

VEU

VILLANOVA ENGINEERING UPDATE

VILLANOVA UNIVERSITY COLLEGE OF ENGINEERING



DEAN'S MESSAGE

"When I was here we didn't have the opportunity to take classes in other programs." That's the response I frequently hear from advisory board members and alumni when they learn of the variety of courses and minors that today's engineering students have access to. It's true that things have changed in recent years as we've turned our focus to educating "whole brain" engineers whose holistic development sets them apart in today's dynamic workplace.

At our recent Engineering Advisory Board meeting there was evidence of this big picture approach as we gathered with Patrick G. Maggitti, PhD, the Helen and William O'Toole Dean at the Villanova School of Business, as well as members of his advisory council. The purpose for meeting together was to give each board a broader view of what is going on across the campus in teaching and research, as well as to communicate the increasing emphasis on collaboration and opportunities for cross-college learning.

Campus-wide there are many examples of interdisciplinary and multidisciplinary learning taking place:

- Service learning like the Nicaragua telehealth project, which involves students from Nursing, Business and Engineering (see "Service Learning that Saves Lives" on page 6)
- ICE CaPS - the Innovation, Creativity, and Entrepreneurship Certificate program for Sophomores of any major
- Entrepreneurial competitions that bring together multidisciplinary teams of students

- An interdisciplinary course that joins students from Engineering, Liberal Arts and Sciences and Business in solving a real-world problem (in 2013-2014, the course is International Technology and Sustainability and the focus will be on a project in Panama)

In addition to the learning opportunities for our students there are also opportunities for our faculty to work together on research and graduate teaching. As each of the Colleges expands into new areas of research we continue to seek ways that we might leverage our individual strengths synergistically to solve important problems facing the country and the world.

Throughout this first issue of the Villanova Engineering Update (VEU), our new annual publication, you'll find stories that illustrate the College and University's commitment to preparing and educating engineers who will be society's future technical leaders working to solve complex global challenges.

ENJOY THE VEU!

Gary A. Gabriele, PhD, Drosdick Endowed Dean
Villanova University College of Engineering

\$500,000 GRANT REWARDS COLLEGE'S COMMITMENT TO WOMEN IN ENGINEERING

Since joining Villanova University seven years ago, Gary A. Gabriele, PhD, Drosdick Endowed Dean of the College of Engineering, has made it a priority to increase the number of female students and faculty in the program. In that regard, the 2012-2013 academic year has been a great success. In addition to receiving a \$500,000 grant to support three new female professorships, Villanova's College of Engineering has surpassed the national average in its percentage of female students and faculty.



Clare Boothe Luce Assistant Professors Verica Radisavljevic-Gajic, Seri Park and Nisha Kondrath with Mechanical Engineering Professor Amy Fleischer

Recognizing the College's ongoing commitment to encouraging and supporting women in engineering, Villanova was the recipient of a \$500,000 award from the Henry Luce Foundation's Clare Boothe Luce (CBL) Program. This grant marks the first time the Program has awarded three CBL professorships to the same university in one year. Since 1989, the CBL Program has funded scholarships, fellowships and professorships for female students and professors. In fact, it has become the single most significant source of private support for women in science, mathematics and engineering in the nation.

“The Clare Boothe Luce Grant recognizes the efforts of Villanova's College of Engineering in opening more doors for female engineers. Under the leadership of Dean Gary Gabriele, the College provides a supportive atmosphere in which women succeed.”
Rev. Peter M. Donohue, OSA, PhD,
Villanova University President

Dean Gabriele sees women on the engineering faculty playing a key role in encouraging female college students to pursue careers in this field: "To be able to attract more women to engineering first

requires that we have women faculty to mentor and demonstrate to young women that engineering is a valid career path for them to consider. The Villanova College of Engineering has been working hard to increase enrollment of women engineering students and we have been able to raise female enrollments to almost 30% of our total, while also retaining female students at the same rate as men. Increasing the number of women faculty has been a key ingredient in that success, and the CBL award allows us to make a significant increase in the number of women faculty."

Women have made up 50 percent of the College's new faculty hires over the past five years, including these Clare Boothe Luce Assistant Professors:

- Seri Park, PhD, Civil and Environmental Engineering
- Nisha Kondrath, PhD, Electrical and Computer Engineering
- Verica Radisavljevic-Gajic, PhD, Mechanical Engineering

As Dean Gabriele noted, the College of Engineering has also been successful in steadily increasing female enrollment over the last 10 years. The percentage of women in the fall 2012 freshman engineering class was 31 percent, compared to 19 percent in 2003. The national average for female engineering undergrads is currently 18.2 percent.

"There is a good deal of misconception and miscommunication about the field of engineering that deters many women, but I believe we are in a time of transition when we're seeing increasing numbers of women engineers assuming leadership positions in the industry," says Amy Fleischer, PhD, Professor of Mechanical Engineering. "As women engineers in leadership become more visible, they can serve as role models and mentors to the next generation of women engineers."

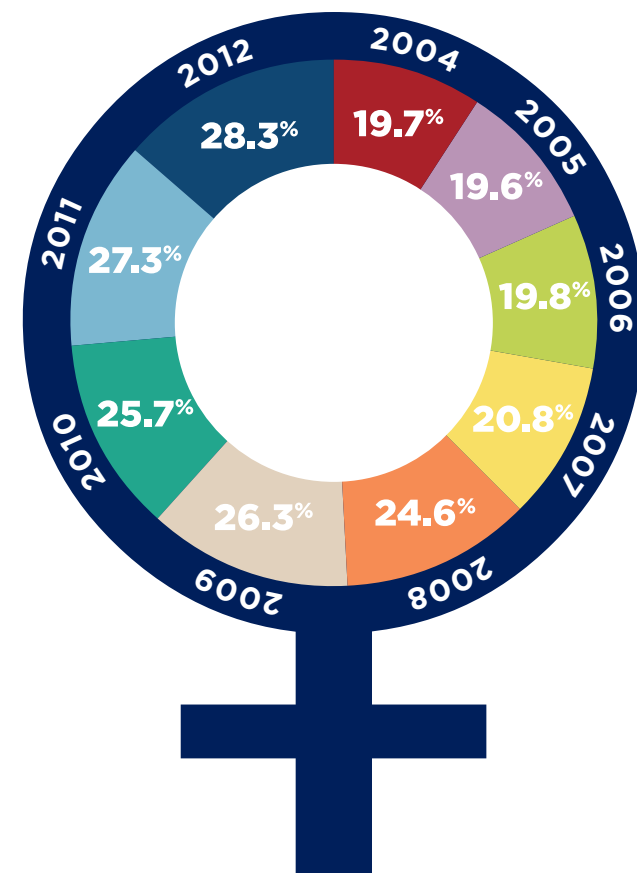
One of those women engineers in a position of leadership is Susan Ward '80 ChE, head of Mergers and Acquisitions and Commercial Finance at Shell Oil Company. Ward believes one of the keys to engaging more women in this field is to spark their curiosity. "Engineers get to work on some of the most amazing projects! We need to expose girls and young women to the types of projects undertaken by engineers, as well as the associated technologies," she says.

