

IGNITE 2022

AN ASSESSMENT OF RESEARCH
AT THE UNIVERSITY OF TOLEDO



THE UNIVERSITY OF
TOLEDO
1872

Acknowledgement

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Frank J. Cefarelli

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THE UNIVERSITY OF
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Dear Members of the UT Community:

We are pleased to present IGNITE as a supplementary document to The University of Toledo's (UT) 5-year strategic plan entitled PATH TO EXCELLENCE. IGNITE is an honest, data-driven appraisal of where UT currently stands regarding research, and offers ideas on elevating the University to one of the top research universities in the state.

This report stresses the role UT leadership must take in placing research as a top institutional priority. I am pleased to endorse this view and the need to prioritize investments in research. The message must be clear that research and scholarship are central to who we are as a university.

Early indicators are validating the potential of our research enterprise. The number of invention disclosures, licenses and start-ups formed per \$10M of research expenditures are beginning to position the university well among Ohio research-oriented institutions; and the number of new competitive awards and new award dollars are external validations of the hard work and dedication of our researchers. While these early indicators/yields are encouraging, the real work is just beginning and we need your support, commitment and collaboration to see this plan through to fruition.

Thank you... and Go Rockets!

Sharon L. Gaber, PhD
President



RESEARCH & SPONSORED PROGRAMS

THE UNIVERSITY OF TOLEDO

As a research university, The University of Toledo is committed to advancing and supporting faculty research and scholarship. Enhancing these areas enables faculty members to make important contributions to the advancement of knowledge—advancements that contribute to the well-being and prosperity of society, and Ohio in particular. Given the breadth of academic disciplines supported by the university, from the arts and humanities to engineering and medicine, UT understands that scholarship, creative activity, and organized research encompasses a broad range of activities on and off campus. The Office of Research and Sponsored Programs advocates in support of scholarship, creative activity, and research to all faculty, in full understanding that the needs to achieve success vary across disciplines.

One measure of a research university's standing is its volume of externally funded projects. Externally funded research brings revenue into the university that supports not only faculty, but also students (at all levels), post-doctoral fellows, and other technical support staff. Externally funded projects help UT purchase advanced instruments that provide faculty with tools to understand complex research questions and provide students with training unique to a research university. Faculty engaged in innovative research and scholarship gain a national reputation for their work, which attracts high quality students to Toledo who wish to work on topics of mutual interest. However, summarizing UT's externally funded research does not capture all of the good work underway at a university. High impact publications, well-reviewed manuscripts, performances of high acclaim, breakthrough medical treatments, valuable patents, and impactful community projects also attest to the contributions of the institution.

This report provides a snapshot of the current status of UT research and scholarship, and provides a framework for enhancing our position as a research university by providing support to faculty, investments in technology, and plans to target areas for additional investment. UT has tremendous talent across a wide footprint of disciplines, and unique research support assets that can be enhanced to provide a strong foundation to build an institution that stands as one of the great research universities of the Midwest.

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III. Executive Summary

Ignite 2022 calls for Inspiration, Initiation, and Implementation of research, scholarship, and creative activities by faculty, staff, and students. This document is a companion to the UT Strategic Plan, PATH TO EXCELLENCE, and provides a comprehensive assessment of the UT Office of Research and Sponsored Programs. Successful implementation of the recommendations outlined in this document depends upon the support and close cooperation of senior offices and officials at the University.

After thorough analysis of data on research awards and expenditures, assessment of faculty publication activity, and an extensive solicitation of campus input from a broad cross-section of stakeholders—including UT's strategic plan, Research Council, and various quantitative assessments—attention must be directed to rebuilding UT's research enterprise. Key findings from this analysis are summarized in the following three goals: 1) make research, scholarship, and creative activities central to the University's mission, 2) improve research support, infrastructure, and partnerships, and 3) foster community engagement through research collaborations.

First, our goal is to **make research, scholarship, and creative activities central to the mission of the University to enhance our national position as a research institution**. It is imperative that the President, Provost, Board of Trustees, Deans, and faculty endorse research, scholarship, and creative activity as central to the University's mission. Likewise, support from various campus offices is necessary to reach this goal: support from the Office of Finance and Administration is needed for internal investments in research infrastructure and policies for the distribution of F&A funds; the Advancement Office can make funding to support endowed chairs and professorships a gifting priority, and can work with the Office of Research and Sponsored Programs to increase funding from foundations for sponsored projects; the Office of Government Relations can advocate in support of research to elected officials, and to connect federal and state funding to UT programs; the Graduate College can help train graduate students in research compliance and integrity, and support tuition waivers for students on research projects; the Office of Diversity and Inclusion can take full advantage of the human capital on campus, and reach the underserved and underrepresented populations in our region; the Office of Facilities and Construction must provide support to maintain high quality laboratories and centers, and; the Office of Information Technology must support the new electronic research administration system and provide high quality computing and communications support for faculty research.

We intend to increase The University of Toledo's national recognition for research and scholarship. This includes recognition by such bodies as the Carnegie Foundation and the Association of Public and Land-Grant Universities (APLU). Faculty research, scholarship, and creative activity will support all fields of study, but as we improve research across campus, we will develop a plan to gain national recognition in up to five areas of research excellence. This document shows that biomedical research and energy/environmental sustainability are two areas in which UT has significant strengths that, through further investment, can serve as areas of national prominence. As shown in Table ES-1, biomedical research accounted for over \$126 million in external awards since 2012; awards to support research on energy and the environment accounted for over \$64 million in awards during this period.

MAJOR AREAS OF RESEARCH FUNDING BY TOP PERFORMING FACULTY	
Focus Area	Sponsored Research
Biomedical	\$ 126,722,896
Energy & the Environment	\$ 64,435,503
Aerospace Engineering	\$ 20,476,941
STEM Education	\$ 19,996,132
Astrophysics	\$ 3,643,518
Agriculture	\$ 3,358,764
Transportation	\$ 2,132,878
Information Technology	\$ 1,737,178
Human Trafficking	\$ 1,460,882

Table ES-1: Major Areas of Research Funding by Top Performing Faculty | FY 2012-17

Through engagement with faculty, we call for an identification of other potential areas in recognition of research excellence. We expect that areas of excellence will leverage the broad diversity of disciplines at the University and have relevance to our region and state.

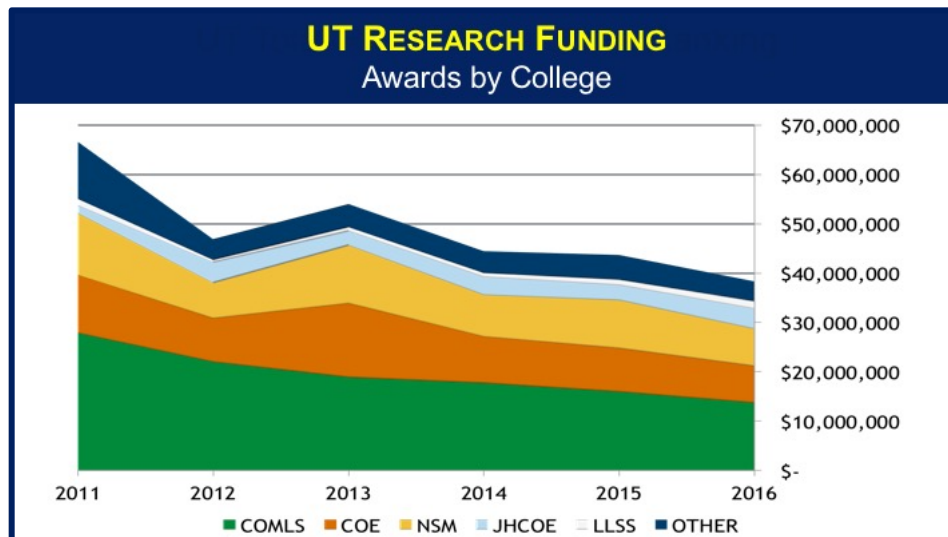


Figure ES-1

As shown in Figure ES-1, external awards to UT have declined since 2011, from a level of almost \$70 million to \$38.4 million. Declines since 2011 have occurred among the top three colleges in winning external funding (Medicine and Life Sciences, Engineering, and Natural Sciences and Mathematics), with the most serious decline noted in the College of Medicine and Life Sciences. The loss of research-intensive senior faculty members partially explains this drop in funding. Although state and federal support for academic research has not been robust over this period, this trend in external funding cannot be solely attributed to these external factors, as UT has lost position as a research university compared to peer institutions.

Our plan is ambitious. We intend to bring external awards to \$80 million by 2022. There are strong external headwinds in achieving this target. One is the need for robust federal funding to support academic research. Although the current budget is positive, the administration's proposed budget

targeted deep cuts in environmental research, biomedical research, and other areas that have been significant sources of federal support to UT faculty. Deep cuts in these programs, plus expected cuts to the Department of Energy's renewable energy program, make achieving the \$80 million target difficult. The other headwind is the lack of support for research from the State of Ohio. A short time ago, Ohio was at the forefront in supporting R&D through programs at the Chancellor's office and through the Third Frontier Project. In recent years, most of the programs that supported academic research have been eliminated or severely reduced. One area unaffected by these developments is water quality research, which brings the institution about \$2 million per year through the Chancellor's office.

UT currently ranks 190th among all universities in the nation in research and development expenditures and ninth in Ohio. In 2011, UT was ranked 166th nationally. Among public universities, UT ranks 147th. To improve these rankings, there must be continued emphasis on the pursuit of external funding by faculty, researchers, and students. Institutional promotion will continue through increasing the number of publications, especially those in high impact journals, increasing the number of faculty who are fellows in national societies and hold endowed chairs, and facilitating an environment that is conducive to sparking creative activities.

To achieve our plan to increase research awards to \$80 million over the next five years, we must: 1) continue to aggressively hire research-oriented faculty members, 2) increase the number of quality proposals submitted to external agencies, and 3) develop connections between UT faculty members and external funding agencies, industries, and other organizations. We will work with deans and department chairs to emphasize the importance of faculty research and to provide programs to mentor early-career faculty members in improving their grant writing skills. We will be more aggressive in seeking partnerships to federal R&D agencies and will work with the Office of the Provost in providing evidence needed to increase time available for productive faculty members to pursue their research, scholarship, and creative activity. We will also assist in the development of a plan to hire new faculty members in areas that will increase research activity, and attract and retain talented faculty. We need to increase the visibility of our faculty members nationally, and work for their appointments to prestigious positions in national scientific societies, such as the American Association for the Advancement of Science and the National Research Council.

We expect significant improvements in the College of Medicine and Life Sciences to achieve our ambitious goals. One strategy is to work with the College in increasing the participation of clinical faculty members in the research enterprise, as is expected at an academic medical center. Compensation policy for clinical faculty has historically discouraged these individuals from receiving a portion of their compensation from grant activity, an issue that can be corrected with a new policy on their institutional base salary.

Second, our goal is to **improve research support, infrastructure, and partnerships**. Customer service must improve and faculty members see their administrative burden decline. As part of this plan, we surveyed UT faculty and students to identify ways to best support their research needs. Feedback indicated that professional staffing in the Office of Research and Sponsored Programs and availability of research-related resources were highly desired. Well-functioning and responsive grants accounting, compliance services, and IRB is integral for the scholarly success of our faculty, researchers, and students. A key highlight in this plan is to improve the automation of grants processing, effectiveness of grants management, and grant writing support. Compliance verification for research projects needs improvement since this is often a factor in the delay of processing grant awards. As we move forward, it is essential that the university upgrade our

research infrastructure and resources to support research and scholarly activity in core labs and facilities.

We have already addressed some of the issues brought forward by focusing on business improvements in the pre-award process. Increasing training and continuing education of Office of Research and Sponsored Programs staff given the changing regulatory environment is also imperative to provide superior support to campus constituents. The University Research and Funding Opportunities program has proven its value to stimulate research, scholarship, and creative activity and this program must continue, even given the current fiscal challenges. The return of a portion of facilities and administrative costs (F&A) to empower and incentivize faculty must be encouraged, and we must adopt more uniform policies across campus.

A challenge for UT, and for institutions of our size, is to provide support for all elements of research compliance that apply to a complex university, with programs in a broad range of disciplines, such as medical research involving human subjects, animal research, research relating to export control issues, and research involving radioisotopes and biohazards. Compliance program support—such as human subjects protection, review of animal research protocols, and committees for handling research misconduct cases—requires faculty participation. UT lacks the deep pool of faculty expertise to support these programs, as one would find at a larger research university, resulting in substantial administrative burden placed on faculty to support compliance programs.

Our last goal is to **foster community engagement through research collaborations that have relevance locally, regionally, and internationally**. A core emphasis of this goal area is to create and produce high quality research and innovation that improves the health, social, and economic conditions in our region. In order to encourage opportunities for community engagement, we intend to create a gateway that promotes the initiation of community-based and industry-sponsored research. This gateway will improve community access to university experts and expertise, especially relating to workforce development, employability, and small business and industry development and research. By promoting these community and university interactions, we strive to increase economic development, commercialization, and technology transfer and continue to make a positive difference in our region.

We will continue UT's outstanding performance in technology transfer and other activities on the pathway toward technology commercialization, such as I-Corps. UT has a robust suite of activities to support technology transfer, business incubation, and commercialization activities that are important to Northwest Ohio. Working with regional partners, UT will enhance these activities and work to secure funds for them through external grants, contracts, royalty distributions, and gifts outside of the core academic budget of the University.

This document outlines ambitious goals that call for continuous monitoring and evaluation. Although we are unable to control all the factors to achieve success, such as federal and state funding allocations to academic research, many of these factors are within the control of the University community. The Office of Research and Sponsored Programs will continue to monitor and track our progress towards reaching the overarching goals of Ignite 2022.

IV. Introduction

ASSUMPTION: The primary assumption associated with the Office of Research and Sponsored Programs Strategic Plan is that the University will allocate resources to the goals and objectives set forth in this document.

The goals and strategies described in this plan will focus on the following three focus areas of the research enterprise:

1. Make research, scholarship, and creative activities central to the mission of the University to enhance our national position as a research institution.
2. Improve research support, research infrastructure, and partnerships.
3. Foster community engagement through research collaborations that have relevance locally, regionally, and internationally.

Given the breadth of UT's programs, professional schools, and success in technology transfer, the university should strive to elevate its standing as a research university. Although this plan is a product of the Office of Research and Sponsored Programs, responsibility in achieving these goals requires the commitment of the entire campus community. In particular, the support of the University President, vice presidents, Provost, deans, department chairs, and faculty is critical for success. Ultimately, our vision is to elevate the University to recognition among the ranks of the great Midwestern research universities.

The Office of Research and Sponsored Programs provides leadership in setting the research agenda of the University by facilitating research and sponsored program activities, and supporting



Research and Technology Complex 1
Main Campus location of the
Office of Research and Sponsored Programs

technology transfer and commercialization efforts of The University of Toledo. The Vice President of Research is a member of the president's cabinet and is responsible for advocating in support of the University's research mission to internal and external constituents.

A major function of the Office of Research and Sponsored Programs is to support faculty in obtaining external support for their research through grants and contracts. Externally funded research is important in supporting projects directly, but the funds also help to support laboratories, instruments, and other activities that enrich the learning environment.

The office's approximately fifty-three employees have offices across the Health Science and Main Campuses. The organizational chart included in Appendix A lists the divisions of the Office of Research and Sponsored Programs and the current staff structure.

Major elements of the office include the Office of Sponsored Programs, which supports proposal preparation and submission, the Research Advancement Office, which is responsible for electronic research and data systems as well as faculty engagement, the Department of Laboratory Animal Research, the Human Subject Research Office, the Technology Transfer Office, LaunchPad Incubation, the Minority Business Assistance Center, and Rocket Innovations.



Center for Creative Education
Health Science Campus location of the
Office of Research and Sponsored Programs

This document is a companion to the UT Strategic Plan, PATH TO EXCELLENCE. We provide an overview of the status of research and scholarship on campus, current standing with respect to peer institutions, an assessment of the support functions offered to faculty, and suggestions on ways to both enhance support for faculty and to build research areas likely to increase the standing of UT as a premier public research university.

Readers of this report will notice it provides limited information when summarizing scholarship and creative activity in areas such as music, theatre, film, and other humanities disciplines. This is not a reflection of the importance of these disciplines to the University; it is simply that transactional data, such as research contracts, are easily reportable and comparable across institutions. We plan to work with the Office of the Provost to collect information on activities in the arts and humanities disciplines to assess their strength and opportunities for enhancement.

Following the review of current sponsored research and publication activity, this document reports on the functions of the Office of Research and Sponsored Programs and the recommended steps to support the goals of the strategic plan. This assessment was informed in part by a survey, undertaken this year, of faculty and graduate students on their evaluation of the research offices. We then provide an overview of centers and institutes, followed by a listing of UT's core laboratories. The next section lists the goals, objectives, and strategies for each of the three focus areas. The last section lists recommended steps forward.

V. Mission and Vision Statement



Mission

The Office of Research and Sponsored Programs provides leadership and guidance in all aspects of external sponsorship of programs and research.

Vision

The University of Toledo will be recognized among the ranks as one of the great Midwestern research universities.



VI. Current Status of Research and Scholarship

As a research university with a broad diversity of academic programs—ranging from arts and humanities disciplines to STEM areas, such as engineering and medicine—UT recognizes that it is not possible to use one measure to evaluate faculty creative activity contributions across the entire campus. Many universities are compared with data that is transactional and simple to measure. External funding of sponsored activities is easy to track and widely used to gauge and compare the research standing of a university, but it provides an inadequate measure of a university's contributions to creating impactful new knowledge, and misses contributions coming from multiple disciplines and their subsets. For instance, Albert Einstein made his breakthrough contributions in relativity theory, the nature of light, and a better understanding of Brownian motion while he was working in a Swiss patent office and had no external research funding support. Given these caveats, we look at externally sponsored funding trends at the University both to see where UT has areas of particular funding concentrations and how we are progressing among our peer institutions. We also summarize data on scholarly publications, which suggest areas where UT faculty members are providing significant contributions.

Research Funding Trends

We measure external funding in two ways. First, UT tracks **awards**. Awards represent a notification by an external sponsor on a particular date that UT will receive an amount of money for a given project. The award may cover one year or multiple years. **Expenditures** are the other primary measure. Expenditures represent funding spent in support of a project. Expenditures lag awards for obvious reasons. Assume a UT faculty member receives an award for \$100,000 on April 1 in a given year to support a project, with a budget that includes faculty and graduate student time, travel, and supplies; UT posts the \$100,000 as an award for that fiscal year, even though it may take two or more years to spend all of the funds.

UT Award Trends

Figure 1.1 shows the trend in total awards to UT by college since FY2011. Awards have declined from almost \$70 million in FY11 to \$38.4 million for FY16. This decline is partially explained by the loss of federal stimulus funding, but the drop has continued well beyond the time of the stimulus.

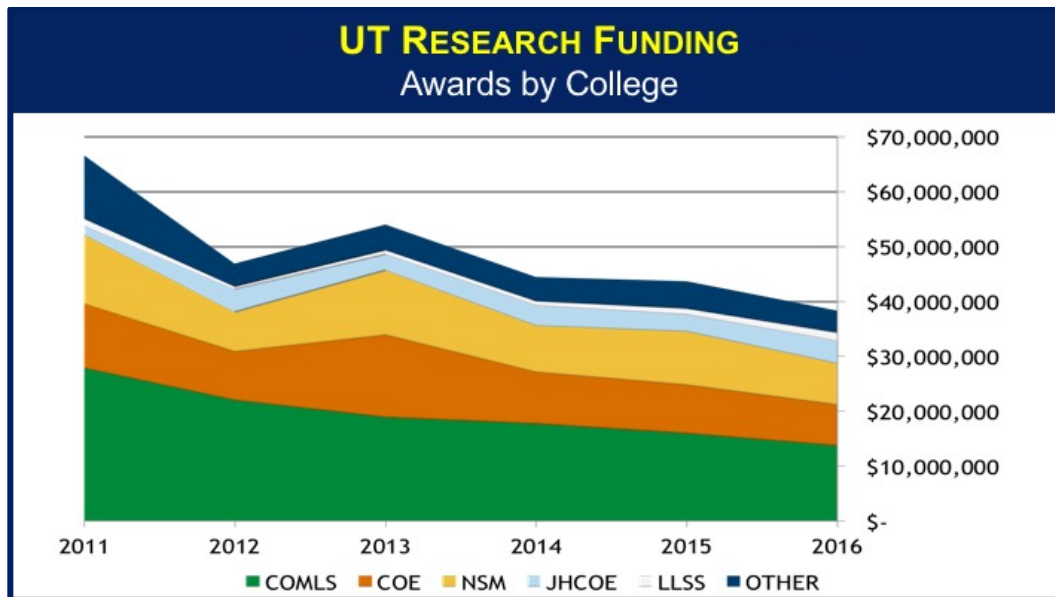


Figure 1.1

The top three colleges receiving external awards are the College of Medicine and Life Sciences, the College of Engineering, and the College of Natural Sciences and Mathematics. Table 1.1 summarizes the total dollar amount of awards for each of these colleges over the FY11 to FY16 period. Although awards dropped in each of these three colleges over the period, the decline in the College of Medicine and Life Sciences is by far the most significant. The table highlights the importance of bringing research awards in the College of Medicine and Life Sciences back to previous levels to achieve targeted research goals for the university.

TOP 3 SPONSORED RESEARCH COLLEGES			
FY	College of Medicine and Life Sciences	College of Engineering	College of Natural Sciences & Mathematics
2011	\$27,899,321	\$11,620,208	\$12,585,700
2012	\$22,077,585	\$8,761,002	\$7,132,817
2013	\$18,914,078	\$14,960,444	\$11,717,360
2014	\$17,770,996	\$9,311,288	\$8,511,855
2015	\$16,079,405	\$8,722,273	\$9,697,125
2016	\$13,771,059	\$7,412,570	\$7,525,424

Table 1.1: Awards for Top Three Colleges | FY 2011-2016

The decline in funding across colleges is partially explained by three factors:

- the loss of top performing faculty members at all ranks,
- the loss of a number of full professors, who have a stronger record in winning external funding compared to associate professors, who also have a stronger record than assistant professors, and
- the loss of state funding programs to support research.

Loss of Faculty at All Ranks

The University of Toledo has lost some top-performing faculty, particularly in the top-three-performing colleges, which also explains why the average award per faculty member has declined. Table 1.2 is an example of such losses, just in the College of Medicine and Life Sciences since 2014. These faculty members were responsible for over \$18 million in external awards to the university. If we assume these faculty members would have received renewals in funded awards for the year no longer in the university, total loss of funding could exceed \$30 million.

Table 1.3 summarizes the average awards recorded by assistant, associate, and full professors over the 2011-2016 period. The far left column in this table shows that the average award to a tenured or tenure-track faculty member stood at over \$65K per faculty member in 2011, and has dropped to just over \$36K per faculty member in 2016. The table also illustrates the difference in performance by rank for each year. In 2011, the average UT assistant professor was responsible for \$40K in sponsored awards, compared to \$94K for a full professor. In 2016, the average assistant professor was responsible for only \$17K in funding, and the average full professor's performance dropped to \$65.5K.

