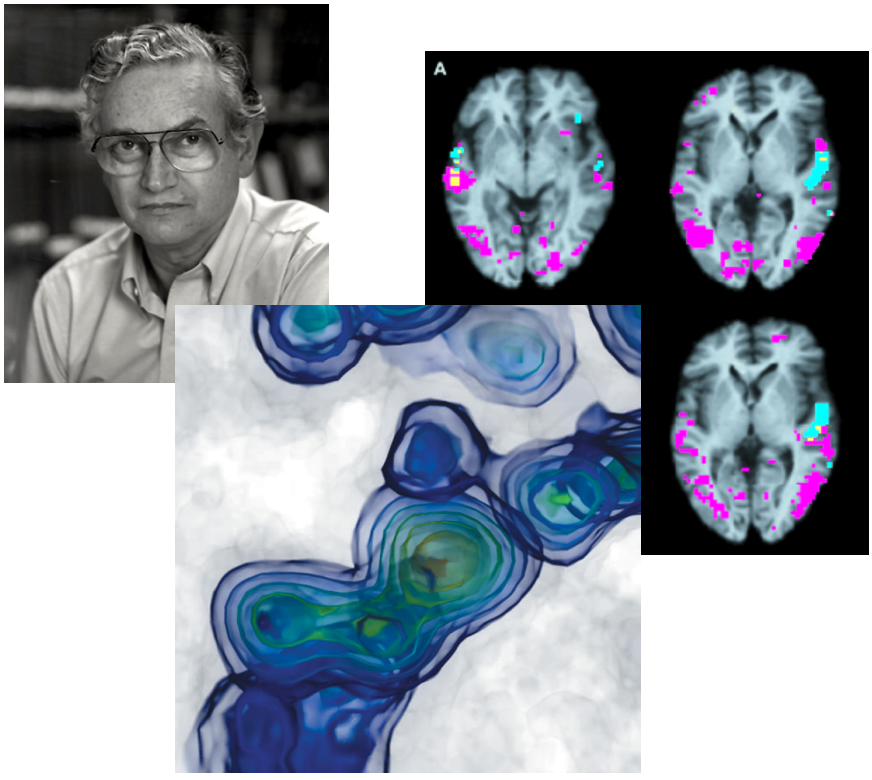
Research, Scholarship and Creative Activity at the University of Michigan

Annual Report to the Regents



Fawwaz T. Ulaby
Vice President for Research
January 17, 2002

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On the cover, from the left: Marshall Nirenberg, 1968 Nobelist; Quantum Dots image; MRI image

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Preface

During Fiscal Year 2001, a total of $592 million was expended in support of research at the University of Michigan, representing an increase of $46 million over FY2000. After discounting for inflation, this one-year increase of 8.5 percent represents net real growth of 4.6 percent over the previous year. New research awards received thus far during the first half of FY2002 total $442 million, an increase of $179, or 68 percent, over the amount received during the corresponding first half of FY2001.

Whereas these expenditure and award figures are very gratifying, they raise a number of critical and timely questions:

- *What is the "value" of research and scholarship to the UM community, the State of Michigan, the nation and ultimately to the broader global society?*
- *Why has the UM been exceptionally successful at winning research grants and contracts?* (Over the past two years, UM Research expenditures associated with externally sponsored sources increased at an average annual rate of 8.8 percent, compared with an average annual growth rate of 6 percent for Federal grant expenditures for research by all U.S. universities.)
- *How does this rapid growth in research impact the University's capacity to sustain the appropriate foundation for this activity, in terms of space, internal support for upgrading research facilities, adherence to Federal regulations, and other related demands on the institution and our faculty, staff and students?*

In this year's annual presentation to the regents, I will attempt to answer the first of the preceding three questions by sharing with you a short video. The program offers an examination of:

(a) how the research training our graduate students receive provides the foundation that later on may lead to great discoveries and innovative applications of technology;

(b) what basic research is and the fundamental knowledge it seeks to discover;

(c) how knowledge is used in the service of society through applied research; and

(d) what steps we take to facilitate the transfer of knowledge and discoveries into the private sector.

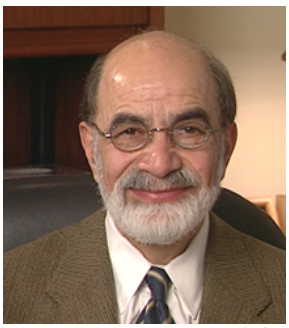
Following the video I will present some additional quantitative indicators of the growth in our level of research activity and then address some of the reasons for this research success. I will also discuss some of the long-term implications of success and the need to start examining our institutional capacity to provide the material and administrative support required for maintaining such a rapid rate of growth in research.

I. The Impact of Research on Society (Video)

A. Introduction

Fawwaz Ulaby
Vice President for Research

At the University of Michigan, research and scholarship encompass an extensive array of scholarly projects over an incredibly diverse set of topics and disciplines. Our commitment to the discovery of knowledge is really a commitment to help solve the complex problems facing society in the environmental, biological, and social arenas. It is a commitment to serve our State, our nation and the world.


Fawwaz Ulaby

I am Fawwaz Ulaby, Vice President for Research. I invite you to join me now as we sample this broad range of research activities taking place on our campus, and how it influences society — through education, through basic and applied research, and through technology transfer.

B. Educating Leaders and Innovators

First and foremost, our greatest contribution to society is through the students we educate. By involving them in research and the pursuit of scholarship we help them develop their abilities to think, to reason, and to contribute. We are proud of all of the contributions made by our alumni for the betterment of society, and we are particularly gratified when some of them win

prestigious awards, or rise to leadership positions in government or the private sector. Let's listen to what a few have to say about their exposure to research at Michigan and how it impacted their careers – we start with Jerome and Isabella Karle, who actually met while in graduate school at Michigan.

Jerome Karle (Ph.D. '44)
Chief Scientist, Laboratory for the Structure of Matter
Naval Research Laboratory
Nobel Prize in Physics, 1985

I would say that the most important aspect of studying at the University was the opportunity that I had at the University of Michigan to take a number of courses that were beyond the usual courses for my studies, which at the time were in physical chemistry in the chemistry department.



Jerome and Isabella Karle

Isabella Karle (BS '41, MS '42, Ph.D. '44)
Senior Scientist
Laboratory for the Structure of Matter
Naval Research Laboratory
National Medal of Science, 1995

My Michigan education taught me how to approach research, how to go about it, both from a theoretical and experimental point of view. What I also found extremely useful was the practical experience that I had in high-voltage equipment, in vacuum technology, in glassblowing, wiring — we called them breadboards at the time — because this was all very new at the time.

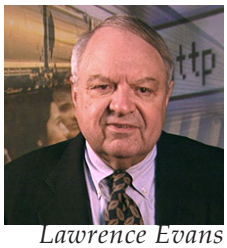
Marshall Nirenberg (Ph.D. '57)
Chief of Biomedical Genetics
National Heart, Lung and Blood Institute, NIH
Nobel Prize in Medicine, 1968



Marshall Nirenberg

The University of Michigan was very important to me because it laid the entire foundation for my becoming a biochemist there. And the graduate school was wonderful. I enjoyed it tremendously. I learned biochemistry, microbiology, chemistry, and really learned how to be a scientist — how to do lab work at the University of Michigan.

Lawrence Evans (MSE '57, Ph.D. '62)
Chairmen & CEO
Aspen Technologies, Inc.



Lawrence Evans

My graduate education at Michigan provided an important foundation for all that I have accomplished. It was where I first learned and got excited about computers. I began to understand just how I could apply this tool to understand the chemical processes. Over time I have been able to tap that foundation in my research while a faculty member at MIT and then to help me build Aspen Technologies into an industry leader providing computer applications of many kinds.

Nancy Benovitch Gilby (BSE '85, MSE '87)
Co-Founder and CEO, PocketThis, Inc.
Entrepreneur - Started 6 companies



Nancy Benovitch Gilby

It is a very high work ethic that I saw at the University of Michigan — in all of the class work that I was involved with. I was asked to meet very high standards for what I needed to achieve to pass and get good grades in my classes. Similarly, when I was selected to be a research assistant, and when I wrote my master's thesis, the norm was a very high work ethic.

The Honorable Geraldine Bledsoe Ford (AB '48)
Judge, Federal Third Circuit (retired)



Geraldine Bledsoe Ford

The experience of understanding myself and finding myself in relation to the world just happened at the University of Michigan. And I can say for that experience and for the fine groundwork I had here, which guided me, I will be very grateful.

C. The Contributions of Basic Research

Fawwaz Ulaby

Basic research is a core activity of the University of Michigan. And our success is greatly aided by our partnership with Federal agencies such as the National Science Foundation. Here are some comments on this partnership from Michigan Congressman Nick Smith, who chairs the House Subcommittee on Research.

Nick Smith
Michigan Congressman
Chair, House Subcommittee on Research



Congressman Nick Smith

Basic research conducted at the universities like Michigan and funded by agencies like the National Science Foundation is vital to our Nation. Both our economic prosperity as well as our national security depends on a steady stream of new research and innovation. We must always be expanding our understanding of the world around us to prepare for unforeseen needs and challenges. And through the NSF funded engineering research centers and science and technology centers, we will be able to draw together researchers from a variety of fields to create the foundation for future technological advances that benefit all of our society.

Philip Bucksbaum
Otto Laporte Professor of Physics


Philip Bucksbaum

Here at the University of Michigan we have been studying new ways to turn x-rays on and off very fast. The new technology involves reflecting x-rays off of a solid crystal and moving the crystal very, very fast using lasers to move it. What we can do is make the x-rays turn on and off on a time scale that is about equal to the motion of atoms in a chemical reaction. If we can perfect this kind of technology, it would really open up a new window for basic research into how chemistry happens.

Thad Polk
Assistant Professor of Psychology

Until recently most scientists interested in the human mind pretty much ignored the brain. And the reason is that there simply wasn't a way to measure neural activity while people were performing cognitive tasks, but a new technique called functional MRI, has changed that. Functional MRI produces high resolution images of brain activity every few seconds and it does so safely and non-invasively; so it is now actually possible to watch the brain work while people are learning or listening or performing a variety of cognitive tasks. Here at the University of Michigan we have a new functional MRI facility on North Campus that a number of faculty in psychology and a variety of other departments at the University are using to study how the brain implements memory, attention, emotion, and a wide variety of cognitive functions.


