MASTERING COMPLEXITY

SETTING A NEW STANDARD FOR ENGINEERING RESEARCH AND EDUCATION
One thing I’ve learned during my tenure as dean is that even the most confident predictions about the future are subject to change. When I assumed the post of interim dean in 2004, the nation was in the midst of an economic boom that, in retrospect, turned out to be a bubble. When that bubble burst, the consequences for the School were severe.

Fortunately, I’ve also learned that there are two essential elements that can help an organization weather the challenges it faces, no matter how unexpected. The first is a plan. The signature document of my term as dean is the School’s strategic plan, developed over the course of a year with input from the entire Engineering School community. We have worked steadily since then, focusing our creativity and resources on implementing it. It has served as our touchstone in good times and bad.

The second is extraordinary people. I am grateful to the School’s faculty members, who have maintained their focus on conducting intellectually significant, societally meaningful research while creating an educational environment that is both demanding and engaging. In addition, I have been fortunate in assembling an administrative team that has dedicated itself, often under difficult circumstances, to advancing the School.

It is also thanks to supportive University leadership and the generosity of our alumni that the Engineering School is in such a strong position as we turn to Craig Benson, the School’s 13th dean, for leadership.

On behalf of the School, I welcome Craig and ask you to join him in taking the School to new heights.

James H. Aylor
Dean of the School of Engineering and Applied Science
Louis T. Rader Professor of Electrical and Computer Engineering
State of the School

Thanks to steps taken in recent years, the Engineering School is better positioned than ever to create rewarding educational programs and career opportunities for our students, to increase and diversify our research portfolio, and to contribute to the economic strength of the Commonwealth.

Kevin Eisenfrats

A team led by nanomedicine engineering major Kevin Eisenfrats (ES ’15) won the $20,000 first-place prize at the University’s Entrepreneurship Cup competition.

George Christ

The opportunity to collaborate with other experts at the University proved a powerful inducement for George Christ, a leader in tissue engineering, to join the Engineering School.

Halle Yungmeyer

Meeting Halle Yungmeyer (ChE ’16) helped persuade Eastman Chemical executives to include the Engineering School in the company’s recruiting efforts.

Craig Benson — 13th Dean of the Engineering School

In July, National Academy of Engineering member Craig Benson will become the 13th dean of the Engineering School. He arrives in Charlottesville from the University of Wisconsin, where he chairs the Department of Civil and Environmental Engineering and the Department of Geological Engineering, co-directs the Office of Sustainability and directs sustainability research and education. He is also an affiliate professor at Wisconsin’s Nelson Institute for Environmental Studies. A team led by University Professor Emerita Anita Jones chose Benson after an extensive international search.

VISIT US ONLINE: www.seas.virginia.edu
The Engineering School is undergoing a remarkable resurgence. We have an energetic, productive faculty, a graduate program that creatively combines research with opportunities for professional development, and an undergraduate program that attracts some of the best students ever to attend the University. Our balanced portfolio of partnerships with government and industry is fueling innovation in research and education.

THE STATE OF THE SCHOOL

The growth of the Engineering School and the retirement of senior faculty means that more than half of the faculty in 2020 will have been with the School less than 10 years. This creates an unprecedented opportunity for the School to set a higher trajectory. Competing aggressively for a limited pool of candidates, we have succeeded in hiring faculty — at both junior and senior levels — who combine excellence in research with a commitment to engaging teaching and mentorship.

Using our strategic plan as a guide, we hired faculty this year with expertise in such fields as machine learning, medical imaging, water desalination and photonics. Equally important, we selected faculty with leadership potential. It will be their responsibility to build on our successes and guide the Engineering School well into the 21st century.

A GROWING, DYNAMIC FACULTY

Although both economic stimulus and sequestration have affected year-to-year totals, the School’s overall trend in research awards has been positive. In 2001–02, the School secured $37.9 million in research awards. In 2013–14, our faculty won grants totaling $51.0 million.