COLLEGE OF MEDICINE AND LIFE SCIENCES RESEARCH FUNDING FROM LOST TOP-PERFORMING FACULTY			
Academic Rank	Department	Total Funding	FY
Professor	Radiation Oncology	\$112,636	2014
Assistant Professor	Medicine	\$25,000	2014
Assistant Professor	Surgery	\$12,916	2014
Associate Professor	Medicine	\$100,000	2014
Professor	Physio Pharm Meta Cardio	\$2,318,178	2014
Associate Professor	Biochemical Cancer Biology	\$751,154	2014
Associate Professor	Biochemical Cancer Biology	\$9,000	2014
Assistant Professor	Medicine	\$25,000	2014
Professor	Obstetrics and Gynecology	\$280,750	2014
Assistant Professor	Medicine	\$33,869	2014
Associate Professor	Medicine	\$187,484	2014
Professor	Obstetrics and Gynecology	\$129,317	2014
Associate Professor	Pediatrics	\$9,105	2014
Assistant Professor	Pathology	\$25,000	2015
Assistant Professor	Medicine	\$144,906	2015
Assistant Professor	Obstetrics and Gynecology	\$103,237	2015
Associate Professor	Radiology	\$234,524	2015
Assistant Professor	Medicine	\$9,240	2015
Professor	Family Medicine	\$21,500	2015
Professor	Urology	\$29,043	2015
Associate Professor	Medicine	\$10,689	2015
Associate Professor	Surgery	\$60,564	2015
Professor	Neurosciences	\$2,453,266	2015
Assistant Professor	Biochemical Cancer Biology	\$681,677	2015
Professor	Surgery	\$28,832	2015
Professor	Medicine	\$1,482,404	2016
Professor	Med Microbiology & Immunology	\$6,500	2016
Associate Professor	Medicine	\$2,405,867	2017
Associate Professor	Pediatrics	\$21,500	2017
Professor	Physio Pharm Meta Cardio	\$103,237	2017
Associate Professor	Pathology	\$80,000	2017
Assistant Professor	Medicine	\$323,466	2017
Assistant Professor	Physician Assistant Studies	\$10,049	2017
Assistant Professor	Physician Assistant Studies	\$4,024,473	2017
Total COMLS Research Funding from Lost Top-Performing Faculty		\$18,553,992	

Table 1.2: College of Medicine and Life Sciences Research Funding from Lost Top-Performing Faculty | FY 2014-2017

RESEARCH FUNDING PER CAPITA \$ PER FACULTY RANK				
FY	\$ per Assistant Professor	\$ per Associate Professor	\$ per Professor	\$ per FTTT
2011	\$40,023	\$59,069	\$94,207	\$65,303
2012	\$24,539	\$29,690	\$73,014	\$42,729
2013	\$27,666	\$40,197	\$90,122	\$53,407
2014	\$23,552	\$25,504	\$71,379	\$40,564
2015	\$21,603	\$28,817	\$66,008	\$41,049
2016	\$17,215	\$25,694	\$65,527	\$36,152

Table 1.3: Per Capita \$ per Faculty Rank | FY 2011-2016

Table 1.4 shows the success rate of new proposal submissions throughout campus over the FY 2011-2016 periods. UT's success rate hovers around 30%, with a marked difference in success rates across disciplines and agencies. Success rates can be high in certain circumstances, especially for members of the faculty who have established relationships with industry sponsors. In other disciplines, such as in the College of Medicine or the Department of Biological Sciences, proposals to increasingly competitive NIH competitions may have success rates of 20% or lower.

UT RESEARCH FUNDING SUCCESS RATE OVER TIME			
Submitted FY	Total New Submissions	Awarded	Success Rate
2011	616	200	32%
2012	666	223	33%
2013	626	191	31%
2014	529	160	30%
2015	536	167	31%
2016	563	179	32%

Table 1.4: UT Research Funding Success Rate Over Time | FY 2011-2016

Table 1.5 shows the loss of UT faculty members over the 2011-2016 period, dropping from 867 in 2011 to 841 in 2016. The loss of 26 faculty members equates to an expected loss of external funding of just under \$1 million annually, if we use the most recent average performance of a faculty member in obtaining funds (\$36,152). However, the rate of full professor loss, from 303 in 2011 to 277 in 2016, translates to a more significant loss of funding.

UT LOST FACULTY				
College	Assistant Professor	Associate Professor	Professor	Total
Medicine	121	62	67	250
Nat. Science & Math	22	34	40	96
Engineering	17	23	32	72
Total University	261	302	277	841

Table 1.5: Total UT Faculty Lost in Top 3 Research Colleges by Rank | FY 2011-2016

To achieve UT's plan to increase research awards to \$80 million over the next five years, we must: 1) continue to aggressively hire research-oriented faculty members, 2) increase the number of quality proposals submitted to external agencies, and 3) develop connections between UT faculty members and external funding agencies, industries, and other organizations. In addition, reaching \$80 million in funding requires improved performance in the College of Medicine and Life Sciences, Natural Sciences and Mathematics, and Engineering. These three colleges account for approximately 75% of the total awards to the University in FY16, employ 50% of the total university faculty, and include the largest share of external funding recipients. Thus, it is reasonable to expect the total awards from these colleges to approach \$60 million to achieve the \$80 million target. Breaking the data down further, in the fall of 2016, the College of Medicine had 250 faculty members, the College of Natural Sciences and Mathematics had 96 faculty members, and the College of Engineering had 72 faculty members. Assuming that research awards to these colleges should reflect the number of faculty members, 60% of the \$60 million target should be from awards made in the College of Medicine. This translates to \$36 million. The target for the College of Natural Sciences and Mathematics is thus \$13.8 million, and the College of Engineering would be \$17.2 million.

The greatest opportunity to expand funded research is to focus on improvement in the College of Medicine and Life Sciences. The College has 70 non-clinical faculty members, of which 30 are assistant professors (42.8%). By contrast, 23% of the faculty in Natural Science and Mathematics are assistant professors; for the College of Engineering, the number is 23.4%. Although the primary responsibility of clinical faculty resides with patient care, UTMC is an academic medical center, where the expectation should be close linkage between research and patient care; in that pursuit, more clinical faculty members in the College of Medicine and Life Sciences will be encouraged to participate in externally sponsored research. Faculty disinterested in the culture of an academic medical center would perhaps find a better fit at a community hospital, where this relationship is not central to their mission.

One factor limiting clinical faculty participation in external grants is the issue of the institutional base salary. At UT, the institutional base salary does not include the UT approved salary through the Physicians Practice Plan. If the institutional base salary, which is the basis for clinical faculty compensation to the NIH and other federal agencies, is only a small portion of the total salary approved by the University, then the amount of compensation from external awards results in a loss of potential compensation if they dedicate full time to clinical activity. The Office of Research and Sponsored Programs worked with the Office of the Dean of the College of Medicine and Life

Sciences to develop a new policy that will permit inclusion of the Physician Practice Plan salary into the administrative base salary for federal reporting, removing an important obstacle that has discouraged clinical faculty member participation in grant activity.

Thus, our plan focuses on supporting the deans of these colleges in recruiting and mentoring early-career faculty members in building their research programs, advocating for the importance of retaining and preventing successful research faculty members from moving to higher-ranked research universities, and increasing the number of successful proposals submitted.

UT FACULTY MEMBERS BY RANK					
FY	Assistant Professor	Associate Professor	Other	Professor	Total FTTT
2011	238	314	12	303	867
2012	251	319	13	306	889
2013	232	314	3	280	829
2014	225	314	1	279	819
2015	235	290	4	269	798
2016	261	302	1	277	841

Table 1.6: UT Faculty Members by Rank | FY 2011-2016

Compounding the loss of well-regarded faculty members is the loss of state funding, as the State of Ohio has walked away from its support of university research and has directed its premier technology-funding program, the Third Frontier Project, to programs that support activities involving commercialization of technology, either in the short term or for entrepreneurial assistance programs. Programs that once supported university research centers, distinguished professors, and instrumentation are mostly gone. In FY 2008, state funding accounted for \$18,346,982 to UT compared to an average of \$6,000,000 per year for FY 2014-2016.

The Vice President of Research, as chair of the Ohio Research Officers Council, is working with the other vice presidents of research to advocate the importance of state investment in academic research to support a robust innovation-based economy.

Table 1.7 summarizes the loss of state programs that supported university research.

RESEARCH SUPPORT PROGRAMS ADMINISTERED BY THE OHIO BOARD OF REGENTS		
Program	FY 2008	FY 2016
Research Challenge (renamed Research Incentive) <ul style="list-style-type: none"> To support competitive external research funding in Ohio 	\$30 million per year (averaged \$16.6 million per year from FY1986 to FY2011; total funding of \$431 million)	0
Action and Investment Fund <ul style="list-style-type: none"> Hayes Investment Fund: To support shared instrumentation across universities in a research consortium (e.g., x-ray crystallography) and Action Fund: To provide required matching funds to compete for external funding for research infrastructure 	\$20 million per biennium (capital budget)	\$3.5 million per biennium (capital budget)
Research Scholars Program <ul style="list-style-type: none"> Joint program with the Ohio Third Frontier to attract high-level research scholars to expand the state's capabilities for technology commercialization as well as to enhance the competitiveness of existing Ohio business and industry 	\$150 million (one-time only with endowments of \$2.5 million, plus both operating and capital funds to support the new research scholars)	0
Ohio Eminent Scholars Endowments and Capital Grants <ul style="list-style-type: none"> To attract high-level research scholars to Ohio's research universities To provide new eminent scholars with attractive start-up packages to set up laboratories 	\$4-8 million per biennium (total funding of \$33.8 million from FY1981 to FY2009)	0
Technology Commercialization Incentive <ul style="list-style-type: none"> To reward public and private universities for successful technology transfer to Ohio business and industry resulting in the commercialization of new products, processes, and services 	\$0.5 million per year	0
Ohio Computer Science Enhancement <ul style="list-style-type: none"> To invest in and enhance computer science doctoral programs statewide To produce more computer science doctoral graduates for Ohio 	\$4 million per year	0

Table 1.7: Research Support Programs Administered by the Ohio Board of Regents | FY2008 and FY 2016

Funding Across Federal Agencies

As a university with a medical school and a school of pharmacy, it is unsurprising that the NIH accounts for the largest share of UT's federal funding. Figure 1.2 shows the NIH contributes 36% of UT's federal funding, followed by the NSF at 20%, and NASA at 14%. While the University has a special relationship with NASA Glenn that has yielded decades of funded research—comprising much of the 14% figure—UT's astrophysicists have also successfully secured NASA grants and funding from various foundations. Aside from NIH, NASA, and NSF, a unit of the USDA's Agricultural Research Service presently works with faculty members on campus regarding problems related to the greenhouse industry, such as greenhouse management, plant nutrients, and pest control. This particular relationship has provided continuous funding for over 15 years, and helped established research connections to community stakeholders in the greenhouse industry. This example, as well as the long-standing relationship with NASA Glenn, attest to the importance of developing close relationships with federal R&D agencies.

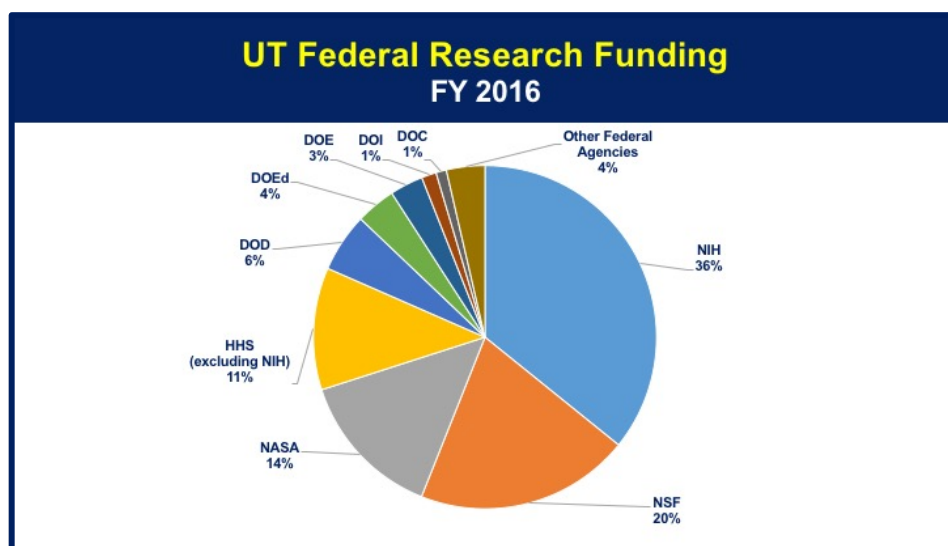


Figure 1.2. Federal Funding Sources | FY 2016

Research Expenditures and Comparisons to Other Institutions

The National Center for Science and Engineering Statistics tracks national research expenditures. Expenditure data generally lags two years behind award data, but the dataset is often used to compare performance of universities against one another. As shown in Figure 1.3, UT ranked #166 in the nation in R&D expenditures at universities. Our position has dropped considerably since then, to its current rank of #190. Table 1.8 shows that UT has also noticeably slipped when compared to other Ohio universities from 2014 to 2015. Ohio has three institutions in the top 100 of ranked universities, with OSU at #20, Cincinnati at #51, and Case Western at #55. UT now stands ninth among all universities in the state and seventh among public universities. Note that BGSU, Northwest Ohio's other public university, is ranked at #345 nationally.

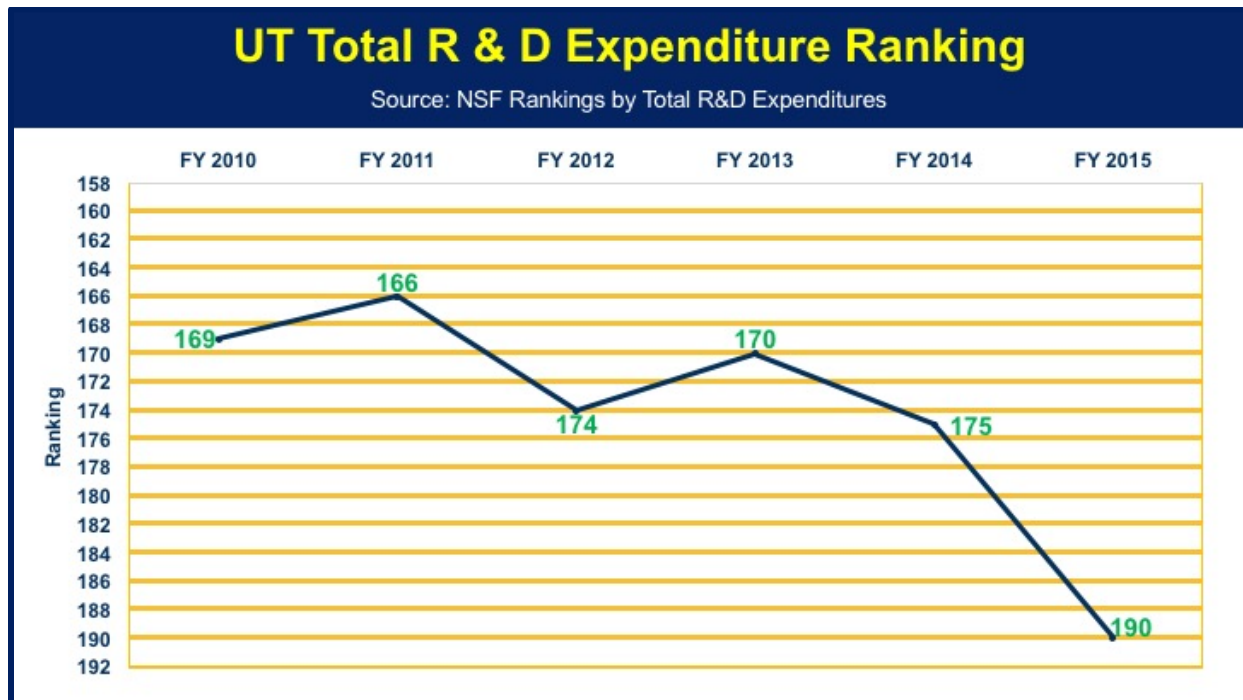


Figure 1.3. UT Total R & D NSF Expenditure Ranking | FY 2010 – FY 2015

OHIO UNIVERSITIES CHANGE IN R & D NSF RANKING	
FY 2014	FY 2015
19 – Ohio State University	20 – Ohio State University (-1)
50 – University of Cincinnati	50 – University of Cincinnati (-1)
51 – Case Western University	55 – Case Western University (-4)
156 – University of Dayton	145 – University of Dayton (+11)
162 – University of Akron	174 – Ohio University (+4)
175 – The University of Toledo	177 – University of Akron (-15)
176 – Cleveland State University	182 – Cleveland State University (-6)
186 – Wright State University	190 – The University of Toledo (-15)
238 – Kent State University	214 – Kent State University (+24)
256 – Miami University	279 – Northeast Ohio Medical University (+4)
283 – Northeast Ohio Medical University	284 – Miami University (-28)
328 – Bowling Green State University	345 – Bowling Green State University (-17)
432 – Youngstown State University	437 – Youngstown State University (-5)

Table 1.8: Ohio Universities Change in R & D NSF Ranking | FY 2014 and FY 2015

Current Areas of Notable Research Funding

As previously mentioned, research funding alone is not an ideal measure of the quality of research and scholarship, for several reasons. First, in some fields large grants are not necessary to conduct important studies. This is true in humanities disciplines, and in theoretical areas such as theoretical physics, mathematics, and other fields where access to computers and time for dedicated thought is most important. Research areas requiring expensive equipment, access to animal laboratories, or other purchases need substantial external funds. Second, a grant or contract provides resources to conduct work, but unless there is a final quality product (such as publication or invention), the outcomes of the award are limited. Despite these caveats, research funding can be helpful in recognizing university strengths, and in making comparisons across institutions in fields where funding predicates success. This section draws upon research funding to identify areas where UT has been successful in securing awards, and compares UT with other institutions in selected areas.

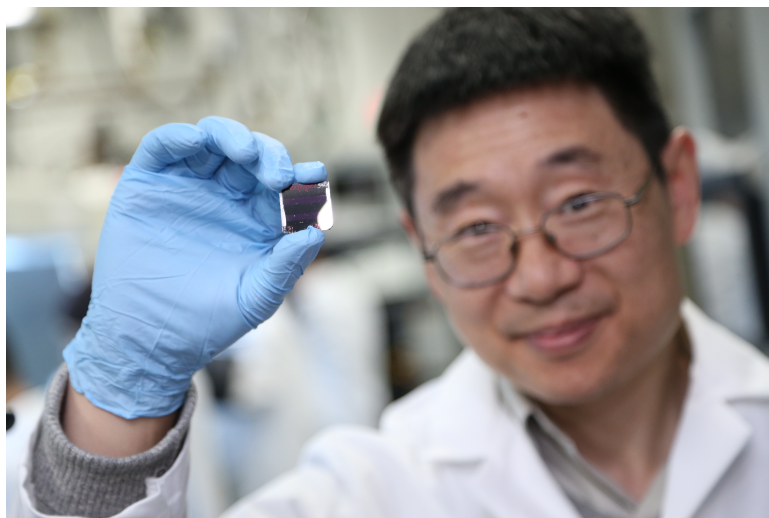
Major Areas of UT External Funding

Table 1.9 summarizes the amount of external awards in research areas received by the top 300 UT faculty members over the 2012-2017 period. As a direct result of certain institutional areas—the medical school, hospital, pharmacy program, nursing program, and College of Health and Human Resources—funding dominates in the biomedical research field. Funding in this area is across the university including, in addition to the units listed above, the College of Natural Sciences and Mathematics (mostly the department of Biological Sciences) and the College of Engineering (mostly bioengineering).

After biomedical research, UT receives substantial funding for research relating to energy and the environment. This includes research on the Great Lakes through UT's Lake Erie Center, land-use practices that relate to water quality problems, environmental remediation projects, climate change research, and research on photovoltaics and other topics relating to renewable energy. Research in this area is interdisciplinary, with primary funding in the College of Natural Sciences and Mathematics, and significant funding in the College of Arts and Letters (Geography and Planning), Engineering, and

Medicine. There is also noteworthy scholarship underrepresented by funded awards in the areas of energy and the environment, including work through the Legal Institute of the Great Lakes and faculty scholarship in the colleges of Arts and Letters and Business and Innovation.

UT's longstanding relationship with NASA Glenn keeps aerospace engineering in the top major areas receiving external funds (see Table 1.9). The College of Engineering has partnered with NASA Glenn for over 40 years, with work performed on campus and by UT technical staff in



Dr. Yanfa Yan, Ohio Research Scholar chair and UT professor of physics holds a perovskite solar cell developed in his lab. Dr. Yan's lab is researching the new solar cell technology in search of cheaper and more efficient ways to provide clean renewable energy.

Cleveland on power and propulsion, fluid dynamics, and other areas of interest to NASA. Last of the top four performing areas, the Judith Herb College of Education holds a strong record in leading projects relating to STEM education, with almost \$20 million in awards over the period. Many of these projects involve faculty members across campus, such as in Engineering, Natural Science and Mathematics, and Arts and Letters, and often the projects involve collaboration and support to local school systems and their teachers.

Other major areas of funding include astrophysics, agriculture, transportation, information technology, and human trafficking. External funding in these areas may not reach the levels of top performers, but these disciplines tend to have fewer faculty members and are less dependent on expensive instrumentation and laboratories.

Table 1.10 summarizes major areas of research funding over the FY 2012-17 period by the top 300 UT awardees, but provides more detail for specific categories of funding shown in Table 1.5, particularly within the biomedical discipline. In this table, funding in the environment and water area is highest with over \$43 million in funding. Energy research, which was included in this category in Table 1.5, stands at \$19.5 million. Major areas of funding within biomedical research are cardiovascular research at \$22.8 million, cancer research at \$17.1 million, orthopedics research at \$15.6 million, mental illness at \$13.8 million, and neurosciences at \$12.3 million.

MAJOR AREAS OF RESEARCH FUNDING BY TOP PERFORMING FACULTY	
Focus Area	Sponsored Research
Biomedical	\$ 126,722,896
Energy & the Environment	\$ 64,435,503
Aerospace Engineering	\$ 20,476,941
STEM Education	\$ 19,996,132
Astrophysics	\$ 3,643,518
Agriculture	\$ 3,358,764
Transportation	\$ 2,132,878
Information Technology	\$ 1,737,178
Human Trafficking	\$ 1,460,882

Table 1.9: Major Areas of Research Funding by Top Performing Faculty | FY 2012-17

MAJOR AREAS OF RESEARCH FUNDING FY 2012-2017	
Focus Area	Sponsored Research
Aerospace Engineering	\$19,835,618
Alternative Energy	\$19,496,656
Astrophysics	\$ 3,252,018
Orthopedics	\$15,624,263
Cancer	\$17,148,134
Cardiovascular	\$22,870,514
Diabetes	\$ 6,958,854
Environment/Water	\$43,338,709
Human Trafficking	\$ 1,460,882
Immunology	\$ 3,919,881
Infectious Disease	\$ 9,055,265
Information Technology	\$ 1,737,178
Mental Illness	\$13,863,864
Microbiology	\$ 6,871,133
Neurosciences	\$12,304,567
OBGYN	\$ 502,710
Organ Transplantation	\$ 4,270,428
STEM Education	\$19,188,545
Transportation	\$ 4,089,879

Table 1.10: Detailed summary of major areas of external funding | FY 2012-17

One of the established Strategic Plan goals for both the institution and the Office of Research and Sponsored Programs is to increase the national reputation of UT as a research university and to identify specific areas of research excellence. The UT Strategic Plan calls for the university to develop and implement a plan for national recognition in up to five areas of excellence. Several areas of research have significant maturity at the national level, with major programs at leading institutions that have tremendous depth and recognition. It would be difficult for UT to strive to gain recognition as one of the national leaders in such areas (e.g., materials research, cancer). Other areas may not be as crowded, or there may exist niche areas within major categories of research where UT could gain national recognition as a national leader (e.g. optical measurements of material surfaces).

From the data on externally sponsored awards, it is clear that UT has significant activity in two major areas of research: biomedical research and research on energy and the environment. These very broad categories include a wide range of specific topics and disciplinary specializations. This plan calls for identification within each of the above major theme areas where we have a unique opportunity to enhance these areas and improve our national stature as a research university. This plan also calls for engaging the university community to identify other areas of opportunity to increase external funding and recognition to the university.



