2020 Sponsored Research Activities

Office of Vice Provost for Research

Highlights
2020

$56.3M
Awards

$31.8M
Expenditures

445
Proposals Submitted

Introduction

We have ended a very successful year of activities, whether working on projects with undergraduate or graduate students, publishing exciting new research results, developing proposals, managing awards, or patenting and licensing new technologies.

WPI researchers were particularly busy seeking funds during Fiscal Year (FY) 2020, submitting 413 proposals for nearly $263 million. While the pandemic has slowed down some of the on-campus research in the past months of the academic year, research activities that could have been done remotely have continued. The number of submissions doubled for the months of May and June, as many researchers spent more time on grant applications when the university restricted campus operations in the spring because of the COVID-19 global pandemic.

WPI researchers were awarded, through the Office of Sponsored Programs (OSP), a record $56.3 million in government, corporate, and private funding for their work during the 2020 fiscal year, up 50 percent from the previous year. The research part of the strategic plan in 2015, we developed with a large number faculty groups, called for an increase in research funding, and funding has increased more than 140 percent since then. Research expenditures, while slightly lagging because of the pandemic, were at $31.7 million. In addition, it was a year with a new record in the number of issues patents (20).

The biggest funder of awards to WPI during 2020 was the National Science Foundation, which originated about $17.9 million in awards to the university's researchers, followed by the U.S. Army, the U.S. Department of Energy, the U.S. Department of Education, and the National Institutes of Health.

I would like to thank our faculty and students for another successful year. I would also like to thank our colleagues in the Offices of Sponsored Programs, Sponsored Programs Accounting (SPA), Technology Commercialization (OTC) and the Research Solutions Institute (RSI), for providing crucial assistance in identifying new opportunities, providing proposal training, developing, reviewing and submitting proposals, negotiating awards, issuing subawards, and ensuring that we are in compliance with a myriad of regulations, processing awards, setting up accounts, and helping our faculty manage these record numbers of awards. I would also like to thank our team of emergency responders who have maintained our research facilities during the campus closure.

The faculty and staff at WPI continue to move forward together with research despite the interruptions and challenges due to COVID. So far, the end of the second quarter in this fiscal year shows WPI receiving more than $23 million from 99 new awards and award increments. We are seeing positive developments by WPI researchers towards the much needed COVID research of current times as well as proposal submissions increasing.

For the fifth year in succession, WPI saw its research awards grow.

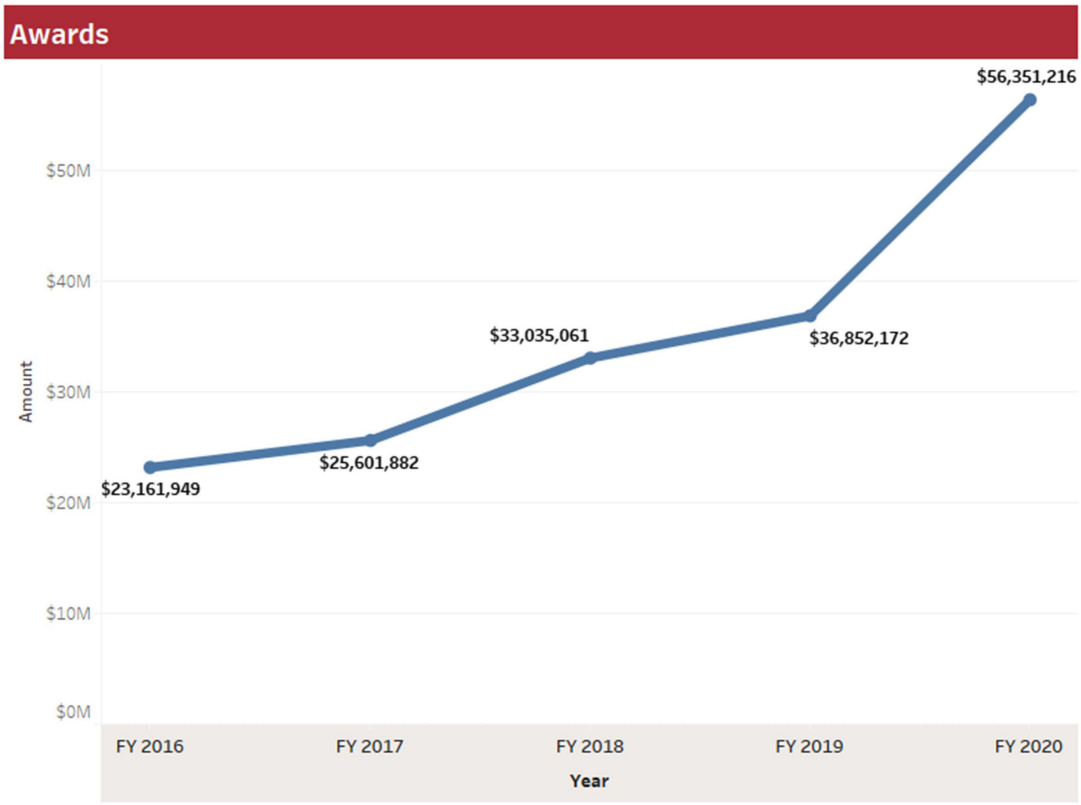
Bogdan M. Vernescu,
Vice Provost for Research

Contents

5 Year Summary

Awards

WPI received $56.3M in new awards in FY2020 – an all-time record. Awards are funds which have been fully obligated and released by the sponsor. Some grants are funded in yearly increments, subject to satisfactory progress and/or availability of funds. In such cases, only those increments received by WPI are counted as awards.



NSF

$555K

Early Investigator Awards

National Science Foundation (NSF) CAREER Awards

This past year, four **WPI faculty received NSF CAREER Awards**, matching WPI's previous record.

Andrew Teixeira, assistant professor in chemical engineering (ChemEng). received the award for his work in pulsed catalysis research. New catalytic processes will enable on-demand, decentralized chemical industries, potentially changing our manufacturing landscape.

Eric Young, assistant professor also in ChemEng, was awarded to develop engineering tools in a nonconventional organism to open up a new domain of life for metabolic engineering and synthetic biology.

Andrew Clark, assistant professor in electrical & computer engineering (ECE) will contribute to the science and engineering of cyber-resilient Cyber-Physical Systems with his CAREER award.

Yanhua Li, assistant professor in computer science (CS), has received the funding to develop, implement, and evaluate a unifying spatial-temporal imitation learning framework for inversely learning and "imitating" the decision-making strategies of human agents from their human-generated spatial-temporal data.

