaged with the BEC.



# Research Development and Administration

Industry research programs are coordinated by the Division of Research Development and Administration (DRDA). This unit provides comprehensive proposal development and award services, including contract negotiation, to ensure smooth, productive engagement with all industry sponsors. DRDA also provides these services to federal, state and other research sponsors.

DRDA staff: (first row) Sharyn Sivyer, Julie Feldkamp, Dave Plawchan, Marie Turner, Elaine Brock, Megan Morin; (second row) Susan Buza, Krista Campeau, Pat Roe, Tony Nielsen, Tom Zdeba, Denise Williams, Julie Wietzke; (third row) Dan Stanish, Glenn Levine, Kate Strzempek, Jeff Longe, Tracy Larkin, Colleen Volger, Jane Santoro, Maryellen Kouba, Karen Sampson; (fourth row) Mitch Goodkin, Gayle Jackson, Laura Cifor, Jill Reed; (fifth row) Bob Beattie, Dennis Cebulski, Marifelice Roulo, Marvin Parnes, Linda Brooks, Jocelyn Jacobs, Dawn Selvius, Kate Koorhan, Kathy Dewitt, Alex Kanous, Terri Maxwell; (not pictured) Andrea Bjorklund, Amanda Coulter, Ellen Hou, Jolette Munoz, Sue Murphy, Suzanne Tainter

# Making Measurable Strides in Prostate Cancer

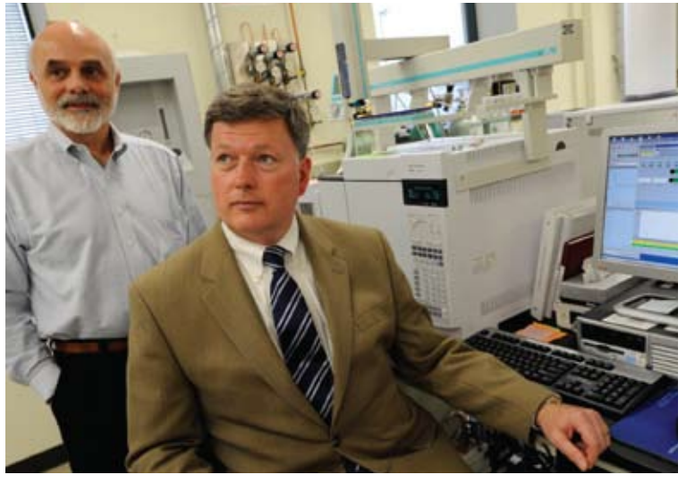
## AGILENT TECHNOLOGIES AND THE MICHIGAN CENTER FOR TRANSLATIONAL PATHOLOGY (MCTP)

Every 19 minutes, a man dies from prostate cancer. At this moment, approximately 2 million American men are living with the disease.

Those statistics make prostate cancer a prime target for researchers at the Michigan Center for Translational Pathology (MCTP). Under the leadership of Howard Hughes Investigator and U-M professor Dr. Arul Chinnaiyan, the Center is striving to accelerate the rate at which molecular genetics research is "translated" from the laboratory into clinical settings.

In 2009, MCTP entered into a collaborative agreement with Agilent Technologies, a Hewlett-Packard spin-off that is today the world's leading manufacturer of test and measurement products. Agilent has pledged $500,000 to help develop better diagnostics and treatments for prostate cancer, a gift that is being matched dollar-for-dollar by the Prostate Cancer Foundation.

According to Chris Beecher, Ph.D., professor of pathology at the U-M Medical School, researchers at MCTP will pursue a systems-biological approach that simultaneously explores the disease at the biomedical and genetic levels. "We expect to be able to make a number of discoveries in prostate cancer and to develop new techniques that will be universally useful."



The Michigan Center for Translational Pathology has received a $500,000 matching gift from Agilent Technologies. The company also donated more than $600,000 worth of equipment to the University's Human Blood Plasma Consortium. Pictured are Chris Beecher, Ph.D., professor of pathology, U-M Medical School (left) and Jack Wenstrand, director, university relations and external research, Agilent Technologies.