Dr. Xin Wang, UT associate professor of psychiatry, studies radiological images of a brain post-injury. Dr. Wang has received a \$3.38 million award from the National Institute of Mental Health to study the brain for early signs of post-traumatic stress disorder after an injury.

How does UT compare nationally in both the areas in which we have significant research funding, or in others? The NIH and the National Center for Engineering Statistics publish data that can help provide a partial comparison to other institutions. As previously mentioned, UT recorded \$127 million in awards to support biomedical research over the 2012-17 period. In 2014, according to records provided by the Blue Ridge Institute for Medical Research, UT ranks #104 in the nation of the 138 schools reported with \$9.2 million in NIH awards. Case Western

recorded the most awards in Ohio totaling \$142 million placing it at #31 in the nation. Other Ohio schools above UT are OSU at #44 and Cincinnati, ranked #58. Certainly, it is beyond ambitious for UT to strive to be a top school in these rankings.

Biomedical research is a broad term so we have compared areas of biomedical research using NIH data on cancer research, mental health, drug abuse, and general medical sciences. In addition, other agencies fund research in the above areas, including the Department of Defense, the Department of Energy, and multiple private foundations

Table 1.11 shows the amount of funding received by UT compared to the state's top performer, and to other UT peers in receiving awards from the National Cancer Institute over the FY 2012-16 period. UT averaged \$1.2 million in awards from the National Cancer Institute over this period and its national ranking ranged from #107 to #144. The nation's top performer is the MD Anderson Center of the University of Texas for three of these five years with funding of \$120 million, \$99 million, and \$91 million. The University of Pennsylvania and UC San Francisco also led the nation for one of these five years. In terms of UT peers, OSU stands out with national rankings from #6 to #10 and with an average funding of \$51 million. UT stands out as third in the state among public universities in cancer research funding. It is unrealistic to believe that UT could raise its profile as one of the top research universities in cancer research, but it is possible that UT could identify a niche area/problem—such as the current opioid epidemic—where the institution could achieve national recognition.

NATIONAL CANCER INSTITUTE AWARDS TO UT AND OHIO PEER INSTITUTIONS						
Ohio Peers	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	5 Year Average
Ohio State	\$47,595,216	\$46,596,682	\$49,787,878	\$55,193,019	\$57,670,637	\$51,368,686
University of Cincinnati	\$4,684,135	\$4,080,036	\$4,703,975	\$6,426,079	\$4,874,744	\$4,953,794
University of Toledo	\$640,509	\$1,070,799	\$1,305,828	\$868,830	\$1,975,874	\$1,172,368
Wright State	\$288,184	\$260,083	\$264,476	\$611,205	\$611,205	\$407,031
University of Akron	\$0	\$257,466	\$245,707	\$0	\$462,580	\$193,151
Miami University	\$161,733	\$0	\$551,781	\$58,251	\$0	\$154,353
Kent State University	\$198,605	\$92,088	\$0	\$0	\$0	\$58,139
Ohio University	\$254,434	\$0	\$0	\$0	\$0	\$50,887
Cleveland State	\$71,000	\$66,740	\$0	\$0	\$0	\$27,548
Bowling Green State	\$0	\$0	\$0	\$0	\$0	\$0
Youngstown State	\$0	\$0	\$0	\$0	\$0	\$0

Table 1.11: Awards made to UT and other universities from the National Cancer Institute
FY 2012-16

The current opioid epidemic in Ohio, and across the nation, is forcing state leaders to address this issue. UT has a hospital and a number of programs (psychiatry, psychology, public health, emergency medical care, criminal justice, counseling, Human Trafficking and Social Justice Institute) to support a robust and comprehensive approach on this topic. Table 1.12 compares UT's standing in receiving NIH funding from the National Institute on Drug Abuse. UT brought in an average of \$1.8 million per year from this agency over the 2012-2016 period, second in the state behind OSU's \$4.8 million. The only other state universities with funding from this agency are the University of Cincinnati (\$1.4 million) and Wright State University (\$657 thousand). The national leader in receiving awards from the National Institute on Drug Abuse is Johns Hopkins University, with annual awards ranging from \$25 million to \$29 million. Given the national relevance and attention to this issue, and with additional state funding opportunities available, substance abuse may be an appropriate area for institutional investment to raise UT's national profile and to support needs in our community.

Funding and publication data indicate that UT has standing in environmental science, certain areas of engineering (aerospace), astrophysics research, and other fields of physical science. The National Center for Science and Engineering Statistics reports data on research expenditures in some academic areas, but not all. We look at areas where UT shows strength in this database.

NATIONAL INSTITUTE ON DRUG ABUSE AWARDS TO UT AND OHIO PEER INSTITUTIONS						
Ohio Peers	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	5 Year Average
Ohio State	\$1,879,142	\$1,829,627	\$735,662	\$1,964,047	\$1,445,930	\$1,570,882
University of Cincinnati	\$1,125,362	\$913,363	\$761,450	\$2,246,381	\$2,290,309	\$1,467,373
Wright State	\$769,532	\$0	\$806,466	\$461,348	\$1,248,311	\$657,131
University of Toledo	\$333,281	\$768,722	\$752,908	\$477,899	\$0	\$466,562
University of Akron	\$0	\$0	\$0	\$0	\$0	\$0
Miami University	\$0	\$0	\$0	\$0	\$0	\$0
Kent State University	\$0	\$0	\$0	\$0	\$0	\$0
Ohio University	\$0	\$0	\$0	\$0	\$0	\$0
Cleveland State	\$0	\$0	\$0	\$0	\$0	\$0
Bowling Green State	\$0	\$0	\$0	\$0	\$0	\$0
Youngstown State	\$0	\$0	\$0	\$0	\$0	\$0

Table 1.12: Awards made to UT and other universities from the National Institute on Drug Abuse | FY 2012-16

Environmental Research

Table 1.13 summarizes how UT compares to other universities in environmental science research expenditures over the 2012-15 period (the most recent data available). UT averaged \$1.8 million per year over this period. By comparison, the leading national universities are the University of Washington and UC-San Diego. The University of Washington's expenditures ranged from \$161 million to \$250 million.

UT, however, is second in Ohio behind OSU who averaged \$5.3 million per year over this period.



Dr. Thomas Bridgeman, UT associate professor of ecology collects water samples to analyze water quality during algal bloom season on Lake Erie.

UT's national standing ranged from 119 (2012) to 268 (2015). Even though UT's national standing in funding under this category is not high, no other university in Ohio, not even OSU, stands among the top 50. The category "environmental research" in this database does not account for research related to UT's water task force, such as research in the College of Engineering on filtration membranes, or research in the Department of Chemistry on analytical tools to evaluate water toxins. UT's second position in the state, our location on Lake Erie, the interdisciplinary work across campus (law, medicine, engineering, etc.), and the presence of the Lake Erie Center all make this a compelling area for further definition and future investment.

Ohio Peers	FUNDING (In Thousands)				
	FY 2012	FY 2013	FY 2014	FY 2015	4 Year Average
Ohio State University	\$10,494	\$10,769	\$162	\$93	\$5,380
University of Toledo	\$3,192	\$3,672	\$265	\$235	\$1,841
Kent State University	\$601	\$600	\$1,976	\$1,359	\$1,134
Wright State University	\$664	\$552	\$1,688	\$1,429	\$1,083
University of Cincinnati	\$951	\$1,195	\$1,159	\$649	\$989
Bowling Green State University	\$1,141	\$2,273	\$74	\$330	\$955
Miami University	\$949	\$1,894	\$528	\$392	\$941
University of Akron	\$269	\$493	\$1,491	\$1,479	\$933
Ohio University	\$1,134	\$1,227	\$88	\$625	\$769
Youngstown State University	\$0	\$64	\$0	\$0	\$16
Cleveland State University	\$0	\$0	\$0	\$0	\$0

Table 1.13: Environmental Sciences NSF HERD Data | FY 2012 – FY 2015

Ohio Peers	FUNDING (In Thousands)			
	FY 2012	FY 2013	FY 2014	FY 2015
University of Akron	256	224	164	162
Wright State University	206	220	157	166
Kent State University	211	217	145	168
University of Cincinnati	189	174	180	214
Ohio University	182	173	311	215
Miami University	190	149	221	240
Bowling Green State University	180	124	121	147
University of Toledo	122	119	255	268
Ohio State University	66	69	286	314
Youngstown State University	UR	311	UR	UR
Cleveland State University	UR	UR	UR	UR

Table 1.14: Environmental Sciences NSF HERD Ranking | FY 2012 – FY 2015 | UR = Unranked

Engineering Research

The College of Engineering is one of the top three colleges at UT in securing external funds since the merger with the Medical University of Ohio. As recently as 2013, the College recorded almost \$15 million in external awards. In 2016, total awards credited to the College of Engineering were \$7.4 million. The Midwest in general, and Ohio in particular, is blessed with strong engineering universities, an expected trend given the engineering focus of the region's manufacturing establishments (automotive, materials, energy, etc.). As shown in Table 1.14, UT stands at sixth among public universities in Ohio in engineering R&D funding over the 2012-15 period with average expenditures of \$15.5 million. Ohio State University is one of the top performers in engineering research, ranked nationally over the 2012-15 period from #12-14 with average expenditures exceeding \$150 million. The University of Cincinnati is second among Ohio's public peers with average expenditures of \$38 million, followed by Akron, Ohio University, Wright State, and then Toledo. In addition to these public universities, The University of Dayton ranked #30 in the nation in 2015 with \$71 million in engineering R&D expenditures, and Case Western ranked #68 with 2015 expenditures of \$31 million. These data suggest that while the College of Engineering is expected to be one of the top research performers on campus, it is difficult to claim that UT is one of the top engineering research universities in Ohio in total funds received. However, in selected areas of engineering research, UT may stand as a leader and further research is needed to identify these areas.

Ohio Peers	FUNDING (In Thousands)				
	FY 2012	FY 2013	FY 2014	FY 2015	4 Year Average
Ohio State University	\$149,341	\$155,507	\$152,592	\$144,216	\$150,414
University of Cincinnati	\$39,668	\$37,388	\$38,667	\$39,108	\$38,708
University of Akron	\$32,182	\$36,384	\$37,673	\$29,895	\$34,034
Ohio University	\$19,526	\$19,488	\$28,670	\$26,851	\$23,634
Wright State University	\$14,831	\$21,804	\$26,572	\$26,610	\$22,454
University of Toledo	\$14,532	\$16,304	\$17,699	\$13,320	\$15,464
Cleveland State University	0	\$16,568	\$19,717	\$10,513	\$11,700
Miami University	\$3,044	\$3,287	\$2,006	\$1,682	\$2,505
Youngstown State University	\$803	\$644	\$1,499	\$931	\$969
Kent State University	\$751	\$599	\$634	\$973	\$739
Bowling Green State University	\$0	\$0	\$0	\$0	\$0

Table 1.15: Engineering NSF HERD Funding Data | FY 2012 – FY 2015

Ohio Peers	RANKING			
	FY 2012	FY 2013	FY 2014	FY 2015
Ohio State University	12	12	14	14
University of Cincinnati	77	82	81	78
University of Akron	92	88	85	95
Ohio University	114	115	98	101
Wright State University	131	108	102	102
University of Toledo	132	125	125	133
Cleveland State University	UR	124	121	147
Miami University	238	194	209	215
Kent State University	237	242	238	228
Youngstown State University	236	239	215	230
Bowling Green State University	UR	UR	UR	UR

Table 1.16: Engineering NSF HERD Ranking | FY 2012 – FY 2015 | UR = Unranked

Astrophysics Research

As shown in the next section, one of the major high profile scientific publications in in astrophysics. This small group of faculty members within the Department of Physics and Astronomy have helped enhance the reputation of UT with highly cited publications in prestigious journals. In terms of funding, astrophysics faculty members have been successful in receiving awards from the NSF, NASA, and other sources. Given the size of the group of faculty members involved compared to those participating in biomedical or environmental research, it is not surprising that the amount of funding secured is not as significant as these other areas. However, it appears that UT holds standing within Ohio as one of the leaders in astrophysics research. With an average of \$1.2 million in R&D expenditures over the 2012-15 period, UT ranks second in Ohio behind Ohio State University in funding to support astrophysics research. Over this period, UT ranking ranged from #41 to #46 nationally, not far behind the OSU ranking range of #31 to 34. (Although not shown on the table, UT also ranked above Case Western in funding for FY15.)

Astrophysics is not as crowded an area of science, and UT has a small, but highly productive group that brings the institution recognition and enhances our status as a research university. Small investments in faculty lines for this area would likely lead to more significant returns to the university's reputation than similar investments in faculty lines where UT is competing against large research groups at other universities.

Ohio Peers	FUNDING (In Thousands)				
	FY 2012	FY 2013	FY 2014	FY 2015	4 Year Average
Ohio State University	\$3,152	\$3,042	\$2,845	\$2,303	\$2,836
University of Toledo	\$1,235	\$1,333	\$1,229	\$964	\$1,190
Ohio University	\$474	\$466	\$269	\$10	\$305
Wright State University	0	\$63	0	0	\$21
Youngstown State University	0	\$3	\$1	0	0
Miami University	0	0	\$2	0	0
University of Cincinnati	0	0	0	0	0
Kent State University	0	0	0	0	0
Cleveland State University	0	0	0	0	0
University of Akron	0	0	0	0	0
Bowling Green State University	0	0	0	0	0

Table 1.17: Astrophysics NSF HERD Funding Data | FY 2012 – FY 2015

Ohio Peers	RANKING			
	FY 2012	FY 2013	FY 2014	FY 2015
Ohio State University	32	31	33	34
University of Toledo	44	41	42	46
Ohio University	55	54	68	114
Youngstown State University	UR	119	122	UR
Miami University	UR	UR	117	UR
Wright State University	UR	91	UR	UR
Bowling Green State University	UR	UR	UR	UR
Cleveland State University	UR	UR	UR	UR
Kent State University	UR	UR	UR	UR
University of Akron	UR	UR	UR	UR
University of Cincinnati	UR	UR	UR	UR

Table 1.18: Astrophysics NSF HERD Ranking Data | FY 2012 – FY 2015 | UR = Unranked

Communicate the Importance of Academic Research with Public and Elected Officials

Perhaps through training, scientists and other research-oriented faculty members are cautious when speaking in public forums on the implications of their research on public policy. There is now a pressing need, however, for universities and faculty members to communicate to the public and elected officials the value of their research and the importance of continued public investment (both federal and state) in supporting university research. Part of this is through engagement with the public on specific projects. Another way is through meeting with elected officials on campus, at field sites, in Washington, D.C., or in Columbus. Providing testimony at legislative hearings can inform lawmakers on the value of evidence-based public policy. Media stories in newsprint, radio, TV or other venues can also reach the public to increase the understanding of why research matters.

Involving the public and students in research projects is gaining importance nationally. Community participation can occur through science activities where citizens are engaged in collecting data or participating in research projects directly. Bringing students at all levels into research projects can excite a new generation to the value of research and why they should attend a research university. These examples, and others, are ways that research provides a broader impact to society, an important criteria for a positive funding recommendation from agencies such as the National Science Foundation.

The Office of Research and Sponsored Programs is working with the Office of Government Relations to educate lawmakers in our federal and state delegation on the important projects underway at UT. Elected officials have visited campus and field sites; these officials have also taken faculty members to Capitol Hill and Columbus to explain projects to elected officials, and to explain the importance of federal and state funding. Our office is working with the Office of Media Relations to increase the number and depth of stories about UT research. The Office of Research and Sponsored Programs grants writer is carefully reviewing NSF broader impacts sections to

improve chances of a positive funding decision, and to engage the community in proposed projects. Work is underway to identify faculty members and students who excel in explaining their research to a broader audience, and in training others who can be ambassadors worthy of highlighting in meetings.



Theater students in UT's School of Visual and Performing Arts stage a production of *The Immortals*.

Scholarly and Creative Activity

Measures of scholarly activity vary within and across disciplines, and no single metric can capture the significance and impact of those activities. For example, in performing arts the creation of new pieces or training students for world-renowned orchestras could provide a measure of scholarly activity. In this summary, we use two general measures to assess scholarly activities. First is an analysis of publications and presentations catalogued in a number of indices that span a myriad of disciplines. The second measure of research activity is the awarding of sponsored research. We use these measures to distinguish between areas of strength at UT.

Scholarly Publications – Comparison with other institutions

A comparative analysis of indexed articles, reviews, meeting abstracts, and proceedings papers published from 2014 through 2016 for a selection of peer, aspirational, and Ohio public universities was made. Databases searched included Science Citation Index Expanded, Social

Sciences Citation Index, and Conference Proceedings Citation Indices – Science and Social Sciences & Humanities. This examination counted all publications with a university-affiliated author.

The citations per total number of items (sum of the first two columns in Table 1.19) provide an average measure of the impact of publications for each institution. The University of Toledo ranked 7th out of the 19 institutions examined, and surpassed a number of UT's peer or aspirational institutions.

Table 1.19 indexes the number of publications and number of citations in 2014 through 2016 for a selection of universities.

SCHOLARLY PUBLICATIONS – COMPARISON WITH OTHER UNIVERSITIES					
Institutions	# of Articles & Reviews	# of Meeting Abstracts & Proceedings Papers	Times Cited	# of Items	Citations per Item
University of Toledo	2,030	679	9,487	2,920	2.35
Kent State University	2,163	352	12,172	2,695	4.52
University of Cincinnati	7,520	1,864	45,518	10,113	4.50
Ohio State University	19,445	5,696	118,025	26,935	4.38
University of Texas, Dallas	3,658	1,230	19,692	5,015	3.93
Northern Illinois University	1,443	213	6,882	1,833	3.75
Bowling Green State University	847	122	2,643	1,125	3.48
Ohio University	1,931	373	7,511	2,527	2.97
University of Nevada, Reno	2,266	462	8,583	2,963	2.90
University of Akron	2,044	424	8,866	2,547	2.35
Central Michigan University	884	208	2,769	1,217	2.28
Wright State University	1,203	458	3,944	1,783	2.21
Florida Atlantic University	1,463	443	4,541	2,105	2.16
University of Memphis	1,628	428	4,658	2,188	2.13
Cleveland State University	703	229	2,077	1,001	2.07
Miami University, Oxford	1,445	329	4,035	2,031	1.99
Western Michigan University	929	319	2,491	1,395	1.72
Eastern Michigan University	333	106	817	508	1.61
Ball State University	647	105	1,180	854	1.38

Table 1.19: Scholarly Publications – Comparison with Other Universities

Current Areas of Notable Scholarly Activity

UT Libraries has assisted the Office of Research and Sponsored Programs in investigating scholarly publications of UT faculty. UT Libraries provided data on the top 100 most cited authors using the Web of Science, with a cut-off of 38 publications, who have a UT affiliation over the FY 2012-17 period. A UT-affiliated faculty member may still carry his or her UT affiliation on a publication even if that faculty left UT for another institution. It should be noted that not all publications are included, as some disciplines are not represented in the Web of Science database.

Table 1.20 summarizes the frequency of citations for the top keyword on the most highly cited articles by UT faculty members. The table shows that many keywords may cut across a number of disciplines such that faculty in one unit may have a number of keywords associated with their publications. For instance, a condensed matter physicist may have the following keywords connected with a publication: materials science, applied physics, energy and fuels, or others. Astronomy and astrophysics, which stands out as a leader in this table, probably has most of their publications connected with this keyword. The table indicates that UT faculty are publishing highly cited papers in astronomy and astrophysics; other strong areas include physical sciences and engineering. Faculty members are also clearly publishing highly cited papers across a number of biomedical and cellular fields, with keywords connected to basic research (cell biology) and others on particular diseases (oncology).

FREQUENCY OF CITATIONS FOR TOP KEYWORDS WITH HIGHLY CITED UT ARTICLES	
Web of Science Category (unique)	Number of Citations
Astronomy & Astrophysics	16
Materials Science, Multidisciplinary	8
Chemistry, Multidisciplinary	7
Multidisciplinary Sciences	6
Physics, Applied	5
Chemistry, Analytical	5
Rheumatology	4
Chemistry, Physical	4
Energy & Fuels	4
Endocrinology & Metabolism	4
Biochemistry & Molecular Biology	4
Psychology, Clinical	4
Cell Biology	3
Cardiac & Cardiovascular Systems	3
Peripheral Vascular Disease	3
Oncology	3
Sport Sciences	3
Psychiatry	3
Engineering, Biochemical	3
Materials Science, Biomaterials	3

Table 1.20: Frequency of Citations for Top Keywords with Highly Cited UT Articles

Section Summary

Data on grants and publications show that external funding has declined in recent years, with a significant drop in the College of Medicine and Life Sciences. The loss of senior research-intensive faculty, either to other universities or to retirement, took a heavy toll on research funding, and the national standing of the university as measured in total R&D expenditures. Given the loss of research funding from the State of Ohio, along with more competition for federal dollars, the absolute drop in research dollars to the University is not unexpected. However, UT's relative position compared to other universities (including Ohio peers) also declined; UT is now ranked 190th in the country in total R&D expenditures. It is important to note that this ranking is for the most recent year reported by the National Science Foundation, which is 2015. We plan to improve UT's rank to #160. Given that UT's research awards have been dropping, we expect that our national ranking in research expenditures will also drop in future reporting years, before we report increases. Thus, we expect UT's national ranking in research expenditures to fall lower than #190 before we begin to climb again in the rankings.

We plan to work with the deans and department chairs to reverse the current downward trend in awards by emphasizing the importance of research and scholarship in their colleges. We will work directly with early-career faculty members by providing them mentorship through our Scholars Institute Program to improve grantsmanship skills across campus. We also recognize that the loss of senior faculty members has a direct impact on UT's level of external funding and our ability to win highly competitive grant awards. We will work with the Provost and Deans to retain research productive faculty members, and prevent them from seeking to leave UT for other universities.

This section identifies several areas of strength at the institution, with research focus based upon external funding and publication activity. The broad categories of biomedical research and research on energy and environmental sustainability stand out. These two areas involve contributions from faculty across colleges of the university. UT also possesses other areas of note, which may not have as much disciplinary reach. These include astrophysics, centered in the Department of Physics and Astronomy, and aerospace research, centered in the College of Engineering.

Our plan is to further explore how the university can make targeted investments in the two major areas of research (biomedical and energy and sustainability) to elevate the institution's national position as a leader in these disciplines. This involves a process to engage faculty members, chairpersons, and deans to identify niche areas where UT stands out, and can gain further recognition and external support through targeted investments. Furthermore, our plan calls for engagement with the faculty to identify other areas where UT has existing strengths and the opportunity to emerge as a recognized leader.

Given the importance of federal and state funding in supporting academic research and achieving the \$80 million target for 2022, communicating the value of science to the community and to elected officials is essential to moving forward. We will continue to have a strong presence in both Washington and Columbus to explain the value of publicly funded research, and how specific federal agency support (NIH, NSF, EPA) is important to UT and Ohio. Efforts will increase to connect research to citizen engagement and work to develop a stronger presence of UT faculty researchers connected to media opportunities and elected officials.

VII. Central Research Support and Leadership

Centrality of Research and Scholarship Enhancement to the University

Successful research universities place research and scholarship as one of their top priorities as demonstrated by the support of the president, the provost, the Board of Trustees, and the faculty. The position of the Chief Research Officer within the university administration also indicates the importance of research to the university's leadership.

UT has demonstrated its strong support toward its research mission as articulated by the President of the University, the Provost, and the Board of Trustees. Of President Sharon Gaber's five goals for the University, two directly relate to enhancements in research and scholarship:

- Raise its national status by recognizing the tremendous achievements of faculty, researchers, clinicians, and students, and;
- Increase externally funded research so UT may continue to make gains in developing new knowledge in multiple fields.