One reason for this trend is the relationships we have cultivated with corporate sponsors, including Rolls-Royce, National Instruments, Volkswagen and Trane. Our pivotal role in the formation of the Commonwealth Center for Advanced Manufacturing has positioned us to expand our industrial partnerships even further, with companies like Airbus and Canon.

We are also poised to expand our research support for government agencies, thanks to the efforts of the University’s Applied Research Institute. This year, it negotiated a task order agreement that allows the Naval Air Warfare Center Aircraft Division to fund a variety of research efforts in areas that include cybersecurity and big-data analytics.

A DIVERSE PORTFOLIO OF PARTNERSHIPS
A SNAPSHOT OF THE SCHOOL

FACULTY
141 tenured/tenure-track faculty
4 members of the National Academy of Engineering
$51 million in research awards

UNDERGRADUATES
2,669 undergraduates
31st in the U.S. News & World Report undergraduate ranking
1,403 mean SAT score
29.7% of applicants offered admission
31.3% of total enrollment are women
14.5% of total enrollment are minorities
572 bachelor’s degrees awarded last year

GRADUATES
648 graduate students on and off Grounds
39th in the U.S. News & World Report graduate ranking
96 doctorates awarded last year, a School record
126 master’s degrees awarded last year

AN ENERGIZED GRADUATE PROGRAM

The Engineering School has developed a comprehensive model of graduate education, one that aligns closely with the principles that shape the undergraduate experience. We now offer professional development programs for graduate students that complement their research. These programs include a research skills seminar series on such topics as publishing, oral presentations and research ethics, a teaching internship program pairing students with faculty mentors, and internships at corporations through relationships with companies like Rolls-Royce, AbbVie and Alcoa.

As a result of these initiatives, we have been able to recruit an increasingly impressive group of students. One sign of their accomplishment is their ability to secure highly competitive national fellowships once they arrive. The National Science Foundation Fellowship, the National Defense Science and Engineering Graduate Fellowship, and the NASA Earth and Space Science Fellowship are just a few of the awards our students have received.

THE UNIVERSITY’S BEST UNDERGRADUATES

Our goal at the Engineering School is not simply to convey knowledge. It is to give students the skills and insights they need to shape that knowledge into an instrument of change. Accordingly, the Engineering School is distinguished by the technical rigor and relevance of the education we provide, as well as by the many opportunities we offer for student research, experiential learning and entrepreneurship.

This distinctive approach to engineering education — at once broad and deep — is the reason the nation’s best students are applying to the School in ever-larger numbers. This year, a record 5,715 students applied to the Engineering School. We offered admission to just 29.7 percent. Because of our increased selectivity, the Engineering School Class of 2018 has the highest mean SAT scores of students of any school at the University.

It is due to our success in realizing our vision that the Engineering School’s undergraduate program has moved to 31st place in the U.S. News & World Report rankings.
Never before has the Engineering School grown so much in such a short time. Since 2002, we have added new buildings for biomedical engineering, chemical engineering, nanotechnology, information technology and experiential learning. By mobilizing philanthropic giving and leveraging state and institutional investment, we’ve increased the gross square footage of the School by 73 percent (details shown in the chart above).

**BUILDING A 21ST-CENTURY PLATFORM FOR ENGINEERING RESEARCH AND EDUCATION**

The generosity of our alumni and friends has been essential in our ability to provide light-filled, flexible spaces that enable faculty members to move easily from lectures to group projects.
The engineering course fee, approved by the Board of Visitors three years ago, and support from corporations like Rolls-Royce have enabled the School to renovate old facilities and purchase new equipment, such as a modern distillation column.
Applications to the Engineering School are at an all-time high. Potential students value the superb technical education we provide, the priority we place on close student/faculty interaction and the opportunity to learn from researchers who are defining their field. They also know they will have the chance to conduct research in faculty labs, gain hands-on experience solving engineering problems in our experiential learning labs and have the occasion to present their work to others as part of their Capstone projects. Finally, students apply to the Engineering School because they want to take advantage of all the resources of one of the nation’s best public universities.

