Chapter 9  Research & Technology Transfer

Goals
Excellence in research and scholarly activity is a central tenet of the University of Michigan’s mission. The broad scope and overall size of the U-M’s research program, along with its emphasis on interdisciplinary approaches, contributes to Michigan’s standing as one of the world’s leading research universities. As such, the faculty attracts generous financial support from the public and private sectors.

The University envisions that the faculty will make contributions to society not only through research and scholarship reported in the ordinary academic channels, but also through the application of discoveries as innovative products and processes. The U-M places a high priority on supporting this activity through the Office of Technology Transfer and the Business Engagement Center.

Overview
Most of this chapter examines readily available data about sponsored projects. Total research expenditures by the University exceed $1 billion per year. However it is important to note that more than 75 percent of the money that the University spends on research in any given year is funding provided by outside sources. The biggest share of that research funding comes from the federal government. When research funding from all sources is counted, U-M ranks No. 2 in the nation among all universities and No. 1 among public universities.

The University’s largest fraction of grant-supported work occurs in the biomedical and clinical sciences. The U-M Medical School alone regularly attracts several hundred millions of dollars each year to support research by its faculty. In 2012, the Medical School’s $310.5 million in new grant funding was eighth highest of all U.S. medical schools.

Some research outcomes are of interest to the private sector. The Office of Technology Transfer works with faculty inventors to file patents and negotiate licensing agreements that benefit our industry partners and fund additional research and development work on campus. Regularly, U-M faculty members establish companies to develop their inventions, thanks in part to an emerging campus culture of innovation and entrepreneurship.

U-M wishes to promote partnerships that involve academia, government and industry. Toward this goal, the University has and will continue to fund interdisciplinary teams that address issues with broad societal impact.

At the same time, the U-M, as well as all of higher education, faces serious challenges to maintaining the quality and productivity of research and scholarly activity. Budget pressures from flat or declining federal funding of research will make it more difficult than ever to maintain the quality of the faculty and the facilities needed to conduct world-class research.

For More Information
Office of the Vice President for Research
www.research.umich.edu
Office of Technology Transfer
www.techtransfer.umich.edu

Charts in Chapter 9
9.1.2  Research Expenditures by Major Funding Source, Adjusted for Inflation, FY2002-12.
9.1.3  Direct Research Expenditures by Discipline, Adjusted for Inflation, FY2002-12.
9.1.4  Sponsored Research Expenditures by Type, FY2012.
9.1.5  Sponsored Research Indirect Cost Recovery by Source, Adjusted for Inflation, FY2002-12.
9.2  Research Workforce by Full-time Equivalents, Fall 2012.
9.4.2  Revenues from U-M Licensing Agreements, FY2002-12.
9.4.3  Formation of Start-up Companies that Utilize U-M Technology, FY2002-12.
9.5  Technology Transfer Indicators for the U-M and Research-Intensive Universities, FY2010.
During the last three decades, total research expenditures from all sources (including U-M funds) have quadrupled, even after adjusting for inflation.\(^1\)

### 9.1.1 Total Research Expenditures, Adjusted for Inflation\(^1\), 1980-2012.

The trend in University of Michigan research expenditures (adjusted for inflation, black line) largely mirrors the total federal non-defense R&D spending (red line) through FY2006. The increase in FY2007 – indicated as (A) – is an artifact of a change how U-M calculates research spending.\(^2\) The further increase at (B) is due to a surge of grant support provided under the American Recovery and Reinvestment Act of 2009 (ARRA).

Likewise, the lack of growth between FY2011 and FY2012 in both total federal non-defense R&D and U-M research expenditures largely reflects the depletion of ARRA funds combined with overall decline in growth of federal funding of research.

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\(^1\) Based on 2012 U.S. Consumer Price Index.

\(^2\) Starting in FY2007, research support originating from the U-M faculty medical group practice was included as research expenditures. Previously this was reported with clinical activity.
Federal grants and contracts fund three-fifths of U-M research expenditures.

9.1.2 Research Expenditures by Major Funding Source, Adjusted for Inflation\(^3\), FY2002-12.

![Research Expenditures by Major Funding Source, Adjusted for Inflation](image)


The dotted line indicates when the U-M began to include research support from the medical group practice revenues as part of Non-sponsored research expenditures (see “A” in chart 9.1.1).

