

**State University System
Education and General
2021-2022 Legislative Budget Request
Form I**

University(s):	University of Central Florida
Request Title:	UCF Powering Up Florida's High Tech Economy
Date Request Approved by University Board of Trustees:	August 4, 2020
Recurring Funds Requested:	\$18,422,400
Non-Recurring Funds Requested:	\$3,000,000
Total Funds Requested:	\$21,422, 400
Please check the request type below:	
Shared Services/System-Wide Request	<input type="checkbox"/>
Unique Request	<input checked="" type="checkbox"/>

- I. Description** – 1. Describe the service or program to be provided and how this issue aligns with the goals and objectives of the strategic priorities and the 2020 University Accountability Plan established by your institution (include whether this is a new or expanded service/program). If expanded, what has been accomplished with the current service/program? 2. Describe any projected impact on academic programs, student enrollments, and student services. University of Distinction proposals should also address the requirements outlined in the separate guidance document.

Description

With ever greater urgency, industries will require a highly educated, high-quality talent pool ready to join a rapidly expanding STEM sector in and around Orlando and the state. UCF has an obligation to our community and state to help meet this need; failure to do so would be at the detriment of the local and state economy.

With an impressive history of achievement, the University of Central Florida's College of Engineering and Computer Science is uniquely positioned to fulfill this urgent request. In a September 2019 report, the Orlando Economic Partnership expressed support for the College of Engineering and Computer Science and how it "demonstrates significant contributions to state and regional competitive advantage in high-wage job creation... [and] supports regional goals to be driven by key enabling technologies and corresponding use cases associated with extended reality (i.e., simulation and training), autonomous vehicles, and smart cities (internet of things), among others."

In this LBR, UCF identifies the College of Engineering and Computer Science (CECS) as a core unit within the institution to reach higher levels of national excellence. CECS has a number of programs under its umbrella, such as Civil, Environmental and Construction, Computer Science, Electrical and Computer Engineering, Industrial Engineering and

Management Systems, Mechanical and Aerospace Engineering and Materials Sciences and Engineering, which serve to fuel the pipeline of workers with Science, Technology, Engineering and Math (STEM) skills.

According to the Florida Council of 100's *Project Sunrise* report "each month, an average of 80,000 high-skilled and 30,000 middle-skilled jobs are left unfilled." By 2025, there will be 2 million unfilled jobs in manufacturing in the US (¹US News, March 27, 2018). The need for workforce talent in computing areas is equally significant. According to the Bureau of Labor Statistics², "Employment of computer and information technology occupations is projected to grow 12 percent from 2018 to 2028, much faster than the average for all occupations. These occupations are projected to add about 546,200 new jobs.

Funding Purpose

This proposal seeks funding to improve CECS undergraduate and graduate program rankings, while concurrently improving the graduating student pipeline and related metrics, to include:

- **Improving quality and success (\$13.1 million)** - by hiring 64 more faculty members and 16 supporting staff positions to ensure UCF meets *and exceeds* its institutional strategic plan goal of offering additional class sections, particularly for high-demand STEM pathway courses;
- **Enhancing the talent pipeline for a 21st-century economy (\$2 million)** - increasing the capacity of programs that recruit, sustain and graduate STEM students at high rates by focusing on STEM learning communities and early engagement in undergraduate research experiences, as well as programs that improve the math placement status of incoming FTICs and thus enhance their 4-year graduation chances; and
- **Growing research and economic prosperity** - funding faculty startup packages and upgrading laboratory equipment (**\$3 million, nonrecurring**) and hiring staff in research supporting positions and student assistants (**\$3.3 million**) to enhance UCF's existing research and industry partnerships in key areas for the state in AI/ML, Cyber, AR-VR, Modeling and Simulation, Space Systems and Engineering, Manufacturing, Automation, Energy and Smart Things.

These funds will target strategic areas of opportunity to further enhance UCF's pursuit of academic and research excellence as a Florida University of Distinction.

COVID-19 Implications

Despite the modifications to instruction and the uncertainties that accompany the current environment in which we are living, the prospect for implementing this initiative, and for its projected outcomes as described herein are not in doubt.

- This initiative can be carried out on the currently modified campus environment. The programs and initiatives herein are deliverable in both face-to-face and virtual settings. In fact, the hybrid offering in both settings significantly increases potential student participation and reach.
- Strategic investment in recruiting top-tier faculty talent at this time represents a competitive opportunity. Universities across the nation are experiencing revenue

challenges resulting in expanded opportunities to recruit outstanding faculty to UCF.

- At UCF, our student retention has remained strong as we continue in the modified mode of educational delivery and operations.
- Not unlike the Great Recession, the Coronavirus pandemic has underscored the fact that diversification of Florida’s economy should remain a statewide focus and priority. This initiative supports not only our existing diverse industries but will significantly expand their capabilities to compete successfully in the global economy. This work directly supports those industry sectors that have not suffered from the impacts of COVID-19, but continue to grow. In the throes of this pandemic, Florida hosted the launch of NASA astronauts to the International Space Station.

A. Evidence of core competency and national, state excellence

The University of Central Florida’s College of Engineering and Computer Science (CECS) is one the State University System’s most distinctive and nationally recognized pillars of excellence.

Originally founded as Florida Technological University to support Florida’s space-related economy, UCF has long excelled in engineering, computer science and related disciplines. Through its commitment to partnering with regional industry to meet the increasing workforce needs of one of the growing, dynamic job markets in the country, CECS has become the talent pipeline of choice for Central Florida’s STEM-related industries.

