

CHAPTER 8

RESEARCH, SCHOLARSHIP, AND CREATIVE ACTIVITY

Students and faculty are attracted to Case by the amount and high caliber of research and creative activity underway, the enthusiasm of those participating in these activities, and the institutional value placed upon the highest ideals of scholarship. Case is sufficiently large and complex to attract significant funding, yet small enough so that collaboration and interdisciplinary efforts are relatively easy to initiate and maintain.

Research at Case consists not only of the exploration and critical analyses of scientific and medical problems, but also of rigorous examination of philosophical views, artistic expressions, and social systems. Case faculty members are experts in their fields, and students benefit from the faculty's drive to create new knowledge. Scholarship in all disciplines is supported by internal and external resources, and the university's physical facilities enhance the climate for imaginative and innovative projects.

In keeping with the service component of the university's mission, vision, and values statement, research and creative endeavors are aimed at transforming not only the learner and the teacher but also society as a whole. A world-class technology transfer program promotes application of scientific, engineering, medical, and other advances. Innovative creative endeavors in the fine and performing arts and the humanities reach large audiences, and entrepreneurial activities are managed in ways that benefit the university's local, regional, national, and global communities.

OVERVIEW

Case is one of the premier research universities in the country. It consistently ranks in the top 20 among private colleges and universities with respect to research expenditures, and in the top 25 among all institutions receiving funding from the National Institutes of Health, its largest single source of research support. Over the past ten years, Case's research funding has grown from \$153 million to \$375 million, an increase of 145 percent. The bulk of this funding, approximately eighty percent, comes from the federal government.

Scientific advances in the areas of genetics, molecular biology, imaging, computer science, and nanoscience have had an increasing influence on the focus of research at Case. The federal government's growing emphasis on interdisciplinary research has also led to expanded activities in fields such as biomedical engineering, cellular therapeutics, genetics, bioinformatics, health outcomes research, aging research, neurosciences, cognitive sciences, and child development, with teams of researchers from medical and engineering disciplines, physical sciences, and social and behavioral sciences working together to advance the knowledge base.

Much of Case's current research energy is concentrated on the development of a new set of inter-school collaborations, a programmatic genre that was also explored for this self-study by the Subcommittee on Interdivisional Collaborations and External Partnerships (see Appendix 1). These centers synchronize faculty research efforts in focused areas with the capacity to achieve national and global leadership. As Case builds from its considerable strengths in fields ranging from

fuel cells to entrepreneurship to biomedical engineering (currently ranked fourth in the nation by *U.S. News & World Report*), its goal is a cross-disciplinary culture of learning that will approach problems in new and creative ways. Case's trustees have authorized a major investment in these groundbreaking focus areas: (1) business as a means to make the world a better place, (2) advanced energy conversion, (3) entrepreneurship and technology to enhance human health, and (4) biomedical engineering.

The strength of the research enterprise at Case is greatly enhanced through meaningful research partnerships. Several such links have been initiated over the past decade, among them the National Center for Microgravity Research on Fluids and Combustion (NCMR), formed in 1997, which builds on Case's longstanding strength in research into the behavior of materials and devices in the low-gravity environment of space. The university's partner in this instance is the Universities Space Research Association, and NASA is the center's principal sponsor. The center is located both on the Case campus and at NASA's Glenn Research Center in Cleveland, with dedicated staff at each location. Its director is Professor Simon Ostrach of the Department of Mechanical and Aerospace Engineering in the Case School of Engineering. The center is national in its scope and mission, serving as a focal point for building a knowledge base for the design and development of reliable, efficient, and cost-effective space systems. Faculty and students from Case participate in the work of the center along with scientists and engineers from NASA and other participating organizations, often developing new avenues of inquiry for their own research while providing important advice for projects initiated by others. NCMR is a key contributor to the success of scores of research projects performed in microgravity environments, and also assists in promoting commercialization of the research results and in sharing information about microgravity topics with K-12 teachers and students.

Case has also entered into several large State of Ohio supported partnerships (over \$70 million in the past year) in the areas of biomedical imaging, stem cells and regenerative medicine, fuel cells, cancer genetics,

and neural engineering. These partnerships are focused on translational research with potential commercial applications and, as such, involve partnerships with both academic institutions and corporations. More information about research links with other organizations can be found in the subcommittee report on interdivisional collaborations and external partnerships.

EXPECTATIONS FOR FACULTY SCHOLARLY AND CREATIVE ACHIEVEMENT

Case earns its reputation as one of the country's leading private research universities through the outstanding work of its faculty. Individual faculty members within each of Case's colleges and schools are independent researchers, scholars, and teachers whose intellectual interests and activities contribute to the transformation of their students, of the larger society, and of themselves. The breadth of expertise among Case's faculty members allows these contributions to span the range of health and medicine, science and technology, social systems, world culture, and systems of thought that are intended to improve the human condition. The activities of the faculties in dance, drama, music, arts, and creative writing add much to the world's culture.

Tenured and tenure-track faculty are expected to make contributions to research, scholarship, and creative endeavors that add to the store of knowledge in their respective fields, thereby bringing national and international recognition to themselves and to the university. Such achievements may include the development of a theory, the invention of a device or process, an original artistic creation, or publication of books or articles that contribute to the general body of knowledge. This expectation of research productivity parallels the university's expectation that tenure-track faculty will be effective teachers as well, mentoring and inspiring students and supporting the overall environment for learning that Case is committed to providing.

Case gives tenured and non-tenured faculty members the freedom to engage in scholarly investigations of their choice, and to disseminate their findings through

CHAPTER 8 – RESEARCH, SCHOLARSHIP, AND CREATIVE ACTIVITY

publications and presentations even if these reports or creative presentations are critical of conventional thought and interests. In addition, Case affords faculty members the freedom to explore in their classes any scholarly topic relevant to the course's subject matter. Case upholds the right of academic freedom against special interest groups that oppose controversial and/or cutting-edge research and scholarship. The university believes that such academic freedom is essential to research and other scholarly and creative activities. Finally, Case encourages all faculty members to achieve ongoing excellence and innovation in their areas of expertise through appropriate professional development activities.