# Enhancing Data Access for High-Performance Computers

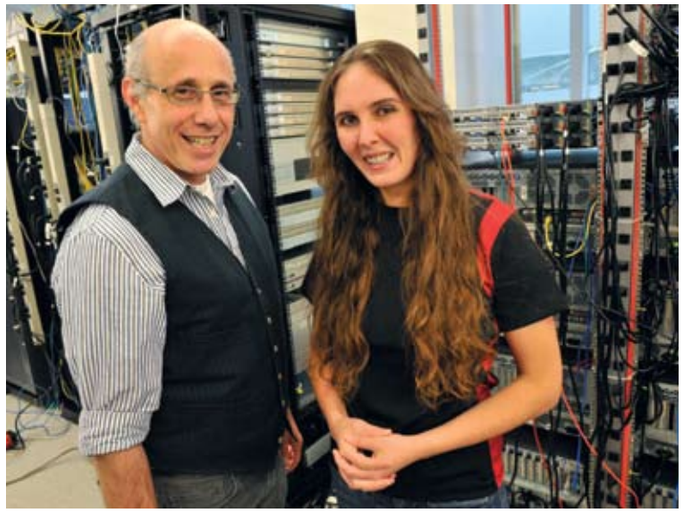
## U-M CENTER FOR INFORMATION TECHNOLOGY INTEGRATION (CITI) AND MICROSOFT CORPORATION

For more than 20 years, CITI has operated in what its director Peter Honeyman calls "idea space." The Center was created to advance information technology by identifying gaps in the cyber-infrastructure and then finding solutions, often through collaborations with industry. The new protocols are then disseminated as open-source software.

Over the years, CITI's research partners have included IBM, NetApp, Sun Microsystems, EMC and other industry leaders. More than a decade ago, CITI helped develop version 4.0 of the Network File System (NFS v4.0) and more recently has been working on version 4.1 for Linux. In 2008, CITI entered into a two-year agreement with Microsoft to support the development of a NFS v4.1 for the Windows operating system as well.

As Honeyman explains, "NFS is a protocol for sharing files among networked computers and storage devices, particularly with UNIX and Linux-based software. Microsoft is funding us to build a new implementation of NFS v4.1 for Windows-based computers that would give high-end computer users secure, transparent access to vast amounts of data across all major operating systems."

"I'm very excited to see the CITI lab embark on this project," said Bob Muglia, president of Microsoft's Server and Tools Business, upon the announcement of the sponsorship in early 2009. Muglia, a U-M alumnus, notes that "NFSv4.1 is an important standard for accessing parallel file systems in the high-performance computing market."



Lead developer Olga Kornievskaia, and CITI director Peter Honeyman are developing a new NFSv4.1 implementation—allowing geophysicists, financial analysts, government scientists and university researchers to access more data in less time—with more security—while worrying less about how and where that data is being stored.

# Catalyzing a Next-Generation Automotive Industry in Michigan

## U-M CONNECTED VEHICLE PROVING CENTER (CVPC)

Cars that refuse to crash. Cruise control systems that automatically adjust to highway conditions. Vehicles that issue oncoming traffic alerts. These and other mobile wireless applications are in the blueprint stages now. And in the near future, more of them could be developed and tested at U-M Dearborn's Connected Vehicle Proving Center (CVPC).

The CVPC was established in 2007 with a $3.15 million competitive grant from the Michigan Economic Development Corporation through its 21st Century Jobs Fund. In 2009, the Center relocated to the Institute for Advanced Vehicle Systems Building at U-M Dearborn.

"As we move from gas engines and mechanical transmissions to electrical engines and transmissions, automotive manufacturers have the opportunity to design cars in a whole new way," says CVPC Co-director Dr. Steve Underwood. "For most of them, the roadmap leads to vehicles that basically drive themselves through the use of wireless connectivity technologies. Our mission is, first, to support innovation by providing research expertise and test facilities and, second, to serve as a linchpin in the development of a new connected vehicle and mobility Internet industry in Michigan."


Indoor laboratories, private proving grounds and public test beds are among the many advanced test facilities CVPC makes available to industry, public agencies and academic partners at its U-M Dearborn headquarters. The Center also offers research expertise focused on mobile computing and communications. Pictured are Steve Underwood (left), director and principal investigator, and Udi Naamani, director and general manager.