Many factors have impacted the College's success in attracting talented female students, including extensive outreach programming. Ward also credits the College's success to "high faculty-to-student ratios, a focus on quality teaching, the characteristics of faculty valued and hired by the University administration, and most importantly, its supportive environment." Liesl Krause '16, an electrical engineering major and member of the College's Society of Women Engineers (SWE), agrees. "I think that

Villanova's College of Engineering attracts so many women because of their encouragement," she says. Liesl adds, "One of the reasons so few girls are interested in engineering, and other STEM fields, is because there is still a stigma that women are not supposed to be interested in the subject. Even from a young age we grow up learning that Legos™ and Bob the Builder™ are for boys, while Barbie™ and Dora the Explorer™ are for girls. One of the best ways that we can encourage women to join engineering is to simply remind them that they are capable of being an engineer."

Steady increase in percentage of female students in the College of Engineering

National average for engineering undergrads: 18.2%





24 Hour Imagination Quest team begins brainstorming in the Multidisciplinary Design Lab.



Team "Fun Run" celebrates its victory.

ENTREPRENEURIAL ACTIVITIES GIVE VILLANOVA STUDENTS AN EDGE

Today it's not enough for engineers to possess solid, or even exceptional technical skills. In the dynamic and increasingly competitive global marketplace, employers need whole-brain thinkers who can innovate and create; strategize and lead; collaborate and execute. Villanova's College of Engineering graduates such engineers.

In 2008, the College of Engineering launched its unique minor in Entrepreneurship for Engineers, and helped create and produce a number of campus-wide programs and resources to foster the development of the entrepreneurial mindset throughout the Villanova community. As part of the Center for Innovation, Creativity and Entrepreneurship (ICE), the College of Engineering is helping engage students in cross-college, interdisciplinary collaborations. Each year, the University sees increasing interest and involvement in these courses and related competitions.

ENGINEERING ENTREPRENEURSHIP

The engineering entrepreneurship initiative receives support from the Kern Family Foundation whose objective is to instill engineers with a "big picture" mindset that enables them to contribute to business success. Serving as a catalyst for the Engineering Entrepreneurship minor and many of the University's creative and entrepreneurial activities is director Edmond J. Dougherty '69 EE, '86 MSCS. Dougherty's objective is to unleash an entrepreneurial mindset on campus, especially for engineers who tend to focus only on the technical aspects of a project. "Through exposure to entrepreneurship, students begin to see the bigger picture as a systems problem, to consider the customer, the societal impact of their work and of course their own careers and personal lives. It's about more than technology for technology's sake," he explains. Clearly students are eager to see the big picture. Enrollment in the Engineering Entrepreneurship minor increases each year. Currently, 20% of freshman engineers have signed up for the minor, the largest in the College.

Among the specific lessons students learn in the Engineering Entrepreneurship minor is how to make the "pitch." Dougherty spends a good deal of time helping them become comfortable with telling their product's story - as succinctly as possible. "We teach the students they need to be able to explain their ideas, hopes and dreams in less than a minute. We call that an 'elevator pitch' because they should be able to convince an important person they meet on an elevator to be part of their vision before the elevator reaches the executive floor. And to add drama, we actually have the students give their pitches in an elevator," says Dougherty. "Those in the entrepreneurship minor probably give their elevator pitch a dozen times a year." Other related exercises include the grandparent/grandkid pitch. Dougherty says, "You need to be able to explain your idea so your grandparents and their grandchildren can totally understand it. If they can't - it means you

have more work to do understanding it yourself." Idea Bounce is another technique described by Dougherty as "karaoke for innovators, where students individually stand up in a room full of entrepreneurs and faculty and explain their ideas and obtain instant feedback." And then there are the 50/50 interviews, which require student teams to speak face to face with 50 potential customers in 50 days to gauge market interest and gather feedback on their product concepts.

The students' hard work culminates in a trade show in April, which draws hundreds of people from around the Philadelphia area. For this event, student teams in the Engineering Entrepreneurship minor set up display booths of their own design to present their prototypes and explain their business concepts to passersby. They are required to have a person on their team do an exit survey with each visitor to gauge how well the visitor understood the presentation.

Why does Dougherty think there's so much interest in the Engineering Entrepreneurship program? "The students describe it as 'refreshing,'" he says. "It's very different from what engineering students usually do and requires them to use the other side of their brain. There's also increasing awareness of the importance of being well-rounded and having a higher level of systems thinking and creativity to differentiate you in the workplace."

ENTREPRENEURIAL COMPETITIONS

With encouragement from Dougherty, Il Luscri, Director of the ICE Center, and many others on campus, students are engaging in an increasing number of opportunities to test their creative, technical and business acumen. In addition to engineering-specific competitions, there are a variety of interdisciplinary challenges campus-wide, and national contests present even more possibilities. Here is just a sampling of the competitions that engineering students entered in 2012-2013:

24 Hour Imagination Quest

Introduced this year, Imagination Quest is a 24-hour challenge during which interdisciplinary teams demonstrate their creativity and originality. Supported by funds from a Kern Entrepreneurship Education Network (KEEN) grant, Villanova invited the University of New Haven, a fellow KEEN member, to participate. The group formed five teams, each tasked with identifying an opportunity, developing a vision and proposing three possible solutions. What followed was a 24-hour whirlwind of activities that included:

- Elevator pitches for their initial product ideas
- Selecting the best solution
- Planning a prototype
- Marketing the idea
- Creating the prototype
- Developing and presenting a trade show for their product

The final step on Sunday morning required each of the teams to make a 10-minute pitch in the "Cat Cage," a boardroom with Apprentice/Shark Tank-style judges who tested the teams' entrepreneurial skills with probing questions.

Paul Pelullo '16 EE was a member of the winning team, Alpha Dogs. He enjoyed the experience and would happily participate again, though he did acknowledge the challenges. "It's difficult at first because you have very little time to get to know each other and you censor yourself because you don't want to risk offending someone," he says. Paul adds, "Working with a team that you don't know does have its advantages, however. It forces you to think outside of the box and stops you from falling into the same rhythm that you might have with a team you've worked with before." Another Imagination Quest competition is anticipated in the fall of 2014.

“ I was amazed by how students from two universities bonded in only 24 hours, the set of skills they all possessed, the level of energy in the room, and the skill of the freshmen who participated. ”

Imagination Quest judge Dr. James Klinger, Assistant Professor of Management and Operations and faculty director of Villanova's Center for Innovation, Creativity and Entrepreneurship

Villanova Student Entrepreneurship Competition (VSEC)

In 2009, the Villanova Student Entrepreneurship Competition was founded by two engineering graduate students, Ronald Warzoha and Timothy Montalbano. Created as an extracurricular, entrepreneurial experience, the competition runs the course of one semester, allowing students across various academic disciplines to collaborate and develop innovative ideas that seek to fill a need in today's world.