Thad Polk

Gregory Wakefield
Associate Professor, Electrical Engineering & Computer Science

I am working with George Shirley and Freda Herseth in the School of Music and Norman Hogikyan in the Medical School in developing models of the human voice. Taking recordings of the human voice we process these electronically to form images of singing. Mountain ranges in these images tell us about the singing voice. The challenge for the teacher and their singer is to figure out how to build smooth ranges out of these mountains. You can even electronically alter these ranges, so that the singer can hear the present sound of their future voice. Longer term implications of this research is to assist singers in their training as well as to help people with voice disorders.


George Shirley (left) and Gregory Wakefield

Fawwaz Ulaby *on the Middle English Dictionary*

Basic research certainly extends well beyond science and engineering. For instance, in August of 2001, we celebrated the completion of the 13th and final volume of the first-ever definitive record of Middle English, defined by scholars to cover the period from 1100 to 1500 A.D. The sheer magnitude of the Middle English Dictionary project is staggering – seven decades of scholarly labor, documented by some 3 million citations, culminating in a 13-volume dictionary of nearly 15,000 pages. Equally impressive is the fact that a single academic institution, the University of Michigan, provided the intellectual power and the bulk of the funding to accomplish this truly monumental task.



Lee C. Bollinger and Robert Lewis, MED Editor

D. Addressing the Needs of Society

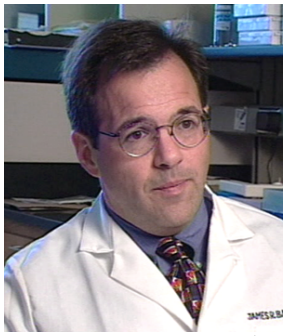
Fawwaz Ulaby

The University has a long-standing tradition of conducting research – whether basic or applied – aimed at enhancing human life and the human condition. This is accomplished by faculty, staff and students involved in research projects aimed at developing practical applications – from synthesizing a new drug to treat asthma, to designing new automotive sensors, and to creating new educational tools for teaching science and math to K-12 students.

One project in our Medical School is developing a potent emulsion called BCTP that kills harmful bacteria, yet it is completely non-toxic to humans.

James Baker, Jr.
Ruth Dow Doan Professor of Nanotechnology

At the University of Michigan we have done extensive testing in a number of different areas that suggest that BCTP is effective for treating anthrax spores as well as a number of different organisms that might be used for biological warfare. What we have done is first to look at cultures of these agents and see whether or not the emulsion will kill them. And there is very clear data that shows now that the emulsion does kill spores as well as bacteria in envelope viruses.



James Baker

Fawwaz Ulaby ***on the UM Transportation Research Institute***

In the University's Transportation Research Institute, many projects provide findings that are important to agencies responsible for transportation safety matters. Other projects help industry understand consumer needs and desires, allowing these companies to better meet the demands of their customers.



Crash Test Sled

Sandra Danziger
Associate Professor of Social Work


Sandra Danziger (right) with graduate

The Michigan program on poverty and social welfare policy is a joint effort at the Schools of Social Work, Public Policy, and Law. In one of our projects we have been interviewing single mothers, who are or have been welfare recipients in Michigan. We find that the women, who face multiple barriers to work, things like health problems, mental health problems, transportation, domestic violence are having more difficulty moving, making the transition from welfare to work and thus, they are at greater risk of losing their benefits. Yet the programs that serve them typically do not assess and treat these problems. We hope that Congress and other policymakers will be able to use our findings when they re-authorize the current law in 2002.

Fawwaz Ulaby *on "Saturday Morning Physics"*


Saturday Morning Physics lecture

Some contributions of research to society are quite direct. For the last seven years, scientists from Michigan's Physics Department have offered a Saturday morning lecture series aimed at the general public. The lectures are quite popular and are attended by thousands of people, from school-age children to elderly citizens.

E. Research for Economic Growth

Fawwaz Ulaby

In some cases, the research conducted by our faculty provides the basis for new products and services, in which case the University may patent and / or license the technology to the commercial sector, thereby contributing to the growth of the nation's economy.


Rick Snyder

Rick Snyder
Chairman, Ardesta, LLC

Technology transfer at the University is very successful these days and it has come a long way. If you go back to when I returned to Michigan back in 1997, I would say that tech transfer was primarily a licensing organization. Over the past few years

though, it really has become a partner — a partner in bringing together researchers and businesses in terms of building good business plans and how to make successful businesses out of great research.

David Humes
Professor of Internal Medicine
Founder, Nephros Therapeutics


David Humes

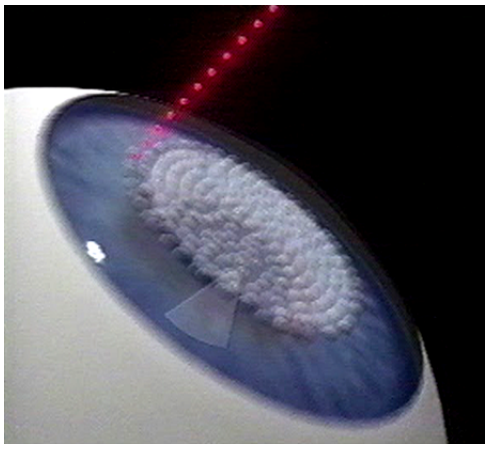
Nephros Therapeutics was started eight years ago as a spinout biotechnology company from the University of Michigan. This technology is based upon the ability of an academic lab to isolate kidney stem cells from adult tissue to fabricate a device that has both living cells and vial biomaterials for the treatment of acute and chronic kidney failure. We have used these devices in early clinical trials initiated at the University of Michigan Hospital on patients with acute kidney failure in the intensive care unit. The initial results are encouraging. It is our hope and the University's hope that this technology will be able to be further developed to aid the hundreds of thousands of patients with both acute and chronic kidney diseases in the United States and worldwide.

Ron Marx
Professor of Education
Co-Founder, Thinking Bridges, Inc.


Ron Marx

I started "Thinking Bridges" in the Spring of 2001 with colleagues in the College of Engineering and the School of Education to commercialize the efforts of our research over the last twelve years. The goal of the company is to make available to American schools research-proven products for science education. We are currently working with an educational publisher to distribute our software and our curriculum to American middle schools and high schools. Over the next year we will be fund raising in the company and developing a new line of products for the classroom use of palm hand-held computers.

Fawwaz Ulaby *on Intralase, Inc.*



Research conducted at the University's Center for Ultrafast Optical Science and Kellogg Eye Center is the foundation of the company, Intralase. A team of Michigan scientists, including the Medical School's Ron Kurtz, discovered a high-precision laser that can be used to greatly improve Laser eye surgery.

Ron Kurtz
Assistant Professor of Ophthalmology

The laser allows the surgeon to create the corneal flap without the use of a mechanical

blade. It does this with light energy, which allows the surgeon to have much higher precision and accuracy and can perform the surgery with greater safety.

Fawwaz Ulaby *on Intralase, Inc. (Cont.)*

The laser system creates the corneal flap by delivering laser energy in a circular pattern directly to the interior layer of the cornea, eliminating trauma to the outer surface of the eye. Intralase has FDA approval for the device and expects to begin distributing the laser system across the United States within the coming year.

F. Concluding Remarks

Fawwaz Ulaby

Thank you for joining me on this quick tour of Michigan research and its impact on society. Providing our faculty, staff and students with a dynamic environment conducive to creativity and innovation is the key to our success as a top-ranked research institution. And whether through the education of innovative leaders, the search for fundamental new insights, the application of research knowledge to real needs, or the development of new technologies into marketable products, Michigan will continue to serve the people of the State of Michigan, the nation and the world with the commitment and dedication to excellence that is at the very core of this great institution.

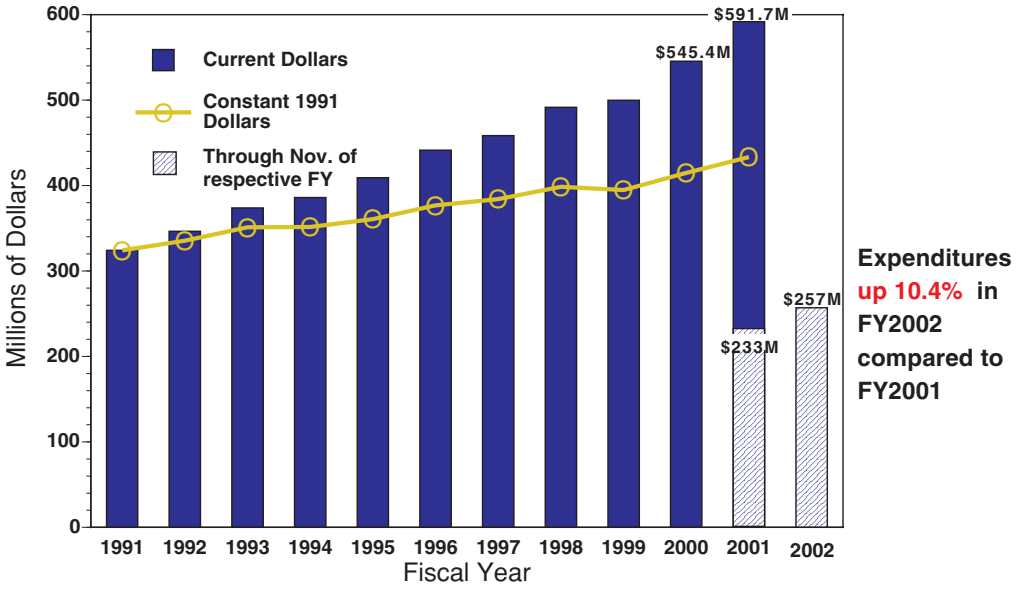
This video is a good reminder of the rationale for and importance of research at the University. What makes this all possible are the faculty, staff and students who conduct this work, the infrastructure they make use of, and the funding from both external and internal sources. As was stated earlier, our expenditure growth has been impressive. In the following section of this report, I will present some details about the funding that supports our research activity, and then address some of the reasons for Michigan's continued success in obtaining the funds that support our large research enterprise. To end, I will make a few comments about the "costs" of sustaining this success.

II. Summary of Research Expenditures and Awards

A. The University as a Whole

Figure 1 charts the University's total research expenditures over the previous decade. For fiscal year 2001, expenditures reached nearly $592 million, an increase of 8.5 percent over fiscal year 2000. Through the first five months of the current fiscal year, total research expenditures have reached $257 million, compared to $233 million for the same period a year earlier, representing an increase of 10.4 percent.

Figure 1
Total Research Expenditures, FY1991 Through November, 2001



A Research and Development Price Index was used to convert R&D expenditures to constant dollars.

