

Executive Summary

Blueprint for Academic Excellence College of Engineering & Computing AY2020-2021

Introduction

CEC offers 10 UG degrees, 7 UG minors, 9 PhD degrees, 14 MS degrees, 8 ME degrees, a Master of Health IT degree, and 2 graduate certificates. Enrollment for UG is currently 3220, up 47.2% from 2013. Enrollment for graduates is currently 597, up 13.5% from 2013. CEC has been growing its T/TT since 2016, and has 35 full-time instructors today. The significant investments in student success, and expansion and modernization of facilities and curricula, have made CEC a destination of choice for students seeking a rigorous education, and successful post-graduation placement, as is evident below. CEC's Fall 2019 freshman class grew modestly to 768 (up 5.6%). Compared to the previous year, the number of entering undergraduate underrepresented minorities increased 9%, from 100 to 109. The number of first-generation students entering the CEC has increased by 14.9% since 2017, from 154 to 177. Capstone students entering CEC has increased by 31.1% since 2017, from 180 to 236.

Highlights

- Professor Sutton was elected to the National Academy of Engineering (Prof. Monnier elected in 2018); the only 2 Academy members in the state
- USC Artificial Intelligence Institute has Dr. Amit Sheth (Google h=103) as its Founding Director.
- Fall freshman class grew to 814 (+4.6%).
- Sponsored Research Awards will safely top \$30M, compared with \$18M in 2016.
- Hired 7 Tenure Track faculty and 5 instructors.
- There are 389 Honors College Students in CEC. CEC has the third highest number of students in the SC Honors College (16.85%)
- Three departures to deanships:
 - Tony Amber, University of Houston, College of Tech
 - Harry Ploehn, East Carolina University, College of Eng and Tech
 - John Weidner, University of Cincinnati, College of Eng and Applied Science

Hossein Haj-Hariri , Dean
USC Educational Foundation Distinguished Professor
College of Engineering and Computing



UNIVERSITY OF
SOUTH CAROLINA
College of Engineering
and Computing



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Foundation for Academic Excellence

Mission Statement

We create and disseminate knowledge that advances the practice of engineering and computing. We are committed to working on complex projects that are inherently inter- and multidisciplinary. We leverage the comprehensive nature of the state's largest university to graduate liberally educated engineers and computer scientists capable of teaching themselves new knowledge beyond the boundaries of their education.

Updated: 03/01/2017

Vision Statement

- **Teaching Excellence:** Our College will be the premier destination of choice in the Southeastern U.S. for engineering and computing students, as well as the companies that hire them.
- **Research/Scholarship:** Our research productivity will be internationally recognized based upon the reputation of our faculty scholarship and its impact upon society.
- **Service:** We will lead the university and the state that supports us in the advancement and dissemination of knowledge in our fields of expertise.

Updated: 03/01/2017

Values Statement

We value innovation, societal relevance, inclusivity, and collaboration.

Updated: 03/01/2017

Goals - Looking Back

No goals have been entered for this section.

Goals - Real Time

Goals for the current Academic Year.

Goal 1 - Student Success and Teaching Excellence

<p>Goal Statement</p>	<p>Attract, inspire, and enable students to become innovative thinkers, life-long learners, and transformative leaders in engineering, computing, and related fields, through: promotion of active learning in the classroom and outside; focus on fundamentals; emphasis on rigor; use of state-of-the-art tools and equipment; leveraging the comprehensive nature of the university and her Carolina Core; and delivering a high-quality, student-centric educational experience.</p>
<p>Linkage to University Goal</p>	<ul style="list-style-type: none"> • Educating the Thinkers and Leaders of Tomorrow • Assembling a World-Class Faculty of Scholars, Teachers, and Practitioners • Spurring Knowledge and Creation • Building Inclusive and Inspiring Communities • Ensuring Institutional Strength, Longevity, and Excellence
<p>Alignment with Mission, Vision, and Values</p>	<p>Fully aligned</p>
<p>Status</p>	<p>Progressing as expected (multi-year goal)</p>
<p>Action Plan</p>	<ul style="list-style-type: none"> • Ensure and monitor that the students show growth in critical analysis and thinking, analytical skills, leadership and communication skills, and problem solving <ul style="list-style-type: none"> ◦ more open-ended hypothesis-based projects, lab/design/research experiences ◦ injection of ethics and professional development throughout the curriculum ◦ thoroughly document the progress, as needed for professional accreditation • Expand the number of the faculty by hiring the best researchers and instructors, with interest and expertise in addressing grand-challenge problems, and mentoring them <ul style="list-style-type: none"> ◦ to achieve an UG/TTT ratio of 20, at the current level of 3,300 UG students, the TTT faculty ranks need to grow to 165. CEC will be at only 130 in 20-21 AY. ◦ full-time instructor ranks need to be 15-20% of the total • Ensure that the degrees are timely, rigorous, and sustainable: <ul style="list-style-type: none"> ◦ Biomedical Engineering (BME) degrees are offered for 15 years as a program, by faculty who have tenure home in other departments. During that period, most other BME programs in the US have become departments. We remain a singularity, and as such at a disadvantage for recruiting of faculty and graduate students, which then affects the

Goals - Real Time

	<p>academic program.</p> <ul style="list-style-type: none"> • Sustain (or expand) undergraduate Engineering and Computing Honors curricula tracks (5-6 HC specific courses per CEC major). • Continue to improve recruiting strategies that target underrepresented students. • Stay focused on improving retention and graduation rates, and post-graduation success.
<p>Achievements</p>	<ul style="list-style-type: none"> • Hired 31 TTT (10 net) and 30+ full-time instructors (net), and addressed the ongoing large deficit of the college so that today the student/TTT is (3300/122=) 27 instead of (3300/80=) 41 that it would have been. Addition of instructors has been transformative. <ul style="list-style-type: none"> ◦ should have another 8+ TTT hires this AY, to allow the ratio to lower to 25. • Significant investments in engineering and computing laboratory and classroom modernization and addition. Without such investment starting in 2016, receiving full accreditation would have been doubtful. • Have created multiple timely and rigorous degrees: <ul style="list-style-type: none"> ◦ created the only aerospace program in the state (one of the largest in the US already) ◦ created the first entrepreneurial engineering and technology innovation MS, aligned, and garnered NSF ICorps funding to create the only SC ICorps Site. • Freshmen and sophomores are advised by 6 professional staff. Increased the staffing of Student Services by almost a factor of three. • Instituted peer mentoring (a quarter of the incoming freshmen have peer mentors). • Expanded undergraduate Engineering and Computing Honors curricula tracks (5-6 HC specific courses per CEC major). Modernized almost all of our curricula to ensure logical prerequisite sequencing, and create significant elective flexibility for taking advantage of the comprehensive nature of the university, including enabling the students to take advantage of timely minor sequences within or outside CEC. CEC continues to have significant recruiting and outreach activities throughout the year. • Upgraded distance education facilities. • Starting active teaching mentorship by resourcing a senior and accomplished instructor to assist our faculty become better instructors (in addition to the superb resources available to our faculty through CTE; they are a great resource for the university). • Received \$1M (Gatzke + Lyons) from NSF for URM undergraduate scholarships. • Received \$1M (Matthews (CEC) and Benitez Nelson (CAS)) from

Goals - Real Time

	<p>NSF to create Bridges to Doctorate, for 2-years of support for 12 minority PhD students (renewable every 2 years).</p> <ul style="list-style-type: none"> • The 6-year graduation rate is up 6 points. • CEC places 86% of its students, with an average starting salary of \$66,000, which is \$8,000 higher than it was in 2015. <ul style="list-style-type: none"> ◦ more than 2/3rd of the students who did not go to graduate school have done an internship as an undergraduate!
<p>Resources Utilized</p>	<ul style="list-style-type: none"> • Tripled the staffing of Student Services. • Invested in expanding our funded Capstone Design projects. Invested in improving all classrooms, hallways and public spaces, as well as student services. • The university invested in a cafe (very important!) and also improving the Career Services offices: <ul style="list-style-type: none"> ◦ the latter improvement is most likely highly correlated with the significant increase in the starting salaries for bachelor degrees.
<p>Goal Continuation</p>	
<p>Goal Upcoming Plans</p>	<ul style="list-style-type: none"> • Significant TTT hiring (net positive) is needed in order to lower the student-to-faculty ratio from mid 20's to 20-21. Peers and peer aspirants are in the high teens to 20. • CEC will continue investing heavily in laboratory upgrades and creation of collaborative and maker spaces. • Encourage the University to create more ~ 120 classrooms on the west side of campus.
<p>Resources Needed</p>	<ul style="list-style-type: none"> • Faculty growth needed to achieve UG/TTT=20: <ul style="list-style-type: none"> ◦ Need 35 more TTT at a total startup of ~\$18M ◦ Some of this will be rolled into the several multi-million-dollar/year research programs that will be forthcoming. ◦ We ask that the University does not tax the IDC from these programs for their first 5 years, and contribute those sums to the necessary startups. • Instructional space, wet labs, and computer labs are areas where central help is needed. • <u>\$500K/year to continue to bring in a new cohort of minority STEM PhD students during the "off" years of the NSF funding for Bridges to Doctorate.</u> These students are supported for two years, and then are supported on research for 2 more years. But given that the program will alternate between UofSC and Clemson, the requested funds will allow the recruiting to continue uninterrupted. • <u>To create the BME department</u>, 6 new positions are needed with 4 in CEC and 2 in SOM. --> 6 salary/fringe lines (\$160Kx6=\$960K recurring) and 6 startups (\$600K*6=\$3.6M one-time) split 2/3rd-1/3rd with SOM.

Goals - Real Time

Goal Notes	
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Goals - Real Time

Goal 2 - Excellence in Research and Scholarship

Goal Statement	Promote a culture of excellence, and the infrastructure, which attracts, cultivates, and retains world-class faculty and staff, and which provides all students and post-doctoral researchers with leading-edge opportunities in research.
Linkage to University Goal	<ul style="list-style-type: none"> • Educating the Thinkers and Leaders of Tomorrow • Assembling a World-Class Faculty of Scholars, Teachers, and Practitioners • Spurring Knowledge and Creation • Building Inclusive and Inspiring Communities • Ensuring Institutional Strength, Longevity, and Excellence
Alignment with Mission, Vision, and Values	Fully aligned.
Status	Progressing as expected (multi-year goal)
Action Plan	<ul style="list-style-type: none"> • Hire new faculty in targeted areas that build upon existing research strengths, or create timely areas of research, that develop high-value multidisciplinary research opportunities. <ul style="list-style-type: none"> ◦ we will not cover all fields, but what we do, we will do extremely well. We will attract strong research faculty (possibly jointly appointed). ◦ ensure the senior hires have a track record of effective mentorship. ◦ promote shared governance. • Support and resource existing research active faculty. • Create critical mass in areas of strength. • Incentivize and support (inter-college and other) collaborative and large projects having high societal impact: <ul style="list-style-type: none"> ◦ in materials, informatics, data science, robotics, AI, electrochemistry, catalysis, water resources and environment, education, assessment, etc. • Invest in infrastructure and graduate student support through research startups. • Continue to offer and improve the PI Academy. • As much as possible, leverage existing equipment and capabilities to attract new faculty.
Achievements	<ul style="list-style-type: none"> • CEC is doing its part to make UofSC become AAU eligible. • Had a second faculty member elected to the NAE in as many years, and had a third one affiliated with us through research. • Hired 31+ new TTT faculty (since 2016) in targeted areas that build upon existing research strengths, or create timely areas of research, that develop high-value multidisciplinary research opportunities. • Hired Professor Sheth, as the Founding Director of the UofSC AI Institute. (Per Google Scholar) Professor Sheth has the

Goals - Real Time

	<p>highest impact of publication of all UofSC faculty, helping elevate the university on that important metric.</p> <ul style="list-style-type: none"> • Supported and incentivized large, multidisciplinary proposals: <ul style="list-style-type: none"> ◦ Starting from \$18M/year in 2016, this year CEC is leading UofSC in awards, and will pass \$30M, on the way to over \$40M next year. • Incentives through return of indirect funds, allocation of CEC-supported graduate students, and creation of central pool of funds for maintenance of large and shared
<p>Resources Utilized</p>	<ul style="list-style-type: none"> • Market-competitive startups, and adequate square footage: <ul style="list-style-type: none"> ◦ CEC has acquired 70,000 additional square feet since 2016 (40,000 for CSE+IIT, 20,000 in SCRA building, and 10,000 atop the old Law School, with another 10,000 to follow). • A third of the IDC is returned to the departments, for generous sharing with the PIs. • Significant practice retention steps every year. • New position of Associate Dean for Research, with the sole task of coalescing and supporting large interdisciplinary teams and partners to put through very large proposals. • Significantly expanded pre-awards group (identification of opportunities and teaming, preparation, submission). • Significantly expanded post awards group (awards management tools, including a real-time app for the PIs to monitor balances, burn-rates, encumbrances, and deadlines.
<p>Goal Continuation</p>	
<p>Goal Upcoming Plans</p>	<ul style="list-style-type: none"> • Once the actual details of the new budget model are known (including the rubrics for the allocation of the strategic funds), re-develop a hiring plan to build up the size of the faculty (across all ranks), similar to what was in place prior to the excellence initiative. • Continue to shepherd the large research programs that are near being awarded. • Continue to seed or identify new large initiatives for the College. • Work with the Architect to achieve a timely completion of the 10,000 sq.ft. Phase-1 space for the UofSC Artificial Intelligence Institute, for August occupancy. • Review all existing international agreements.
<p>Resources Needed</p>	<ul style="list-style-type: none"> • Continuation of matching funds is needed to provide for startups. <ul style="list-style-type: none"> ◦ This must be built into the budget model: every hire in CEC requires a very significant startup. We are the only college which has this characteristic (whereas some chemistry or physics hires can be expensive, they add up to a much lower value when averages across CAS). • FRIP and other similar incentives should be continued. • Wet and specialized lab space remain at a premium and

Goals - Real Time

	present a significant expense to the college. Continued help from the university and foundation is needed. There needs to be flexibility in the types of funds that can be used to pay rent for space in non-university property.
Goal Notes	<ul style="list-style-type: none">• Our hiring has slowed down because of the significant uncertainty in the CEC budget under the new model.