SOCIETAL IMPACT OF CASE RESEARCH AND SCHOLARSHIP

The university's commitment to the generation of new knowledge is balanced by an equal commitment to providing its students with an unparalleled research-based experience that will transform the way they learn, think, and ultimately make their own contributions to humanity's development. Research is being generated in all of Case's areas of endeavor: arts and sciences, dental medicine, engineering, law, management, medicine, nursing, and social work. The impact this work has on the university, the community, and the world is significant. The research leads to real-world applications through advanced technology; critical insights for social policy and ethical issues; and products that are wholly intellectual, helping people explore, understand, and appreciate the human experience.

From the myriad examples of Case research, four endeavors point up the breadth of work in progress at the university and the equally broad range of implications for society. (1) Based on his theory of emotional intelligence, a best-selling management professor enlightens the thinking of the business world with his groundbreaking methods. (2) A faculty member at the School of Medicine and her research team are making enormous strides in finding a cure for cystic fibrosis, the most common genetic disease in the United States. (3) Last year, a Case music scholar published *Shakespeare's Songbook*, assembling for the first time in history the entire repertoire of songs – including ballads and rounds – that Shakespeare quotes or alludes to in his plays.

(4) A well-known physics professor has determined the age of the universe to be a billion years older than previously thought.

The level of research at Case, as measured by outside funding, typically rises every year, with academic year 2003-04 funding total exceeding \$370 million. For example, the Case School of Engineering has more than doubled its research awards in the last five years, amassing a record high of nearly \$60 million last year and increasing the number of researchers who contributed to the total. Another example: Dating back to its strategic plan in 1997, the School of Dental Medicine has made tremendous progress in rebuilding its research program.

The research program at Case is also defined by an increasing number of collaborative efforts, from the individual and interdepartmental levels to the institutional level. Among the newest and most notable of these research links is the Case Research Institute (CRI), created in 2002 in concert with the 50-year partnership established that year with the university's long-time primary hospital affiliate, University Hospitals Health System (UHHS). For many decades, all medical staff at UHHS's flagship unit, University Hospitals of Cleveland (UHC), have been required to qualify for faculty appointments at Case's School of Medicine. Led by the university's dean of medicine and vice president for medical affairs, who works with a board with representation from both UHC and the School of Medicine, CRI is a joint venture that brings together strategic planning, operations, and financial support for the very extensive range of collaborative research in clinical disciplines involving the school and the hospital. The results of this cooperation include improved ability to recruit outstanding researchers, more effective use of space, improved efficiency in providing support for research, and greater impact on society from the research.

At the same time, Case has recently established a unique partnership with the Cleveland Clinic Foundation to create the Cleveland Clinic Lerner College of Medicine (CCLCM) at Case Western Reserve University (see Chapter 9). The research affiliations that are flourishing as a result of this educational partnership indicate both institutions' commitment to transformational growth.

Members of the research faculty of the Clinic's Lerner Research Institute are now members of Case's faculty, opening doors to collaborations that cross previous institutional boundaries. The Cleveland Clinic's NIH grants have been transferred to Case, and all new proposals are submitted under the CCLCM.

Another specific example of medical research with societal impact is the consortium that has been formed with the Louis Stokes Veterans Affairs Medical Center and MetroHealth Medical Center, resulting in strong interdisciplinary teams of physicians, therapists, and engineers. In recognition of the consortium's importance, the Department of Veterans Affairs established the Cleveland Functional Electrical Stimulation (FES) Center of Excellence. The clinical impact of FES technology is broad, and provides a major opportunity both for restoring the independence of people with disabilities and for commercial growth. Current research is focused on new technologies to allow multiple implants throughout the body and to develop the capability to interface directly with the brain and spinal cord. Clinical conditions such as Parkinson's disease and epilepsy could be added to the clinical modalities of treatment.

In 2003, Case published its inaugural edition of *The Value of Research*.¹ This 50-page report highlights research strengths that have led to specific societal benefits.

ENVIRONMENT FOR RESEARCH AND SCHOLARSHIP

Research Infrastructure

Physical facilities and sophisticated instrumentation for cutting-edge research are priorities at Case, and students often reap the benefits of practical experiences derived from innovative projects. Case employs ongoing efforts to maintain and expand the research infrastructure. In 2001, the university acquired the site of the former Mount Sinai Medical Center, and has since been developing it to support research needs. A new building to house a world-class NMR facility for structural biology research and a fuel cell research and testing facility is under construction. In 2003, the 320,000-square-foot Wolstein Research Building was completed. This facility

will be home for up to 700 researchers in such fields as cancer and genetic epidemiology. The Animal Resource Facility in the School of Medicine is undergoing a multi-million dollar upgrade. Other elements of the research infrastructure at Case include glass, chemical, and electronics stores; instrumentation repair and machine shops, including a design and fabrication center that will custom-build new equipment or modify existing equipment to meet researchers' needs; major analytical research facilities in the physical sciences and engineering; and core research facilities in the biomedical sciences.

Case's Office of Sponsored Projects Administration (OSPA) and its Office of Research Compliance (ORC) support and coordinate the university's research efforts. OSPA reviews and approves proposals to external sponsors and reviews, negotiates, and executes contracts that involve sponsored projects. In its continuing effort to develop efficient processes, OSPA has recently delegated this responsibility to the School of Medicine research office for its proposals and contracts.

When awards are received, OSPA generates the account information through PADS (the Proposal and Awards Database System), which transmits this information electronically to the Case accounting system. Changes to accounts, communication with sponsors, and project close-out are also coordinated through OSPA. Finally, OSPA develops electronic applications and databases for the internal management of research administration information and provides support for Case's interface with external proposal submission and grants management systems.

The ORC has responsibility for ensuring that the research conducted at Case is compliant with all laws, regulations, and the policies of both the university and the sponsor. See Chapter 12, Research Integrity, for additional details.