In addition, the Chief Research Officer of the University holds a Vice President position and reports directly to the president as a member of her senior leadership team. At universities that do not value research as highly, the Chief Research Officer may hold a position as vice provost or director; the Chief Research Officer's Vice President position is a measure of the significance placed on research at the institution. The UT Board of Trustees expects progress in growing UT research and includes measures of sponsored research performance (proposals submitted, research awards, etc.) as part of its dashboard monitoring system. The Research Council, chaired by the Vice President of Research, provides support from the university faculty in advocating in support of research and scholarship.

In sum, research has a strong voice at The University of Toledo and the University leadership expects research to be central to the mission of the university and to life on campus.

Faculty and Graduate Student Perceptions of the Office of Research and Sponsored Programs

In Fall 2017, an electronic survey was sent out to all faculty and graduate students. A ten question survey (see Appendix E) assessed the following: demographics, involvement in externally funded projects, what additional resources or assistance they would like to receive for scholarly activities, perceptions of IRB or IACUC, what types of incentives/ resources would increase scholarship activities, what assistance and resources are most helpful in the submission of grant proposals and management of awards, what types of training programs would improve research and grant writing productivity, and if there are other resources or needed programs to increase productivity, scholarship, and creative endeavors.

Through this assessment, we collected useful data regarding ways the Office of Research and Sponsored Programs can better serve faculty and staff. Over 138 faculty and graduate students completed the survey. The majority of respondents were full professors (27%), followed by assistant professors (23%), and associate professors (18%). Almost one quarter (23%) of respondents collectively indicated that they were a dean, department chair, lecturer, visiting professor, or post-doctoral researcher. Nine percent of respondents were graduate students. In

examining past experience with an externally funded grant, just over half (51%), reported being a PI or CO-I.

The question exploring additional resources and assistance needed to help identify grants, develop proposals, and assist with submission was open-ended; a thematic analysis was conducted to determine the most common suggestions. Issues frequently mentioned related to frustration with the grants management system, long turn-around times for the processing of grants, and assistance with locating funding sources and request for proposals (RFPs). Respondents commented that low staffing levels in the Office of Research and Sponsored Programs impeded their grant development process. The hiring of additional staff and a grant writer was requested often, as was having extra staff available to review grants prior to submission. Faculty and staff voiced similar suggestions regarding additional assistance with the grants management process. Written responses focused on support in the production of current budget reports, faster processing of awards and account availability, assistance with budget management, and assistance with post-award report writing.

This assessment also measured the current perceptions of IRB. Although slightly over half (51%) felt that institutional support for IRB was adequate, respondents included several suggestions to improve the process: 1) quicker review times for submitted protocols, 2) upgrading to more user friendly software, 3) increasing the frequency of IRB review committee meetings, and 4) providing more templates and examples to assist with the development of applications. In terms of other needed resources and assistance to increase research and grant productivity, Table 2.1 provides insight to some of the most requested training programs.

WHAT TYPES OF TRAINING PROGRAMS WOULD BE USEFUL TO YOU IN INCREASING YOUR RESEARCH PRODUCTIVITY OR GRANT WRITING? (CHECK ALL THAT APPLY)		
Answers	Response Percent	Response Count
How to Identify Grant Opportunities	56.8%	63
How to Prepare an Effective Proposal	58.6%	65
How to Prepare an IRB Protocol	22.5%	25
How to Prepare an IACUC Protocol	12.6%	14
Compliance & Export Control	9.9%	11
Post-Doctoral Training	18.9%	21
Other (Please List)	26.1%	29

Table 2.1: Assessment of Research Needs | Question 8

Table 2.2 summarizes some of the requested assistance and resources.

WHAT ASSISTANCE AND RESOURCES ARE MOST HELPFUL TO YOU IN SUBMISSION OF GRANT PROPOSALS AND MANAGEMENT OF AWARDS? (CHECK ALL THAT APPLY)		
Answers	Response Percent	Response Count
How to Identify Grant Opportunities	38.3%	51
Assistance in Formation of Interdisciplinary Groups	21.8%	29
Preparing Budgets	54.9%	73
Preparation of Non-Narrative Materials (i.e. CVs, Management Plans, Facilities and Equipment)	26.3%	35
Identification of Broader Outreach Activities	16.5%	22
Grant Editing/Writing Assistance	46.6%	62
Departmental Administrative Research Support Pre-Award	22.6%	30
Statistical Consulting	27.8%	37
Student Support	18.8%	25
Additional Grants Management Assistance (Please Specify in Other Box)	6.0%	8
Departmental Grants Administrative Support Post-Award	21.1%	28
Mentoring by Colleagues in My Discipline	18.0%	24
Internal Peer Review of Grants	24.8%	33
Internal Peer Review for IRB (use of human subjects in research) Protocols	9.0%	12
Internal Peer Review for IACUC (use of animals in research) Protocols	3.0%	4
Other (Please List)	15.8%	21

Table 2.2: Assessment of Research Needs | Question 7

Lastly, Table 2.3 helps to identify which incentives/resources would be most effective in helping to increase scholarship and research activity.

TO HELP FACULTY INCREASE THEIR SCHOLARSHIP AND RESEARCH ACTIVITY, WHICH INCENTIVES/RESOURCES WOULD BE MOST EFFECTIVE? (CHECK ALL THAT APPLY)		
Answers	Response Percent	Response Count
Release Time Adjust of Teaching Loads	76.9%	103
A portion of indirect returned to college/department and PI	67.2%	90
Funding to Attend Meetings	53.0%	71
Internal Grant Competitions	47.8%	64
Recognition (e.g., Awards)	36.6%	49
Other (Please List)	30.6%	41
Cost Sharing	20.9%	28

Table 2.3: Assessment of Research Needs | Question 6

Sponsored Programs (pre-award, grants accounting, grant writer, SPIN)

Sponsored Programs assists UT researchers with all phases of the grant application and post-award process. Our grant writer assists investigators or multi-investigator teams with preparing competitive grant applications. Grants coordinators work with investigators to ensure they meet all of the requirements for their grant applications, budget development, application coordination, and submission. In addition, grants coordinators process awards following Sponsored Programs procedures, forward to compliance and contracts for completion of all required disclosures and training, and work with Grants Accounting to set up the accounts to manage funds. Grants Accounting is a division of the Office of Finance and Administration, is responsible for the financial management of all research awards, and plays an integral part of the research enterprise.

Figure 2.1 displays the normal process for setting up awards upon notification from an external sponsor involving the Office of Research and Sponsored Programs and Office of Grants Accounting.

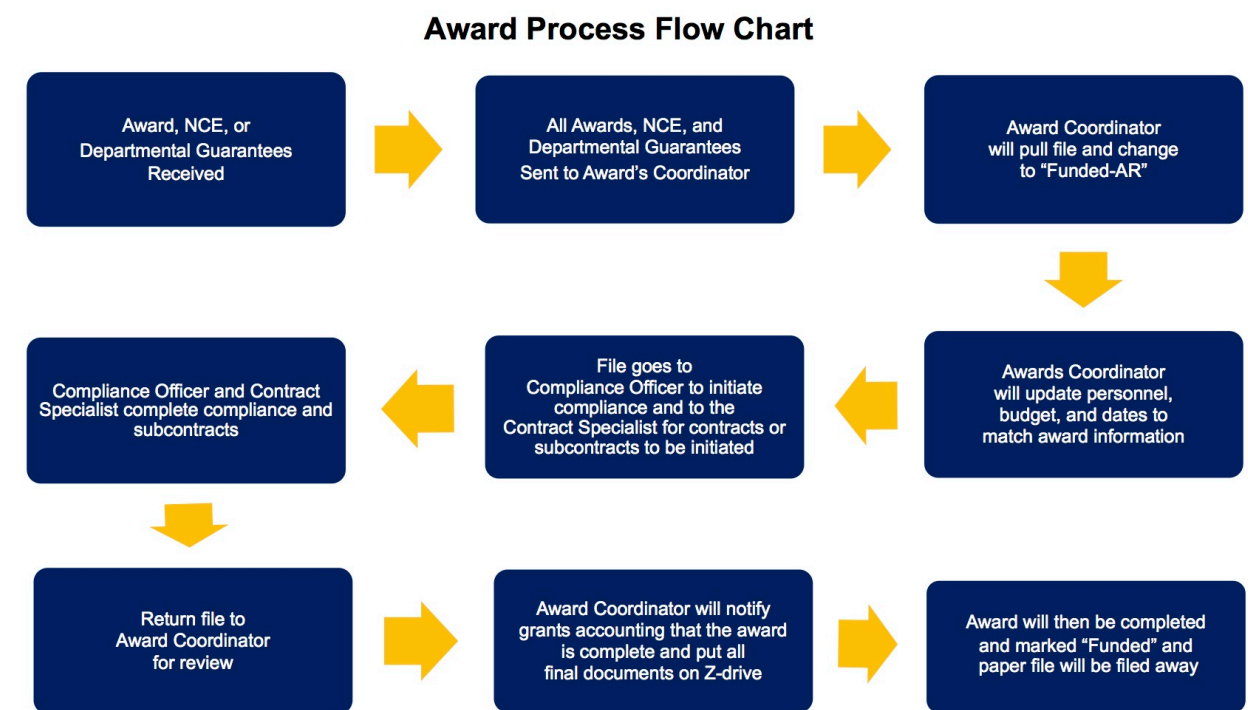


Figure 2.1

Staffing investments to the Office of Research and Sponsored Programs have increased the number of grants coordinators to provide better support for grants development and submission. It is important that office staff are current in the latest grant and contract requirements of federal and state agencies. We plan to increase the training and continued education of grants coordinators and others in the Office of Sponsored Programs. Depending upon the availability of travel funds, we will encourage their active participation in national organizations such as the Society of Research Administrators (SRA) and the National Council of University Research Administrators (NCURA). Not only will participation in conference and workshop events increase their level of participation, this will help them connect to a broader community of professionals as resources in addressing new questions.

In addition to highly qualified Grants Coordinators and other Sponsored Program staff to assist in grant submission and award follow-up, UT faculty, staff, and students have access to the world's largest database of sponsored funding opportunities through SPIN Infoed Global®. This database provides access to more than 40,000 funding opportunities ranging from federally sponsored programs, state based grant opportunities, non-profit agency funding, and private or corporate opportunities. By utilizing this database, simple or complex searches can assist investigators with locating opportunities.

Technology Transfer and Commercialization

The Office of Research and Sponsored Programs has a number of programs and offices dedicated to support the transfer of UT technology into the marketplace, and support commercialization through the development of both UT spin-off companies and other new companies through incubation activities. Support ranges from early stage assistance in the development of technologies and ideas that display market potential to assisting companies in entering the market.

In order to remain current and competitive, research universities must engage in innovation and entrepreneurial activities, including the support of technology commercialization. In 2012-2013 the Ohio Department of Higher Education released a comprehensive report centered on the condition of Higher Education in Ohio, with a strategic focus on advancing Ohio's innovation economy (Ohio Department of Higher Education, 2013). This report concludes that in order for Ohio to position itself to compete and lead in the global innovation economy, we must create conditions that support enhanced levels of technology transfer and commercialization. To accomplish this goal, ten recommendations are outlined to guide the state, universities, and industry:

1. Increase availability of capital from proof of concept to mature venture funds.
2. Create university systems and develop strategies that promote a culture of entrepreneurship.
3. Universities should create entrepreneurial programming allocating additional resources, including and above curricular activities.
4. Create state policy support for entrepreneurial activities, including development of statewide and regional strategies focused on the knowledge-based economy, and support the adoption of policies that will create, recruit and retain high tech businesses and the talent to run them.
5. Better align education with emerging needs for STEM, and train skilled workers needed for growth realized through increased commercialization activities.
6. Industry, private, and higher education should work collaboratively—with government support—to develop an entrepreneurial ecosystem that addresses the various needs of technology ventures.
7. Universities should provide incubatory capacity for faculty and industry collaboration to occur, and nurture startup companies.
8. Create a platform to gather and publicize performance of key commercialization metrics in order to make decisions regarding how and where to apply the critical resources needed to grow these activities.
9. Universities should seek long-term relationships with key corporate partners, including and beyond licensing and service agreements.
10. The state should create a portal to promote the aforementioned activities and make it easier for industry to interact with faculty who have interest in research partnerships.

At the time of this report, The University of Toledo was, in many ways, a leader in this area and therefore responsive to the recommendations, with notable accomplishments in numbers 1, 2, 3, 4, 5, 6, 7 and 9. The outcome of these activities has resulted in robust innovation, entrepreneurship, and commercialization assets, as well as strong partnerships with public and private entities who have also invested in this area of development. The assets developed have positively affected students, faculty, staff, and the region – they include:

ASSETS DEVELOPED BY UT COMMERCIALIZATION EFFORTS	
Activity	Recommendations Addressed
Strong Technology Transfer	1, 2, 3, 6, 9
LaunchPad Incubation	1, 2, 3, 4, 5, 6, 7, 9
Rocket Innovations	1, 2, 3, 6
Minority Business Development Center	2, 4, 6, 7, 9
Minority Business Assistance Center	1, 2, 4, 9
EDA i6 – Rocket Fuel Fund	1, 2
Entrepreneurial Services Provider Program (ESP)	1, 2, 3, 4, 6, 7, 9
SBA Accelerator Challenge	1, 2, 3, 7, 9
I-Corps Site	1, 2, 3, 4, 6
SBIR/AIR Grant Initiatives	1, 2, 9
TVSF I & II	1, 2, 3, 9

Table 2.4: Assets Developed by UT Commercialization Efforts

Each of these programs is a unique element to the strong innovation ecosystem The University of Toledo has built, and each are critical to the success of entrepreneurial programming and culture development, and overall commercialization efforts.

Technology Transfer

The University of Toledo (UT) technology transfer team provides professional services to faculty, staff, and students as they develop commercializable innovations that create new jobs and economic growth for the local community and beyond. The team works to facilitate the transfer of UT-developed creations, discoveries, and innovations to the marketplace. Primary duties include guiding inventors through the process of protecting and licensing university-developed intellectual property, identifying and helping to secure funding, including grants and sponsored research opportunities for further development, and working with inventors to help validate their platform technologies as commercially valuable or form spin-off businesses.

Other functions of the technology transfer team include:

- Assisting with invention disclosure forms
- Analyzing commercial potential of creations, discoveries, and innovations
- Obtaining protection for intellectual property and marketing technologies to potential licensees

- Preparing and executing agreements including confidentiality, material transfer, industry-sponsored research, inter-institutional memoranda of understanding, and licenses
- Developing and maintaining relationships with industry to get feedback on new technologies and execute agreements

UT's technology transfer metrics stand among the highest performers in the State of Ohio.

Incubation and Commercialization

- **LaunchPad Incubation**

LaunchPad Incubation (LPI) is a UT-based technology incubation program focused on taking UT and regional business ventures from concept to commercialization, providing a framework for companies to become thriving, self-sustaining members of the community. The program works to bolster innovation in our region by providing access to capital, business development resources, and expertise focused on enhancing community collaboration and communication for entrepreneurial development. In that pursuit, LPI offers:

- Business model development: We focus on a “lean launch” methodology, featuring the NSF-backed Business Model Canvas, which supports evidence-based entrepreneurship.
- Hands-on business coaching and mentoring: LaunchPad Incubation pairs start up participants with advisors in their industry who can provide key information and expertise.
- State-of-the-art facilities: We offer private offices of varying size, lab space, co-working facilities and meeting rooms, and newly updated features like a UT Makers Space and a multimedia center.
- Access across UT: Resources from UT's entire campus community, from Main Campus to the Health Science Campus and the tech corridor, are available, including students, faculty, technology and tech experts, and companion startups in LPI.
- Essential networking opportunities: Monthly tenant mixers, mentor meet and greets, and other events offer introductions to top business leaders within various industries.
- Access to capital: We work closely with the primary funding sources in our region—and beyond—to provide access to funding and investment opportunities.
- Rooted within Research: LPI is rooted within UT's Office of Research, providing access to UT technology and talent assets. Additionally, this provides a robust team to support our activities, like UT's technology transfer office and pre-seed fund, Rocket Innovations.
- NSF I-Corps Site Program: The goals of this program are to spur technology to market, encourage collaboration between academia and industry, and to train our region in innovation and entrepreneurship. NSF funding through I-Corps Sites enables academic institutions to support teams whose projects are likely candidates for commercialization.

- **Facilities**

The University of Toledo entrepreneurial ecosystem is comprised of three primary facilities: Research and Technology Complex 1, The Nitschke Technology Commercialization Complex, and the Laboratory Incubation Center. The ‘specs’ of these buildings are unique and customized for the needs of our researchers and clients. They include:

- **The Research & Technology Complex 1 (R1)**

A 42,489 square foot mixed use facility. The building houses 12,000 square feet of office space, 4,000 square feet of wet and dry lab space, 4,000 square feet of undeveloped flex space, and 19,000 square feet of common space. Various types and sizes of lab, office, and other spaces are available within the building. The building offers state-of-the-art conference rooms for tenant use, furnished with Mediascape equipment that easily enable video conferencing, presentation projection, and multimedia playback. A fully outfitted training room is available for all building occupant use, designed for simultaneous accessibility by multiple parties. Both floors of the building have full kitchen areas equipped with refrigeration and cooking capability, including a full range on the first floor. The second floor provides a modern seating area for building tenants to use for lunch and break times, relaxed meetings over coffee, and small daytime receptions of guests.

- **The Nitschke Technology Commercialization Complex (NTCC)**

NTCC is a recently constructed, 40,000 square-foot facility that boasts large, customized spaces to fit the needs of hi-tech companies. NTCC is our flagship facility, which supports wet and dry labs, light manufacturing, bio-medical manufacturing, rapid prototyping, collaboration space, and varying types and sizes of offices. The NTCC can accommodate small businesses and their rapid growth to effectively serve its clients, starting from one person in the group workstation center, and evolving to open environments of up to 3,000 square feet of customized space. As companies grow, our larger spaces include capabilities for light manufacturing, wet and dry lab, an ISO 7 clean room, and medium and large office spaces. This building also offers client amenities such as state-of-the-art conference rooms with tele/video conferencing capabilities, a multimedia center for hi-quality video production and editing, and a Maker Space for 3D printing/prototyping. Both floors of the NTCC have kitchen areas equipped with refrigeration, microwaves, and nook seating for meal preparation and eating.

- **The Laboratory Incubation Center (LIC)**

LIC is designed with science and technology businesses in mind. This facility is a unique combination of wet and dry labs and office spaces, accommodating companies at every stage of size and growth, from incubation to acceleration. The incubator is designed for those companies that require sophisticated wet and dry laboratory facilities, and that can benefit from access to a variety of university resources. With 18,000 square feet of space, there are seven wet labs ranging in size from 178 to 446 square feet. The flexible design of the spaces in the incubator enables clients to customize their space for individualized needs. Modifications for any variety of life science, engineering, or chemistry-based companies are well within our capabilities. Available building spaces provide the basic setup for use as a wet or dry lab environment. The laboratory spaces are furnished with phenolic resin or epoxy coated tabletop and bench work surfaces, cupboard space offering ample storage, and is ready for easy installation of chemical vapor hoods wherever needed.

Since inception in 2014, LPI has focused on the importance of basic and translational research and we are proud to support the continuum from lab to launch. In that time, we have focused our efforts on supporting student- and faculty-led technology commercialization projects side-by-side with regional technology ventures tied to UT. Our work has produced great results for the institution and the region, with over 170 jobs created, over \$8M in professional investment, and 4 program graduates. As LPI continues to evolve, its clients and the entrepreneurial culture mature, we expect those numbers to grow, ultimately increasing economic impact. Goals for 2017 - 2022 include: 1) seven

companies graduate and become self-sustaining businesses contributing to the region, 2) create 250 jobs, 3) \$12M in professional investment raised by participating companies, and 4) assist 150 faculty, staff, and students with various entrepreneurial and innovative activities.

We must implement specific strategies in order to seed this growth:

1. Complete the build out of core facilities
 - NTCC is the flagship facility for the LPI program, however it is only 85% renovated. By 2022, we will complete the internal construction and have the ability to rent at full capacity.
 - The LIC is an important laboratory facility, especially as we continue to build basic and translational research commercialization activities. By 2022, we will install ventilation hoods in 7 labs in order to be at full capacity.
2. Grow the professional investment, service provider, and mentor networks in order to provide all the necessary resources to bring ventures from the lab to the marketplace.
3. Become self-sustaining, leveraging grants, rent revenue and program graduates

- **Rocket Innovations**

Rocket Innovations is an investment arm of UT's commercialization portfolio; it began with a \$10 million investment of university auxiliary funds. The goal is to invest in promising start-up companies connected to UT, which would result in an evergreen fund from returns on these investments, so the university could continue to assist new technology companies. Rocket Innovations is a separate company from UT, with the University as its sole member.

The return on investment to date has not been as anticipated. Consequently, Rocket Innovations is unable to invest in new ventures and is now working to manage its portfolio of remaining companies. Over the 2016-17 academic year, we sought external funding support from grants and contracts to supplement the salary of the Rocket Innovations' Executive Director so the program could continue. Changes were also proposed to reduce the Board of Directors to five members. We successfully secured external funds to continue Rocket Innovations, with its focus on the management of its current portfolio companies, and changes to the Board of Directors will be made in FY18.

- **Minority Business Development Center**

The University of Toledo Minority Business Development Center (UTMBDC) mission is to foster an environment that offers assistance for minority-owned, early-stage firms. The UTMBDC will help nurture entrepreneurial and economic development in the Toledo community by providing office space, training, mentoring and a network of professional advisors.

Located on The University of Toledo Scott Park Campus, the UTMBDC provides an ideal environment to help a selected number of established minority owned businesses grow. Working in partnership with local, community-based business professionals, the UTMBDC provides information, essential services, and networking resources to assist early-stage companies. The center helps entrepreneurs turn their ideas into viable businesses, promoting innovation and job creation. This strengthens the economic fibers of the community, benefiting everyone. The UTMBDC does not replicate existing services available to businesses or organizations; rather, it complements these services through a focus on minority-owned companies.

The UTMDC has been in operation since 2009, and MBDC companies reported \$15.5M in sales among its 11 members and 11 affiliates.

- **Minority Business Assistance Center**

The Minority Business Assistance Center (MBAC) Program serves the needs of Ohio's small, minority and disadvantaged businesses by providing important services at no cost. The MBAC provides MBE and EDGE entrepreneurs with management, technical, financial, contract procurement, and certification assistance, in addition to loan and bond packaging services.

The University of Toledo began to host this program in 2015 and met all state key performance metrics in that time: MBAC worked with 211 new clients and developed 68 business plans. Based on the success of the current MBAC program, The University of Toledo secured a \$330,000 grant renewal for FY18/19 to continue the center. Over the next grant cycle, the MBAC will engage 1,000 clients, help obtain 60 MBE and 50 EDGE certifications resulting in \$10M in public sector awards for clients, and create and retain 250 jobs.

- **EDA i6 Challenge – Rocket Fuel Fund**

In 2016, The University of Toledo was awarded an EDA i6 Challenge grant, with the purpose of creating a fund for technology maturation of IP from UT and other research institutions in Northwest Ohio. This award allows us to expand our funding opportunities for entrepreneurs, and provide a grant opportunity for funding the best commercialization opportunities from academic and other non-profit institutions throughout Northwest Ohio: University of Toledo Rocket Fuel Fund (UTRFF).

The goal of the UTRFF is to provide funding to advance development of potentially valuable technologies to a point at which industry can justify funding to support additional R & D, execute a license agreement, or establish a new commercial venture. The UTRFF seeks early stage technologies with a strong market potential in the following areas: Advanced Manufacturing; Advanced Materials; Biomedical/Life Sciences; Drug Development; Energy/Smart Energy Solutions; Medical Devices; Sensors, and; Software/Information Technology.

The UTRFF hopes to fund up to 10 proposals annually over the next three years.