Just two years ago, 17 teams entered VSEC; in 2013, that number had grown to 55. From those, seven teams were selected to present their ideas to an audience of judges; five of those seven finalists teams included engineering students as members. Mechanical engineering senior Tom Belatti was with "Fun Run," the team that took first prize for its competitive, socially driven mobile application designed to add motivation and fun to exercise. This is the third consecutive year that an engineering student participated on the winning team.

The third-place VSEC award went to "Du Riz," a team of engineering juniors. Members Frederick Hesse-Tetteh CpE, Warren Chan CEE and Joseph Reckamp ChE developed an inexpensive, portable rice huller to benefit impoverished rice farmers. Du Riz also took home an award for being the most promising social entrepreneurship idea. Having first shared the rice huller idea in the 2011-2012 Annual Review ("Student Snapshot"), Joseph was pleased to report, "It's fulfilling actually getting to put the product together instead of just talking about it in class."



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Innovation Encounter team: Cameron Piper '14 ME, SeHwan Kim '14 EE, Chidananda Matada Shivananda '16 MSEE, Caroline Franchino '16 ME and Paul Pelullo '16 EE

Innovation Encounter

Last fall, five engineering students traveled to Detroit to participate in Lawrence Tech's Innovation Encounter national competition, which presents teams with a client's real-world problem. Students have less than 24 hours in which to identify a solution, create a business case and develop a presentation for the judges. Working with business leaders from Microsoft, Ford Motor Company and Masco, the Villanova team (pictured above) brought home the second place trophy.

Meyer Innovation and Creative Excellence (ICE) Award

Created and endowed by Patrick Meyer '74 VSB, the ICE Award recognize students who possess a spirit of innovation, creativity and entrepreneurship that enhances Villanova University. A faculty award was also presented.

Stephen Schraer '13 ME won the ICE Award for the College of Engineering, earning recognition for his work with the engineering service learning program and for leading the humanitarian UXO (un-exploded ordinances) robotics initiative. The faculty award went to Engineering Entrepreneurship director Ed Dougherty.

RENOWNED LECTURER

Given the campus-wide interest in innovation, creativity and entrepreneurship, Mike Nuttall was the ideal guest speaker for the 2013 Patrick J. Cunningham Jr. and Susan Ward '80 Endowed Lecture Series. An internationally renowned technology designer best known for the original Microsoft mouse, Nuttall spoke on "Design, Innovation and Entrepreneurialism." More than 300 engineering and business students attended the lecture where they were introduced to a broader understanding of design.

Dr. Gary A. Gabriele, Drosdick Endowed Dean of the College of Engineering, was pleased with the perspective offered by Nuttall's presentation. "When engineers think of design, they ask, 'Will it function?,' whereas an industrial or product designer like Mike considers how the design will present itself to the user. The intersection of these two concepts of design is something that students rarely get to see," he says.

A DECADE OF SUCCESS FOR THE CENTER FOR ADVANCED COMMUNICATIONS

With Moeness Amin, PhD, Professor of Electrical and Computer Engineering at the helm, the past decade has been very good for Villanova University's Center for Advanced Communications (CAC); however, the past two years have been exceptional. As he reflects on his 10th anniversary as CAC director, Dr. Amin is celebrating the Center's national distinction as "excellent and rare," and its largest and most competitive research grants to date.

National Recognition

A 2012 report prepared for the Industry-University Cooperative Research Center Program (I/UCRC) of the National Science Foundation (NSF), has named the Center for Advanced Communications (CAC) "an excellent and rare example of how to sustain and grow a research operation in a smaller university." In the report titled "Research Center Sustainability and Survival: Case Studies of Fidelity, Reinvention and Leadership of Industry/University Cooperative Research Centers," the authors credit leadership by a "very productive, forceful, and, from a grantsmanship perspective, entrepreneurial director" with the Center's transformation and success.

The report also identifies a number of additional factors that were critical to making the CAC successful:

- Five state of the art research labs
- Staffing which included hiring three research professors who are among the most productive faculty in the College
- Technical focus on information technologies
- Academic integration and graduate education (the Center's research professors serve as advisors to senior projects, masters, and doctoral students)
- Research quality that has produced a variety of scientific, technological and socially valuable outcomes ("a commendable record of accomplishment")

The authors note that, given Villanova's focus on student education and community engagement, and when considering the school's limited funding and research expenditures, it is "indeed an accomplishment for Villanova to mount the research talent, lab

facilities and entrepreneurial mindset to successfully maintain, and in fact grow, the CAC." They point to the Center as an "excellent and rare example of how to sustain and grow a research operation in a smaller university that is by no means nationally competitive in terms of sponsored research in science and engineering." The report recommends the CAC case to chief research officers or provosts in smaller universities that "nonetheless have aspirations to mount significant research programs in areas of niche expertise."

\$1.65M in Competitive Research Grants

Given that the NSF report describes Villanova University as "no means nationally competitive in terms of sponsored research in science and engineering," it is delightfully ironic that the Center for Advanced Communications was recently awarded a total of \$1.65 million from three different Department of Defense research agencies. In all three cases, Villanova was the sole award recipient.

The broad research area covered by these awards is radar signal processing, focusing on urban and border sensing using electromagnetic waves and a minimum number of antennas and frequencies. The individual grants include:

- Office of Naval Research - \$750,000, Dr. Amin (PI) and research professors Drs. Yimin Zhang and Fauzia Ahmad (CO-PIs). This is the largest sole competitive research grant Dr. Amin and the CAC have received since the Center's inception in 1990.
- Air Force Research Lab - \$450,000, Dr. Zhang (PI) and Dr. Amin (CO-PI).
- Army Research Office and Army Research Lab - \$450,000, Dr. Ahmad (PI) and Dr. Amin (CO-PI).

This spring, Dr. Amin and the CAC reached an important milestone with a \$1.05 million three-year award for research into the use of radar technology to assist elderly who live alone. This is the Center's first research project with direct civilian applications. Submitted to the Qatar National Research Fund under its National Priorities Research Programs (NPRP), the proposal is titled "Advanced Signal Processing and Emerging Sensing Technologies for Assisted Living." Villanova will receive 35% of the funding as it partners on this research with Qatar University. Dr. Amin will serve as Principal Investigator for the entire project, including the Qatari part.



Engineering Dean Gary A. Gabriele, Ed Dougherty, Patrick Meyer and Stephen Schraer

WHAT'S NEXT?

For the 2013-2014 academic year, the College of Engineering will be offering three sections of its Creativity and Innovation course. Normally contained to one section, the increase is in response to interest from students campus-wide. For the first time, those in the School of Business and the College of Liberal Arts and Sciences have enrolled in the course.