Goals - Real Time

Goal 3 - Sustainability of CEC Mission

Goal Statement	Keep the College on sound financial and administrative footing to sustain the goals in teaching, research/scholarship, and service. This goal underpins all other goals.
Linkage to University Goal	<ul style="list-style-type: none"> • Educating the Thinkers and Leaders of Tomorrow • Assembling a World-Class Faculty of Scholars, Teachers, and Practitioners • Ensuring Institutional Strength, Longevity, and Excellence
Alignment with Mission, Vision, and Values	Enables the Mission, and the Vision.
Status	Progressing as expected (multi-year goal)
Action Plan	<ul style="list-style-type: none"> • Align with the new budget model. • Expand the number of TTT faculty significantly. • Continue investing in the undergraduate laboratories, pre-awards office personnel, professional advising and student services, TA support, lecturer support (moving toward elimination of TA-taught courses/sections). • Continue seeking and establishing partnerships. • Return of 30% of the overhead to the department, and 1/3rd thereof to the faculty in further support of their research. • Finalize development of departmental budgets, with some elements of hybrid RCM.
Achievements	<ul style="list-style-type: none"> • Working to optimize the alignment with the new budget model. • Hired 7 TTT, and are interviewing for about 10 more. • Continued investing in the undergraduate laboratories, pre-awards office personnel, professional advising and student services, TA support, lecturer support (moving toward elimination of TA-taught courses/sections). • Finalizing the partnership with NUST in Oman. • Returned of 30% of the overhead to the department, and 1/3rd thereof to the faculty in further support of their research.
Resources Utilized	<ul style="list-style-type: none"> • Faculty lines • Competitive startups <ul style="list-style-type: none"> ◦ graduate student support ◦ summer salary ◦ equipment • Space, including investment to acquire, update, renovate, as the case may be
Goal Continuation	This goal remains in effect every year.
Goal Upcoming Plans	<p>Detailed in the appropriate section but this year we have a specific goal:</p> <ul style="list-style-type: none"> • Using our Biomedical Engineering Program as a springboard,

Goals - Real Time

	<p>create a Biomedical Engineering Department.</p> <ul style="list-style-type: none"> ◦ justification is provided under a separate goal ◦ Letters of support are located in Appendix 8
<p>Resources Needed</p>	<ul style="list-style-type: none"> • In order to lower the UG/TTT to 20, a significant level of hiring of TTT faculty is needed (30+) with a startup of \$18M+: <ul style="list-style-type: none"> ◦ Central help, in direct form, or indirect form (returning of the IDC on large contracts/grants) would be needed. • To cover 24 Honors specific sections need to hire more instructors: <ul style="list-style-type: none"> ◦ Central help with lab, office-space needs, and startups. • For creating Biomedical Engineering Department: <ul style="list-style-type: none"> ◦ Six new hires (4 in CEC and 2 in SOM) with \$960K/yr recurring, and \$3.6M one-time startups. • Expand FRIP to very large multi-PI proposals, so that colleges can afford to hire the personnel that are needed to ensure the success of the program, as well as building capacity to create new programs.
<p>Goal Notes</p>	

Goals - Real Time

Goal 4 - Sustainability of the Mission: Converting the Biomedical Engineering Program into the Biomedical Engineering Department

Goal Statement	<p>Leverage the existing strengths of the Biomedical Engineering Program, coupled with a strategic hiring plan between the College of Engineering and Computing (CEC) and the School of Medicine (SOM) to create a Biomedical Engineering Department within CEC. The new department will enhance the research portfolios and national recognition of both CEC and SOM, and amplify ongoing efforts to improve the sustainability and educational mission of all four Biomedical Engineering degree programs.</p> <p>Benefits to the University and the State</p> <ul style="list-style-type: none">• <i>It is vital for a successful SOM to have a vibrant Biomedical Engineering Department to interact.</i>• A Biomedical Engineering Department would have increased stature at large funding agencies: the perceived "environment" is a critical aspect of proposal reviews.• Co-location of faculty will improve the quantity and quality of collaborative proposals, as well as awareness of funding opportunities.• Appointing faculty within a Biomedical Engineering Department will revitalize the Biomedical Engineering graduate program in terms of student numbers and recruiting - we will be a more attractive destination• A Biomedical Engineering Department will create a consistent set of expectations for junior faculty, which is missing in the current program structure. Such a change would increase the effectiveness of junior faculty in all areas. Mentoring of junior faculty would be vastly improved.• A Biomedical Engineering Department would be a more attractive destination for talented junior hires and experienced senior hires.• The administrative burden of a 260+ undergraduate student population could be streamlined, as service to the department would be well-defined in faculty contracts and easy to assign and assess; this streamlined administration would benefit the accreditation process.• Formation of a department would naturally lead to a growth in faculty number, so we could effectively administer and manage a larger undergraduate student population.• <i>We would become the first Biomedical Engineering department in the state</i>, Clemson has a Bioengineering Department, and we could use this as a college selling point.• A Biomedical Engineering Department would be able to better establish formal partnerships with UofSC's colleges/departments such as Biology, Pharmacy, and Nursing in order to allow translation and integration of projects and
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Goals - Real Time

	<p>ideas developed within Biomedical Engineering.</p> <ul style="list-style-type: none"> • A stand-alone Biomedical Engineering Department will allow seamless collaborations and interactions between UofSC and Industry. These interactions could also facilitate the integration of industry and clinical educational components, such as graduate student rotations and fellowships at industry sites. <p>A Biomedical Engineering Department would be a more visible and cohesive entity to engage clinical and provider partners in terms of applying and supporting Biomedical Engineering in strategic and thematic areas affecting South Carolina citizens: cardiovascular disease, neurodegenerative/cognitive disorders, and cancer.</p>
<p>Linkage to University Goal</p>	<ul style="list-style-type: none"> • Educating the Thinkers and Leaders of Tomorrow • Assembling a World-Class Faculty of Scholars, Teachers, and Practitioners • Spurring Knowledge and Creation • Building Inclusive and Inspiring Communities • Ensuring Institutional Strength, Longevity, and Excellence
<p>Alignment with Mission, Vision, and Values</p>	<p>This goal aligns with the UofSC’s mission, vision, and values.</p>
<p>Status</p>	<p>Newly Established Goal</p>
<p>Action Plan</p>	<ul style="list-style-type: none"> • Provide a biomedical-engineering tenure home so that the faculty will have: <ul style="list-style-type: none"> ◦ undivided commitment, and ◦ autonomy in creating research direction. • Grow the faculty core, in strategic areas of focus, to achieve the critical mass to support: <ul style="list-style-type: none"> ◦ collaborative research, ◦ a strong graduate program, and ◦ the teaching needs of the four degree programs. • Hire jointly with SOM: <ul style="list-style-type: none"> ◦ 4 in CEC and 2 in SOM: three with 100% FTE's in home colleges, and three at 70-30. ◦ There are currently: <ul style="list-style-type: none"> ▪ 13 TTT faculty, 3 instructors, and 2 admin staff in CEC ▪ 7 TTT faculty, and 2 instructors in SOM • Enhance integration into existing UofSC initiatives by leveraging: <ul style="list-style-type: none"> ◦ Artificial Intelligence Institute ◦ Research Center for Transforming Health, and ◦ Cardiovascular Translational Research Center. <p>Hiring areas:</p> <p>0) SmartState Advanced Tissue Biofabrication Endowed Chair</p>

Goals - Real Time

	<p>(Full)</p> <ol style="list-style-type: none"> 1) Cardiovascular Mechanics / Modeling (Full/Associate/Assistant) 2) Cardiotoxicity / Big Data (Full/Associate/Assistant) 3) Biomaterials for Localized Delivery / Regenerative Medicine (Full/Associate/Assistant) 4) Neuromodulation / Device (Full/Associate/Assistant) 5) Protein Science / Diagnostics (Full/Associate/Assistant) 6) Biomanufacturing (Full/Associate)
<p>Achievements</p>	<p>We will focus on achievements made by the Biomedical Engineering Program, which have laid the groundwork for the future success of the Department. The Biomedical Engineering Program at UofSC was formed in 2006 in response to initiatives at the state and university levels requiring expertise in biomedical engineering. Creation of the program brought together a number of faculty throughout UofSC engaged in biomedical research to create an education infrastructure for BS, MS, and PhD degrees; an ME degree was added in 2014. Programmatic efforts have been supported internally as well as externally by a Research Infrastructure Improvement (RII) grant from the National Science Foundation, awarded in 2004, as well as an Institutional Development Award (IDeA) Networks of Biomedical Research Excellence (INBRE) grant from the National Institutes of Health, awarded in 2009. These grants were renewed in 2009 and 2015, respectively, providing additional support.</p> <p>Since 2006, <i>the faculty associated with the program has grown to include contributions of 20 tenure/tenure-track faculty and 5 instructors, who contribute to the program in varying degrees as a result of commitments to their home departments.</i> In parallel, enrollment at the undergraduate level has risen to over 260 students, while enrollment at the graduate level has grown to between 10 and 15 students. Faculty research expertise has developed in areas of <i>biomaterials, biocomputation, biomolecular, and biomechanics.</i></p> <p>The proposed goal to transition to a Department harnesses the existing faculty excellence at the SOM/CEC into more focused and productive research thematic areas that will enhance the clinical, academic and teaching missions, strengthen UofSC SOM, and address relevant health care issues affecting South Carolina citizens. <i>All top-ranked SOM's have affiliated with them a vibrant biomedical engineering department.</i></p> <p>Existing Strengths</p>

Goals - Real Time

	<ol style="list-style-type: none"> 1. Collaborative teaching and research activities between SOM and CEC 2. Complementary thematic research areas of interest in biomaterials (nanoparticles, gels), simulation and bioinformatics, biomarker identification and detection, and cardiovascular development and disease 3. Motivated and relatively junior faculty with a collaborative mindset <p>Areas of Research Competence</p> <ul style="list-style-type: none"> • Cardiovascular engineering - with focus on biomechanics, mechanobiology, and development • Regenerative medicine - with focus on scaffolds and signaling • Protein science - with focus on diagnostics and disease pathogenesis • Computation - with focus on thermodynamic and mechanical theory <p>While these areas certainly overlap and indeed faculty within these areas have successfully obtained joint funding, there is significant growth potential that is facilitated by the hiring plan. The formation of a department would foster increased collaboration among faculty, enhance our competitiveness for obtaining large grants, and facilitate the identification of gaps in expertise that hamper proposal competitiveness and thus guide future hiring initiatives to fill these gaps.</p>
<p>Resources Utilized</p>	<p>There have been no resources directed toward this goal at this time.</p>
<p>Goal Continuation</p>	<p>This proposed goal is (officially) new.</p>
<p>Goal Upcoming Plans</p>	<p>We will initiate the hiring plan outlined in the "Action Plan" and "Notes" sections Faculty lines. Networks to be leveraged in this hiring plan, including those with the Cardiovascular Translational Research Center, the Artificial Intelligence Institute, and the Research Center for Transforming Health, have already been established.</p>
<p>Resources Needed</p>	<ul style="list-style-type: none"> • Faculty lines, as described in the hiring plan • Competitive startup funding • Laboratory space appropriate for biomedical research • Office space in which to consolidate Biomedical Engineering faculty
<p>Goal Notes</p>	<p><u>External Support</u> We attach four outside letters (as Appendix 8) from nationally recognized Biomedical Engineering Department Chairs that supporting our efforts to transform Biomedical Engineering into a department at UofSC.</p>

Goals - Real Time

- Dr. Noshir Langrana from Rutgers
- Dr. Samir Ghadiali from The Ohio State University
- Dr. Kaiming Ye from Binghamton University, who is also Chair-elect of the Council of Chairs of the Biomedical Engineering Society
- Dr. Raphael Lee (NAE), University of Chicago

These letters outline the advantages of creating a Biomedical Engineering Department and the limitations to administration of Biomedical Engineering via a program. Some key points include:

- Biomedical Engineering is widely recognized as a separate engineering discipline, with numerous departments existing to represent this discipline.
- Programs (vs. departments) impede the ability to create autonomous research direction and to recruit top faculty, thus formation of a department is critical to the effective execution of a hiring plan.
- Programs (vs. departments) impede the ability to develop a strong graduate program.
- Formation of a department has been associated with increased enrollments, enhanced ease of accreditation, and elevated levels of collaboration.
- Formation of a department will elevate competitiveness for research funding, particularly NIH funding.
- Formation of a department will allow Biomedical Engineering at UofSC to become a nationally recognized and respected academic unit.

Goals - Looking Ahead

No goals have been entered for this section.

Academic Programs

Program Rankings

Academic programs that were nationally ranked or received external recognition during the Academic Year.

The 2020 graduate rankings for the College are currently embargoed by US News (See Appendix 1 for the engineering programs/departments). The highest-ranked programs in the College are chemical engineering (66th, 38th among publics) and nuclear engineering (21st, 17th among publics). Strategic investments (and partnerships) are envisioned to leverage the College in niche areas, such as nuclear and aerospace.

The level of noise to signal is quite high in that neighborhood of our rankings. However, we are ranked 102nd today. Among public universities, we have risen from 79th to 67th. Our performance numbers would have us placed 20-30 places better. However, we continue to suffer from low peer and recruiter scores, mostly due to our inadequate communications and marketing activities. We have filled the position of senior director for communications and are expanding that office significantly.

Instructional Modalities

Innovations and changes to Instructional Modalities in unit's programmatic and course offerings that were implemented during the Academic Year.

- Lecture-capture facilities are incorporated into three classrooms. We will explore better ways to deliver online courses.
- The fee structure for APOGEE remains a challenge, and makes the offerings essentially non-competitive outside of SC.

Program Launches

Academic Programs that were newly launched during the Academic Year; those that received required approvals but which had not yet enrolled students are not included.

Program Terminations

Academic Programs that were newly terminated or discontinued during the Academic Year.

Master of Science in Information Security
Master of Science in Software Engineering

Academic Initiatives

Experiential Learning for Undergraduates

Initiatives, improvements, challenges, and progress with Experiential Learning at the Undergraduate level.

- Modernizing and upgrading the undergraduate laboratories and curricula (\$500K/year)
- Envisioning a plan for the woodchip area of the Biomass building to convert it to 30,000 square feet of maker and experiential activities space with rapid prototyping, light machining, simulations and computing space, in addition to technicians and space for students and other groups. Preliminary plans are completed.
- Expanding on the existing required capstone-design experience of our students, by developing a college-wide capstone design experience which can address more complex and multi-disciplinary projects sponsored by companies. The teams will be drawn from multiple departments in CEC, or from other colleges as well. Today more than 50 of the projects are sponsored by funds from industry. The goal is to expand to over 90 next year.
- Pathways for Graduation with Leadership Distinction in Research are well-established and include applicable CEC coursework. Identifying applicable coursework that we can offer that meets the expectations of other GLD pathways is a challenge to improvement.
- Undergraduate Research: Many undergraduates participate in research but do not pursue GLD.
- Co-ops and Internships: CEC provides space and collaboration with the university Career Center to house a satellite office in Swearingen. This office focuses on engineering and computing students and the companies that hire them, and facilitates co-op and paid internship placements. An ongoing challenge is expanding the number and types of co-op and internship opportunities.
- McNair Junior Fellows Program: This highly selective program brings about 40-50 undergraduates into McNair Center and engages them in research for 5-10 hours per week. The students get real-world experience in research; many publish papers or give presentations and many also work closely with the sponsors of the research projects. As of the summer of 2019, 33 Fellows are supported by the college for summer research.

Experiential Learning For Graduate Students

Initiatives, improvements, challenges, and progress with Experiential Learning at the Graduate or Professional level.

A graduate degree in engineering or computing, unless it is purely-course-based, by definition has a significant experiential learning component in the form of a thesis, dissertation, or project. As we continue to bring on board research active faculty who establish new research areas and new laboratories, we will continue to expand the options for our graduate students. Furthermore, we provide opportunities for collaborative research with international institutions.

Affordability

Assessment of affordability and efforts to address affordability.

Academic Initiatives

- At the graduate level, with the exception of self-paid masters students (not large in number), the rest of the students receive some level of stipend and tuition support. The packages are competitive so that we can attract them to USC.
- At the undergraduate level, the good students from within or outside of the state have access to full-ride scholarships (some with stipends). In addition to many other university and state level scholarships, the College itself hands out close to \$500,000 in scholarships annually to over 500 students.
- UofSC CEC provides the top-ranked (by NRC) programs in the state, without being the most expensive: For CEC the tuition plus the fees are lower than the tuition alone for Clemson University, which has significant fees of its own.

Reputation Enhancement

Contributions and achievements that enhance the reputation of UofSC Columbia regionally and nationally.

- Hiring world-class faculty, and attracting great students
- Nominating the faculty and students for awards, and winning these
- We had one faculty member elected to the National Academy of Engineering (NAE). Two more are nominated currently, and we are in conversations with 3 more to attract them to USC. We are also in conversation with a member of the NAS to join our college.
- Engaging and partnering with local and regional industry, schools, and the state government
- Engaging and partnering with other universities, and national labs
- Development of national and international collaborations with institutions all over the globe to enhance reputation

Challenges

Challenges and resource needs anticipated for the current and upcoming Academic Years, not noted elsewhere in this report and/or those which merit additional attention.

These were noted, but listed again:

- Startup in engineering is expensive. Also space is short on quantity and quality. More help is needed centrally.
- Short on lab space, and computer classroom space
- Insufficient large classrooms on the west side of the campus

Faculty Population

Faculty Employment by Track and Title

The following data was provided by UofSC's Office of Institutional Research, Assessment, and Analytics.

Table 1. Faculty Employment by Track and Title.

