Annual Report 2010-2011
College of Engineering
North Carolina State University

Overview

The College of Engineering at North Carolina State University is the flagship engineering college in the University of North Carolina system. With 6,365 undergraduates and 2,586 graduate students in 12 departments, nine of which are administered in the College, it is the largest engineering college in the state and among the largest in the nation. The College ranks among the top 10 percent of engineering colleges in multiple rankings — *US News & World Report*, the Academic Ranking of World Universities and *Wall Street Journal* recruiter rankings.

Despite the challenges created by multiple years of budget cuts, the College has maintained its long-term goal of "becoming and being perceived as the leading public college of engineering in the US and one of the preeminent colleges of engineering in the world." This is consistent with the UNC Tomorrow plan for the College to become a "premier college of engineering." The investments made by the state legislature and the University in support of this vision are making a positive impact on the College. Research awards and expenditures are up for the fifth year in a row.

The College's strategic plan continues to focus on investments in people and infrastructure in interdisciplinary enabling technologies (bio, nano and IT) and areas of important societal need and impact such as energy and environmental systems, health systems, security and critical infrastructure. These align closely with the National Academy of Engineering's Grand Challenges for the 21st Century. The College is also committed to providing its students an educational experience with depth in technical content and breadth in the "softer skills" consistent with the National Academy of Engineering vision of the "Engineer of 2020." This emphasis is consistent with the University's newly adopted strategic plan.

Research

The College's high aspirations have created a culture that has produced four NSF Engineering Research Center proposals over the last three years, with one being funded and a second making it to the final stages of funding. The NSF FREEDM Systems ERC was funded at $18.5 million over five years. Now in its third year, the center is an established leader in research and education in the area of distribution and management of renewable energy and the development of the smart grid of the future. It has drawn significant attention to NC State as a national leader in energy-related research. In April, a new type of transformer under development at the FREEDM Systems Center was named to MIT *Technology Review's* 2011 list of the world's 10 most important emerging technologies. Most recently, the center attracted and hosted a tour for members of President Obama's Council on Jobs and Competitiveness, underscoring the national reputations of the center and NC State as leaders in energy-related research.

The Modeling & Simulation for Nuclear Reactors Energy Innovation Hub, also known as the Consortium for Advanced Simulation of Light Water Reactors (CASL), is another significant national research effort in which NC State plays a significant leadership role. NC State's Dr. Paul Turinsky serves as chief scientist for this Oak Ridge National Laboratory-led effort. The US Department of Energy will fund CASL at a level of approximately $122 million over five years – with the possibility that the contract will be renewed for an additional five years. NC State is expected to receive approximately $11 million in CASL funding over the next five years.

Other research successes in the College include several large research grants. Examples include a $2.3 million grant from the US Army Research Office to support the Secure Open Systems Initiative; a $1.6 million grant from the National Science Foundation (NSF) to support development of an intelligent cyberlearning system for interactive scientific modeling in elementary science education; a $1 million grant from NSF in support of collaborative research on climate change; and a $1 million grant from the US Department of Energy for research into nanostructured materials for renewable alternative energy.

Collaborations with other colleges are also important to the College. Ongoing significant collaborations with other colleges include the pioneering work being done in the area of rapid prototyping of prosthetic devices for animals with the CVM; serious gaming research and education with four other colleges (COD, CHASS, COEd, and COM); nanotechnology and high performance computing efforts with PAMS; and biofuels-related research with CALS. The College also collaborates with other universities within the UNC system. Most notable is the collaboration with UNC-Chapel Hill in the joint Department of Biomedical Engineering. These partnerships are critical to our research efforts as well as the education of our students.

In addition to attracting and leading major research centers and playing a leadership role in a national consortium, the faculty excel at landing major research awards, including National Science Foundation Career Awards. This year, four more faculty in the College received Career Awards. This speaks highly to the quality of new faculty who have been recruited to the College.

NC State engineering faculty have been very successful this year receiving awards for research. During 2010-11, the College received 523 awards totaling $74,238,515. Research expenditures for the year were equally impressive with a total of $135,882,732 from all sources. This is an increase of approximately five percent over the previous record year.