- **Entrepreneurial Services Provider Program (ESP)**

In 2017, The University of Toledo collaborated with ProMedica, Bowling Green State University, and Mercy Health Systems to create a Northwest Ohio Entrepreneurial Services Provider Program. The goal of the ESP Program is to significantly increase technology-based, entrepreneurial commercialization outcomes, and to focus the effort on strategic technology-based sectors that offer exceptional economic development prospects. Each ESP represents a coordinated network of high-value services and assistance providers that is visible and easily accessible to technology-based entrepreneurs and small tech-based companies. Each ESP provides an approach that tightly integrates sources of deal flow, entrepreneurial support, and capital to grow technology-based entrepreneurial commercialization outcomes. The Northwest Ohio ESP received over \$4M and created a hub called NextTech, while also providing funding to each partnering organization to provide services to regional technology entrepreneurs. The grant runs through 2018, at

which time the team will be eligible to reapply with the goal of continuing the activity and building additional services for the Northwest Ohio region.

- **SBA Accelerator Challenge**

Through LaunchPad Incubation, The University of Toledo was named an SBA Accelerator through the SBA Accelerator Challenge Program in 2016. This funding allowed for the creation of the Site to SBIR program. When an idea or tech is identified, we introduce them to our “Site to SBIR” program. Each team must first participate in one of our regularly scheduled NSF I-Corps Site-level programs, which includes a 4-week course on basic market validation and value proposition design. Once through the Site, teams apply for the NSF I-Corps National program, a more intensive 7-week course. After that course, each team receives \$50,000 and returns home where we assist in preparing their application to the SBIR program most suited for their technology. It has been statistically validated that teams completing an NSF I-Corps program are 60% more successful on an SBIR application. Our goal is to bring every qualifying technology through the continuum described above. Each team moving through the Continuum process receives support from LPI through each step, and has automatic acceptance to the LPI program upon SBIR approval.

- **I-Corps**

The University of Toledo was named one of the first four NSF I-Corps Sites in the nation in 2014. The initial focus was an interdisciplinary student-based program including Senior Design, Business Law, and Entrepreneurship. This was a successful experiential learning program; however, it did not produce the quantifiable outcomes the NSF desired (ex: companies created, teams moving to I-Corps National, etc.). Therefore, in 2016, we created the Introduction to Customer Discovery Program in order to support a more traditional, faculty-based I-Corps team program, and served more than twenty-five teams in the first year alone. This activity led to The University of Toledo being ranked at #1 for I-Corps National teams in 2016 and #6 in the nation for number of teams overall. In early 2017, the I-Corps Site was renewed for three additional years at \$300,000. Over the next grant cycle, we will hold four Intro to Customer Discovery courses serving thirty teams annually. Of the thirty site teams, our goal is to qualify eight teams for the I-Corps National program, resulting in four new SBIR/STTR/AIR grant proposals.

- **SBIR/AIR Grants**

The Small Business Innovation Research (SBIR) program is a highly competitive program that encourages domestic small businesses to engage in Federal Research/Research and Development (R/R&D) that has the potential for commercialization. Through a competitive awards-based program, SBIR enables small businesses to explore their technological potential and provides the incentive to profit from its commercialization. By including qualified small businesses in the nation's R&D arena, high-tech innovation is encouraged and the United States gains entrepreneurial spirit as it meets its specific research and development needs. The SBIR is a great program for technological and commercial advancement utilizing non-dilutive funding tools. Through our Site to SBIR program, the I-Corps Site and National Program, the TVSF and our internal program efforts, we have helped faculty apply for six SBIR/AIR grants, with one awarded and kicked off and five awaiting decision. Moving forward we will continue to build upon and leverage these programs to apply for four SBIR/AIR grants annually.

- **TVSF I & II**

The goal of the Ohio Third Frontier Technology Validation and Start-up Fund (TVSF) is to create greater economic growth in Ohio, based on start-up companies that commercialize technologies developed by Ohio institutions of higher education and other not-for-profit research institutions. The Technology Validation and Start-Up Fund:

- a) supports protected technologies developed at Ohio research institutions that require validation/proof it will directly impact and enhance both their commercial viability and ability to support a start-up company, and
- b) supports Ohio start-up and Ohio young companies that license validated/proven technologies from research institutions.

In the past The University of Toledo, through its Technology Transfer department, has had substantial success in TVSF Phase I and Phase II grants, securing a significant number of grants in each cycle—a total of 20 grants, placing **UT 2nd in the state for TVSF grant awards**. The TVSF program is an excellent way to secure non-dilutive capital for faculty-based projects, and assist with validating the technological and commercial merit of a company.

FUNDING HISTORY OF UNIVERSITY RESEARCH FUNDING OPPORTUNITY (URFO) PROGRAMS								
	deArce-Koch Mem Fund	Interdisc Research	Summer Fellowship	Biomed Research Innov	STEM Research Innov	Phase 0 SBIR	Proposal Prep Mini- Grants	Total Distributed
URFO Funding FY 11 – FY 16	\$559,623	\$607,031	\$778,127	\$134,000	\$40,000	\$24,000	\$19,010	\$2,207,891
Resulting External Awards FY 12 – FY 16	\$4,936,052	\$4,535,639	\$2,145,991	\$0	\$0	\$147,418	\$417,275	\$12,182,375
Ratio of Seed Grant Funds to External Awards to Date (May 2017)	8.82	7.47	2.76	0.00	0.00	6.09	21.95	5.63

Table 2.5: Funding History of University Research Funding Opportunity Programs and Return on Investment

Internal Grant Programs

The University of Toledo has long maintained a suite of seed grant programs aimed primarily at junior faculty. The University Research Funding Opportunities (URFO) are internal grant programs administered by Research and Sponsored Programs to support the diverse range of faculty research and scholarship at UT. These awards provide support to meritorious projects, stimulate new research and scholarly endeavors, support new faculty in developing on-going programs of research and scholarship, and help senior faculty move in new directions. These awards also

provide support to help faculty gather preliminary data to enhance their ability to compete for external awards. To be eligible, the PI must be a full-time, tenured or tenure-track faculty member at UT and must be on campus during the full academic year of award. The University Research Council provides guidance for these internal programs, and evaluates proposals.

Analysis of the external awards to URFO award recipients from FY 2011 through FY 2016 indicates that the programs have been quite successful, with \$2.2M over 6 years (\$560K from a Foundation endowment) yielding over \$12M in external funding to date, for a return ratio of 5.63. Final reports show a strong record of presentations and publications resulting from the programs.

Facilities and Administrative Costs and Research Support (F&A)

Facilities and Administrative Costs (F&A) are federally negotiated rates that reimburse universities for the “pooled” costs of supporting research that cannot easily be directly applied to individual projects. Costs include those for facilities, such as research laboratories, and for administrative services, such as those provided by the Office of Research and Sponsored Programs, Grants Accounting, Purchasing, Payroll, and other administrative offices. It is important to note that these costs help defray the cost of supporting research activities and should not be assumed a “profit.” Private research organizations often have F&A rates above 100% to account for the cost of operating a research enterprise.

The University of Toledo has two approved rates, one for each campus. Beginning July 2017, the rate for research for the main campus will be 49.5% and for the Health Science Campus 53.5%. One of the goals in this plan (Focus Area #2) is to re-evaluate and revise the F&A distribution policy to incentivize faculty research. For the main campus, central administration holds 70% of the F&A to support pooled activities such as mentioned above. Of the remaining 30%, 20% is provided to the department of the faculty member or members who are the investigators on the project. The remaining 10% is distributed to the respective dean. There is no uniform policy across campus providing direction on how departments or deans should incentivize faculty members through a direct return of these funds. The College of Medicine also receives 30% of the total F&A, but has its own policy to provide an additional distribution to faculty members who secure multiple grants.

Our position is that faculty PIs and their department chairs should have a distribution of funds to empower them to support research, without needing to request support from the Office of Research and Sponsored Programs for activities such as journal page charges, conference travel, small item purchases (e.g., laptops), and instrumentation upgrades or replacements. In addition, such funds should be held in designated accounts that are not swept at the end of the fiscal year, so that the PI and chair have an account that is available for contingencies (unexpected equipment failure).

The Office of Research and Sponsored Programs will work with the Office of Grants Accounting, the Provost Office, and the University Research Council to develop a campus-wide policy on F&A distribution to support and empower faculty research.

Matching Funding

The Office of Research and Sponsored Programs has limited funding to support matching needs for selected projects. Matching funds for proposals are available depending upon the requirements of the agency or program, and the centrality through which the proposal supports the research and educational mission of the Institution. Matching may be in the form of direct cash or in-kind support.

The first priority for university cash matching funds are for proposals to competitive research agencies or foundations where matching funds are required. In these cases, the office will provide \$2 for every \$1 dollar provided by the PI's College and/or department. Proposals that do not require matching may be eligible if institutional matching funds will enhance the likelihood of a positive review. An example would be a request for funding to obtain or upgrade a unique instrument that is not an eligible expense on the proposed grant itself. The Office may provide \$1 for every \$1 dollar provided by the PI's College and/or department.

Other lesser priority contributions would be for projects not clearly aligned with the academic mission of the university.

Compliance (IRB, Electronic Grants System)

The University of Toledo provides oversight and management of compliance in research through a number of offices reporting to the Vice President of Research. Compliance with federal and state regulations and policies is imperative for the conduct of research at a university. Violations may result in a suspension of federal funding for research, penalties, or even legal action resulting in prosecution. The University of Toledo thus must take research compliance very seriously.

A challenge for UT, and for institutions of our size, is that we must provide support for all elements of research compliance that apply to a complex university with programs in a broad range of disciplines, including medical research involving human subjects, animal research, export control issues, and radioisotopes and biohazards. For instance, with just over 800 faculty members, UT must provide comprehensive support for research compliance across the same range of areas as the University of Michigan with over 3,000 faculty members. Support of many compliance programs, such as human subjects protection, review of animal research protocols, committees for handling research misconduct cases, requires faculty participation. UT lacks the deep pool of faculty with expertise, typically available at a larger research university, to support these programs. As a result, this places an increased burden on faculty to support compliance programs.

- **The Department of Human Research Protection (DHRP)**

DHRP is the administrative office for the university's two Institutional Review Boards (IRB). These boards (one for biomedical research, one for social-behavioral and educational research) reviewed approximately 1,200 IRB-related actions over the last fiscal year.

The department reports on the number of new and ongoing human research activities to the university administration and research community on a monthly basis, and in an annual summary. The University's Federalwide Assurance with OHRP and Institutional Review Board rosters are managed and updated as needed by the department Director in compliance with federal requirements. The FDA performs routine (not for cause) audits of drug and device trials approximately every five years. FDA-regulated research at The University of Toledo was audited in 2008 and 2014, and the human subjects protection program at UT received no citations for either visit. Currently, three IRB Coordinators/Analysts and one Director support the administrative requirements for all biomedical and social/behavioral research at the institution.

In addition to the DHRP staff, the university employs two, full-time compliance officers to cover different areas. One coordinates and monitors research involving animal subjects, biohazardous materials, recombinant DNA, and toxins on campus for compliance with all federal and local laws, University policies, and compliance with funding agency agreements and contracts. Funded grants and contracts are reviewed for congruency in proposal to protocol relationships.

Central university funds support the DHRP with the expectation that cross-departmental charges and charges to external users will supplement the budget. Revenue from these sources has decreased because of a decline in research activity, a loss of staff to support accepting external projects, and frustration from faculty and administrators in using the required electronic research administration system (Kuali Coeus). Open positions in the Department went unfilled for much of this year, as we waited for clarification on a joint IRB with ProMedica, as part of the affiliation agreement. The Department also reviews protocols for underfunded and student (unfunded) projects.

The implementation of a new electronic research administration system will ease some of the frustration and administrative burden, but this will not be available until mid to late 2018. Meanwhile, administrative review of protocols for unfunded projects and student projects at the dean or academic chair level prior to submission to the IRB can reduce workload in the department. Departments and colleges should also be charged for the review of these proposals.

The Department will develop a new fee structure to better reflect the cost of maintaining its operations, but central support is still required.

- **Conflict of Interest**

All individuals involved in the design, conduct, and reporting of sponsored projects are required to complete an annual disclosure of financial interests, as well as project-specific disclosures of relevant interests. In those cases, where a conflict of interest is identified, the conflict is either managed through a documented plan, or is not allowed.

UT employs a second compliance officer in the sponsored programs office to screen projects and persons for other compliance concerns, including COI, export control, and restrictions on persons and publications. This employee uses Visual Compliance subscription software to confirm that persons engaged in sponsored research projects do not match the names of persons who are debarred or otherwise inappropriate choices. This software provides a further benefit by notifying the compliance officer of any future matches of names against the list of persons checked at the time of setup. Foreign person restrictions in sponsored agreements are noted, and trigger the validation of citizenship status before being added to a project.

Difficulties in confirming current status of disclosures has resulted in delays in the processing of grant awards. Part of the problem relates to the timely submission of documents by faculty and students, along with workload exceeding staff capacity in the Office of Research and Sponsored Programs. We are working to address problems in this area.

- **The Institutional Animal Care and Use Committee (IACUC)**

Annual reports are submitted to Office of Laboratory Welfare (OLAW) and the USDA. The committee conducts semi-annual reviews in March and September to inspect on- and off-campus facilities and conduct post-approval protocol audits, which are then submitted to the Institutional Official. The Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) accredits the University every three years, which is a critical component for access to funding streams such as the Department of Defense, NIH and NASA, etc.

- **The Institutional Biosafety Committee (IBC)**

Annual reports are submitted to the Office of Biotechnology Activities at the NIH. They are also notified when there has been a change in membership. Activities are monitored to assure compliance with DHHS, adherence to NIH Guidelines for Research Involving rDNA, and the local and state DOH.

- **Training Requirements**

Training requirements are monitored by use of training completion updates from the CITI system into a UT personnel database, and checked against requirements for projects and protocols.

- **Export Control**

Export control regulations are intended to control the release of commodities, technologies, technical data, software code, and services to non-US persons and foreign countries for reasons of national security or foreign policy. UT is committed to identifying research, educational, and operational activities subject to export control restrictions, and ensuring we conduct all activities in compliance with applicable regulations.

Restrictions are based on specific commodities, technologies and services, end-users, and governments. Principal sources of regulations include Export Administration Regulations (EAR) administered by the Bureau of Industry and Security (BIS) of the U.S. Department of Commerce; International Traffic in Arms Regulations (ITAR) administered by the Office of Defense Trade Controls of the U.S. Department of State; Office of Foreign Assets Control (OFAC) Country Sanctions administered by the U.S. Department of the Treasury, and; the Denied Persons Lists.

- **Growth and Progress in Export Control Compliance**

- The past 3 years has seen a significant increase in research funding with export control restrictions, resulting in an 86% increase in the need for technology control plans.
- UT has received research awards declined by other universities that are unable to accept restricted research.
- Screening of persons extends to departments throughout UT, with the total numbers of persons screened approaching 15,000.
- Export Control training has been customized and completed at a variety of departments, with the following results in the past 3 years:
 - commodity jurisdiction and classification requests have increased monthly,
 - restricted party screenings have increased monthly, and
 - additional trainings have been requested by affected departments.

- **Conclusions Regarding Compliance**

UT is in compliance in all of the aforementioned areas, but the current system could gain significantly in speed, efficiency, and reduction in faculty burden. We expect the implementation of an integrated software solution to address these issues, with more efficient means for both researchers and research administration staff to update and confirm compliance requirements for research projects.

Compliance is a shared responsibility with all campus members, and a culture of compliance is necessary to meet federal, state, and university standards and to ensure the expedient processing of grants and contracts. In some cases, faculty members fail to provide timely disclosures or complete forms as necessary, resulting in delays in processing awards or contracts. We will be working to provide better campus-wide education on the importance of working with our office on compliance matters, and will involve deans in cases where faculty members do not complete required documents.

Electronic Research Administration System

Faculty across campus have expressed dissatisfaction with the support provided by UT's electronic research administration system. UT decided to implement a Quali Coeus system for the entire research environment (pre-award, post-award, IRB, IACUC, compliance, etc.). UT rolled out the IRB module in 2015, to the frustration of many users of the IRB. After consultation with faculty and staff involved with the IRB, coupled with the slow rollout of Quali Coeus as a comprehensive product for UT, we made the decision in Fall 2016 to move away from Quali Coeus in favor of a more robust system. We are evaluating other options for a comprehensive system for implementation in the 2017-18 academic year. An RFI has been posted, and a selection process following an RFP is expected to conclude by Fall 2017.

Research Misconduct

The Office of Research and Sponsored Programs ensures high standards for research integrity. Allegations of research misconduct are dealt with in strict accordance with a process described in university policy. The Vice President for Research serves as the University Research Integrity Officer. The Research Council is involved in all cases of alleged research misconduct. The Vice President of Research reports research misconduct in research funded by PHS annually to the Office of Research Integrity (ORI).

Over the course of the 2016-17 academic year, the Office of Research and Sponsored Programs and the University Research Council handled six cases of research misconduct. Of these six cases, four cases involved a formal investigation. In addition, the Office handled a case of a faculty member violating Ohio's ethics policy on nepotism relating to a grant. This document recommends that UT require all active research investigators to complete training in the responsible conduct of research for their discipline, and complete Ohio Ethics training.

Also during the 2016-17 academic year, the Office of Research and Sponsored Programs worked with the University Research Council to update and revise the research misconduct policy. This ensures consistency with federal compliance policy (PHS, NSF, and NEH) and eliminates problems the current policy created in setting up panels and committees and in the conduct of the work of these panels and committees. Furthermore, the new policy narrows its scope toward issues relating to misconduct in research and scholarship, not misconduct relating to instructional matters that do not involve research or scholarly activity used for wider dissemination.

Research Council

The University Research Council is a body of faculty that provides guidance to the Vice President of Research in advocating and supporting research and scholarship on campus. The Council recommends funding for internal grants programs, evaluates proposals for the creation of new centers and institutes, evaluates and approves university research policies, participates in addressing cases of research misconduct, and provides input into the selection of research areas of focus. Thus, the Research Council will have significant responsibilities in the implementation of this strategic plan.

In accordance with The University of Toledo Policy 3364-70-03 – Research Council (see Appendix B), the University Research Council is comprised of a combination of appointments by the President, Faculty Senate, and Graduate Council Executive Committee, as well as through ex officio membership. Members of the Research Council represent disciplines including Medicine–3 representatives, Engineering–2 representatives, Natural Sciences–2 representatives, and one representative each for Education, Health Science, Human Service, Business, Law, Nursing, Pharmacy, Arts, Social Services, Humanities, and the Libraries. The length of service varies with the appointment basis:

- Faculty Senate Appointment Term – 3 years
- Graduate Council Executive Committee Appointment Term – 3 years
- Presidential Appointment – 1 year

Meetings are held monthly and alternate between the University's Main and Health Science campuses.

Summary

The Office of Research and Sponsored Programs provides faculty with the support expected at a research university. Given the breadth of disciplines at the University, the Office must provide support to projects dealing with human subjects, animals, export-control issues, faculty start-up businesses, and challenges such as allegations of research misconduct.

Although the Office of Research and Sponsored Programs has all of the essential elements in place, feedback from the faculty survey demands improved customer service. The Office hired additional staff to improve support, and plans to increase the professional training of current office staff. As new positions were added over the course of the 2016-17 academic year, staff has been consolidated into two major locations to help with cross-trained support. In addition, the Director of the Office of Grants Accounting has an office in the main campus grants office to increase communication between the award process and budget set-up. A proposal has gone to the Office of Facilities Planning to relocate the entire Office of Grants Accounting in the R1 building to have a one-stop location for pre-award, compliance, contracting, post-award, and grants budgeting. The relocation of the Office of Grants Accounting is a recommendation of this report.

VIII. Overview of Centers and Institutes

Organized research centers and institutes bring faculty and students together around particular areas of inquiry, outside of the normal hierarchy of academic departments and colleges at The University of Toledo. Institutes and centers may bring together scholars to focus on an area within a particular discipline, or serve scholars across disciplines who benefit through collaboration with colleagues who share a particular interest or wish to use specialized equipment or data sources. UT has a number of centers and institutes, but few have the self-sustaining external funding that is normally associated with best-performing centers and institutes at national universities. Best practices call for a separate budget to support the activities of the center, funding to support the center director, and funding to support a program of activities. The enhancement of selected centers and institutes is important to support designated areas of research excellence at UT.

The following list includes research-oriented centers or institutes that have been reviewed and approved by the UT Research Council, or are currently under review.

- **Center for Drug Design and Development (CD3)**

College of Pharmacy and Pharmaceutical Sciences

The CD3 has an established network of expert resources and capabilities that generally span the entire spectrum, from the discovery of fundamental research concepts and initiation of new therapeutic paradigms, to the submission of IND activities and related clinical investigations. Any component or mix of components, from this network can be brought to bear on problems of interest to the private sector.

In addition to its network within UT Main Campus (MC) and the Health Science Campus (HSC), the CD3 has developed extensive ties with two neighboring medical research centers: The Toledo Hospital (TTH), and St. Vincent Mercy Medical Center (SVMMC). The CD3 is also in close contact with BioOhio and Bowling Green State University (BGSU).

- **Engineering Center for Orthopaedic Research (E-CORE)**

College of Engineering & The College of Medicine and Life Sciences

The Engineering Center for Orthopaedic Research Excellence (E-CORE) strives to increase the understanding of causes of joint abnormalities and associated pain, which often reduce an individual's quality of life. These research efforts lead to new and effective surgical procedures to restore a patient's normal life style.

- **Plant Science Research Center (PSRC)**

College of Natural Sciences and Mathematics

The Plant Science Research Center (PSRC) undertakes basic research in plant biology with an emphasis on plant molecular biology, nutrition, pathology, bioremediation, and ecology. The PSRC instructs students from undergraduate through post-doctoral levels; develops, in collaboration with other academic, government, and industrial partners, technologies for transfer to the public and private sectors, and; serves as a regional and global resource for research in the plant sciences.

- **The Jack Ford Urban Affairs Center**

- College of Arts and Letters*

- The Jack Ford Urban Affairs Center conducts research and special projects relating to urban issues. In collaboration with The Center for Geographic Science and Applied Geographics and the Department of Geography & Planning are pleased to announce a new initiative called Toledo View. Toledo View is a convenient desktop application where users can perform secure, interactive queries online to gather and analyze a wealth of targeted geographical data and visualize their findings in downloadable maps, spreadsheets, charts, graphs, or reports.

- **The Legal Institute of the Great Lakes (LIGL)**

- College of Law*

- The Legal Institute of the Great Lakes (LIGL) is a multi-disciplinary research center within The University of Toledo College of Law. Founded in 1993, the LIGL supports research, maintains publications, and sponsors conferences on legal, economic, and social issues of importance to the Great Lakes region of the United States and Canada.

- **Center for Successful Aging**

- College of Health and Human Service*

- The University of Toledo is committed to providing quality education, research, and services to older adults and their families through the Center for Successful Aging. The commitment and emphasis on quality, educational experiences for students at The University of Toledo, as well as health care professionals within our community, puts the Center for Successful Aging at the forefront of academic health care institutions. Through the development of the Center, The University of Toledo is positioning itself appropriately in order to meet the expanding needs of older adults and their families in Northwest Ohio.

- **The Asian Studies Institute**

- College of Arts and Letters*

- The Asian Studies Institute manages the Asian Studies program. The program offers a B.A. degree in Asian Studies, awarded by the College of Arts and Sciences. The program is designed to provide students with a comprehensive and systematic education in Asian affairs. Emphasis is placed on language, culture, political science, economics, history, geography, and business environment and other related areas. In addition to taking these Asian Studies courses, students may participate in activities including seminars and study abroad programs in Asia.