	Fall 2019	Fall 2018	Fall 2017
Tenure-track Faculty	122	117	113
Professor, with tenure	53	50	53
Associate Professor, with tenure	44	44	36
Assistant Professor	25	23	24
Librarian, with tenure	0	0	0
Research Faculty	13	14	11
Research Professor	4	4	3
Research Associate Professor	1	0	0
Research Assistant Professor	8	10	8
Clinical/instructional Faculty	22	18	10
Clinical Professor	0	0	0
Clinical Associate Professor	0	0	0
Clinical Assistant Professor	0	0	0
Instructor	22	18	10
Lecturer	0	0	0
Visiting	0	0	0
Adjunct Faculty	22	24	27

Faculty Population

Faculty Diversity by Gender and Race/Ethnicity

Note: UofSC follows US Department of Education IPEDS/ National Center for Education Statistics guidance for collecting and reporting race and ethnicity. See https://nces.ed.gov/ipeds/Section/collecting_re

Table 2. Faculty Diversity by Gender and Race/Ethnicity.

	Fall 2019	Fall 2018	Fall 2017
Gender	169	150	135
Female	25	22	19
Male	144	128	116
Race/Ethnicity	169	150	135
American Indian/Alaska Native	0	0	0
Asian	48	46	41
Black or African American	3	2	2
Hispanic or Latino	7	5	4
Native Hawaiian or Other Pacific Islander	0	0	0
Nonresident Alien	17	12	7
Two or More Races	0	1	2
Unknown Race/Ethnicity	0	1	0
White	94	83	79

Illustrations 1 and 2 (below) portray this data visually.

Faculty Population

Illustration 1. Faculty Diversity by Gender

2019 Faculty Gender

Male Female



2018 Faculty Gender

Male Female



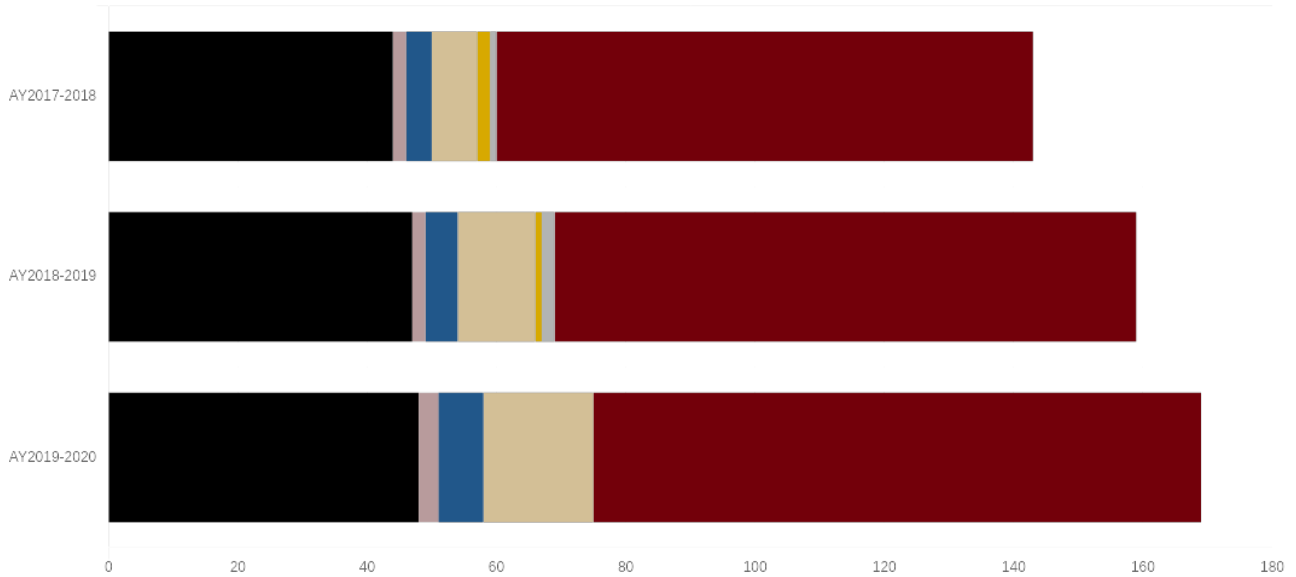
2017 Faculty Gender

Male Female



Illustration 2. Faculty Diversity by Race & Ethnicity

American Indian/Alaskan Native Asian Black Hispanic Native Hawaiian or Other Pacific Islander Nonresident Alien
Two Or More Races Unknown Race White



Faculty Information

Research and Scholarly Activity

Please refer to Appendix 3, which provides detailed information from the Office of the Vice President for Research, department of Information Technology and Data Management, including:

- 1) The total number and amount of externally sponsored research proposal submissions by funding source for the appropriate Fiscal Year.*
- 2) Summary of externally sponsored research awards by funding source for the appropriate Fiscal Year. Total extramural funding processed through Sponsored Awards Management (SAM) in the Fiscal Year, and federal extramural funding processed through SAM in the Fiscal Year. (Available at: <http://sam.research.sc.edu/awards.html>) Amount of sponsored research funding per faculty member for the appropriate fiscal year (by rank, type of funding; e.g., federal, state, etc., and by department if applicable).*
- 3) Number of patents, disclosures, and licensing agreements for three most recent Fiscal Years.*

ACADEMIC ANALYTICS STUDY

Please see Appendix 5

Faculty Development

Efforts at Faculty Development, including investments, activities, incentives, objectives, and outcomes. Optional

The college continued its cross-departmental approach to faculty searches and hires in the prior year, with searches organized across technical focus areas. This year we hired Professor Amit Sheth to be the first Director of the UofSC Artificial Intelligence Institute; he started here in Fall 2020. The Department of Computer Science is currently conducting a search for additional faculty to be affiliated with the AI, as are other departments. Also, we expect to hire one faculty member in connection with the current NSF RII Track-1 project, “Materials Assembly and Design Excellence in South Carolina.” This faculty member will receive \$275k in startup support from the grant. The College continued supporting new faculty development via its Principal Investigator Academy, as described in prior Blueprint reports.

CEC has continued efforts to form inter-college and inter-university teams to pursue large interdisciplinary research projects. Professor Paul Ziehl now serves as Associate Dean for Research, with a specific charge to work on development of large proposal teams. Several preproposals have been submitted for DoD MURIs, NSF MRIs, NSF ERCs, as well as direct conversations with and campus visits by DoD program managers, most notably those associated with the Office of Naval Research. We have had several successes to date. Professor Elizabeth Regan, chair of IIT, is leading an NSF ERC full proposal on the topic of Health Care Transformation. The College organized a workshop for the Office of Naval Research that led to the establishment of a Naval-X Technology Bridge based at the Naval Information Warfare Center in Charleston. Professor Srihari Nelakuditti in the Department of Computer Science has submitted an NSF proposal for a Major Research Instrumentation grant to build a laboratory facility to allow investigators to ascertain “ground truth” measurements. Professor Michel van Tooren has submitted a NASA ULI grant, and CEC faculty are

Faculty Information

collaborating with a team led by Georgia Tech on a second NASA ULI proposal. Professor Amit Sheth has received an NSF Planning Grant to enable pursuit of a significant Center proposal. Professor Chaudhry has submitted an NSF RII Track 2 proposal that is related to Professor Sheth's planning grant. The college has hosted multiple meetings with various organizations from the U.S. Army and is currently in confidential discussions about major initiatives to be based at UofSC.

Supplemental Academic Analytics Report

Content from Academic Analytics appears as Appendix 5. (bottom)

Teaching

Faculty to Student Ratio

The following data was provided by UofSC's Office of Institutional Research, Assessment, and Analytics.

The formula used to compute the ratio uses data from Faculty Population by Track and Title and Student Enrollment by Time Basis, as follows:

$$\frac{\text{(Total Full-time Students + 1/3 Part-time Students)}}{\text{((Total Tenure-track Faculty + Total Research Faculty + Total Clinical/Instructional Faculty) + (1/3 Adjunct Faculty))}}$$

Table 4. Faculty-to-Student Ratio.

	Fall 2019	Fall 2018	Fall 2017
Analysis of Ratio	01:21.6	01:21.8	1:16.3

Analysis of Ratio

Analysis of the ratio, agreement with the data, and plans for the future to impact this ratio.

The goal at the start of my deanship was to reverse the alarming trend in our student/faculty ratio. Using the nationally normed metric of undergrad students to TTT faculty our numbers from 2015, 2016, 2017, 2018, 2019 are: 24.5, 26.8, 27.0, 26.0, and 26.2. In other words, our student enrollment keeps increasing faster than our net faculty growth. The college needs more resources to hire faculty.

Student Recruiting and Retention

Student Recruitment

Efforts, including specific actions, to recruit students into College/School programs.

Undergraduate Recruitment:

- High school classrooms, Career Fairs, FIRST Robotics Competitions. Director of Outreach and Recruitment presents to students at K-12 schools and regional robotics competitions. Participate in college and career fairs at K-12 schools
- Website, Flyers, and Brochures
- College “Daily Tours” provided throughout the year: Daily tours are led by CEC student ambassadors that are trained and supervised by the Director of Outreach and Recruitment.
- Three “Big Fridays” each semester: Big Fridays include presentations by the Dean and the Director of Outreach and Recruitment, a student panel Q&A, and tours of the departments led by faculty.
- College-Specific Admitted Student Yield Efforts:
 - Postcards to all admitted students sent by CEC students.
 - Signed postcards to all female admitted students sent by members of Women in Computing and the Society of Women Engineers student organizations.
 - Email sent to all admitted students by Director of Enrollment Management
 - Letters to families of admitted students sent by Associate Dean.
 - Dean’s Letter to admitted students, crafted by the college’s Associate Dean for Academic Affairs and Director of Enrollment Management.
 - Dean, Associate Deans, Department Chairs, and Faculty participate in Admissions Office events, including Fall Open House, Admitted Student Days, Scholar Socials, Meet the Honors College Social, Carolina Top Scholars Weekend and Out of State Top Scholars Weekend.
- Collaborates with the UofSC Admissions office to send brochure to all admitted students that includes the Dean’s Letter to admitted students.
- CEC provides hundreds of students with scholarships: Most target new freshmen.
- UofSC Science and Engineering Fair: College faculty provides leadership and judges for the Engineering Division and the Computer Science Division.
- Articulation Agreements: Transfer student recruitment is facilitated through active articulation agreements with UofSC System campuses, SC Technical Colleges, and several 4-year regional institutions. Two more in the works with SC State University and Claflin University.

Graduate Recruitment:

Senior Associate Dean Mike Matthews is co-PI and co-Director of a new NSF Bridge to the Doctorate award from the Louis Stokes Alliance for Minority Participation. This award, for \$1.075M, will support a cohort of twelve new STEM doctoral students who are from URM groups. The first cohort is now being recruited, for Fall 2020 matriculation. CEC supports recruitment with staff who prepare recruitment materials and who support outreach. CEC hosted a GEM GRAD lab in October 2019, with about 50 URM students in attendance who visited UofSC’s STEM graduate programs. Faculty and staff from across the college attended 10 regional or national meetings to recruit graduate students. These meetings included an

Student Recruiting and Retention

annual graduate student fair at Oak Ridge National Laboratory, the National Society of Hispanic Engineers, and the National Society of Black Engineers. CEC welcomed one new GEM Fellow and two Affiliate Fellows in Fall 2019. Also, we have direct internal funds to be used as top-off stipend funding for highly-qualified U.S. citizens and permanent residents who are seeing PhDs in CEC. We call this the CEC Teaching Fellows program, and we recruited our first cohort of 12 Teaching Fellows for Fall 2019.

Student Retention

Efforts at retaining current students in College/School programs.

Undergraduate Retention:

- Carolina Pre-Calculus Review: Math-readiness of students has been identified as a challenge to retention for CEC's engineering and computer science degree programs. CEC collaborates with the Student Success Center to provide 6-day on-line pre-calculus intensive review courses during the summer before the freshman year. Content includes math concepts critical for success in the math, science and engineering courses required of CEC students.
- New Student Orientation: The presentation by Associate Dean for Academic Affairs to all incoming students and families is data-driven and focuses on academic success strategies and student engagement recommendations.
- Hand-Off Advising Model: CEC uses professional staff advisors for the first two years for freshmen and at least one semester for transfer students to help new students transition successfully. Faculty Advisors advise continuing students to help students connect with their fields of study and career opportunities.
- Tutoring: In collaboration with the Student Success Center, the college provides tutoring centers in Swearingen and in the Engineering and Computing Community. CEC currently has the only academic building with a satellite of the Student Success Center.
- Engineering and Computing Community: In collaboration with Housing, a CEC Faculty Advisor and the Assistant Dean for Student Services provide linked courses and beyond-the-classroom activities for this themed living-learning community.
- Student Organizations: College provides meeting rooms, storage, advisors, administrative, and other support to over 35 CEC-oriented student organizations.
- Big Wednesday: The day before classes start, new students interact with representatives of over 30 CEC-orientated student organizations, with the intended outcome of improved student engagement.
- Events for Current Students: On-going student professional development and engagement events that are coordinated at the college-level include e-week events, a Women in Engineering and Computing Panel, Dean's Leadership Conversation, and CEC Organizational Leaders Workshop.

Student Enrollment & Outcomes

The following data was provided by UofSC's Office of Institutional Research, Assessment, and Analytics.

Note: Student enrollment and outcomes data are calculated by headcount on the basis of primary program of student only.

Student Enrollment by Level & Classification

Table 5. Student Enrollment by Level & Classification.

	Fall 2019	Fall 2018	Fall 2017
Undergraduate Enrollment			
Freshman	737	727	691
Sophomore	696	666	665
Junior	652	665	669
Senior	1107	1175	1185
Sub Total	3192	3234	3210
Graduate Enrollment			
Masters	224	234	276
Doctoral	339	331	307
Graduate Certificate	0	1	2
Sub Total	563	566	585
Professional Enrollment			
Medicine	0	0	0
Law	0	0	0
PharmD	0	0	0
Sub Total	0	0	0
Total Enrollment (All Levels)	3755	3800	3795

