Growth & Diversification
Dear Friends,

Year after year, the University of Maryland (UMD) continues to reach new heights in research, scholarly achievement, and impact. In fiscal year 2015, the University of Maryland achieved a record $550 million in research awards, an increase of more than $70 million over the 2014 fiscal year. This record-breaking growth is a reflection of our strategic approach to diversifying and deepening our research portfolio through partnerships with other institutions and corporations; internal and partner seed grant programs; mentoring of researchers; focus on large opportunities; and cross-disciplinary collaborations by Maryland faculty members.

As the leading research university within the Capital Beltway, our unique location allows us to leverage our expertise, partnerships, and strategic vision to take our place among the best institutions in the world.

In this report, we’ve shared our top five strategies for growth and diversification of the University of Maryland’s research portfolio. With these strategies as our compass, we will continue to forge ahead toward our goal of becoming the model 21st century research university, where a vibrant and creative research environment delivers the highest quality education.

Best regards,

Patrick O’Shea
Vice President and Chief Research Officer

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**STRATEGIES**

- Cultivate comprehensive strategic **PARTNERSHIPS** with national labs, industry, academic institutions, government partners, and arts and cultural organizations to create a framework that promotes shared successes.

- Establish the university as a catalyst for regional **ECONOMIC** diversification and growth through leadership in research, innovation, and development.

- Transform the academic ecosystem to foster and incentivize interdisciplinary activities between pillars of excellence through a modernized **REWARDS** structure and tenure and promotion policy.

- **COMMUNICATE** the value of our research to achieve global impact, infuse knowledge, and improve human life, pioneering an outreach model for the 21st century research university.

- Live by the principles of the Modern Metropolitan Model of the Land-Grant University by developing programs with a commitment of **SERVICE** to the community beyond the university, striving toward global impact.
The University of Maryland research enterprise achieved a record $550 million in research awards in fiscal year 2015, a one-year increase of more than $70 million over the 2014 fiscal year, despite the generally-tight research and funding environment.

A Record-Breaking Year

This achievement reinforces UMD’s status as a model 21st century research university, reflecting:

- Global leadership in critical research fields of the future
- A thriving innovation ecosystem in College Park, Md.
- Prime location as the leading public research university inside the Capital Beltway
- Strategic partnerships with corporations, agencies, and institutions
- Leading research productivity and a broad, deep, and diversified research portfolio

QUICK FACTS

- UMD is the only U.S. university ranked in the Top 25 in all of the following areas: Computer Science, Criminology, Economics, Engineering, Information Studies, Information Systems, Mathematics, Physics, Public Health, Public Policy, Sociology
- UMD is the highest world-ranked public university in the mid-Atlantic and Northeast regions
- UMD publishes over 4,700* academic articles a year, ranking No. 6** for most research articles among all U.S. public universities

UNIVERSITY PROFILE

- Research Awards in FY 2015: $550,384,756
- Fall 2015 enrollment
  - 27,500 Undergraduate
  - 10,700 Graduate
  - 12 percent International
  - 44 percent Minority
- Number of Faculty: 4,500
  - Tenured/Tenure-Track: 1,500
  - Nobel Laureates: 3
  - Pulitzer Prize Winners: 3
  - Members of the National Academies: 56
- Academic Colleges: 12
- Campus Size: 5 square kilometers
- Year Founded: 1856

*Web of Science **2016, Nature Index of Research Output

Diversity

- Corporations and Foundations
- Department of Defense (DoD)
- National Science Foundation (NSF)
- Department of Commerce
- NASA
- Department of Health & Human Services
- Department of Agriculture (USDA)
- State Government
- Other Federal
- Other Non-Federal

Research Awards by Funding Source

2011-2015 GROWTH

- $500M
- $70M
- $550M

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Interdisciplinary Research Themes

Computing, Data, & Discovery

QUANTUM COMPUTING
The complexities of our modern scientific challenges—such as mapping the human brain, advancing personalized medicine, and safeguarding communications networks—demand faster processing and greater technological advances. By building a computing device based on quantum bits, or qubits, it may be possible to store, process, and transmit information faster, better and more securely than today’s technology. UMD is an established world leader in the transformative field of quantum science, with dozens of experts, state-of-the-art facilities, and three research centers focused on different aspects of the field.