- **Polymer Institute**

- College of Engineering*

- The Polymer Institute in the College of Engineering is a plastics application center designed to provide industrial support through contract research and development activities. The Institute serves as a Center for Research and Development in polymers and plastics technology, and an education and industrial training center for Polymer Science and Engineering.

- **Center for Geographic Information Sciences and Applied Geographics (GISAG)**
College of Arts and Letters
 The Center for Geographic Information Sciences and Applied Geographics (GISAG) at The University of Toledo serves as a focal point for GIS contract research on campus and in the local and regional community, a clearinghouse for GIS research opportunities, and provides sources of expertise to enhance student learning at all levels and across a wide range of academic disciplines.
- **Precision Micro-Machining Center (PMMC)**
College of Engineering
 Established in 1999 by Dr. Ioan Marinescu, the Precision Micro-Machining Center is an integrated industry-academia research center. The aim of this center is to conduct research and development on micro-machining processes and technologies in order to facilitate their use in industry.
- **Institute for Sustainable Engineering Materials (ISEM)**
College of Engineering
 ISEM is an umbrella research institute. It combines three current areas of strength within the College of Engineering, and extends collaborations across UT and with industrial partners to target application-driven design, synthesis, and processing of sustainable engineering materials.
- **The Lake Erie Center**
College of Natural Sciences and Mathematics
 The mission of the Lake Erie Center is to:

 - Research environmental conditions and living and non-living aquatic resources in Maumee Bay and western Lake Erie, as a model for the Great Lakes and aquatic ecosystems worldwide
 - Discern the linkages among land-use practices, water quality, habitat, economics, natural resources, sustainability, and environmental and public health
 - Provide a state-of-the-art research and education facility for sponsored research and collaborations by faculty from The University of Toledo, other universities, federal and state agencies, and visiting scientists
 - Facilitate hands-on, cutting-edge environmental research and education experiences for graduate and undergraduate students
 - Engage secondary school students, teachers, and the public with environmental education, sustainable living, and informed outreach awareness programs
- **Ritter Astrophysical Research Center/Ritter Planetarium**
College of Natural Sciences and Mathematics
 The Department of Physics and Astronomy operates the Ritter Astrophysical Research Center at The University of Toledo as part of its research and instructional programs, the latter ranging from a Ph.D. program to public planetarium education. The Center's creation was initiated through a substantial gift by George W. Ritter of Toledo, supported by contributions from several corporations and individuals. The Ritter Astrophysical Research Center was dedicated in October 1967.

The Center is located in the Ritter Observatory and Planetarium building, which houses the astronomy part of the Department of Physics and Astronomy. In addition to providing offices for the astronomy faculty and graduate students, the Ritter building also houses a 1-meter Ritchey-Chretien reflector and a planetarium featuring a Spitz Scidome XD projector in a 40-foot dome.

- **Small Turbine Institute**

- College of Engineering*

- The Small Turbine Institute provides students with hands on training with equipment that provides them with experience needed for the aerospace industry.

- **Global Business Development Institute (GBDI)**

- College of Business and Innovation*

- Since its inception, the GBDI has provided guidance for firms taking their first steps into international commerce, assisted local economic agencies in attracting direct foreign investment into NW Ohio and SE Michigan, and introduced students to international business through study-abroad programs and internships. Global Target helps small and medium-sized companies develop plans and strategies to expand into global markets and the International Trade Association Center (ITAC) provides expert assistance to area manufacturers to enter or grow on a global stage.

- **Area Health Education Centers (AHEC)**

- College of Medicine and Life Sciences*

- The Area Health Education Center (AHEC) is a partnership that includes the UT-AHEC program and programs in Bryan, Lima, the Sandusky area, and the Mercy Family Practice Center in Toledo. This collaboration reaches out to underserved areas, helping to provide educational opportunities to health care professionals in these communities. AHEC is a clerkship rotation for UT medical students to gain valuable experience throughout Northwest Ohio. AHEC also sponsored and administers CampMed for students entering 9th grade, providing them with a first-hand experience in what it is like to be a doctor.

- **Center for Health and Successful Living**

- College of Health and Human Services*

- The Center for Health and Successful Living is a collaborative venture between different departments at The University of Toledo. The Center features a novel design that blends educational experiences for students, research opportunities for faculty members, volunteer opportunities for survivors of chronic illnesses, service opportunities for members of the community, and a provision of customized services. To our knowledge, this is the first center in the United States to feature this educational "hub" design.

- **Center for Student Advocacy and Wellness**

- College of Health and Human Services*

- The Center for Student Advocacy and Wellness serves all UT students by providing resources to help those in need of support and/or advocacy. Additionally, the Center is committed to prevention and education, through the offering of campus-wide programming, classes, and wellness events related to sexual assault, dating and domestic violence, consent, bystander intervention, stalking, and legal issues. The Center works to enhance understanding of all types of victimization through academic research and collaboration with local and state agencies.

- **Human Trafficking and Social Justice Institute**

College of Health and Human Services

This institute provides strategies to address issues directly related to human trafficking and social justice. Additionally, they focus on root causes and larger issues that impact and impede progress in enhancing social justice.

IX. Core Facilities and Infrastructure

The University of Toledo has invested substantial resources to develop, maintain, and expand Core Laboratories. The UT Core Labs include the following:

- Advanced Microscopy and Imaging Center (AMIC) – College of Medicine and Life Sciences
- Flow Cytometry Core – College of Medicine and Life Sciences
- Genomics Core – College of Medicine and Life Sciences
- Instrumentation Center – College of Natural Science and Mathematics
- Nuclear Magnetic Resonance Facility – College of Natural Science and Mathematics
- Center for Drug Design and Development (CD3) – College of Pharmacy and Pharmaceutical Sciences
- Center for Materials and Sensor Characterization (CMSC) – College of Engineering

These Core Labs are equipped with state-of-the-art instruments and offer cutting-edge technological services in various research fields. (See Appendix G for a more detailed description of these)

Major instruments include:

- Multiphoton Laser Scanning Microscope
- Confocal Microscopes
- Laser Capture Microdissection System
- In vivo Imaging Systems
- Multicolor High-Speed Cell Sorter
- Microarray Scanner
- MALDI-TOF/TOF Mass Spectrometers
- Scanning and Transmission Electron Microscopes
- Robotics for Protein Crystallization
- Nuclear Magnetic Resonance Spectroscopies (NMR)
- X-ray Diffractometer
- Confocal Raman Spectrometer

The UT Core Labs are staffed with experts in the fields, and provide core users with basic and advanced on-site training. Depending on user needs, facilities can process and analyze samples.

X. Future Directions: Research and Sponsored Programs Goals, Objectives, and Strategies

Goals of Primary Focus Areas

1. Make research, scholarship, and creative activities central to the mission of the University to enhance our national position as a research institution.
2. Improve research support, research infrastructure, and partnerships.
3. Foster community engagement through research collaborations that have relevance locally, regionally, and internationally.

Research Scholarship and Creative Activities

Focus Area 1

Make research, scholarship, and creative activities central to the mission of the University to enhance our national position as a research institution.

Goals

- a. Articulate research, scholarship, and creative activity as central to the mission of The University of Toledo and supported by the President, Provost, leadership, and faculty, and endorsed by the Board of Trustees.
- b. UT will receive national recognition in up to five areas of research excellence, building upon faculty strengths at the University, unique assets and centers, and opportunities for growth and development. Two areas will be identified under the following existing areas of research and scholarship strength:
 - i. Biomedical Research
 - ii. Energy and Environmental Sustainability
- c. Integrate research and student learning.
- d. Create a process to identify, nurture, and nominate promising candidates for prestigious faculty awards and fellowships, and to increase the visibility of our research in the global community.
- e. The University of Toledo receive recognition by such external organizations as Carnegie and the Association of Public and Land-Grant Universities (APLU).

Objectives

1. UT's ranking in research expenditures will improve to 160.
2015 Baseline: 190 in research expenditures | Source: National Science Foundation HERD rankings
2. UT's ranking in R&D expenditures among Ohio public universities will improve to third.
2015 Baseline: sixth in R&D expenditures | Source: National Science Foundation HERD rankings
3. By 2020, the number of new external grant proposals per year will increase to 620.
2016 Baseline: 564 new external grant proposals | Source: Office of Research and Sponsored Programs Database
4. Annual external sponsored research funding will increase to ~\$80 million.
2016 Baseline: ~\$38 million | Source: Office of Research and Sponsored Programs Database
5. Multi-unit or multi-disciplinary (three or more faculty across two or more departments) contracts or grants will increase by 15%, from an average of 47 to 55 annually by 2022.
2016 Baseline: Baseline to be determined | Source: Office of Research and Sponsored Programs Database
6. Industry-supported awards (including clinical trials) will increase by 15%.
2016 Baseline: Baseline to be determined | Source: Office of Research and Sponsored Programs Database
7. UT will develop three institutional relationships with federal R&D agencies and/or federal R&D laboratories by 2020.
Baseline: New Initiative | Source: Office of Research and Sponsored Programs Database
8. By Fall 2017, an implementation and investment plan developed by the faculty will be in place for the biomedical and environmental sustainability area.
Baseline: New Initiative | Source: Office of Research and Sponsored Programs Database
9. By Spring 2018, additional areas of excellence developed by the faculty will be identified with master plans for implementation.
Baseline: New Initiative | Source: Office of Research and Sponsored Programs Database
10. By Spring 2022, up to five areas of excellence will be identified and investment plans will be underway.
Baseline: New Initiative | Source: Office of Research and Sponsored Programs Database
11. We will develop a mechanism for measuring the number of joint faculty-student publications as reported in Faculty 180.
Baseline: New Initiative | Source: Faculty 180

12. Increase the number of students awarded fellowships or participating in experiences/internships at federal laboratories as reported in Faculty 180.
Baseline: New Initiative | Source: Faculty 180
13. Increase the percentage of students enrolled in courses with a research-intensive designation to 20 courses by FY 2022.
2017 Baseline: 3 courses | Source: Faculty Office of Undergraduate Research
14. The number of faculty who are PIs or co-PIs on grants and contracts will increase by 5 percent by 2022.
5-year Average Baseline from FY 2012-2016: 276 | Source: Office of Research and Sponsored Programs
15. The average external support to UT tenured and tenure-track faculty members will increase from \$36K per faculty member to \$60K by 2022.
Source: Office of Research and Sponsored Programs
16. The number of UT faculty who are fellows of national societies will increase 2% by 2022.
Baseline to be established in FY 2018 | Source: Faculty 180
17. UT will be ranked 3rd in Ohio among public institutions abstracted in the Web of Science in the number of citations per article by 2022.
Source: UT Library Services
18. Number of UT endowed professors will increase from 5 to 10 by 2022.
Source: The Provost Office
19. Number of meeting abstracts and proceeding papers abstracted in the Web of Science will increase to 750 by 2022 (2019-2022).
FY 2014-2016 Baseline: 679 | Source: UT Library Services

Institutional Strategies

1. Increase research funding and scholarly activity.
 - a. Develop a stronger partnership with the UT Foundation in initiatives to garner private and foundation support for UT.
 - b. Increase connections and support from federal R&D agencies and federal R&D laboratories.
 - c. Increase engagement with industry to support collaborative research.
 - d. Improve opportunities for interdisciplinary grants and assist faculty in the application process.
 - e. Establish coordinated efforts to become competitive for research training grants.
 - f. Make specific efforts to target external funding for instrumentation and research infrastructure.

2. Promote UT excellence in scholarship.
 - a. Aggressively position UT for recognition by external, national, and international organizations such as Carnegie and APLU.
 - b. Encourage UT faculty members to seek and achieve fellowships in national societies.
 - c. Increase the number of endowed professors at UT.
 - d. Develop a proactive policy to ensure the retention of faculty who are highly accomplished in RSCA.
 - e. Develop an institution-wide process for faculty/staff to report research scholarship and creative activities in a manner that facilitates subsequent data analysis.
3. Invest in two areas of research excellence—biomedical research and energy and environmental sustainability—in which UT will build a national and international reputation displaying the comprehensive breadth of UT programs. Investments will be made in new faculty hires and other areas of support.

Other areas for consideration include:

- a. research and scholarship of interest to the international community;
 - b. research that leads to innovative products and processes;
 - c. research and scholarship to address societal challenges spanning from local to global issues, and;
 - d. research and scholarship that demonstrates UT's role in advancing culture and creative arts.
4. Increase student participation with faculty on research projects, co-authoring of published articles, and co-presenting at national conferences to strengthen UT's reputation as supportive to student research across disciplines.
 - a. Increase participation in the annual Undergraduate Research Day.
 - b. Develop integrated research experiences within undergraduate and master's programs.
 - c. Create an institutional program on responsible conduct of research for faculty, staff, and students at all levels.
 - d. Support interdisciplinary training grants.
 - e. Encourage hiring undergraduate and graduate students on grants.
 - f. Develop a process to identify opportunities for interdisciplinary training grants.

- g. Increase the number of undergraduate courses having a research-intensive designation.
- h. Promote external research opportunities for students (e.g. ORAU, internships, fellowships).
- i. UT student participation will increase in regional, national, and international conferences, including oral and poster presentations and research paper presentations.

Focus Area 2

Improve research support, research infrastructure, and partnerships.

Goals

- a. Support of research and scholarship will be a University budget priority.
- b. Appropriately resource the UT Research, Grants Accounting, and compliance offices against peer institutions in areas such as staffing levels, automation of grants process, effectiveness of grants management, and grant writing support.
- c. Establish high levels of expectations and empower faculty and staff to exceed these levels in research, scholarship, and creative endeavors.
- d. Advance UT internal support for research through improved research support infrastructure and support of the internal grants program (URFO).
- e. Re-evaluate and revise the Facilities & Administration (F&A) distribution policy to incentivize faculty research including carry-over of funds.
- f. Enhance our current processes to identify opportunities for interdisciplinary grants, assist faculty in the grant writing process, and improve the dissemination of information about these opportunities on a regular basis to faculty and researchers.
- g. Begin the process of renovation and building new research and science facilities by implementing the Campus Master Plan.
- h. Enhance research training that focuses on responsible conduct of research and ethics in research and scholarship.
- i. Develop an annual UT Research Summit to foster internal collaborations and interdisciplinary efforts.

Objectives

- 1. Benchmark the UT research, grants accounting, and compliance offices against those of other peer universities.

Source: Office of Research and Sponsored Programs

2. Staff UT's research, grants accounting, and compliance offices at a level equivalent to aspiring universities by 2022.
Source: Office of Research and Sponsored Programs
3. Implement a new, comprehensive electronic research administration system by 2019.
Source: Office of Research and Sponsored Programs
4. Offer new faculty research start-up packages above the median in their disciplinary fields benchmarked to peer institutions.
Source: Provost Office
5. Increase the number of full professors in the pool of UT full-time faculty to 300 by FY 2022.
FY 2016 Baseline: 277 | Source: Provost Office
6. Faculty workloads in various disciplines will be comparable to peer institutions.
Source: Provost Office
7. UT will maintain its Research High designation within the Carnegie Classification through each evaluation cycle.
Source: The Carnegie Classification of Institutions of Higher Education
8. By 2020, the Office of Research & Sponsored Programs and Grants Accounting will be staffed comparably to peer institutions
Baseline will be established in FY 2017-2018 | Source: Office of Research & Sponsored Programs
9. By 2019, UT will financially support and implement a comprehensive electronic research administration system.
2016 Baseline: 0% completed | Source: Office of Research & Sponsored Programs
10. UT's investment in research support infrastructure will be at the level of aspirational peers.
Source: Office of Institutional Research
11. UT will renovate an additional 11.5% of existing research lab/lab service space as specified in the Campus Master Plan.
2016 Baseline: 1.5% | Source: Office of Facilities & Construction
12. UT will establish a policy requiring all research active investigators to complete training in the Responsible Conduct of Research for their discipline and Ohio Ethics Training by 2018.
2016 Baseline: No Policy | Source: Office of Research and Sponsored Programs

Institutional Strategies

1. Invest in infrastructure
 - a. Provide staff and operating support for Sponsored Research (RSP office), Grants Accounting, and Compliance programs to provide a responsive grants administration program.
 - b. Maintain modern core and animal care facilities.
 - c. Provide access to statisticians to assist with research proposal design and project support.
 - d. Improve research support infrastructure (e.g. strong library and IT support; matching equipment funds).
2. Invest in faculty research development and support
 - a. Enhance programming or funding for internal grants.
 - b. Statistical consulting will be available for all faculty seeking services.
 - c. Increase sabbatical support.
 - d. Provide support for travel to meetings and conferences.
 - e. Establish mentoring and training programs (including ethics and compliance training).
 - f. Develop formal post-doctoral and research faculty training.
 - g. Strengthen and upgrade university, college, and departmental promotion and tenure guidelines (elaborations) to value and raise the standards of research productivity with consistency across colleges.
 - h. Develop policies regarding the roles and advancement paths for research professors (faculty supported entirely by external funding) and increase the numbers of research professors at all levels.
 - i. Support retention and promotion of faculty.
 - j. Identify and pursue opportunities for interdisciplinary training grants and grants that align to UT strengths.
 - k. Develop additional institutional relationships with federal R&D agencies or laboratories and strengthen existing institutional partnerships that already exist.
 - l. New faculty research start-up packages will be above the median in their disciplinary fields benchmarked to peer institutions.
3. Provide support to deans and chairs to help them mentor, support and monitor faculty productivity in research, scholarship, and creative activity.

- a. Make promoting and developing research an explicit part of deans and chairs responsibilities.
- b. Offer faculty research mentoring programs.
- c. Ensure that faculty active in research have teaching and service loads equivalent to those for similarly productive faculty at aspirational peer institutions. Establish faculty tiers of research active, research intensive, and research excellent. Update policies and guidelines to provide competitive start-up packages, teaching and service loads that reflect a faculty member's research and scholarship contributions.
- d. Re-evaluate UT's F&A distribution policy to incentivize faculty research (allow carryover of funds to next fiscal year).
- e. Tenure and promotion requirements will reflect the centrality of research to faculty expectations. Revise policies to endorse and recognize RSCA in tenure and promotion.
- f. Develop a policy to ensure the retention of highly accomplished faculty researchers.
- g. Provide reasonable financial support for faculty members to increase acceptance of prestigious fellowships and appointments (e.g. Fulbright; NSF program managers).
- h. Implement an electronic institutional-wide process for faculty/staff to report research, scholarship, and creative activities that enables data compilation for report purposes

Focus Area 3

Foster community engagement through research collaborations that have relevance locally, regionally, and internationally.

Goals

- a. Create and produce high quality research and innovation that will improve the health, social, and economic conditions in our region.
- b. Create a gateway that promotes community-based and industry-sponsored research.
- c. Improve community access to university experts and expertise, especially relating to workforce development, employability, small business and industry development and research.
- d. Increase involvement with economic development, commercialization, and technology transfer by advancing UT's connections with community stakeholders.

Objectives

1. External views of faculty expertise database will increase 3 percent per year from 2017-2022.
Baseline will be determined when Faculty 180 becomes operational in AY 2017-2018
Source: Research and Sponsored Programs Website & Webmaster's Office
2. UT Technology Transfer will continue to be one of the top performers in the state in the areas of invention disclosure, licenses, license income, reimbursement rate, and startups formed per \$10 million in research expenditures annually.
FY2011-2014 Baseline: Invention Disclosure: 10.0, Licenses: 2.2, License Income: \$128,629, Reimbursement Rate: 56%, Startups Formed: 0.40 | Source: Technology Transfer AUTM data
3. Increase the number of exhibits and performances by faculty and students to a level that will be determined after establishment of baseline.
Baseline will be determined when Faculty 180 becomes operational in AY 2017-2018
Source: Faculty 180
4. Create a community engagement dashboard relating to educational attainment, workforce development, employability, and career success.
5. UT's technology transfer and commercialization activities, including Rocket Innovations will be self-sustaining through external support.
6. Maintain UT's designation from APLU as an Innovation and Economic Prosperity University.

Institutional Strategies

1. Target and support research that addresses local and commercial challenges or needs.
 - a. Track and report UT activity that leads to economic development, commercialization, and technology transfer in Northwest Ohio.
 - b. Provide leadership in the development of Northwest Ohio's innovation ecosystem, and other research collaborations that expand the regional advancement of knowledge, health, technology, and commercialization.
 - c. Continue support for UT technology transfer and commercialization activities to create opportunities for technology-based business entrepreneurship.
 - d. Increase engagement with industry to support collaborative research.

2. UT will be recognized by national organizations for fostering research that contributes to addressing problems in our region and state.
 - a. Increase involvement with economic development, commercialization, and technology transfer by advancing UT's connections with community stakeholders and broadening collaborations with business, industry, government, and nonprofits—including Rocket Innovations—to encourage faculty and staff to pursue entrepreneurial efforts; track and report these activities through UT's website.
 - b. Work with external community partners advisory board to help support local and regional research and community engagement.
 - c. Seek external support for collaborative projects that address regional challenges.
 - d. Boost our national prominence in performing arts and creative activities through enhancing our partnership with local and national entities, such as the Toledo Museum of Art, the Toledo Symphony Orchestra, etc.

XI. Recommended Steps

Through creation of Ignite 2022 and this strategic planning process, recommendations were developed and reaffirmed through continuous feedback. These recommendations assume the investment of funds from the University, a challenge given the state budget for public higher education. The following are global recommendations to meet the goals and objectives proposed in this document:

a. **Developing Areas of Excellence**

The UT Strategic Plan calls for the university to develop and implement a plan for national recognition in up to five areas of research excellence building upon faculty strengths, unique assets and centers, and opportunities for growth and development. Unique assets and centers include UT's breadth across a range of disciplines, the ownership of a hospital, and unique laboratories and facilities (e.g., Lake Erie Center). It also recognizes that UT has two "umbrella" areas in which the university has significant external funding, publications in leading journals, and relate to needs in our region. Furthermore, the strategic plan calls for the implementation of a plan to define the specific subareas under these two broad umbrella areas where there are promising opportunities for UT to gain national recognition and increase external support. The plan also includes a charge that additional areas of excellence are to be determined through engagement with the faculty.

The two major umbrella areas already identified are biomedical research and energy and environmental research. Data supporting these areas are included in this Research Plan. UT also possesses other fields with strengths in external funding and publications, such as aerospace research, astrophysics, and STEM education.

b. **Re-examine Faculty Workload Distribution to Support Research Activity**

The University of Toledo has a tripartite mission of teaching, research (professional activity), and service. The administration acknowledges the importance of all three components and recognizes that faculty may not contribute to the University mission in the same way. Since the nature of faculty work differs amongst departments, the application of uniform workload guidelines is not possible; therefore, credit hour equivalencies are developed accordingly for instruction, research, and service by deans and department heads, in consultation with departmental faculties. Departmental mission and the level of students served should be considered when determining teaching and research loads. Certain principles apply: all tenure and tenure-track faculty are expected to contribute to departmental and university service, and should be provided the opportunity for a workload that supports continued research activity, recognizing that different types/levels of research will be taken into account. Faculty assigned a workload based upon expectations in research must fulfill those expectations to be assigned a similar load in future years.

The Office of Research and Sponsored Programs will work with the University Research Council to develop metrics that measure faculty contributions in research, scholarship, and creative activity across the disciplines at UT. This will include working with deans and department chairs to help emphasize the importance of supporting a culture that champions research, scholarship, and creative activity across campus.

- **Faculty 180**

The Office of Research and Sponsored Programs will collaborate with the Office of the Provost in the Faculty 180 reporting system to compile information on faculty activities to benchmark improvements in faculty research and scholarship, and to monitor progress in meeting many of the goals outlined in this plan. Information such as publications, invited presentations, appointment to prestigious organizations and committees, conferences organized, and other significant activities will be tracked to reflect the breadth of activities underway across campus. The information collected will be valuable in gauging success in meeting the goals in our plan.