Student Enrollment & Outcomes

Illustration 3. Undergraduate Student Enrollment by Classification

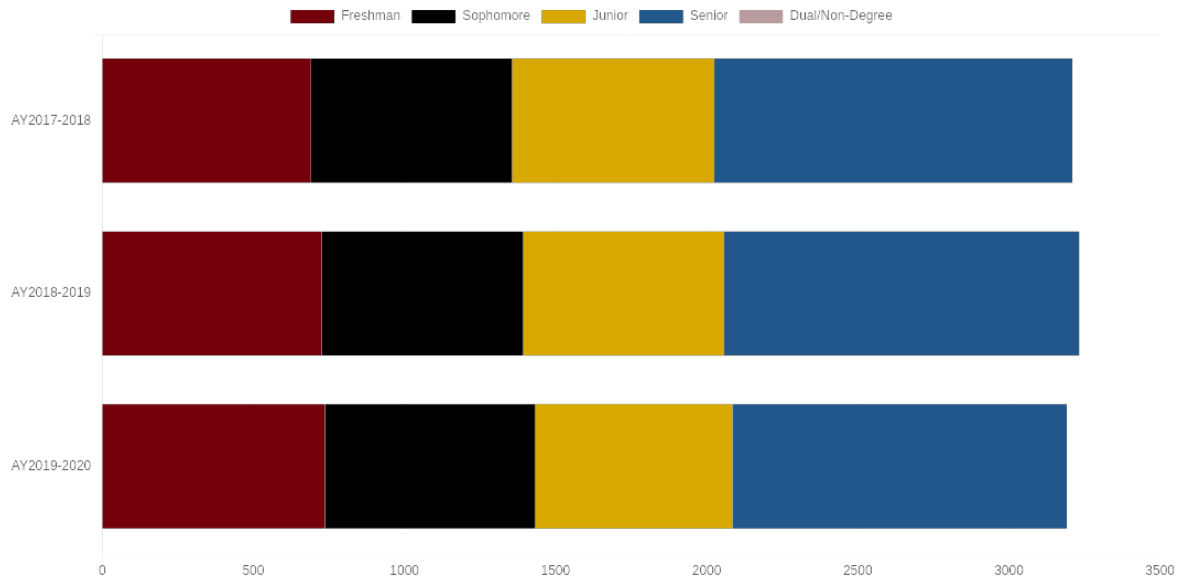
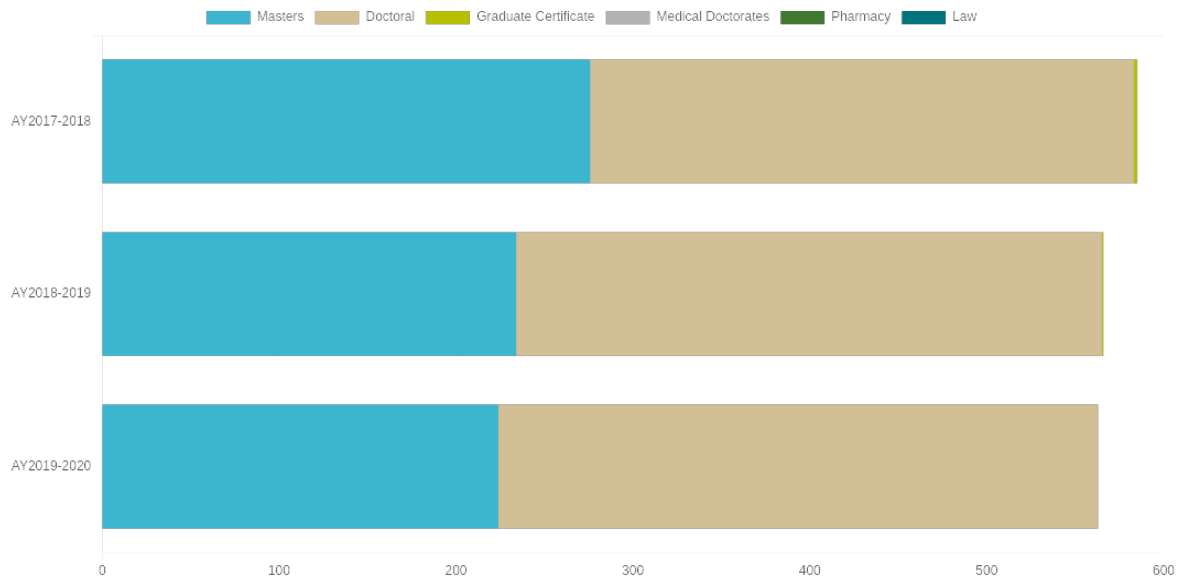
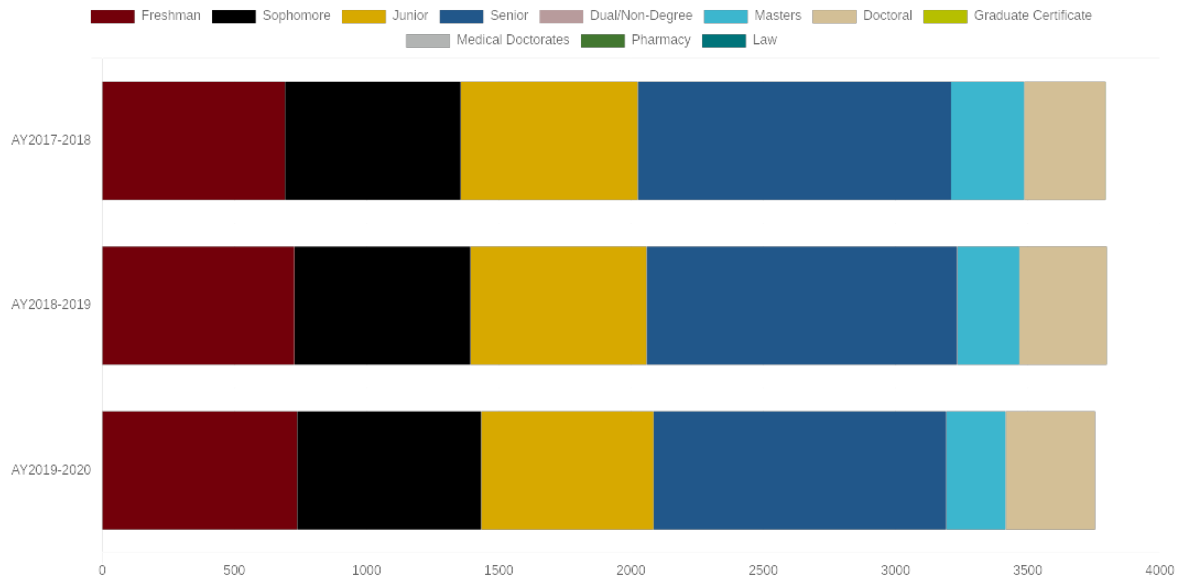


Illustration 4. Graduate/Professional Student Enrollment by Classification



Student Enrollment & Outcomes

Illustration 5. Total Student Enrollment by Classification (All Levels)



Enrollment by Time Status

Table 6. Student Enrollment by Level and Time Status.

	Fall 2019	Fall 2018	Fall 2017
Undergraduate	3192	3234	3210
Full-Time	3056	3091	2985
Part-Time	136	143	225
Graduate/Professional	563	566	585
Full-Time	433	410	420
Part-Time	130	156	165
Total - All Levels	3755	3800	3795
Full-Time	3489	3501	3405
Part-Time	130	156	165

Student Enrollment & Outcomes

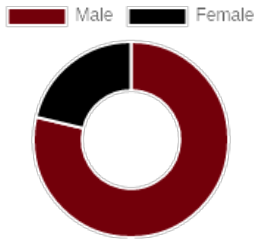
Student Diversity by Gender

Table 7. Student Enrollment by Gender.

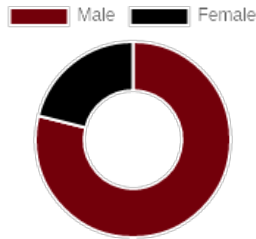
	Fall 2019	Fall 2018	Fall 2017
Undergraduate	3192	3234	3210
Female	680	682	634
Male	2512	2552	2576
Graduate/Professional	563	566	585
Female	146	125	132
Male	417	441	453

Illustration 6. Undergraduate Student Diversity by Gender

2019 Undergrad Gender



2018 Undergrad Gender



2017 Undergrad Gender

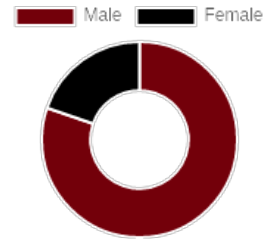
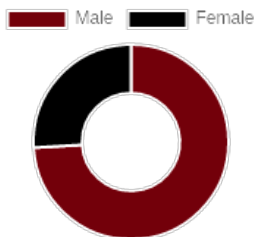
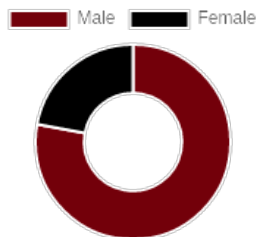


Illustration 7. Graduate/Professional Student Diversity by Gender

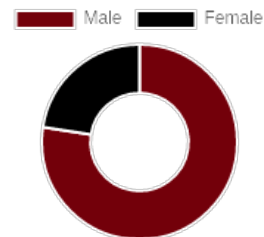
2019 Graduate Gender



2018 Graduate Gender



2017 Graduate Gender



Student Enrollment & Outcomes

Student Diversity by Race/Ethnicity

Table 8. Student Enrollment by Race/Ethnicity.

	Fall 2019	Fall 2018	Fall 2017
Undergraduate	3192	563	3234
American Indian/Alaska Native	9	7	6
Asian	172	153	147
Black or African	278	305	317
Hispanic or Latino	186	168	159
Native Hawaiian or Other Pacific Islander	3	4	2
Nonresident Alien	132	153	155
Two or More Races	135	128	116
Unknown Race/Ethnicity	26	30	35
White	2251	2286	2273
Graduate/Professional		566	585
American Indian/Alaska Native	1	2	0
Asian	16	14	14
Black or African	31	39	33
Hispanic or Latino	16	17	13
Native Hawaiian or Other Pacific Islander	0	0	2
Nonresident Alien	310	293	306
Two or More Races	14	15	17
Unknown Race/Ethnicity	8	6	5
White	167	180	195

Student Enrollment & Outcomes

Illustration 8. Undergraduate Student Diversity by Race/Ethnicity

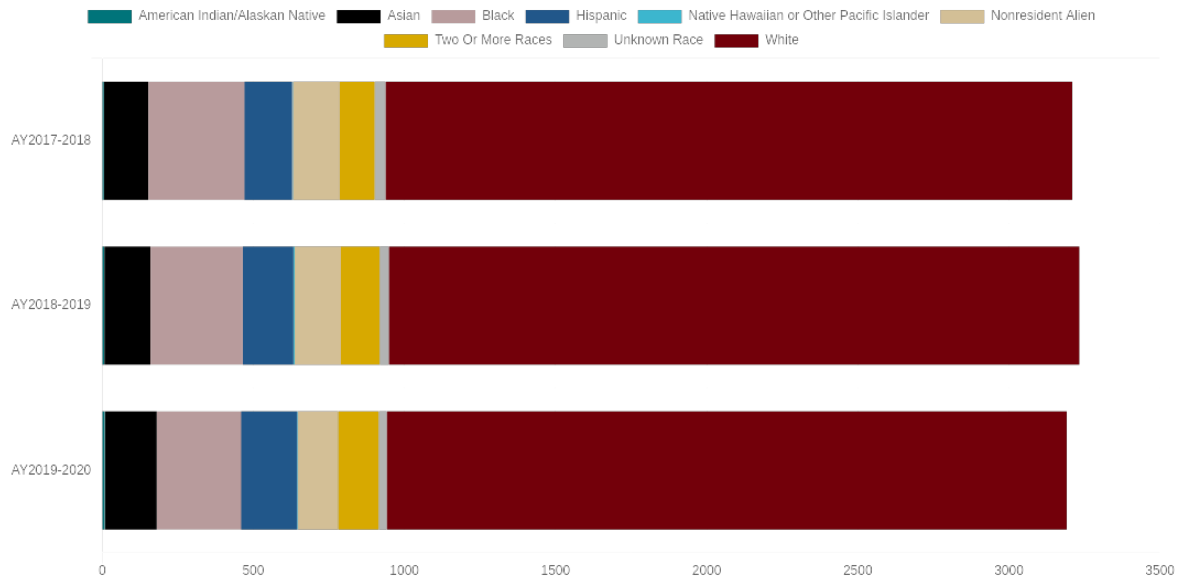
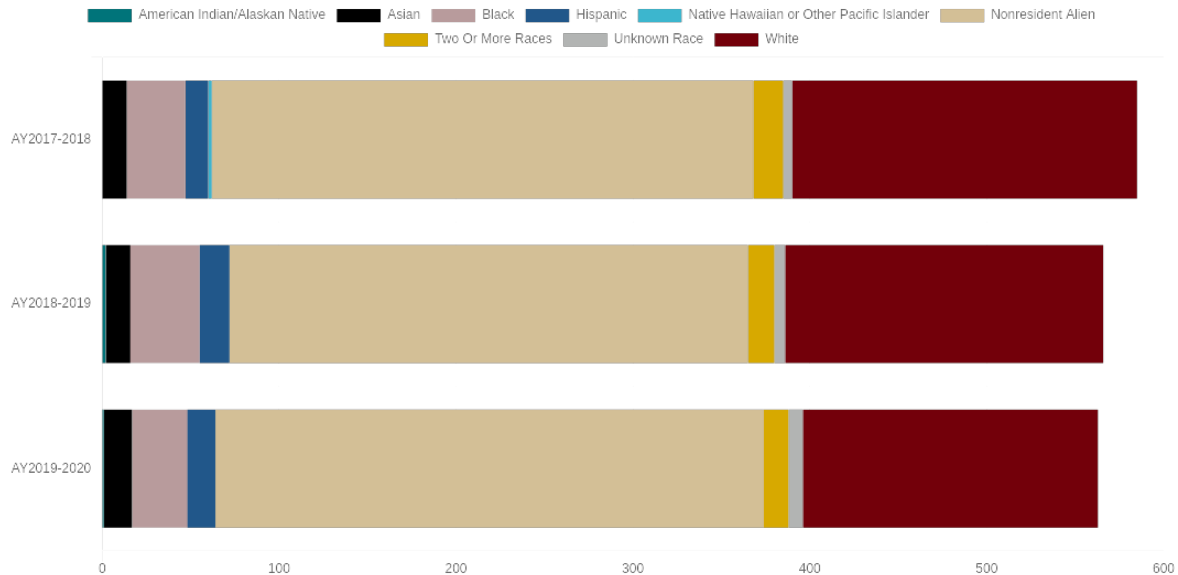


Illustration 9. Graduate/Professional Student Diversity by Race/Ethnicity



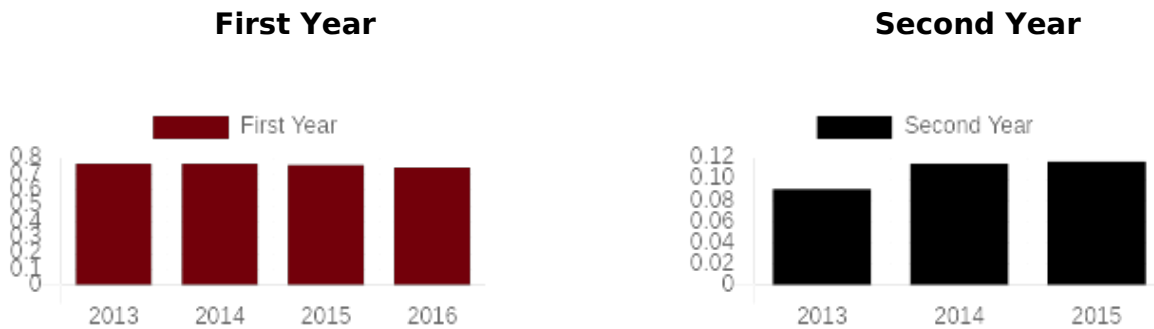
Student Enrollment & Outcomes

Undergraduate Retention

Table 9. Undergraduate Retention Rates for First-time Full-time Student Cohorts

	First Year	Second Year
Fall 2017 Cohort	71.2%	14.2%
Fall 2016 Cohort	74%	11.7%
Fall 2015 Cohort	75.9%	11.5%
Fall 2015 Cohort	76.6%	9.1%

Illustration 10. Undergraduate Retention, First and Second Year



Student Completions Graduation Rate - Undergraduate

Table 10. Undergraduate Graduation Rates for First-time Full-time Student Cohorts at 4-, 5-, and 6 Years.