It's clear that Villanova students are developing a passion for a whole-brain approach to thinking, exploring, learning and creating. "We really are igniting change; I can see the entrepreneurial spirit spreading across campus," says Ed Dougherty. It's one more characteristic that will set Villanova students apart."



VSEC Team "Du Riz" explains its rice huller concept to a visitor.



Drs. Yimin Zhang, Moeness Amin and Fauzia Ahmad

Ten-Year Review

To record the accomplishments of the past decade, Dr. Amin directed the publication of a CAC Ten-Year Review, which highlights the Center's contributions to education, mentoring and research in the broad areas of:

- Communications
- Radar
- Satellite navigation
- Ultrasound

The Review also brings attention to some of the CAC's major accomplishments as evidenced by its externally-sponsored research, publications, partnerships and international collaborations. Faculty, research fellows, international visitors and alumni are also acknowledged for their contributions to the Center's decade of success.

Those interested in learning more about the Center for Advanced Communications can request a copy of the Center's Ten-Year Review by contacting Janice Moughan at 610-519-4599. You can also visit the CAC website where a copy of the Review is available for download.

VILLANOVA ALUMNI AND FRIENDS HELP ES2 DEVELOP RELATIONSHIP WITH NATIONAL INDUSTRY GROUP

In 2011, the National Science Foundation established the Industry/University Cooperative Research Center for Energy-Smart Electronic Systems (ES2), one of about 60 I/UCRC managed by the NSF in strategic U.S. technology areas. A partnership between Villanova University, Binghamton University, The University of Texas at Arlington and the Georgia Institute of Technology, the ES2 is committed to developing innovations that will make data centers – the lifeline of today's businesses – more energy efficient, sustainable and cost-effective to operate. The ES2 Villanova site leader is Alfonso Ortega, PhD, the University's Associate Vice President for Research and Graduate Programs and James R. Birle Professor of Energy Technology. While pleased with the Center's growth in its first year, Dr. Ortega recently made a connection with the data center industry that he believes will have a significant impact on ES2 for years to come.

Impressed by the Center's research, ES2 industry partners encouraged Dr. Ortega to reach out to the 7x24 Exchange, one of the most important interest groups in the data center industry. Almost all of the current ES2 members belong to the organization and it was clear to them that there were obvious mutual benefits for the 7x24 Exchange to be aligned with the Center. Dr. Ortega took the first step in establishing the relationship by hosting the group's regional meeting at Villanova in fall 2012. With the help of the 7x24 Exchange local chapter president and Villanova engineering alumnus Tom Reusche '83 BSEE, Dr. Ortega successfully hosted the group's meeting and at the same time raised awareness of ES2 with a key industry group.

Of the meeting's approximately 100 guests, Dr. Ortega was surprised to discover the number of loyal Villanova alumni in attendance. Present was alumnus Dennis Cronin '74, a 7x24 Exchange founder and one of the best known data center professionals in the country. Cronin is chief operating officer of Steel ORCA, a leader in the digital utility center industry. Dave Crocker, president of Steel ORCA (and interestingly, a former kicking coach for Villanova football), also was present and invaluable in helping to establish this collaborative relationship between the industry and academia. Dr. Ortega notes, "Dave Crocker, Dennis Cronin and Tom Reusche were key in bringing together the 7x24 Exchange and ES2. They seem to know everyone there is to know in the regional data center industry and are happy to make introductions. When I met them, I basically met everybody."

Crocker feels the connection is important and recognizes what Dr. Ortega brings to the table. "Dr. Ortega clearly appreciates the value of blending commercial, environmental and academic

interests in the data center industry. The 7x24 Exchange provides a unique instrument that allows him to capitalize on the talents and interests in the academic community for the benefit of this business and socially critical industry," he says. Cronin adds, "As a founder and the original sponsor of the 7x24 Exchange, I have always sought the engagement of the next generation to continually improve upon what we have accomplished in the past. Thanks to Dr. Ortega, the partnership we have fostered between Villanova and the 7x24 Exchange will continue to enhance industry knowledge by providing an academic curriculum addressing real world challenges through the use of engineering and business analytics."

Crocker and Cronin are in the process of establishing their own digital utility center in Princeton, New Jersey. Slated to open later this year, the facility will be home to VSORC, the Villanova Steel ORCA Research Center, which Crocker calls "a teaching hospital for data center research." As a Villanova alumnus, Cronin knows the quality of Villanova University's engineering school. "I am keenly aware of the talent and discipline in the engineering organization, and under the leadership of Dr. Ortega, I am confident that our joint investments to build the Villanova Steel ORCA Resource Center will provide a positive impact on education as well as industry," he says.

After Dr. Ortega shared the ES2 story at the 7x24 Exchange regional meeting, he was overwhelmed by the support and encouragement of alumni and the response from companies in Pennsylvania, New Jersey and New York. Since the meeting, he has networked with industry leaders, made many new business contacts and generated significant interest in the activities of the Center from potential new members.

The regional meeting was not Dr. Ortega's only opportunity to interact with the 7x24 Exchange on a large scale. Crocker, Cronin and Reusche helped take the relationship to the next level when they introduced him to the organization's national president, Bob Cassiliano, who invited Dr. Ortega and his graduate students to attend the national 7x24 Exchange annual meeting in Orlando in June 2012. This all-expenses paid opportunity allowed Dr. Ortega to present the ES2 to data center professionals nationwide. The interest in the Center was so great that Cassiliano has asked Dr. Ortega to be one of four keynote speakers for the June 2013 national meeting. In addition to presenting ES2, there will also be an opportunity for him and Dave Crocker to announce the Steel ORCA partnership. "This invitation to speak is both a huge honor and huge opportunity," says Dr. Ortega.



Dr. Al Ortega and Tom Reusche '83 EE

Villanova's ES2 Center has been embraced by both the local chapter and national 7x24 Exchange, and Dr. Ortega gives all the credit to the Center's industry partners. "They made it happen. These companies understand that the ES2 needs their support to survive and succeed," he explains. To demonstrate its commitment to its member companies and to the sustainable future of its industry, the 7x24 Exchange has decided to become a member of the ES2 as well. Reusche explains the benefits of this partnership: "Members of the 7x24 Exchange can interact with AI and the research team, discuss the pertinent issues and challenges, and share their future-state vision. This interaction should help the ES2 focus on what is important to data center-related businesses, and develop technologies these businesses will need and utilize in the future." He and Ortega look forward to a long and productive relationship.



The 7x24 Exchange regional meeting drew many Villanova alumni.



Graduate student researchers display various types of biomass materials.