Awards by School

$23.4M

Arts & Sciences

$30.6M

Engineering

$672K

Business

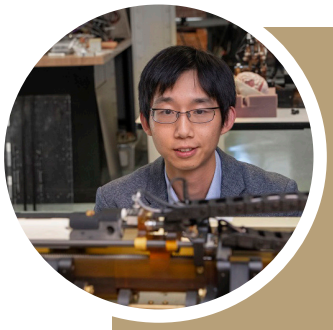
$259K

IGSD

$1.4M

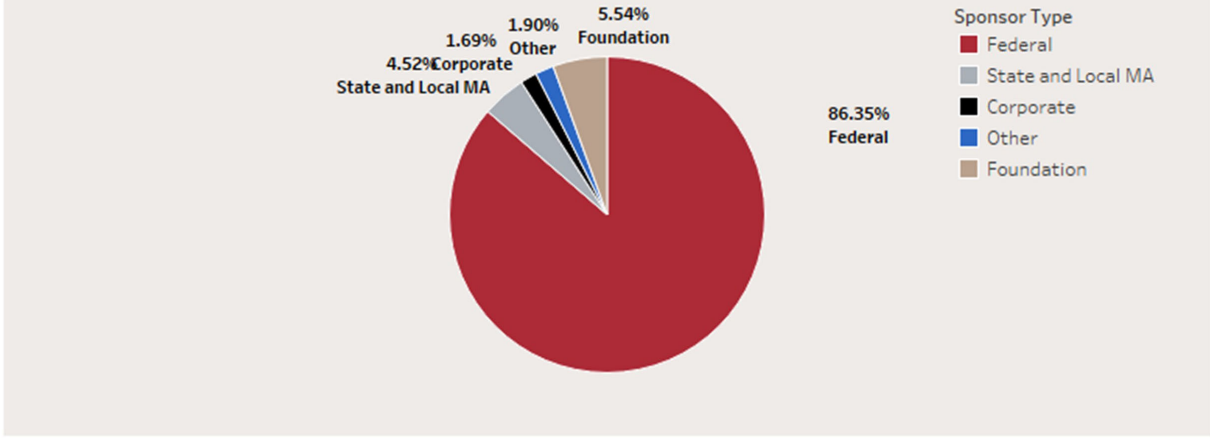
Other

Awards by Sponsor

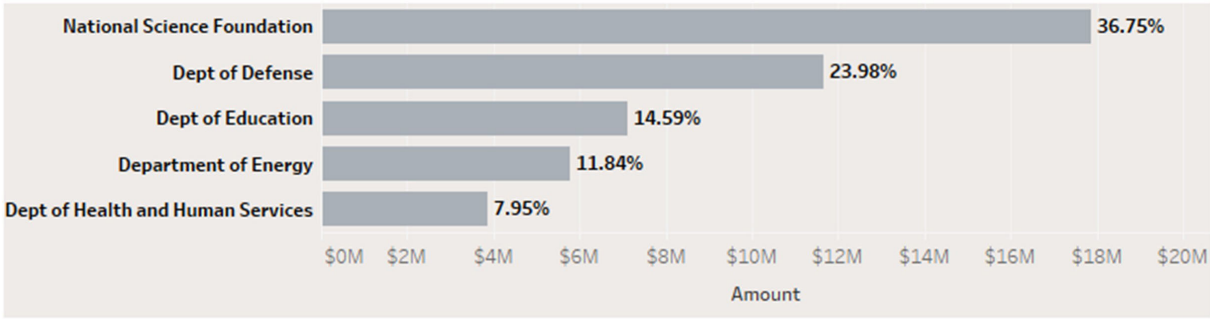


For the first time, one of our faculty has received the prestigious National Institutes of Health (NIH) Director's Early Independence Award. Kai Zhang, assistant professor in robotics engineering (RBE), received the award for his work to create a robotic system that will detect and analyze three different indicators of prostate cancer. Prostate cancer is the second-leading cause of cancer-related deaths among American men.

Awards by Sponsor Type



Awards by Top Federal Sponsors



WPI

Fiscal Year 2020

Awards by School and Department

Awards by School and Department

		FY 2016		FY 2017		FY 2018		FY 2019		FY 2020	
		No.	Amount	No.	Amount	No.	Amount	No.	Amount	No.	Amount
Arts & Sciences	BBT	33	$1,213,770	23	$1,067,222	39	$3,051,221	9	$655,028	22	$1,110,439
	CBC	9	$1,573,880	8	$1,604,628	6	$1,471,733	3	$821,680	4	$1,466,252
	CS	32	$3,896,366	20	$3,729,980	26	$4,143,102	43	$9,984,257	42	$16,955,436
	HUA	3	$199,988	3	$388,935	3	$313,937				
	MA	16	$1,057,195	11	$825,620	15	$1,434,785	12	$1,162,181	16	$1,273,780
	PH	5	$610,200	2	$116,493	8	$5,384,219	5	$1,093,973	7	$588,440
	SSPS	6	$79,740	5	$2,085,881	4	$1,166,001	4	$2,285,847	5	$2,007,631
	Total	**104**	**$8,631,139**	**72**	**$9,818,759**	**101**	**$16,964,998**	**76**	**$16,002,966**	**96**	**$23,401,978**
Business	FBS	22	$575,950	10	$365,835	6	$219,895	10	$659,530	4	$672,457
	Total	**22**	**$575,950**	**10**	**$365,835**	**6**	**$219,895**	**10**	**$659,530**	**4**	**$672,457**
Engineering	BME	21	$3,700,807	15	$2,391,854	17	$2,576,545	18	$1,707,437	24	$3,680,071
	CEE	8	$113,536	5	$554,322	7	$447,064	3	$83,250	6	$689,499
	ChE	22	$1,498,354	10	$1,114,167	10	$1,254,479	15	$3,970,306	14	$2,708,330
	ECE	37	$1,858,977	22	$2,522,295	14	$995,325	11	$1,556,514	20	$1,206,598
	FPE	9	$1,432,039	8	$385,359	7	$268,626	4	$868,403	4	$407,669
	ME	34	$4,619,070	42	$6,568,925	50	$8,598,634	48	$10,597,340	63	$21,874,800
	Total	**131**	**$13,222,783**	**102**	**$13,536,922**	**105**	**$14,140,673**	**99**	**$18,783,250**	**131**	**$30,566,966**
IGSD	IGSD	1	$61,214			1	$68,448	1	$75,175	3	$259,245
	Total	**1**	**$61,214**			**1**	**$68,448**	**1**	**$75,175**	**3**	**$259,245**
Other	Other	10	$670,863	15	$1,880,367	15	$1,641,047	10	$1,331,251	13	$1,450,569
	Total	**10**	**$670,863**	**15**	**$1,880,367**	**15**	**$1,641,047**	**10**	**$1,331,251**	**13**	**$1,450,569**
Grand Total		**268**	**$23,161,949**	**199**	**$25,601,882**	**228**	**$33,035,061**	**196**	**$36,852,172**	**247**	**$56,351,216**

Multiple Sponsors

Funding Spotlight

MatR: Materials Reimagined—Energy

Michael Timko, associate professor of ChemEng, received a Department of Energy (DOE) grant for a project that addresses Hydrothermal Liquefaction of Food Waste and Remediation of Aqueous Byproducts.

