Monthly Report to the Board

February 2016

Pathways through Montgomery College: Engineering

Analytic skills, creativity, and communication are among the most important skills for a successful engineer, according to *The Engineer of 2020: Visions of Engineering in the New Century*, published by the National Academy of Engineering. While the need for these three attributes in the professional engineer has not changed in decades, the field of engineering has changed with extraordinary speed. Advances in technology require constant adaptation by educators and professionals already in the field, demanding increased breadth and depth in education. Training in business and management along with leadership are now important aspects of the 21st century engineer. Fortunately for Montgomery College, our engineering program is integrating all of these facets into the education of future engineers while also preparing them for transfer and, ultimately, for employment.

Best practices in several areas have allowed MC's engineering program to double its enrollment over the last eight years while maintaining the standards that have won it national acclaim. In this issue of *President's Focus*, I will explore how five aspects of the engineering program have supported this extraordinary success: highly trained faculty with links to industry, diligent advising, partnerships, extra-curricular opportunities, and an ambitious approach to funding for students and facilities. No single one of these factors has vaulted the engineering program to its current status, but

together they have created a strong network of student support and instruction that is propelling an impressive number of students to academic and professional success. Several of the strategies used by the engineering program at MC are mentioned in *Redesigning America's Community Colleges*, by Thomas Bailey, Shanna Smith Jaggars, and Davis Jenkins, as best practices for community colleges more generally.

MC's engineering program offers students an associate of science in engineering, which is not a terminal degree. Thus, our program also prepares students to transfer to a four-year institution to complete a bachelor of science. MC's engineering transfer program is the largest in the nation, with 1,500 students currently enrolled. The College awarded 76 AS degrees in engineering during the 2013–2014 academic year, and 80 percent of our graduates transferred, the majority of them before completing a degree. The most popular destination institution is the University of Maryland College Park (eight percent of engineering students, or about 100 students per year), followed by UMBC. But students also transfer locally to Catholic University, Frostburg State, George Washington University, George Mason University, Howard University, University of Maryland Baltimore, and Virginia Tech, among others. Additionally, students have also transferred to highly competitive institutions like the Massachusetts Institute of Technology, the Georgia Institute of Technology, Texas A&M, Rensselaer Polytechnic Institute, and the University of Illinois at Urbana-Champaign.

Engineering is currently the third largest major at Montgomery College and has 11 different engineering specialties available. The three most popular by size are mechanical, electrical, and computer engineering. The most recently developed specialties are materials science & engineering, bioengineering, and computer engineering, which are added to the longer-standing areas of engineering at MC such as aerospace, civil, chemical, fire protection, general engineering, and nuclear.

Faculty in the engineering department constitute a pillar of the program. An impressive 70 percent of those teaching engineering at MC have doctorates. Our students are being taught by engineers whose training, in some cases, is more advanced than instructors at four-year institutions. Equally as important, though, are the links that faculty members have to engineering firms in Maryland. Experience with local

employers —such as Hughes Network Systems, Raytheon, the National Institute for Standards and Technology (NIST), and the Centers for Disease Control (CDC)—allow faculty to bring real-world experience to the learning process, keeping the engineering curricula fresh, and preparing students optimally for what they will encounter in the work world. Such relationships with industry also help students to find out about internships, undergraduate research opportunities, and, sometimes, make connections for later employment.

Another vital component of the engineering program is advising. Bailey et al. argue that "the academic advisor is the most important resource to help new students clarify their goals and select courses that lead toward those goals." MC's engineering program currently has 12 faculty advisors. Because most engineering students transfer and many four-year institutions have strict rules about what credits they will accept, proper advising about which classes to take and how to begin the transfer process is critical. MC has formal articulation agreements with several upper-division schools, including the University of Maryland College Park and the Georgia Institute of Technology, as well as less formal arrangements with a number of other schools nationwide.