Students

Undergraduate Enrollment : With over 6,000 undergraduate students, the goal in 2010-11 was not to increase the numbers but to continue to increase the quality of our students. The fall 2010 undergraduate enrollment was 6,365 (1,577 freshmen, 1,279 sophomores, 1,485 juniors, 2,024 seniors). While enrollment of undergraduate women increased to 1,038 (16.3 percent) in fall 2010 from 998 (15.7 percent) in the previous year, this is still below the national average of 19%. Fall 2010 undergraduate minority enrollment included 423 African Americans, 367 Asian Americans, 210 Hispanic students, 3 Pacific Islanders, 22 Native Americans and 83 students of more than one race.

Graduate Enrollment: Graduate student enrollment increased by 8% with fall 2010 enrollment at 2,586 (1,567 master's and 1,019 doctoral) compared to 2,399 in fall 2009 (1,406 master's and 993 doctoral). This includes enrollment for the off-campus Master of Engineering degree, which totals 74. International students made up 50 percent (1,288 students) of the enrollment and 23 percent (582) of the students were women. Minority enrollment was 10 percent (250 students: Asian American 122, African American 72, Native American 3, Hispanic 42).

Degrees Awarded

The number of bachelor's degrees awarded to all engineering majors for 2009-10 was 1,086. This is an increase over the 1,038 degrees granted in 2008-09.

The number of graduate degrees awarded during 2010-11 was 754 (615 master's degrees and 139 doctoral degrees). In 2009-10, there were 696 degrees awarded (master's degrees and doctoral degrees).

Recruiting

During spring 2011, five "Spend a Day in Engineering" sessions were offered for freshmen admitted for fall 2011 and their parents. One of these events took place during the finalists' weekend for Park Scholarship nominees and was offered specifically for these students. The visitations included a Saturday event, which permitted the accommodation of 100 students instead of the usual 50-60. The Saturday events were particularly popular with out-of-state families. Approximately 325 students and 800 parents attended the visitation days.

Engineering Open House in March 2011 drew approximately 2,000 admitted and prospective high school, middle school and community college students plus parents. Overall attendance was around 4,500. For the second year in a row, the tournament social for the regional FIRST Robotics tournament held in Raleigh was hosted on Centennial Campus. This event drew approximately 1,000 high school students and team leaders from 12 states. In addition, regional receptions for prospective undergraduate students and parents were held in Greensboro, Winston-Salem, Hickory, Charlotte, Wilmington and Raleigh. More than 1,100 students and parents participated in these events.

For graduate student recruiting, the Engineering Foundation provides a $40,000 budget to bring outstanding graduate applicants to the campus for personal interviews. Of the 91 students who visited the campus, approximately half are expected to enroll. The Directors of Graduate Programs encourage continuation of the activity.

Minority Engineering Programs

The Minority Engineering Programs offer a variety of specially designed initiatives aimed at recruiting and retaining talented minority engineering students. These programs include the Overnight Minority Recruitment Weekend, which is a yield event that brings high school students who have been admitted to the College to campus for a weekend program that exposes them to the opportunities offered at NC State. This year, all but one of the 43 participants at the March event paid enrollment deposits for the 2011-12 academic year. Other successful programs include the Summer Transition Program (STP), the Student Advancement and Retention Teams (START), and Student Professional Development Courses.

Women in Engineering Program

Mentoring for female first year students continued, beginning with a bridge program for admitted female students (ESCAPE to Engineering). Forty incoming female students attended the week-long program in July 2010. The program introduced female students to female faculty members, local professional engineers and NC State alumni, and upperclassmen. In past years, camp attendees have been retained and have outperformed their peers in their first year of college. This camp has been funded for July 2010 by additional donations from John Deere and Progress Energy.

Throughout the year, mentoring continued especially with the support of the WISE program, as can be seen in its own section of this report. The "Taste of Engineering" event was sponsored by the Women in Engineering program and was a success this January, 2011. The event, held for

female students, used tasty examples to illustrate various engineering disciplines. Additionally, efforts were made to improve recruitment and retention of female students in engineering departments. As a result, the departments of Materials Science and Electrical & Computer Engineering will be working with consultants in the fall of 2011 to assess and improve their female recruitment and retention efforts.

