



ONTARIO SCHOOLS PREPARE FOR TOMORROW'S ENGINEER

Expansions at engineering schools across the province will see new cross-disciplinary programs and initiatives that address the needs of industry, sustainability and entrepreneurship.

BY ZALINA ALVI

Engineering education at Ontario universities is anything but stagnate these days. With new programs and increasingly specialized options, innovative extra-curricular initiatives to support entrepreneurship and high-tech sustainable buildings cropping up across the province, it's hard to find a school that doesn't have big plans for the next generation of engineers.

Making the biggest waves is York University, which in May approved the creation of the Pierre Lassonde School of Engineering. The \$250-million endeavour will mean a huge expansion in engineering education at the university, including the construction of a new high-tech building at its Keele Campus and the hiring of up to 70 new professors.

The school will take an approach to engineering education guided by a vision of a new kind of engineer put forth by benefactor Pierre Lassonde, P.Eng., chairman, Franco-Nevada Corporation. Lassonde donated \$25 million to the school, alongside a \$50-million endowment from the Ontario government. Outlined at an April 18 workshop titled "Envisioning the Renaissance engineer," it's a vision of engineers who are well-rounded problem solvers—socially responsible, entrepreneurial, creative in their artistry and technically proficient—which was first put forth by Lassonde's late wife, Claudette MacKay-Lassonde, P.Eng., PEO's first female president.

Tasked with spearheading this vision is new School of Engineering Dean Janusz Kozinski, PhD, P.Eng., and Associate Dean Richard Hornsey, PhD, P.Eng. "Employers are crying out for this new type of engineering graduate—one who is not only technically proficient but also knows how business operates and understands the social implications of their work," says Hornsey.

After moving over its current undergraduate programs in computer, geomatics, software and space engineering from its other schools, new programs in the works will include electrical (2013), mechanical (2014), civil (2014) and chemical (2015) engineering, with expectations to add engineering science, materials engineering and bioengineering in 2016. The school will also incorporate crossover programming with York's Schulich School of Business and Osgoode Hall Law School, as well as a new Institute for Sustainability in Engineering and Design.

The number of undergraduate engineering students enrolled at York could climb to 1800 by the end of the decade, a tremendous increase from

the approximately 180 enrolled during the 2011-2012 year. Applications to its current undergraduate engineering programs for the 2012-2013 year saw a 30 per cent increase from the previous year.

York isn't the only Ontario university expanding its program offering. Guelph University will see its first graduating classes in computer, mechanical and biomedical engineering over the next couple of years, and the engineering school expects a 2012 intake of 400 students, a significant jump from 300 in 2009. By 2014, numbers are expected to reach 1200 undergraduates and 230 graduate students, twice the 2010 enrolment.

Helping to support this expansion is Wolfgang Haessler, engineering graduate and founding member of the school's industrial engineering advisory board, who pledged \$1 million in April to fund expansions of engineering facilities through Guelph's BetterPlanet Project, a fundraising campaign for teaching and research in food, environment, health and communities, as well as scholarships for upper-year undergraduate engineering students. With a focus on preparing the next generation of engineers, who he says has "an increasingly important role in solving the problems of the planet," Haessler also committed to mentoring each of the 20 recipients of the \$5,000 scholarships over a period of five years.

In an April 11 event at Guelph to announce the pledge, Haessler lent his support to the establishment of an engineering management program at Guelph, which is under consideration. In doing so, he stressed the importance of practical training in work and shop environments for teaching management skills.

"Engineers by definition are professionals who apply theory to solve practical problems," he said in his speech. "It must be understood, however, that management is primarily a practical skill that does not lend itself—except for the theory of management—to be taught in the classroom. This type of training is foreign to most universities today, but could have distinguishing benefits if implemented successfully to students, universities and future employers."

These kinds of advancements, not just in expanding enrolment and facilities but also the move toward greater integration of management and other practical skills into curriculum, are happening all across the province. Alongside York and Guelph, other engineering schools are expanding their offerings to address a need to build bridges with industry, new areas of specialization and a push to create a more broadly educated graduate with a social conscience and an entrepreneurial spirit.

PROGRAMMING: MORE SPECIALIZED, PRACTICAL AND CROSS-DISCIPLINARY

Ensuring that engineering graduates are prepared to work in industry is front-and-centre with new programming at Ontario universities. The University of Toronto (U of T), for one, approved a flexible PhD option this past spring for its doctoral program in mechanical and industrial engineering that launches this fall. The program involves the same requirements as the regular PhD program, but with an extended



timeline to allow students to work concurrently in a research and development setting.

“Selecting highly-qualified engineers to pursue a PhD while remaining employed is a unique opportunity to advance knowledge from the university to industry and to enhance the competitiveness of Canadian industry,” says Jean Zu, PhD, P.Eng., chair, mechanical and industrial engineering, U of T.