MC faculty and advisors are often vital links to private industry as well as local and public agencies that can support students with internships and scholarships. Such support can help engineering students to access professional opportunities and nurture their academic development. With help from MC's full-time engineering internship coordinator, many MC engineering students secure internships and undergraduate research opportunities while still in school or during summers. Such experiences make students more marketable and give them connections to potential future employers. The largest number of our students finds internships at the National Institute of Standards and Technology. Through a grant-funded program called NIST-MC Scholars, students have the chance to work with professional engineers at this federal agency that works to develop and apply technology, measurements, and standards. Other MC engineering students have interned at places such as the Centers for Disease Control, the National Aeronautics and Space Administration, the National Institutes of Health, and the US Department of Energy.

Another strength of the engineering program at MC parallels one of the best practices for achievement cited by Bailey: opportunities for inquiry-based learning. According to Bailey,

research on motivation shows that students thrive when they are given the opportunity to enhance their autonomy as learners "by investigating questions on their own rather than being told the answer." Engineering faculty encourage this process inside the classroom with group projects and undergraduate research. MC also offers outstanding math and science tutoring centers where students can get additional, one-on-one attention. Several extracurricular programs at MC enable students to apply their skills outside the classroom, testing their capacities and challenging them to expand their horizons. Through Engineers Without Borders (EWB), for example, MC students have the opportunity to travel to developing countries and help improve conditions through engineering projects. EWB is a nonprofit humanitarian organization with a student chapter at MC—the only community college chapter—which has sent students to El Salvador, Mexico, and Panama. Students are currently working with the DC Professional Chapter of EWB to design and help construct a building to house a library and computer center in Panama. Closer to home, MC students can test their classroom learning by participating in clubs which are orientated toward engineering applications, such as the robotics, aerospace, astronomy, or geology club. Groups such as these create informal learning communities of the sort encouraged by Bailey et al., helping students to stay motivated and to practice teamwork approaches to problem-solving.

In addition to MC's experienced faculty and enhanced learning opportunities, the College has worked hard to acquire scholarships for engineering students with financial need. The engineering program benefits from several grants that MC was awarded through hard work and persistence of faculty members. In 2015 the Clark Charitable Foundation pledged $500,000 to support a new scholarship fund for engineering students at MC. Last year, the National Science Foundation awarded the College a four-year $600,000 grant through its Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) program, for which eligible engineering and computer science students can apply. Over the life of the grant, the ACCESS Engineering portion provides 150 scholarships to qualified engineering and computer science majors, who also receive academic, career, and transfer support services as well as supplemental instruction, mentoring, and internships. Engineering students at MC also benefited in previous years from the Fund for the Improvement of Postsecondary Education (FIPSE) grant from the US Department of Education.

The $471,142 grant, active from 2007 to 2013, aimed to boost the numbers of women and minorities at the College who pursue engineering degrees. In addition to scholarship funding, MC has also used donor funds to improve the facilities in which it educates students. Improvements to the Science East Building (built in 1966) and Science West (built in 1971 and currently undergoing renovation) have brought important updates to our laboratories and classrooms. Teaching spaces are now better designed for collaborative learning and hands-on interactions. State-of-the-art equipment includes industry standard 3-D design and modeling software, an engineering machine shop, and an art digital logic laboratory.

According to a National Science Foundation study, over 40 percent of engineers begin their education at a community college. This does not surprise me when I look at the structure and successes of MC's thriving engineering program. By partnering with people and institutions with a shared interest in engineering, we have expanded our students' opportunities. The diligent efforts of our faculty ensure that the education we provide in the classroom is tightly coupled with technology developments in the field. According to best practices, we make advising a priority, have clear articulations for transfer, and enrich our students' learning experiences with the latest pedagogy as well as hands-on approaches. Collaborating with stakeholders who also see the future of engineering has helped us provide scholarships and extracurricular experiences that many of our students could not access on their own. Such activities keep them engaged and stimulated, and prepare them optimally for work in the field. The contributions that MC's engineers will make to the national demands for skilled workers cannot be overstated. According to the National Association of Colleges and Employers' salary report, eight out of 10 of the highest paid academic majors are in engineering fields. Not only should our graduates find themselves on secure financial footing, but they should be poised to contribute to the innovation that spurs broader economic growth and strengthens communities.

Discussion Questions:

1. What information stood out to you in this report?

2. Are there any strategies that engineering has used to propel its success from which other academic disciplines might also benefit?

3. How can we attract more women to our engineering program?