EXASCALE COMPUTING
The next big challenge in high-performance computing is exascale computation, which requires that a single computer perform 10^18 operations per second. This level of performance is nearly 100 times the largest computer in the world today. In addition to the goal of pure performance, the exascale effort requires that such a computer not use more than 20 megawatts/hour of electricity. UMD researchers have expertise in high-performance computing and are ready to take on these research challenges.

VIRTUAL AND AUGMENTED REALITY
UMD offers world-class expertise in both virtual reality, which can mimic real-world settings or create fantasy worlds, as well as augmented reality, which embeds digital information into real-world settings. Both fields are expected to expand exponentially in applications tied to surgery and medical training, scientific visualization, entertainment, military uses, architecture, and education. UMD’s 1,000-square-foot Augmentarium is a revolutionary facility, bringing together projection displays, augmented reality visors, GPU clusters, human vision, and human-computer interaction technologies to study and facilitate visual augmentation of human intelligence and simplify situational awareness.

SPACE DISCOVERY AND EXPLORATION
UMD researchers have a long history of collaborative research activities with NASA’s Goddard Space Flight Center, located only five miles from campus. These research initiatives include space exploration missions, studying distant exoplanets beyond our solar system, and better understanding comets and other celestial bodies inside and outside our solar system, among other programs. Many of these initiatives involve the use of national observatories, satellites, and supercomputers.

Human Health

BRAIN AND BEHAVIOR
UMD is currently engaged in a major, multidisciplinary, campus-wide Brain and Behavior Initiative involving seven colleges, bridging neuroscience, cognitive science, engineering, computer science, and the humanities. Researchers are collaborating to create novel tools and technologies to better understand the functions of the brain and its relation to behavior, focusing on the themes of: neural circuits; learning and plasticity; motor control; sensation, perception, and communication; and mental health.

MEDICAL DEVICES AND REGULATORY SCIENCE
UMD bioengineering researchers are working to develop innovative new medical devices to help save lives. The UMD Center for Excellence in Regulatory Science and Innovation (M-CERSi) brings together experts from UMD, UMB, and the U.S. Food and Drug Administration to make Americans safer through science-based processes to improve consumer safety and streamline regulations. The center will be located in a new 184,000-square-foot building, A. James Clark Hall, scheduled to open in 2017. The new facilities will help spur transformative new research to advance human health, serving as a central hub for new partnerships and collaborations in Maryland and the Washington, D.C., region.

HUMAN PERFORMANCE
UMD, in collaboration with UMB, is currently engaged in new research to help improve human performance and advance the discovery of innovative diagnostics and treatments through interdisciplinary efforts at both campuses. New state-of-the-art research facilities at UMD’s Cole Field House, supported by a $25 million gift from Under Armour Founder and CEO and UMD alumnus Kevin Plank, will feature 16,000 square feet of laboratory space focused on: human physiology and performance, concussion and traumatic brain injuries, muscle-brain physiology and biochemistry, exoskeleton-robotic treatments, and medical biomechanics.

HEALTH EQUITY
The Maryland Center for Health Equity is engaged in broad, multidisciplinary research initiatives to help position the university as a national leader in the elimination of racial and ethnic health disparities aimed toward achieving the nation’s Healthy People 2020 goal of health equity. UMD researchers are helping to establish and sustain a community-engaged research enterprise on critical health disparities, raising visibility and promising solutions, and facilitating action for change in the structural determinants of health.
Interdisciplinary Research Themes

National and Global Security

CYBERSECURITY
UMD researchers are developing innovative, interdisciplinary solutions to help protect our national infrastructure and our citizens from emerging cyber threats, and to help educate and develop the future leaders of the cybersecurity workforce. Last year, UMD joined a team led by MITRE that was awarded a Federally Funded Research and Development Center (FFRDC) supporting the National Cybersecurity Center of Excellence (NCCoE), while Northrop Grumman has supported UMD’s unique Advanced Cybersecurity Experiences for Students (ACES) program.

AUTONOMOUS SYSTEMS
UMD has emerged as a leader in autonomous systems, unmanned vehicles, and robotics. From unmanned aircraft to underwater and terrestrial autonomous robots, UMD researchers are working on autonomous research applications related to security, disaster resilience, weather monitoring, search and rescue, as well as agriculture, product delivery, and efficient transportation. The UMD Unmanned Aircraft Systems Test Site in Southern Maryland was launched in 2014 with the help of partnerships with Naval Air Systems Command (NAVAIR), industry, academia, and government agencies.