- c. **Office of Research and Sponsored Programs Staffing**

Staffing investments to the Office of Research and Sponsored Programs have increased the number of grants coordinators to provide better support for grants development and submission. It is important that office staff are current in the latest grant and contract requirements of federal and state agencies. Our plan is to increase the training and continued education of grants coordinators and others in the Office of Sponsored Programs. Depending upon the availability of travel funds, we will encourage their active participation in national organizations such as the Society of Research Administrators (SRA) and the National Council of University Research Administrators (NCURA). Not only will participation in conference and workshop events increase their level of participation, this will help them connect to a broader community of professionals as resources in addressing new questions.

- d. **Faculty Training**

- **Responsible Conduct of Research**

We will increase the level of training faculty and students receive in the responsible conduct of research. Responsible Conduct of Research is research ethics and compliance training given online through the Collaborative Institutional Training Initiative (CITI), of which UT is a member. Modules in the areas of authorship, collaborative research, conflict of interest, data management, financial responsibility, mentoring, peer review, plagiarism, human subject research, research involving animals, and research misconduct. Additionally, modules on subjects such as environmental and social dimensions of engineering research, export control and national security, and research ethics and society are provided.

Responsible Conduct of Research training is required by UT for all faculty, staff and students participating in research funded by the National Institutes of Health, National Science Foundation, and the National Institute of Food and Agriculture (USDA). Participants may choose the area of focus that best aligns with their research area:

- Biomedical Sciences
- Engineering and Computing
- Humanities
- Physical Sciences
- Research Administration
- Social, Behavioral, and Education (SBE) Sciences

The Office of Research and Sponsored Programs will support the Graduate College in requiring training for all graduate students. The Office of Research and Sponsored Programs will work with deans and chairs to ensure faculty compliance with training requirements.

- **Ohio Ethics Training**

Ohio Executive Order 2011-03K requires that state employees and officials participate in an annual ethics training. In addition, The University of Toledo requires annual Ohio Ethics Training for specific administrative offices, including the Office of Research and Sponsored Programs and Grants Accounting. UT employees have the opportunity to attend a live presentation given by a representative from the Ohio Ethics Commission or to view the video training online to complete this annual requirement. Tracking of the completion of this requirement for RSP and GA is done by UT Research Compliance.

- **UT Scholars Institute Program**

An important strategy to increase research funding is to work with newly hired and early-career faculty members to improve their ability to submit quality proposals and receive awards from competitive agencies and foundations. Given this strategy, and as a result of the Office of Research and Sponsored Programs internal assessment findings indicating that faculty would like to receive additional training in the areas of research and grant writing, we are pleased to announce the inaugural UT Scholars Institute Program (SIP). This is an opportunity designed to help prepare early career faculty members in the area of grant writing and serving as a principal investigator on grants. Participation in the institute is open to all non-tenured faculty members who are within their first 4 years of hire. Participants in the institute will acquire broad perspectives regarding topics important to externally-funded projects including:

- Preparing for Grant Submissions
- Identifying External Sources of Funding
- Seeking Collaborators On and Off Campus
- Conducting Human Subject Research
- Using Animals in Research
- Accessing UT Resources (e.g., Statistical Consulting)
- Managing Conflicts of Interest
- Protecting Intellectual Property
- Setting Up Budgets and Managing the Awards

Other topics will be selected based on the interests of the selected participants.

The 2017 institute will convene in May 2017 and consist of six monthly sessions, concluding in October 2017. Selected participants will meet once per month to attend presentations and discussions facilitated by current members of the Office of Research and Sponsored Programs faculty and staff, with time for internal discussion. Participation will be limited to 20 faculty members and the monthly meetings will be scheduled for Friday mornings.

- e. **Endowed Chairs and Professorships**

An endowed professorship (or endowed chair) is a position permanently paid for with the revenue from an endowment fund specifically set up for that purpose. The Provost, in consultation with the Deans, will be responsible for formulating recommendations for the policies and procedures of the program. Faculty members and the University Office of Advancement are asked to provide advice and comments on all aspects of the program. Typically, the position is designated to be in a certain department; however, at UT there are opportunities for University, College, and interdisciplinary positions. At The University of Toledo, there are over 50 endowed professors and chairs.

Securing Endowed Chairs is a common strategy to increase a university's research funding and to raise the national profile of a university. Endowed chairs may be in programs that are not normally associated with external funding (e.g., political science, music, or law) or in programs where significant external funding is an expectation (engineering, medicine, physical sciences). An Endowed Chair, according to the UT Foundation is to be "...conferred on a new or existing faculty member who has demonstrated a sustained high level of accomplishment and potential for original future contributions to the academic field. The holder represents performance at the highest level in teaching, research, scholarly investigation, or activity based on national and international recognition and accomplishments."

The UT Foundation calls for a gift of at least \$2 million, with a suggested range from \$2-3 million to support an Endowed Chair. UT currently has 32 endowed chairs (see Appendix E). Several positions are open. Using a return of 4% annually, an endowed chair at \$2 million will provide \$80,000 toward the position, and at \$3 million will provide \$120,000. These funds are generally insufficient to create a new tenured position at UT, but could greatly supplement the salary on top of an existing faculty line. It is common for Endowed Chairs to also receive additional funding to support travel and administrative support.

Seeking additional support for endowed chairs should be a high priority for the University, but the minimal level of giving should be increased to provide the full salary and fringe benefit support for the Endowed Chair.

f. Improvements to the Grant Submission and Awards Process

Changes were made during the 2016-17 academic year to improve customer support from the grants office in the areas of pre-award, compliance, contracting, post-award, and budget setup. A reorganization of the office resulted in placing one senior administrator in charge of electronic research administration systems and faculty development, and the other to provide oversight to the grants offices. In addition, new hires include another grants coordinator to provide more support for proposal submission, a grant writer to support faculty in the preparation of grant proposals, and a new contract administrator to provide high quality responsiveness in developing and approving contracts. The University Hall grants office was closed, and the grants coordinators were relocated to the R1 building to provide more staff support and better management oversight. In addition, the Director of the Office of Grants Accounting has been co-located in the main campus grants office. We recommend that the entire Office of Grants Accounting be relocated from the Scott Park campus to space in the R1 building to improve communication between the post-award and grant budget setup.

In order to ensure a smoother award process, attention must be paid to the lack of required forms and timely compliance verification. First, too many proposals are coming to the grants office without signed RSP100 forms. These forms are important because they identify possible compliance issues, note approval from the dean and chair, identify space requirements for the conduct of the study, and provide agreements on the distribution of F&A, in cases with investigators from multiple colleges. The Office now insists on the submission of completed RSP100s with grant applications. Second, compliance verification for research projects needs improvement, since this is often a factor in the delay of processing grant awards. Clearing compliance status for faculty and students for grants hinders the timely process of awards, and subsequent implementation of the project. Part of this relates to the complexity of issues such as export-control. However, more responsiveness from faculty and staff is needed to submit required disclosures.

g. F&A Distribution to Incentivize Faculty

Faculty members report problems concerning their control of F&A funds. Our position is that faculty PIs and their department chairs should have a distribution of funds to empower them to support research, without needing to request support from the Office of Research and Sponsored Programs for activities such as journal page charges, conference travel, small item purchases (e.g., laptops), and instrumentation upgrades or replacements. Such funds should also be held in designated accounts that are not swept at the end of the fiscal year, so the PI and chair have funds available for contingencies (unexpected equipment failure). The Office of Research and Sponsored Programs recommends a collaborative approach with the Office of Grants Accounting, the Provost Office, and the University Research Council to develop a campus-wide policy on F&A distribution to support and empower faculty research.

h. Implementation of a Comprehensive Electronic Research Administration System

A review of Requests for Information (RFIs) is underway in Spring 2017 of proposals submitted by vendors to provide UT with a comprehensive electronic research administration system. A review is now underway of the submissions. A formal Request for Proposals (RFP) will be released in Summer 2017 for review. This new system will replace Quali Coeus and will require institutional funds to implement. At this time, the amount of the investment is unknown but will certainly be in excess of \$100,000 per year, plus UT staff support. We recommend UT provide the financial support for a new system.

i. Increase Number of Interdisciplinary Research Groups

Leveraging UT's breadth of expertise across a broad range of disciplines, UT has the ability to pull together faculty teams to address research problems that are interdisciplinary in nature. The institution already has a number of interdisciplinary teams working across campus in areas such as biomedical science, water research, orthopedics, public health, etc. The Office of Research and Sponsored Programs will work to identify opportunities for funding where UT can pull together teams across colleges and departments to submit competitive proposals. We also plan to create an expertise database to help internal and external parties find faculty and researchers for specific interests, providing additional support to faculty searching for collaborators in interdisciplinary projects.

j. Core Laboratories and Facilities

Core laboratories and research facilities are critical to supporting faculty research. UT has a number of such laboratories but there is a need to improve connections between core facility directors, and provide more consistency in supporting upgrades to instrumentation. The Office of Research and Sponsored Programs will work with core facility directors in assessing reporting lines, budget support, and charge back to both internal and external customers.

k. Support Technology Transfer, Incubation, and Commercialization Initiatives

As the only research university in Toledo, we recommend that UT continue providing leadership to support the development of the innovation ecosystem in Northwest Ohio. Thus, a strong technology transfer and commercialization system at UT is imperative. UT has an exceptional record in technology transfer metrics (including royalty revenues back to UT), but this does not always translate into local jobs and industry development. UT's incubation programs and Rocket Innovations support the incubation of both UT and community start-up companies. Additionally, UT is a major player in the regional state-supported Entrepreneurial Assistance Program (ESP), with the Vice President of Research serving as chair of the Oversight Committee for the new company (NexTech) formed to lead this effort.

Given the declining state support for public higher education, we cannot recommend that UT provide significant internal resources to invest in commercialization activities at this time (including incubation and Rocket Innovations). Supporting faculty research is a higher priority and is necessary to build the basis for new technology development. Central support to the Office of Technology Transfer is a good investment given the office's success in bringing royalty revenue back to UT faculty and university. UT will continue to support its incubation and commercialization activities by seeking external grant support from federal and state agencies. However, external grants require that central funds provide required cost-share. If state support to public higher education continues to decline, the ability to provide even cost-sharing funds to support incubation and commercialization activities may need to be reevaluated.

We recommend that UT increase its engagement with regional industry to support collaborative research, and to build connections that will provide market-based insight into faculty research while providing industry with access to research experts and unique research instrumentation. We also recommend improving our method of tracking success in supporting economic development activities through technology transfer and commercialization activities.

I. Increase Public Engagement and Communicate the Value of UT Research

Given the importance of federal and state funding in supporting academic research and achieving the \$80 million target for 2022, UT has a responsibility to communicate the value of science and research to the public and elected officials. In addition, involving the public and students in research projects demonstrates the value of research to society. Our plan is to increase the involvement of citizens and students at all levels in research projects.

The Office of Research and Sponsored Programs will continue to collaborate with the Office of Government Relations to educate lawmakers in our federal and state delegation on the important projects underway at UT and work with the Office of Media Relations to increase the number and depth of stories about UT research. We will continue to provide a strong presence in both Washington and Columbus to explain the value of publically funded research, and the impact of specific federal agency support (such as NIH, NSF, and EPA) on UT and Ohio. Moving forward, we will increase our efforts to connect research to citizen engagement and work to have a stronger presence of UT faculty researchers connected to media opportunities and elected officials.

XII. Conclusions

With the formation of Ignite 2022, we will reengineer our research enterprise to compete with peer and aspirational institutions. With this new plan, we will strive to improve our infrastructure, scholarly, and creative activities while securing external funding awards. This plan will serve as a guide to benchmark our progress and align our efforts with The University of Toledo's strategic plan, PATH TO EXCELLENCE. The Office of Research and Sponsored Programs looks forward to launching The University of Toledo's research enterprise into the future.

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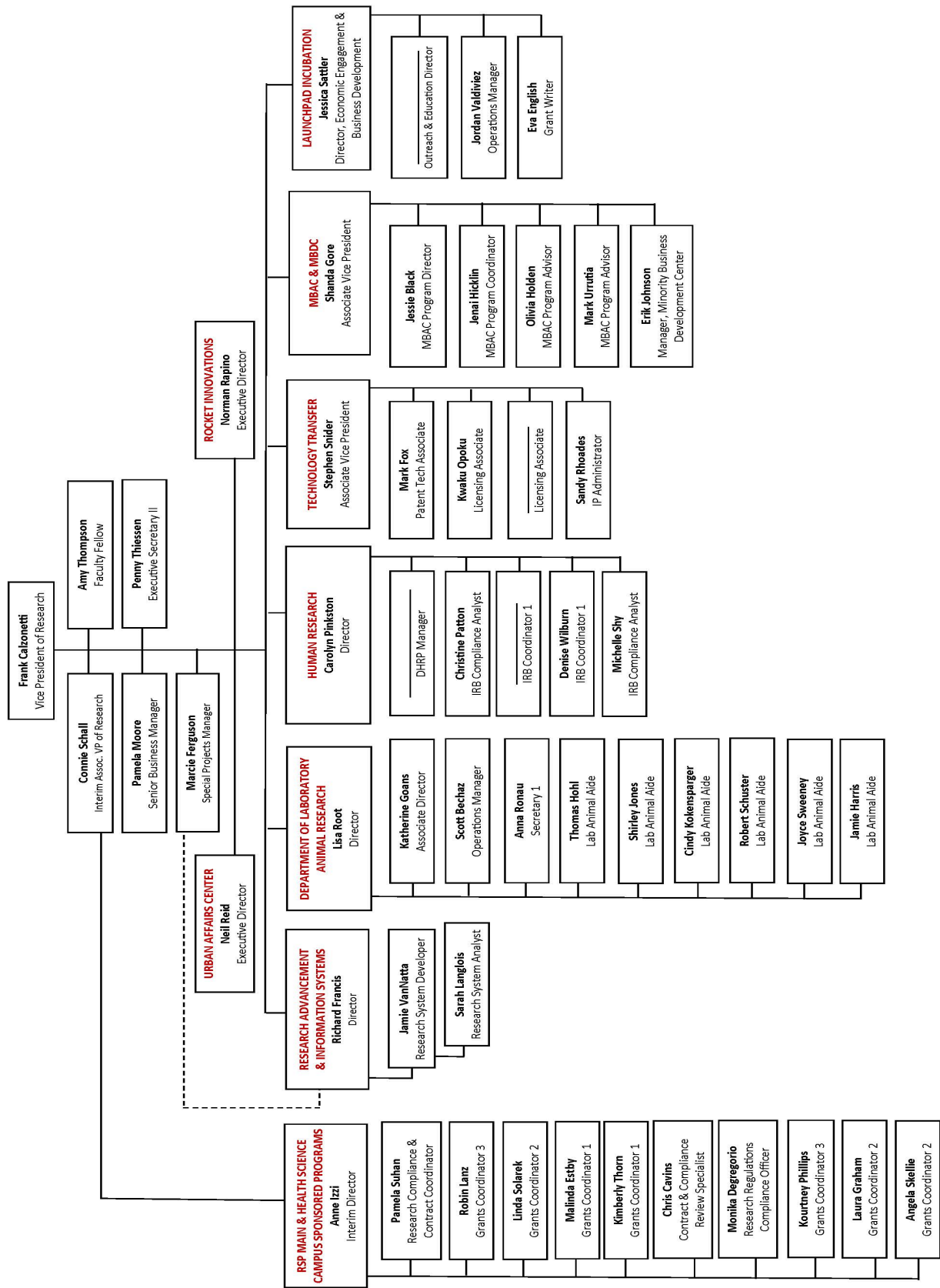
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 - Aspirational Peers
 - Peers Institutions
 - Ohio Peers
 - Mid-American Conference Schools Outside of Ohio
- C. An Assessment of Research Needs – Survey Questions and Response Options (if applicable)
- D. Core Laboratories
- E. Endowed Chairs and Professorships
- F. Outcomes
- G. Central Research Office Staffing Comparisons with Peer Institutions

Appendix A. Research and Sponsored Programs Organizational Chart

OFFICE OF RESEARCH AND SPONSORED PROGRAMS



Appendix B. The University of Toledo Peer Institutions

Aspirational Peers



University of Pittsburgh

Peer Institutions



Ohio Peers



OHIO UNIVERSITY



Mid-American Conference Schools Outside of Ohio



Appendix C. An Assessment of Research Needs Survey

Listed below are the survey questions and where applicable the answers to the questions. This survey was distributed to University college and department leadership, academic and research faculty, graduate students and post-doctoral researchers via Survey Monkey.

SURVEY QUESTIONS

1. What is your position? (Check All That Apply)
 - ☐ Dean (All Levels)
 - ☐ Department Chair
 - ☐ Professor
 - ☐ Associate Professor
 - ☐ Assistant Professor
 - ☐ Lecturer
 - ☐ Research Professor (All Levels)
 - ☐ Visiting Professor
 - ☐ Graduate Student
 - ☐ Post-Doctoral Research
 - ☐ Other (Please Specify)
2. Have you served as a PI or Co-I on externally funded programs (research, fellowship or other sponsored programs) at UT in the past three years?
 - ☐ Yes
 - ☐ No
3. What additional resources and/or assistance from the Office of Research and Sponsored Programs would help you in grant identification, development and submission processes? (Please Describe)
4. What additional resources and/or assistance for grants management would be most helpful in increasing your research productivity after receiving funding? (Please Describe)
5. Is the University support for developing an IRB or IACUC protocol satisfactory? (If "NO", Please Describe)
 - ☐ Yes
 - ☐ No
6. To help faculty increase their scholarship and research activity, which incentives/resources would be most effective? (Check All That Apply)
 - ☐ Release Time/Adjust of Teaching Load
 - ☐ Internal Grant Competitions
 - ☐ Funding to Attend Meetings
 - ☐ A portion of indirect returned to college/department and PI
 - ☐ Cost Sharing
 - ☐ Recognition (e.g., Awards)
 - ☐ Other (Please List)
7. What assistance and resources are most helpful to you in submission of grant proposals and management of awards? (Please check your top 3 answers)
 - ☐ How to Identify Grant Opportunities
 - ☐ Assistance in Formation of Interdisciplinary Groups
 - ☐ Preparing Budgets
 - ☐ Preparation of Non-Narrative Materials (i.e. C.V.'s, Management Plans, Facilities)
 - ☐ Identification of Broader Outreach Activities
 - ☐ Grant Editing/Writing Assistance
 - ☐ Departmental Administrative Research Support Pre-Award?
 - ☐ Statistical Consulting
 - ☐ Student Support
 - ☐ Additional Grants Management Assistance (Please Specify in Other Box)
 - ☐ Departmental Grants Administrative Support Post-Award
 - ☐ Mentoring by Colleagues in My Discipline
 - ☐ Internal Peer Review of Grants
 - ☐ Internal Peer Review of IRB (use of human subjects in research) Protocols
 - ☐ Internal Peer Review of IACUC (use of animals in research) Protocols
 - ☐ Other (Please List)

8. What types of training programs would be useful to you in increasing your research productivity or grant writing? (Check All That Apply)
- | | |
|---|--|
| <input type="checkbox"/> How to Identify Grant Opportunities | <input type="checkbox"/> Compliance & Export Control |
| <input type="checkbox"/> How to Prepare an Effective Proposal | <input type="checkbox"/> Post-Doctoral Training |
| <input type="checkbox"/> How to Prepare an IRB Protocol | <input type="checkbox"/> Other (Please List) |
| <input type="checkbox"/> How to Prepare an IACUC Protocol | |
9. How could the Office of Research and Sponsored Programs assist you to become more successful in your scholarship and research? (Please Describe)
10. What other resources are needed to increase research productivity, scholarship and creative activities? (Please Describe)

Appendix D. Core Laboratories

The University of Toledo has invested substantial resources to develop, maintain, and expand Core Laboratories. This brochure is designed to make the UT Core Labs more visible in the community. The UT Core Labs include the Advanced Microscopy and Imaging Center, Flow Cytometry Core, Genomics Core (College of Medicine and Life Sciences), Instrumentation Center, Nuclear Magnetic Resonance Facility (College of Natural Sciences and Mathematics), Center for Drug Design and Development (College of Pharmacy and Pharmaceutical Sciences), and Center for Materials and Sensor Characterization (College of Engineering). These Core Labs are equipped with state-of-the-art instruments and offer cutting-edge technological services in various research fields.

Major instruments include: multiphoton laser scanning microscope, confocal microscopes, laser capture microdissection system, in vivo imaging systems, multicolor high-speed cell sorter, microarray scanner, MALDI-TOF/TOF mass spectrometers, scanning and transmission electron microscopes, robotics for protein crystallization, nuclear magnetic resonance spectroscopies, X-ray diffractometer, and a confocal Raman spectrometer. The UT Core Labs are staffed with experts in the fields, and can provide core users with basic and advanced on-site training. Depending on user needs, they also can process and analyze samples.

Please contact individual Core Labs for specific inquiries.

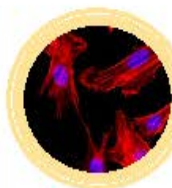
The University of Toledo

Core Laboratories

	Page
Advanced Microscopy and Imaging Center (AMIC)	2
Center for Drug Design and Development (CD3)	3
Center for Materials and Sensor Characterization (CMSC)	4
Flow Cytometry Core	5
Genomics Core	6
Instrumentation Center	7
Nuclear Magnetic Resonance Facility (NMR)	8
Histology Core Facility	9



Advanced Microscopy & Imaging Center (AMIC)

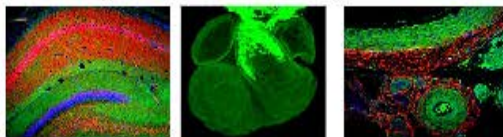


The University of Toledo Advanced Microscopy and Imaging Center on the Health Science Campus is a 3,000 square foot facility designed to bring together advanced light and fluorescence microscopy systems and "state-of-the-art" image analysis software to perform biomedical research. The AMIC consists of a 1,000 sq. ft. general microscopy laboratory that contains the following instrumentation.



TCS SP5 Laser Scanning Confocal Microscope

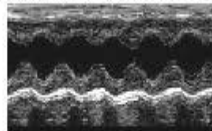
with MP is equipped with both conventional and high-speed resonance scanners. This includes conventional lasers plus multi-photon excitation (458, 488, 514, 561, 633, and a tunable Ti:Sapphire MP laser 710-990nm). This system is capable of collecting up to five colors simultaneously for quantitative confocal image analysis in both live cell and animal imaging, fixed tissue and includes the capabilities for 3-D reconstruction, FRAP, FRET, animation, stereo imaging, single layer projection, time lapse collection, and co-localization analysis.



OLYMPUS™ FluoView™ FV1000 Confocal Microscope

is a next-generation imaging system designed for high-resolution, confocal observation of both fixed and living cells. The FV1000 offers advances in confocal system performance while providing the speed and sensitivity required for live cell imaging with minimal risk of damage to living specimens.

SIEMENS ACUSON Sequoia C512 cardiac ultrasound imaging system. This Echocardiography system is a valuable tool for studying cardiovascular disease processes in small animals, including ischemic heart disease, heart failure, cardiac hypertrophy and remodeling, hypertension and diabetic cardiomyopathy. Capabilities include high-resolution imaging, tissue harmonic imaging, differential echo amplification, spectral Doppler (pulsed and continuous wave), color Doppler (for measurements of velocity energy and tissue Doppler imaging) and color-Doppler M-mode imaging.



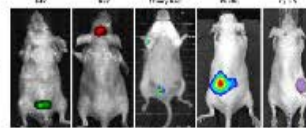
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Email: andrea.kalinoski@utoledo.edu
Web site: utoledo.edu/corelabs

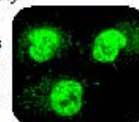


IVIS Spectrum

whole animal fluorescence imaging system developed by Xenogen/Caliper Life Sciences. The IVIS Spectrum is a multimodal bioluminescent and fluorescent imaging system specifically designed for noninvasive longitudinal imaging of cells and tissues in small animals. This instrument facilitates the study of biological processes via fluorescence in small animals, including tumor growth, cancer metastasis, bacterial infections, immune responses and inflammation, and regulation of tissue-specific gene expression.