The line across the bar chart shows the University's research spending in constant 1991 dollars. For the past five years, the higher education inflation index has exhibited an average annual rate of 3.1 percent, fluctuating from 1.9 percent in 1997 to 3.9 percent in 2001. Over the same period, the Federal Government's research funding to academic institutions has increased at an average rate of 6 percent per year. Relative to those figures, our research expenditures of Federal funds -- which comprise more than two-thirds of our total research spending -- grew over the past five years at an average annual rate of just under 7 percent. Furthermore, over the last two years, UM research expenditures from Federal sources is up nearly 9 percent per year. Between FY1996 and FY2001, the University of Michigan's total research expenditures increased by $150 million, or $56.6 million in constant 1991 dollars, that is, after taking inflation into account.

Figure 2 shows the distribution of expenditures for FY2001 grouped by the sources of funds. More than two-thirds of UM's research spending originates from Federal grants and contracts. The next largest segment is institutional spending — the money we invest in facilities, seed funding of new areas of inquiry, and cost-sharing on certain projects. Industry sponsors funded about 6 percent of our total, with foundations, trade groups and other sources funding the remainder.

FIGURE 2
TOTAL RESEARCH EXPENDITURES BY SPONSOR GROUP, FY2001

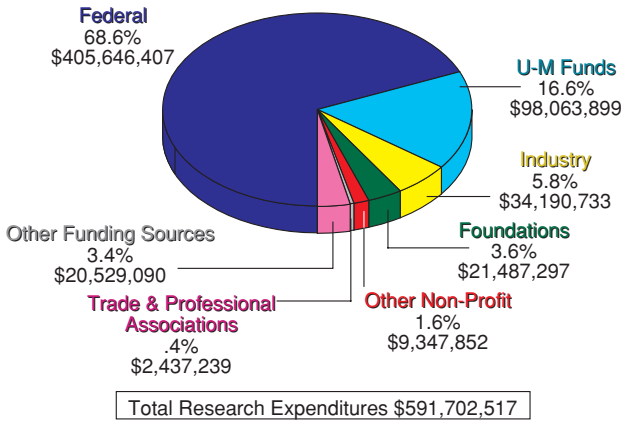
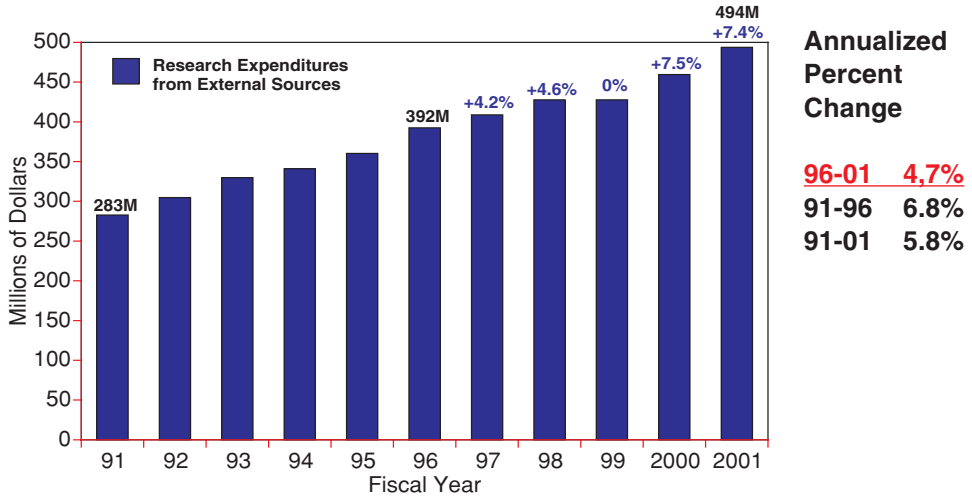


Figure 3 shows the trend in research expenditures by all UM units from external sponsors for the last decade.

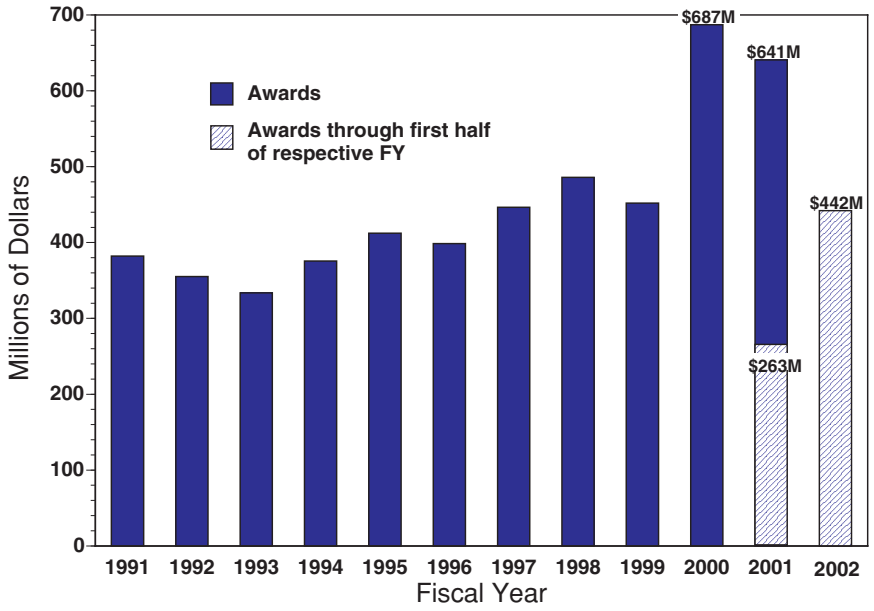
FIGURE 3
TOTAL RESEARCH EXPENDITURES FROM EXTERNAL SOURCES, FY1999-FY2001



New research awards are crucial to continuing the growth trends demonstrated in the previous figures. Figure 4 presents the annual value of total research awards over the past decade, from FY1991 through the first half of FY2002. Each year's total represents the sum of the full value of all awards over their entire,

multi-year duration. Put another way, the funds awarded in any one year will support research activity for several years to come. A year ago I was pleased to report that new awards in support of our faculty's research for FY2000 exhibited an increase of over $200 million compared to FY1999. One concern was whether our faculty could sustain this high level of awards, since we know that there is a certain cyclic pattern to awards. Happily, our researchers have cultivated another healthy crop of new awards in fiscal year 2001 — totaling $641 million. Furthermore, the first half of FY2002 shows a significant increase in the dollar value of new awards compared to the same period of FY2001. This figure provides some reassurance to me that our current high level of research spending growth should continue into the foreseeable future.

FIGURE 4
RESEARCH AWARDS, FY1991 - FY2002 (2Q)



A Research and Development Price Index was used to convert R&D expenditures to constant dollars.

With the big picture of research activity at the University in mind, I want to turn now to several questions. The first is "What does the funding profile look like for academic units with large research programs?" and then, "Which units have experienced large increases in research funding?"

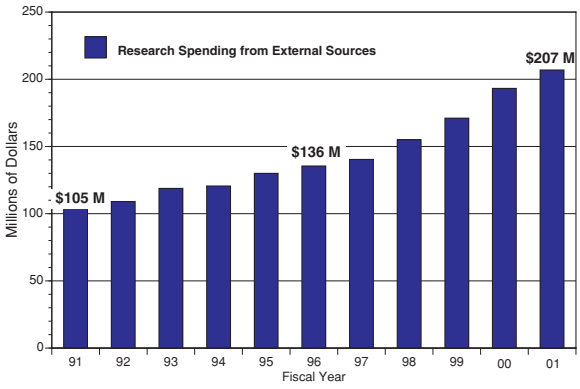
B. ACADEMIC UNITS WITH LARGE RESEARCH PROGRAMS

The following figures address where the increases in funding are occurring by focusing on research expenditures stemming from *external* sources only, since in many ways the amount of funds secured from outside the institution is the more impartial indicator of research funding success. The first set of figures shows research spending from external sources for the University's largest units — the Medical School, College of Literature, Science and the Arts, and the College of Engineering.

• The Medical School (Figure 5) spent $207 million from external sources in FY2001, and has been growing at an average rate of 9.2 percent since 1996.

The growth rate in externally funded research for the institution as a whole for this same period is about 4.7 percent. Not only is the growth rate of the Medical School impressively high, but considering the size of the expenditure base, the actual growth of $71 million over the past five years represents the largest fraction of the University's overall growth over this time period.

FIGURE 5
MEDICAL SCHOOL RESEARCH EXPENDITURES, EXTERNAL SOURCES, FY1991-FY2001

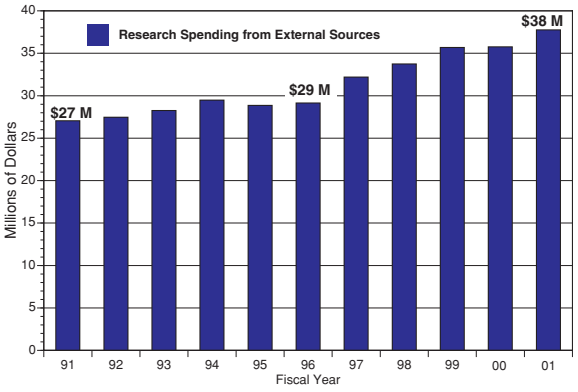


Annualized Percent Change

96-01	9.2%
91-96	5.1%
91-01	7.1%

• Research spending growth has been relatively slower in the College of Literature, Science and the Arts, which spent $38 million from external sponsors in FY2001 (Figure 6). However, it has grown at an annual rate of about 5.5 percent over the last five years, an increase from a growth rate of 1.5 percent per year in the first half of the 1990s.

FIGURE 6
COLLEGE OF LITERATURE, SCIENCE & THE ARTS RESEARCH EXPENDITURES, EXTERNAL SOURCES, FY1991-FY2001



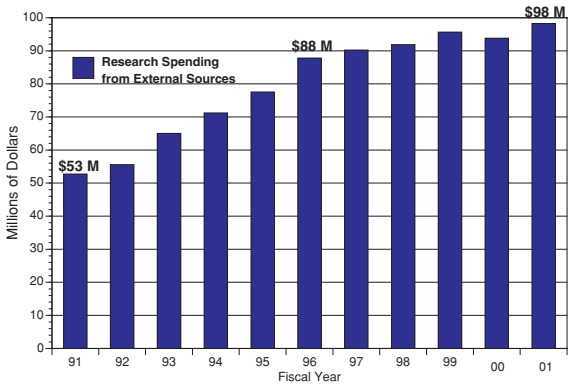
Annualized Percent Change

96-01	5.4%
91-96	1.5%
91-01	3.4%

• The College of Engineering has a much larger research budget than LS&A, which now approaches $100 million in expenditures from external funds (Figure 7). Its recent growth rate is 2.3 percent annually for the last five years, following a period in the early 1990s when the rate topped 10 percent.