LANGUAGE SCIENCE
Integrating faculty language experts from a variety of backgrounds, UMD provides a breadth of interdisciplinary research supporting national and global security, diplomacy, and economic competitiveness. UMD has established several research centers to advance language-related technologies, educate current and future language professionals, improve language readiness and capabilities for national security, and inform and advise government agencies and private industry.

BEHAVIORAL STUDIES
A critical objective in improving global security is developing a better understanding of the causes of behaviors that result in international security threats. UMD’s National Consortium for the Study of Terrorism and Responses to Terrorism (START), supported by the U.S. Department of Homeland Security, is comprised of an international network of scholars specializing in the study of the causes and human consequences of terrorism. START’s research portfolio is informed by work in areas such as adversary modeling, criminality, deviant behavior, international and civil conflict, risk communication, social movement theory, and many others.

Climate Adaptation & Sustainability

MODELING AND ANALYSIS
Researchers from across campus—in disciplines ranging from public policy, agriculture and natural resources, computer, mathematics, and natural sciences, and engineering—are working together to address environmental and energy challenges. The UMD Council on the Environment (ConE) serves as an advisory group on research, education, outreach, and economic development related to the global and regional environment. The new Center for Global Sustainability will employ a multi-stakeholder approach to analysis and policy assessment, focusing on four topical areas: climate mitigation policy; energy pathways; resilience and adaptation; and ecosystems and health.

UMD’s Earth System Science Interdisciplinary Center (ESSiC) is oriented toward understanding, monitoring, and predicting the physical processes responsible for climate variability and predictability, including atmospheric conditions, the global carbon cycle, and the behavior of water. Researchers from the Joint Global Change Research Institute (JGCRI), a research collaboration between UMD and the Pacific Northwest National Laboratory, create models to simulate the economic and physical impacts of global change policy options, offering insights on how global stakeholders might respond to climate change mitigation policies including carbon taxes, carbon trading, and accelerated deployment of energy technology.

SPACE-BASED REMOTE SENSING
UMD researchers are partnering with NASA to develop a growing suite of technologies deployed on the International Space Station (ISS), providing important data about the Earth’s environment. The Global Ecosystem Dynamics Investigation (GEDI) uses a system of laser beams to map the 3-D structure of vegetation over a range of biomes to provide unprecedented observations of the Earth’s forests and their response to changes in climate and land use.

ENERGY STORAGE
The University of Maryland Energy Research Center offers particular strength in innovative energy storage technologies. Through the utilization of such strategies as low-cost ceramic fabrication techniques, all solid-state technology, and incorporation of renewable materials like water, wood, and sodium, researchers are developing a variety of alternative energy storage technologies that are higher-performing, more affordable, more environmentally friendly, and safer than today’s lithium-ion battery technology. UMD has secured major awards from NASA and DOE ARPA-E over the last year to support energy storage research.
Innovation & Entrepreneurship

UMD has developed a comprehensive innovation ecosystem on its College Park campus to transform research into new ventures and collaborations, bringing ideas from the laboratory to the marketplace to help stimulate the regional economy.

On campus, the Office of Technology Commercialization, the Maryland Technology Enterprise Institute (Mtech), the Academy for Innovation and Entrepreneurship, the Dingman Center for Entrepreneurship, and the Startup Shell nurture entrepreneurship and encourage new ventures with sophisticated educational programs, incubator programs, state-of-the-art facilities, mentorship and guidance, support for invention disclosures, assistance in safeguarding intellectual property, and technology commercialization resources.

Regionally, UMD has teamed with George Washington University, Virginia Tech, and Johns Hopkins University to launch a regional National Science Foundation (NSF) Innovation Corps (I-Corps) node in the Washington, D.C., region to encourage faculty and student innovation. UMD’s Maryland Small Business Technology Development Center links private enterprise, government, higher education, and local economic development organizations to help small businesses grow. UM Ventures connects College Park innovations with University of Maryland, Baltimore ventures to advance the MPowering the Region State initiative.

The University of Maryland family of inventions, including those developed by alumni, faculty, and students, spans across many well-known products. If you have ever scanned a universal product code, driven a Prius, searched on Google, turned on a satellite radio, watched “The Muppets” or “Seinfeld,” put on Under Armour gear, or conducted a teleconference on a Polycom device, then you have experienced University of Maryland innovation in your daily life.

