

# MTU's National Research Rankings, FY2001

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## Introduction

The MTU mission, "We prepare students to create the future", and the MTU vision, "MTU will be a national university of choice", require a vigorous research and development enterprise. Our strategic targets of 15% of total enrollment to be graduate students and achievement of \$50 million in research expenditures by 2010 are directly dependent on our ability to grow our research and graduate programs. Our goal of increased scholarship activities by faculty, staff, and students is also dependent on our external research and development funding.

It is important to remember two things:

- Funding level is only an index of research and development activity, the outputs are really such things as graduate degrees, scholarly publications, patents, and commercialized technology; and
- Research and development activities are pursued by the faculty, staff, and students in every unit of the university.

Each institution has a different mix of disciplinary activities, and it is difficult to compare funding levels for research and development activities across broad disciplinary boundaries. Still, research and development expenditures commonly influence external perceptions and institutional reputation. It is important for the campus community to honestly understand how disciplines rank nationally compared other institutions of higher education. This is essential as we formulate strategies to achieve our mission of being a national university of choice.

This report has three objectives:

- To provide objective information on national research rankings to units to use when reviewing their strategic planning documents and to increase understanding of the requirements necessary to improve those rankings;

- To provide information that can be used to identify areas where MTU has opportunities to become a national research leader, and to provide information that can be used to prioritize the use of institutional research-related resources to improve our national reputation and such institutional activities as research-related legislative initiatives; and
- To provide a basis for internal evaluation of MTU's classification and reporting of research and development activities.

## Data

All universities that receive federal research and development funding participate in an annual survey of academic research and development expenditures conducted by the National Science Foundation (<http://www.nsf.gov/sbe/srs/nsf03316/sectb.htm>). The data are self-reported by the institutions; at MTU, Research Accounting prepares and submits the information annually. Information available includes expenditures associated with funding from five categories of funding sources: federal government, state and local government, industry, institutional funds, and other sources of funding (primarily non-profits, but also foreign and other sources). Comparisons are available by broad disciplines (e.g., engineering) and for some sub-disciplines (e.g., mechanical engineering) from the published tables. The compiled data from FY01 were made available by NSF in April, 2003. This report draws on FY01 data and earlier publications (National Science Foundation, 1995-2003). Reports and tables from previous years are available at the web site identified above. Institutional details for MTU and other universities for the most recently published year are available at <http://www.nsf.gov/sbe/srs/profiles/data/ip002292.htm#rd1>.

The data do not include sponsored program expenditures for instruction or public service. At MTU, all gifts were classified as 'instruction' prior to January, 2003; this has largely been appropriate in the past, but an increasing number of gifts appear to be designated for general departmental or programmatic research and development support, and this practice has been changed to reflect the growth of gift support for research. Also, funding for such programs as senior design are currently considered 'instruction'. While we should not re-classify expenditures to falsely inflate our numbers, we should appropriately classify our expenditures to match practices at our peer institutions.

Finally, the reported expenditures do not exactly correspond with the monthly sponsored programs departmental summaries posted by Research Accounting ([http://www.admin.mtu.edu/acct/dept/research/spons\\_prog.html](http://www.admin.mtu.edu/acct/dept/research/spons_prog.html)). The posted amounts correspond to summations of monthly Banner account statements; the NSF survey allows the inclusion of some institutional funds that are not included in the Banner summaries. As noted above, non-research and development expenditures are not included in the NSF surveys, but they are available on the posted monthly sponsored program expenditures.

## Overall MTU Rankings

The overall MTU expenditures and expenditures by disciplinary field included in the survey and associated rankings for FY1993-FY2001 are given in Appendix Table A.1. In FY01, total reported MTU research expenditures reached \$29.613 million, an increase of 8.9% over FY00. Even with this increase, MTU fell one place in our overall ranking among all universities, from 172<sup>nd</sup> to 173<sup>rd</sup>, and fell one place among public universities from 121<sup>st</sup> to 122<sup>nd</sup>.