Rene Garrido, Nydia Ruiz-Felix and Nicole Hammer at work in the BRCT lab

VILLANOVA ENGINEERING LAB ENGAGES STUDENTS IN BIO-OIL RESEARCH

Dr. Justinus Satrio and his research assistants are not afraid to get their hands – or lab coats – dirty. "No matter how many times I wash mine, even with bleach, I can't get it clean," says PhD chemical engineering student Nydia Ruiz-Felix. The stubborn stains she's referring to are bio-crude oils, the desired end-product of research she is conducting with fellow graduate assistants Rene Garrido and Nicole Hammer. Together they are working with a dozen undergraduates, including seven seniors and a handful of freshmen, sophomores and juniors. The entire project is being supervised by Dr. Satrio and Dr. Charles Coe, both assistant professors in the College's Department of Chemical Engineering.

Villanova University is part of a 14-member consortium led by the U.S. Department of Agriculture's Agricultural Research Service at the Eastern Regional Research Center in Wyndmoor, Pa. With \$6.8 million in funding from the Department of Energy's Biomass Research and Development Initiative, the government, industry and academic partners of the consortium are working on converting agricultural and forestry by-product materials into bio-oils. The three-year project aims to support research, development and demonstration on utilizing lignocellulosic biomass, i.e. switchgrass, forest wood wastes and animal manures, for the production of bio-crude oil via a process called fast pyrolysis. For its part, Villanova has received \$300,000 in funding to develop catalytic materials for use in the catalytic pyrolysis process and for upgrading bio-crude oil. The research is congruent with the initiatives of Villanova's Biomass Resources and Conversion Technologies (BRCT) laboratory.

"The first stage in our research is to screen different types of feed stocks to see how they work in the bio-process system," explains graduate student Nicole Hammer. "All biomass is not created equal," notes Dr. Satrio. Different forms – from paper mill sludge to mushroom substrates – offer varying quality and energy output as bio-oils. "The goal is to try to understand how biomass properties correlate to the quality of the bio-oil products," says Dr. Satrio. At its most simple utilization, the bio-crude oil being produced can act as a heating oil replacement, but its heating value is low. The goal is to find catalysts which upgrade the end-product for use in gasoline and diesel fuels, and ultimately discover a replacement for fossil fuels.

Dr. Satrio is happy to point out the many opportunities that exist for interdisciplinary collaboration in the BRCT lab. From the lab's pyrolyzer ("the workhorse"), built by a mechanical engineering student, to the biology department's growing of switchgrass as energy feedstock, a variety of disciplines are involved in the process. Dr. Satrio is also delighted by the number of students, freshmen through seniors, engaged in the work. He finds, "They are driven and passionate about issues of sustainability and the environment." Students who take part in his freshman mini-project "Biofuels and Sustainability" often stay committed to the work, volunteering their time throughout their undergraduate years and gaining valuable experience in the process. The BRCT lab serves as a prime example of what distinguishes an undergraduate Villanova engineering education from the competition – the opportunity for students, beginning in their first year, to learn from and work in the lab alongside graduate research assistants and their professors.

To learn more about research being conducted in Villanova's Biomass Resources and Conversion Technologies laboratory visit www3.villanova.edu/biomass.



Drop Foot team members discuss next steps for their project.

MECHANICAL ENGINEERING STUDENTS FILE U.S. PATENT APPLICATION FOR NOVEL ORTHOTIC DEVICE

In spring 2013, a team of Villanova mechanical engineering students advised by Dr. Young Chun, Associate Professor of Mechanical Engineering, took first place among 20 departmental senior design presentations with their project “Drop Foot Push-Off Device.” Members Brendan Kearney, Lester (Jim) McMackin, Jess Swaringen and Sean Wilson not only faced the challenge of the project itself, but accepted the additional complication of collaborating with students at the University of Dayton, more than 500 miles away. With support from the McDonnell Foundation, the teams focused their efforts on creating an orthotic device to help those with drop foot, a physical condition which limits the ability to walk. The innovative and promising device that developed through this collaboration led to filing a U.S. patent application number 13/842-811 containing an impressive 36 claims.

On April 5, 2013, Villanova’s Drop Foot team members were joined on campus by their University of Dayton counterparts, as well as George Simmons ’87 MSCS, Director of the Multidisciplinary Design Lab, and Edmond Dougherty ’69 EE, ’86 MSCS, Director of the Engineering Entrepreneurship program. Also in attendance for the meeting and luncheon were Ellen and Michael McDonnell ’58, ’61 JD whose Foundation sponsored the project. Supporting the students’ work personally meant something to Michael McDonnell who has the drop foot condition and has tried a variety of devices to improve his mobility. In the presence of their friends Patrick ’57 EE and Eileen Gallagher, McDonnell presented each student with a pin and certificate of appreciation for their work on this project.

Drop foot is characterized by total or partial loss of ankle control and mobility resulting from damage to the peroneal nerve, which is a branch of the sciatic nerve that supplies movement and sensation to the lower leg. Current solutions either lock the ankle in an immobile 90 degree position or use

some sort of spring/elastic motion to amplify push-off force. These devices are intended to aid patients with mild drop foot; however patients with total loss of control and functionality cannot initiate any push-off force whatsoever. McDonnell challenged the teams to design a device that could achieve push-off for anyone, even someone with severe drop foot.

Work on the “Drop Foot Push-Off Device” began with advisors and students from Villanova and the University of Dayton meeting for the first time in September 2012 for extensive briefings on the project. Throughout the fall semester, students from both schools scheduled weekly remote check-ins, each contributing insight, research and guidance from industry connections. “Dayton brought a lot to the table because of their close proximity to a number of research and manufacturing firms which pertain to our project. Our sponsor, the McDonnell Foundation, is located in Philadelphia, so having us here also benefits Dayton,” explains Villanova’s Jess Swaringen. As collaboration on the project continued through the fall semester, however, it became increasingly clear that the teams were moving in different directions with regard to the finished project.

The Villanova team chose to pursue an active dynamic system to address the challenges of severe drop foot, basically trying to replicate the body’s muscles which raise the heel to push the front of the foot downward. As the body’s gastrocnemius muscles (back of the leg) relax and the tibialis (front of the leg) flex, an individual is able to swing their foot without fear of tripping over their toes, while also achieving proper heel strike. The orthotic device designed by Villanova students uses artificial muscles (in this case Flexinol muscle wire) on the front and rear to imitate those key muscles. By sending an electrical current through the front or back muscle wires, the device can raise and lower the front of the foot and achieve the push-off force (around 125 pounds) to help someone walk. While the orthopedics market has only offered patients passive systems that aid mild cases of drop foot, these students have created an active system helpful for all drop foot conditions.

While Brendan, Jim, Jess and Sean have presented their senior design project, they still have work to do. Next steps include completing a functional prototype with full actuation, sensors and controller, and then proceeding to clinical trials. The team also hopes to continue their working relationship with the students from Dayton. “It’s possible we will combine elements from both of our designs to come up with one improved model,” says Villanova team member Jim McMackin.