Eric Young, assistant professor in ChemEng, received four grants totaling more than $2M to support his research into using yeast and fungi to engineer organisms to make it easier to develop numerous products, e.g., biofuels.

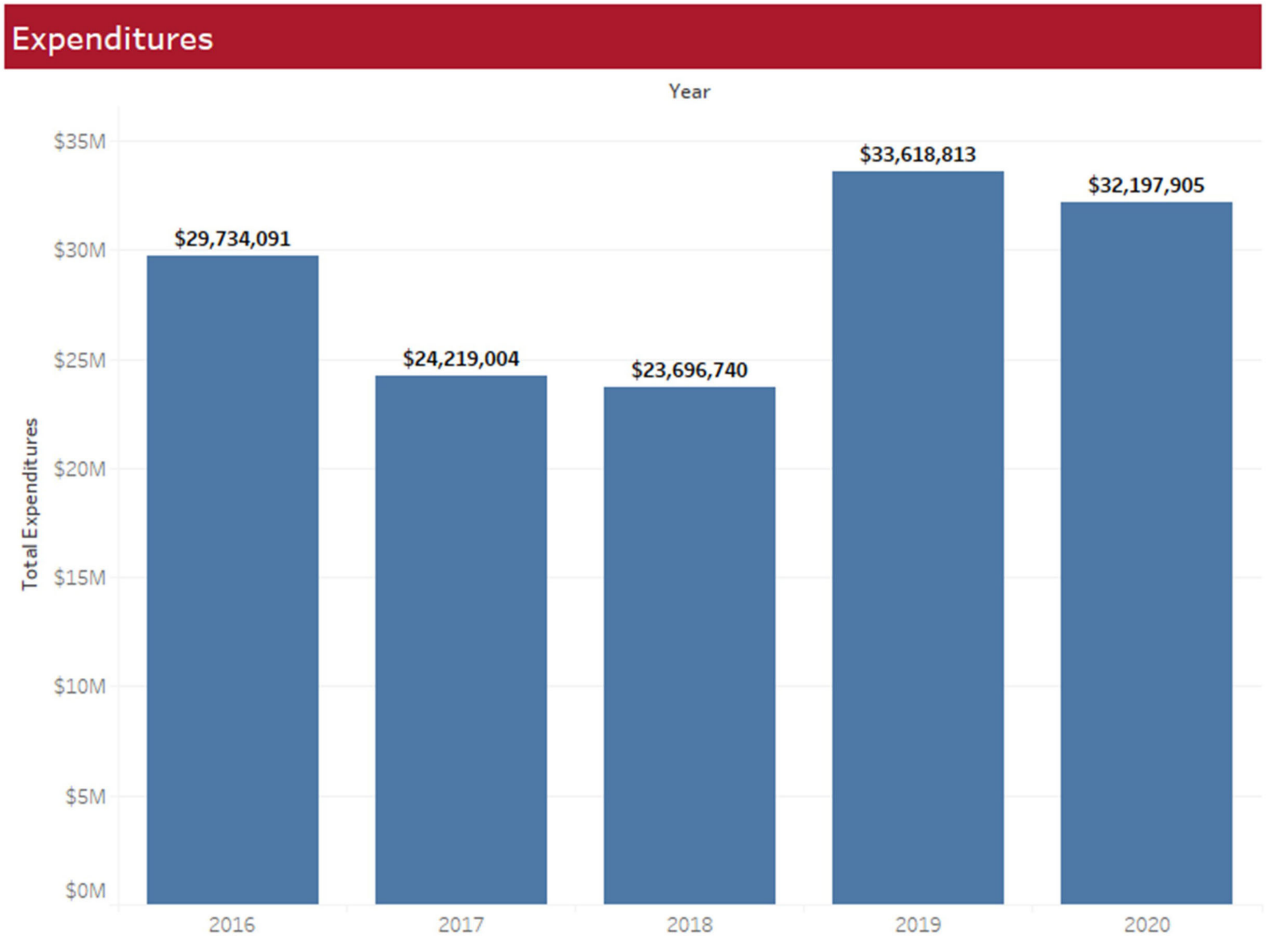
Jamal Yagoobi, professor and department head of Mechanical Engineering (MechEng) has received a $4 million award from the DOE and Massachusetts Clean Energy Center (MassCEC) to support advanced manufacturing R&D with a special focus on energy efficiency in industrial drying.

Adam Powell, associate professor in MechEng, was awarded a three-year, $1.5 million grant from the DOE to test a new type of welding that could lead to future designs of car joints used in ultra-light car doors and other vehicle body applications.

5 Year Summary

Expenditures

Expenditures are the actual costs paid for by WPI's external funding in a given year. These costs are recorded in real-time as the research is taking place, unlike awards which are recorded as a lump sum. As such, expenditures provide the most consistent year-over-year measure of funded research activity at WPI. Research expenditures were slightly lower last year because of research interruptions due to COVID.



NSF
$108K

Funding Spotlight

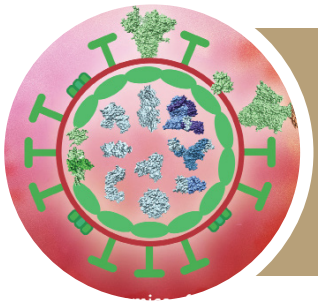
Global Initiatives—Social Justice

Renata Konrad, assistant professor and **Andrew Trapp,** associate professor (both in the Foisie Business School) have received a grant from the NSF for a project using analytics to develop tools to understand and address human trafficking networks. They will use data analytics and optimization to determine the most efficient use of shelters and services for homeless youths in New York City. Their goal is to disrupt the "supply side" of human trafficking networks by reducing the vulnerability of those most at risk of exploitation.

WPI

Fiscal Year 2020

Expenditures



Dmitry Korkin, professor in CS, had his work on the structural 3D roadmap of COVID-19 featured on the cover of the April issue of the Viruses journal.