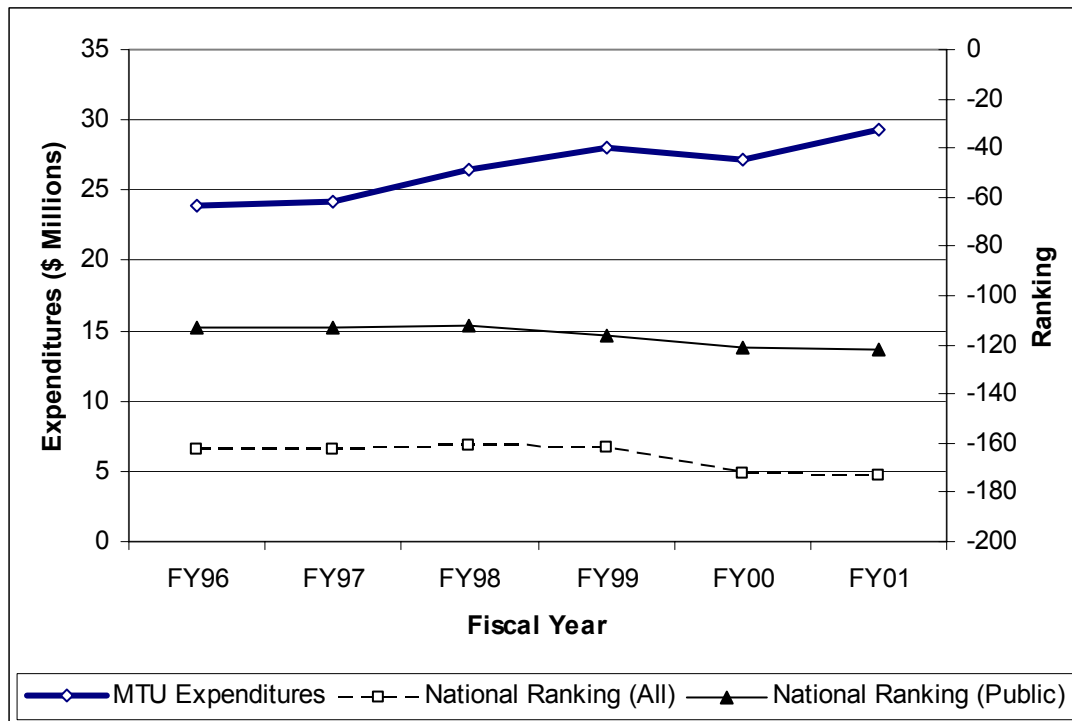


Figure 1. MTU's research expenditures and national research ranking among all institutions and among public institutions, FY96-FY01 (Source: NSF, 1998-2003). Ranks are shown as negative values in order to put the highest rankings at the top of the axis.

The decline in research expenditures in FY00 led to a drop of 10 places (from 162 to 172) in our overall national ranking. There was an additional slight decline in ranking to 173<sup>rd</sup> in FY01. Experiences of other universities indicate that it is difficult to rise in rankings relative to peer institutions, but it is relatively easy to decline. MTU's growth in research expenditures resumed in FY01, but did not reverse the decline in our national ranking following the FY00 decline.

It is difficult to identify a single reason for the decline in MTU research expenditures in FY00. The number of full-time equivalent tenured and tenure track faculty was 336.25 in FY99, 341.25 in FY00, and 339.75 in FY02; research expenditures per FTE moved in synch with research expenditures over these three years (Figure 2). It is interesting

to note that in FY02, information that has not yet been reported by NSF, there was an increase in research expenditures per tenured and tenure track faculty FTE to \$92,111/FTE while the number of tenured and tenure track faculty FTEs declined to 325.75 (a 9.6% decline in FTE from FY01; <http://www.admin.mtu.edu/ia/compendium/index.html>). From Figure 2, FY02 is the only year when there appears to be a possible change in the relationship between research expenditures and number of tenured and tenure track faculty FTEs. Whether or not this will continue in FY03 and beyond, and whether it will impact MTU's national research rankings remains to be seen. In any case, the decline in research expenditures in FY00 does not appear to be related to changes in number of tenured and tenure track faculty FTEs.