Gina O’Neil (CEE ’15) loves the real-world applicability of civil engineering. “Climate change and water shortages only underscore the importance right now of having good civil engineers,” says O’Neil, a civil engineering major concentrating in environmental and water resources.

Last summer, she gained insight into how civil engineering can be applied to ancient worlds as well. Since 2010, Professor Richard Miksad has brought several teams of students to Peru to study Incan sites that have deteriorated because their original drainage systems had been disrupted. O’Neil and her fellow students helped collect the missing data points to complete a 3-D model of the temple site Saqsaywaman.

“We believe their original topography was meant to divert rainwater to very specific locations on the site, protecting the structure,” she explains. The group is using its model as a basis for restoring proper drainage. “It was really cool to see that a civilization so long ago had such intricate plans and engineering,” she says. O’Neil incorporated the work into her senior thesis, a proposal to the Peruvian government describing how it can regrade the site.

O’Neil’s plans after graduation include working with an environmental firm specializing in land development or water treatment. “My project in Peru showed me that a wide range of situations call for technical input from civil engineers,” she says.
KEVIN EISENFRATS
MAKING SURE ALL PETS ARE WANTED

Biomedical engineering students are bright, curious and, most of all, inventive. But as nanomedicine engineering student Kevin Eisenfrats (ES ’15) notes, “Engineering students often think of great ideas for products, but most of them are eventually put on a shelf and forgotten.”

Eisenfrats himself was one of those students, but an email invitation to attend a meeting organized by BioTrep, an organization formed by three recent U.Va. alumni to promote student entrepreneurship, changed all that. In November 2014, Eisenfrats’ four-person team — including first-year students Ann Liu, Melissa Pena and Alexander Karimi — won the $20,000 first-place prize at the University’s Entrepreneurship Cup competition. Their product: Contraline, a gel-based contraceptive injection for dogs and cats. Eisenfrats has been accepted by the Darden School’s i.Lab at UVA Incubator to continue work on the project.

“The guidance and support I gained from the BioTrep community was critical to this success,” he says.

Eisenfrats has a long-standing interest in reproductive health. For the past three years, he has worked at U.Va.’s Center for Research in Contraceptive and Reproductive Health, directed by Professor John Herr, and has studied in vitro fertilization as an intern at the National Institutes of Health. When Alex Zorychta (BME ’13), one of the co-directors of BioTrep, challenged the students attending the meeting to identify an issue that lacked a good solution, Eisenfrats proposed population control for dogs and cats. Current neutering procedures are costly, invasive and irreversible and also change the animal’s hormone balance.

Zorychta encouraged Eisenfrats to confirm the need by interviewing veterinarians and animal-shelter operators. Eisenfrats worked with the BioTrep team, which includes Shaun Moshasha and Ian Rahman, both graduates of the McIntire School’s M.S. in Commerce program, on his business plan and SWOT (strengths, weaknesses, opportunities and threats) analysis. He also refined his presentation with Elizabeth Pyle, the Engineering School’s associate director for technology entrepreneurship.

In providing this guidance, the BioTrep founders are sharing entrepreneurial experiences that they gained in the process of translating their ideas into potentially commercial products. Zorychta and Moshasha were members of the University team that developed a rapid, inexpensive diagnostic test for whooping cough. They took a silver medal at the Americas East Regional Jamboree of the International Genetically Engineered Machine (iGEM) competition in 2012. On returning to Grounds, they took first prize in the 2012 Entrepreneurship Cup and secured a U.Va.-Coulter Translational Research Grant to fund further development.