\(^3\) Based on 2012 U.S. Consumer Price Index.
The small increase in direct research expenditures between FY2011 and FY2012 reflects the depletion of federal “stimulus” funding for research.

9.1.3 Direct Research Expenditures by Discipline, Adjusted for Inflation⁴, FY2002-12.

Direct expenditures cover salaries and benefits of researchers, whether faculty, staff or students, as well as equipment and supplies, research-related travel and other expenses tied to specific projects. Chart 9.1.5 displays overhead spending – known as “indirect” costs – that supports the entire research enterprise.

⁴ Based on 2012 U.S. Consumer Price Index.
Nearly half of the total annual sponsored research expenditures on the Ann Arbor campus cover salaries and benefits for faculty, staff and graduate students.

**9.1.4 Sponsored Research Expenditures by Type, FY2012.**

**FY2012 Total: $889,461,827**

- **Indirect Costs** $239M (27%)
- **Salaries** $327M (37%)
- **Equipment** $13M (1%)
- **Subcontracts** $84M (9%)
- **Supplies & Services** $131M (15%)
- **Benefits** $75M (8%)
- **Financial Aid** $21M (2%)


The FY2012 total externally sponsored research expenditures for the Ann Arbor campus was $889,461,827. As the chart indicates, the conduct of research and scholarship is labor-intensive with a large fraction of expenditures attributable to salaries and benefits.

Indirect costs (IDC) are the costs of University operations that are not readily assignable to a particular project. Indirect costs can be thought of as overhead, and include costs for general research administration, utilities use in research space, and other services that contribute broadly to the operation of the University’s research enterprise.

While the effective indirect cost rate for FY2012 was 23 percent as shown in the chart, the actual rate indirect cost recovery varies by project according to the type of research activity and the sponsor. The indirect cost rate for research funded by the Federal government or industry is 55.5 percent for on-campus research and 26 percent for off-campus research. Clinical trials conducted on campus supported by the Federal government or industry have a distinct indirect cost rate of 30 percent.

The indirect cost rates charged to foundations and public charities vary from zero to 20 percent, according to the published policies of such non-profit sponsors. Research sponsored by State of Michigan agencies also varies depending on the specifics of the funded project.
Federal sponsored projects provide more than 90 percent of indirect cost recovery funds.

9.1.5 Sponsored Research Indirect Cost Recovery by Source, Adjusted for Inflation⁵, FY2002-12.

The decline in indirect cost recovery from FY2011 to FY2012 is largely due to the end of federal “stimulus” funds that had supported research.

⁵ Based on 2012 U.S. Consumer Price Index.
A fall 2012 snapshot of personnel paid under sponsored projects shows that grants and contracts fund the full-time equivalent of 4,319 faculty members, post-docs, staff and students.

9.2 Research Workforce by Full-time Equivalents (FTEs), Fall 2012.


Many tenured and tenure-track faculty members play key roles in sponsored research activity. Research faculty members, post-doctoral fellows, graduate (and some undergraduate) students and a subset of the staff also contribute in major ways to the research enterprise.

The Fall 2012 total represents a drop of 124 FTEs supported on sponsored projects compared to Fall 2011.
U-M led the nation’s public universities in total research spending for six of the last 10 years.