OSPA and the ORC offer a Research Seminar Series that faculty, postdoctoral scholars, staff, and graduate and professional students are encouraged to attend. Given on a regular basis throughout the academic year, seminars cover such topics as conflict of interest, technology transfer, proposal writing, and changes in the regulatory

1. The Value of Research report may be viewed online at <http://ora.ra.case.edu/showcase/value%20of%20research%2003-04.pdf>

environment for research. All Case researchers who participate in research with human subjects are required to remain up-to-date on the ethics of human subjects research. These seminars are one of several mechanisms that enable researchers at Case to meet this requirement.² A monthly Research Newsletter keeps researchers apprised of seminar topics, changes in federal policies, and funding opportunities.³

The university's Department of Occupational and Environmental Safety (DOES) is responsible for implementing safety plans and monitoring the use of radiation, chemical, and biological hazards. DOES provides mandatory training programs for faculty, students, and staff involved in handling and storing hazardous substances, including instruction in the proper use of safety equipment, packaging and disposal of wastes, and compliance with all appropriate regulations. DOES is responsible for the safe transportation and disposal of hazardous wastes and for monitoring containment facilities, ensuring the adequacy of safety procedures, and advising units on the proper number, placement, and function of safety equipment.

The Provost's Commission on Research and Graduate Education issued its report in April 2004.⁴ This document is intended to serve as a guide for expanding the research enterprise at Case, and funds are being secured to implement a number of its recommendations. The commission made several recommendations for improvement to the research infrastructure. These include new space for faculty and graduate students, a facility for small conferences of 100-200 people, space for training and housing research staff, labs for observations of human interactions, continued increased expenditures on the university library, a computational research facility, grid computing, improved grants management capabilities, and desktop and classroom video conferencing.

The Libraries of Case Western Reserve University

The university's libraries include:

- Cleveland Health Sciences Library (oversight for the Allen Memorial Medical Library, Dittrick Medical History Center, and the Health Center Library)
- Lillian F. and Milford J. Harris Library, which serves the Mandel School of Applied Social Sciences
- Judge Ben C. Green Law Library
- Kelvin Smith Library (collections in the arts, humanities, social and behavioral sciences, engineering, natural sciences, management and economics); oversight for the Astronomy Library, the Kulas Music Library, and the Geological Sciences Map Collection

Through an agreement between the College of Arts and Sciences and the Cleveland Museum of Art, which houses the fourth largest art museum library in the United States, the museum's collections and services are also available to Case art students and faculty. Likewise, Case music students and faculty use the Cleveland Institute of Music's collections, which complement rather than duplicate the university's Kulas Music Library collections. Case students also have access to the collections of the Cleveland Institute of Art and the Siegal College of Judaic Studies.

Case is a member of the Association of Research Libraries (ARL). In addition, a collaborative arrangement that greatly enhances the university community's access to library and information services is a charter membership in OhioLINK, a statewide consortium serving eighty-four Ohio colleges and universities with access to more than thirty-eight million library items statewide.

Each campus library maintains its own administrative structure (including budget and personnel management), collection development and management, technical processing, technology infrastructure, and other services. The University Library reports to the provost and maintains the core technological infrastructure for

2. The Research Compliance Education Programs website is located at http://ora.ra.case.edu/orc_education.asp.

3. The Office of Sponsored Projects Research Newsletter may be viewed at <http://addison.ra.case.edu/ospa/News/index.cfm>.

4. View the Provost's Commission on Research and Graduate Education report at <http://www.case.edu/menu/commissionaprilfinal.pdf>.

CHAPTER 8 – RESEARCH, SCHOLARSHIP, AND CREATIVE ACTIVITY

the campus libraries; the other libraries report to their respective deans. The library directors meet regularly with the Faculty Senate Library Committee, and each library has a discipline-specific library advisory group.

Like all academic libraries, Case’s have experienced a shift from in-house use of print collections to network-based delivery of information and services. From June to September 2003, the libraries’ web pages were accessed over 1.4 million times (this figure does not include the law library). Similarly, the number and use of electronic journals are growing exponentially. In 1998-99 there were 2,500 e-journals available to the campus community. By fall 2003 that number had increased to 7,000. Scholars at Case downloaded 49,604 articles in 1998-99 and 502,464 articles in 2002-03. Use of research databases shows a similar pattern.

At Case, librarians partner with faculty through the Information Literacy Program to expand opportunities for students to acquire information and research skills at all levels of the curriculum. Information literacy training sessions ensure that students know how to access information efficiently, critically evaluate and incorporate information into their existing knowledge base, use information to accomplish specific goals, and understand the many economic, legal, ethical, and social issues surrounding the use of this information.

Integration of this instruction into classroom assignments shows students how to use the information tools they need, when they need them. For example, the students in an anthropology course, Introduction to Human Evolution, were given an assignment asking them to locate and identify various sources of information

Comparative Library Statistics								
	2002-03	2001-02	2000-01*	1999-00	1998-99	1997-98	1996-97	1995-96
Volumes Held	2,292,265	2,236,337	2,205,774	2,033,085	2,015,763	1,996,479	1,965,478	1,938,840
Volumes Added (Gross)	59,740	37,630	32,692	32,252	30,528	35,499	29,814	28,984
Current Serials	19,227	17,506	16,773	15,863	15,024	14,042	12,973	13,599
Total Expenditures (\$000)	\$12,755	\$11,733	\$11,295	\$11,416	\$10,795	\$10,781	\$10,387	\$9,822
Total Staff*	119	115	119	133	134	142	147	144

*No longer includes positions, salaries, and expenses of individuals who have provided technical support for integrated library systems and user support services. These groups were reassigned to Information Technology Services in the late 1990s and are not part of the library’s organization at this time (2004).