	Fall 2011	Fall 2010	Fall 2009
4-Year Same	27.9%	25.2%	27.6%
4-Year Diff	9.1%	11.7%	13.4%
4-Year Total	9.1%	11.7%	13.4%
5-Year Same	41.3%	42.5%	41%
5-Year Diff	18.3%	20.3%	22.2%
5-Year Total	59.6%	62.8%	63.2%
6-Year Same	44%	44.6%	45.1%

Student Enrollment & Outcomes

6-Year Diff	20%	21.7%	24.5%
6-Year Total	64%	66.3%	69.6%

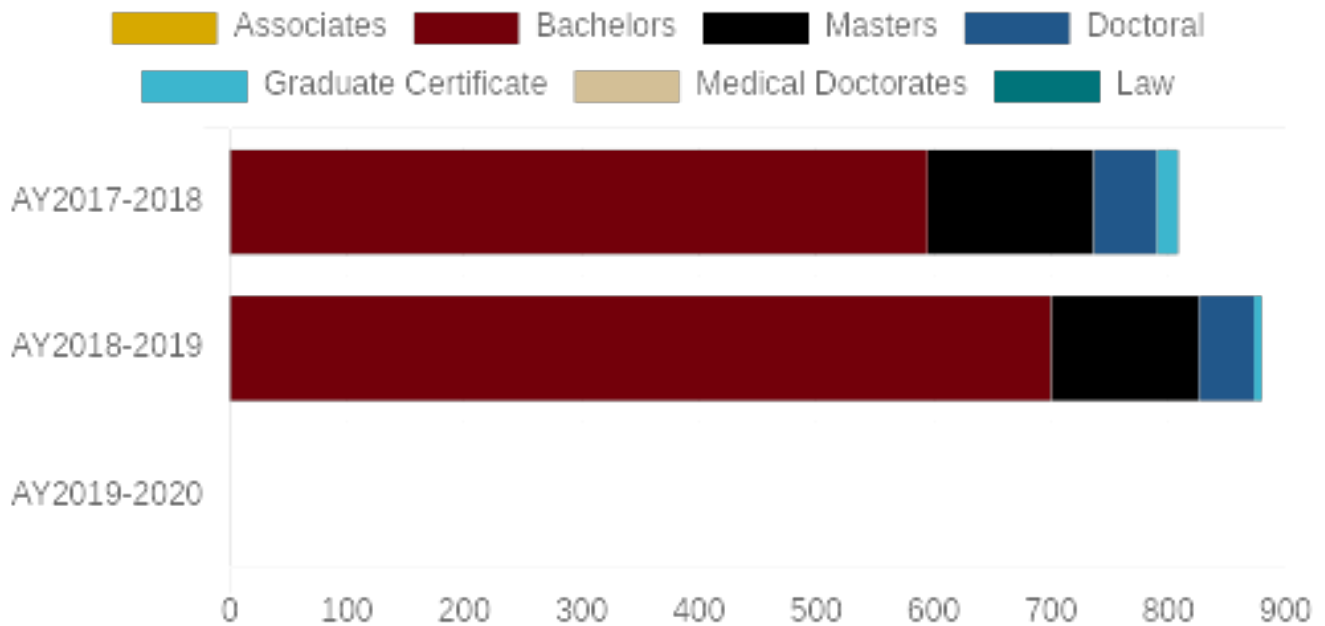
Student Enrollment & Outcomes

Degrees Awarded by Level

Table 11. Degrees Awarded by Level.

	AY2019-2020	AY2018-2019	AY2017-2018
Associates Degree		0	0
Bachelors		700	595
Masters		126	141
Doctoral		47	54
Medical		0	0
Law		0	0
Pharmacy Doctorate		0	0
Graduate Certificate		7	19

Illustration 11. Degrees Awarded by Level



Faculty Awards Nominations

No Awards Nominations have been entered for this section.

Faculty Awards Received

Faculty of CEC were recognized for their professional accomplishments in the categories of Research, Service, and Teaching.

Research Awards

Recipient(s)	Award	Organization
Knight, Travis	2020 Breakthrough Leadership in Research	USC VPR Office
Yu, Lingyu	2020 Breakthrough Star	USC VPR Office
Sutton, Micheal	Elected Member of National Academy of Engineering	National Academy of Engineering
Hu, Jianjun	CSE Junior Researcher Award	Computer Science and Engineering Department
O'Kane, Jason	CSE Senior Researcher Award	Computer Science and Engineering Department
Hikmet, Neset	The Stafford Beer Medal	The Operational Research Society
Heyden, Andreas	CEC Research Achievement Award	College
Hu, Jianjun	CEC Research Progress Award	College
Rekleitis, Ioannis	CEC Young Investigator Award	College

Faculty Awards Received

Service Awards

Recipient(s)	Award	Organization
Valtorta, Marco	Biedenbach Service Award	CEC
Lyons, Jed	Outstanding Faculty Service	UofSC Educational Foundation
Moss, Melissa	Samuel Litman Distinguished Professor Award	CEC
Huang, Chin-Tser	CSE Service Award	Computer and Engineering Department
Uline, Mark	Ada B. Thomas Outstanding Faculty Advisor Award	Office of the Provost

Faculty Awards Received

Teaching Awards

Recipient(s)	Award	Organization
Valafar, Homayoun	CSE Graduate Teaching Award	Computer Science and Engineering Department
Shepherd, JJ	CSE Undergraduate Teaching Award	Computer Science and Engineering Department
Gatzke, Ed	Garnet Apple Award for Teaching Innovation	UofSC

Faculty Awards Received

Other Awards

Recipient(s)	Award	Organization
Wang, Song	CSE MVP Award	Computer Science and Engineering Department
Rekleitis, Ioannis	IROS ICROS Best Application Paper Award finalist, 2019	International Conference on Intelligent Robots and Systems
Sheth, Amit	Distinguished Alumni Award for Academic Excellence	Ohio State University: Franklin College of Engineering

Alumni Engagement & Fundraising

Alumni

Substantial activities, engagements, and initiatives with alumni, focusing on relationships and activities with alumni.

In FY19, CEC made significant staffing increases filling several vacancies. An Assistant Director of Alumni Engagement was hired with a strong communications and social media background. A graduate from the journalist school with Honors. An Assistant Director of Development was hired during the summer of 2019 who was formerly from Student Affairs with a strong annual fund and event planning background. The Development Coordinator's position was realigned with more data strategies and annual fund telefund calling.

In FY19, despite these changes the CEC maintained a calendar of old and new events. This included the following:

- Various campus tours, meetings and strategy sessions with potential corporate partners in consultation with the Office of Economic Engagement and the Development Corporate and Foundations Office.
- Significant increase in Dean/Donor engagement at the Principal Gift level and significant major gift qualification, cultivation and solicitation. Dean's engagement included several who have the capacity to name the school and or departments (Alex Molinaroli, Bill Best Jr., Dan Sanders)
- Annual Homecoming Celebration with increase participation and significant revenue savings
- Annual Scholar Donor event with increase participation of both donors and scholars
- Creation of Dean's Circle and new Annual Fund Brochure
- Giving Opportunity Funding Sheet for donors for each department and program including student clubs
- Young Alumni Board Meeting with Young Alumni Social Events
- Two Young Alumni Local Events
- Cockaboose to promote Young Alumni Board
- Basketball suite for Young Alumni and Dominion Corporation
- E-Week Activities
- Alumni Spotlights on web/social media, several lunch and learns with prominent alumni and students.

Development, Fundraising and Gifts

Substantial development initiatives and outcomes, including Fundraising and Gifts.

In January 2019, CEC hired Jennifer Shepard, Senior Director of Development. Jennifer came to CEC from the UofSC Honors College and prior to that was at Rensselaer Polytechnic Institute, University of Pennsylvania and Carnegie Mellon. Jennifer has focused a significant amount of time on organizing the school and department's priorities while focusing on alumni who have significant giving capacity.

Alumni Engagement & Fundraising

Year-to-date the College has secured \$1,701,759 in total giving from 774 donors. With several major/principal gifts pending we are at or close to exceeding FY20 goal.

The College of Engineering and Computing will continue to focus on high-level Dean's engagement at the Principal Gift level with visits as needed with donors rated \$100,000 or more. The focus this year will be uncovering a new major gift and annual fund (unrestricted) pipeline for the Unit. Increasing alumni communication to garner more support and look at key areas that need corporate funding such as First Generation Bridge Program, Artificial Intelligence Center, Cybersecurity, financial aid for undergraduate students and graduate fellowships. Plans to grow a new pool of Dean's Circle members to increase the unrestricted revenue to the College.

Community Engagement

Community Engagements and Community - Based Activities

Community engagement and community based research, scholarship, outreach, service or volunteerism conducted, including activities at the local, state, regional national and international levels.

Personnel

- Senior Associate Dean for Academic Affairs
- Assistant Dean for Student Services
- Director of Precollege Education
- Director of Enrollment Management
- Inclusive Programs Coordinator
- Graduate Recruitment Coordinator

Outreach

- Develop and maintain partnerships with various companies: MEBA, K-12 Schools, Southern Regional Education Board and Department of Education
- Deliver Cost effective teacher professional development workshops that increase awareness of and interest in engineering and computing careers among K-12 teachers.
- Enhance engineering and computer science related education through events.
 - E-Week Open House during National Engineers Week that celebrates professionals in all fields of engineering and computing. CEC host an Open House geared toward k-12 students. This free event features dozens of interactive exhibits that highlight our academic programs and research.
 - Engineering Competitions are held during UofSC's spring break each year. Competitions varies from K-12 and with robotics and engineering competitions.
 - Visiting K-12 Classrooms, Career Fairs, and Robotics Competitions throughout the state and region.
 - Daughter Date Night invites middle school age girls to collaborate, design and test a hands-on engineering activity and dinner with current CEC students and alumni. This event takes place during the National Engineers week "Introduce a Girl to Engineering" day.
- Increase engineering and computing academic content in K-12 with engaging, rigorous and relevant hands-on content.
 - Lead Academy is provided by our college for high school students to be engaged in hands-on project-based learning all day. This one-day experience is designed to work in conjunction with the SC educational standards to provide students with experiences in a particular area of engineering and computing.
 - Duke Tip is open to current 5-6 grade students. UofSC is a partnership with Duke Tip as the only university in the state of South Carolina authorized to offer Academic Adventures to students who have participated in the Duke TIP search.
 - Open to rising 6-12 grade students, Carolina Master Scholars Summer Camps are

Community Engagement

- engaging, challenging and fun in these innovative week-long educational courses. Our summer camps included gaming, engineering, aerospace, VEX robotics, and 3D Printers.
- Middle School day is a free event held during UofSC's fall break each year. It is open to any middle school class that want to be engaged and learn experiences from our faculty and students that cover various fields of engineering and computing.

Community Perceptions

How unit assesses community perceptions of engagement, as well as impact of community engagement on students, faculty, community and the institution.

The Engineering and Computing Open House is a great community event that draws close to 1000 visitors to our College campus in February.

Incentivizing Faculty Engagement

Policies and practices for incentivizing and recognizing community engagement in teaching and learning, research, and creative activity.

There are many different ways that the faculty of CEC can engage with the community. As such we do not have a uniform policy to address all possible means of interaction and engagement. For engagements that are substantial and impactful, we will count it as a substantial element for the service that each faculty member needs to do. For more significant levels of engagement, we can consider other incentives. We will address on a case by case basis.

Collaborations

Internal Collaborations

Our most significant academic collaborations and multidisciplinary efforts characterized as internal to the University.

- Administration and Finance
- Arnold School of Public Health (Environmental Health Sciences; Exercise Science; Health Promotions, Education and Behavior; Health Service Policy and Management; Epidemiology and Biostatistics)
- College of Arts and Sciences (Biological Sciences; Chemistry and Biochemistry; Mathematics; Physics & Astronomy; Geography; Archeology & Anthropology; Earth and Ocean Sciences; Statistics)
- College of Education (Educational Studies; Instruction and Teacher Education)
- College of Hospitality, Retail and Sports Management (Retailing)
- College of Information and Communication (Journalism and Mass Communication)
- College of Nursing
- College of Pharmacy (Drug Discovery & Biomedical Sciences; Clinical Pharmacy and Outcomes Sciences)
- College of Social Work
- Darla Moore School of Business (Management)
- Office of Economic Engagement
- Information Technology (High Performance Computing)
- School of Earth, Ocean and Environment
- School of Medicine (Cell Biology & Anatomy; Pathology, Microbiology & Immunology; Neuropsychiatry)
- President
- University Libraries
- USC Aiken

External Collaborations

Our most significant academic collaborations and multidisciplinary efforts characterized as external to the University.

- AccuStrata, Inc
- Advanced Research Projects Agency-Energy
- American Cancer Society
- American Institute of Chemical Engineers
- Ames Laboratory
- Apache Corporation
- Arizona State University
- Association of Environmental Engineering and Science Professors (AEESP) Foundation
- BASF Corporation
- Battelle Energy Alliance, LLC
- Boeing
- Bristol-Myers Squibb Foundation, Inc.
- Carnegie Mellon University

Collaborations

- C&B Tech
- CDF Research Corporation
- Clemson University
- Coastal Carolina University
- College of Charleston
- Compact Membrane Systems, Inc
- Concurrent Technology Corporation
- Duracell
- Electric Power Research Institute
- Emera Technologies, LLC
- Environmental Research and Education Foundation
- Florida State University
- General Atomics
- General Motors
- Georgia Institute of Technology
- Golder Associates Ltd.
- Greenville Health System
- Gulfstream
- Hitron Technologies
- Idaho National Laboratory
- Jacobs Engineering
- Korea Army Academy
- Lockheed Martin Corporation
- Los Alamos National Security, LLC
- Medical University of South Carolina
- Michigan State University
- Morgan State University
- National Energy Technology Laboratory
- Navy Surface Warfare Center
- Nuclear Regulatory Commission
- Oak Ridge National Laboratory
- Ohio State University
- Pacific Northwest National Laboratory
- Pennsylvania State University
- Physical Sciences Incorporated
- Radiation Monitoring Devices, Inc
- Reaction Engineering International
- Samsung Electronics America, Inc.
- Savannah River National Laboratory
- Savannah River Nuclear Solutions
- SC Research Authority
- SC Space Grant Consortium
- SC Spinal Cord Injury Research Fund
- Siemens Energy, Inc.
- Skyre Inc.
- Solvay S.A.
- Spirit AeroSystems
- Texas Research Institute-Austin
- TIGHITCO

Collaborations

- Toray
- Transportation Technology Center, Inc
- Universal Technology Corporation (UTC)/ Air Force Research Laboratory (AFRL)
- University of Central Florida
- University of Kansas
- University of Puerto Rico
- UOP LLC
- Vanderbilt University
- W.L. Gore & Associates
- Westinghouse Electric Company LLC

Other Collaborations

Our most significant academic collaborations and multidisciplinary efforts that are not otherwise accounted for as Internal or External Collaborations.

Supplemental Info - Collaborations

Any additional information about Collaborations appears as Appendix 8 (bottom).

Equity and Diversity Plan

Improve Under-Represented Minority (URM) Student Enrollment

Undergraduate outreach and recruitment activities aim to 1) increase participation of URM and female K-12 students in college-level outreach and recruitment initiatives, 2) increase applications to CEC programs from URM and female population, and 3) convert “admitted URM and female” students to “enrolled URM and female” students. Related activities include:

- Develop and maintain partnerships with K-12 educational organizations, such as K-12 schools, Department of Education, Midlands Education and Business Alliance (MEBA).
- Facilitate on-campus educational programs for K-12 students, such as Lead Academy, Duke TIPs, Carolina Master Scholars camps, and Partners for Minorities in Engineering and Computer Science.
- Promote engineering and computing through community outreach events, such as eWeek Open House, career fairs, and engineering competitions, and volunteer work with organizations such as Boys and Girls Club.
- Engage Students, Faculty, and Staff in recruitment efforts, such as daily college tours, and other regional recruitment events.
- Identify targeted high schools with high percentage of minority students and high average SAT scores for recruitment.
- Offer scholarships and incentives for admitted students. CEC recently received nearly \$1 million in funding through a grant from the National Science Foundation Scholarships in Science, Technology, Engineering and Mathematics Program (S-STEM) to support academically-talented engineering and computing students based on financial need.
- Promote Engineering and Computing to transfer students, including regional technical colleges and historically black colleges and universities (HBCUs).
- Adopt diversity-aware faculty search practices to increase hiring of minority and female faculty; thus appeal to URM and female students.

Graduate outreach and recruitment efforts aim to attract URM and female graduate students to apply to CEC.

- Promote Graduate Education for Minorities (GEM) opportunities for CEC undergraduate and graduate students. Actively participate in GEM events. In 2019, CEC hosted GEM Lab.
- Visit and conduct recruitment events in regional HBCUs and minority serving universities.
- Hold recruiting events at diversity conferences, such as National Society for Black Engineers (NSBE), Grace Hopper Celebration (GHC) conference, Society of Hispanic Professional Engineers (SHPE) National Convention, Society of Women Engineers (SWE) conference, and Richard Tapia Celebration of Diversity in Computing conference.
- Facilitate access to research scholarships and awards. UofSC has recently received \$1 million grant from the National Science Foundation (NSF) to establish a Bridge to Doctorate (G2D) fellowship program. The program is funded through the NSF Louis Stokes Alliance for Minority Participation (NSF-LSAMP). The B2D fellowship program, will be administered through UofSC’s College of Engineering and Computing (CEC) and the College of Arts and Sciences (CAS).
- Adopt diversity-aware faculty search practices to increase hiring of minority and female

Equity and Diversity Plan

faculty; thus appeal to URM and female students.