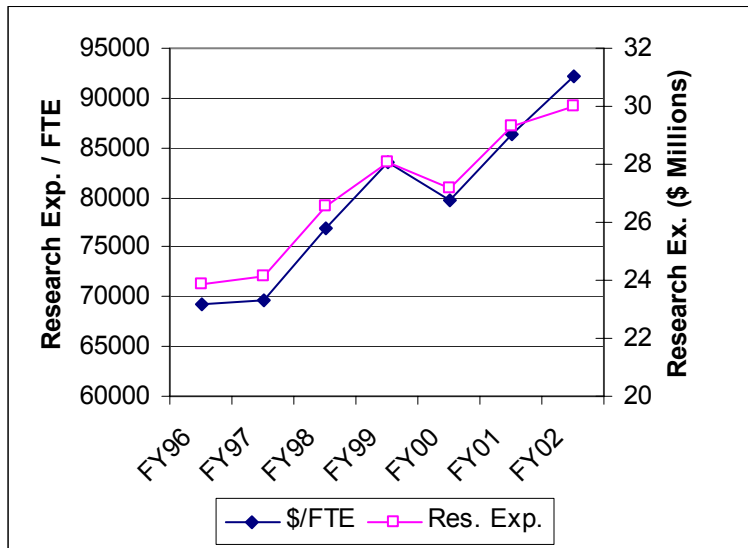


Figure 2. MTU total research expenditures and research expenditures per full time equivalent tenured and tenure track faculty, FY96-FY02.

There was a large reduction in the internal Research Excellence Fund at the same time that total reported research and development expenditures declined. The REF expenditures declined from \$ 715,351 in FY99 to \$ 200,000 in FY00 and \$ 146,779 in FY01. Internal research funding declined from 24.2% of MTU's total research expenditures in FY97 to 18.5% in FY00, contributing to the decline in total research funding in FY00. Research and development expenditures and national ranking would still have declined in FY00 if REF had held constant, so there is more to the story than simply internal REF allocation.

There were also factors beyond the availability of internal funding that contributed to the FY00 decline. There was a decline in proposal submission levels in the two years before FY00, and this can lead to a reduction in subsequent expenditures. This may simply be a residual effect of the transition to a semester calendar and the associated demands on faculty time. At Virginia Tech, for example, research expenditures were \$169,808,000 in FY97, \$167,118,000 in FY98, and \$169,250,000 in FY99 following a semester transition. Virginia Tech's national research ranking declined from 44<sup>th</sup> to 50<sup>th</sup>

in this period. Growth in research expenditures resumed in FY00, but Virginia Tech has still not recovered its national ranking. Michigan State has a similar experience, but at MSU the effect was not a reduction in expenditures, but a slowing of their growth (with a smaller drop in national ranking).

As noted earlier, MTU increased its research expenditures by 8.9% between FY00 and FY01, yet decreased one spot in the national rankings. Figure 2 shows the growth rate from FY00 to FY01 for all universities ranked from 151<sup>st</sup> to 200<sup>th</sup> nationally in FY01. To achieve a total of \$50 million in research and development expenditures by 2010, MTU must increase at an annual rate of 7.6% from a base of \$30 million in FY02. *Given the information in Figure 3, accomplishment of our strategic goal of \$50 million in research and development expenditures will not be sufficient to maintain our current national ranking.* In fact, an achievement of exactly \$50 million in research and development expenditures in FY10 will likely lead to a decrease in MTU’s national research ranking.