Expenditures by School

	Arts & Sciences	Engineering	Business	Other
Undergraduate Support	$240,187	$194,346	$12,686	$12,035
Travel	$236,715	$205,198	$4,111	$53,676
Participant Support	$834,147	$271,572	$17,927	$14,708
Supplies	$461,932	$720,388	$1,181	$41,091
Benefits	$674,536	$718,536	$28,118	$33,029
Other	$948,761	$805,796	$17,984	$165,891
Graduate Tuition	$1,259,489	$816,906	$18,322	$36,000
Equipment	$498,180	$1,958,533	$0	$6,909
Subcontracts	$1,864,437	$1,803,924	$8,444	$23,965
Graduate Support	$2,312,350	$2,498,659	$89,725	$99,167
Salary - Faculty	$2,375,557	$2,526,785	$104,481	$182,381
Indirect Cost	$3,034,229	$3,748,416	$118,975	$97,520
Grand Total	**$14,740,520**	**$16,269,059**	**$421,954**	**$766,372**

NSF
$199K

Funding Spotlight

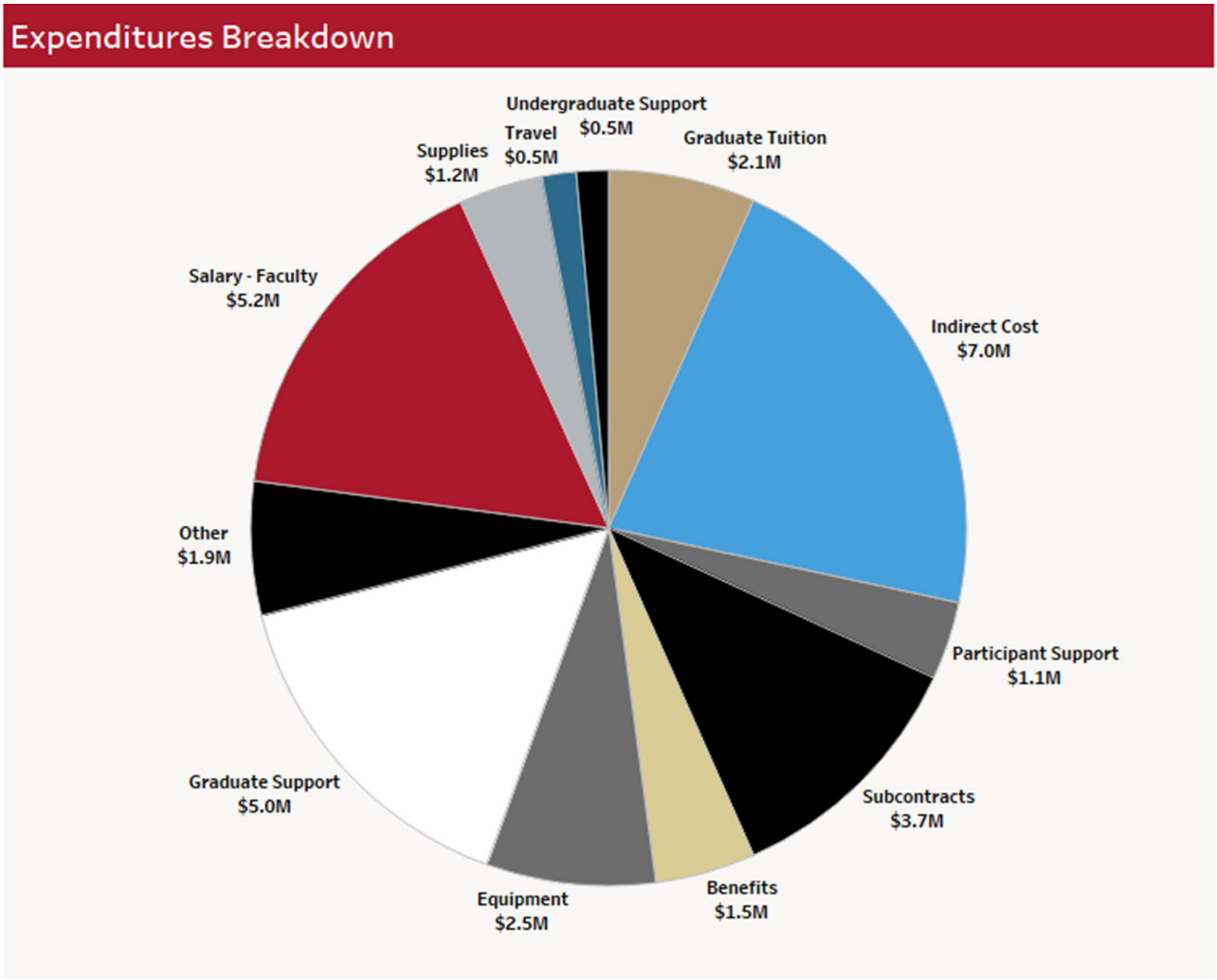
Civil and Environmental Engineering—Shichao Liu

Researchers with expertise in fields ranging from psychology to architectural engineering will use a $199,999 grant from NSF to study how the novel coronavirus global pandemic is affecting stress in college students and their ability to learn in remote settings.

The research is notable because it will be done during a real pandemic and gather data about the real strains felt by students, said Shichao Liu, assistant professor of civil and environmental engineering (CEE), who is the principal investigator (PI) of the one-year project.