With a similar focus on incorporating real-world needs into programming, Western University in September 2011 launched a practical elements in mechanical engineering (PEME) undergraduate program in collaboration with Fanshawe College. The first of its kind in Canada, the optional certificate program is taken over eight months at the college and involves hands-on courses in machining, welding and metrology, among others skills, to better equip engineering students with a well-rounded array of skills and practical knowledge.

Meanwhile, Queen’s University approved in March a new graduate certificate to train professionals in building better relations between the mining industry and the communities they work in, which will be offered for the first time in August 2012. The program is open to engineering students, as well as students in other disciplines involved in the mining industry. It is a response to an expressed need of the more than 100 communities in Canada that depend on the minerals industry and the mining companies tasked with

ensuring that relationships with the community, which can often be tense, remain co-operative.

“Engineers who are responsible for a mine must get this relationship right, not just for the success of the mine but also to ensure that the community benefits from the presence of the mine,” says Brian Surgenor, PhD, P.Eng., associate dean and professor, mechanical and materials engineering, Queen’s University. “This observation is a reflection of the ever-increasing non-technical demands of the profession, and that engineering students must be sensitized to the social and environmental implications of their technical assignments.”

Alongside a push for greater integration between academics and the needs of industry is also a move toward further specialization of program options and more cross-over between disciplines.

At the University of Windsor, for instance, a new aerospace option was recently added to its undergraduate mechanical engineering program, and as of September 2011 at U of T, the Institute of Biomaterials and Biomedical Engineering began offering a concentration in clinical engineering option for PhD students. The faculty of applied science and engineering at U of T will also this fall begin offering a new certificate in mineral resources.

Elsewhere in Toronto, Ryerson University’s biomedical engineering program, the first standalone undergraduate program of its kind in English Canada, was accredited by the Canadian Engineering Accreditation Board (CEAB) for the first time in July. Launched in 2008, the program’s intake this fall is expected to be 80 students, up from 70 the previous year.

While the program focuses specifically on biomedical engineering—the design of medical devices and technologies related to hardware, software and applications—the curriculum is interdisciplinary, says Associate Dean of Engineering Sri Krishnan, PhD, P.Eng., in that it incorporates aspects of biology, physics, electrical engineering,

mechanical engineering, chemical engineering and computer engineering.

Ryerson's new master's program in digital media will also require students to take courses across several disciplines, inside and outside of engineering. Encompassing elements of design, business management and engineering, the engineering component will involve designing hardware, software and media applications. Under review by Ryerson's senate, the program, if approved, will be launched in September 2013.

As Ryerson builds bridges through digital media, another growing focus of cross-disciplinary programming at Ontario engineering schools involves the importance of sustainability, which, as it pertains to engineering, means that energy and resources are used at a rate that does not undermine the natural environment or weaken the ability of future generations to meet their own needs.

While sustainability and environmental concepts have been incorporated into engineering education for a while now (see "Sustainability beginning to infuse engineers' formation," *Engineering Dimensions*, March/April 2011, p. 28), recent developments are to be found at Carleton University, where the first two students in the master of sustainable energy program graduated in February. The program involves aspects of both the policy and engineering sides of achieving sustainability, much like the collaborative master's program in applied sustainability at Queen's University, which is a joint offering between the faculty of engineering and school of policy studies first offered in September 2010. As well, Carleton's bachelor of engineering program in architectural conservation and sustainability, launched in September 2011, is the first program in Canada to combine civil and environmental engineering with architectural studies to educate students in sustainable green building design and heritage conservation.

Nowhere else is the growing importance of sustainability more visible, however, than on the university campuses themselves.

SUSTAINABLE DESIGN MOVES OUTSIDE THE CLASSROOM

A growing trend at Ontario universities involves incorporating environmental considerations right into the construction of new facilities, which then function as "living" laboratories for students researching sustainable



design. In fact, Windsor, Carleton, Guelph and McMaster universities have all in the last year built such centres, building expansions and laboratories.

At the University of Windsor, the new \$112-million Ed Lumley Centre for Engineering Innovation (CEI), which opens this fall, is the largest capital investment ever made by the university. Besides having more space and high-tech tools for engineering students at the school, the centre will also act as a living lab for real-time monitoring of the building's green roof, cross-atrium bridges and HVAC performance.

Similar real-time monitoring is a feature of the new Delta Controls Lab at Carleton University, which opened in May. Another living lab of sustainable design, it is located in the campus's Canal Building as a portal to the information collected by the building automation system (BAS) on its energy use, thermal comfort, lighting, air quality, heating, cooling, ventilation and green roof performance. The sensors and simulation modeling allow students in civil and environmental engineering, mechanical engineering, industrial design, architecture and even information technology to research and develop ways to build smarter, more efficient and sustainable buildings.