The "Engineering on the Road" outreach activity served over 7,000 students statewide, more than twice as many as the previous year. Work continued on the two major grants, $2 million from the National Science Foundation and $500,000 from the GE Foundation. These grants provide support for efforts to increase the number and diversity of students in Wake County schools entering algebra by eighth grade and calculus by twelfth grade. Staff continued to support two engineering elementary schools, Brentwood in Wake County and Freeman in Wilmington, NC sponsored by a National Institute of Health grant to develop and implement engineering curriculum at the elementary school grade level. In addition, work began with a new school in Vance County, Clarke Elementary, training teachers and staff to implement an elementary engineering curriculum sponsored by a Department of Education grant with a focus to improve engineering and technological literacy.

Summer Programs and K-12 Outreach

Engineering Summer Programs continued its successful high school engineering orientation programs through 10 specialized workshops. The workshops included aerospace engineering, autonomous robotics, biological engineering (environmental and biofuels options), Wolfpack Motorsports, civil engineering, chemical engineering, computer science, industrial engineering and materials science. During three one-week sessions, 395 students participated in specialized departmental experiences. Approximately 20 percent of the participants in summer programs were female students, and 21 percent were minority students.

Engineering camps for middle and elementary school students continue to grow quickly. In summer 2010, we offered an additional week of camp on campus, increasing from three week-long sessions to four sessions. Approximately 225 students from third grade through eighth grade attended one of four weeklong day camps. Off-site camp offerings were doubled from two to four. Camps continued to be offered in collaboration with the 2+2 Programs at Craven and Lenoir Community Colleges. The additional camps are in Rocky Mount and Hickory, introducing engineering to 200 more students around the state.

The "Engineering on the Road" outreach activity served more than 7,000 students statewide, more than twice as many as the previous year. Teacher training efforts have increased. In the spring of 2011, more than 50 teachers and undergraduate engineering students were trained to implement engineering principles at the elementary and middle schools for summer camps across the state. In addition, as a designated training site for the Boston Museum of Science's Engineering is Elementary curriculum for the state of North Carolina, a workshop was offered to introduce the curriculum to teachers from around the southeastern US. In addition, staff collaborated with members of the College of Education to plan programs allowing education students to take engineering-oriented classes. A course covering Engineering in Elementary Education is now required of all elementary education undergraduates here at NC State.

Faculty

The successful results of the College's research program are directly tied to its faculty growth, which is why faculty hiring continues to be a major investment. Twelve new faculty, including

two women, joined the College in 2010-11. Two faculty members were named distinguished professors. Substantial investments were also made in faculty start-up needs, staff support where appropriate, and other operating needs, including those required by the College's growing graduate enrollment. The ability to provide competitive start-up packages in a responsive manner continues to be a challenge. This situation has been adversely impacted by the budget reductions of the last years.

Over the last four years, the College has added 11 women, four African American, and one Hispanic to its faculty, bringing its totals to 25 women, 14 African Americans and five Hispanics. While the College is making steady progress, we still have a ways to go to achieve a level of diversity in our faculty ranks that would mark it as a leader in this regard among its peers. The efforts of Dr. Christine Grant, associate dean for Faculty Development and Special Programs and her office, have had an extremely positive impact on faculty recruiting and retention efforts and enhancing faculty diversity in our College.

Rankings

The latest *US News & World Report* rankings of graduate engineering programs has the College 31st among our peers nationwide. The College stands at 19th among public colleges of engineering. In the Academic Ranking of World Universities, the College is ranked 32nd overall, 25th among US colleges of engineering, and 17th among US publics. Other rankings include a survey of top recruiters published in the *Wall Street Journal* that ranked the College 15th in the nation.