“We were lucky to encounter mentors at every stage of the process,” Zorychta says. “We felt that by building a student community around innovation, sharing our experiences and insights, and helping students connect with local resources, we could make the process easier for students interested in being biotechnology entrepreneurs.”
Jonna Adadevoh (ChE ’17) hadn’t originally intended to become a chemical engineer. She left Nigeria for the University of Delaware at 18 planning to become a physician. Initially, she turned to chemical engineering as a way to meet her pre-med requirements, but given the excellence of Delaware’s chemical engineering program, this proved to be a risky strategy. Four years later, Adadevoh arrived in Charlottesville to pursue a doctorate in chemical engineering.

“I was attracted to the department because of the quality and variety of research projects I could take part in,” Adadevoh says. Growing up in Nigeria, she was acutely aware of problems caused by groundwater pollution, especially in areas dominated by the oil and gas industries. This was one of the reasons that led her to join Professor Roseanne Ford’s lab and work on bioremediation, the use of bacteria to remove chemical pollutants from groundwater.

Currently, most attempts to clean groundwater rely on surfactants, which allow pollution to be flushed from the aquifer, or on encouraging naturally occurring microbes that use pollution as a food source. Neither method can effectively reach pockets of pollutants trapped in layers of sand. Adadevoh is exploring the use of chemotactic bacteria, chosen for their attraction to specific polluting chemicals, as an alternative. When she injected bacteria into a laboratory sand column, she found that approximately 50 percent more of the chemotactic bacteria remained in the column, compared to the nonchemotactic bacteria. This suggests that the chemotactic bacteria were attracted to the pollutant.

The next step is to conduct mathematical modeling and simulation to determine if the chemotactic bacteria retained in the sand column can enhance naphthalene degradation.

Adadevoh has become adept at explaining her research to specialists and nonspecialists alike. This past fall, she presented a poster on her research at the Ninth International Symposium on Subsurface Microbiology. Adadevoh recently took the $1,000 first prize at U.Va.’s Three Minute Thesis (3MT) Competition, which tests graduate students’ ability to explain their research clearly to a general audience.
J. Scott Remer (SIE ’16) has always been interested in teaching. In fact, it was an important reason why he decided to pursue a doctorate. But with the exception of serving as a teaching assistant while a master’s degree student at George Mason University, he had no real experience as a classroom instructor. Before completing his doctorate at U.Va., he wanted to find out what it would be like to teach a course. The Engineering School’s Graduate Teaching Internship Program gave him the chance to find out.

The program gives students considering an academic career the opportunity to develop and co-teach a course with experienced faculty mentors. Students selected for the one-semester fellowship receive a stipend to compensate them for time away from research.

A Jefferson Fellow interested in the social and economic impacts of engineering, Remer enlisted Associate Professor Garrick Louis as his mentor. Together they taught Ethics in Engineering Research and Practice, a graduate seminar that Remer had already taken. Starting with a syllabus that Louis had developed, they collaborated on lecturing and leading discussions, devising assignments and quizzes, and grading papers.

For Remer, it was an eye-opening experience that gave him a more nuanced understanding of a teacher’s responsibilities. He was impressed by the amount of preparation it takes to lead a class. “When you make a presentation as a student, you get a round of applause for your effort,” Remer says. “As a teacher, your ability to speak extemporaneously about any aspect of the material is taken for granted.” Remer also realized that students assume that a faculty member’s knowledge is definitive as well as comprehensive. “As a faculty member, you have to be careful about how you present the material,” he says. “This is especially true in a field like ethics.”

Louis was gratified to see that Remer gained confidence in his teaching as the semester progressed. “At the beginning of the semester, Scott was so conscious of his need to master the material that he overprepared, precluding time for discussion,” Louis says. “Over time, he became comfortable with a more open approach, touching on the main points and allowing students to learn actively by encouraging discussion.”
As a young researcher, Professor George Christ focused on the molecular mechanisms that cause tissue to lose function over time. The longer he worked on this problem the more he became fascinated with the potential of reverse-engineering these processes and restoring lost function. From there, it was a short intellectual leap to manipulating these processes to create new tissue to repair congenital defects or the damage caused by trauma.