FIGURE 7

COLLEGE OF ENGINEERING RESEARCH EXPENDITURES, EXTERNAL SOURCES, FY1991-FY2001



Annualized Percent Change

96-01	2.3%
91-96	10.8%
91-01	6.6%

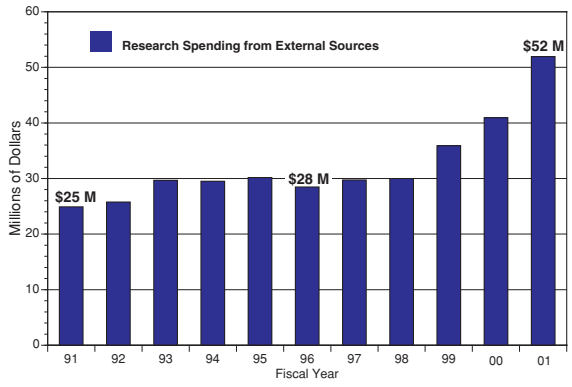
C. ACADEMIC UNITS EXPERIENCING EXCEPTIONAL GROWTH IN RESEARCH

The next three figures feature units that have grown at exceptional rates over recent years.

• The Institute for Social Research (ISR), which spent $52 million from external sources on research last year, has been growing at an average rate of 13 percent in recent years (Figure 8). In general terms, ISR attributes this growth to the increased interest on the part of the National Institutes of Health to conduct research that can be done so expertly at ISR. For instance, NIH decided to expand the scope of the Health and Retirement Survey already being conducted by ISR social scientists, adding more than $4 million in new funding to what is already a large project. The Michigan Interdisciplinary Center on Social Inequalities is a new NIH-funded activity operated jointly with the School of Public Health, and grows out of the fact that the UM has a superb cadre of faculty and so many NIH projects from which this Center can draw.

FIGURE 8

INSTITUTE FOR SOCIAL RESEARCH RESEARCH EXPENDITURES, EXTERNAL SOURCES, FY1991-FY2001



Annualized Percent Change

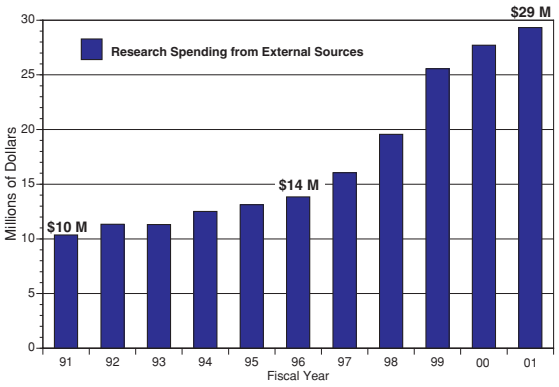
96-01	13.2%
91-96	2.9%
91-01	8.1%

Another reason for ISR's growth stems from a conscious and planned effort to expand the volume of surveys undertaken by the Survey Research Center (SRC). Over the past four years, the SRC has sought to increase the volume — in dollars of expenditures as well as numbers of surveys — by accepting more bids

from both on-campus and off-campus academics. This plan was hugely successful and is another reason why ISR research spending has grown rapidly.

• Since 1996, the School of Public Health has been growing steadily at an impressive rate of 16.5 percent! (Figure 9). Public Health attributes this success in part to an internal decision made in the mid-1990s to increase the School's own investment in research support for its faculty. Subsequently, faculty in Public Health have been awarded several large research awards from the National Institutes of Health and the Robert Woods Johnson Foundation. These factors combined have helped elevate the School of Public Health into a national leader among peer institutions.

FIGURE 9
SCHOOL OF PUBLIC HEALTH RESEARCH EXPENDITURES, EXTERNAL SOURCES, FY1991-FY2001

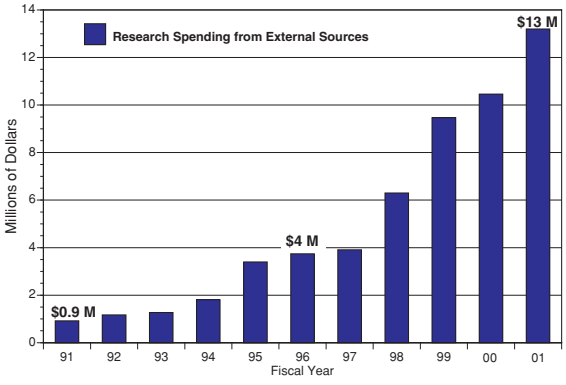


Annualized Percent Change

96-01	16.5%
91-96	6.0%
91-01	11.3%

• Finally, Figure 10 shows the research growth trend for the School of Education. In 1991, the School of Education represented a relatively small part of the institution's research portfolio, but that has changed very markedly over the past decade. Research expenditures from external sources topped $13 million last year, as a result of steady growth at the phenomenal average annual rate of 30 percent since FY1996! This school attributes its growth to research partnerships its faculty have formed with faculty from other UM schools, such

FIGURE 10
SCHOOL OF EDUCATION RESEARCH EXPENDITURES, EXTERNAL SOURCES, FY1991-FY2001



Annualized Percent Change

96-01	30.5%
91-96	35.2%
91-01	32.9%

as with the College of Engineering and LS&A, and to greater attention being paid to research questions of national significance. The Center for Highly Interactive Computing in Education (Hi-CE) is one of these very successful collaborations between the School of Education and Engineering, leading not only to well-funded research, but also to the development of new educational technology that has formed the basis for a new spin-off company. As examples of the research focus of its faculty, the School of Education is now the home of three national research centers funded by the U.S. Department of Education:

(a) The National Center for Postsecondary Improvement,

(b) The Consortium for Policy Research in Education, a collaboration with the University of Pennsylvania, and

(c) The Center for the Improvement of Early Reading Achievement, a collaboration with Stanford University and the University of Pennsylvania.

D. Other Research-Related Sponsored Activities

I have one other indicator of growth and success that I want to share with you, even though by National Science Foundation standards, it is not strictly defined as "research." We receive some grants and contracts to support activity that is coded as "Instructional" or "Community Service." In some schools, these funded projects are in fact important contributors to the research program and prestige of that unit nationally. One large category consists of "training grants" that the NIH awards us to support graduate study in the health sciences. These are counted as Instructional grants and not included in our research totals, yet they support our research mission and we compete successfully for them because of our research excellence. Likewise, faculty in the School of Social Work were involved for many years in a unique worker re-education project that we conducted for the United Auto Workers. In part, this project involved the UM because of the expertise in testing and evaluation that our faculty offered.

In the category of projects coded as "Community Service," some of our units received some very large and prestigious awards, which again are important indicators of the excellence of our faculty and their research. One major example is a grant that has gone to the School of Public Health to operate the Population Fellows Program for the U.S. Agency for International Development, which provides placements around the world for professionals involved in advanced degree work in population studies.

Let me show you just three examples of where these "Other Sponsored Activities" can make a significant contribution to our overall research and education mission (Figure 11).

• First, the School of Public Health, as I mentioned, has both a number of training grants and the U.S. AID grant that involves some $48 million in project expenditures over the five-year period ending in 2004. When we add these figures to the school's totals, its average growth for the past two years is nearly 20 percent per year, further raising the already impressive average annual rate of 16.5 percent for research expenditures alone.

• Two other units where other external funding makes a significant difference in the picture of their activity are the Flint and Dearborn campuses. At Dearborn, for instance, the growth in the Instructional and Community Service spending categories *exceeds* that for externally sponsored research over the last two years. At Flint, where the *rates* for externally funded Research and externally funded Instructional and Community Service Projects are about the same, the *magnitude* of spending from other sponsored categories is about 2.5 times larger than for research. By including the figures for growth in these additional areas of externally sponsored activity, we can more accurately represent the vibrancy that these two campuses contribute to the University.

Because it is useful to consider sponsored activity in these other categories, a table including this information for all schools and colleges has been added to this year's Appendix as Table 3.

FIGURE 11
THE SIGNIFICANCE OF "OTHER SPONSORED ACTIVITY"

School of Public Health	FY1999	FY2000	FY2001	Avg. % Chg.
Total Expenditures	$30M	$36M	$43M	19.90%
Research, External	25M	28M	29M	7.40%
Research, Internal	0.6M	4M	3M	249%
Other External	3.9M	4.9M	11.0M	75%

UM-Dearborn	FY1999	FY2000	FY2001	Avg. % Chg.
Total Expenditures	$3.7M	$5.4M	$4.9M	18.70%
Research, External	1.6M	2.6M	2.0M	18.10%
Research, Internal	0.7M	0.7M	0.8M	7.9%
Other External	1.4M	2.2M	2.1M	28.10%

UM-Flint	FY1999	FY2000	FY2001	Avg. % Chg.
Total Expenditures	$2.1M	$3.0M	$3.1M	24.80%
Research, External	0.5M	1.0M	0.8M	50.30%
Research, Internal	0.6M	0.4M	0.3M	-34.30%
Other External	0.9M	1.6M	2.1M	48.70%

Note: "Other External" is the combined total of expenditures from external sponsors coded as "Instructional" or "Community Service."

III. WHY IS THE UNIVERSITY'S RESEARCH PROGRAM SO SUCCESSFUL?

The University has a remarkable record of growth in research expenditures over many years, even while the number of faculty has not changed significantly. Why have we enjoyed this level of success? I believe there are four major contributors to our success:

- our interdisciplinary culture;
- our continued support for new and improved research infrastructure,
- our process for responding to new Federal research initiatives, and
- our efforts to nurture new areas of research expertise.

As the first two factors have been the subjects of previous reports by my office and others, I will address them only briefly. I will then address the second two factors in some detail.

A. The University's Interdisciplinary Culture

As I and my predecessors have said many times, Michigan has such a long tradition of promoting interdisciplinary research so that this is now part of our "culture." In addition, interest in collaborative, interdisciplinary research continues to rise — both on campus and nationally. Funding agencies realize that many complex problems facing society in the environmental, biological, and social arenas clearly require a cross-disciplinary, team approach. Recent history teaches us that many of the major breakthroughs occur at the interface between traditional disciplines, and that interdisciplinary work often leads to new frontiers in knowledge and education. The Provost and the Vice President for Research, as well as the Deans, have been committed to nurturing an atmosphere on campus that encourages faculty to work collaboratively and across departmental, school, college and research unit boundaries, and I think this pays off when our faculty seek funding to support their work.