UCF is graduating students who contribute to Florida’s economy with high-paying jobs. This is evidenced, in part, by:

- In 2016-17, **64 percent of engineering bachelor’s graduates were employed in Florida** and earned average first-year salaries ranging from \$54,080 to \$65,420.
- *Aviation Week* magazine has named UCF **the No. 1 supplier of graduates** to the U.S. aerospace and defense industries for **five consecutive years**.
- A longstanding partnership with Lockheed Martin includes **500 students per year who intern** at the company. UCF graduates represent 27 percent of the Lockheed-Martin Orlando workforce (70 percent in STEM-related positions).
- NASA’s Kennedy Space Center reports that **30 percent of its employees** hold UCF degrees, mostly from CECS.

B. Strong national engineering reputation

In the 2021 *U.S. News and World Report* rankings, UCF achieved Top 50 public university rankings for its undergraduate and graduate engineering programs.

<i>2021 U.S. News and World Report</i>	Public Ranking	Overall Ranking	SUS Ranking
Graduate Engineering	43	74	2
Undergraduate Engineering	49	83	2

Table 1: 2021 U.S. News and World Report Undergraduate and Graduate Engineering Ranking

UCF CECS' growing national reputation shows no signs of slowing. In the past five years of *U.S. News* Graduate Engineering rankings among the current top 50 public institutions, UCF was a Top 5 mover having improved 11 spots (in last year's chart, Graduate and Undergraduate Engineering's overall ranking was 75 and 85, respectively).

U.S. News and World Report ranked **every graduate engineering program in the Top 55** among public institutions.

<i>2021 U.S. News and World Report</i>	Public Ranking
Optical Sciences and Engineering	5
Industrial Engineering	30
Electrical Engineering	33
Computer Engineering	36
Materials Engineering	36
Aerospace Engineering	37
Mechanical Engineering	43
Environmental Engineering	43
Civil Engineering	53

Table 2: 2021 U.S. News and World Report Graduate Engineering Programs Ranking

C. Strong national computer science reputation

UCF's College of Engineering and Computer Science ranked 51st among public institutions for Computer Science.

<i>2021 U.S. News and World Report</i>	Public Ranking	Overall Ranking	SUS Ranking
Computer Science	51	82	2

Table 3: 2021 U.S. News and World Report Computer Science Ranking

Additionally, the UCF student quality in these fields is evident by the national performance of the UCF Cyber Defense team, such as **winning Raytheon's National Collegiate Cyber Defense Competition (NCCDC) in 2014, 2015 and 2016**, and earning a 2nd place in the same competition in 2018, 2019 and 2020. In all, UCF appeared seven out of eight times in the national cyber competition and no other competitor won as many trophies as UCF (three 1st place trophies and three 2nd place trophies).

UCF's Programming team has been in existence for more than 30 years. UCF has been a perennial presence in the Programming World Finals by winning the Southeast (SE) Regional Programming Competition 60 percent of the time. In the World Finals of 2017 and 2018, the UCF team **placed 13th worldwide (1st in the US) and 10th (1st in North America)**, respectively, outperforming teams from prominent universities such as MIT, UC Berkeley, Cornell, Princeton, UT Austin, University of Illinois Urbana Campaign (UIUC), Stanford, Carnegie Mellon University (CMU), University of Southern California (USC) and University of Maryland.

A partnership with Microsoft has provided UCF with graduate fellowships that have allowed students to be on the cutting edge of work in cloud computing. UCF's emerging focus on artificial intelligence, deep learning and machine learning - supported, in part, by our Microsoft partnership - is consistent with employment trends suggesting that expertise in these topics will be essential for most computer science graduates.

D. Expanding student opportunity

Student diversity is well represented among those who graduate with UCF CECS degrees. Of approximately 2,250 degrees awarded in 2019-20, 44 percent went to minority graduates and 19 percent to female graduates.

Among bachelor's graduates, 43 percent were Pell-eligible, and 23 percent were the first in their families to attend college.

National Public University Rankings			
UCF	Total Degrees	Degrees to African American Students	Degrees to Hispanic Students
Engineering	13	4	4
Computer Science or Information Technology	5	8	2

Rankings from 2015-16 IPEDS data based on fields offered by UCF

Table 4: Engineering and Computer Science or IT National Public University Rankings

UCF has demonstrated outstanding success with previous additional state investments to improve engineering and computer science outcomes. In 2014, UCF was awarded a Targeted Educational Attainment (TEAm) Grant by the Board of Governors. UCF served as the lead institution in partnership with the University of South Florida and Florida International University to help close the gap between supply and demand in computer engineering, computer science, and information technology graduates (CSIT TEAm). The initiative promised the expansion of upper-level students and an increase in the graduation volume. After five years, **UCF achieved a 119 percent increase in these computer science-related graduates** - 288 graduates to 631 - to help address critical workforce needs.

The Honors College

UCF's Burnett Honors College (BHC) recruits approximately 500 outstanding students annually. BHC currently enrolls about 2,200 students and is recognized as one of the top 20 honors colleges in the country. In Fall 2019, BHC welcomed a class of 526 freshmen with an average SAT of 1465 from 29 states, 27 different countries of origin, who speak 28 different languages. BHC annually recruits about 90 National Merit Scholars and about 170 Provost Scholars, approximately half of its incoming fall Honors cohort. It is notable that more than 40 percent of the Honors students are College of Engineering and Computer Science (CECS) students. New CECS hires, requested in this LBR, and the strong CECS student Honors pool will jointly contribute in the pursuit of these goals for the sustained and improved well-being of the state's economy.