CHAPTER 8 – RESEARCH, SCHOLARSHIP, AND CREATIVE ACTIVITY

dealing with this topic. They were asked to find scholarly journals, provide citations to articles, locate books in the library collection, and name databases in which they could find scientific research. As another example, students in a SAGES seminar, *The Evolution of Scientific Ideas*, were asked to write a paper on the transition from one scientific theory to a new one. These students needed to understand how to use a wide range of research tools to investigate not only a specific scientific theory, but also the history of that theory and the social setting of the time period in which the transition took place. Having an assignment on which to use their newly learned information literacy skills provided the students the opportunity to put learning into action. In both cases, the library's information literacy librarian provided a class session on using the various tools available to the students. The students then used these tools to answer the questions on their assignments.

The Case libraries support learning and research by providing access to information through acquiring, organizing, managing, housing, and preserving collections. The libraries collaborate to design appropriate technologies for presenting, manipulating, and retrieving information such as Electronic Tools and Ancient Near Eastern Archives⁵ (ETANA) and by building digital libraries.⁶ They provide personalized reference services, and teach people how to develop critical research skills and use information technology through the KSLearn⁷ program.

KSLearn's mission is to provide keys to information literacy that, in turn, will define the ability to select appropriate information resources, understand the structure and purpose of those sources of information, and critically evaluate the information retrieved. Information literacy in today's technologically advanced environment has become increasingly complex. The KSLearn program will continue to provide faculty, students, and staff with the necessary tools to:

- Make informed choices about the thousands of resources that have become available from the desktop

- Have sufficient skill to make effective use of those resources
- Have sufficient knowledge to evaluate the validity and usefulness of information retrieved
- Be aware of the principles regarding the ethical use of information based on a knowledge of information property rights and legislation
- Train on software products such as Microsoft Office and Macromedia that will support skills needed to excel in various employment capabilities

For the first five months of the 2004-05 fiscal year, the KSLearn program served 607 staff members, 223 students, and 60 faculty.

The libraries have a coherent planning process and keep the university community up-to-date on recent acquisitions and information access opportunities. Since demands on the library grow rapidly and resources increase at a more modest rate, it is necessary to evaluate expenditures in terms of efficiency and effectiveness (assess collections, processes, and services) when deciding how to allocate funds and focus efforts.

With the exception of the Kelvin Smith Library, which has recently developed a comprehensive business plan, the Case libraries plan in collaboration with their academic units. The libraries have, however, written a collaborative communications plan to be implemented during the 2004-05 academic year. This plan presents a framework for effective two-way communication between the libraries and their users and other constituent groups. It sets goals and strategies to build greater awareness of library services, to inform about library/information technology issues, and to encourage support for the libraries. In addition to communicating about the libraries, the plan includes strategies for collecting and analyzing information that will help the libraries understand and adapt to the evolving information requirements of the campus community.

The critical issues facing academic research libraries may be summarized as unsustainable economic demands in an environment that is characterized by constant and

5. View the Electronic Tools and Ancient Near Eastern Archives website at <http://www.etana.org/>.

6. The KSL Digital Library and Digital Case are available at <http://library.case.edu/ksl/ecoll/>.

7. The KSLearn program website is available at <http://library.case.edu/kslearn/about.aspx>.

profound change. It is clear that library collections are making a slow transition from print materials to digital formats, but it is just as clear that this transition will extend for a long time and may not be completed in the lifetimes of today’s students. At the heart of this issue is the soaring cost of library materials. Price inflation for books, serials, and electronic formats continues to increase at disproportionate rates: serial unit prices have increased 227 percent over the past fifteen years, compared to a 64 percent increase in the consumer price index. At the same time, the volume of publication has also radically increased. This increase in quantity, coupled with an increase in prices, translates into an overall decline in the capacity of libraries to purchase in proportion to the volume of material published. Digital materials, unlike traditional printed volumes, are for the most part licensed, not purchased; therefore, as soon as the library ceases to pay for the service, or the publisher withdraws the material, library users no longer have access to the material’s intellectual content.

Nevertheless, digital texts, increasingly the format of choice for scholarly communication, are dynamic, interactive, and offer significant advantages. The Case libraries continue to be transformed by information technologies, a trend that requires information to be purchased/licensed, organized, and made accessible in new ways. The library collections and digital texts are supplemented with an effective interlibrary loan system operating through OhioLINK, which ensures that faculty and students have access to all necessary scholarly resources. OhioLINK is the state supported inter-library loan consortium of Ohio university and college libraries.⁸

Adapting to the demands of network-based materials is just one of many challenges the Case libraries face at the beginning of the twenty-first century. The following strategies, adopted by the Case libraries, assure optimum library/information services for the university community over the next decade:

- Build outstanding collections (locally owned as well as licensed)

- Seek partnerships with faculty, information technology groups, other libraries, etc.
- Foster an environment and a culture that emphasizes improvement through learning, evaluation, and assessment;
- Maintain organizational agility in the face of constant change
- Identify and pursue new sources of earned income and financial support from donors and foundations as well as state and federal grants
- Increase visibility through public relations, outreach, programs and special events

External and Internal Financial Support for Research

The majority of documentable funding for research at Case comes from external sources. Note that the university does not methodically calculate the value of faculty salaries and other expenditures relating to research, scholarship, and other creative endeavors that are not externally supported. As previously mentioned, external funding for research has grown 145 percent over the past ten years. The following table provides a breakdown of funding for sponsored projects at Case in the fiscal year ending June 30, 2004:

External Awards for Research, 2003-04 (\$000)	
Public Health Service (includes NIH)	\$246,756
National Science Foundation	8,566
Department of Defense	5,516
NASA	4,289
Other Federal	31,054
State, Local, and Other Government	55,706
Foundations and Associations	16,169
Industry	3,978
Other Private Sources	2,868
Total	\$374,901

8. Access the OhioLINK website at <http://www.ohiolink.edu/>.

CHAPTER 8 – RESEARCH, SCHOLARSHIP, AND CREATIVE ACTIVITY

The university also provides internal support for research through cost sharing on awards, as necessary, and seed funds to develop pilot projects. Capital improvement projects and faculty recruitment packages are also designed to support and promote research.