B. Infrastructure Support and Development

Second, we have supported the infrastructure for research at substantial levels, with the contributions coming from all levels of the University — from the departments, the schools and colleges, and the central administration. For FY2001, the UM spent $98 million of its own funds — 16.6% of our total research expenditures — to assist in the creation of new facilities (such as the Life Sciences Institute, to name one prominent example), to upgrade existing laboratories across the campus, and to provide seed funds for faculty developing new areas of inquiry. In addition, the University has provided substantial support for the library system and our computing facilities to try to keep up with our faculty's needs and the new powerful technologies that enhance the effectiveness of these resources. Our internal spending in support of research has grown — and must continue to grow — if we wish to continue our impressive record of research growth.

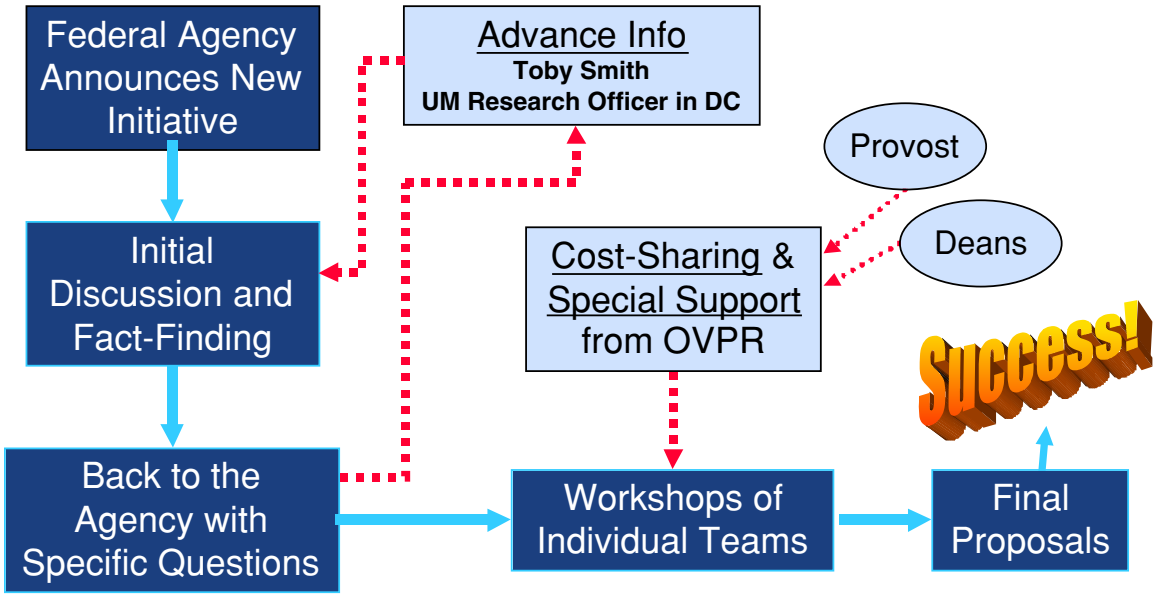
C. Responsiveness to Federal Initiatives

In recent years, as the complexity and scope of major funding opportunities has increased, OVPR has responded by instituting more workshops to orient faculty and staff to proposal requirements and stimulate competitive proposals. This process, outlined in Figure 12, often begins with information gathering by DRDA Project Representatives who are familiar with sponsor agency offerings or, in some instances, with advanced intelligence from our Research Officer in Washington D.C. about new, major initiatives that have yet to receive wide public notice. Once aware of the opportunity, we identify potential faculty applicants, often through our network of Research Deans, as well as requirements for additional information or clarification from the sponsor. Frequently,

we will pay a visit to the agency personnel in Washington responsible for a new initiative to make sure that the information we will be providing our faculty is up-to-date and accurate.

OVPR Workshops are organized with assistance from DRDA as well as Schools and Colleges and serve several purposes. First, while agency solicitations include basic information on project requirements, we can often provide more

FIGURE 12
FLOWCHART OF COORDINATED RESPONSE TO FEDERAL INITIATIVES



refined advice based on what the sponsor is "really" looking for in successful proposals. Second, workshops are often used to identify potential team members, an increasingly important element in interdisciplinary proposals that may require forging new relationships between scholars in widely dispersed areas of study. Lastly, the workshop prepares participants for the mechanics of proposal preparation, especially when there are unusual requirements. For example, if an agency has set a limit on the number of proposals it will accept from an individual institution, we will hold an "internal competition" to determine which proposals will go forward. In other cases, unusually high levels of cost sharing from academic units and OVPR or new facilities approval from the Provost may be needed so that our proposals are competitive. To prepare the faculty for all of these possibilities, we will hold a series workshops, as more information becomes available.

An illustration of this process can be seen in the UM's successful competition for awards related to the multi-agency Federal Information Technology Initiative. This program designated new Federal resources for innovative, interdisciplinary projects to advance several academic areas related to information technology. Preliminary meetings were held early in the initiative's life between

our Washington Research Officer and OVPR staff with legislative staffers developing the initiative and later with sponsoring agency officials to clarify high priority interests and additional criteria that might be applied in project selection. Early in the process, preliminary meetings were conducted with a wide-ranging group of faculty to seed ideas. Follow-up workshops were conducted as more information became available and as research proposal writing teams were formed. OVPR provided proposal preparation assistance and coordinated cost sharing and other resource requests with participating academic and administrative units.

FIGURE 13
INFORMATION TECHNOLOGY INITIATIVE

- **Federal Allocation: $90M in first year**
- **UM success: 3 major projects (>$500K each) 5 individual projects (<$500K each)**
- **Awarded $8M (8.9%) of the $90M Total**

The results for our faculty (Figure 13) were impressive, with UM being in the group of institutions with the highest number of successful proposals and one of the highest award levels. Faculty reported that the advance knowledge and continuing support had an impact on their competitiveness. We believe that this approach, used creatively and selectively, will continue to have a positive impact on our success in winning awards.

D. NURTURING NEW RESEARCH AREAS

OVPR also plays a role in major research initiatives where UM, rather than an external sponsor, is the primary source of funds. Though there are many research projects seeded by academic units, individually or in collaboration with one another, when an area is unusual in its interdisciplinarity, cross unit complexity, or specialized resource needs, OVPR is more likely to play an organizing role. The substantive research areas in such instances are identified through a variety of means, sometimes "bubbling up" from the faculty as novel but potentially significant innovations and at other times identified by Research Deans or OVPR staff when potential funding opportunities are matched against institutional capacity. We are most likely to invest significantly in research areas where UM has the capacity to be a leader and yet it has not adequately focused its efforts and resources to realize its potential. As might be expected, this is often because of the inter-unit teamwork and coordination required that no one particular unit has either been able to advance or was even aware of the need to initiate.

An example of such an initiative is the one in Spatial Analysis and Geographic Information Systems. An area of growing interest in many disciplines spurred on by increasingly sophisticated technological advances, it boasted a small, active group of faculty proponents from many units who had been seeking assistance for a number of years. In discussion with OVPR, it became apparent that without some increase in resources, education, and facilitation, UM would not

be able to achieve its full potential in this critical area that was, in addition to being a focus of research, of growing importance as a research tool in many disciplines.

Through a series of discussions with faculty and Research Deans a proposal was forged that laid out an ambitious plan to stimulate growth in Spatial Analysis and GIS, not only by upgrading the infrastructure available for training and proposal development, but also by supporting specific pilot projects that might seed sponsor funded proposals as well. With the participation of the Provost and several Deans, a fund of $1.26 million was established and awarded competitively over a two year period (Figure 14). OVPR hired an expert Research Scientist to support these efforts and lend technical as well as administrative support to the initiative.

FIGURE 14
SPATIAL ANALYSIS AND GEOGRAPHIC INFORMATION SYSTEM INITIATIVE

- Two-year initiative
- Total Initiative funding : $1.26 M
  - OVPR $560,000
  - Provost $200,000
  - Rackham $135,000
  - Schools/Colleges..... $365,000
- Number of Team Awards: 7
- Investment return to date:
  - $3.1M (new awards)
  - $1.8 M (proposals pending)
- Rackham Certificate Program established

To date, the results have been impressive, and we are seeing continuing ramifications. There has been a Certificate Program established through Rackham to provide an interdisciplinary training program for graduate students across the campus. Several projects have already resulted in successful sponsor awards totaling $3.1 million and there are nearly $2 million in proposals awaiting action by sponsors. While not all internal initiatives are of this scope and funding, they have all had comparable results, establishing the credibility necessary to win competitive awards from external sponsors and building the intellectual and technological infrastructure increasingly necessary to remain in the forefront of scholarship and research.

IV. THE "COST" OF SUCCESS

As we look to the future we are faced with two intertwined questions:

- What do we need to do to continue to be successful in attracting research funding?
- What are the costs of success?

Michigan's impressive achievements in research rest upon our faculty's ability to continue to compete successfully for research resources on a global scale. While creativity and persistence are essential to remaining in the forefront of their disciplines, the faculty also rely on an infrastructure that provides:

(a) clusters of complementary colleagues,

(b) state-of-the-art specialized equipment and technical support,

(c) access to archives and research sites around the world (as well as outer space!), and

(d) interaction with the brightest graduate and undergraduate students in the nation.

The requirement for resources is relentless, as is the competition, and we cannot take for granted that the synergy of creativity and infrastructure will be maintained without diligent attention, planning, and organizational commitment.

As we face tight budgets and the many legitimate competing demands for limited funds, we must factor into our resource allocation decisions how easy it is to fall behind in providing a superlative climate for research. Investments in some disciplines require many years to yield visible results. In some instances, failing to keep pace may leave us without the capacity to participate in newly emerging, significant intellectual areas or to ever catch up once we fall behind! Other institutions have demonstrated the capacity to focus research resources in order to leap ahead of their peers, including Michigan, in critical areas of research. While Michigan has always prided itself on remaining competitive across a wide array of disciplines, this approach can only be sustained with an aggressive, comprehensive investment plan.

And what if we continue to succeed at the prodigious rate we have demonstrated over the past ten years? What are the potential costs associated with heeding the admonition to compete and grow? In addition to those implied above, UM will need facilities well beyond those currently envisioned. We will face greater complexity in administering grants and contracts. The demands will grow for ensuring compliance with the ever expanding volume of Federal and State regulations. And we must always be aware of the need to balance the demands on our faculty to maintaining both high-quality instruction and scholarship.