9.3 University R&D Expenditures, U-M and Other Leading Institutions, FY2002-11.

<table>
<thead>
<tr>
<th>Institution</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Johns Hopkins U</strong></td>
<td>$1,140M</td>
<td>$1,244M</td>
<td>$1,375M</td>
<td>$1,444M</td>
<td>$1,500M</td>
<td>$1,554M</td>
<td>$1,681M</td>
<td>$1,856M</td>
<td>$2,004M</td>
<td>$2,145M</td>
</tr>
<tr>
<td>U MICHIGAN</td>
<td>$674M</td>
<td>$780M</td>
<td>$769M</td>
<td>$809M</td>
<td>$800M</td>
<td>$809M</td>
<td>$876M</td>
<td>$1,007M</td>
<td>$1,184M</td>
<td>$1,279M</td>
</tr>
<tr>
<td>U Washington</td>
<td>$627M</td>
<td>$685M</td>
<td>$714M</td>
<td>$708M</td>
<td>$778M</td>
<td>$757M</td>
<td>$765M</td>
<td>$778M</td>
<td>$1,023M</td>
<td>$1,149M</td>
</tr>
<tr>
<td>U Wisconsin</td>
<td>$662M</td>
<td>$717M</td>
<td>$764M</td>
<td>$798M</td>
<td>$834M</td>
<td>$841M</td>
<td>$882M</td>
<td>$952M</td>
<td>$1,029M</td>
<td>$1,112M</td>
</tr>
<tr>
<td>Duke U</td>
<td>$442M</td>
<td>$520M</td>
<td>$521M</td>
<td>$631M</td>
<td>$657M</td>
<td>$782M</td>
<td>$767M</td>
<td>$805M</td>
<td>$983M</td>
<td>$1,022M</td>
</tr>
<tr>
<td>UC San Diego</td>
<td>$585M</td>
<td>$647M</td>
<td>$709M</td>
<td>$721M</td>
<td>$755M</td>
<td>$799M</td>
<td>$842M</td>
<td>$879M</td>
<td>$943M</td>
<td>$1,009M</td>
</tr>
<tr>
<td>UC San Francisco</td>
<td>$597M</td>
<td>$671M</td>
<td>$728M</td>
<td>$754M</td>
<td>$796M</td>
<td>$843M</td>
<td>$885M</td>
<td>$948M</td>
<td>$936M</td>
<td>$995M</td>
</tr>
<tr>
<td>UCLA</td>
<td>$788M</td>
<td>$849M</td>
<td>$773M</td>
<td>$786M</td>
<td>$811M</td>
<td>$823M</td>
<td>$871M</td>
<td>$890M</td>
<td>$937M</td>
<td>$982M</td>
</tr>
<tr>
<td>Stanford U</td>
<td>$538M</td>
<td>$603M</td>
<td>$671M</td>
<td>$715M</td>
<td>$679M</td>
<td>$688M</td>
<td>$704M</td>
<td>$840M</td>
<td>$908M</td>
<td></td>
</tr>
<tr>
<td>U Pittsburgh</td>
<td>$400M</td>
<td>$410M</td>
<td>$462M</td>
<td>$522M</td>
<td>$530M</td>
<td>$559M</td>
<td>$596M</td>
<td>$623M</td>
<td>$822M</td>
<td>$899M</td>
</tr>
</tbody>
</table>

Source: National Science Foundation, Higher Education Research and Development Survey.

The U-M has been the nation’s leading public university in total research spending for the years enclosed in boxes in the table. The University of Wisconsin is the only other institution to lead all U.S. public universities in research expenditures over the last decade.

The list above is ordered by total research expenditures for FY2010. Private universities are in italics.

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6 Starting in FY2010, the NSF ranked institutions by geographically separate campuses, each headed by a campus-level president or chancellor. Prior to that, some institutions were ranked by the aggregate R&D expenditures for all campuses in a multi-campus university or state system. For the U-M, data for FY2001-2010 includes the Ann Arbor, Dearborn and Flint campuses.

7 Johns Hopkins University expenditures include those by the Applied Physics Laboratory. In FY2011, APL R&D expenditures totaled $1.161M, 54% of JHU’s total for the year.
Since 2001, U-M faculty, staff and students have reported more than 3,000 inventions, leading to some 900 agreements, 1,400 U.S. patent applications, and 900 U.S. patents.


Invention reports are descriptions of discoveries made by U-M faculty, staff and students with the potential to be further developed into new products or processes. Patent applications are filed for intellectual property that shows some promise for future development and application. License and option agreements are legal arrangements with companies (some of which have U-M faculty involvement) that allow the firms to use University-owned technology in products or processes being developed for the market.
Over the last decade, U-M discoveries have generated $183 million in revenues. The inventors and University share these revenues, with the U-M’s portion devoted to ongoing research and development.

9.4.2 Revenues from U-M Licensing Agreements, FY2002-12.

SOURCE: U-M Office of Technology Transfer.

Revenues from licensing agreements support technology transfer operations as well as provide valuable resources for investment in research, education, and innovation.

Royalty revenues reached an all-time high in FY2010, largely due to one-time revenues earned under the University’s FluMist® agreement.