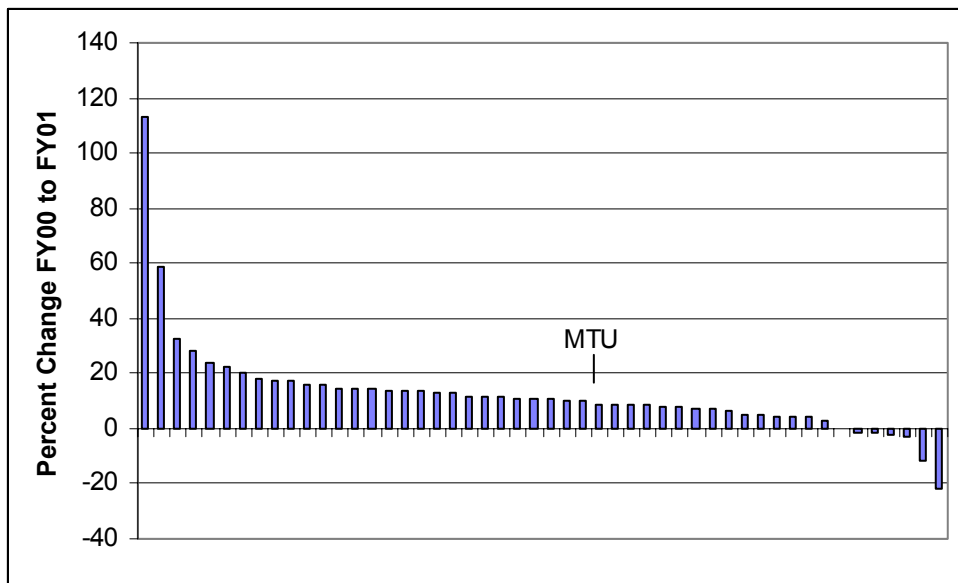


Figure 3. FY00 to FY01 percentage increases in research expenditures for all universities ranked from 151<sup>st</sup> through 200<sup>th</sup> in total research expenditures in FY01 ordered from largest percentage increase to largest percentage decrease; MTU’s increase was 8.9%.

Understanding the mix of our research sponsors is important to understanding the national trends that will impact our research portfolio. For instance, in FY02 about 60% of MTU’s research expenditures were from federal projects, while about 9% were from industry sponsored projects (Figure 4). In FY01, MTU’s \$4.176 million in industry sponsored research ranked 18<sup>th</sup> nationally among all universities and 10<sup>th</sup> among public universities in the proportion of research that is sponsored by industry. Industrial research support does diversify the research base, but this component is subject to greater variability due to economic conditions. For example, MTU’s industry sponsored research percentage declined 14% n FY01 to 9% in FY02, reflecting general economic conditions.

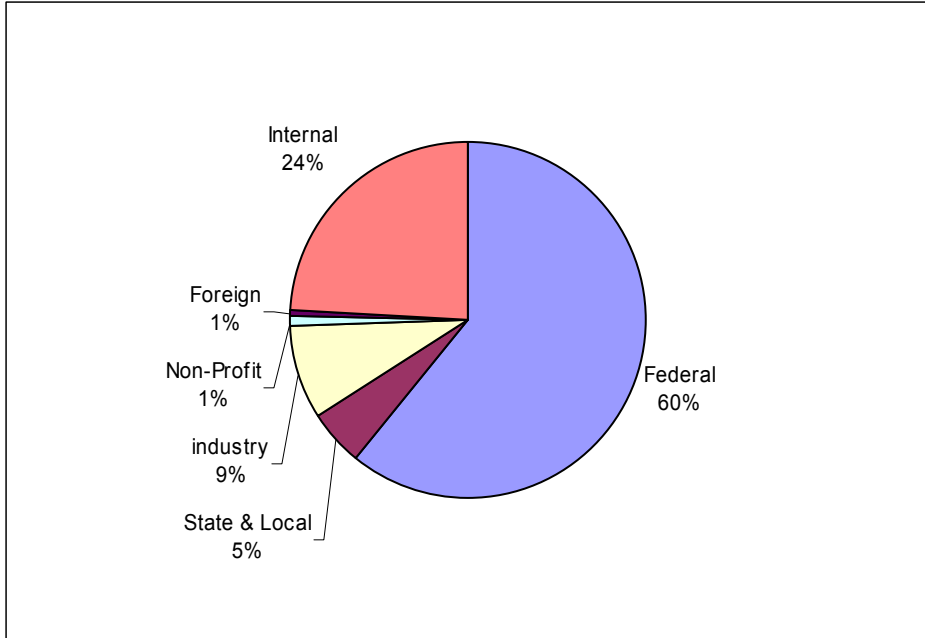


Figure 4. MTU FY02 research expenditures by sponsor category.