Improve The Number Of Full-Time URM Faculty Across Academic Units

The College of Engineering and Computing aims to increase diversity of faculty candidate pools; thus increase the potential of recruiting URM and female faculty. Related activities include: Recruitment

- College-level oversight of faculty position posting for diversity-conscious job description and placement.
- Adopt and require university-level diversity training for search committees and the designation of a diversity advocate for each search committee.
- Establish metrics in the hiring process for diversity contribution and standard questions for each candidate.
- Make active recruitment a requirement for each CEC department and require diversity statement from faculty candidates.
- Develop diversity-aware information booklet for CEC/UofSC and provide this information to each faculty candidate.
- Facilitate meeting between Associate Dean for Diversity, Engagement, and Inclusion and faculty candidates with questions regarding diversity climate of CEC.

Retention

- Establish multi-level faculty mentoring for academic success.
- Establish measurement for diversity contribution within the tenure and promotion process.
- Identify and support unique research support needs of URM and women faculty.
- Reduce service load for URM and women faculty at all rank.
- Provide mentoring and promotion guidance/training for post-tenure URM and women faculty.

Enhance Outcomes For URM Undergraduate and Graduate/Professional Students

Undergraduate retention is built on three pillars: 1) Academically: provide education resources to the students to make the path to graduation as smooth as possible, 2) Socially: help students feel connected to UofSC and CEC, and 3) Professionally: offer development opportunities to the students via the Career Center.

- Improve academic advising by focusing on individual student's needs and establishing a positive relationship with the academic advisors.
- Ensuring faculty and staff knowledge of course curricula and special needs, such as transfer credits and inclusive classroom resources.
- Focus staff advising on transitional issues and faculty advising on career planning and

Equity and Diversity Plan

professional development.

- Promote student success center, supplemental instructions and tutorial for students. Identify academically at-risk students to develop appropriate intervention.
- Develop peer-mentoring for undergraduate students to help with both academic and social progress. Monitor success of students through academic applications.
- Develop onboarding programs for new freshman, such as summer bridge program to prepare students for the academic work at the college.
- Build support structures, such as Engineering and Computing Living and Learning Community. Develop programs and events to connect students with faculty and each other.
- Provide resources for URM and women student chapters, such as NSBE, SPHE, SWE, Women in Computing (WiC), Minorities in Computing (MIC), and Alpha Omega Epsilon (AOE).

Graduate retention addresses progress towards M.S. and Ph.D. graduations.

- Department-level academic oversight of progress towards graduation.
- Financial support in forms of fellowship and scholarships, graduate teaching and research assistantship.
- Unit and university-level support for scholarship applications, such as NSF graduate scholarship and GEM support.
- Provide support to participate in diversity conferences, such as NSBE, GHC, Richard Tapia, etc.
- Organize social events to facilitate meeting with faculty and other graduate students.

Improve Post-Graduate Outcomes For URM Undergraduate and Graduate/Professional Students

The Career Center of CEC provides support for students, faculty, alumni, and potential employers. Special workshops on these services are provided at URM student chapter meetings. The following services are available for CEC students from the Career Center:

- support career planning: career coaching, assessment tools, online career management platform (Handshake).
- Facilitate internship, co-op, and job shadowing opportunities.
- Provide resume writing and interview preparation workshop.
- Support job searching activities, including interviewing skills, salary negotiation, and preparation of “elevator pitch.”
- Provide information about graduate education and scholarship information.
- Support preparation for Career Fair and successful job negotiation.

Increase the engagement of students, faculty, staff, administrators in Equity and Inclusion

CEC aims to increase engagement of students, faculty, staff, administrators in equity and inclusion activities. The current activities focus on overcoming the following challenges: 1) limited engagement between faculty and URM/female students, 2) limited diversity and cultural awareness of faculty and instructors, 3)

Equity and Diversity Plan

lack of motivation/know how of tenure-track and tenured faculty to support gender and ethnic diversity initiatives. The current and planned activities include:

- Require diversity commitment by each department and make it part of the annual evaluation for the departments.
- Generate diversity support materials for research funding, including broader impact write up and broadening participation. Distribute these resources for all CEC researchers and administrators.
- Connect student chapters and faculty by organizing joint events, such as CEC women power lunch, leadership forum, and invited speakers series.
- Engage alumni of CEC to serve as mentors for organizations and individual students.
- Increase faculty awareness about the benefit of diverse work environment. Promote diversity seminars organized by the UofSC Center for Teaching Excellence.
- Host workshops/presentations/meetings with minority universities and colleges.
- Improve visibility of diversity activities and their impact on improved educational and research productivity.

Improve The Sense Of Inclusion Amongst All University Community Members

CEC aims to develop an inclusive academic environment where discrimination and bias against any of the members of our community are not tolerated. Related activities include:

- Assessment of the diversity knowledge and perception of CEC students, faculty, and employees. This leads to the understanding of key challenges faced by faculty, staff, and students with respect to diversity and inclusiveness. Assessment is performed via 1) discussions with student chapters/students, 2) discussions with departments/faculty/staff, 3) feedback on accessibility and usage of diversity training resources, such as inclusive classroom environment, cultural awareness, hidden bias.
- Increase the knowledge about discrimination and bias of CEC students, faculty, and staff by 1) promoting training programs, 2) facilitating access to resources to report inclusive academic environment.
- Organize college-wide events to provide interaction between all students, faculty and staff.

Concluding Remarks

Quantitative Outcomes

Explain any surprises regarding data provided in the quantitative outcomes modules throughout this report.

Cool Stuff

Describe innovations, happy accidents, good news, etc. that occurred within your unit not noted elsewhere in your reporting.

Professor Sutton got elected into the NAE. CEC has the only three Academy members of UofSC, and the only three NAE members in the state.

AI Institute is up and running. We have hired a senior practitioner from IBM, to go along with our Founding Director, Professor Sheth. The top floor of the old Law School is being renovated for this Institute.

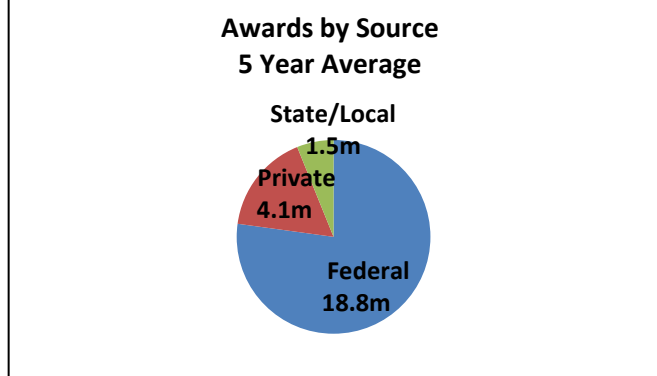
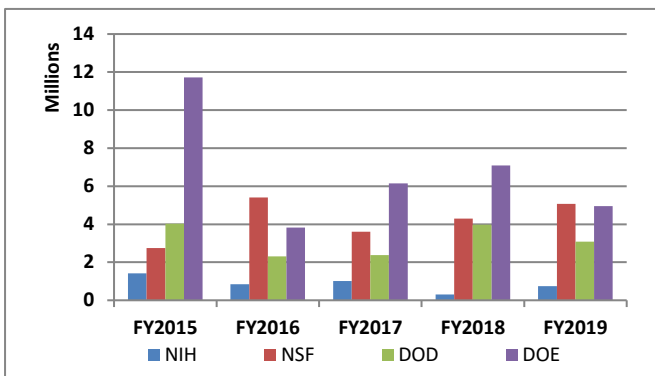
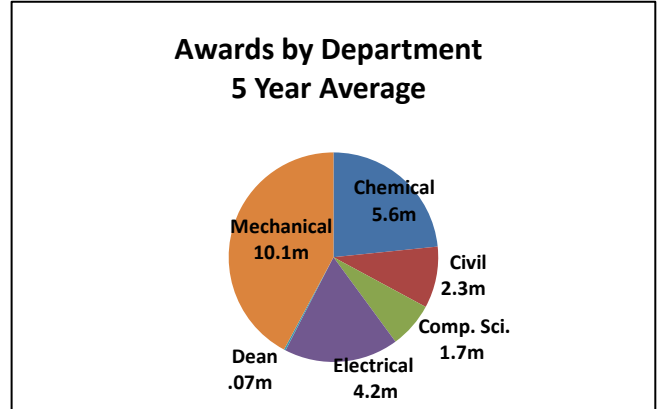
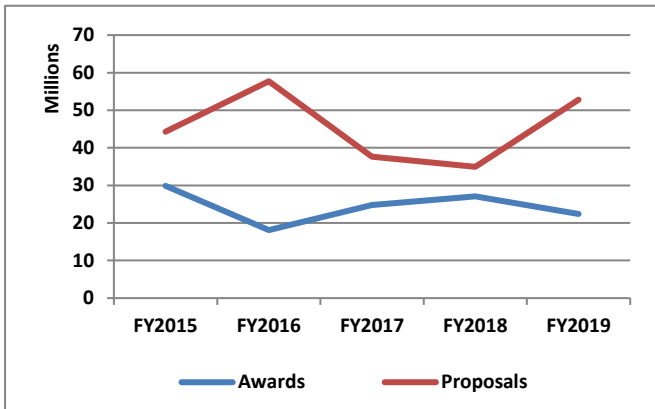
Several large DoD initiatives are in progress.

Appendix 3. Research & Scholarly Activity

Office of Research IT and Data Management Office

College of Engineering and Computing Summary of Awards

SAM ACTIVITY	FY2015	FY2016	FY2017	FY2018	FY2019	% Change Avg. (15-18) & 2019
Division Award Totals	29,879,446	18,102,611	24,769,514	27,055,385	22,398,581	(10.2)
Unit Totals						
Chemical Engineering	7,109,558	4,994,201	5,859,555	5,371,003	4,781,264	(18.0)
Civil & Environmental Engineering	2,123,889	1,655,138	3,377,993	1,727,180	2,526,009	13.7
Computer Science & Engineering	1,574,282	1,823,971	2,453,729	831,752	1,796,625	7.5
Electrical Engineering	4,564,633	1,894,689	3,495,582	7,625,747	3,628,483	(17.4)
Engineering & Computing, College of	320,435	3,363	4,557	0	0	(100.0)
Mechanical Engineering	14,186,649	7,731,249	9,440,109	10,906,114	8,442,376	(20.1)
Source						
Federal	22,464,788	14,956,082	20,159,582	19,522,796	17,186,506	(10.8)
Private	2,431,855	2,844,906	4,191,085	6,913,808	4,051,176	(1.1)
State/Local	4,982,803	301,623	418,847	618,781	1,160,899	(26.5)
Proposals						
Submissions	320	260	244	282	353	27.7
Dollars Requested	44,275,139	57,708,851	37,636,384	34,942,599	52,800,444	21.0



COLLEGE OF ENGINEERING & COMPUTING

	Invention Disclosures	Provisional Patent Applications	Non-Provisional Patent Applications	Issued Patents
TOTALS:	43	46	33	13
Department Breakdown				
Chemical Engineering	17 (ID no. 1345, 1350, 1348, 1354, 1362, 1363, 1364, 1365, 1366, 1372, 1391, 1393, 1396, 1408, 1414, 1421, 1380 <i>(shared w/ Mechanical Engineering)</i>)	19 (ID no. 1309, 1354, 1345, 1348, 1362, 1363, 1364, 1366, 1372, 1366, 1391, 1408, 1391, 1396, 1350, 1414, 1393, 1421, 1326 <i>(shared w/ Electrical Engineering)</i>)	15 (ID no. 1273 (Utility), 1176, 1273 (PCT), 1267, 1261, 1219 <i>(shared w/ Biomedical Engineering)</i> , 1295, 1304, 1365, 1067, 1326 <i>(shared w/ Electrical Engineering)</i> , 1271, 1348, 1339, 1212 <i>(shared w/ Electrical Engineering)</i>)	7 (ID no. 1131, 1219 <i>(shared w/ Biomedical Engineering)</i> , 1030, 1096, 1067, 916, 1176)
Civil & Environmental Engineering	4 (ID no. 1353, 1383, 1388, 1389 <i>(shared w/ Public Health)</i>)	3 (ID no. 1353, 1383, 1388)	2 (ID no. 1153, 1303)	1 (ID no. 1124)
Computer Science & Engineering	1 (ID no. 1359)	1 (ID no. 1359)	0	0
Electrical Engineering	9 (ID no. 1356, 1357, 1384, 1385, 1387, 1394, 1395, 1411, 1392 <i>(shared w/ Arts & Sciences)</i>)	9 (ID no. 1357, 1316, 1356, 1395, 1394, 1387, 1326 <i>(shared w/ Chemical Engineering)</i> , 1394, 1392 <i>(shared w/ Arts & Sciences)</i>)	5 (ID no. 1212 <i>(shared w/ Chemical Engineering)</i> , 978, 1302, 1316, 1326 <i>(shared w/ Chemical Engineering)</i>)	3 (ID no. 1139, 948, 978)
Mechanical Engineering	13 (ID no. 1349, 1351, 1367, 1382, 1410, 1368 <i>(shared w/ School of Medicine)</i> , 1369, 1380 <i>(shared w/ Chemical Engineering)</i> , 1413, 1416, 1415, 1420, 1422)	15 (ID no. 1368 <i>(shared w/ School of Medicine)</i> , 1198, 1310, 1343, 1292, 1367, 1349, 1351, 1227, 1343, 1342, 1413, 1343, 1198, 1422)	12 (ID no. 1262, 1277, 1275, 1262, 1074, 1272, 1164, 1081, 1310, 1324, 1193, 1325)	2 (ID no. 1080 <i>(shared w/ Public Health)</i> , 1081)
Biomedical Engineering	0	0	2 1219 <i>(shared w/ Chemical Engineering)</i> , 1320 <i>(shared w/ Pharmacy)</i>)	1 1219 <i>(shared w/ Chemical Engineering)</i>)

Appendix 5. Academic Analytics Report

ACADEMIC ANALYTICS STUDY

Peers for the College of Engineering and Computing

We examined the Full-Field “Engineering” database within Academic Analytics (AA), which contains 231 listings. Of these we excluded programs that are not ranked by US News and World Report (USNWR) in their “Top Engineering Graduate Schools” listing. We also excluded schools that are not Carnegie Very High Research or that have a USNWR ranking below UofSC CEC. We also excluded UNC-Chapel Hill (no engineering college, only an environmental engineering program); Emory University (AAU, but only an UG program offered by transfer to Georgia Tech), University of Oregon (no engineering college), and the University of Southern Mississippi (ocean engineering only). There remain 33 public AAU institutions and 24 private AAU institutions having traditional engineering colleges; all AAU universities are Very High Research. Of the non-AAU universities, the AA database has an additional 44 public engineering colleges and 8 private universities that are Carnegie Very High Research and ranked equal to or above the 2019 USNWR ranking for CEC. These 119 universities comprise the global set of schools from which UofSC CEC should select its peers and aspirants.

Academic Analytics Broadfield Gauge

This tool compares UofSC CEC to all 231 institutions in the AA database. As explained above, many of these institutions are less than Carnegie Very High; others are specialty “one major” institutions or otherwise not considered peers or peer aspirants. So this particular AA tool actually sets a fairly low bar for comparison. Nevertheless we can learn something from the Broadfield Gauge.

Figure 1 presents the Z scores from the Broadfield Gauge for several metrics. A positive Z score means UofSC CEC is above the national mean. CEC faculty score well on the percentage of faculty with a citation, article, or grant; this means a higher-than-national average fraction of the faculty are research active. CEC scores low on the size of federal grants (dollars per grant), federal grant dollars per faculty member, and on number of honorifics (awards) such as Fellow of a society or Academy membership. CEC is near the national average on the other metrics such as citations per publication and citations per faculty member.