E. Research excellence contributing to higher ranking

External Research Funding

In terms of research success, UCF reported a new record of \$204.9 million in new grants during 2020 (as of July 15 - excluding CARES Act funding), and of this total, engineering and related disciplines represented \$74.2 million (36 percent) of overall grant funding.

National Ranking

Based on the National Science Foundation's 2018 Higher Education R&D survey, **UCF ranked 37th nationally for public universities** and second in the SUS for engineering

research expenditures. The same survey **ranked UCF 10th nationally for public universities and first in the SUS** for computer science research expenditures.

Quality of Junior Faculty

In the last six years, more than 80 new faculty (a significant number were junior faculty) were hired in the College of Engineering and Computer Science to improve the student-to-faculty ratio as well as to enhance research excellence. This faculty hiring focus has paid dividends in the short term and is expected to continue paying dividends in the long term. Not only have the research expenditures steadily improved (See Table 8 in Part II: Return on Investment), the NSF ranking of these research expenditures in both engineering and computer science programs has also significantly improved.

UCF leads the state and ranks sixth in the nation for the number of NSF CAREER Award recipients in 2019. As of July 22, UCF confirmed 12 awards. The College of Engineering and Computer Science represents seven of the 12 awards.

The CAREER awards are among the most prestigious in the nation and include funding. Recognizing early-career professionals with promising research, the awards are part of the NSF's Early Career Development Program and are given to recipients who have the potential to serve as academic role models and lead their respective fields. The junior faculty in the College of Engineering and Computer Science have also received other prestigious Young Investigator awards from agencies such as NASA, Air Force Office of Research, Office of Naval Research and Defense Threat Reduction Agency.

These junior faculty have worked closely with undergraduates in UCF's Honors' college and participated in the EXCEL program to provide a well-rounded education to UCF students that includes involvement in research, thus raising the quality of the produced talent pipeline. It is our intention to emulate and expand CECS's aforementioned successes with the support from this LBR through the hiring of 64 new faculty.

Entrepreneurial Work Leading to Patents

UCF ranks 31st among public universities in the nation and among the top 100 universities in the world in generating patents, and according to new rankings released in 2019 by the National Academy of Inventors and the Intellectual Property Owners Association, UCF has ranked in the top 100 in the world for the past five years.

To spur the growth in research, UCF recently established a Big Data, Artificial Intelligence Initiative (cross-campus) with an accompanied announcement of COVID-19 seed grants. Additionally, Research for Undergraduates (REU) funded by the National Science Foundation has significantly enhanced the research capabilities of our students in the areas of Computer Vision (at more than 30 years running it is the longest-running NSF REU program in the nation), Cyber, Nano-technology and other areas. UCF also leads the management of one of the world's largest active radio telescopes, the iconic Arecibo Observatory in Puerto Rico. The recent research recognitions at UCF provide an opportunity for CECS to increase its ranking further and enhance the national and international reputation of the college and the institution.

F. Job Growth in Central Florida

UCF engineering and computer science students are actively sought by industry and the college is ranked by Aviation Week as the nation's No. 1 supplier of graduates in

aerospace and defense industries. Manufacturing and computing are embraced by aerospace, automotive, medical, defense, photonics, microelectronics and other high-tech industries, such as the ones that gained Central Florida's reputation as the hub of a vibrant modeling and simulation community. CECS' current curriculum, addressing the aforementioned industry needs, accompanied with training through a plethora of internships (e.g., Lockheed), is specifically designed so that students learn fundamental and practical skills needed for their professional success. In a 21st century economy, CECS students' educational experiences provide the potential for sustainable long-term employment in Florida. CECS graduates go on to become global leaders of Florida industries.

CECS Employability Numbers:

The College of Engineering and Computer Science surveys its graduating students six months after graduation to determine employment status. CECS' survey results for the 2018-2019 CECS graduating class indicated that:

- A vast majority of respondents reported being employed either full-time or part-time (88.1 percent undergraduate; 90.5 percent master's; and 92.7 percent doctoral).
- Of those who reported employment, the majority of the respondents were employed on a full-time basis (93 percent undergraduate; 90.5 percent master's; and 92.1 percent doctoral).
- Of those who reported employment, many of the respondents indicated they were employed in Florida (66.1 percent undergraduate; 55.2 percent master's; and 52.6 percent doctoral).
- Of the undergraduates and graduate student respondents who provided their annual salary information, the average was \$66,919 and \$81,180, respectively.

In 2018-2019, CECS graduated 1,533 BS, 390 MS and 108 Ph.D. students. The employability numbers, mentioned above, indicate that CECS produced, in 2018-2019, more than 1,100 engineering and computer science graduates for Florida's economy. Trends indicate that the number of graduates in CECS will continue to increase for years to come. Furthermore, this LBR's focus on student retention and graduation (EXCEL learning communities, math boot camps, 4-year graduation) are expected to further increase the number of CECS graduates in future years. Therefore, it is expected that CECS will soon be producing, with this LBR's support, more than 1,500 engineering and computer science graduates, annually, for the State of Florida.

UCF Powering Up Florida's High-Tech Economy

Quality, impact, diversity, workforce and research success demonstrate why the university is proposing an investment in engineering, computer science and related disciplines, designed to meet the unmet needs of Central Florida's quickly growing STEM-based economy while accelerating the university's pursuit of excellence and statewide impact.

Our plan is to power the UCF College of Engineering and Computer Science past the Top 40 of the *U.S. News and World Report* undergraduate and graduate public university rankings by 2025, with an aspirational goal of the Top 25 by 2035.