The Presidential Research Initiative (PRI) grant program annually provides grants for pilot research that involves interdisciplinary research teams from two or more schools or colleges within the university. It is expected that this research will lead to extramural applications and, eventually, extramural support. The PRI grant program is supported with funds from the Provost's Office through a Research Challenge grant from the Ohio Board of Regents and proceeds received by the Technology Transfer Office from the commercialization of Case intellectual property. In addition, it is expected that the schools or departments of the co-principal investigators will collectively match the funding provided by the Provost's Office in a 1:2 ratio. Proposals may request up to \$120,000 for up to two years of support. Proposals are reviewed by two faculty members selected from outside the departments represented by the co-principal investigators and who have the necessary expertise to assess the scientific merit of the application. Specific merit review criteria available from the Office of Sponsored Projects Administration guide these reviews.

The Provost's Opportunity Fund (POF) further develops the infrastructure needed to support research. This program provides one-time support for significant new initiatives within the schools and colleges at funding levels typically in the \$200,000 to \$500,000 range. During the 2003-04 proposal cycle, a total of \$2.5 million was awarded. Proposals are solicited at least annually, and are evaluated against criteria that focus on the relationship of the initiative to the university vision (does the project promote the creation of a powerful learning environment, support a potential world-class center, or advance the research agenda of the university?) and the opportunity to leverage other activities, create fund-raising activities, or gain significant advantage for Case. The POF is also used to strengthen the university's attractiveness to underrepresented groups in hiring and retention initiatives. Typically, \$750,000 is reserved for these purposes.

Interdisciplinary Research

Interdisciplinary research is critical to the advancement of knowledge in most areas, and Case facilitates these efforts in a variety of ways. Specific centers and institutes such as the Center for Computational Genomics; the Schubert Center for Child Development; the Center for Science, Health and Society; the Center for Global Health and Disease; the Baker-Nord Center for the Humanities; and the Center for Modeling Integrated Metabolic Systems provide a framework and resources for interdisciplinary efforts. The Presidential Research Initiative grant program awards \$400,000 each year in support of these initiatives.

Case sponsors an annual Research ShowCASE, discussed later in this chapter, which brings together faculty, students, and staff from all of the university's schools and colleges and from affiliated institutions to present their research via posters, exhibits, panel discussions, and public talks. This event provides a forum for the academic community as well as representatives from industry, government, and the nonprofit sector to become better informed about the breadth of research at Case and better able to identify partnership opportunities. Attendance at this event exceeds 1,400 annually, with almost forty percent of participants coming from outside the university. The 2005 Research ShowCASE will highlight the university's many creative and artistic works in addition to research in engineering and the sciences.

STRATEGIC PLANNING FOR RESEARCH

Much of the strategic planning for research takes place at the school or college level. Each school or college is involved on an ongoing basis with identifying its research strengths, weaknesses, and opportunities. For example, the College of Arts and Sciences has identified cognitive sciences as a growth area, has created a department in this field, and is recruiting its founding chair. The college has also created a grants specialist position to assist its interdisciplinary centers in identifying funding opportunities and applying for these funds. The Case School of Engineering is committed to expanding its Department of Electrical Engineering and Computer

Science and, as a result, growing the research base in this area while maintaining strength in biomedical engineering, materials science, fuel cell research, and other fields. The School of Medicine’s Research Committee has a long and successful history of strategic planning for research, and has identified population-based research as one of several new focus areas.

Case also engages ad hoc planning groups to identify strategies for building research competency in areas that cut across two or more schools or colleges. An example includes the Nanomaterials and Medicine Steering Committee that is currently identifying ways to promote the growth of nanoscience research at Case by forming alliances among researchers in the biomedical, engineering, and physical sciences departments. This committee has representatives from several schools and colleges. As another example, the Provost’s Commission on Research and Graduate Education has recommended the creation of a university-wide Research Council that will engage in strategic planning activities as they relate to research policy and administration as well as research infrastructure and resources. It is expected that this council will include a respected researcher from each of the university’s eight schools and colleges.

TECHNOLOGY TRANSFER

As part of its mission, Case renewed and revitalized its commitment to technology transfer in 2001 with the establishment of a new centralized office. Since that time, the office has grown to a staff of nine professionals and four support staff. (Prior to 2001, technology transfer activities were spread across different groups and departments, with the total number of professionals dedicated to the effort ranging from two to four people.) The Technology Transfer Office (TTO) at Case is now responsible for commercializing the inventions of all the university’s researchers, including those based at University Hospitals of Cleveland, the MetroHealth Hospital System, and the Louis Stokes Veterans Affairs Medical Center of Cleveland.

The volume of technology transfer results relates to the amount of sponsored research at an institution;

therefore, these results cannot be accurately assessed without taking into account the size of an institution’s research base. Based on more than ten years of data from the Association of University Technology Managers (AUTM), one assumes that approximately \$2-4 million of funded research activity is required per invention disclosure. Even within this range, a variety of factors can have a profound impact on the rate of new invention disclosures produced by an institution’s researchers, not the least of which are the culture and values of the institution itself.

Case is an institution that embraces and rewards innovation and entrepreneurship, and encourages researchers to participate in technology transfer. Likewise, the TTO is focused on establishing a positive record, so that Case researchers view their own participation in the process as a good investment of their time and energy. In less than three years, the new TTO has outperformed the national average of \$2-4 million of funded research per invention disclosure (see the table to follow).

The Case TTO decision model for pursuing invention disclosures is based on the potential size of the commercial market for the invention being evaluated. The TTO’s primary goal is to transfer the outcomes of Case research into the commercial marketplace for the benefit of society, while also operating a financially self-sustaining organization. The TTO’s standard for making a “pursue” decision is that the invention in question must represent a significant commercial opportunity that justifies the investment in its development, both in terms of economics and impact on the marketplace.