The motivation behind his research is not simply intellectual. While at Wake Forest’s Institute for Regenerative Medicine, Christ began conducting research for the Armed Forces Institute of Regenerative Medicine, which is dedicated to advanced treatment options for severely wounded service members. Christ is part of its craniomaxillofacial reconstruction program, which draws on the combined expertise of specialists in different fields to develop...
A top undergraduate student at Tsinghua University in Beijing, Assistant Professor Yanjun Qi had the opportunity to conduct research with a faculty member on methods of multimedia data mining. It changed her life.

An earlier homework assignment on computer recognition of written characters whetted her interest in machine learning. Her research project confirmed it. “I found that I really enjoyed the process of developing mathematical techniques that could be used to identify patterns in the data,” Qi says.

Over her career, Qi has applied machine learning in a variety of contexts, most recently in biomedical and health care applications. “There are many data-driven problems you can tackle,” she says. “I want to work on projects that can make a difference.”

Qi has worked with Professor John Lach, chair of the Charles. L. Brown Department of Electrical and Computer Engineering; postdoctoral fellow Jiaqi Gong; and graduate student Philip Asare to analyze the potential of using gait monitoring as an indicator of health. Their research won the best-paper award at the ICST BodyNets conference this past fall.

Qi has also become an affiliated faculty member with the Medical School’s Center for Public Health Genomics, which is dedicated to translating discoveries about genes and gene interactions into advances in health care and disease prevention. With Mazhar Adli M.D., an assistant professor in the Department of Biochemistry and Molecular Genetics, she is exploring the use of machine learning to discern patterns at the genome and epigenome level related to human disease and cell development.

Qi looks at her teaching as an opportunity to encourage new generations of students to pursue their interests in machine learning, much as her teachers did for her. She enjoys the challenge. “There’s no one way to mentor students,” she says. “I adjust my approach depending on their character, personality and passion.”

complex, multitissue composites for restoring function to wounded warriors.

“The explosive forces of devices like IEDs have created injuries to these young men and women that are quite disfiguring and disabling,” Christ says. “These are people who gave everything they had for their country. You just want to do something to help them.”

With substantial new support from the Department of Defense, Christ has developed a muscle repair technology platform to address volumetric muscle loss injuries, instances in which muscle loss is so significant that the body cannot heal itself. He is also designing a treatment for cleft lip in adults that has the potential to serve as a meaningful prototype for more extensive facial repairs. He plans to submit an application to the Food and Drug Administration to begin clinical trials of this technology later this year.

The opportunity to work with collaborators who could complement and extend his expertise was a powerful inducement for Christ to join the Department of Biomedical Engineering at the beginning of the 2014–15 school year. If he were to advance beyond the small volume of tissue required to repair cleft lip, for instance, he would need expertise in such fields as multiscale modeling, muscle mechanics, angiogenesis, molecular-level analysis and vascular imaging. It would also be critical to work closely with experts in orthopaedics.

The Engineering School has world-class programs in all of these areas. Christ was also offered a joint appointment in the Medical School’s Department of Orthopaedics as the Mary Muilenburg Stamp Professor in Orthopaedic Research, providing an opportunity to create a transformational research enterprise in muscle repair. “U.Va. is a great fit for me,” he says. “Much of the expertise that could help take the technology to the next level is right here.”

VIDEO
Join Professor George Christ in the laboratory to learn more about his efforts to regenerate muscle tissue.

www.uvef.seas.virginia.edu/regenerative-tissue-research-at-u-va/
Eric Starkloff (EE ’97), executive vice president of global sales and marketing for National Instruments (NI), says, “We have a fundamental belief that our tools can improve the teaching of science and engineering concepts.”