How does sponsor Michael McDonnell feel about what these Villanova students have accomplished? “I think we moved the world!” he says. “I believe the technology now exists to make this happen. Our kids are infinitely closer to a solution that will change lives.”



Early prototype for the drop foot push off device

ENGINEERING STUDENTS TAKE TO THE STREETS FOR REAL-WORLD EXPERIENCE

When former Federal Highway Administration engineer Leslie Myers McCarthy, PhD, arrived at Villanova University’s College of Engineering in 2009, she had firsthand knowledge of the challenges faced by state transportation agencies, local municipalities and other public agencies. The state of the economy had left most of them with shrinking budgets and reduced staffing at a time when increasingly regulated programs required additional support. In this area of need, however, Dr. McCarthy, PE, Assistant Professor of Civil and Environmental Engineering, saw a tremendous opportunity for Villanova students. “Real-world engineering service projects were right outside our doorstep,” she says.

“Students are interested in participating in real-world projects before joining the working world. These projects not only help them apply their academic knowledge, but also train them to think like professional engineers.”
Dr. Seri Park, Clare Boothe Luce Assistant Professor of Civil and Environmental Engineering

Win-Win Opportunities

Dr. McCarthy first established partnerships with local municipalities and began advising student participants in 2009. In 2011 she was joined by department colleague Seri Park, PhD, Clare Boothe Luce Assistant Professor. In this program, students interested in transportation engineering conduct several projects, which culminate in a final report delivered to the local agencies and a poster presentation at Civil and Environmental Engineering Day on campus. Their work has included studies on:

- Traffic impacts
- Signal coordination
- Streetscape design
- Transportation policy
- Infrastructure asset management

One student project became the subject of an article in *Public Roads*, a magazine published by the FHWA. “Innovative Partnerships Help Inventory Traffic Signs” was the cover story for the publication’s March-April 2013 issue. Co-authored by Drs. McCarthy and Park and FHWA engineers John McFadden, PhD, PE, PTOE, ’91 ECE, ’94 MSCE and George Merritt, the seven-page article explores both the results of the work completed by Villanova civil engineering students, as well as how they gained real-world experience in the process.

“It means something to the students that what they produce is tangible, impacts people and generates results that will stand the test of time.”
Dr. Leslie Myers McCarthy, Assistant Professor of Civil and Environmental Engineering

A Focus on Experiential Learning

Experiential learning is one of the cornerstones of Villanova’s top-ranked engineering program. Beginning in their first year, students are required to participate in multidisciplinary, hands-on projects. As they progress through the program, undergraduates have the opportunity to work alongside faculty on cutting-edge research projects. Through the College’s Multidisciplinary Design



Villanova civil engineering students work on a traffic sign project.

Lab, industry, government and other organizations are invited to partner with students on real-world projects. Service work also provides practical experience, along with an opportunity to give back to the community, one of the fundamentals of the University’s Catholic Augustinian tradition.

The resoundingly positive response to the students’ work has provided Drs. Park and McCarthy with more requests for help than they can fill. “Last spring I spoke at the annual meeting of the Pennsylvania Municipal Managers Association, and the word spread like wildfire about our student service projects,” says Dr. McCarthy. She and Dr. Park have more than a half-dozen projects currently underway.

You can download a copy of “Innovative Partnerships Help Inventory Traffic Signs” on our website (find this article in our News Archives) or at www.fhwa.dot.gov/publications/publicroads/. *Public Roads* is a quarterly publication sent to approximately 2,000 transportation agencies and consultants throughout all 50 states.

“My student research project and safety assessment report allowed me to achieve a further understanding of the transportation world through real-life data analysis.”
Diana Chivetta ’13 CEE



Dr. Pritpal Singh and his team configure the computer system needed for the telehealth project.

SERVICE LEARNING THAT SAVES LIVES

A commitment to service is one of the cornerstones of a Villanova University education. Each year, students from the College of Engineering take that commitment to areas of need around the world, working to solve complex global problems. Waslala, Nicaragua is one of a handful of regions in which engineering students have been particularly active. For more than a decade, their efforts have focused on water supply issues. During that same period, Villanova nursing faculty and students have been providing Waslala's communities with healthcare education workshops. In 2010, the Colleges came together to address the region's critical need for access to quality healthcare providers.

Rough, rugged terrain and great distances between Waslala's 92 rural communities and the region's only hospital mean that professional healthcare is often an hour or more away. During the rainy season, travel can be impossible. Under the leadership of Dr. Pritpal Singh, Professor and Chair of Villanova's Department of Electrical and Computer Engineering, more than 35 faculty members and students from the College of Engineering, School of Business and College of Nursing have been engaged in an interdisciplinary telehealth project, which uses low-cost communications and computer technology to improve the quality of healthcare in rural Nicaragua.

How it Works

Though few communities have electricity and there is virtually no Internet access, the Waslala region does have fairly widespread cellular phone service, which makes a telehealth solution feasible. Using text messaging run on locally-based, inexpensive cell phones, the system allows local community health leaders (CHLs) to communicate data or questions about patient condition to hospital staff, who then communicate diagnoses or treatment recommendations back to the community. In emergency cases, CHLs can directly text the Ministry of Health nurse for immediate assistance. Though a fairly simple concept, the system requires both a technological and a human component for success. Volunteer CHLs (who often have no more than an elementary level education) need standard medical equipment as well as training in basic physiology, preventive care, reading vital signs and making simple health assessments. Villanova's College of Nursing faculty and students address this human/medical dimension of the system.

For their part, engineering students were tasked with creating the infrastructure for an Information and Communications Technology (ICT) system to enable:

- Collection and transmission of patient information
- Data storage and organization in electronic health records
- Communication of assessments and remote medical assistance by health care professionals

To connect these rural sites to a remote monitoring center requires a cellular modem, router, medical server and computer for the doctor or nurse. CHLs also need to be trained on how to use the cell phones for texting information.

Progress to Date

Since 2010, teams of Engineering, Nursing and Business students and faculty have made nine trips to the project site and have established a working system. Among their specific accomplishments:

- Placed in-country office staff, including a project manager, office manager, and two nurses who visit the communities to reinforce CHL training
- Equipped a nurse, who works for Nicaragua's Ministry of Health and volunteers on the project, with a computer and modem to access health records
- Provided 50 CHLs with diagnostic equipment, cell phones, solar chargers and training
- Installed a server and backup power system
- Produced simplified Spanish manuals and a text training video
- Established several key partnerships with local organizations and universities

Without question, what students on this project take the most pride in is knowing that the telehealth system helps save lives. In one case, a 12-year-old girl with bacterial meningitis received the care she critically needed because a CHL was able to communicate her symptoms to the region's Ministry of Health. There have also been five cases in which pregnant women were safely transported to the hospital when they hemorrhaged during labor. The recovery of these women and their newborns was the result of CHLs texting the Ministry of Health nurse to secure an ambulance.