Expenditures

Expenditures Breakdown



NSF
~$6M

Funding Spotlight

Smart World—Robotics

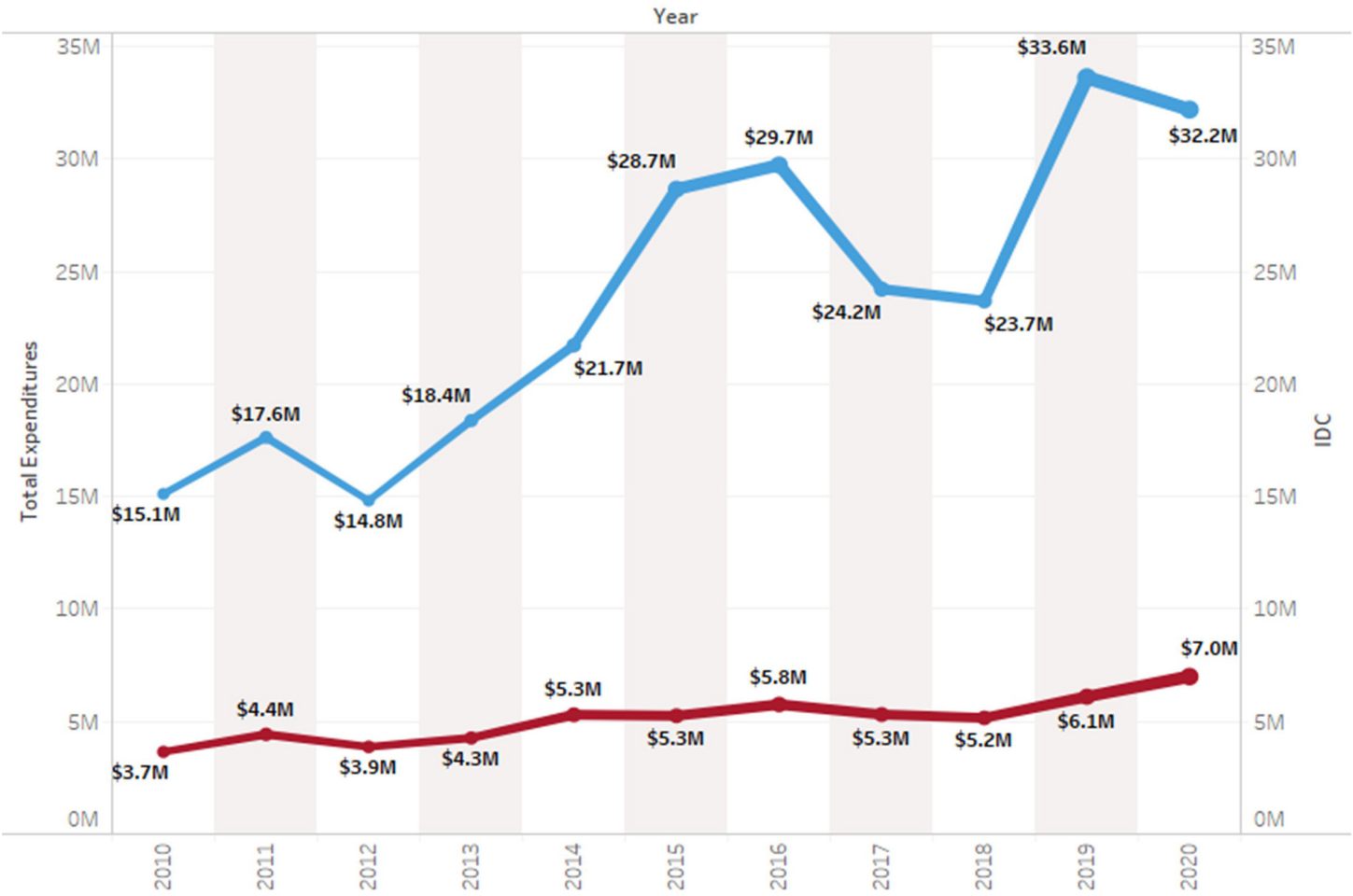
Berk Calli, assistant professor in RBE **is** the lead PI on a $2.5M NSF funded project that aims at developing robotics technology that could help recycling center workers sort waste in a safer, cleaner, and more profitable manner.

WPI researchers, under the lead of RBE's **Cagdas Onal h**ave secured a five-year, $3M NSF NRT grant focusing on research and training related to the adoption of robotic assistants in the workplace.

In addition, WPI has received funding ($67K) for a new IUCRC in Robotics, led by Pr**ofessor and Department Head Jing Xiao.** It focuses on applied robotics and sensing research for a wide range of applications, including energy, healthcare, material handling, security, and service domains.

Expenditures

Expenditures and IDC Over 10 Years



Multiple Sponsors
$12M
NSF
$1M

Funding Spotlight

Smart World—Learning Sciences

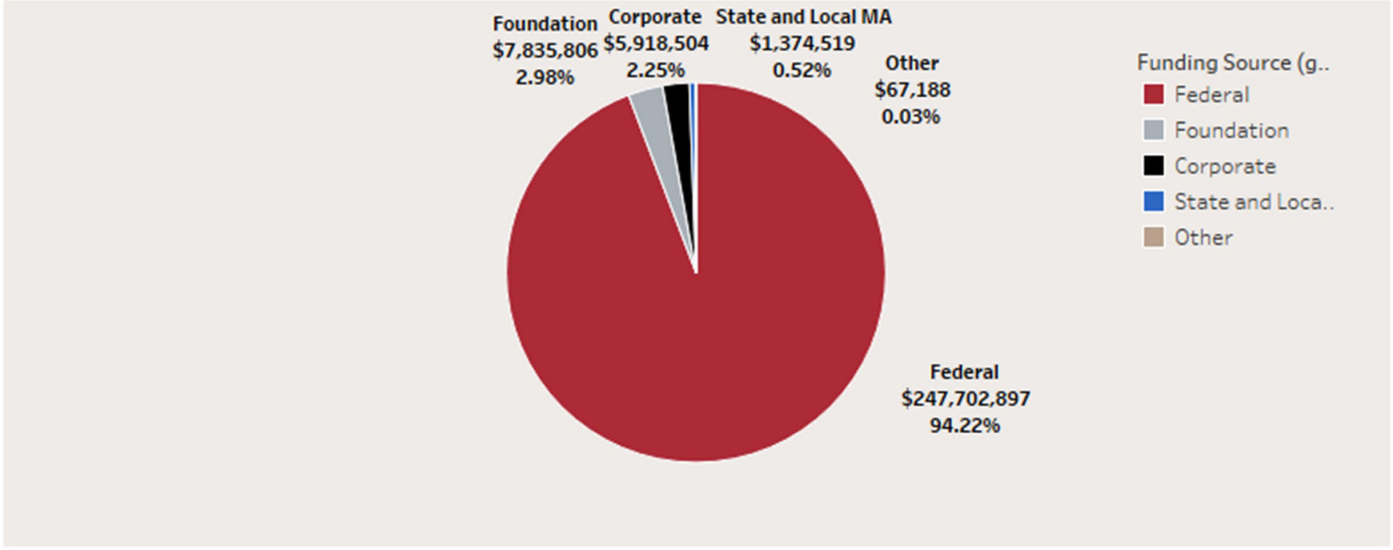
The Learning Sciences group, led by **Neil Heffernan,** professor in CS, continues to expand and bring in record amounts of funding (more than $12M in FY20) for work done at WPI in collaboration with colleagues at other universities and companies in the digital learning space. Multiple larger grants support WPI's collaboration with the ASSISTments Foundation.

Another CS researcher, Erin Solovey, has received a $1M NSF grant that could lead to significant breakthroughs in technology platforms for the American Sign Language (ASL)-signing Deaf Community. She will investigate the effectiveness of computer interfaces that will allow deaf individuals to navigate, search, and interact with technology completely in ASL.