When the Charles L. Brown Department of Electrical and Computer Engineering took up curriculum reform in 2013, the faculty set its sights on better integrating knowledge across the curriculum and making active, hands-on learning the centerpiece of our courses. These goals, in turn, led naturally to a change in teaching style, a shift from the traditional lecture-lab arrangement to studio-style classes that emphasize hands-on learning and collaborative projects.

NI was instrumental in helping the department achieve this vision. Just as it was reinventing its introductory courses for majors (the three-course Fundamentals sequence known as the FUN classes) as a studio sequence, the company introduced VirtualBench, which combines five traditional benchtop instruments in a single, compact device.

“We couldn’t have created studios without it,” says Associate Professor Harry Powell, who also serves as the director of instructional labs.

But the relationship is not one-sided. NI has started stepping up its recruiting of ECE students, finding them an excellent fit for its Engineering Leadership Program. “We are looking for students like Kyle Teegarden (ECE ’14) who are really strong technically in engineering and who also have the potential to be business leaders in different parts of our company,” Starkloff says. “With its emphasis on communication, U.Va. is an excellent place for us to recruit.”
Finding and hiring new employees used to be called recruiting. Now it is called talent acquisition, a new name that signals a change of philosophy by large corporations. Talent acquisition reflects the recognition that hiring is a cost, susceptible like other costs to analysis to determine how to maximize return on investment. In the past, companies cast their nets widely, but today many find it more cost-effective to concentrate on a limited number of universities. They offer internships only to their students, send recruiters only to their job fairs and hire only their graduates.

This approach puts departments like U.Va.’s Department of Chemical Engineering at a disadvantage. Corporations question the wisdom of devoting time and resources to visit a school with 40 chemical engineering majors when they could visit a school with 400.

Fortunately, we have a persuasive answer: the exceptional quality of Engineering School students. When corporate recruiters meet them, they find their combination of technical and leadership skills irresistible. The challenge has been to get them in front of recruiters — and in this regard the School’s students, assisted by alumni and faculty, often play a decisive role.

Take the case of Halle Yungmeyer (ChE ’16). Yungmeyer grew up in Kingsport, Tennessee, the home of Eastman Chemical. A transfer student from the College of Arts & Sciences, Yungmeyer thought that a summer internship at Eastman Chemical after her first year would be the ideal way to confirm her decision to become a chemical engineering major. She enlisted Professor Roseanne Ford’s help, who contacted recruiters at Eastman Chemical. The response Ford received was discouraging. Yungmeyer could submit her resume, but because U.Va. was not a target school, her chances of being awarded an internship were slim. The department submitted two resumes the following year, but with similar results.

Coincidentally, the University was pursuing closer ties with Eastman Chemical through its Strategic Corporate Partners program. Pace Lochte, the University’s assistant vice president for strategic initiatives, learned of Yungmeyer’s background and made a point of enlisting Yungmeyer, a University Guide, to give tours for Eastman senior executives. “They were impressed by how articulate she was, especially in explaining why she enjoyed being an Engineering student at U.Va.,” Lochte says. “She was one of the reasons why Eastman added us to its list of target schools.”

This year, Eastman Chemical attended the Engineering School’s career fair, and Yungmeyer was the first student offered an internship. “It will be great working for a company that played such an important role in my daily life growing up,” she says.
INVEST IN OUR FUTURE

As this issue of UNBOUND makes evident, the Engineering School is undergoing a remarkable resurgence. This direction would not be possible without substantial and sustained investment in the School — by dedicated faculty, by the University and Commonwealth, and by our many benefactors.

They have invested their hopes and aspirations, their intellect and creativity, and their time and money to advance our School's mission — and they have made a difference.

There is more to be done. As we welcome Craig Benson as our 13th dean, we ask you to join us at www.giving.virginia.edu/engineering as we take the Engineering School to new heights.

JOIN THE CONVERSATION

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