Future Plans

After a trip to Nicaragua in May 2013, Dr. Singh reported a successful and encouraging meeting with the Ministry of Health in Managua. The Ministry's leadership has planned a late June visit to Waslala to review how the project is impacting health care in the region and to speak with some of the local health leaders to determine what has been going well and where there have been challenges. Their goal is to learn the best practices from this pilot program and then work with the Villanova group to expand nationally. Together they will explore funding options for this expansion.

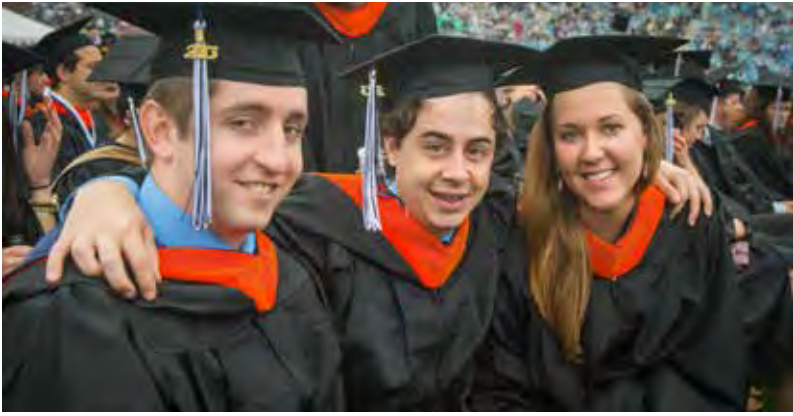
To date, the telehealth project has been supported by startup funding from the NCIIA, the National Collegiate Inventors and Innovators Alliance, as well as foundations including Halloran Philanthropies. A donation of cell phones and air time from Claro, Nicaragua's main telecommunications provider, has also been essential.

Work on future student service trips to Waslala will call for upgrading systems and software capabilities, reinforcing health worker training and training new leaders, and measuring and reporting outcomes and the impact of the project.

For more information about the telehealth project, or to get involved, contact Dr. Singh at 610-519-7378 or psingh@villanova.edu.



Villanova students gather for a photo with Waslala's volunteer Community Health Leaders.



CELEBRATING THE ENGINEERING CLASS OF 2013

This May, the College of Engineering celebrated another stellar graduating class. In addition to the many awards, scholarships and achievements they earned throughout their years at Villanova, commencement was a time to recognize those whose contributions went above and beyond.

The College's 79 doctoral and Master of Science candidates were recognized and presented with awards by Dr. Gerard 'Jerry' Jones, PhD '72, Senior Associate Dean for Graduate Studies and Research. The College of Engineering Outstanding Doctoral Student Award was presented to Peiman Naseradinmousavi for outstanding scholarship in the doctoral program and exemplary leadership and service to Villanova University and the College of Engineering. Receiving the Outstanding Graduate Student Medallion was Kailash Choudhary '13 MSEE. Choudhary was also recognized with the Outstanding Graduate Student Certificate Award for the Department of Electrical and Computer Engineering. These students also received the Certificate Award from their individual departments:

- Eric C. Nolan '13 ME
- Benaiah Anabaronye '13 Che
- Adrienne G. Donaghue '13 WRE
- Lauren A. Pugh '13 SUST

Dr. Randy D. Weinstein, Associate Dean of Academic Affairs, recognized and presented awards for undergraduate students. The following earned medallions from their individual departments for demonstrating academic excellence and leadership:

- Jelena Renic '13 ChE
- Erica J. Sokoloski '13 CEE
- Michael A. Ciavarella '13 CpE
- Dang Wang '13 EE
- Ian P. Dardani '13 ME

President of the Engineering Alumni Society, Mr. John Happ '85 had the honor of presenting the prestigious Robert D. Lynch Award, which is given on behalf of the EAS to acknowledge a graduating senior for their outstanding academic achievements and exemplary dedication to serving the community. Representing the highest values of Villanova University and the College of Engineering, the 2013 Robert D. Lynch Award recipient was Ian P. Dardani '13 ME.

For a look at the post-graduation plans of some of our 226 Bachelor's degree graduates, visit our website at www.villanova.edu/engineering/about/meetgrads2013.



The College's state-of-the-art E-Learning classroom at the Philadelphia Navy Yard

COLLEGE OF ENGINEERING INTRODUCES NEW GRADUATE PROGRAMS

Graduate programs in Villanova's College of Engineering offer the flexibility and convenience that today's working professionals need. Students can take classes on campus or through the E-Learning program, and degrees can be pursued on a full-time or part-time basis.

In response to industry needs, the College is introducing two new Master of Science degrees in Biochemical Engineering and Cybersecurity. They will begin in Fall 2013, joining the seven engineering master's degree programs already in place.

Biochemical Engineering

Part of the Chemical Engineering department, Biochemical Engineering is a growing and increasingly important discipline within the industry. The courses in this program will prepare students to design and optimize pharmaceutical facilities, processes and products using state-of-the-art analyses and technology. Courses include Biomaterials and Drug Delivery, Protein Engineering, Systems Biology, Global Pharmaceutical Business and more. For additional information about the program, contact co-director Noelle Comolli, PhD, Assistant Professor of Chemical Engineering at noelle.comolli@villanova.edu or 610 519-7134.

Cybersecurity

Part of the Department of Electrical and Computer Engineering, Cybersecurity is an essential discipline given our nearly complete dependence on big data and information technology. The master's degree program fully prepares students for careers in major security areas related to our interdependent network of information technology infrastructures. Students have a choice of three areas of specialization: Systems, Policy and Operations. All students in the program are required to take Cryptography and Network Security and Cybersecurity Threats and Defense. Associate Professor of Computer Engineering Richard Perry, PhD, can be reached at richard.perry@villanova.edu or 610 519-4969.

More Info

To learn more about specific graduate courses and program requirements, as well as E-Learning options, visit gradengineering.villanova.edu

*Master of Science degrees are also available in: Chemical Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, Mechanical Engineering, Sustainable Engineering, and Water Resources and Environmental Engineering.

SUSTAINABLE ENGINEERING AT VILLANOVA - ENGINEER THE FUTURE *by Kelly Wellman*

As the earth's population grows and standards of living rise, the world faces increasingly complex challenges such as depletion of resources, environmental pollution and damage to ecosystems. At the forefront of making decisions that will have long-term implications for the planet, today's engineers are called upon to not only meet today's global human needs, but to also provide sustainable access to the world's resources for generations to come. Mr. William Lorenz, Director of Villanova's Sustainable Engineering graduate program, says:

"Mankind is simply overusing the Earth's resources. Developed countries like the U.S. contribute to millions of tons of waste and pollution annually, and businesses are now realizing the imminent need to transform our economy to live off nature's income, rather than to continue to take withdrawals from nature's capital. The sustainable engineering field is emerging to train engineers, scientists and others interested in this global economic transformation to approach sustainability issues from a holistic point of view."