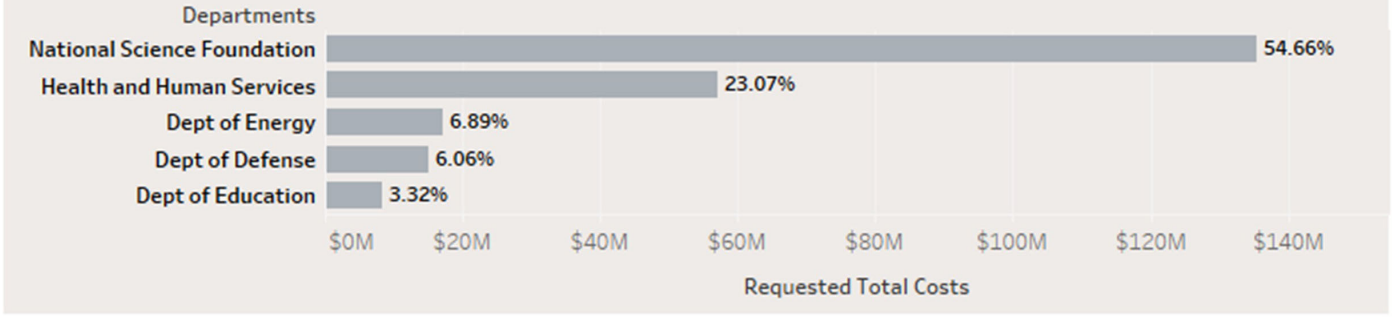
Proposals

In FY20, there were 445 proposals submitted, totalling a request of $265M. Almost 95 percent of the proposals were submitted to Federal sponsors, totalling $247.7M. Of the Federal sponsors, most proposals (almost 55 percent) were submitted to the National Science Foundation totalling $135M.

Submitted Proposal Amounts by Sponsor



Submitted Proposals to Top Federal Sponsors



NextFlex & M2I2 **$770K**

Funding Spotlight

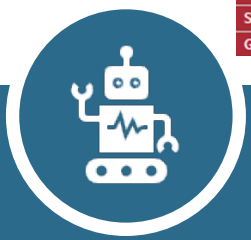
Mechanical Engineering: Pratap Rao

Pratap Rao, associate professor in MechEng, has been funded by NextFlex to lead a project on the development of processes for reliable inkjet printing of fine miniaturized circuits, along with partner companies Raytheon Technologies Research Center, Eastman Chemical Co. and local company Carpe Diem Technologies (Franklin, MA). In addition, Rao has received funding to participate in another NextFlex project that seeks to measure the performance of printed stretchable conductors, led by Binghamton University (NY) and in collaboration with UMass Lowell. Equipment for both these projects has been provided by the Commonwealth of Massachusetts through the MassTech Manufacturing Innovation Initiative (M2I2), which has enabled the establishment of a new printed electronics lab within the WPI LEAP (Lab for Education and Application Prototypes).

5 Year Summary

Proposals Submitted by School and Department

SCHOOL: Departmen..	Departments	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Arts & Sciences	Biology & Biotechnology	$16,664,582	$10,512,283	$5,316,339	$8,999,980	$9,832,646
	Chemistry & Biochemistry	$14,031,454	$14,915,134	$15,164,667	$19,419,599	$19,760,315
	Computer Science	$91,081,859	$63,829,585	$55,780,679	$66,060,649	$53,074,129
	Humanities & Arts	$2,801,271	$1,504,311	$950,449	$30,000	$2,028,121
	Mathematical Sciences	$7,138,020	$12,443,081	$10,847,099	$6,799,916	$14,686,177
	Physics	$6,972,843	$7,507,363	$11,223,643	$6,386,832	$5,458,809
	Social Science & Policy Studi..	$9,874,384	$5,648,375	$10,307,868	$3,531,577	$1,053,103
Engineering	Biomedical Engineering	$20,916,371	$16,139,455	$17,464,934	$34,232,381	$36,155,282
	Chemical Engineering	$7,359,639	$9,573,181	$13,336,931	$7,516,896	$20,175,607
	Civil & Environmental Engin..	$8,004,878	$6,240,237	$2,204,135	$2,717,516	$1,708,005
	Electrical & Computer Engin..	$10,289,038	$5,348,862	$6,172,118	$6,929,073	$17,043,007
	Fire Protection Engineering	$627,926	$5,573,438	$3,251,568	$5,406,240	$2,125,325
	Mechanical Engineering	$23,943,163	$41,005,082	$41,725,321	$59,438,631	$64,778,562
IGSD	IGSD	$91,000	$221,955		$427,278	$918,458
Other Departments	Academic & Corporate Devel..	$1,217,630				
	Academic Affairs		$638,963	$65,809		$299,576
	Admissions Office		$0			
	Assistant Provost Office	$349,995				
	BETC			$241,103		$85,000
	Center For Stem Teaching		$450,872	$1,318,839	$857,254	$6,025,911
	Chemistry S/R		$526,561			
	Corporate & Professional Ed..		$110,994	$112,205		
	Dean Of Graduate Studies			$43,658		$498,714
	Health Care Delivery Institute		$129,000			
	Human Resources	$244,858				
	Intellectual Property & Inno..			$499,995	$50,000	$50,000
	K-12 Outreach			$0	$632,458	$74,594
	Library Services					$108,228
	Office of Multicultural Affair		$226,000			
	Office Of Sponsored Progra..					$1,999,295
	Office Of Undergraduate Stu..		$941,654	$8,374		
	Physical Education			$53,320		
	Pre-Collegiate Outreach Pro..				$169,594	$381,270
	President's Office					$50,000
	Provost's Office	$19,298				
	Student Affairs			$239,987		
	Student Department				$170,000	$453,895
School of Business	School Of Business	$2,737,718	$7,795,124	$6,415,282	$1,404,014	$5,050,532
Grand Total		$224,365,927	$211,281,510	$202,744,323	$231,179,888	$263,874,561