Called *UCF Powering Up Florida's High Tech Economy*, the plan will enhance our distinctive areas of engineering and computer science excellence by addressing 1) successful student outcomes, 2) talent pipeline for industry, and 3) research and economic prosperity.

UCF Powering Up Florida's High Tech Economy	
64 faculty members	\$13.1 million recurring
16 support positions	\$1.3 million recurring
EXCEL/Bridge Program Investments	\$2 million recurring
Funds for Student Assistants	\$2 million recurring
Laboratory Equipment Upgrades	\$3 million non-recurring
Total	\$21,422,400

Table 5: Breakdown of UCF Powering-Up Florida's High Tech Economy Resources Request

Specifically, UCF requests \$21.4 million in recurring and non-recurring resources to:

- 1) **Improve quality and student success:** Hire more faculty strategically to increase student retention and graduation rates and shorten average time to degree. These improvements will lead to a higher-quality experience for students with more efficiency toward degree completion and reduced costs for students. Hire support positions (at a 1:4 ratio with faculty) to ensure the laboratory managers and personnel infrastructure are in place to support the faculty hires.
- 2) **Enhance the talent pipeline for a 21st-century economy:** Increase programs that recruit, sustain and graduate STEM students at high rates by focusing on STEM learning communities and early engagement in undergraduate research experiences (e.g., EXCEL program at UCF). Expand and enhance bridge programs, such as math bootcamps that improve the math placement status of incoming FTICs and thus enhance their 4-year graduation chances. These programs ensure our students are successful within their degree programs and are best prepared for high-paying jobs upon graduation.
- 3) **Grow research and economic prosperity:** Enhance UCF's existing research and industry partnerships in key areas for the state, encompassing a number of engineering and computer science topic areas including AI/ML, Cyber, AR-VR, Modeling and Simulation (Mega Area 1; for more details see below), and Aerospace Science, Manufacturing, Automation, Energy, Smart Things (Mega Area 2; for more details see below) through hiring more faculty, providing faculty startup packages, upgrading laboratory equipment and hiring staff in research support positions.

These funds will target strategic areas of opportunity to further enhance UCF's pursuit of academic and research excellence as a Florida University of Distinction.

1. Improve quality and success

Hiring 64 more faculty members will ensure UCF meets *and exceeds* its institutional strategic plan goal of offering additional class sections, particularly for high-demand STEM pathway courses. Increasing the number of faculty enhances the student experience by providing more opportunities for quality student-faculty engagement in both education and research.

The College of Engineering and Computer Science 4-year graduation rate is one of the focal pursuits of this LBR effort. While only 27 percent of CECS students graduate in four years, this is a significant improvement over the 21 percent 4-year graduation rate observed five years ago. Furthermore, our data show that another 14 percent graduate in just one extra semester, which indicates that there is a potential of significant improvement with a reasonable amount of effort. If those students are able to graduate *one semester earlier*, the overall four-year graduation rate for UCF would immediately rise by 3 percentage points based on CECS improvements.

Hiring 16 support positions will ensure faculty and labs have the appropriate infrastructure to be successful.

2. Enhance the talent pipeline for a 21st-century economy

As identified previously, UCF is the engine that will propel Central Florida's tech sector into the model of a 21st-century economic success story.

UCF Powering Up Florida's High Tech Economy will strengthen the rich educational experience for all of UCF's students.

UCF will Power Up student success in engineering and computer science by:

- **Tripling the EXCEL program**, including the expansion of the supported math courses from College Algebra through the Calculus sequence and into Differential Equations.
- **Tripling the EXCEL learning communities** that place cohorts of students into math, introduction to engineering, and possibly science courses.
- Offering **10 times as many seats** in Math Bootcamps.

Originally started in 2006 with an NSF grant, UCF's EXCEL program focuses on the first two years of student enrollment and increases the likelihood of graduation in a chosen STEM discipline. EXCEL accomplishes this feat by creating STEM-learning communities that focus on math skills in year one, providing early engagement with undergraduate research experiences in year two, and expanding the personal advising that the students get in their first two critical years of their college experience.

The program has achieved 92 percent first-year retention, a 54 percent increase in STEM graduation compared to the matched non-EXCEL cohort, placed more than 800 students in research experiences, and has engaged more than 5,200 students in STEM learning communities. In comparison to the matched cohort, EXCEL has recruited higher percentages of female and Hispanic students (42 percent female students in EXCEL's 2019 cohort compared to 34 percent in the matched cohort, and 35 percent Hispanic students in EXCEL's 2019 cohort compared to 30 percent in the matched cohort). Furthermore, the graduation success of female and Hispanic students has been equally impressive or better than that observed in the total EXCEL population, with a 54 percent increase in STEM graduation for female students and 59 percent increase in STEM graduation for Hispanic students.

Math placement and success is a major driver among STEM time-to-degree. EXCEL has utilized a Math Bootcamp that includes a one-week intensive math session and an updated math placement exam. This program gives students an opportunity to start their

STEM program on the appropriate math pathway and because of the one-week intensive Math Bootcamp, quite often, at an accelerated pathway with verifiable success. If this program is expanded 10-fold, per this LBR’s plan, we expect that the number of UCF’s STEM students being in a 4-year graduation pathway to increase significantly.

3. Grow research and Florida’s economic prosperity

As Orlando’s only public research university, UCF is the academic research leader for Central Florida. The university has achieved more than \$1 billion in external research grants during the past decade and continues to be one of 94 public institutions in the nation designated as an “R1: Doctoral University: Very high research activity” among Carnegie classifications. This last year, UCF set an institute record with more than \$200M in research awards.