The Case licensing process involves intense market research to identify the top licensees in the invention’s field, and then a focused effort to market the invention to these licensees. Whenever possible, the TTO initially licenses to local and small companies. The TTO does not employ the “shotgun” tactic of trying to market all inventions to all companies, nor does it subscribe to passive models such as posting a list of technologies on a website. Each professional member of the TTO staff manages a portfolio of technologies that have already been selected based on the likelihood of their market significance.

CHAPTER 8 – RESEARCH, SCHOLARSHIP, AND CREATIVE ACTIVITY

The selection process consists of creating a non-confidential description of the technology to be licensed and packaging this description in a marketing summary. The marketing summaries are then sent to potential licensees that have been identified as companies who are leaders in producing products that incorporate the technology. This targeted approach typically results in a high response rate. If a company expresses interest in the technology, the TTO follows up with more information and/or personal contacts from the case manager. These discussions may lead to a licensing agreement or other commercial venture.

Even when a company is not interested in licensing a technology, it usually provides valuable feedback to the TTO regarding the technology's potential or drawbacks. If none of the companies approached are interested, the information they provide is compiled and presented to the inventor, so that he or she will understand exactly why the technology is not a good fit for the marketplace, or perhaps is not yet mature enough for adoption. In this way, the TTO avoids judging technology based on technical merits; rather, the marketplace provides direct feedback on commercial viability. This process is repeatable and results-oriented, and engages the inventor at each step, resulting in higher satisfaction regardless of the final outcome.

Case has made a commitment to Northeast Ohio to be a catalyst for positive change in the local economy, and the significant resources invested in the TTO reflect this commitment. The current professional staff consists of business people with master's level science degrees or equivalent technical training, and many of them have significant startup company and venture investing experience.

In addition to highly qualified business professionals, the TTO is armed with a significant tool for accelerating new company formation: a multi-million dollar pre-seed fund. Through Case Technology Ventures (CTV), the TTO is able to make investments (in the form of convertible debt) in new ventures that need assistance with forming a business plan, recruiting management talent, developing prototypes, or renting facilities and equipment in order to accelerate those new ventures and

better equip them for raising professional investment dollars as they move closer to achieving the successful commercial deployment of a university-based technology. This commitment to starting new companies, with the added support of CTV, has resulted in the creation of seven new companies since 2002.

Case's renewed commitment to technology transfer is already producing significant impact in terms of the number of researchers engaged in the process and the amount of income generated. The most direct measure of researcher engagement in the process is demonstrated by the amount of research expenditure required to produce one invention disclosure. Before 2001, on average, \$3-4 million was required to produce one disclosure. Today, approximately \$1.9 million spent on research results in a disclosure, compared to the national average of \$2-4 million.

Prior to 2001, the technology transfer function had never produced more than \$1.2 million per year in licensing revenue. In 2004, the TTO produced almost ten times that amount. This level of income enables the TTO to be self-sustaining and enables the university to invest the proceeds from technology transfer into research.

Establishing credibility for a new office that is charged with carrying out a business function in an academic environment requires patience, perseverance, and consistent performance. Educating faculty, staff and students about the benefit of technology transfer has been a priority. Although the new office has established credibility in terms of performance and results, the need to educate stakeholders never diminishes. As new faculty join the university, new research centers are established, or laws and regulations change, there is a constant need for education. Creating a balance between allocation of resources to fund educational efforts and to maintain daily operations has been a challenge.

There is also an ongoing need to provide information to external stakeholders about the TTO's contributions to regional economic development. In order to be effective in dealing with industry partners, the TTO needs to distribute information about the office and the university's research strengths. As new ventures are

established, a considerable amount of effort is made to publicize these developments in order to help the new companies gain visibility in the region and promote themselves to investors.

Although early results have been significant enough to launch Case into the top twenty technology transfer operations in the U.S., the TTO at Case is still in its infancy. Successes have helped the office gain credibility with Case researchers and visibility in the community. The goal is to keep the technology transfer operation among the top twenty by demonstrating consistent performance at the same high level.

ENTREPRENEURSHIP AND INNOVATION

Case’s Role in Regional Economic Development

As one of its goals, Case seeks to have a transformational impact on its local and regional community, in part by serving as a leading force for economic and technological development. Case is doing this by creating new initiatives, building on existing ones, and in all cases working hand-in-hand with its partners throughout Northeast Ohio.

The primary way that Case is increasing its economic role in the region is through its growing expertise in technology transfer, which draws upon the entrepreneurial spirit of the campus to move inventions from the lab bench into the marketplace. In 2001, Case committed fresh resources and renewed resolve to its Technology Transfer Office, building it into an aggressive business operation that focuses on the strongest candidates in top technologies. Since that time, all the measures of its technology transfer effort have shown dramatic improvement.

Entrepreneurial education represents the second way in which Case contributes to the region’s economic development. Programs in this area have grown appreciably in the past five years. The nucleus of this effort at Case is the Weatherhead School of Management, whose entrepreneurial reach extends throughout much of the university. With the Case School of Engineering, it offers the Master of Engineering and Management degree program, through Case’s recently created Institute for Management and Engineering (TiME). The Weatherhead School also cooperates closely with the College of Arts and Sciences in that school’s Science Entrepreneurship

Technology Transfer at Case					
	Total Research Expenditures (\$000)	Invention Disclosures Received	\$M Research Funding per Invention Disclosure	Licenses and Options Executed	Gross License Income (\$000)
2004	261,559	135	1.9	18	11,028
2003	224,367	107	2.1	15	10,002
2002	233,000	88	2.6	10	3,033
2001	183,950	70	2.6	5	2,020
2000	210,100	54	3.9	5	1,245
1999	176,519	59	3.0	10	505
1998	169,069	52	3.3	7	1,244
1997	157,528	42	3.8	6	197
1996	140,562	43	3.3	10	543
1995	159,300	45	3.5	15	217

CHAPTER 8 – RESEARCH, SCHOLARSHIP, AND CREATIVE ACTIVITY

Program, a two-year master's program that combines training in scientific disciplines with real-life work experiences for students with an interest in starting new high-tech businesses and growing them successfully. The Weatherhead School also maintains interdisciplinary links to Case's schools of law and medicine.