UMD ranked NO.10 in the nation for undergraduate entrepreneurship education

UMD ranked NO. 21 among the nation’s Most Innovative Schools

VisiSonics Corporation
Computing, Data, and Discovery

VisiSonics Corporation has created a totally immersive audio experience using innovative technology in the area of 3-D sound. VisiSonics has developed methods for creating 3-D audio for gaming and virtual reality applications. In 2014, Oculus licensed VisiSonics’ RealSpace 3-D Audio for the upcoming release of their Oculus VR Software Development Kit. They have also partnered with automakers like Tesla.

Remedium Technologies
Human Health

Remedium Technologies has created a proprietary life-saving technology called Hemogrip™, which acts to stop traumatic bleeding rapidly. Hemogrip™ is able to orchestrate the self-assembly of a clot-like seal upon contact with blood. Severe hemorrhage is the leading cause of death on the battlefield, and within the civilian setting, traumatic injuries are the leading cause of death among surgery patients under the age of 44. Remedium Technologies is dedicated to saving lives both in the field and in the operating room.

FLEXEL, LLC
Climate Adaptation and Sustainability

Founded in 2008, FLEXEL develops innovative, high performance, cost effective, and mass producible custom battery solutions for demanding applications. FLEXEL has developed battery solutions for products, such as: high performance, wearable electronics; smart packaging; remote sensing and transmission devices; military applications; sensor networks for structural, environmental, and medical applications; and disposability consumer electronics applications.

SentiMetrix, Inc.
National and Global Security

SentiMetrix has developed new technology to help understand people’s emotions and analyze language, opinions, and other metrics on social networks. SentiMetrix technology performs real-time analysis on huge data sets in many languages to determine solutions to various challenges when it comes to predicting user behavior. The company is working to provide solutions related to national security applications, among others.
New Facilities

Construction cranes have become a consistent and ever-present addition to the College Park campus landscape, as the University of Maryland continues to add a variety of state-of-the-art research facilities, including the following:

PHYSICAL SCIENCES COMPLEX
UMD’s new Physical Sciences Complex provides 160,000 square feet of space for collaborative research with nearby federal agencies like NIST, NASA, and NIH, housing research centers including the Joint Quantum Institute, the Joint Space-Science Institute, and the Institute for Physical Science and Technology, among others.

EDWARD ST. JOHN LEARNING AND TEACHING CENTER
The Edward St. John Learning and Teaching Center will serve as the centerpiece of a new standard of teaching space for the campus. The 180,000-square-foot building will encourage active learning with state-of-the-art technology throughout its 22 classrooms and labs. It will also be home to the Academy for Innovation and Entrepreneurship and the new Teaching and Learning Transformation Center.

BRENDAN IRIBE CENTER FOR COMPUTER SCIENCE AND INNOVATION
The new Brendan Iribe Center will be located near the front entrance of the university, highlighting UMD’s commitment to technology and education. The new facilities will feature a new makerspace for student innovation and creativity, a virtual and augmented reality space for immersive multimedia experiences, as well as world-class classroom and laboratory space. The Iribe Center will provide resources to introduce students to cutting edge teaching techniques and learning environments.

A. JAMES CLARK HALL
A. James Clark Hall will spur the development of transformative new bioengineering research and technologies that advance human health innovation. When it opens in 2017, the 184,000-square-foot building will serve as a central hub for new partnerships and collaborations throughout the Maryland and Washington, D.C., region. The new building will facilitate world-class research and educational programs, offering state-of-the-art laboratories, student project space, and a new home for the Robert E. Fischell Institute for Biomedical Devices.

THE NEW COLE FIELD HOUSE
UMD’s newly redesigned Cole Field House will combine state-of-the-art research facilities, clinical space, and athletic training facilities. Laboratory space will focus on research related to: human physiology and performance, concussion and traumatic brain injuries, muscle-brain physiology and biochemistry, exoskeleton-robotic treatments, and medical biomechanics.
Mission: Global Impact

The University of Maryland is dedicated not only to the dissemination of knowledge but also to the creation and application of knowledge for the good of all people. As one of the world’s leading research institutions, the University of Maryland will continue to develop sustainable partnerships to:

- Strengthen the research undertaken by the university in areas of strategic importance to address global issues.
- Enable the university to pursue large-scale, global research opportunities.
- Enhance the research administration framework through the Borderless Research Administration Knowledge Exchange (BRAKE) program.

LEARN MORE ABOUT UMD’S INTERNATIONAL RESEARCH COLLaborATIONS AT:
RESEARCH.UMD.EDU/INTERNATIONAL