"Sustainability in engineering education simply makes smart economic sense. It encourages engineers to consider solutions that are successful during a system's entire life cycle," says Liam O'Brien, PhD, assistant professor, architectural conservation and sustainability engineering, who is leading building controls research and teaching in the Delta Controls Lab.

The lab will include four micro environmental chambers with the same sensors and computer interface as the Canal Building, so students can experiment with their own heating, ventilation and lighting control strategies without impacting the function of the building.

Both McMaster and Guelph are also incorporating sustainable building technologies into new spaces currently in development. At McMaster, a student levy for the building of a new Engineering

Centre for Experiential Learning was passed in March. The building will function as a student space, as well as a living lab for sustainable building technologies in much the same way as those at Windsor and Carleton. At Guelph, ongoing \$40-million building expansions include a green roof, wind turbine, solar panels and rainwater cistern, from which data will be collected and made available to engineering students.

CREATING MORE ENTREPRENEURIAL AND BUSINESS SAVVY ENGINEERS

Alongside sustainability, entrepreneurship has become a major focal point of new programming and initiatives at many Ontario universities. From new course offerings and programs to incubators and leadership development initiatives, schools are encouraging engineering students to tap into their business and management potential.

The University of Ottawa's faculty of engineering, which celebrated its 25th anniversary last year, has been encouraging entrepreneurship for the past five years through its Entrepreneurship and Innovation Endowment Fund (EIEF). Since 2007, the fund's main programs have included the Entrepreneurship Bridges Lecture Series, jointly organized with the Telfer School of Management, and the Prizes in Entrepreneurship and Innovation (PEI) student competitions. The 2012-2013 year will also see a new course, technology entrepreneurship for engineers and computer scientists, which will join its other programs like the engineering management and entrepreneurship option for undergraduate students, and the master of engineering program in engineering management.

New programs with a similar management component are also underway at the University of Waterloo, which graduated its first class of undergraduate management engineering students in June, and U of T, which recently saw its first class of students graduate from its unique-in-Canada engineering business minor, a program run in collaboration with the Rotman School of Management.

U of T also recently launched a new initiative for undergraduate students dubbed the entrepreneurship hatchery. Created to support the entrepreneurial ideas of undergraduate engineering students, it includes regularly scheduled Ideas Market sessions where students can network with each other and a panel of mentors, as well as a lecture series by business leaders and entrepreneurs.

A similar incubation centre opened in October 2011 at McMaster University, which also just completed its pilot year of the SELECT program, a leadership development program for undergraduate engineering students who are also involved in extra-curricular activities. The program involves mentorship with senior students, staff and faculty, the completion of interactive workshop modules and evaluation for certification. With 48 participants in its pilot year, the program included workshops covering organizing conference events and publishing student articles.

"The interactive modules assist in building character, discipline and goal-setting skills," says engineering student and SELECT participant Benjamin Kinsella. "They develop team-building techniques, as well as the ability to understand and work with unique personalities, all of which are invaluable in the engineering field."

The Summer Innovation Institute at Queen's University, launched this past summer, also encourages engineering students to tap into their business sides by enabling them to work with commerce students to develop new ideas while learning organizational leadership skills. Working with mentors, groups with a mix of engineering and commerce students are expected to use the institute as an incubator for start-up companies or corporate innovation projects with the goal of winning \$25,000 to develop them. Kicking off the summer with a two-week intensive program of workshops, seminars and talks from business and technology experts, the program pays each of the 20 students \$7,000 for their participation over the entire summer.

York's new Lassonde School of Engineering may be offering a similar initiative in the near future, as the university recently received a \$2-million gift from Douglas and Sandra Bergeron to establish the Bergeron Entrepreneurs in Science and Technology (BEST) program, which will support newly created entrepreneurial programs and initiatives focused on science, technology, engineering and mathematics (STEM) majors.

While management, business and entrepreneurial skills are being added to the next generation of engineers' toolkits, Western University is also adding a global perspective. Alongside its current civil engineering and international development program (see "Sustainability beginning to infuse engineers' formation," *Engineering Dimensions*, March/April 2011, p. 28), it recently launched WE Go Global, a new certificate option for undergraduate engineering students interested in creating an international network and improving their language skills. To be completed concurrently with the bachelor of engineering science, it includes a 12-week "externship" in an international setting that may involve volunteer work and courses in ethics, foreign languages, global studies, sociology, geography and political science.

As universities add such a wide array of supplementary skills to the core engineering disciplines, chances are the next generation of engineers will be more than ready to tackle the problems of tomorrow. Σ