Enterprises such as the Technology Transfer Office, the entrepreneurship programs, and TiME help Case create and nurture partnerships with businesses and organizations beyond the campus boundaries. Case is committed to deepening these partnerships, which have an impact on the economy in the region. These fertile collaborations range from newly defined partnerships with University Hospitals of Cleveland and the Cleveland Clinic to the seamless, city-wide digital network OneCleveland (see Chapter 10), and from the young-business accelerators BioEnterprise and JumpStart, Inc. (discussed in following sections) to the State of Ohio's Wright Centers for Innovation. In its partnerships, as with its entrepreneurial education and technology transfer efforts, Case's goal is to serve as an engine for new companies, new jobs, and new economic growth and investment in Northeast Ohio. At the same time, the university is leading an effort to change the social and cultural fabric of the region by working to help make the area a magnet for talent.

Research ShowCASE

The first annual Research ShowCASE was held in April 2003. This "trade show," focusing on today's research and tomorrow's technology, had 621 exhibits spotlighting the innovation and creativity taking place on the campus and at the university's partner institutions – the Cleveland Clinic and University Hospitals of Cleveland. The expo was helpful in promoting the institutions' work among venture capitalists and among representatives of the media, government, foundations, and corporations. It also served as a means to stimulate interdisciplinary collaboration among the university's faculty simply by providing them with a comprehensive look at all the work their colleagues are doing.

Research ShowCASE 2005 is scheduled for April 6-7. This year, in addition to displays of traditional scientific research posters, displays of all research, scholarship and

creative activities in any format (e.g., live and/or video presentation, active demonstration or other types of exhibits) are invited from faculty, graduate/professional students, undergraduate students, and postdoctoral scholars/fellows.

Entrepreneurship in Northeast Ohio

Case has brought substantial resources to bear on the challenge of reinvigorating the entrepreneurial climate in Northeast Ohio as co-founder and/or part owner of economic development entities. Formed in 1987, Enterprise Development, Inc. (EDI) was a not-for-profit subsidiary of Case and a cooperative venture with the Weatherhead School of Management. Its goal was to manage and advise local and statewide programs focusing on educating, incubating, and recognizing growing entrepreneurial companies with the potential to add significant value to the Northeast Ohio area.

Launched in 2002 after a significant community dialogue, the BioEnterprise Initiative was a collaborative creation of Case, the Cleveland Clinic Foundation, and University Hospitals Health System. The mission of BioEnterprise is to establish Northeast Ohio as a nationally recognized center of bioscience commercialization activity within a period of five years. In just two and a half years, the BioEnterprise initiative, which brings together the Case Research Institute Office of Technology Transfer, the Cleveland Clinic's Innovation group, University Hospitals, and the Summa Enterprise group of neighboring Summit County, has seen investment of more than \$100 million in the companies it has created and assisted.

After the highly successful launch of BioEnterprise, Case began a process of reviewing and refocusing all of its programs that focused on economic development. As a result of that process, carried out in close concert with the region's business, academic, and economic development leadership, EDI was dissolved, and Case launched JumpStart Inc, a nonprofit entity owned by Case and the Northeast Ohio Technology Coalition (NorTech). This organization brought another model of support for entrepreneurial activity to Northeast Ohio. JumpStart's focus on all areas of technology and business activity is broader than the biosciences focus of BioEnterprise. JumpStart began full operations in 2003.

In tandem, the two entities, which themselves cooperate in a number of areas, offer strong support to the region's entrepreneurial community and help to assure that ideas and technologies developed in Northeast Ohio stay in the region.

In its three-year business plan, JumpStart lays out a range of very specific metrics to track its development and success. Some of its goals include:

- Assisting over 225 companies with their business plans
- Investing equity capital in more than thirty companies that have the ability to create 150 additional high-paying jobs within three years, and to attract an additional \$30 million in venture capital
- Serving as a virtual and real convener for all stakeholders in the success of early-stage companies located throughout Northeast Ohio via events and Internet tools

Business Launch Competition

The Institute for Management and Engineering (TiME) is a collaboration between the Case School of Engineering and the Weatherhead School of Management. TiME organizes an annual Business Launch Competition designed to address the void in funding that technology start-ups often encounter at the prototype and business concept development stage. The winners are selected from an initial pool of applicants narrowed to a group of semifinalists. These entrepreneurs are evaluated both for their likelihood of success and their ability to enhance regional economic development.

The winner receives up to \$50,000 to launch a technology-based or technology-enabled company. Second- and third-place winners receive up to \$20,000. Arterioocyte, a Cleveland-based startup company that will commercialize non-embryonic stem cell-based therapies for the treatment of chronic ischemic diseases such as stroke and coronary artery disease, was the 2004 BioScience track winner in the third annual Business Launch Competition. ComSense Technology, Inc., a

sensor technology company located in Cleveland, took first prize in the competition's General Technology track. Contest finalists meet others to round out their start-up teams, and are offered mentoring from successful venture capitalists and entrepreneurs, and introductions to key people in the entrepreneurial community. Perhaps most important, they receive feedback on their business concepts.

Among the sponsors for the Business Launch Competition are the National Science Foundation, Cleveland's Council of Smaller Enterprises (COSE), BioEnterprise, JumpStart, Inc., the Keithley Foundation, and Keithley Instruments, Inc.

Summer on the Cuyahoga

Alumni of Case, Yale, Princeton, and Colgate worked together in summer 2004 on an innovative program that provided fifty-five undergraduates from around the U.S. with experiential learning opportunities and internships at major Cleveland-area businesses. In an effort to promote Cleveland as a place to live, work, learn, and play, Case co-hosted the regional alumni associations' ten-week "Summer on the Cuyahoga 2004" program.