UM needs to carefully assess how to respond to these complexities with the collaboration, as well as under the scrutiny, of the many stakeholders who take an active interest in UM's future. Assessing the proper path for growth and how our institution must continue to develop and transform itself to meet that future is a worthy challenge.

In conclusion, let me leave you with three points. First, all of the indicators suggest that Michigan continues to be a "research star" among US universities. In large part, this is due to our substantial strengths all across the spectrum of academic activity.

Second, we must never forget that most of the credit for UM's success goes to its creative faculty, dedicated staff and eager-to-discover students.

And last, the Administration must maintain an unwavering commitment to providing sufficient internal resources to support our research enterprise. It is this institutional support that serves as an important foundation for our success, and allows the faculty to do their part in maintaining Michigan's prominence as a top research university.

University of Michigan

Appendices of Table and Charts for Expenditures, Proposals, and Awards

The following tables provide additional detail about research activity at the University of Michigan, as reflected by three major measures: (1) research expenditures, (2) research proposals, and (3) research awards. These data reflect the rich diversity of research activities and capabilities that have earned the University of Michigan the distinction of the nation's leading public research university.

Increases in annual total **research expenditures** in support of research demonstrate the continued leadership of the University in the discovery of new knowledge and in the application of leading-edge technologies for the benefit of society. Research expenditures in FY2001 totaled $591.7 million, recording an 8.5% increase over the previous fiscal year.

New **research awards** should exceed annual expenditures in order for the University to sustain its research momentum in the face of increasing costs. In FY2001, this "margin" between research awards and expenditures was $147.2 million ($640.8 million in new awards and $493.6 million in expenditures from externally funded sources). Many awards are made on a multi-year basis. Therefore, a portion of the dollars awarded in any given year may be spent in subsequent years. Nonetheless, we believe this marked increase speaks to the continued strength of our faculty in winning competitive awards.

Research proposals submitted provide some indication of the new research opportunities being offered by prospective sponsors and reflect the responsiveness of the faculty to these program opportunities. The majority of proposals are in response to specific requests for proposals—RFP's—which, in turn, reflect the highest priority research initiatives of the sponsors. The dollar value of the 3,529 proposals submitted in FY2001 exceeded $2.3 billion.

Table 1: Volume of Research Expenditures By Sponsor

SOURCE	FY 2000	PERCENT OF TOTAL	FY 2001	PERCENT OF TOTAL	PERCENT CHANGE
FEDERAL SOURCES					
Health and Human Services					
Centers for Disease Control	222,872,575	40.9%	247,472,514	41.8%	11.0%
Food and Drug Administration	3,000,866	0.6%	6,413,767	1.1%	113.7%
Heath Care Financing Administration	538,932	0.1%	1,443,625	0.2%	167.9%
Health Resources & Services Administration	869,849	0.2%	1,332,730	0.2%	53.2%
National Institutes of Health	507,897	0.1%	616,646	0.1%	21.4%
Substance Abuse and Mental Health Services	277,519	0.1%	391,047	0.1%	40.9%
Other HHS	1,060,018	0.2%	1,368,931	0.2%	29.1%
Total Health and Human Services	229,127,656	42.0%	259,039,260	43.8%	13.1%
National Science Foundation	41,717,204	7.6%	50,655,579	8.6%	21.4%
Department of Defense					
Army	11,556,255	2.1%	12,190,223	2.1%	5.5%
Air Force	9,283,115	1.7%	8,669,185	1.5%	-6.6%
Navy	7,808,433	1.4%	7,355,030	1.2%	-5.8%
Other	7,384,183	1.4%	6,809,290	1.2%	-7.8%
Total Department of Defense	36,031,986	6.6%	35,023,728	5.9%	-2.8%
Energy	14,693,765	2.7%	15,584,679	2.6%	6.1%
N.A.S.A.	13,183,889	2.4%	12,615,688	2.1%	-4.3%
Education	10,314,069	1.9%	10,626,862	1.8%	3.0%
Transportation	6,290,841	1.2%	6,241,577	1.1%	-0.8%
Environmental Protection Agency	6,056,189	1.1%	5,516,980	0.9%	-8.9%
Commerce	5,728,465	1.1%	4,864,041	0.8%	-15.1%
International Development Cooperation Agency	6,044,351	1.1%	3,623,449	0.6%	-40.1%
Justice	1,266,038	0.2%	1,697,161	0.3%	34.1%
Social Security Administration	946,791	0.2%	1,090,814	0.2%	15.2%
Agriculture	777,539	0.1%	871,636	0.1%	12.1%
General Services Administration	469,930	0.1%	395,551	0.1%	-15.8%
Interior	148,792	0.0%	124,082	0.0%	-16.6%
Museum and Library Services, Institute of	72,093	0.0%	104,614	0.0%	45.1%
Veterans Affairs	623,244	0.1%	86,796	0.0%	-86.1%
National Endowment for the Humanities	140,957	0.0%	71,843	0.0%	-49.0%
Housing and Urban Development	178,330	0.0%	55,430	0.0%	-68.9%
Emergency Management Agency	188,456	0.0%	0	0.0%	-100.0%
Labor	142,549	0.0%	-5,510	0.0%	-103.9%
Other Federal	477,681	0.1%	-2,637,853	-0.4%	-652.2%
Total Federal Government	**374,620,815**	68.7%	**405,646,407**	68.6%	8.3%
OTHER SPONSORS					
Industry	33,252,658	6.1%	34,190,733	5.8%	2.8%
Foundations	19,494,347	3.6%	21,487,297	3.6%	10.2%
Public Charities	7,365,301	1.4%	9,377,172	1.6%	27.3%
Other (includes voluntary contributions)	7,446,436	1.4%	9,347,852	1.6%	25.5%
Endowment	2,474,004	0.5%	5,798,520	1.0%	134.4%
State, Local, and Other Governments	4,664,905	0.9%	5,144,073	0.9%	10.3%
Trade and Professional Associations	6,988,532	1.3%	2,437,239	0.4%	-65.1%
International Organizations	349,607	0.1%	209,325	0.0%	-40.1%
Total Other Sponsors	**82,035,790**	15.0%	**87,992,211**	14.9%	7.3%
Total Sponsored Research	**456,656,605**	83.7%	**493,638,618**	83.4%	8.1%
UNIVERSITY OF MICHIGAN SOURCES					
University of Michigan Funds	88,761,433	16.3%	98,063,899	16.6%	10.5%
TOTAL RESEARCH EXPENDITURES	**545,418,038**	100.0%	**591,702,517**	100.0%	8.5%

Table 2: Total Research Expenditures by School, College, and Other Units

UNIT	FY 1999	FY 2000	FY 2001	Average Percent Change
Architecture & Urban Planning, Taubman Total	**515,078**	**615,476**	**527,732**	2.6%
External Research Support	366,848	434,463	333,948	-2.4%
Internal Research Support	148,230	181,013	193,784	14.6%
Art and Design Total	**107,855**	**231,196**	**303,108**	72.7%
External Research Support	27,797	37,515	78,807	72.5%
Internal Research Support	80,058	193,681	224,301	78.9%
Business Administration Total	**7,358,573**	**8,101,604**	**9,026,107**	10.8%
External Research Support	2,290,225	2,798,595	3,355,942	21.1%
Internal Research Support	5,068,348	5,303,010	5,670,165	5.8%
Dentistry Total	**8,090,925**	**8,819,110**	**9,332,280**	7.4%
External Research Support	7,291,060	7,988,069	8,197,052	6.1%
Internal Research Support	799,865	831,041	1,135,229	20.3%
Education Total	**9,904,899**	**11,588,077**	**14,275,130**	20.1%
External Research Support	8,725,466	10,460,198	13,199,739	23.0%
Internal Research Support	1,179,434	1,127,880	1,075,391	-4.5%
Engineering Total	**103,535,505**	**104,479,760**	**112,998,660**	4.5%
External Research Support	91,963,773	93,811,822	98,269,806	3.4%
Internal Research Support	11,571,732	10,667,937	14,728,854	15.1%

UNIT	FY 1999	FY 2000	FY 2001	Average Percent Change
Graduate School, Rackham Total	**1,500,150**	**2,074,755**	**3,766,987**	59.9%
External Research Support	384,028	708,515	1,225,628	78.7%
Internal Research Support	1,116,122	1,366,240	2,541,359	54.2%
Information Total	**3,851,161**	**3,935,680**	**3,045,703**	-10.2%
External Research Support	3,762,187	3,606,147	2,652,561	-15.3%
Internal Research Support	88,974	329,533	393,143	144.8%
Kinesiology Total	**1,267,141**	**641,481**	**1,010,202**	4.1%
External Research Support	447,857	220,681	267,911	-14.7%
Internal Research Support	819,284	420,800	742,290	13.9%
Law Total	**1,346,047**	**1,898,821**	**1,765,146**	17.0%
External Research Support	1,072,406	1,689,249	1,710,229	29.4%
Internal Research Support	273,641	209,572	54,917	-48.6%
Literature Science, and the Arts Total	**45,693,220**	**47,820,595**	**50,662,256**	5.3%
External Research Support	33,402,514	35,748,759	37,751,710	6.3%
Internal Research Support	12,290,705	12,071,836	12,910,546	2.6%
Medical School Total	**179,571,227**	**204,912,583**	**216,787,352**	10.0%
External Research Support	167,971,062	193,245,569	206,929,993	11.1%
Internal Research Support	11,600,165	11,667,014	9,857,359	-7.5%
Music Total	**420,474**	**220,454**	**232,967**	-20.9%
External Research Support	814	4,365	14,843	338.1%
Internal Research Support	419,660	216,089	218,124	-23.8%