UCF faculty drive Central Florida’s research enterprise, both in their laboratories and through partnerships with industry, advancing economic development through translational research. UCF faculty play a critical role in the pursuit of excellence. Below, we describe two mega areas of research that have unique strengths at UCF and drive Central Florida’s, as well as Florida’s economy, that this LBR intends to enhance.

Central Florida provides a unique locational advantage for such research endeavor as seen in the accompanying diagram (**Figure 1**) that showcases Florida industries that power up Florida’s high-tech economy.

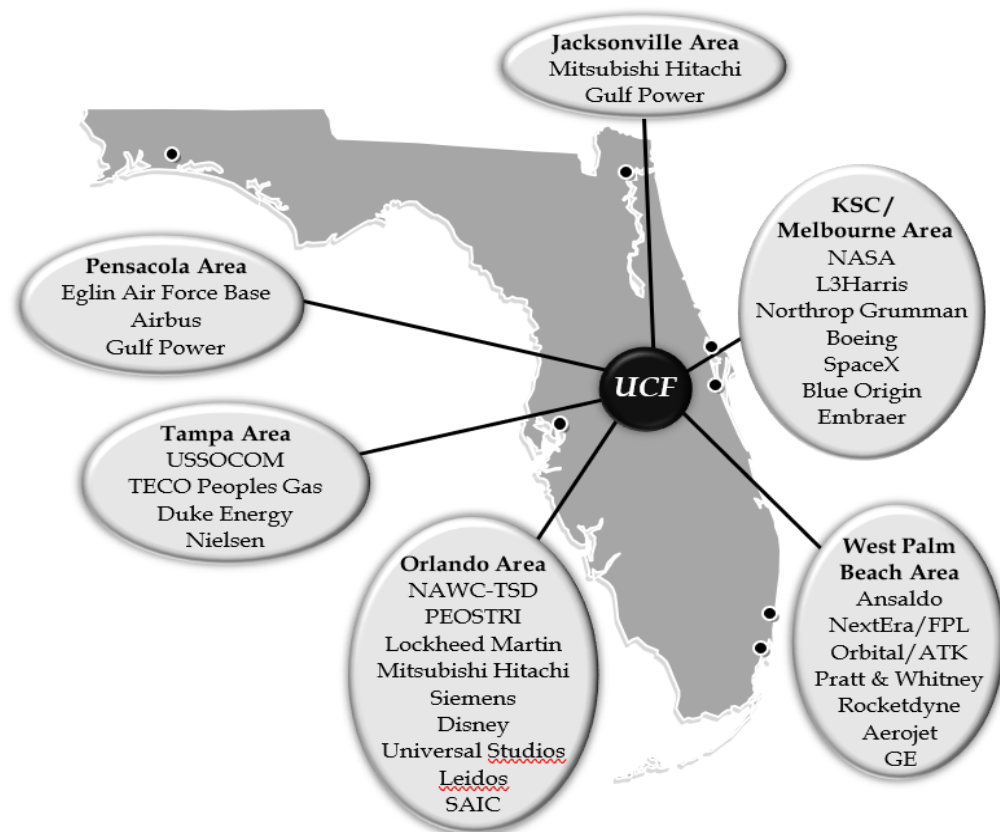


Figure 1: A diagram with Florida companies and their respective locations in the State of Florida. These companies have core business areas of topics contained in Mega Area 1 and/or Mega Area 2.

Mega Area 1: AI/Cyber/AR/VR/Modeling & Simulation Research:

One of the mega-areas of research that has brought economic prosperity in the State of Florida - and is projected to continue - includes the following topic areas (all computing-related areas of focus and of critical importance in the digital era): Artificial Intelligence, Cyber, Augmented Reality-Virtual Reality, and Modeling and Simulation (AI/Cyber/AR-VR/MS).

The need for workforce talent in these computing areas is significant. According to the Bureau of Labor Statistics², “Employment of computer and information technology occupations is projected to grow 12 percent from 2018 to 2028, much faster than the average for all occupations. These occupations are projected to add about 546,200 new jobs. Demand for these workers will stem from greater emphasis on cloud computing, the collection and storage of big data, and information security.” In particular, for AI, a 2019 report from Gartner³ shows that enterprise applications for AI have grown 270 percent in four years, fueling a level of demand that outstrips the current supply of qualified job candidates.

AI/Cyber/AR-VR are areas of increasing and sustained critical importance to the modeling and simulation community in Central Florida, which has been designated as the State’s Center of Excellence in Modeling and Simulation. UCF’s main campus is adjacent to Research Park, a unique collaborative alliance formed by U.S. leading military modeling and simulation R&D commands (PEO STRI (Army), NAWCTSD (Navy), AFAMS (Air Force), PM TRASYS (Marines)). UCF’s Research Park is home to several branches of the military and a vibrant modeling and simulation industry boasting 100+ companies. The US Department of Defense in UCF’s Research Park provides annually \$6B worth of contracts to companies in UCF’s vicinity as well as other companies nationwide. This year, the Navy established the NavalX Central Florida Tech Bridge and the Tech Grove, a public-facing entity formed through a partnership between NAWCTSD and UCF’s Research Foundation to solve challenging warfighter problems. The state is significantly vested to sustain and enhance the status of Central Florida as the nationwide location of excellence in modeling and simulation and has invested in five Partnership buildings that co-house the military, the well-renowned UCF’s Institute for Simulation and Training and the National Center for Simulation (representing 260+ companies). AI/Cyber/AR-VR are of increasing and sustained interest to a number of Aerospace and Defense companies, such as Lockheed Martin, L3Harris, Northrop Grumman, Raytheon, Leidos and SAIC, as well as entertainment giants such as Disney, Universal and Sea World, all of which are in short driving distance from UCF.