NSF
$273K
NIH
$541K

Funding Spotlight

Smart World/Bio-Point

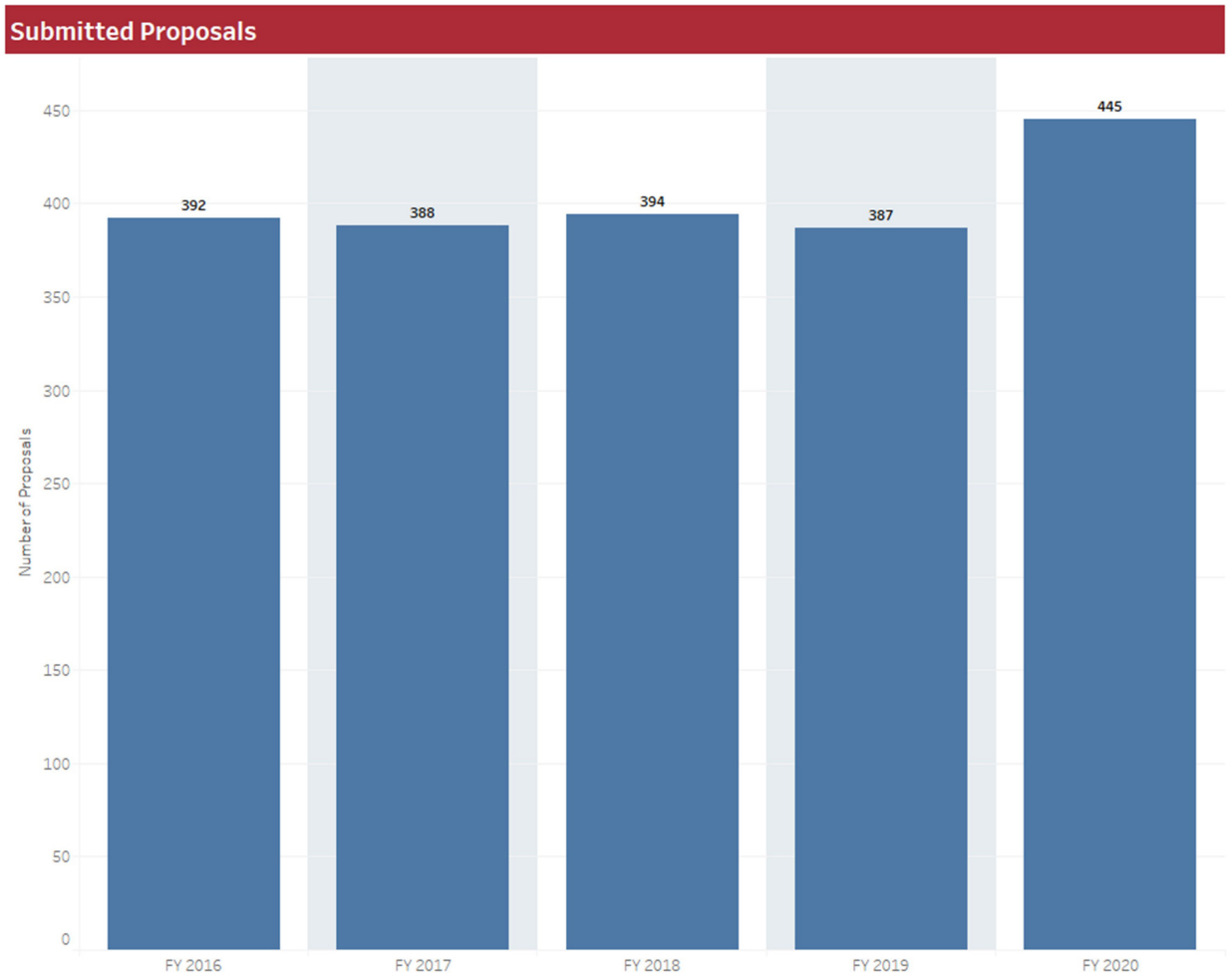
Interesting work has been happening at the intersection of the Smart World and Bio-Point groups, at least partially facilitated by the opening of our new Practice Point facility.

Greg Fischer, professor in RBE, who has been working on projects dealing with robotic surgery, has received an NSF award to Accelerate Research in Robotic Surgery.

He has been joined by **Kai Zhang**, who has received NIH funding for creating a new medical robot that uses minimally invasive technologies to safely and accurately detect and monitor prostate cancer.

Loris Fichera, assistant professor in RBE, has received NIH funding to create steerable laser probe, which will enable physicians to reach and treat anatomical locations that are normally inaccessible during office procedures, and potentially spare many patients the need for expensive surgical treatment.

Proposals



NSF
$355K
Dept of Army
$56K

Funding Spotlight

Smart World—Data Science

Elke Rundensteiner, professor in CS and director of the Data Science Program, has been awarded an NSF grant to design an integrated paradigm for end-to-end anomaly discovery. The resulting system enables the analyst to steer the discovery process with human ingenuity, empowered by near real-time interactive responsiveness during exploration.

Randy Paffenroth, associate professor in mathematical science (Math), also Data Science faculty, was awarded a cooperative agreement by the Army to use data science methodologies to identify new materials, and new material combinations that lead to improved sensor performance. The goal is to optimize sensor materials to work in complex environments, respond to many different analytes, increase performance and concomitantly reduce load.

RSI HIghlights 2020

4

CAREER proposal development

$3.5M

Department of Energy AMO submission

$500K

NSF Award

$155K

Department of Energy EERE

$2.5M

MII awards

WPI

Research Solutions Institute (RSI) Overview

RSI's mission is to help faculty and collaborative teams identify and capture funding support for new research initiatives

NIH and NSF Assistance

RSI assisted WPI faculty on scientific and grantsmanship aspects of their research proposals, and/or review/editing on 34 total submitted proposals (NIH, NSF), contributing to the creation and support of another Center at WPI which will focus on Wound Care as well as Pressure Ulcer Prevention, and assisted with WPI's new Neuro-physiology suite at PracticePoint in terms of selection of imaging devices, clinical research procedures, and for acquisition of preliminary data to be used in the future proposal submissions to NIH/NSF.

Manufacturing USA Institutes and Related Activities

RSI coordinates an active portfolio of research and education initiatives in advanced manufacturing through WPI's memberships in eleven federally-sponsored Manufacturing USA Institutes. Each Institute is a large consortium of industry and academic members collaboratively focusing on applied R&D challenges in particular sectors of advanced manufacturing technology. WPI recently became a member of America Makes (additive manufacturing and 3D printing). Total MII funding awarded in FY20 (from the Institutes and additional synergistic and/or MA State funding) was approximately $2.5M on 6 awarded projects, and total expended was approximately $2M on projects in-progress.

Synergies resulting from Manufacuring Innovation Institute (MII) Engagement

Several synergies among and beyond the MIIs are starting to take shape leading to additional funding avenues, cross-team interactions, and expanded impact of MII investment.

Synergy Spotlight: Massachusetts LIfe Sciences Center (MLSC) provided funding for Cell Engineering Research Equipment Suite (CERES@ WPI), leveraging MII projects: To leverage and expand work in current funded industry-academic projects that span workforce development (NIIMBL), and cell and tissue manufacturing technical projects (ARMI BioFabUSA). Projects and equipment grants supported by MLSC include a $877K Open Capital Grant to Marsha Rolle, Eric Young, and the BETC to build CERES@WPI, a fee-for-service cell analytics facility that will accelerate cell engineering research across WPI and regional startups (MBI).