UNIT	FY 1999	FY 2000	FY 2001	Average Percent Change
Natural Resources and the Environment Total	**1,823,511**	**2,624,484**	**3,062,469**	30.3%
External Research Support	1,743,239	2,020,061	2,504,766	19.9%
Internal Research Support	80,272	604,423	557,703	322.6%
Nursing Total	**3,444,889**	**3,832,270**	**3,688,322**	3.7%
External Research Support	3,282,550	3,640,553	3,482,015	3.3%
Internal Research Support	162,339	191,717	206,307	12.9%
Pharmacy Total	**5,595,554**	**4,914,230**	**4,578,792**	-9.5%
External Research Support	5,445,588	4,445,994	4,096,984	-13.1%
Internal Research Support	149,967	468,236	481,808	107.6%
Public Health Total	**26,040,871**	**31,427,739**	**32,014,139**	11.3%
External Research Support	25,446,038	27,706,967	29,321,285	7.4%
Internal Research Support	594,832	3,720,772	2,692,854	248.9%
Public Policy, G Ford Total	**309,511**	**317,232**	**361,510**	8.2%
External Research Support	154,200	162,221	262,459	33.5%
Internal Research Support	155,312	155,012	99,051	-18.1%
Social Work Total	**9,392,124**	**9,391,380**	**4,585,463**	-25.6%
External Research Support	8,176,813	7,836,738	3,701,012	-28.5%
Internal Research Support	1,215,311	1,554,642	884,451	-7.6%
Institute of Social Research	**47,751,561**	**57,496,431**	**75,089,565**	25.5%
External Research Support	38,162,428	40,929,078	51,929,352	17.1%
Internal Research Support	9,589,133	16,567,353	23,160,213	56.3%

UNIT	FY 1999	FY 2000	FY 2001	Average Percent Change
OVPR Research Units	**27,961,834**	**27,978,846**	**29,610,122**	2.9%
External Research Support	18,446,746	19,551,636	21,862,637	8.9%
Internal Research Support	9,515,088	8,427,210	7,747,485	-9.7%
Other Units Total	**3,383,683**	**4,395,317**	**5,154,351**	23.6%
External Research Support	2,630,385	3,402,641	4,122,966	25.3%
Internal Research Support	753,298	992,677	1,031,385	17.8%
UM Dearborn Total	**2,327,928**	**3,242,881**	**2,808,337**	13.0%
External Research Support	1,594,278	2,531,288	1,962,296	18.1%
Internal Research Support	733,649	711,593	846,042	7.9%
UM Flint Total	**1,119,469**	**1,403,717**	**1,074,308**	1.0%
External Research Support	465,705	1,043,093	799,178	50.3%
Internal Research Support	653,764	360,624	275,130	-34.3%
University Administration Total	**319,112**	**92,060**	**46,469**	-60.3%
External Research Support	244,175	67,771	40,051	-56.6%
Internal Research Support	74,937	24,289	6,418	-70.6%
Unassignable Services Total	**7,089,628**	**2,961,858**	**5,895,041**	20.4%
External Research Support	4,114,558	(4,587,563)	(4,434,550)	-107.4%
Internal Research Support	2,975,069	7,549,421	10,329,591	95.3%
All Activities Total	**499,721,932**	**545,418,039**	**591,702,517**	8.8%
External Activities Support	427,612,742	459,504,425	493,638,618	7.4%
Internal Activities Support	72,109,189	85,913,614	98,063,899	16.6%

Table 2

Table 3: Research and Research-Related Community Service and Instructional Support Expenditures by School, College, and Other Units

UNIT	FY 1999	FY 2000	FY 2001	Average Percent Change
Architecture & Urban Planning, Taubman Total	**639,009**	**710,270**	**636,753**	.4%
External Research Support	366,848	434,463	333,948	-2.4%
Internal Research Support	148,230	181,013	193,784	14.6%
External Research Related Support *	123,931	94,794	109,021	-4.3%
Art and Design Total	**163,437**	**258,679**	**303,108**	37.7%
External Research Support	27,797	37,515	78,807	72.5%
Internal Research Support	80,058	193,681	224,301	78.9%
External Research Related Support	55,582	27,483	-	-75.3%
Business Administration Total	**8,571,103**	**9,148,981**	**10,146,259**	8.8%
External Research Support	2,290,225	2,798,595	3,355,942	21.1%
Internal Research Support	5,068,348	5,303,010	5,670,165	5.8%
External Research Related Support	1,212,530	1,047,377	1,120,152	-3.3%
Dentistry Total	**9,254,084**	**10,042,724**	**10,512,671**	6.6%
External Research Support	7,291,060	7,988,069	8,197,052	6.1%
Internal Research Support	799,865	831,041	1,135,229	20.3%
External Research Related Support	1,163,159	1,223,614	1,180,390	.8%
Education Total	**11,279,615**	**13,064,057**	**15,938,610**	18.9%
External Research Support	8,725,466	10,460,198	13,199,739	23.0%
Internal Research Support	1,179,434	1,127,880	1,075,391	-4.5%
External Research Related Support	1,374,716	1,475,979	1,663,481	10.0%

UNIT	FY 1999	FY 2000	FY 2001	Average Percent Change
Engineering Total	**107,408,935**	**107,458,496**	**115,873,062**	3.9%
External Research Support	91,963,773	93,811,822	98,269,806	3.4%
Internal Research Support	11,571,732	10,667,937	14,728,854	15.1%
External Research Related Support	3,873,430	2,978,736	2,874,402	-13.3%
Graduate School, Rackham Total	**1,746,438**	**2,314,954**	**4,098,982**	54.8%
External Research Support	384,028	708,515	1,225,628	78.7%
Internal Research Support	1,116,122	1,366,240	2,541,359	54.2%
External Research Related Support	246,288	240,199	331,995	17.9%
Information Total	**5,556,275**	**6,588,993**	**6,377,495**	7.7%
External Research Support	3,762,187	3,606,147	2,652,561	-15.3%
Internal Research Support	88,974	329,533	393,143	144.8%
External Research Related Support	1,705,115	2,653,312	3,331,792	40.6%
Kinesiology Total	**3,127,733**	**2,483,505**	**3,196,503**	4.1%
External Research Support	447,857	220,681	267,911	-14.7%
Internal Research Support	819,284	420,800	742,290	13.9%
External Research Related Support	1,860,592	1,842,024	2,186,301	8.8%
Law Total	**1,515,833**	**2,035,855**	**1,875,849**	13.2%
External Research Support	1,072,406	1,689,249	1,710,229	29.4%
Internal Research Support	273,641	209,572	54,917	-48.6%
External Research Related Support	169,785	137,034	110,703	-19.3%
Literature Science, and the Arts Total	**49,138,072**	**52,147,720**	**56,743,297**	7.5%
External Research Support	33,402,514	35,748,759	37,751,710	6.3%
Internal Research Support	12,290,705	12,071,836	12,910,546	2.6%
External Research Related Support	3,444,853	4,327,125	6,081,041	33.1%

UNIT	FY 1999	FY 2000	FY 2001	Average Percent Change
Medical School Total	**191,741,559**	**219,928,467**	**236,034,029**	11.0%
External Research Support	167,971,062	193,245,569	206,929,993	11.1%
Internal Research Support	11,600,165	11,667,014	9,857,359	-7.5%
External Research Related Support	12,170,332	15,015,883	19,246,677	25.8%
Music Total	**465,842**	**433,935**	**303,568**	-18.4%
External Research Support	814	4,365	14,843	338.1%
Internal Research Support	419,660	216,089	218,124	-23.8%
External Research Related Support	45,368	213,481	70,600	151.8%
Natural Resources and the Environment Total	**2,288,544**	**2,928,010**	**3,345,386**	21.1%
External Research Support	1,743,239	2,020,061	2,504,766	19.9%
Internal Research Support	80,272	604,423	557,703	322.6%
External Research Related Support	465,033	303,526	282,917	-20.8%
Nursing Total	**4,027,520**	**4,667,713**	**4,907,927**	10.5%
External Research Support	3,282,550	3,640,553	3,482,015	3.3%
Internal Research Support	162,339	191,717	206,307	12.9%
External Research Related Support	582,631	835,443	1,219,605	44.7%
Pharmacy Total	**5,860,505**	**5,204,808**	**4,938,855**	-8.1%
External Research Support	5,445,588	4,445,994	4,096,984	-13.1%
Internal Research Support	149,967	468,236	481,808	107.6%
External Research Related Support	264,951	290,578	360,063	16.8%
Public Health Total	**29,935,786**	**36,382,732**	**43,033,091**	19.9%
External Research Support	25,446,038	27,706,967	29,321,285	7.4%
Internal Research Support	594,832	3,720,772	2,692,854	248.9%
External Research Related Support	3,894,915	4,954,993	11,018,951	74.8%

UNIT	FY 1999	FY 2000	FY 2001	Average Percent Change
Public Policy, G Ford Total	**514,457**	**382,493**	**977,985**	65.0%
External Research Support	154,200	162,221	262,459	33.5%
Internal Research Support	155,312	155,012	99,051	-18.1%
External Research Related Support	204,946	65,260	616,475	388.2%
Social Work Total	**10,431,418**	**11,097,857**	**6,402,910**	-18.0%
External Research Support	8,176,813	7,836,738	3,701,012	-28.5%
Internal Research Support	1,215,311	1,554,642	884,451	-7.6%
External Research Related Support	1,039,294	1,706,476	1,817,447	35.3%
Institute of Social Research	**48,819,734**	**59,279,202**	**77,401,809**	26.0%
External Research Support	38,162,428	40,929,078	51,929,352	17.1%
Internal Research Support	9,589,133	16,567,353	23,160,213	56.3%
External Research Related Support	1,068,174	1,782,770	2,312,244	48.3%
OVPR Research Units	**29,153,786**	**29,465,444**	**31,721,992**	4.4%
External Research Support	18,446,746	19,551,636	21,862,637	8.9%
Internal Research Support	9,515,088	8,427,210	7,747,485	-9.7%
External Research Related Support	1,191,951	1,486,598	2,111,870	33.4%
Other Units Total	**11,777,820**	**13,951,707**	**12,771,916**	5.0%
External Research Support	2,630,385	3,402,641	4,122,966	25.3%
Internal Research Support	753,298	992,677	1,031,385	17.8%
External Research Related Support	8,394,137	9,556,390	7,617,565	-3.2%
UM Dearborn Total	**3,704,987**	**5,408,538**	**4,949,177**	18.7%
External Research Support	1,594,278	2,531,288	1,962,296	18.1%
Internal Research Support	733,649	711,593	846,042	7.9%
External Research Related Support	1,377,059	2,165,657	2,140,840	28.1%