AI/Cyber/AR-VR/Modeling and Simulation is a mega area of existing strength at UCF. An example of strength of AI-related research at UCF is the Center for Research in Computer Vision (CRCV), established in 2012, which has been funded extensively by federal sources (e.g., DARPA, NSF) and industries (e.g. Lockheed Martin, L3Harris). Computer Vision’s increased prominence in solving important problems in a number of application areas (surveillance, automation) relies on recent advances in AI (e.g. Deep Learning) and high-performance computing (e.g. GPU’s). According to CSRankings.org Computer Vision Research at UCF is ranked in the top 20 in the nation ahead of many premier institutional powerhouses and every other institution in the State of Florida.

Another example of strength in AI-related research at UCF is Transportation Science and Technology led by faculty in Civil Environmental and Construction Engineering (CECE).

Transportation Science and Technology at UCF has been extensively funded by federal sources (USDOT) and state sources (FDOT). According to the 2020 ARWU (Academic Ranking of World Universities), UCF's Transportation Science and Technology has been ranked No. 5 in the U.S. ahead of some of the most prominent institutions around the nation. UCF's increased prominence in Transportation Science and Technology is fueled by the increased focus on AI, Big Data and the increased computing power that makes extraction of knowledge from big data possible.

A recently established Cyber cluster is providing strength in the Cyber area. This past year, the Cyber Cluster brought in a multi-million-dollar research portfolio funded by a number of federal agencies (e.g., NSF, DoD) and industry (e.g., Sophos). This strong research presence accompanied by the sustained and impressive accolades of UCF's Cyber team provides a multi-faceted UCF strength hard to emulate elsewhere. This year, UCF faculty and students partnered with industry and DoD to pioneer a cyber red team pipeline program to grow the next generation of cyber operators that conduct national defense cybersecurity assessments. This cyber workforce development program is vital for Central Florida as home to the National Cyber Range Complex and U.S. Cyber Command's Persistent Cyber Training Environment.

Faculty in the AR-VR/Modeling & Simulation area are also housed in the College of Nursing, College of Medicine and College of Arts and Humanities, with a focus on the science and applications of these topical areas. The AR-VR/Modeling & Simulation interest is further enhanced by the parallel interest of the entertainment industry (Disney, Universal), partially serviced by the Themed Experiences program, led by the College of Arts and Humanities with support from the College of Engineering and Computer Science and the Rosen College of Hospitality Management. This interest is also enhanced by the parallel interest of the medical community, spearheaded by the College of Medicine and the College of Nursing, to incorporate simulation-based education in medicine (education and research). More importantly, there is parallel increased interest (post COVID-19) of the education community (nationwide) to incorporate AR-VR/Modeling & Simulation to more effectively engage in remote teaching and learning.

To continue to excel in our research and provide the talent pipeline to our industry partners, UCF will hire faculty that have expertise in the various topic areas of Mega Area 1.

Mega Area 2: Space Systems and Engineering/ Manufacturing/ Automation/ Energy/ Smart Things:

The aviation and defense industries in Central Florida are thriving and well-diversified. This industry conducts R&D tailored programs to meet the growing demands for highly skilled workers, fueling our economic engine and impacting business in nearly all 23 counties [floridahightech.com⁴]. UCF researchers have participated in collaborative research with the corridor companies and agencies like NASA and Eglin Air Force Base. Our industry partnership includes research areas such as rocket propulsion, hypersonic systems, technologies that deploy telescopes and satellites, AI/ML augmented SSA (Space Situation Awareness) algorithms, high temperature durability of materials, radio and optical techniques for aeronomy and space phenomena at Arecibo Observatory, and lunar and asteroid surface science. UCF has key infrastructure labs to conduct research in these areas and its faculty have published widely in high-impact journals. UCF provides a rich supply chain and talent pool (No. 1 workforce provider for aerospace and defense companies) to the ever-evolving aerospace and defense industry.

According to the National Association of Manufacturing (NAM)³, manufacturers in Florida account for over 5 percent of the total output in the state, employing 4 percent of the workforce. Total output from manufacturing was \$56B in 2018 from an average of 327,000 manufacturing employees in Florida, with an annual overall compensation of more than \$66,000 per employee. The topic areas represented in Mega Area 2 are part of the core business areas for a number of large industries in the state, such as Lockheed Martin, L3Harris, Northrop Grumman, Siemens, Mitsubishi, NextEra/FPL and Duke, as well as the entertainment giants, such as Disney, Universal and others. These are also areas of core business for many small businesses (more than 100) that fuel innovation and entrepreneurship, all located in UCF’s dynamic Research Park.

UCF has already established three energy-focused clusters. One such example is CATER (Center for Advanced Turbomachinery and Energy Research), with strong, consistent support from industries such as Siemens, and through federal funds from agencies such as AFRL and DoE. CATER has several dedicated faculty conducting research in interdisciplinary areas of aerodynamics, alternative fuels, material coatings and integrity, and design and manufacturing. Areas of focus for this Center are improved composites, compact turbomachinery and energy storage for smaller power plants and digital twin. CATER’s digital twin focus will benefit from advances in AI, Big Data and cyber security and its potential impact is not limited to turbomachinery companies.

UCF’s strengths in Mega Area 2 are also established in the College of Optics and Photonics (CREOL), one of the world’s foremost institutions for research and education in optical and photonic science and engineering. CREOL has been funded by several arms of DoD. For instance, CREOL currently has 11 projects with DARPA that include the development of the world’s fastest laser. CREOL faculty and students are engaged in research covering all aspects of optics and photonics including lasers, optical fibers, integrated photonics, nonlinear and quantum optics, and imaging, sensing and display. These technologies have applications in industry and manufacturing, communication and information technology, biology and medicine, energy and lighting, and defense and homeland security.