OTC HIghlights 2020

14
Licenses Executed

6
Start-up Pipeline

48
Active licenses

Economic Impact of IP and Licenses

55
Jobs

$20.5M
Capital Raised

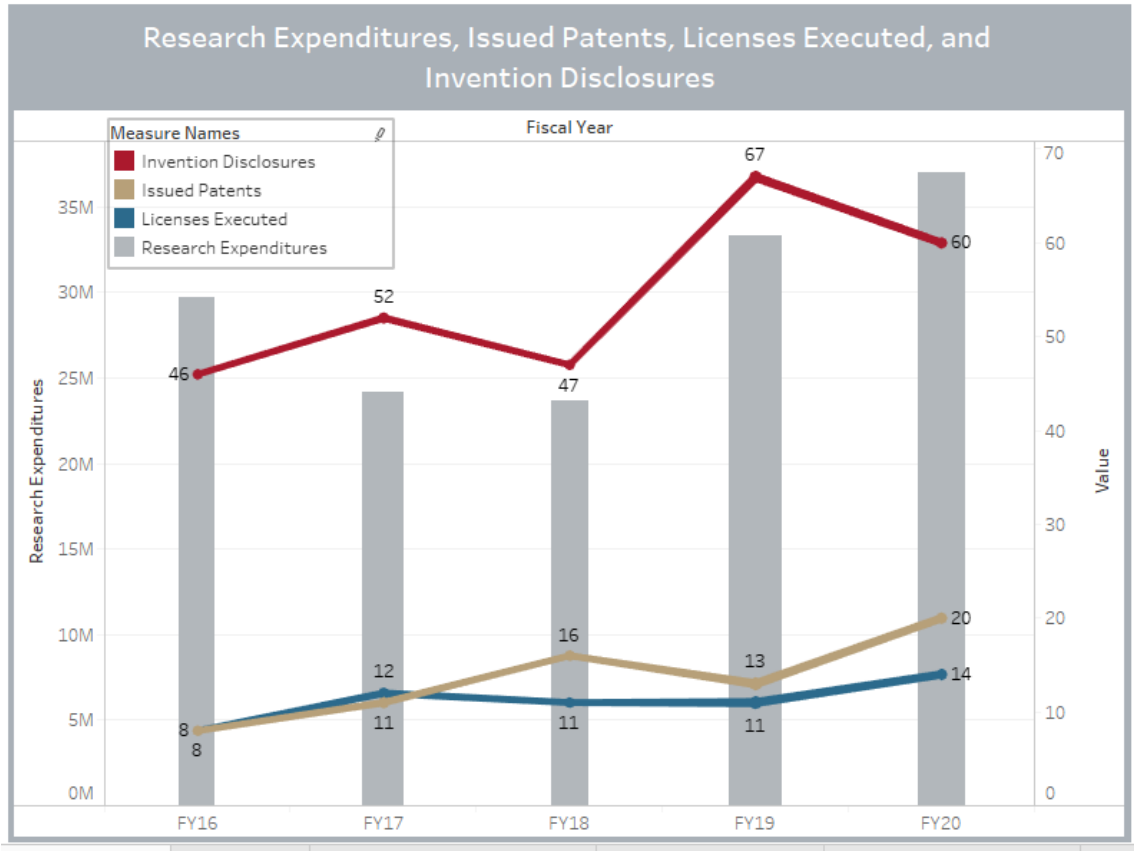
Office of Technology Commercialization (OTC) Overview

OTC accelerates the transfer of WPI discoveries from the lab to the market for the benefit of society on a local, national and global basis.

In addition to accelerating ideas on a commercial pathway via licensing of Intellectual Property (IP), the OTC serves to:

- Help recruit and retain entrepreneurial faculty
- Stimulate and educate students in the IP and Commercialization process
- Promotes local economic impact with the jobs created and money raised by WPI spin-out companies

OTC has experienced significant growth of invention disclosures by WPI faculty and students, patents issued, and most importantly, licenses executed. This has resulted not only in increased income via the reimbursement of patent expenses, but also in the creation of 19 new WPI start-up companies. These companies, located primarily in the Worcester area, have created 55 new jobs.



OTC Overview

WPI startups resulting in product on the market

Battery Resourcers, located in Worcester recycles Lithium Ion Batteries with a patented method where the materials that come out of their process are actually better than what comes out of the ground. This work came out of the lab of Yan Wang.

AiM Medical Robotics also of Worcester, is developing a surgical robot that can operate inside a MRI, which means it has no metal. This allows for precise, real time guidance using the MRI imaging. This work came out of the Greg Fischer lab. Several patents are involved with this technology.

Sports Engineering is producing a sports shoe that reduces knee injuries by using a unique sole design. The "Goat's Head™" spring, as well as several other patents came out of MQP projects in the Chris Brown lab.

OTC was selected to present at the AUTM National Meeting (virtual) in March 2020 for its best practices in technology transfer, especially regarding its effective marketing of technologies. It is unique to use alumni and friends of WPI as "IP Evaluators" of emerging technologies to gain industry insights into licensing and commercialization pathways prior to running up a large patent expense. We have over 200 IP Evaluators (and growing) in our group.

OTC has implemented a new approach to evaluating the potential of technologies in sending a Technology Opportunity Sheet - a short, non-confidential write-up of the technology - to IP Evaluators and solicit feed-back via email or Zoom call.

In addition to the licensing activity, OTC runs two other important programs

- The NSF's I-Corps program, which focuses on two aspects of the startup process, i.e. coming up with a "hypothesis" or value proposition and then conducting customer discovery to test it. 50 teams have gone through the program in the past five years, and we currently have a cohort of 10 (our target number) to participate in the fall. Teams almost always "pivot" from their original hypothesis and leave with a much better value proposition.
- WPI's Commercialization Fund, which is an internal investment vehicle funded by donations to WPI. It includes the smaller Ignite (up to $10,000) to build prototypes or conduct market research to advance an idea to the next investment opportunity, and Innovation, which can provide funding up to $50,000. There have been 16 investments (both Ignite and Innovation) since the program started in late 2012.

This report, published annually by the Office of Sponsored programs, aims to provide a summary of key data related to WPI's extramural funding activities, including proposals submitted, awards received, and funds expended. As with prior years, this report includes only those proposals and awards administered by OSP. Gifts, internal funding, individual fellowships, and MQP/IQP project funding are not included here. We welcome your feedback on this report. Comments and suggestions can be submitted via email to Priscilla Vazquez, Grants & Contracts Administrator (pvazquez@wpi.edu).

Report layout, design, and OSP sign photo: Priscilla Vazquez
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