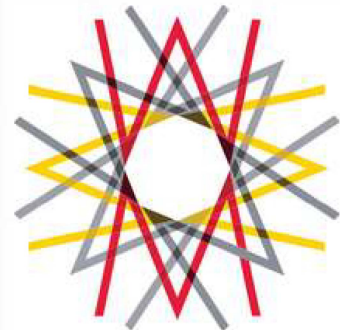


**UNIVERSITY OF
MARYLAND
CENTER FOR
ECONOMIC AND
ENTREPRENEURSHIP
DEVELOPMENT**

FY2023 REPORT



FY23 report on University of Maryland Center for Economic and Entrepreneurship Development (UMCEED) progress at University of Maryland, College Park (UMD)

UMCEED shall advance the education of students by developing degree and credential programs in the following fields of study:

- a. Virtual and augmented reality*
- b. Neurosciences*
- c. Biomedical devices*
- d. Data analytics*
- e. Cybersecurity*
- f. Quantum Technologies, Advanced Data Computing, and Information Technologies (added via SB943 in spring 2021)*

Introduction

In higher education, it takes several years to launch new or expand existing academic programs. In addition to developing the curriculum and obtaining the required approvals, instructors must be hired, laboratories and classrooms must be equipped, and students must be recruited to the new programs and make progress to degree. It is also important to note that academic programs are very distinct from entrepreneurship and economic development activities related to IP and startup companies. In FY23, UMCEED funds have been used to support economic development through faculty recruitment, degree programs, and other infrastructure to further the campus mission of economic development in the sectors identified in the bill. Significant progress has been made in recent years toward our UMCEED goals, and we are pleased to provide this FY23 report.

Progress on degree production in current UMCEED-related programs and certificates

- **Immersive Media Design Major**

In Fall 2021 the University launched the new major in Immersive Media Design, through a collaboration between the Colleges of Arts and Humanities (ARHU) and Computer, Mathematical and Natural Sciences (CMNS). This major represents a substantive collaboration between STEM fields and the Arts, and will prepare students to be leaders in the production of Augmented Reality, Virtual Reality, and related Immersive Media Design disciplines. Students will collaborate over the course of several semesters to jointly study and address some of today's most pressing questions about the role of technology as a creative medium. First degrees from this program are expected in May 2024, assuming that some students would be able to transfer into the program from other disciplines. The program increased from a handful of majors when launched in Fall 2021 to 42 in the Fall 2022 and 75 for the Fall 2023.

- **College of Information Studies programs**

There has been an extraordinary amount of growth in the Information Studies College (INFO) over the past few years, spurred by the tremendous success of new undergraduate majors and specializations. INFO continues to grow its programs and graduates, with additional faculty hires using UMCEED funding. The undergraduate major in Information Science, launched in 2016, now has nearly 1740 majors (as of Fall 2023) on the College Park campus as well as a very successful transfer program at the Universities at Shady Grove, with 109 additional majors. In FY23 there were over 560 bachelor's degree recipients, and 220 recipients of master's degrees, and about 33% of the master's degrees were in Human-Computer Interaction.

With prior funding from Governor Hogan's Workforce Development Initiative (WDI), INFO also launched a new specialization in Cybersecurity, and two academic minors in Information Risk Management and Privacy and in Technology Innovation Leadership. While these will not produce new degree recipients, they will broaden the expertise of students majoring in this area. INFO has also recently added a new joint bachelor's/master's option between its BS in Information Sciences and the Master of Information Management.

- **Computer and Data Science**

With the implementation of a limited enrollment program in computer science, the number of majors has stabilized at an enrollment of nearly 3500 students, but the number of degrees granted continues to increase, up 40% in 2022 relative to 2019, with nearly 950 bachelor's degrees in FY22. Annual degree production does fluctuate, and in FY23 there were 856 degrees conferred. UMCEED funds have been allocated towards additional faculty to support the very large enrollments. In FY22, a minor in Data Science was added through a collaboration between the departments of Mathematics and Computer Science. A Data Science major has been designed but not yet moved forward for approval, pending identification of resources. Additionally, the CS major was modified to include a Quantum Information track, to complement the existing specialty areas of Data Science, Machine Learning, Cybersecurity and CS education. The first degrees in the Quantum Information track were conferred in FY23. Also notable is that the number of master's degrees conferred has increased substantially since 2019, with 111 graduates in FY23.