To continue to excel in our research and provide the talent pipeline to our industry partners, UCF will hire faculty who have expertise in the various topic areas of Mega Area 2.

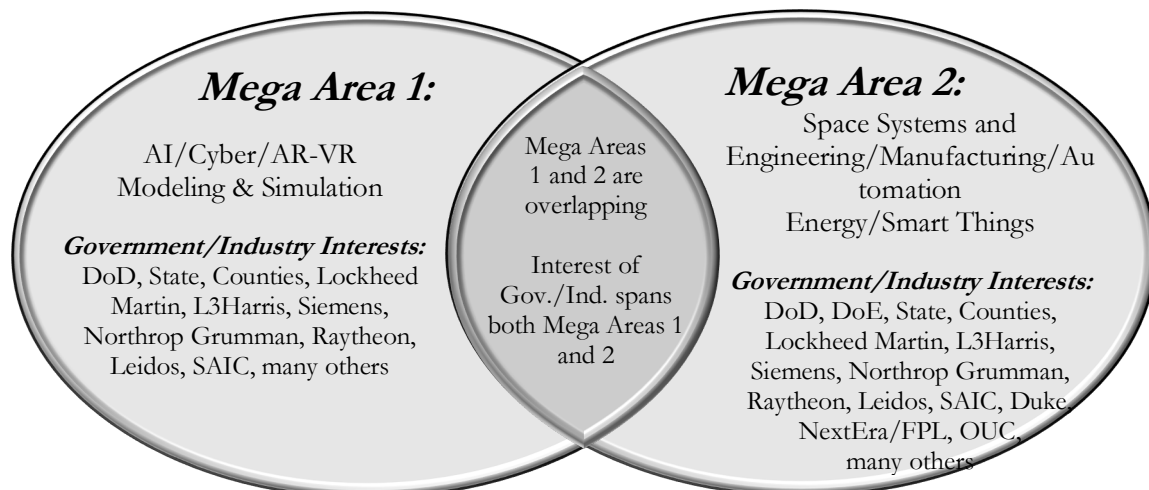


Figure 2: The two mega areas of strength at CECS/UCF are depicted in separate circular objects, where a select, non-exhaustive, group of government, industry entities with a strong presence in Central Florida, and/or State are shown. The overlapping area of the two circular objects represents the overlapping nature of science/technologies that affect these mega areas (e.g. AI plays a critical role in automation), as well as the commonality of interests of government, industry stakeholders in the topical areas of each mega area (e.g. Lockheed Martin has a strong interest in manufacturing (Mega Area 2), as well as cyber (Mega Area 1)).

LBR Request

The additional 64 faculty lines included in this request will help enhance UCF's existing research strengths and industry partnerships in these key areas for the state. These new faculty lines will help the College of Engineering and Computer Science reach its goal of \$115 million in research funding by 2022-2023, as well as enhance the quantity and quality of the talent pipeline needed by Florida's economy. The requested \$3 million in laboratory equipment upgrades and additional 16 research support lines will provide the necessary infrastructure to propel UCF's research to greater levels. The additional funds requested for the EXCEL program and bridge programs and the student assistants' support will enhance the academic credentials of the student pipeline, entering UCF, so that they are successful in their pursuit of STEM degrees that Florida's economy needs.

II. Return on Investment - *Describe the outcome(s) anticipated, dashboard indicator(s) to be improved, or return on investment. Be specific. For example, if this issue focuses on improving retention rates, indicate the current retention rate and the expected increase in the retention rate. Similarly, if the issue focuses on expanding access to academic programs or student services, indicate the current and expected outcomes. University of Distinction proposals should also address the requirements outlined in the separate guidance document.*

UCF's Powering Up Florida's High-Tech Economy aligns with regional economic needs, the university's strategic plan and the Board of Governors strategic plan.

In its September 2019 report, the Orlando Economic Partnership stated the importance of "the alignments of UCF's focus on engineering and computing with the OEP's Three-Year Mission." The report further stated that UCF's plan aligns with regional efforts, including "the expansion of initiatives designed to enhance our talent ecosystem. These broad sector categories will be driven by the diffusion of key enabling technologies - ranging from 5G and distributed ledger technologies to co-biotics and extended reality - each clearly supported by UCF's enhanced E/C (Engineering and Computer Science) focus."

UCF's Collective Impact Strategic Plan includes promises designed to elevate the university, demonstrate a commitment to students, and impact our region, state and nation. Promise 2 is to "attract and cultivate exceptional and diverse faculty, students and staff" and directly relates to the hiring plan and student support enhancements. Promise 3 is to "deploy our distinctive assets to solve society's greatest challenges" and is supported through the two mega area research foci and the talent pipeline that UCF is generating in these fields. Promise 4 is "create partnerships at every level that amplify our academic, economic, and cultural impact and reputation" demonstrated by the research partnerships detailed in Figures 1 and 2.

UCF’s LBR demonstrates alignment to the Board of Governors Strategic Plan – State University System 2025 Strategic Plan by focusing on the same three core areas. Excellence is included through increased reputation of the academic programs and improved student success. Productivity is supported by research expenditures and student pipeline and diversity. The third core area, Strategic Priorities for a Knowledge Economy, is demonstrated by the selection of engineering and computer science as the area of expansion and enhancement.