UNIT	FY 1999	FY 2000	FY 2001	Average Percent Change
UM Flint Total	**2,066,895**	**2,999,920**	**3,133,585**	24.8%
External Research Support	465,705	1,043,093	799,178	50.3%
Internal Research Support	653,764	360,624	275,130	-34.3%
External Research Related Support	947,426	1,596,204	2,059,277	48.7%
University Administration Total	**1,060,034**	**1,231,419**	**1,542,799**	20.7%
External Research Support	244,175	67,771	40,051	-56.6%
Internal Research Support	74,937	24,289	6,418	-70.6%
External Research Related Support	740,922	1,139,359	1,496,330	42.6%
Unassignable Services Total	**7,977,167**	**4,406,916**	**7,407,550**	11.7%
External Research Support	4,114,558	(4,587,563)	(4,434,550)	-107.4%
Internal Research Support	2,975,069	7,549,421	10,329,591	95.3%
External Research Related Support	887,539	1,445,057	1,512,509	33.7%
All Activities Total	**548,226,588**	**604,023,393**	**664,575,167**	10.1%
External Activities Support	427,612,742	459,504,425	493,638,618	7.4%
Internal Activities Support	72,109,189	85,913,614	98,063,899	16.6%
External Research Related Support	48,504,657	58,605,354	72,872,650	22.6%

* External Research Related Community Service & Instructional Support

Table 4: Summary of Research Proposals by Sponsor Group

SPONSOR	7/1/99 - 6/30/00 Number	7/1/99 - 6/30/00 Amount	7/1/00 - 6/30/01 Number	7/1/00 - 6/30/01 Amount	Percent Change Number	Percent Change Amount
Agriculture	20	1,803,131	17	2,870,760	-15.0%	59.2%
Commerce	61	6,277,244	48	6,449,240	-21.3%	2.7%
Defense	132	105,650,658	143	137,370,690	8.3%	30.0%
Education	22	16,272,547	27	26,079,505	22.7%	60.3%
Energy	51	30,227,148	68	45,526,680	33.3%	50.6%
Environmental Protection Agency	21	2,966,651	17	3,681,400	-19.0%	24.1%
Health and Human Services	734	994,540,543	750	1,066,918,680	2.2%	7.3%
Interior	1	15,465	2	155,550	100.0%	905.8%
Justice	6	2,344,616	7	2,637,941	16.7%	12.5%
Labor	3	48,961			-100.0%	-100.0%
National Aeronautics & Space Administration	145	76,567,392	132	58,039,292	-9.0%	-24.2%
National Science Foundation	506	244,091,973	522	417,892,972	3.2%	71.2%
State	2	484,490	1	300,000	-50.0%	-38.1%
Transportation	-	-	7	11,136,034	N/A	N/A
Treasury	5	3,572,015	-	-	-100.0%	-100.0%
Other Federal Government	14	4,268,569	17	4,079,905	21.4%	-4.4%
Total Federal Government	1,723	1,489,131,403	1,758	1,783,138,649	2.0%	19.7%
Foreign Governments	6	1,085,390	8	1,101,624	33.3%	1.5%
Foundations	237	86,116,747	240	99,166,835	1.3%	15.2%
Industry	626	76,430,842	598	107,913,845	-4.5%	41.2%
International Organizations	7	286,661	7	881,065	.0%	207.4%
Other Non-Profit Organizations	484	203,125,787	488	199,649,265	.8%	-1.7%
Public Charities	197	41,486,015	191	34,274,257	-3.0%	-17.4%
State and Local Governments	90	14,546,442	77	10,368,290	-14.4%	-28.7%
Trade/Professional Organizations	125	14,917,106	162	14,215,139	29.6%	-4.7%
Total Non-Federal Government	1,772	437,994,990	1,771	467,570,320	-.1%	6.8%
Grand Total	3,495	1,927,126,393	3,529	2,250,708,969	1.0%	16.8%

Table 5: Summary of Research Proposals by Unit

UNIT	7/1/99 - 6/30/00 Number	7/1/99 - 6/30/00 Amount	7/1/00 - 6/30/01 Number	7/1/00 - 6/30/01 Amount	Percent Change Number	Percent Change Amount
Architecture & Urban Planning	14	903,567	15	1,254,419	7.1%	38.8%
Art and Design	1	1,029,253	1	849,598	.0%	-17.5%
Business Administration	18	3,255,223	7	1,428,605	-61.1%	-56.1%
Dentistry	55	50,683,314	60	64,044,959	9.1%	26.4%
Education	53	37,185,667	63	55,703,710	18.9%	49.8%
Engineering	865	382,132,103	831	452,914,358	-3.9%	18.5%
Graduate School	5	2,089,416	5	3,714,753	.0%	77.8%
Information	18	19,122,689	40	73,245,242	122.2%	283.0%
Kinesiology	16	4,785,617	15	8,071,822	-6.3%	68.7%
Law	1	81,250	2	71,086	100.0%	-12.5%
Literature, Science & the Arts	475	179,157,063	480	198,168,614	1.1%	10.6%
Medical School	1,274	881,931,859	1,260	955,326,145	-1.1%	8.3%
Music	2	42,000	1	199,280	-50.0%	374.5%
Natural Resources and Environment	84	12,465,326	74	14,829,536	-11.9%	19.0%
Nursing	31	19,245,194	57	25,149,949	83.9%	30.7%
Pharmacy	40	19,229,406	51	16,659,484	27.5%	-13.4%
Public Health	125	101,263,012	122	112,749,076	-2.4%	11.3%
Public Policy	4	1,618,911	8	1,171,134	100.0%	-27.7%
Social Research, Institute for	140	91,608,229	166	125,393,680	18.6%	36.9%
Social Work	31	22,496,695	30	11,413,300	-3.2%	-49.3%
OTHER UNITS						
OVPR Units	127	59,522,342	110	59,677,181	-13.4%	.3%
Other Units	21	9,468,646	21	4,905,351	.0%	-48.2%
U-M Dearborn	59	8,118,004	67	30,977,574	13.6%	281.6%
U-M Flint	10	646,977	19	2,613,168	90.0%	303.9%
University Administration	26	19,044,630	24	30,176,945	-7.7%	58.5%
GRAND TOTAL	3,495	1,927,126,393	3,529	2,250,708,969	1.0%	16.8%

Table 6: Summary of Research Awards by Sponsor Group

SPONSOR	7/1/99-6/30/00 Number	7/1/99-6/30/00 Amount	7/1/00-6/30/01 Number	7/1/00-6/30/01 Amount	Percent Change Number	Percent Change Amount
Agriculture	9	968,661	14	746,296	55.6%	-23.0%
Commerce	44	2,210,112	56	21,568,976	27.3%	875.9%
Defense	52	24,092,051	70	36,485,460	34.6%	51.4%
Education	11	6,337,535	7	2,427,151	-36.4%	-61.7%
Energy	29	26,155,807	21	4,844,499	-27.6%	-81.5%
Environmental Protection Agency	18	3,000,444	11	674,192	-38.9%	-77.5%
Health and Human Services	291	404,927,420	300	325,602,657	3.1%	-19.6%
Interior	1	61,755	2	18,765	100.0%	-69.6%
Justice	3	2,089,559	3	1,659,816	.0%	-20.6%
Labor	1	23,989			-100.0%	-100.0%
National Aeronautics & Space Administration	71	16,492,752	67	9,330,607	-5.6%	-43.4%
National Science Foundation	192	57,142,415	192	43,860,416	.0%	-23.2%
State	-	-	-	-	N/A	N/A
Transportation	8	4,809,026	3	70,250	-62.5%	-98.5%
Treasury	-	-	-	-	N/A	N/A
Other Federal Government	13	2,757,868	6	2,839,426	-53.8%	3.0%
Total Federal Government	743	551,069,394	752	450,128,511	1.2%	-18.3%
Foreign Governments	1	549,460	0	0	-100.0%	-100.0%
Foundations	124	23,873,805	108	71,173,866	-12.9%	198.1%
Industry	487	48,906,959	395	45,121,226	-18.9%	-7.7%
International Organizations	3	96,619	2	16,897	-33.3%	-82.5%
Other Non-Profit Organizations	229	36,314,311	238	47,661,028	3.9%	31.2%
Public Charities	74	13,148,259	75	11,361,573	1.4%	-13.6%
State and Local Governments	50	7,038,364	76	8,959,181	52.0%	27.3%
Trade/Professional Organizations	71	6,262,605	54	6,405,763	-23.9%	2.3%
Total Non-Federal Government	1,039	136,190,382	948	190,699,534	-8.8%	40.0%
Grand Total	1,782	687,259,776	1,700	640,828,045	-4.6%	-6.8%

Table 7: Summary of Research Awards by Unit

UNIT	7/1/99 - 6/30/00 Number	7/1/99 - 6/30/00 Amount	7/1/00 - 6/30/01 Number	7/1/00 - 6/30/01 Amount	Percent Change Number	Percent Change Amount
Architecture & Urban Planning	6	150,484	5	186,060	-16.7%	23.6%
Art and Design	-	-	-	-	N/A	N/A
Business Administration	11	1,943,339	8	2,013,395	-27.3%	3.6%
Dentistry	25	14,175,424	19	8,492,654	-24.0%	-40.1%
Education	35	12,000,944	16	10,716,810	-54.3%	-10.7%
Engineering	461	97,034,239	458	114,158,768	-.7%	17.6%
Graduate School	3	2,515,086	3	3,002,485	.0%	19.4%
Information	10	1,994,500	17	3,941,978	70.0%	97.6%
Kinesiology	-	-	1	5,000	N/A	N/A
Law	-	-	1	50,902	N/A	N/A
Literature, Science & the Arts	206	61,157,797	226	44,873,690	9.7%	-26.6%
Medical School	618	251,900,480	543	297,273,364	-12.1%	18.0%
Music	2	13,000	-	-	-100.0%	-100.0%
Natural Resources and Environment	51	5,144,125	55	4,064,399	7.8%	-21.0%
Nursing	11	7,760,116	18	8,306,144	63.6%	7.0%
Pharmacy	14	2,436,256	17	5,433,258	21.4%	123.0%
Public Health	67	54,283,699	73	50,867,311	9.0%	-6.3%
Public Policy	3	274,008	6	726,132	100.0%	165.0%
Social Research, Institute for	66	134,415,883	91	51,590,346	37.9%	-61.6%
Social Work	17	3,857,742	14	4,860,750	-17.6%	26.0%
OTHER UNITS						
OVPR Units	103	24,882,664	73	14,587,423		
Other Units	17	5,869,663	12	2,367,057		
U-M Dearborn	32	1,540,997	23	1,391,851	-28.1%	-9.7%
U-M Flint	6	227,170	7	182,034	16.7%	-19.9%
University Administration	18	3,682,160	14	11,736,234	-22.2%	218.7%
GRAND TOTAL	1,782	687,259,776	1,700	640,828,045	-4.6%	-6.8%