- **Neuroscience**

Our newly established undergraduate major in Neuroscience successfully launched in Fall 2020, despite the emergency conditions of the pandemic, to help address a critical need to recruit and train talented students at UMD. The Neuroscience major offers rigorous training in the interdisciplinary study of brain and behavior, preparing students for a broad range of career paths, including scientific research, medicine, clinical psychology, allied health professions, and science-related government,

nonprofit, and private sector employment. In the Fall of 2020, there were 97 majors, of which 51 were direct admit new freshmen. As of Fall 2023, there are 357 current majors and 77 alumni.

The major is now projected to grow over the next three-year period to a steady state of approximately 500-plus students. The new neuroscience major will continue to encourage more academically talented Maryland residents to stay in-state for undergraduate training at their flagship institution, thereby increasing the probability that they will contribute to the local scientific, medical, and allied health professions workforce later, rather than going out-of-state for college and graduate training.

Recently approved academic programs and certificates

Three new undergraduate degree programs, one master's program and three new certificate programs were approved in FY22, related to the strategic areas of UMCEED.

- **Bachelor of Arts in Technology and Information Design**

As noted earlier, the Information College has also developed a new Bachelor of Arts in Technology and Information Design, launched in Fall 2022. The program has 67 enrolled students as of Fall 2023. This program broadens opportunities for those students who are less interested in the technical aspects of information science but more interested in meeting the needs of humans as information consumers. Enrollments are anticipated to be more modest than the Information Science major, but has already exceeded the projection of 50 students per year.

- **Bachelor of Science in Social Data Science**

This newly created major combines the technical requirements of data science with disciplinary areas within the social sciences. The major builds expertise in the complex skills needed to create and work with information that captures aspects of human behavior. Social data science encompasses all elements of the data life cycle, including measure conceptualization, data gathering, management, manipulation, analysis, presentation, archiving, and re-use. 67 students are enrolled in this major, with some students already in designated tracks: Economics (6 students), Geographical Sciences (1), Government and Politics (5), Psychology (9), and Sociology (3). In Spring of 2023, a new track in Public Health was approved.

- **Master of Professional Studies in Bioinformatics and Computational Biology**

This program was launched in Fall 2023 and has an initial cohort of 8 students. Students will learn multiple problem-solving methods in bioinformatics and computational biology and apply these methods to problems in biology and biomedical research.

- **Post-Baccalaureate Certificate of Professional Studies in Quantum Computing**

This certificate program was launched in Spring 2023 and has an initial cohort of 4 students. Students explore applications of quantum computing for the areas of optimization, chemistry, encryption, information theory, and communications.

- **Master of Professional Studies in Quantum Computing**

This program was approved in Spring 2023. It will provide students with foundational, practical and theoretical topics of quantum computing. Students in the certificate program may continue on with the master’s program.

Research, Patents, IP, and Economic Development related to the UMCEED sectors

Inventive, patenting, and licensing activity for FY23 is listed below

While it is very unlikely to be able to make a direct correlation to an academic degree program and patents and licensing by faculty and students, the table below identifies new invention disclosures, patent applications, patents issued, and agreements executed across the six UMCEED areas of focus.

Area	Invention Disclosures	Patent applications filed	Patents issued	Agreements Executed
VR/AR	2	2	1	0
Neuroscience	2	3	0	0
Biomedical Devices	21	17	7	2
Data Analytics	7	2	0	0
Cybersecurity	0	2	3	0
Quantum	20	25	11	0

- **Brain and Behavior/Neuroscience Initiative**

The Brain and Behavior Institute (BBI) was launched in January 2021 to elevate and expand neuroscience research efforts across our campus and with UMB. The focus of the BBI is to solve challenges in global health and wellness related to nervous system function in development, aging and disease, and is establishing the University of Maryland and the State of Maryland as a nexus for excellence in research and education in the field of neuroscience. The BBI advances Maryland neuroscience through the recruitment of a cohort of world-class scientists, the development of cutting-edge tools, the facilitation of collaborations with diverse partner disciplines, and the promotion of the translation of basic science.

Since 2016, UMD has invested in the Brain and Behavior Institute (née Initiative), including \$3.5 million in the form of seed grants that have been successfully translated into \$28 million in new research