Conclusions and Actions-Figure 1

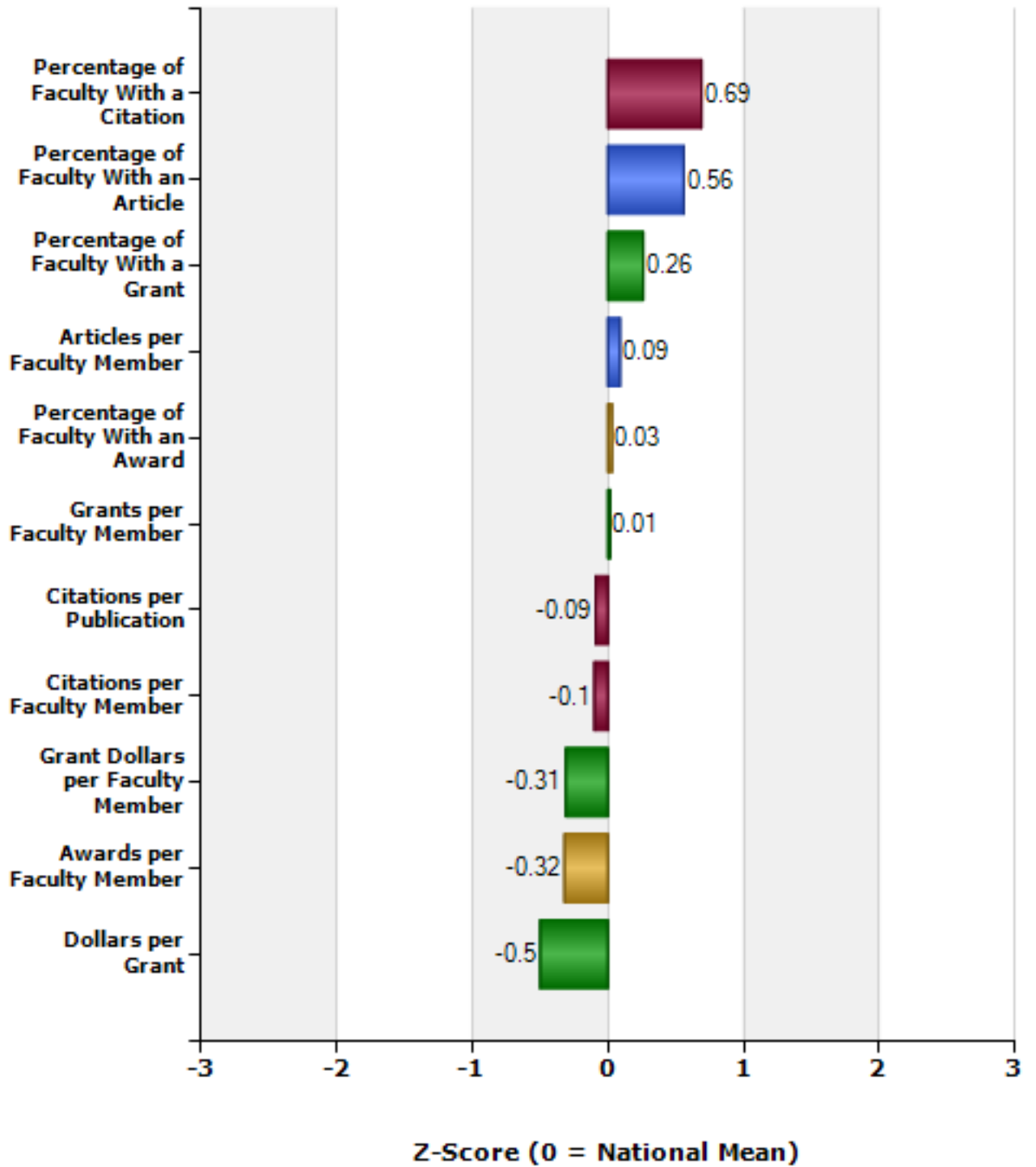
- Associate Dean for Research Paul Ziehl is charged with helping our faculty develop large team proposals. This will address the both the size and the per-faculty amount of federal grants.
- CEC wants to increase the scholarly publication and citation metrics so that our publications will have a greater scholarly impact in both academia and among our federal and industrial sponsors. We have initiated some efforts to support graduate student writing quality.
- CEC also needs to nominate more of its faculty for national honorifics.

Peers and Near-Peers, including AAU Institutions

Based on input from our departments, suggestions from the VPR, and geographic and cultural considerations we selected 26 programs as peers or aspirants from the list of 119 universities described above. The list of peers and aspirants is shown in **Table 1** and includes AAU and non-AAU institutions and a mix from EPSCoR and non-EPSCoR states. Table 1 covers a broad range of faculty sizes. The table also shows the most recent USN & WR ranking; the ranking is dated 2019 but it is based on data

BroadField Gauge - Index Variables

University of South Carolina | Engineering



submitted by colleges as of Fall 2018. We are interested in how the USNWR rankings correlate with actual quantitative performance data.

Table 1. UofSC CEC PEERS AND ASPIRANTS						
University	USNWR Rank (2019)	ASEE Fac Count	Private	Land Grant	AAU	EPSCoR State
NC State U	24	384		Y		
U Cal-Santa Barbara	24	131			Y	
Ohio State U	27	371		Y	Y	
U Washington	27	339			Y	
Rice Y	27	112	Y		Y	
U Virginia	41	161			Y	
Arizona State U	44	412				
U Florida	45	312		Y	Y	
U Mass-Amherst	58	152		Y		
U Tennessee	58	231		Y		
U Connecticut	67	146		Y		
Clemson	69	203		Y		Y
Oregon State U	73	191		Y		
U Central Florida	75	149				
U New Mexico	85	141				Y
U Cal-Santa Cruz	87	79			Y	
U South Florida	89	123				
UofSC CEC	95	124				Y
U Kentucky	95	135		Y		Y
U Nebraska	95	192		Y		Y
U Missouri	95	106		Y	Y	
U Kansas	95	113			Y	Y
U Oklahoma	106	132				Y
Oklahoma State U	106	165		Y		Y
LSU	106	116		Y		Y
Tulane U	106	22	Y		Y	Y

For the following analyses we consulted the following recent sources of data:

- Academic Analytics: data on articles published and citations to articles, and metrics related to publications and citations. Database AAD2018.04.01458.
- ASEE and USNWR: ASEE data tables are self-reported by colleges, the latest available data are for Fall 2018. These data include doctoral, masters, and bachelors enrollments and degrees granted; total research expenditures, and percentage of NAE members. The USNWR rankings employ ASEE data as well as reputational surveys of peers (other engineering administrators) and employers (people in industry).

- NSF HERD survey: Data on total federal R&D expenditures for 2018, the latest AY available.

Table 2: EPSCoR + AAU Comparison

There are only four AAU universities in EPSCoR states that have engineering schools. Two of these were chosen for comparison: Tulane/Louisiana and the U of Kansas/Kansas. (The other two EPSCoR/AAU engineering schools are Dartmouth and Brown, private Ivy League schools in small states that are not comparable in any sense to UofSC). **Table 2** shows the performance of UofSC CEC to these EPSCoR/AAU schools and to Clemson University School of Engineering and Applied Sciences. Some data come from the ASEE F 2018 data set and other data from Academic Analytics. Table 2 also shows the USNWR ranking for 2019 (based on Fall 2018 data). We include the faculty count as a point of reference; note that the ASEE and AA have different methodology for faculty counts thus do not match. We report the totals in each category (the total impact of a college) as well as the per-faculty metric (a measure of faculty productivity).

The shaded entries in Table 2 are those quantitative metrics where UofSC CEC is NOT the top performer. Clemson tops all metrics in total size (impact), with a faculty nearly twice the size of UofSC CEC. CEC far outperforms the AAU+ EPSCOR schools Kansas and Tulane in almost every category. Tulane outperforms UofSC in the per-faculty productivity of PhD students, research expenditures, and articles published. Tulane has only three programs in its engineering college (Biomedical, Chemical, and Materials Engineering) and has much lower teaching loads.

A discussion of USNWR rankings is in order. Table 2 includes eight of the USNWR metrics, indicated by an asterisk *. Clemson is ranked 69 by USNWR, UofSC 95. The primary reason for this disparity is the USNWR peer score (given by a survey of academics) and recruiter score (given by a survey of companies that hire advanced degree candidates). The Peer and Recruiter scores are subjective. Note that the USNWR rankings do not include any measure of scholarly output/impact such as publications and citations.

Conclusions and Actions-Table 2

- On a total performance basis and on most per-faculty metrics, UofSC CEC outperforms the two AAU+EPSCOR Engineering colleges, while supporting higher enrollments and per-faculty teaching loads. On all per-faculty metrics, with the exception of Master's student teaching, UofSC CEC outperforms Clemson.
- USNWR peer and recruiter scores do not reflect the overall better performance of UofSC in the "countable" metrics. The USNWR graduate ranking methodology does not take into account support of teaching undergraduate students.
- CEC must continue to find ways to promote its identity and the actual performance of its faculty in research and teaching. CEC has built up its internal communications staff significantly in an effort to get out the "good news" about the college and its programs. CEC needs to continue seeking strategic communications opportunities, and it needs the support of UofSC central communications.

Table 2. Peers that are (EPSCoR + AAU) , plus Clemson University				
Metric	UofSC CEC	Tulane	Kansas	Clemson
# ASEE FT Fac	121	36	128	227
# Acad Analytics Fac	124	22	113	203
USNWR rankings and selected metrics				
Rank 2019	95	106	95	69
Peer score*	2.4	2.4	2.5	3.0
Recruiter score*	2.8	3	3.33.4	
Percent NAE members*	0.8	0	0.8	0.4
Total Size (Impact)				
PhD enrolled	300	91	231	533
PhD graduated*	57	11	32	91
Tot Res Expenditures*	\$24.1M	\$8.6M	\$14.0M	\$40.2M
Total Articles	1415	262	1012	2071
Total Citations	24,474	2,561	16,540	26,597
MS Enrolled	167	14	167	591
BS Enrolled	3,085	526	2,217	5,331
Per Faculty (Productivity)				
PhD enrolled/FT Fac*	2.48	2.53	1.80	2.35
PhD degrees/FT Fac	0.47	0.31	0.25	0.40
Res Expend/FT Fac*	\$199,363	\$238,039	\$109,583	\$176,963
Articles/FT Fac	11	12	9	10
Citations/Article	14	8	13	10
MS enrolled/FT Fac*	1.38	0.39	1.30	2.60
BS enrolled/FT Fac	25.5	14.61	17.32	23.48
* Indicates USNWR ranking metric				

Table 3: USNWR Near-Peer Comparisons

UofSC CEC is ranked #95 by USNWR. Table 3 shows the chosen set of metrics for CEC and the four other engineering colleges that are tied at #95 according to USNWR. Table 3 also shows the USNWR “reputation score” for the five schools, computed by combining and normalizing the USNWR Peer and Recruiter scores . Note that only Missouri has fewer faculty members than UofSC CEC. As in Table 2 we have shaded those metrics for which UofSC CEC is NOT #1 or #2. Nebraska is #1 on several metrics, but has 70 more faculty than UofSC. Missouri and Nebraska both show a Master’s program somewhat larger than UofSC, and Missouri graduated more PhDs in the ASEE reporting year (Rall 2018). Missouri and Nebraska combined outperformed UofSC on a total of 4 per-faculty metrics. CEC has the highest undergraduate teaching load of the five schools.

Conclusions and Actions-Table 3

- If not in first place, UofSC was second in all metrics except total UG enrollment and total MS enrollment. UofSC has the lowest weighted USNWR composite reputation score of any of these schools ranked #95. The composite score is calculated from an average peer ranking and an average recruiter ranking $((0.25 * \text{peer score} + 0.15 * \text{recruiter score}) / 0.4)$. The peer score and recruiter score for the #95 schools is essentially inversely related to the performance metrics shown above. UofSC has most of the highest rated performance metrics in this group, but the lowest reputational ranking.
- The low-ranked AAU universities (and Nebraska, a former AAU member) apparently have AAU status without a lot of help from their engineering colleges. In contrast, UofSC CEC has the potential to increase its research funding and scholarly productivity to be a major player in the university's push to AAU-like metrics.
- CEC must continue to find ways to promote its identity and the actual performance of its faculty in research and teaching. CEC has built up its internal communications staff significantly in an effort to get out the "good news" about the college and its programs. CEC needs to continue seeking strategic communications opportunities, and it needs the support of UofSC central communications.

Metric	UofSC CEC	Kentucky	Nebraska	Missouri**	Kansas**
# ASEE FT Fac	121	158	194	114	128
# Acad Analytics Fac	124	135	192	106	113
USNWR reputation score	2.55	2.65	2.65	2.78	2.80
Total Size (Impact)					
PhD enrolled	300	283	368	290	231
PhD graduated	57	35	48	61	32
Tot Res Expenditures*	\$24.1M	\$19.6M	\$39.0M	\$14.9M	\$14.0M
Total Articles	1415	1277	2005	1095	1012
Total Citations	24,474	15,329	31,051	17,471	16,540
MS Enrolled	167	129	171	187	167
BS Enrolled	3,085	3,282	3,452	2,323	2,217
Per Faculty (Productivity)					
PhD enrolled/FT Fac*	2.48	1.79	1.90	2.54	1.80
PhD degrees/FT Fac	0.47	0.22	0.25	0.54	0.25
Res Expend/FT Fac*	\$199,363	\$124,257	\$200,901	\$130,485	\$109,583
Articles/FT Fac	11	9	10	10	9
Citations/Article	14	10	13	13	13
MS enrolled/FT Fac*	1.38	0.82	0.88	1.64	1.30
BS enrolled/FT Fac	25.5	20.77	17.79	20.38	17.32
* Indicates USNWR ranking metric. ** Indicates AAU member					

Table 4: AA scholarly metrics for the peers and aspirants of Table 1.

Table 4 is a comparison with the full set of peers and aspirants from Table 1, a group with several universities that are much higher performers than in Table 2 and 3. Table 4 lists several “scholarly” metrics available from Academic Analytics, namely the total and per-faculty publication and citation metrics. These are a measure of the impact, productivity, and scholarly value of the research done by CEC faculty. The right-hand column of Table 4 lists the schools in Table 1 that UofSC CEC outranks. AAU schools are boldfaced in Table 4. Note that UofSC outranks some AAU schools in certain per-faculty metrics, and does particularly well in citations per article published. UofSC CEC does not outrank the AAU schools Ohio State, UC-Santa Barbara, Ohio State, Rice, Virginia, or Washington in any of the metrics. The only non-AAU state schools from Table 2 that consistently outrank UofSC are Arizona State, Connecticut, Tennessee, and NC State.

Conclusions and Actions-Table 4

- UofSC consistently outranks the smaller AAU schools Missouri, Kansas, and Tulane that are not engineering- or STEM-centric. CEC does particularly well in articles per faculty member and in citations per article, even against the larger and much higher ranked AAU schools UC-Santa Cruz and Florida. CEC needs to find a way to distance itself from Missouri, Tulane and Kansas in terms of reputation.
- UofSC CEC does not outrank the AAU schools Ohio State, UC-Santa Barbara, Ohio State, Rice, Virginia, or Washington in any of the metrics.
- The only non-AAU state schools from Table 2 that consistently outrank UofSC are Arizona State, Connecticut, Tennessee, and NC State.
- CEC is currently growing to a target faculty size of 140. If we consider the subset of colleges from Table 1 with roughly that same number of faculty (110 to 160) but higher USNWR rankings, then the peer-aspirants in the near future would be Rice, UC-Santa Barbara, Virginia, Massachusetts-Amherst, Connecticut, Central Florida, and South Florida

Table 4. Relative Rankings for Selected Academic Analytics Scholarly Metrics	
Metric	UofSC CEC Outranks These Schools
Articles published per faculty member	UC Santa Cruz , Clemson, Kentucky, U Mass-Amherst, Missouri , Nebraska, Oklahoma State, South Florida, Kansas
Total Citations	Kentucky, LSU, Missouri , Oklahoma State, South Florida, Tulane, Kansas
Citations per faculty member	Clemson, Kentucky, LSU, Missouri , Nebraska, Oklahoma State, South Florida, Tulane, Kansas
Citations per article published	Central Florida, Clemson, Florida , Kentucky, LSU, Missouri , Nebraska, Oklahoma State, South Florida, Tulane, Kansas

Appendix 8. Collaborations

Kaiming Ye, PhD
Professor and Chair
Department of Biomedical Engineering
Thomas J. Watson School of
Engineering and Applied Sciences
Director, Center of Biomanufacturing for Regenerative Medicine

PO Box 6000
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kye@binghamton.edu
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February 16, 2020

Mark J. Uline, Ph.D.
Associate Professor
Department of Chemical Engineering
Undergraduate Director, Biomedical Engineering Program
University of South Carolina
301 Main Street Room 3C17
Columbia, SC 29208

Dear Dr. Uline,

I am very pleased to write this letter to support your plan of launching a new Department of Biomedical Engineering.