Villanova's Master of Science in Sustainable Engineering (MSSE) degree program is at the forefront of this emerging field. The program employs a whole-systems approach to problem-solving through a life-cycle lens. "The last decade of research has clearly shown we must rethink how we design products, services and the built environment. There needs to be a fundamental shift in design to include the entire lifecycle – from raw materials, through consumer use, and ultimately recycling and disposal. The role of a sustainable engineer is to evaluate the balance of resources within each stage of the lifecycle," says Lorenz.

One of just a few programs in the country and one of only two currently available in-class or entirely online, Villanova's MSSE degree is off to a successful start. Launched in January 2010, the program has graduated more than 30 students with another 60 currently working towards their degree. The critical advantage of earning an MSSE degree at Villanova is the program's practical approach to current and future real-life situations. Students work in small teams to evaluate and solve problems that companies around the world are facing.

In describing the mission of the MSSE program, Lorenz references an excerpt from *Cradle to Cradle*, a book written by William McDonough and Michael Braungart, "We see a world of abundance, not limits. In the midst of a great deal of talk about reducing the human ecological footprint,

we offer a different vision. What if humans designed products and systems that celebrate an abundance of human creativity, culture, and productivity? That are so intelligent and safe, our species leaves an ecological footprint to delight in, not lament?"

Sustainable engineering is engineering of the future, for our future.

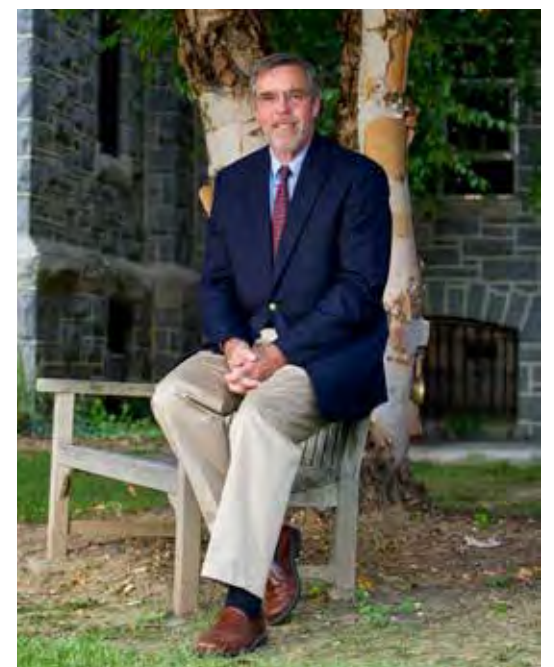
Earn Your MSSE Degree

Like each of the College's graduate programs, the Master of Science in Sustainable Engineering can be pursued on a full-time or part-time basis with courses available on campus or via E-Learning. MSSE students select from four technical tracks:

- Alternative and Renewable Energy
- Watershed Sustainability
- Environmental Sustainability
- Sustainable Infrastructure and the Built Environment

Students are required to take core courses in Climate Change/Sustainability, Life Cycle/Impact Assessment, and Economic/Social Equity Integrators.

To learn more about the Sustainable Engineering program, visit www.msse.villanova.edu or contact program director Bill Lorenz, at william.lorenz@villanova.edu or 610 519-6195.



Mr. William Lorenz, Director of Villanova's Sustainable Engineering graduate program

SECURING THE FUTURE FOR VILLANOVA ENGINEERING

Villanova’s College of Engineering has experienced tremendous success over the past decade. For the past seven years, the school has been ranked among the top 10 undergraduate engineering programs in the nation by *U.S. News and World Report*. Interest in our undergraduate and graduate programs is at an all-time high, especially from students with exceptional academic and extracurricular backgrounds.

Along with the growth of our programs, the College continues to attract increasingly diverse faculty members. As highlighted in our Clare Boothe Luce story (page 1), we are exceeding the national average for women professors, which in turn has helped us attract more women students to the College. New faculty have ignited a renewed interest in research and this has spurred new graduate curriculums and expanded undergraduate research opportunities.

“ The CEER expansion is vital to our ability to remain a leading, innovative college of engineering. ”
Gary A. Gabriele, PhD, Drosdick Endowed Dean,
Villanova University College of Engineering

This growth, coupled with the College’s tradition of balancing both theory and practice has placed significant demands on existing resources, including the availability of physical space to accommodate new faculty labs and expanded student labs and project space. Finding adequate space to accommodate our growth is the College’s highest priority.

The College has completed an architectural study to determine how we might best meet our growth needs for the near term. The study identified three separate additions to the Center for Engineering Education and Research (CEER) building:

- Engineering Innovation Lab
- Student Learning Commons
- Engineering Hub

The new Engineering Innovation Lab will be a high bay space that provides students the opportunity to work on scalable real-world engineering projects in a facility designed to support the College’s teaching and learning model. Plans call for a two-story, 3,330 square foot open garage/high bay space, complete with a large, overhead crane.

The Student Learning Commons will offer much needed space for students to collaborate, work together in teams and gather in community – things the College routinely emphasizes. In addition to providing for the students’ needs, the 4,600 square foot space, which will enclose the current patio area, offering a place for seminars and lectures, College and University functions, and meetings and presentations with industry representatives.

“ In order to expand the minds of future engineers, there needs to be new academic space to facilitate a collaborative environment that will help foster Villanova’s commitment to producing young engineers prepared to meet tomorrow’s challenges. ”
Christine Alizzi ’13 CEE



Proposed CEER Expansion

The Hub will serve as the administrative “home” for the College that provides a more professional space for welcoming everyone from prospective students to industry leaders. Creation of this space will also allow the College to reclaim valuable academic and research areas for faculty, undergraduate and graduate students. The two-story, 5,430 square foot Hub will house the deans’ offices, seven offices for engineering staff, and a multimedia conference room.

The expansion of the CEER building will be instrumental in the success of the College fulfilling its strategic vision to become one of, if not the, most innovative undergraduate engineering programs in the country. This \$10 million capital project will be completely funded by donor support. If you are interested in one of the naming opportunities please contact Cynthia Rutenbar, Director of Major Giving, College of Engineering at cynthia.rutenbar@villanova.edu or 610-519-6973.

“ Excellent facilities attract excellent faculty talent, which results in an excellent education. ” **John and Michael Dearborn,**
parents of Gregory ’12 ChE and Christopher ’15 ChE,
and College of Engineering benefactors

The College’s Office of External Relations wants you to STAY CONNECTED

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- LinkedIn: [linkedin.com, search “Villanova College of Engineering”](https://linkedin.com/search/Villanova%20College%20of%20Engineering)
- ProtoTYPE—the College’s e-newsletter: engineering@villanova.edu
- To be added to our email distribution list, send your address to kimberly.shimer@villanova.edu.

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