Similarly, the mix among our federal sponsors is important, and can serve to identify opportunities for growth. Figure 5 shows the distribution of federal research awards received during FY02. It is important to note that the National Institutes of Health, which sponsors one-half of all federally sponsored research and development, is not shown because the amount we receive from NIH is so small. This presents an immense opportunity for MTU. In mechanical engineering, for example, the President’s FY04 budget request to congress requests \$1.822 billion for mechanical engineering research within NIH; this is 5.75 times the amount requested for mechanical engineering research at NSF<sup>1</sup>. There is substantial opportunity for expanding our funding base for ongoing research programs across campus in the NIH domain.

Analyses of research expenditures by discipline and subfield are discussed below. These discussions are organized by MTU academic unit. It is important to remember that the NSF survey is completed without regard to the departmental structure of the institution. In other words, “engineering” research may include engineering research that is conducted outside the College of Engineering. At MTU for example, KRC’s research expenditures are included as ‘mechanical engineering’ and IMP is included as ‘metallurgical and materials engineering’.

<sup>1</sup> Reischman, M. 2003, Mechanical Engineering in the FY 2004 Budget. In: Research and Development FY 2004. American Association for the Advancement of Science, AAAAS Report XXVII.

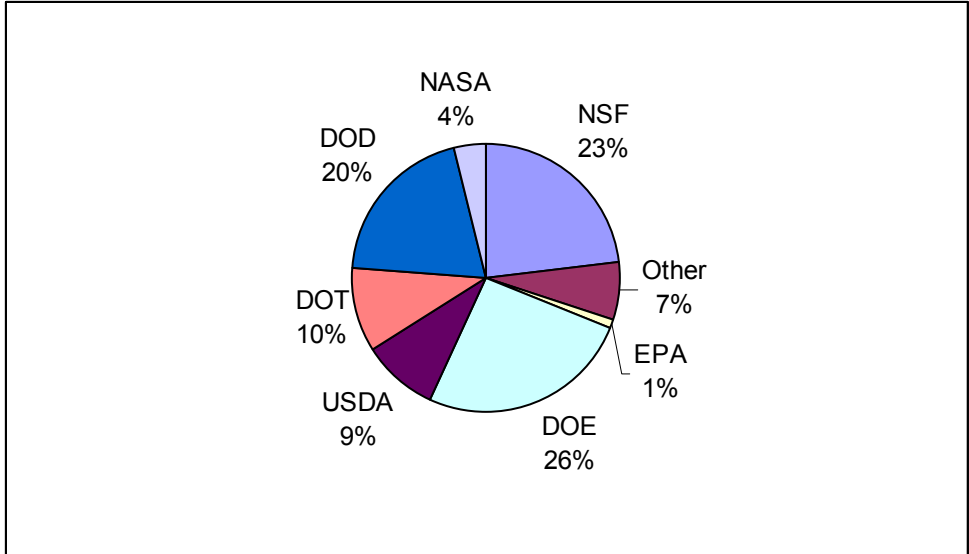


Figure 5. MTU research awards by federal agency for FY02.

**College of Engineering**

MTU Engineering research and development expenditures for FY01 were \$19.688 million, 67<sup>th</sup> among all universities nationally. MTU’s federal engineering research expenditures were \$11.300 million, substantially ahead of Michigan State’s \$ 6.970 million.

In the State of Michigan, MTU ranks third in total engineering research and development expenditures behind UM and Michigan State in FY01, and second in federally sponsored engineering research behind UM. Figure 6 illustrates the recent historic comparisons between MTU and Michigan State in total engineering research and development expenditures.

Michigan Tech had been slowly, but steadily, increasing in national ranking until FY01, when the national ranking dropped 5 places in spite of an increase in expenditures of over 7% from FY00. In FY00 MTU had surpassed Michigan State in national ranking, but this reversed again in FY01 (even though MTU retains the lead in federally-sponsored engineering research by a considerable margin). Unfortunately, MTU’s increase in ranking relative to Michigan State has been due more to MSU’s failing to keep pace nationally than to MTU’s increase relative to other universities. This reversal of positions in FY01 affirms this conclusion.