As Chair-Elect of the Council of Chairs of Bioengineering and Biomedical Engineering, I am leading a team to plan for the 2022 Biomedical Engineering Summit focused on developing a national strategy for biomedical engineering education and workforce training. We realize that Biomedical Engineering is a field at the interface of engineering, medicine and biological sciences. It combines the practical problem-solving ability of engineering to diagnostic, monitoring, and therapy needs of medical sciences. The evolution of academic disciplines often follows the sequence of first being a multi-disciplinary program evolving into an interdisciplinary program and then becoming a discipline in itself with a variety of sub-disciplines. Biomedical Engineering has followed that path and is now widely recognized as a separate discipline within engineering. We witnessed more and more universities launched a new department of biomedical engineering in the last several years.

This is certainly true based on my own experience. In 2012, I helped launch a new Department of Biomedical Engineering from a program homed at the Department of Biological and Agriculture Engineering at University of Arkansas. The launching of the new department was very successful. The enrollment of the first class reached 100 when we launched the new department. The department kept growing in both enrollment and faculty numbers. After joining Binghamton University, State University of New York (SUNY), I renamed our department from Bioengineering to Biomedical Engineering. The name change led to 75% increase in student enrollment in the first year. It also made easier for ABET accreditation, due to a clear and simple administration in curriculum development and student outcome assessment.

I had a chance to visit your program in April 2019. I observed your rapid growth and expansion. I also felt your pain in growth. The designation as a program limits your ability to grow, your

ability to recruit talent students who consider BME as the one of the fast-growing professional choices, and your ability to recruit top faculty members to help further grow and expand your program. The establishment of a new department will remove these burdens and streamline your administration and curriculum development. It will eliminate competing interests between two programs within one department, which will fundamentally streamline faculty hiring and tenure and promotion processes. It will help faculty to compete for NIH funding which views a favor for biomedical engineering faculty due to a consideration of research environment.

Finally, I would like to offer my assistance in helping you to plan for and eventually to launch a new department if needed.

I strongly support your plan of establishing a new Department of Biomedical Engineering.

Yours faithfully,

A handwritten signature in black ink, appearing to read "Kaiming Ye", with a stylized flourish at the end.

Kaiming Ye, Ph.D.
Professor and Department Chair
Director, Center of Biomanufacturing for Regenerative Medicine

February 24, 2020

Dr. Tayloe Harding
Interim Executive Vice President for Academic Affairs and Provost
Office of the Provost
University of South Carolina
102 Osborne Admin Building
Columbia, SC 29208

Dear Dr. Harding,

At the request of Dr. Mark Uline, I am submitting my support for the establishment of a Biomedical Engineering Department at your university. I have been at Rutgers, The State University of New Jersey, for over 40 years. In my tenure at Rutgers, I have observed a tremendous growth in Biomedical Engineering (BME) at Rutgers as well as many other universities. I am an ABET (Accreditation Board for Engineering and Technology) program evaluator and team leader; in this capacity, I have observed the advantages of being in a “department” compared to “program”. I am very familiar with the process of going from a program to a department and what it takes to make a department successful. Let me first state what we went through in our development and then I will comment on Mark’s proposal.

The Biomedical Engineering program at Rutgers University was initially established in 1965 as a track within Electrical Engineering, offering M.S. degrees with a Biomedical Engineering emphasis. In 1986, the State of New Jersey formally chartered the Rutgers Department of Biomedical Engineering as an independent entity within the School of Engineering (SoE) with exclusive responsibility for granting M.S. and Ph.D. degrees in biomedical engineering.

The undergraduate program in Biomedical Engineering was inaugurated in 1991 under the “Applied Sciences” option within the School of Engineering; a formal undergraduate B.S. degree in BME was approved by the University in 1997. In Fall 1999, our BME department started an official undergraduate degree program. In order to qualify for a BME leadership award (which was instrumental in getting a new BME-dedicated building), Former SoE Dean, Michael Klein, requested six SoE faculty from other established departments to have a joint appointment in BME and their home department. The department faculty grew over the next few years from eight to fourteen. In addition, ten new faculty members were hired in a span of seven years. The first BS degree class was four (4) students in May 2000. The class of 2020 is one-hundred twenty-two (122). Our BME undergraduate program initially received ABET accreditation in 2005 and has been successfully renewed since.

A BME building was dedicated on April 18, 2007. The 80,000-square-foot education and research facility featuring state-of-the art micro fabrication, tissue culture, and microscopy laboratories, including small animal facilities. The 2nd and 3rd floors are “open lab space” concept with no walls. We have seen tremendous advantages of collaborative research work and sharing of resources because of the environment that has been created. Currently, we are 25 BME core and 71 graduate faculty, over 300 undergraduate students (4th largest in the country) and over 100 graduate students. I strongly believe this type of growth cannot occur with a “program” alone; it has to be through a “department”.

Having said that here are my comments on the proposal by the College of Engineering and Computing (CEC) at the University of South Carolina (UofSC):

1. Biomedical Engineering at the University of South Carolina should be administered as a department. They have been functioning as a program, but now this step is necessary to have an impact on the program as well to the university. Currently, there are 13 faculty members, 3 instructors, and 2 administrative staff members who are supporting the BME program. There is a need to strengthen the activity of BME by creating a department and developing a critical “core” faculty size. The department will get firm commitments from the residing faculty and they will share the resources and develop collaborative research programs.
2. The hiring proposal is modest, and it is developed with the consideration of three existing research centers: The Artificial Intelligence Institute, the Research Center for Transforming Health, plus the Cardiovascular Translational Research Center. With the addition of five faculty members, the department will be a decent size of eighteen faculty members. This will make BME comparable to existing departments at other universities. One of the Accreditation criteria is faculty size and expertise. The current hiring plan will avoid the concern about the small faculty size. The department of 18 faculty members will be able to handle advising, teaching, research and mentoring all BME undergraduate students.
3. The faculty hiring plan is designed by your internal functioning and expertise to acquire. It is a fact that that hiring plan will be severely hampered if a BME department is not established. Based on experience, we can state that we have been able to attract excellent faculty because we are a full BME department and we have built an environment with a collaborative culture. I am certain that you will observe a significant amount of collaborative activities which will result into successful funding, research growth and the ability to attract new junior, as well as senior, faculty members.
4. In the UofSC College of Engineering and Computing (CEC), Biomedical Engineering exists as a program, rather than a department. Once the program becomes a department, it should become a nationally respected academic unit. Clemson University is the only other university in South Carolina with a similar yet distinct academic unit, a Bioengineering Department. The University of South Carolina’s Biomedical Engineering Program has reached the stage now to become a department to its own identity and build a unified autonomous entity. This will allow BME to create a research direction and make a name for their own challenges. The next set of hiring in Cardiovascular Mechanics & Modeling; Cardiotoxicity; Big Data; Biomaterials for Localized Delivery; Regenerative Medicine; Protein Science; Diagnostics; and Biomanufacturing will enhance the current strength, plus the teaching, training and clinical practice should address relevant health care issues affecting SC citizens.
5. The department will be able to further outreach the local universities and build partnerships in biomedical engineering related devices.
6. The undergraduate and graduate student population will have a home; they will be your assets and ambassadors of your department and they will become part of your complete endearment as they provide valuable services to the department. It is possible that Biomedical Engineering may become the largest degree granted program in the CEC. All faculty will be in close vicinity which will enhance faculty collaboration. All-in-all, it will be a win/win situation.

I wish you all best of luck in the formulation of the department and look forward to constructive progress in Biomedical Engineering at the University of South Carolina.

Warm regards,

A handwritten signature in black ink that reads "Noshir A. Langrana". The signature is written in a cursive style with a large, prominent 'N' and 'L'.

Noshir A. Langrana, Ph.D, .P.E.
Distinguished Professor
Interim Undergraduate Program Director
Former Chairman of BME Department, 2005-2017

February 24, 2020

Dear Dr. Uline:

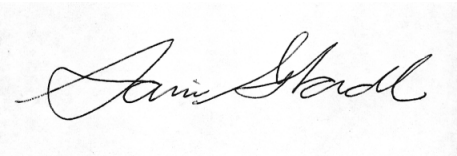
I am writing regarding the pending formation of a Biomedical Engineering department at the University of South Carolina. As you can see from my comments below, I am very supportive of this effort and know first-hand how important the formation of a BME department can be to the growth of our discipline. To provide some context, let me first describe my background. After completing my PhD in Biomedical Engineering from Tulane University and post-doctoral training at the University of Pittsburgh, I was recruited to Lehigh University in 2003 as an Assistant Professor in Mechanical Engineering and part of my job description was to co-develop a Bioengineering program at the undergraduate level. I helped develop the curriculum and structure for this program, which rapidly became a very popular undergraduate major. However, there were several limitations as a program, the primary of which was that tenure-line faculty needed to be hired in other engineering departments and that limited our ability to specifically hire the faculty needed for the Bioengineering undergraduate program. The lack of a department also hindered the development of a Bioengineering graduate program. Although I moved to Ohio State University in 2007, I am happy to note that Lehigh now has a strong Bioengineering department with tenure-line faculty.

I am currently, Chair of the Biomedical Engineering (BME) department at the Ohio State University (OSU) and the history of BME at OSU is typical of many BME programs. It was initially a research center that offered graduate degrees (MS and PhD) for many years before becoming a full department in ~2006 with an undergraduate program. Simply stated, becoming a department has been transformational for BME at OSU. In the past 14 years, we have grown to be a large department (~550 undergraduates, ~100 graduate students and 30+ faculty members) that offers a large range of services to our students. The most critical aspect of becoming a department was the ability to directly hire tenure-line faculty in areas where we wanted to grow. Specifically, our department has very strong ties to the OSU Medical Center and particularly strong ties with several hospitals and research institutes on campus (e.g. James Cancer Center, Davis Heart & Lung Research Institute, Spine Research Institute, etc.). As an independent department, we were able to target our faculty recruitments in these areas and cost-share these lines with Institutes and Divisions in the Medical Center. As a result, we have recruited outstanding faculty members who are making significant impacts on both engineering research and clinical care. The department has also been able to provide outstanding resources to our students which have allowed them to excel in many areas as evidence by the recent winning of "chapter of the year" award to our undergraduate student society at BMES. Being a full department has also helped us enhance our graduate programs, obtain better access to larger scale funding resources and develop the resources needed to deliver high quality teaching, research and service in BME. It has allowed BME to be a full partner with other departments in the college of engineering and this can be most visibly seen in our new state-of-the-art building that will go online this summer (<https://engineering.osu.edu/bmec>). This building will house two departments, BME and Material Science and Engineering, and will foster new collaborative efforts in the area of biomaterials development and significantly enhanced resources for our undergraduate and graduate students. Development of this type of collaborative facility would not have been possible if Biomedical Engineering did not have full departmental status.

Department of Biomedical Engineering
Bevis Hall, Room 270, 1080 Carmack Road
The Ohio State University
Columbus, OH 43210
ghadiali.1@osu.edu, 614-292-7742

In summary, although I recognize the significant effort and resources that are required to form a new BME department, the benefits of this effort will be significant and likely out-weigh the costs. BME is now a very mature discipline and in my opinion, Universities and Colleges that do not have a department structure are at a significant disadvantage when it comes to national recognition, the ability to recruit faculty members/students and provide the collaborative resources required by our discipline. It sounds like a very exciting time at the University of South Carolina and I am excited to hear about your plans for forming a department. I wish you the best in this endeavor and would be happy to answer any questions you have about our department at Ohio State or this letter.

Sincerely,



Dr. Samir N. Ghadiali, PhD
Professor and Department Chair
Department of Biomedical Engineering
The Ohio State University

Professor (Joint Appointment)
Department of Internal Medicine
Division of Pulmonary, Allergy and Critical Care Medicine
Dorothy M. Davis Heart & Lung Research Institute
Ohio State University Wexner Medical Center

Raphael C. Lee, MD, ScD, FACS
Paul and Allene Russell Professor
Director, Center for Molecular Regeneration Therapeutics

Friday, February 28, 2020

Dr. Tayloe Harding
Interim Executive Vice President for Academic Affairs and Provost
Office of the Provost
University of South Carolina
102 Osborne Admin Building
Columbia, SC 29208

RE: USC DEPARTMENT OF BIOMEDICAL ENGINEERING

Dear Provost Harding,

I am delighted to learn that the University of South Carolina's College of Engineering is proposing the establishment of a Department of Biomedical Engineering. While there are several structural advantages of establishing a departmental structure around biomedical engineering, there are even more important scientific and academic reasons to do so. Thus, I am writing to strongly encourage in the strongest terms the University of South Carolina to create a department of biomedical engineering, especially one that links the School of Medicine with the College of Engineering.

Decades ago when I was a graduate student in engineering, there was general skepticism regarding the concept of biomedical engineering as a distinct intellectual discipline. At that time there was no unique intellectual skillset that either defined biomedical engineering pedagogy or justified biomedical engineering as a distinct academic discipline. Now the situation has completely changed.

Today, the application of engineering systems science to biology and medical research is resulting in the discovery of new engineering design principals for self-organizing, and even living, materials that have performance capabilities not achievable with other materials. These new biomaterials are robust and adaptive. They self-repair and manifest emergent behaviors that define structure-function-property relationships which are new to engineering science. It seems most likely that the future of engineering science and pedagogy will be heavily influenced by investigating and learning the rules of biological systems. Increasingly public and private engineering research dollars are being directed toward biomedical engineering research. Today, biomedical engineering is rapidly becoming the flagship engineering department within colleges of engineering.

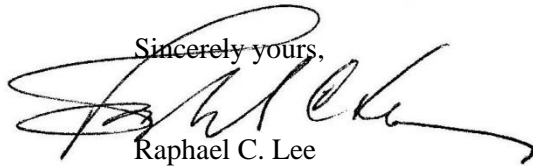
It is also becoming clear that engineering science is of fundamental importance to the advancement of biology and medicine. The scientific questions being addressed by biologists today are increasing about how cellular systems behave. In medicine a patient is seen as a robust and adaptive complex feedback-controlled closed-loop homeostatic system, and disease is a malfunction resulting from a disorder in that system. The goal of medical research now is to move away from population-based validation of drugs and

devices and move towards personalized therapies based on the genetics and regulating epigenetic factors for each patient..

Success in accomplishing personalized medicine inexorably requires a working knowledge of how to accomplish a steady-state beneficial change in the behavior of closed-loop control systems which is a skillset unique to engineering. Thus there is a fundamental need to converge engineering and medical pedagogies to train tomorrow's physicians.

I wish to congratulate the USC College of Engineering on increasing the investment in biomedical engineering. I am totally confident that this will prove to be a wise investment that will not only benefit future students, but the future of both engineering and medicine as well.

Sincerely yours,

A handwritten signature in black ink, appearing to read 'Raphael C. Lee', with a long, sweeping underline.

Raphael C. Lee