Royalties are periodic payments by a licensee to the University of Michigan in order to have continued access to U-M-owned intellectual property. Equity and Paid-up Royalties are transfers of stock or cash payments by a licensee to the U-M.
Since 2002, 103 new companies employing U-M discoveries were launched.

9.4.3 Formation of Start-up Companies that Utilize U-M Technology, FY2002-12.

While much of the new technology developed at the University is licensed to existing companies for use in new products and processes, some inventions become the basis of new enterprises. Often this occurs when the U-M inventors wish to have hands-on involvement in the further development of the technology.

Several U-M start-ups have reached a level of success such that larger firms have acquired them. For example, two medical device start-ups – HandyLab and Accuri Cytometers – were acquired by Becton Dickinson in 2009 and 2011, respectively. Arbor Networks, which provides internet protection tools, was purchased in 2010 by Tektronix Communications, and Health Media, developer of health support programs, was acquired in 2008 by Johnson & Johnson. And in October 2012, Compendia Bioscience, which has developed an oncology database that drug companies utilize in drug discovery work, was acquired by Life Technologies Corp.

In 2011, the U-M opened the Venture Accelerator at the North Campus Research Complex. The Venture Accelerator provides laboratory and office space, as well as business services, to startup companies emerging from the pipeline of new ventures at U-M Tech Transfer.

A list of U-M start-ups is found on the Office of Technology Transfer web site: (www.techtransfer.umich.edu/about/startups.php).
By several indicators of technology transfer activity, the U-M ranks highly compared to the ten U.S. universities that spend the most on research.

9.5 Technology Transfer Indicators for the U-M and Research-Intensive Universities, FY2010.

<table>
<thead>
<tr>
<th>Institution (FY2010 R&amp;D Expenditures)</th>
<th>Invention Reports</th>
<th>Issued Patents</th>
<th>New Agreements</th>
<th>Startups</th>
<th>License/Equity Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johns Hopkins U ($2,004M)</td>
<td>355</td>
<td>53</td>
<td>104</td>
<td>11</td>
<td>$12.4M</td>
</tr>
<tr>
<td>U Michigan ($1,184M) 2nd</td>
<td>290 (10th)</td>
<td>82 (6th)</td>
<td>97 (4th)</td>
<td>10 (5th)</td>
<td>$39.8M (6th)</td>
</tr>
<tr>
<td>U Wisconsin ($1,029M)</td>
<td>356</td>
<td>133</td>
<td>62</td>
<td>5</td>
<td>$54.3M</td>
</tr>
<tr>
<td>U Washington ($1,023M)</td>
<td>354</td>
<td>69</td>
<td>196</td>
<td>7</td>
<td>$69.0M</td>
</tr>
<tr>
<td>Duke U ($983M)</td>
<td>214</td>
<td>43</td>
<td>99</td>
<td>5</td>
<td>$25.7M</td>
</tr>
<tr>
<td>UC San Diego ($943M)</td>
<td>367</td>
<td>73</td>
<td>36</td>
<td>13</td>
<td>$21.0M</td>
</tr>
<tr>
<td>UCLA ($937M)</td>
<td>379</td>
<td>94</td>
<td>52</td>
<td>27</td>
<td>$27.5M</td>
</tr>
<tr>
<td>Stanford U ($840M)</td>
<td>467</td>
<td>180</td>
<td>90</td>
<td>10</td>
<td>$65.5M</td>
</tr>
<tr>
<td>U Pennsylvania ($836M)</td>
<td>373</td>
<td>64</td>
<td>68</td>
<td>4</td>
<td>$11.3M</td>
</tr>
<tr>
<td>U Minnesota ($786M)</td>
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<td>46</td>
<td>73</td>
<td>8</td>
<td>$83.9M</td>
</tr>
<tr>
<td>MIT ($677M)</td>
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<tr>
<td>U Illinois ($515M)</td>
<td>327</td>
<td>94</td>
<td>61</td>
<td>8</td>
<td>$13.5M</td>
</tr>
</tbody>
</table>

SOURCE: Association of University Technology Managers, National Science Foundation.

The highest technology transfer indicator value in each category is highlighted in green. The University of Michigan rank for every indicator is listed next to each indicator’s number value. These universities are ordered according to the size of their research enterprise, as measured by total FY2010 R&D expenditures reported to the National Science Foundation.