Extension and Engagement

A major extension and engagement activity in the College is the Industrial Extension Service (IES), an organization that impacts the state in many different and vitally important ways. In addition to its traditional support of small businesses and manufacturers, it now serves the healthcare, pharmaceuticals and financial sectors, among others. In 2006, IES set a goal to create $1 billion in economic value to manufacturers in North Carolina during calendar years 2006-2010, a campaign called 1B4NC. To celebrate the successful — and early — completion of the 1B4NC campaign, IES planned and conducted a 5-day, 1,100-mile statewide tour to highlight "Made in NC" products and the people who make them. The "Manufacturing Makes It Real" (MMIR) tour was made official by a proclamation from Governor Beverly Perdue and was mentioned in *New York Times*-bestselling author Guy Kawasaki's book, *Enchantment: The Art of Changing Hearts, Minds, and Actions*. In early 2011, the MMIR was transitioned into the Manufacturing Makes It Real Network, which will connect NC manufacturers — 10,184 companies with 433,897 employees, according to the Employment Security Commission — and continue to promote manufacturing as the basis of a healthy modern economy.

The Golden LEAF BTEC, or Biotechnology Training and Education Center, is also a critical player in extension and economic development, particularly in providing human resources needed to grow and enhance the biomanufacturing sector in North Carolina. Its efforts, which include the involvement of the NC Community College System, are supported by bio-related industries in the state as well as the Golden LEAF Foundation.

This year BTEC had more than 573 undergraduate students attending our classes, an increase of 23% from fiscal year 2009-2010. Because of a new suite of graduate courses, graduate enrollment rose to 153 students, an 80% increase from the previous fiscal year. The BTEC facility was designed for an average of 250 students per semester or about 500 students per year,

while the total of undergraduate and graduate students this year came to 726. The BTEC facility is working at full capacity, and this limits the number of customized and open-enrollment courses that it can hold for industry each year. It also limits the utilization of the facility for process and analytical services. The success of BTEC's academic programs, which have seen their budgets cut, is now hurting prospects for growing the center's programs for industry which can generate the revenue needed to overcome these budget cuts. As a result, BTEC is renting 5,000 square feet of space at the Keystone Center (BTEC Annex) with the goal of using this facility full-time for customized professional development courses and process and analytical services activities.

Another important extension and engagement activity in the College is the NC Solar Center, which acts as a focal point on solar energy technologies and building practices. The College continues to support this activity and assists the center's efforts to obtain legislative support for continuing its work. The NC Solar Center also administrates the Database of State Incentives for Renewables and Efficiency (DSIRE), a searchable web-based comprehensive source of information on state, local, utility and federal incentives and policies that promote renewable energy and efficiency.

External Relations

Fiscal year 2010-11 gifts and grant commitments from corporations, foundations, and individuals exceeded $12 million. Gifts and pledges made directly to the NC State Engineering Foundation (NCSEF) totaled more than $8 million. There were 20 new endowments established to benefit the College of Engineering. New professorships have been added by ABB, Frank and Doris Culberson (two), and S. James "Jim" Ellen Jr., with several more in the negotiating stage. With about 60 percent of the endowments still "underwater" as of June 30, 2010, estimated lost spending for 2011-12 will be about $1.4 million; $432,430 in scholarships, $227,200 in fellowships, $476,640 in professorships, and $261,325 in programmatic endowments. Once again donors will be contacted and asked to supplement their endowments during these challenging times. Due to positive responses from donors and a special allocation from the Chancellor, we were able to renew all scholarship commitments for 2010-11.

Areas of major focus for next year will be new strategies to finance the completion of the move of the College to Centennial Campus and to increase of the number of endowed professorships in the College. A feasibility study will be conducted on the advisability and potential success of raising private funds to help cover some of the costs of moving the remaining departments on main campus to Centennial Campus.

In addition to its focus on endowed professorships, the Foundation Board of Directors has worked with staff to increase alumni involvement and giving to benefit all areas of the College. Additional emphasis has been placed on educating current students on the role of the Foundation and its philanthropic impact on their education. Private support enhances the College's ability to attract and retain the best faculty and students, develop new programs, enhance existing initiatives, create and renovate facilities, upgrade equipment and licenses, and more, by providing a flexible revenue source above and beyond the monies that are provided by the state.