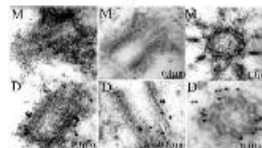
TIRF (Total Internal Reflection Fluorescence) Microscopy is available on an Olympus IX81 inverted microscope/imaging system that allows the visualization of fluorescent molecules either in wide-field (conventional) or exclusively at the cell-glass interface (TIRF). This latter capability allows selective, real-time tracking of single molecule or particle dynamics at the



Transmission Electron Microscopy

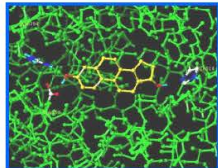
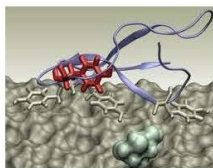


A state-of-the-art Electron Microscopy Laboratory is part of the Advanced Microscopy & Imaging Center. The EM facility is directed by Dr. William Gunning who specializes in ultrastructural diagnosis of human disease and also provides research support to the University of Toledo. The EM lab is equipped with two transmission electron microscopes, one being used for clinical diagnostic purposes and the other available for use by researchers.



Center for Drug Design and Development (CD3)

The CD3 assists with the design and/or development of potential small molecule diagnostics, biomarkers, therapeutics and preventative agents, and facilitates the translation of such agents towards clinical application.



Chemistry

Drug Design

- X-ray structure analysis
- Computational modeling
- Virtual screening
- Structure/ligand-based design
- Prodrug/softdrug strategies

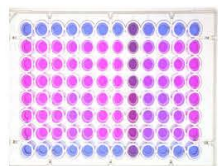
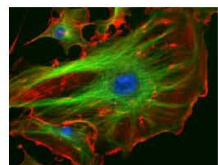
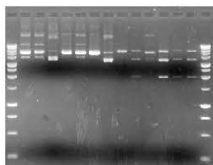
Chemical Synthesis

- Compound libraries
- Small to pilot scale
- Analytical standards, decomposition products, metabolites

Analytical

Bioanalytical Chemistry

- HPLC and LC-MS/MS
- Method development/validation
- GLP compliant assays
- Formulation/stability testing
- Biological matrix analyses



Biology

Molecular Biology

- DNA cloning/manipulation
- Protein expression (bacteria, mammalian, insect cells)
- Protein isolation/characterization
- Real-time PCR

In Vitro Screening

- Biochemical/cell-based assays
- Assay development/validation
- Moderate to high throughput screening
- ADMET testing

In Vitro Testing

- Blood/tissue/urine collection
- PK testing/analysis
- Xenograft tumor models
- Fluorescence/luminescence and ultrasound imaging
- Implantable pumps

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Website: utoledo.edu/corelabs

Center for Materials and Sensor Characterization (CMSC)

The Center for Materials and Sensor Characterization (CMSC) is a state of the art materials and chemical characterization and research facility. CMSC has multiple laboratories housing high end characterization equipment and highly trained personnel to operate them and to perform materials related research. The mission of CMSC is to advance research and education and to serve as a transformative partner for industries. CMSC has a vision to produce competitive researchers, advance materials characterization and research, and promote economic growth in the region.

Microscopy

- Hitachi S-4800 UHR Scanning Electron Microscope (SEM)
- FEI Quanta 3D FEG Focused Ion Beam and ESEM (FIB/ESEM)
- Hitachi HD-2300A Scanning Transmission Electron Microscope (STEM)
- Bruker Nanoscope IIIa Multimode Scanning Probe Microscope (AFM)



Spectroscopy

- Perkin Elmer Frontier FTIR/NIR imaging system with array detector
- Varian Excalibur Series FTIR with FTS-4000 and UMA- 600 microscope
- Jobin Yvon Horiba Confocal Raman Spectrometer
- Bruker FT-Raman Spectrometer
- Varian 320-MS LC-MS/MS triple quadrupole mass spectrometer
- Thermo Scientific XSeries2 ICP-MS
- SensiQ Discovery Surface Plasmon Resonance (SPR)
- Shimadzu UV-2450 UV/Vis Spectrophotometer



Thermal Analysis

- PerkinElmer Diamond Differential Scanning Calorimeter (DSC)
- TA Instruments Q800 Dynamic Mechanical Analyzer (DMA)
- TA Instruments Q50 Thermogravimetric Analyzer (TGA)

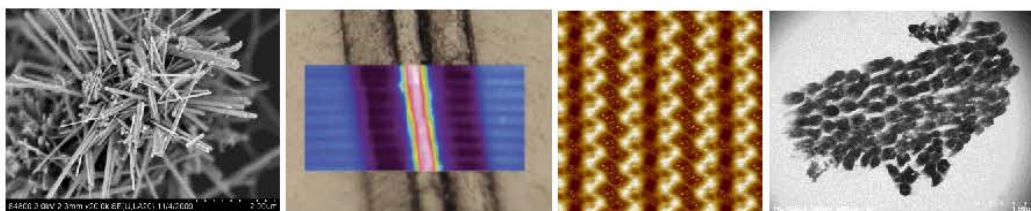


Other Instrumentation

- Micromeritics ASAP 2020 particle and porosity analyzer
- Micromeritics gas Pycnometer
- Mars 230/60 Microwave System
- Microfluidic based particle imaging velocimetry (PIV) system
- YSI 2300 STAT PLUS Glucose and Lactate Analyzer
- Gamry Instruments Reference 600 Potentiostat with RDE710
- Tante Model CAM-Micro contract angle meter
- Rigaku Ultima III X-ray Diffractometer (XRD) with Small Angle X-ray Scattering (SAXS)
- Shimadzu Gel Permeation Chromatography (GPC)
- Perkin Elmer Gas Chromatography (GC), with Turbomatrix ATD and Turbomatrix 40
- Instron 5566 Universal tester
- ZetaCompact automated Zeta Potential



Instruments to support analyses, such as sputter coater, ultramicrotome, critical point dryer, precision saw, ultrasonicators, fluorescence microscopes and optical microscopes are also available.



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Webpage: utoledo.edu/corelabs

Genomics Core

The Genomics Core Laboratory (GCL) provides researchers and students with advanced analytical tools and approaches for biomedical research utilizing microarray technology. Microarrays can track tens of thousands of molecular reactions in parallel to detect specific genes or to measure the activity of genes. The massive amounts of data produced from these studies require “mining” or the systematic application of statistics to determine significant findings.

Microarray Scanning

Affymetrix GeneChip® System



Hybridization Oven 640



Fluidics Station 450



3000 Scanner (6G)

PerkinElmer ScanArray® System



ScanArray 4000

Microarray Data Analysis

There is high and increasing demand for analysis of data from microarray experiments. Statistical analysis is available by Dr. David Weaver and in some cases, consultation with Dr. Sadik Khuder, statistician in the Department of Medicine. This includes data from experiments done on the Affymetrix or PerkinElmer systems here at UT or on Illumina Bead-Array equipment through our contract with the Cleveland Clinic Foundation. Analysis can also be accomplished with data from third-party vendors or other laboratories.

Affymetrix GeneChip® System

Users will provide biotin-labeled, fragmented cRNAs and arrays. The GCL will be responsible for hybridization, washing/staining and scanning of arrays.

PerkinElmer ScanArray® System

Hybridized slides, in a microscope slide array format, can be brought to the GCL for scanning. The PerkinElmer system uses lasers with 543 nm and 633 nm excitation intensities for generation of the image.

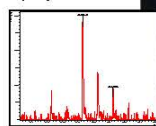
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Website: utoledo.edu/corelabs

Instrumentation Center

In 1985 the state of Ohio appropriated money for the creation of the Instrumentation Center at the University of Toledo. The purpose of the center is to support faculty research, provide access and training for graduate students in the use of advanced instrumentation and provide a scientific support base for local industries through technical advice and sophisticated problem solving capabilities. The Center also offers outreach programs that allow cyber-access to instruments. Areas of advanced technologies include scanning electron microscopy (SEM), mass spectrometry (MS), and crystallography.

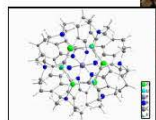
MALDI/TOF/TOF MS with a PROTEINEER for LC-MALDI and ImagePrep system



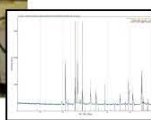
SEM with a STEM detector, EDS, and EBIC applications



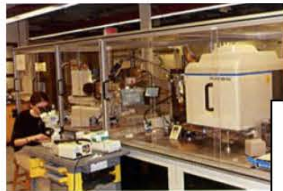
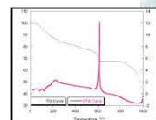
Three small molecule diffractometers



Two powder X-ray diffractometers (P-XRD)



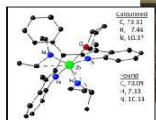
Thermal gravimetric differential thermal analyzer (TG-DTA)



High brilliance macromolecular diffractometer



Combustion analysis (CHN Analysis)



Sivarajan Kumarasamy



Robots for protein crystallization



UV/Vis/NIR Spectrometer also available for use.



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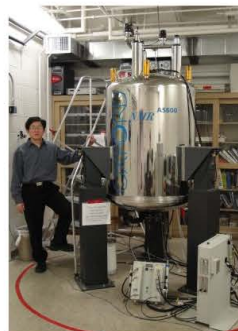
Nuclear Magnetic Resonance Facility (NMR)

NMR spectroscopy is a powerful tool for the determination of molecular structure, the study of molecular dynamics, and the characterization of materials at the molecular level. The NMR Facility mission is to support research and teaching at the University of Toledo. Instrumentation training and consultation are available to companies that use the NMR spectrometers. The NMR Facility is located in the basement of Bowman-Oddy Laboratories. It houses 4 NMR spectrometers: Bruker Avance 600MHz, Varian Inova 600MHz, VXR5 400MHz and Gemini 200MHz.

Varian Unity Inova 600 Mhz with a Penta, $^1\text{H}\{^{13}\text{C},^{15}\text{N},^{31}\text{P},^2\text{D}\}$ probe
It is an indirect detection probes designed for versatility in biomolecular applications. It is tuned to allow decoupling of up to four different nuclei including ^2H lock.

Other probes:

- Triple Resonance, $^1\text{H}\{^{13}\text{C},^{15}\text{N}\}$ indirect detection probe with triple axis (XYZ) gradients for superior solvent suppression
- Double Resonance Indirect, $^1\text{H}\{^{15}\text{N} - ^{31}\text{P}\}$ probe, outer coil is tunable over the frequency range ($^{15}\text{N} - ^{31}\text{P}$)
- Dual Broadband ($^{15}\text{N} - ^{31}\text{P}\}\{^1\text{H}\}$ 5mm and 10mm probes Multinuclear probes optimized for superior sensitivity for nuclei in the typical frequency range of $^{15}\text{N} - ^{31}\text{P}$



Bruker Avance 600 MHz with a Dual resonance 5mm Cryoprobe, DCH with Z gradient. CryoProbes. While it is optimized for ^{13}C detection, the ^1H sensitivity is also very good. The Cryoprobe delivers the single largest increase in NMR sensitivity in the last few decades. This enables an increase sample throughput by up to 16- fold.



Other probes

- 4 mm Top-loading DVT Multinuclear Double Resonance MAS probe tunable from ^{15}N to ^{31}P , with 50 μL active volume and 15 kHz maximum spinning speed. VT range -50°C to +120°C
- 5 mm SMARTProbe™ sample diameter with actively shielded Z-gradient and digital tuning for observation over the range from ^{15}N to ^{31}P as well as ^{19}F with ^1H decoupling

Varian Vxrs 400MHz with versatile AutoSwitchable ($^{13}\text{C}/^{31}\text{P}\}\{^1\text{H}/^{19}\text{F}\}$ probes

Other probes: Dual Broadband ($^{15}\text{N} - ^{31}\text{P}\}\{^1\text{H}\}$ 5mm and 10mm probes

Varian Gemini 200MHz with versatile AutoSwitchable ($^{13}\text{C}/^{31}\text{P}\}\{^1\text{H}/^{19}\text{F}\}$ probes.

Esquire-LC (Bruker-HP) routinely configured with ESI source and manual injection. This system combines Hewlett Packard's HP1100 series HPLC with Bruker's multipole ion trap MS and MSn analyzer.

Other resources:

Atmospheric Pressure Chemical Ionization (APCI)
Nanospray

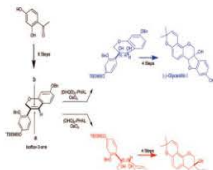
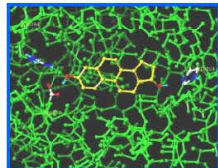
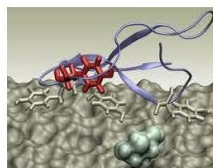


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Center for Drug Design and Development (CD3)

The CD3 assists with the design and/or development of potential small molecule diagnostics, biomarkers, therapeutics and preventative agents, and facilitates the translation of such agents towards clinical application.



Chemistry

Drug Design

- X-ray structure analysis
- Computational modeling
- Virtual screening
- Structure/ligand-based design
- Prodrug/softdrug strategies

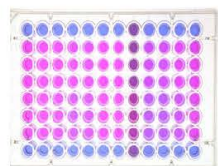
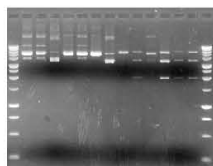
Chemical Synthesis

- Compound libraries
- Small to pilot scale
- Analytical standards, decomposition products, metabolites

Analytical

Bioanalytical Chemistry

- HPLC and LC-MS/MS
- Method development/validation
- GLP compliant assays
- Formulation/stability testing
- Biological matrix analyses



Biology

Molecular Biology

- DNA cloning/manipulation
- Protein expression (bacteria, mammalian, insect cells)
- Protein isolation/characterization
- Real-time PCR

In Vitro Screening

- Biochemical/cell-based assays
- Assay development/validation
- Moderate to high throughput screening
- ADMET testing

In Vitro Testing

- Blood/tissue/urine collection
- PK testing/analysis
- Xenograft tumor models
- Fluorescence/luminescence and ultrasound imaging
- Implantable pumps

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Appendix E. Endowed Chairs and Professorships

- Alan H. and Karen A. Barry Endowed Professorship in Accounting
- The Ability Center of Greater Toledo, Endowed Chair in Disability Studies
- NEG Endowment for Silicate Science Endowed Chair in Advanced Films and Coatings
- Anderson-Fornoff Endowed Chair in Law and Values (supports 4 professorships)
- Arthur H. Black Professorship in Chemistry
- Helen Luedtke Brooks Endowed Professorship in Astronomy
- Judith Daso Endowed Chair in Education
- The Frederick W. Hiss Endowed Professorship in Diabetes
- S. Amjad Hussain Endowed Professorship in Thoracic and Cardiovascular Surgery
- George Isaac Endowed Chair in Cancer Research
- Joan and Julius Jacobson Endowed Professorship in Biomedical Research
- Iman Khattab Endowed Professorship of Islamic Studies
- Kenneth A. Kropp M.D. Endowed Professorship in Urology
- Phil Markowicz Instructorship/Professorship in Judaism and Jewish Biblical Studies
- The Clair Martig Endowed Chair in Neurology
- Harold & Helen McMaster Chair in Photovoltaics
- McMaster-Gardner Endowed Chair of Orthopaedic Biomedical Engineering
- The Helen and Harold McMaster Endowed Chair in Biochemistry and Molecular Biology
- The Medical College of Ohio Alumni Endowed Chair in Surgery
- Mercy Health System-Northern Region Visiting Professor
- The Mercy Health System-Northern Region Chair of Excellence in Education
- The Adela and Alfred Mundt Endowed Professorship in Transplantation Cardiology
- Thomas & Margaret Murray Professorship in Catholic Thought
- Endowed Chair in Nanoscale PV Surface and Interface Science
- John B. & Lillian Neff Endowed Chair in Finance
- The University of Toledo College of Medicine and Life Sciences Endowed Professorship in Nephrology
- John T. Schaeufele Endowed Professorship in Pediatrics
- Edward H. Schmidt Endowed Professorship for Sales & Business Marketing
- The Rita T. Sheely Endowed Chair in Obstetrics and Gynecology
- Frank D. Stranahan Endowed Chair for Oncological Research
- Robert A. Stranahan Endowed Chair for Microbiology and Immunology
- Edmund Vickroy Collins Endowed Professorship in the Department of Pediatrics

Appendix F. Outcomes – Research, Scholarship & Creative Activities

Outcomes	Baseline 2016	Target 2022	Responsibility
Improve research support, research infrastructure and partnerships			
An implementation and investment plan for the biomedical and environmental sustainability areas	0% completed	100% completed	RSP, Provost, President Deans
Additional areas of excellence developed by the faculty with plans for implementation	0% completed	100% completed	RSP, Provost, President Deans
UT's research, grants accounting, and compliance offices will be staffed and trained appropriately to achieve high customer satisfaction rates as measured by a customer service survey distributed in May of each fiscal year by FY 2022	Customer Service: New Initiative Training: No Formal Training	100% Completed	RSP OFA
A new comprehensive electronic research administration system will be staffed and implemented by 2019	New Initiative	100% Completed	RSP
New faculty research start-up packages will be above the median in their disciplinary fields benchmarked to peer institutions			RSP
Increase the number of full professors in the pool of UT full-time faculty	277	300 in FY 2022	Provost
Faculty workloads policy in various disciplines will be comparative to peer institutions	New Initiative	100% Completed	Provost
A new comprehensive electronic research administration system will be staffed and implemented by 2019	New Initiative	100% Completed	RSP
New faculty research start-up packages will be above the median in their disciplinary fields benchmarked to peer institutions			RSP
Increase the number of full professors in the pool of UT full-time faculty	277	300 in FY 2022	Provost

Improve research support, research infrastructure and partnerships			
National ranking in NSF research expenditures	190	160	RSP Provost
Ranking in R&D NSF expenditures among Ohio public universities	6th	3rd	RSP Provost
Number of faculty publications in high impact national and international journals	Baseline will be determined when Faculty 180 becomes operational in AY 2017-2018	Goal to be determined after establishment of baseline	Provost, All Colleges, RSP, IR
Number of faculty who are fellows of selected national societies	Baseline will be determined when Faculty 180 becomes operational in AY 2017-2018	Goal to be determined after establishment of baseline	Provost, All Colleges, RSP, IR
Number of faculty participants as organizers, chairs and invited keynote speakers at national and international professional conferences	Baseline will be determined when Faculty 180 becomes operational in AY 2017-2018	Goal to be determined after establishment of baseline	Provost, All Colleges, RSP, IR
Number of new external grant proposals per year will increase	564 new external grant proposals	620 new external grant proposals	RSP
Annual external sponsored research funding will increase	~38 million	~80 million	RSP
Multi-unit or multi-disciplinary (3 or more faculty across 2 or more departments) contracts or grants will increase by 15%	Baseline data to be determined	Baseline data need to determine 2022 target	RSP
Industry-supported awards (including clinical trials) will increase	Baseline data to be determined	Baseline data need to determine 2022 target	RSP

Improve research support, research infrastructure and partnerships (con't)			
The number of UT's institutional research partnerships/membership with federal research and development agencies or federal research and development laboratories will increase	1 agreement with Agricultural Research Service	3 Agreements	RSP
By Fall 2017, an implementation and investment plan, developed by faculty, will be in place for the biomedical and environmental sustainability area	New Initiative	100% Completed by Fall 2017	RSP Provost
By Spring 2018, additional areas of excellence developed by the faculty, will be in place for the biomedical and environmental sustainability area	New Initiative	100% Completed by Spring 2018	RSP Provost
Up to 5 areas of excellence developed by the faculty, will be identified with master plans will be underway	New Initiative	100% Completed	RSP Provost
Develop a mechanism for measuring the number of joint faculty-student publications as reported in Faculty 180	New Initiative	100% Completed	Faculty 180
The number of faculty who are PIs or co-PIs on grants and contracts will increase by 5 percent	5-year average from FY 2012-2016:276	289 (5% of 276 is 13.8)	RSP
The average external support to UT tenured and tenured track faculty members will increase.	\$36K per faculty member	\$60K per faculty member	RSP
The number of multi-unit or multi-disciplinary contacts or grants will increase	Annual Average 47%	Annual average 55%	R&SP
The number of UT Faculty who are fellows of National Societies will increase by 2%	Baseline to Be Established in FY 2018	Baseline needed to determine Target	Faculty 180
Number of funded UT endowed chairs and professors will increase	5 members	10 members	The Provost Office
Number of meeting abstracts and proceeding papers abstracted in the Web of Science will increase	FY 2014-2016 Baseline: 679	750	UT Libraries
Carnegie Classification on UT's research activity	R2 Doctoral Research University and Research Doctoral: Comprehensive Programs with Medical/Veterinary School	R2 Doctoral Research University and Research Doctoral: Comprehensive Programs with Medical/Veterinary School	President, Provost, RSP, GR, COGS, IR
Investment in research support infrastructure	Baseline will be determined after completion of assessment in summer 2017	UT's investment in research support infrastructure will be at the level of aspirational peers	RSP, Comp, IF, F&A

Foster community engagement through research collaborations that have relevance locally, regionally and internationally.			
Number of faculty and staff participating local research and community engagement activities	Baseline will be determined when Faculty 180 becomes operational in AY 2017-2018	Goal to be determined after establishment of baseline	Provost All Colleges, RSP
Number of local exhibits and performances by faculty, staff and students	Baseline will be determined when Faculty 180 becomes operational in AY 2017-2018	Goal to be determined after establishment of baseline	Provost, All Colleges, RSP
External views of faculty expertise database will increase by 3% per year from 2017-2022	Baseline will be determined when Faculty 180 becomes operational in AY 2017-2018	Goal to be determined after establishment of baseline	RSP Provost
Create a community engagement dashboard relating to educational attainment, workforce development and employability and career services	New initiative	Have the dashboard established	Provost

Foster community engagement through research collaborations that have relevance locally, regionally and internationally. (con't)

UT Technology Transfer will continue to be one of the top performers in the state.	FY 2011-2014 Baseline per \$10 million in research expenditures annually: Invention Disclosure: 10.0 Licenses: 2.2 License Income: \$128,629 Reimbursement Rate: 56% Startups Formed: 0.40	Maintain our current high ranking in the state in the following measures: Invention Disclosure Licenses License Income Reimbursement Rate Startups Formed per \$10 million in research expenditures annually	R&SP
UT's Technology Transfer and commercialization activities, including Rocket Innovations, will be self-sustaining through external support	New Initiative	UT's Technology transfer and commercialization activities, including Rocket Innovations, will be self-sustaining through external support providing that funds are not swept at the end of the fiscal year.	RSP
Obtain UT's designation from APLU as an Innovation and Economic Prosperity University	New Initiative	Application to be submitted by the Office of Research and Sponsored Programs and obtain ranking by FY 2022	RSP

Appendix G. Central Research Office Staffing Comparisons with Peer Institutions

Institution	FY 2016 Research Expenditures	Proposals / Pre-Award FTE	FTE per \$100 million FY 2016 Research Expenditures		
			Pre-Award	Post-Award (non-financial)	Compliance (non-IRB, ACUC)
OU	\$59,117,000	292.40	4.23	4.23	0.85
UA	\$58,800,000	NA	7.14	0.43	NA
WSU	\$55,484,000	186.75	7.21	NA	1.80
UM	\$46,675,000	92.60	10.71	10.71	1.07
UT	\$50,019,000	147.03	7.40	7.00	4.00
KSU	\$38,069,000	127.24	13.79	7.22	0.66
MU	\$16,057,000	129.00	18.68	NA	3.11



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