The program is a unique economic development initiative launched to offset Northeast Ohio's reputation as an area that is losing young talent, also known as "brain drain." The objective of the program is to create a "brain gain" for the future by attracting students from the four hosts and other universities to settle in Northeast Ohio permanently. The summer 2004 effort expands on the Yale Club's successful "Bulldogs on the Cuyahoga" program held in summer 2003.

The program brought talented undergraduates to Cleveland for high-quality paid internships, community engagement, alumni mentorship, and social events. The program also presented an opportunity for the region to showcase its professional, civic, and personal offerings. Students left the program convinced that Cleveland is a good destination for young leaders to pursue their ambitions, understanding that this community presents diverse opportunities for development and impact, and that the region is eager to embrace new leadership.

CHAPTER 8 – RESEARCH, SCHOLARSHIP, AND CREATIVE ACTIVITY

The 55 participants came from all across the country for the 2004 program, selected from more than 300 students who applied to participate. They worked at a variety of companies including National City Corporation, Ohio Savings Bank, Eaton Corporation, and American Greetings. They also worked at nonprofit organizations and public institutions such as the Cleveland Clinic, Cleveland Metroparks, the George Gund Foundation, and the City of Cleveland.

SUMMARY: STRENGTHS AND CHALLENGES

Case has long been and continues to be a premier research university. This is clearly demonstrated in the continued high level of scholarly and creative productivity of the faculty and in consistent increases over time in external research funding. The university strives to ensure that this high level of intellectual activity is not only maintained but is also expanded in innovative ways.

One of the challenges in this area is for the university to provide the leadership and support necessary to facilitate the research, scholarship, and creative activity for which it is noted. At the most basic level this will require maintaining and upgrading physical facilities (e.g., laboratories, instrumentation, and libraries) and the necessary administrative and financial support for obtaining external research funding and running research projects. The university's long-range plans include substantial expenditures on physical facilities that are directly related to its research mission, such as the Wolstein Research Building and the development of the Mount Sinai Medical Center site. The costs for these substantial enhancements of physical facilities are significant.

The administrative support needed to meet the changing needs of the university is being developed in some areas, such as those involved in technology transfer and in ensuring that the university plays an increasingly important role in regional economic development. Great strides have recently been made in these areas, but they are ones that will require the continued close supervision and support of the university and a willingness to risk

applying innovative (and, therefore, potentially risky) solutions if this transformation of the university into one that has a broader societal impact is to continue to be successful. Given the early success of these programs, there is every reason to believe that the necessary administrative and financial support can be developed. As indicated below, however, providing the necessary support for at least some innovative efforts may present more of a challenge to the university.

There is increasing recognition both within and outside Case that many issues and problems can best be addressed with an approach that cuts across different disciplines, and that establishing successful administrative units to address such problems may require some basic transformations in the way universities are organized. Recognition of the importance of such ventures has resulted in the establishment of several key interdisciplinary centers that cut across departments within the same school and to some extent across administrative units (at least with respect to participating faculty), such as the Center for Computational Genomics and the Schubert Center for Child Development. Since they do not fall within a home department, such centers encounter unique problems, such as a limited budget and the fact that most faculty participating in these centers owe their first loyalty to their home departments. The initial efforts of these units has been encouraging, but continued administrative and financial support by the university, possibly including innovative administrative and budgetary structures, may be needed to take these centers to the next level.

In addition to centers such as those named above, there are numerous examples of interdisciplinary programs within the same school, such as childhood studies, Asian studies, and American studies. Such programs suffer from the same limitations as centers but tend not to have the same level of support. According to the report of the Subcommittee on Interdivisional Collaborations and External Partnerships, many faculty felt that such interdisciplinary programs were created in spite of the university, rather than with the help of the university. If these interdisciplinary programs are truly an integral component of a major research university,

their establishment and maintenance may require more of an investment by the university. It is worth noting, however, that the beliefs of most faculty were based on activities that occurred prior to the establishment of the Presidential Research Initiative and the Provost's Opportunity Fund. Such funds are specifically designed to foster innovative programs and should thus play a key role in fostering the development of interdisciplinary programs. In addition to financial support, however, there is still a need for the university to assist in the development of appropriate administrative mechanisms for such programs.

Even more challenging, but potentially more important over the long run for the maintenance of the research preeminence of the university, is the establishment of units that truly cut across schools. There are numerous examples of degree-granting programs that involve cooperation between different schools. There are also many examples of individual researchers from different schools who have established cooperative research efforts. However, there are few examples (other than a few centers) of permanent units established within the university infrastructure that will allow the long-term maintenance of such efforts. That such inter-school programs can work is perhaps best demonstrated by the Department of Biomedical Engineering, which includes faculty with primary appointments in both the schools of engineering and medicine. Such units are likely to be increasingly essential in the future, but they will almost certainly require the kind of innovative planning and budgeting that can only be instituted at the university level.

Finally, although a primary goal of research is to produce new knowledge, an associated goal in a university is to produce students with an understanding of what research is and how it is done. This belief has long been part of Case's institutional culture. Involvement in research is increasingly seen as part of the transformational process that all Case students should undergo. Many Case students do in fact become involved in research of some kind, particularly laboratory-based research. However, many students have graduated with little direct exposure to the process of creating new knowledge. Recognition of the importance of such an experience was a key

motivation behind making a capstone project the final component of the new SAGES undergraduate initiative.

When SAGES is fully implemented (beginning in the 2005-06 academic year), many undergraduate students will have some exposure to the research process through the capstone project. With potentially hundreds of students attempting to complete a research project within a limited period of time, there will undoubtedly be strains on both the time of faculty and the administrative units, particularly research compliance, which must monitor such studies. These problems (as well as others which will undoubtedly surface as SAGES is fully operationalized) will not be easily solved at the department or even the college level. Similarly, students desiring to pursue an original creative activity as their SAGES capstone will stress resources in these areas. Successful implementation of the capstone projects will require innovative solutions, which will depend on a major input from the university. The recent opening of SOURCE (see Chapter 4, Undergraduate Research, Independent Study, and Creative Performance) begins this process.