funding. Resources to support the institute are drawn from UMCEED, The Clark Family Foundation gift, E-Novate funds and contributions from the Provost, Vice President for Research, and the Deans of participating colleges. Three new BBI faculty hires have opened their research labs as of Fall 2023, and a fourth investigator has signed his contract and will open his lab at UMD in August 2024.. The BBI has also facilitated recruitment of affiliate faculty in computer science, psychology, and philosophy to College Park. To expand campus research in molecular and behavioral science, the BBI has procured and staffed new state-of-the-art equipment cores, including the BBI-Advanced Genomic Technologies Core (BBI-AGTC) and the BBI-Small Animal MR Imaging facility (SAMRI). The BBI-AGTC, which opened in April 2021, offers the latest approaches to molecular biology and bioinformatics. Following a successful international search for a nuclear physicist to direct the core, imaging is underway at the BBI-SAMRI, where UMD undergraduates in mechanical and bioengineering are also gaining hands-on experience by completing keystone projects to streamline the acquisition and analysis of scanning data. Additionally, the BBI has ordered equipment to expand campus's focused ion beam scanning electron microscopy capabilities to allow for 3D reconstruction of biological ultrastructure, including the nervous system, for the first time. The BBI hopes to open this third core, a cryo-FIB-SEM facility, in 2024.

The BBI also made a major contribution to the upgrade to the campus MR facility, which facilitated the success of BBI investigators in garnering research grants from the NIH HEALTHy Brain and Child Development (\$7.5 million over five years) and the NSF Learning the Rules of Neuronal Learning (\$3 million over five years). The BBI's grants development office actively promotes the formation of interdisciplinary research teams to compete for large extramural awards, and strategic partnerships forged by the BBI continue to promote the expansion of basic science. In June 2021, the BBI secured funding from MPower to participate in the UMB Institute for Clinical and Translational Research, and UMD faculty, postdocs, and graduate students have competed for multiple awards through this UMB CTSA. In 2023, the BBI development office contributed to the successful funding of UMD faculty in the KL2 and ATIP programs and of two Neuroscience and Cognitive Science graduate students in the ICTR's TL1 program.

Strengthening the brain and behavior community will continue the success of UMD and UMB in recruiting talented faculty to perform cutting-edge, interdisciplinary research. Synergy with the emerging MPower initiatives focused on neurobiology, aging and global health will afford support and collaboration opportunities for existing and new faculty in brain research, amplifying clinical trial capabilities at UMD while elevating and extending our competitiveness to acquire external funding from leading federal agencies.

- **Quantum Technology - Establishing the Capital of Quantum**

Building on UMD's decades of global leadership in advancing quantum information science and technology, UMD is now leading regional efforts to build an inclusive quantum innovation ecosystem. The Institute for Robust Quantum Simulation, one of just five NSF Quantum Leap Challenge Institutes, became operational in 2022 as UMD's latest major quantum research center. UMD has also invested \$20 million to accelerate practical quantum computing and networking through the unique National

Quantum Laboratory (Q-Lab) partnership with IonQ, a UMD spin-off that became the first publicly traded pure-play quantum computing company in 2021. Q-Lab's physical colocation space opened in Fall 2023, and it is already supporting research projects in high-energy physics, materials science, image processing, cybersecurity and computational fluid dynamics.

UMD is preparing the workforce through a wide range of quantum education efforts at all levels. These include a new quantum information specialization in computer science, training for local K-12 teachers to integrate quantum education into their classrooms, summer programs for high school and middle school girls and underrepresented minority students, an international bootcamp to build a community of quantum computing and earth science researchers and graduate students, quantum hackathons, and launching the Quantum Machine Learning stream in the First-Year Innovation & Research Experience (FIRE) program. As noted above, a new post-baccalaureate certificate in Quantum Computing was approved in spring 2022. To support these new educational efforts, UMD has allocated \$1M in UMCEED funding towards new tenure track faculty hires in Computer Science and in Engineering.

UMD also leads the Mid-Atlantic Quantum Alliance, which enables collaboration between over 30 regional partners from government, industry, academia and non-profits.

- **Discovery Fund & Quantum Startup Foundry**

The [Discovery Fund](#) and the [Quantum Startup Foundry](#) are critical parts of the strategy to accelerate the quantum innovation ecosystem to achieve the vision of making Maryland the Capital of Quantum

The Discovery Fund is UMD's first ever venture fund. Its investments aim to spur growth of startups in high technology areas like quantum in the Discovery District and Prince George's County, and it is supported by \$1 million annually from UMCEED. Highlights from the Discovery Fund in FY2023:

- *5 investments for \$700K*
 - *\$150,000 investment in [Medcura](#), a UMD startup housed in the Discovery District and spun out of the Fishell Bioengineering department that has developed an advanced wound treatment platform provides rapid and reliable bleeding management.*
 - *\$150,000 investment (2nd tranche) [alongside Toyota Ventures](#) and Alsop Louie in [Ion Storage Systems](#), a UMD startup spun out of Prof. Eric Wachsman's lab that makes smaller, lighter, safer, and more powerful batteries.*
 - *\$100K Convertible Note in Hungry Harvest, a startup [founded by UMD alum Forbes 30 Under 30 Evan Lutz](#).*
 - *\$125 K investment in [BEIT Inc.](#) a Polish quantum startup that has relocated business operations to College Park and is developing optimization algorithms for quantum computer hardware and software (April 2023).*
 - *\$125 K investment in Channel Program, a two-sided marketplace focused on the IT Channel and founded by a UMD alum (May 2023).*
- *Expanded Advisory Board to include Jim Chung, Alex Castelli and Shane Kim*

- *Leveraged Discovery Fund as a tool to encourage companies to relocate to Discovery District (quantum and non-quantum companies).*

The Quantum Startup Foundry (QSF) at the University of Maryland creates a vibrant quantum commercialization ecosystem with everything quantum entrepreneurs and startups need to be successful. That includes access to UMD’s research and education strengths, and UMD’s talent and infrastructure. QSF also brings in investors and other funders, critical services like legal and IP support, and business expertise and mentoring like the [NSF Mid-Atlantic I-Corps Hub](#) innovation training program. Highlights from the QSF in FY2023:

Quantum Startups in MD

- Since its inception two years ago, the QSF incubator has already developed strong relationships with dozens of global quantum startups with 10 of them currently, or in the process of, establishing or relocating their headquarters at the QSF incubator here in College Park.
 - FY23 QSF leases/licenses with quantum companies conducting daily operations at QSF
 - QC82 is operating from QSF temporary location on a daily basis with at least one new hire (two persons total)
 - Error Corp. is shifting daily activities to QSF from their previous location
 - Additional new lease licenses at various stages of Facilities Use Application process include: BEIT, NanoQT, SwainTech, gSpin Tech, QRCrypto, and Psirch
- Funding for startups participating in QSF programs
 - Non-dilutive funding:
 - Error Corp & SBIR/STTR grants. After graduating from the QSF Pre-TraQtion Program, Error Corps has been awarded:
 - SBIR/STTR grants: Phase I from NSF; Phase I & II from the Department of Energy for the total of \$2.1M in non-dilutive funding; Phase I from NSF for the total of \$275k
 - MIPS grants: a graduate of Pre-TraQtion training and QSF TraQtion company received MIPS grant:
 - QC82 in partnership with Mario Dagenais/UMD: \$90k funding
 - Dilutive funding:
 - Discovery Fund has completed the investment in BEIT
 - Discovery Fund has a pipeline of quantum startup candidates for investment consideration
- Quantum startup pipeline:

- Engaged with a total of 30 quantum startups through ongoing TraQtion program
- Continued to develop a pipeline of quality quantum startups to be considered for current and future QSF programs

Space/new facilities in the Artemesia building at 8400 Baltimore Avenue

- Began the renovation project for an expanded and permanent QSF location at 8400 Baltimore Ave (in partnership with Facilities Management and the State of Maryland):
 - Conceptual Design phase was completed

Global visibility and quantum community participations

- Relationships with existing and emerging quantum hubs and public and private stakeholders
 - Deepened relationship with Qubit by Qubit (The Coding School)
 - Discovery Fund awarded QxQ with \$70k grant to offset QSF rent and fund the 2024 joint with QSF educational activities
 - Established new relationships with recently opened quantum hubs:
 - The Deep Tech Lab - Quantum in Copenhagen
 - Continued deepening relationship with Quantum Delta Netherlands through participation in their Quantum Days
 - Continued deepening relationship with local partners and stakeholders and secured QIS'23 sponsorships from:
 - Prince George's County Economic Development Corporation
 - Montgomery County Economic Development Corporation
 - Carter Deluca IP Law Firm
 - Continued a very fruitful collaboration with MD Department of Commerce:
 - Connected with foreign quantum startups who are looking to establish business in the U.S./MD, examples include: NanoQT, Qilimanjaro, Kiutra, ParityQC, HQS Quantum Simulations, Single Quantum, Qblox, Kipu Quantum, Qubig, Quantum Optics - Jena
 - Joined MD Commerce Global Gateway program. Four startups from QSF pipeline applied and were accepted into the program: BEIT, NanoQT, Aegiq, QRCrypto
 - Continued and deepened relationships with founding sponsors: EY and IonQ
 - Established relationship with the new quantum leader at McKinsey&Co

The number of University of Maryland graduates who are employed in Maryland based businesses.

39% (1502 students) based upon the 2022 Graduation survey report.

* "Employed" includes students who are employed FT, employed PT, volunteering or in a service program, serving in the military, or starting a business.