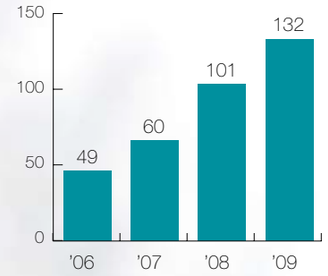
To read more, go to www.ttannualreport.umich.edu

# Engaged in Economic Development

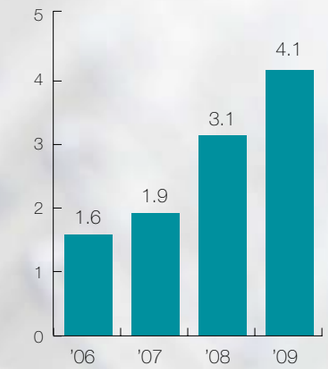
IRLEE | The Institute for Research on Labor, Employment, and the Economy (IRLEE) assesses the impact of economic restructuring and provides hands-on assistance to distressed businesses, non-profits and communities throughout the Great Lakes region. These efforts, undertaken by staff, students and faculty, enhance the retention and revitalization of existing businesses undergoing economic transition and assist communities experiencing major plant shutdowns and downsizing by linking them to resources and facilitating new enterprise formation. IRLEE also provides local, state and regional economic forecasting services for business, government and academic constituencies.

IRLEE staff from left: Scott Jacobs, Marian Krzyzowski, Niki Vick, Kristen Cunningham, Lawrence Molnar, Steve Wilson

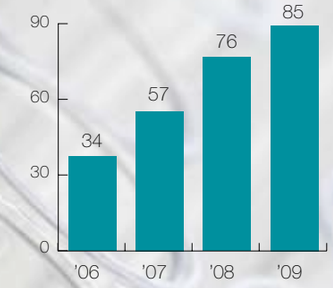
**ACTIVE CLIENT FIRMS RECEIVING ASSISTANCE**




**EXTERNAL SPONSORED CONTRACT REVENUES**
(in millions)




**COMMUNITIES RECEIVING ASSISTANCE**



## BARRACUDA NETWORKS

It is critical for the University to continue to play a role in attracting companies to our region. Barracuda Networks—a leading provider of content security appliances with international headquarters in Campbell, California—opened an engineering office in Ann Arbor due, in large part, to the large population of very talented U-M students interested in their business sector. By connecting the Barracuda Networks team to MEDC and Ann Arbor SPARK, the Business Engagement Center facilitated the development of an attractive package to solidify Barracuda Networks' presence in town. U-M's partnership with Barracuda Networks continues to grow as the company launches new products from the Ann Arbor office and expands its footprint in town.

## INDUSTRY EVENTS

The University is committed to providing forums for the exchange of ideas and the fostering of partnerships with industry. One example was the Industry Partnership Town Hall held on May 11th, 2009 (pictured below), at the newly expanded U-M Museum of Art. More than 200 businesses and entrepreneurs heard about our plans to more fully engage with the business and venture communities. Afterwards, they took advantage of ample networking time to renew acquaintances and meet new potential innovation partners.

Ann Arbor Chronicle



## MICHIGAN VENTURE CENTER

U-M Tech Transfer has launched 83 start-ups ventures since 2001. To enhance our venture creation capabilities, we recently created the Michigan Venture Center (MVC), the central hub of talent, funding and resource connections for all start-up ventures based on U-M technology.

At the core of the MVC is our tech transfer team of experienced business formation specialists who work with inventors to plan and execute new business concepts. The MVC includes the Catalyst Resource Network of mentors, industry experts, consultants, management candidates and students. Additionally, the MVC includes Tech Transfer's Mentor-in-Residence program that "embeds" experienced entrepreneurs alongside our Business Formation team. The MVC leverages internal tech transfer "gap" funds and identifies other funding resources to resolve key technical and market issues. With a wide array of venture creation resources, the MVC provides a "front door" into the University for entrepreneurs and venture partners interested in partnering to create high growth start-up ventures based on U-M technology.

Mentor-in-Residence team: (front) Thomas Collet, Mahendra Ramsinghani; (back) Nicholas Cucinelli, James Bertolina, David Hartmann, William Wood

## MIIE

The Michigan Initiative for Innovation and Entrepreneurship (MIIE) is a consortium of all 15 Michigan public universities collaborating to enhance statewide economic competitiveness. Grants from the C.S. Mott Foundation and the New Economy Initiative provided the initial pool of funds to support university proposals for technology commercialization, as well as industry and entrepreneurial engagement and entrepreneurial education.

# U-M North Campus Research Complex

In June 2009 the University completed the purchase of a research complex containing two million square feet of research space located on 174 acres that previously was home to one of Pfizer's largest pharmaceutical research facilities. This new campus, the U-M North Campus Research Complex (NCRC), is adjacent to our U-M's North Campus and promises to transform our ability to conduct research, educate students, commercialize discoveries and engage with industry partners. These facilities are planned to expand our core research and partnerships; key areas of interest include healthcare, biomedical engineering and energy technologies.