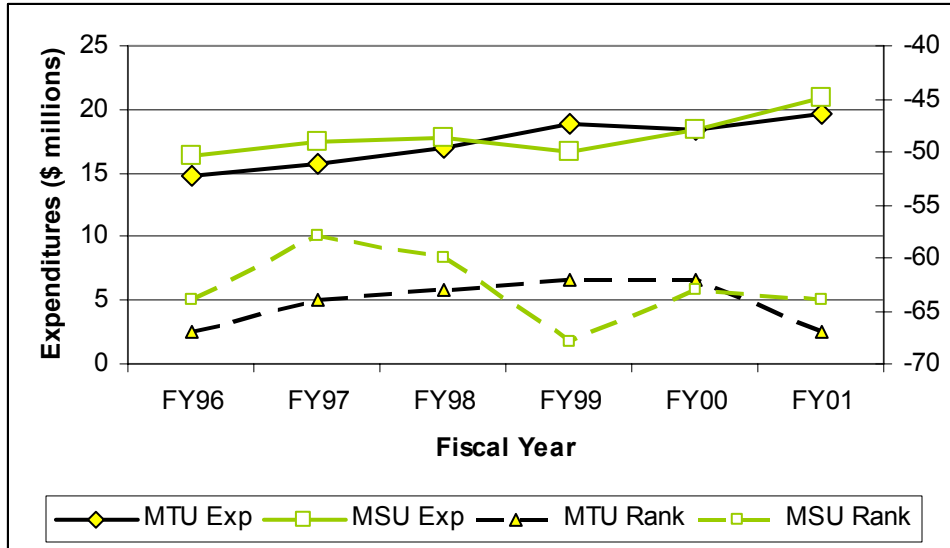


Figure 6. Engineering research expenditures and national ranking for MTU and Michigan State, FY96-FY01.

### Engineering subfields

The annual NSF survey provides national ranking by engineering subfield. Areas where MTU reports research and development activities include bioengineering/biomedical, chemical engineering, civil engineering, electrical engineering, mechanical engineering, and metallurgical and materials. Research centers are reported in appropriate subfields (KRC in mechanical and IMP in metallurgical/materials).

Numerical rankings and annual reported expenditures are given by subfield in Appendix Table A.1 and the national rankings are shown graphically in Figure 7. There are at least three engineering subfields where MTU has the potential to achieve a top 20 national ranking within 3-5 years: civil engineering, mechanical engineering, and metallurgical and materials engineering. In FY01, the 25<sup>th</sup>-ranked university in civil engineering had \$8,034,000 in annual research expenditures compared to MTU's \$5,664,000, the 25<sup>th</sup> mechanical engineering university had \$5,775,000 in research expenditures compared to MTU's \$5,269,000, and the 25<sup>th</sup> ranked metallurgical/materials program had \$5,239,000 in research expenditures compared to MTU's \$3,611,000; all of these are clearly reachable for MTU. There are two subfields where our national ranking has declined in recent years: Chemical engineering (from 29<sup>th</sup> in FY98 to 67<sup>th</sup> in FY01) and bioengineering/biomedical (from 36<sup>th</sup> in FY99 to 50<sup>th</sup> in FY01). Bioengineering/biomedical was not even reported separately in the NSF survey until FY98, and the acquisition of even one average NIH grant could dramatically impact MTU's national ranking. Chemical engineering would need to triple current research expenditures to reach the top 25 while electrical engineering expenditures would have to increase by a factor of 10 to do the same.