The return on investment for the requested funds will be measured by progress toward the objectives and key performance targets set forth in the university’s Collective Impact Strategic Plan (<https://www.ucf.edu/strategic-plan/>).

Through UCF’s annual Accountability Plan and the institutional strategic plan implemented in 2016, the university already has a robust tracking system on progress toward its goals, using institutional data alongside statewide and national benchmarks.

These LBR investments will result in further improvements to UCF’s Accountability Plan priority metrics of increasing student success, strengthening our faculty and staff and increasing our research impact by 2025.

1. Improve quality and success

UCF has developed college-based Accountability Plan metrics and targets. Hiring additional academic advisors and faculty will allow CECS to exceed the positive trajectory already planned for student success metrics including 4-year graduation rate, academic progress rate and excess hours rate. In turn, this also will have a positive impact on the average cost to the student, ensuring UCF’s continued affordability and high-quality education.

Metric	History	Current	Trend	Trend with Investment
CECS First-year Retention	85.5% 2013-14	91.7% 2018-19	92.1% 2022-23	93.0% 2022-23
CECS Four-year Graduation Rate	21.0% 2010-14	27.4% 2015-19	33.5% 2019-23	34.5% 2019-23
CECS Six-year Graduation Rate	63.8% 2008-14	63.9% 2013-19	66.9% 2017-23	68.4% 2017-23
CECS Average Time to Degree	4.71 2014-15	4.51 2018-19	4.36 2022-23	4.29 2022-23
CECS Percent of Students Graduating Without Excess Hours	54.2% 2014-15	67.2% 2018-19	69.7% 2022-23	71.5% 2022-23

Table 6: UCF Powering-Up Florida’s High-Tech Economy Metrics (Set 1)

2. Enhance the talent pipeline for a 21st-century economy

The focus on bridge programs and diverse alumni will benefit the metrics associated with diverse graduates and alumni success, including median wages of bachelor’s graduates employed full-time.

Metric	History	Current	Trend	Trend with Investment
CECS Degrees Awarded	1,646 2014-15	2,249 2019-20	2,427 2022-23	2,577 2022-23
CECS Graduate Diversity	34.3% 2014-15	43.9% 2018-19	45.5% 2022-23	46.7% 2022-23
CECS Bachelor's First-Year Salaries	\$50,780 2012-13	\$58,232 2017-18	\$59,300 2021-22	\$60,500 2021-22

Table 7: UCF Powering-Up Florida's High-Tech Economy Metrics (Set 2)

3. Grow research and economic prosperity

Faculty hires related to research of strategic statewide importance will benefit key measures of success, including research expenditures and the number of post-doctoral appointees. Benchmarks for these metrics are included in the university's Accountability Plan and additional investments will result in greater outcomes.

Metric	History	Current	Trend	Trend with Investment
CECS Research Expenditures (in millions)	\$47.4 2013-14	\$92.1 2018-19	\$105.0 2022-23	\$115.0 2022-23
NSF Engineering Research Expenditure Rank (among publics)	66 2013-14	37 2017-18	32 2022-23	Top 30 2022-23
NSF Computer Science Research Expenditure Rank (among publics)	25* 2013-14	10 2017-18	8 2022-23	Top 7 2022-23

* Note: Ranking was Math and Computer Science combined in 2013-14

Table 8: UCF Powering-Up Florida's High-Tech Economy Metrics (Set 3)

III. Facilities (If this issue requires an expansion or construction of a facility, please complete the following table.):

	Facility Project Title	Fiscal Year	Amount Requested	Priority Number
1.				
2.				

REFERENCES

- <https://www.usnews.com/news/stem-solutions/articles/2018-03-27/commentary-the-need-to-focus-on-advanced-manufacturing>
- <https://www.bls.gov/ooh/computer-and-information-technology/home.htm#:~:text=Employment%20of%20computer%20and%20information,ad d%20about%20546%2C200%20new%20jobs.>
- <https://www.gartner.com/en/newsroom/press-releases/2019-01-21-gartner-survey-shows-37-percent-of-organizations-have>
- <https://www.nam.org/state-manufacturing-data/2019-florida-manufacturing-facts/>

2020-2021 Legislative Budget Request
Education and General
Position and Fiscal Summary
Operating Budget Form II
(to be completed for each issue)

University: University of Central Florida
Issue Title: UCF University of Distinction in Engineering and Computer Science

	<u>RECURRING</u>	<u>NON-RECURRING</u>	<u>TOTAL</u>
<u>Positions</u>			
Faculty	64.00	0.00	64.00
Other (A&P/USPS)	16.00	0.00	16.00
	-----	-----	-----
Total	80.00	0.00	80.00
	=====	=====	=====
<u>Salary Rate (for all positions noted above)</u>			
Faculty	\$10,240,000	\$0	\$10,240,000
Other (A&P/USPS)	\$960,000	\$0	\$960,000
	-----	-----	-----
Total	\$11,200,000	\$0	\$11,200,000
	=====	=====	=====
Salaries and Benefits	\$14,422,400	\$0	\$14,422,400
Student Assistants	\$2,000,000	\$0	\$2,000,000
EXCEL/BRIDGE/Labs	\$2,000,000	\$3,000,000	\$5,000,000
Operating Capital Outlay	\$0	\$0	\$0
Electronic Data Processing	\$0	\$0	\$0
Special Category (Specific)	\$0	\$0	\$0
	\$0	\$0	\$0
	\$0	\$0	\$0
	\$0	\$0	\$0
	-----	-----	-----
Total All Categories	\$18,422,400	\$3,000,000	\$21,422,400
	=====	=====	=====