Our annual fall Leadership Dinner, which serves as our annual Board of Directors Dinner and honors Dean's Circle members, had 112 people in attendance and was held at Park Alumni Center. The annual Endowment Dinner, held at McKimmon Center, was attended by 250 donors and students.

The College Relations Committee of the NCSEF Board of Directors again hosted a series of recruiting events in Charlotte, Hickory, Greensboro, Raleigh, Winston-Salem and Wilmington. In addition, the NC State Engineering magazine, which is underwritten by the NCSEF and sent to all engineering and computer science alumni, received an Award of Excellence from the Council for the Advancement and Support of Education (CASE) District III. This marks the second year in a row that the magazine has received an Award of Excellence.

Infrastructure

The highlight of the year was the completion of Engineering Building III, which was was occupied in the summer of 2010. This marked a tipping point for the College with more than two-thirds of the College now located on Centennial. EB III houses the Joint NCSU/UNC Department of Biomedical Engineering and the Department of Mechanical and Aerospace Engineering and provides state-of-the-art laboratory space, a new wind tunnel facility and much-needed office and classroom space. It also houses major interdisciplinary centers including CASL as well as new space for our faculty development efforts.

Unfortunately the current economic downturn and the legislative budget cuts have put funding for the fourth and fifth engineering buildings on Centennial Campus in jeopardy. In 2009-10, the NC Senate pushed forward a bill to provide a bond for funding the planning and construction of EB IV and other buildings and capital improvements; however, this bill fell short of the required votes to pass. Support for the design and construction of these buildings and the completion of the move of the College to Centennial Campus remains a high priority as it is critical to the growth and success of the College and University.

Issues of Concern for the Future

NC State and the state of North Carolina can take pride in the outstanding accomplishments and the excellent national and international reputation of its flagship College of Engineering. While the College made significant progress in many areas of engineering research and education prior to 2007, this progress had not kept pace with that of other colleges of engineering that were once comparable peers. With the support of our state legislature, efforts since 2007 have focused on addressing faculty and capital infrastructure needs that are critical for the College to take its rightful place among the leading colleges of engineering in the world.
The operational support received in 2010-11 allowed the College to hire 12 more faculty in interdisciplinary areas such as bioengineering and health systems, energy and environmental systems. Investment in this area is an important step in increasing the number of research active faculty to a level more comparable with peer colleges of engineering. The College's ability to continue to recruit and retain outstanding faculty will be a major challenge as we move forward with the growth of the College. This challenge is made more difficult by the recent downturn in the economy and the planned budget cuts for FY11-12.

Similarly, the capital infrastructure support provided since 2007 facilitated the construction of Engineering Building III. Completion of EBIII was a critical step in the College's move to Centennial Campus, its future growth, and the realization of its mission. While the current budget situation has delayed support for the planning and design of EB IV and V and their eventual construction, funding for these buildings and the completion of the move of the College of Engineering to Centennial Campus is our highest priority.

It is critical for the College to maintain the positive momentum that has improved its stature nationwide. The impact of legislative support in maintaining this momentum and growing the

quality and quantity of engineering talent the College provides to the state as well as the economic impact of the many endeavors carried out by the College throughout the state cannot be understated. Many of these endeavors are also a result of the federal and external support generated by the faculty who have been hired through prior legislative allocation. These same faculty have successfully attracted important investments from the Department of Energy, the National Science Foundation and other federal agencies. While these other sources of support are crucial they do not replace the necessary investments from the state.

With one of the largest enrollments in engineering in the country, the College is a major producer of high-quality engineering talent for the state and nation. This distinction helps North Carolina attract major companies and helps fuel the state's economy. The ability to grow the College's enrollment and provide greater access to engineering education throughout the state depends on legislative support. Since it is clear that the level of state support will likely decrease in the near future, being able to attract more support from the private sector as well as revenue sources such as differential tuition for engineering majors will need to be considered to maintain the growth, both in size and reputation, of the College. Related concerns and challenges include increasing research expenditures, increasing endowment holdings for scholarships, fellowships and professorships, and expanding distance education activities across the state, nation and world.