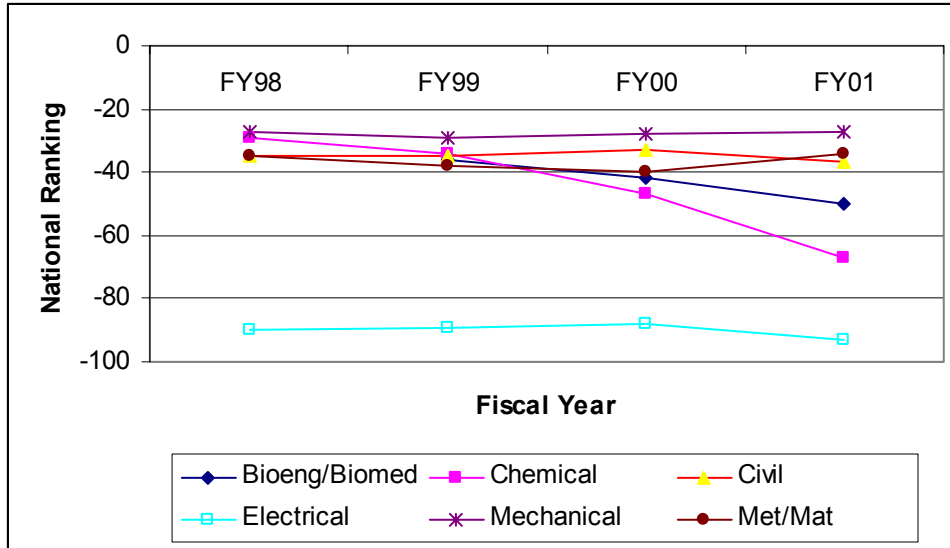


Figure 7. National ranking by engineering subfield, FY96-FY01.

### College of Science and Arts

In disciplinary subfields, NSF identifies the top 100 programs nationally in terms of research and development expenditures. In FY01, MTU did not rank in the top 100 universities for any of the disciplines in the College of Science and Arts (Table 1). There are three programs, though, that have the potential of becoming nationally ranked in the next few years: Computer Science, Mathematical Sciences, and Physics. Each of these programs could become nationally ranked with an approximate doubling of research expenditures relative to peer institutions, a goal that could reasonably be achieved through strategic allocation of resources in a relatively short time period (3-5 years). Social Science and Chemistry would require more significant increases to achieve a national ranking; this could be achieved over a longer time period (such as 'by 2010'), but is probably less realistic over a shorter (3-5 year) timespan. Biological Sciences would require an increase to a level of 15 times the current level, or approximately 2/3 of the expenditures of the entire MTU College of Engineering, to achieve national ranking.

Table 1. Research expenditures (\$ millions) by discipline in the College of Science and Arts in FY01 and comparisons with nationally ranked institutions.

Discipline	Estimated MTU Expenditures, FY01	Nationally Ranked Programs		
		100 <sup>th</sup>	50 <sup>th</sup>	25 <sup>th</sup>
Biological Sciences	0.952	13.990	41.922	65.554
Chemistry	0.358	3.044	6.977	11.143
Computer Science	0.731	1.694	4.198	8.273
Mathematical Science	0.320	0.674	1.878	4.204
Physics	1.554	2.702	6.732	12.745
Social Science	0.353	3.556	8.539	14.072

## **School of Forest Resources and Environmental Science**

Research and development expenditures in the School of Forest Resources and Environmental Science are currently reported as Agricultural Science. As such, SFRES is in direct competition with the land grant colleges and universities, and it is extremely unlikely that MTU's SFRES will ever rank even in the top 50 in this category due to the formula funding dedicated to land grant institutions. Duke University faced the same situation. Duke administratively joined the School of Forestry and Environmental Science with the Duke University Marine Laboratory in 1991, and in 1997 added the Department of Geology to create the Nicholas School of Environment and Earth Science. In FY97, Duke ceased reporting any Agricultural Science expenditures and reclassified all expenditures in this School as Environmental Science, with the old Agricultural Science expenditures reclassified as Environmental Sciences, Other. This immediately more than doubled Duke's Environmental Science research expenditures and advanced them significantly in those rankings. MTU has the same opportunity; reclassifying SFRES research and development expenditures as Environmental Science, Other would triple our Environmental Science expenditures and move us into the national rankings. Since much of the research and development in the Department of Biological Science is related to environmental issues, those expenditures could also plausibly be classified as Environmental Science, as could much of the research in Social Sciences, which would further increase our institutional ranking. These reporting changes could have significant impact on the way MTU represents itself to the public, potential students, legislative leaders, and other constituencies.

In FY01, MTU ranked 68<sup>th</sup> nationally in agricultural research expenditures with \$3,800,000. This was a \$724,000 (12.4%) increase, which led to an improvement from 72<sup>nd</sup> in the national rankings. In FY02, research expenditures increased to \$5,809,300, an increase of 53% which would have ranked 57<sup>th</sup> in agricultural sciences in FY01.

### **Summary**

MTU reversed a decline in research expenditures in FY00 and showed an increase of 8.9% in FY01, to a reported research expenditure level of \$29,613,000. This resulted in a national ranking among all universities of 173<sup>rd</sup> in FY01, a drop of one position from FY00. An 8.9% annual rate of increase is insufficient to maintain our place in the national rankings, even though it will result in expenditures exceeding \$58,000,000 by 2010 if it continues.

Within a 3-5 year timeframe, MTU is currently positioned to move into the top 20 nationally in three disciplines: Civil Engineering, Mechanical Engineering, and Metallurgical/Materials Engineering. Within a 3-5 year timeframe, MTU is positioned to move into the national rankings in three disciplines: Computer Science, Mathematics, and Physics. We face challenges in all six of these disciplines that must be overcome in order to advance our national recognition, and these challenges differ by discipline.

Environmental Science is an area where MTU could legitimately change its method of classifying and reporting research activity in order to advance our national visibility. This would greatly impact the way MTU presents itself to the public, potential students, research sponsors, the legislature, and other constituencies. NSF, for example, has highlighted environmental science as a major area of expansion in the next few years, and many private foundations target environmental issues as an area of spending.

MTU has also been examining other reporting issues. Procedures for accurately tracking and reporting expenditures derived from research-related gifts were implemented in early 2003. Classification of external funding related to Enterprise programs as research and development is also being implemented. Other methods of more accurately tracking and reporting internal research expenditures are also being examined and should be implemented in the coming year.

Accurate and unbiased understanding of our current national research standing, realistic expectations of what it will take to advance at the national level in comparison to our peer institutions, and identification of disciplines that are most likely to be successful in achieving national prominence are critical to the successful achievement of our mission and vision. It is clear that we cannot achieve national leadership in all fields and that investing equally in all fields will not advance us toward our strategic goals. At the same time, there are a handful of disciplines and sub-disciplines where MTU must have a significant presence if the term ‘technological university’ is to have any meaning. Some current areas need to be strengthened. At the same time, it is also clear that there are some fields where we can achieve national leadership, and several more where we can become nationally recognized. This does not mean that other disciplines should be ignored. They should, rather, be evaluated and strategies developed to promote their growth over a longer time horizon

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**Appendix**

Table A.1. Expenditures (\$ Millions) and national ranking by NSF disciplinary classification (Source: National Science Foundation, 1995-2003)

Unit	FY93	FY94	FY95	FY96	FY97	FY98	FY99	FY00	FY01
MTU*	18.696	21.786	22.798	23.882	24.140	26.522	28.074	27.204	29.613
Ranking (All Institutions)		(160)	(162)	(163)	(163)	(161)	(162)	(172)	(173)
Ranking (Public Institutions)		(114)	(114)	(113)	(113)	(112)	(116)	(121)	(122)
Engineering**	11.940	14.714	14.752	14.801	15.714	16.959	18.896	18.387	19.688
		(59)	(66)	(67)	(64)	(63)	(62)	(62)	(67)
Bioengineering/Biomedical	-	-	-	-	-	0	0.390	0.483	0.217
							(36)	(42)	(50)
Chemical	-	2.085	2.239	2.596	0.726	3.365	3.157	2.561	1.622
						(29)	(34)	(47)	(67)
Civil	-	3.292	3.709	3.735	3.118	4.308	5.201	5.440	5.664
						(35)	(35)	(33)	(37)
Electrical	-	0.503	0.257	0.548	0.737	1.155	1.426	1.297	1.152
						(90)	(89)	(88)	(93)
Mechanical	-	3.915	3.828	3.965	1.969	4.588	4.829	4.874	5.269
						(27)	(29)	(28)	(27)
Metallurgical and Materials	-	2.621	2.753	2.604	1.443	2.719	2.724	2.439	3.611
						(35)	(38)	(40)	(34)
Agriculture***	2.215	1.887	2.057	2.143	2.901	3.146	3.479	3.076	3.800
		(76)	(75)	(73)	(68)	(67)	(68)	(72)	(68)

\* Numbers in parentheses are national ranking (given when available).

\*\* Numbers for Engineering include activities in some research institutes (e.g., KRC and IMP), data for Bioengineering/Biomedical were not included in the survey until FY98.

\*\*\* Numbers for Agriculture are from the School of Forest Resources and Environmental Science.