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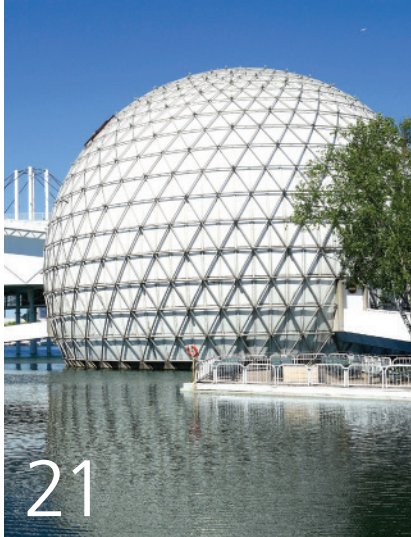


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Cover: Engineering students at the
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their hyperloop prototype in prepa-
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ENTERING A NEW ERA OF INNOVATION

By Nicole Axworthy

ENGINEERING DIMENSIONS

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Welcome to the last issue of 2019. Although the year seemed to pass quickly, engineers have been hard at work innovating the technologies of tomorrow.

What has become a biennial tradition, our innovation issue is one of my favourites because we get to explore all the fascinating research projects and startups that are happening right here in Ontario and talk to the great minds behind the work. In this issue of *Engineering Dimensions*, we are also pausing for a brief moment to highlight a handful of historical, engineer-led inventions that have paved the way for new technologies of the future. In "Looking back: 5 ingenious inventions that were made in Ontario" (p. 21), we'll introduce you to five notable Ontario-based inventions, such as IMAX film, which could not have evolved without the engineering ingenuity of William Shaw—a 1985 winner of an Ontario Professional Engineers Award in recognition of his engineering achievements—who led the development of IMAX's original projection system and a number of other patents that were critical to the company's success; and Donald Hings' original prototype of the walkie talkie, which helped lay the foundation for the vast range of technological opportunities in the area of communications today.

After taking a trip back in time, we then step into the future, starting on page 31. In "Innovating the future: 5 industries that are taking over," we look at the evolution of specific fields of study—such as artificial intelligence,

the hyperloop, and augmented and virtual reality—that are creating a world unlike any we've experienced before. We speak to industry innovators who are continuing to lead tech-related advancements that affect every facet of society and are launching Canada into its exciting future. In this article, we focus on engineers' involvement and the tools and training they need to keep up.

Ingenuity is very much valued in the engineering profession, explaining why PEO has been annually celebrating the Ontario Professional Engineers Awards since 1947. On November 16, the 2019 awards gala will honour the professional excellence and achievements of nine professional engineers. The event will also recognize a team of engineers that has executed an outstanding project or achievement. We'll have full coverage of the swanky event in the next issue, but in the meantime, head over to page 12 to find our call for nominations for the 2020 awards, and page 18 for the call for an engineering team whom you think is deserving of recognition for a recent project. You can also find the nomination forms at www.peo.on.ca, or email awards@peo.on.ca. **e**

THIS ISSUE Engineers are innovative by nature, and Ontario's professional engineers are among the profession's leaders. To celebrate, *Engineering Dimensions'* biennial innovation issue recognizes both historical and current innovative projects by Ontario's leading-edge engineering minds, from the Avro Arrow to the hyperloop and IMAX movies to augmented and virtual reality.

TRUST, BUT VERIFY

By Nancy Hill, P.Eng., LLB, FEC, FCAE



In my last column, I shared that PEO was in the process of retaining a governance advisor. I am happy to report that we have since engaged Government Solutions Inc. (GSI) to support Council in leading the development and maintenance of sound governance and leadership practices during the 2019–2020 term.

GOVERNANCE

Representatives from GSI, which include a parliamentarian, attended our September Council meeting to observe the proceedings and provide me, as chair of the meeting, with procedural advice. GSI has already identified a number of key issues that Council needs to address to enhance its governance culture and practices. I am happy to note that a post-meeting survey of Council and senior staff showed agreement on these important issues. One such issue is the line between operations (staff) and governance or policy (Council)—or, in the words of our CEO/registrar, the difference between church and state. To be an effective governing board, Council must take a “trust, but verify” approach when confronted with operational matters.

To continue our improvement process, GSI provided governance training at the Executive Committee’s meeting in October and will do so again during Council’s November plenary session. GSI will also be working with the committee to re-examine its role and determine how it can be most effective. In addition, our consultants will be helping me set the agenda for the November Council meeting to ensure the focus is on governance and policy issues, as well as PEO’s role to serve and protect the public interest, rather than issues related to operations.

I am very pleased with the results of this collaboration thus far and look forward to many successes as we progress on our journey of governance improvement.

ACTION PLAN

At the September Council meeting, CEO/Registrar Johnny Zuccon, P.Eng., FEC, presented a high-level action plan to address the 15 recommendations in PEO’s external regulatory performance review (see p. 50). The presentation was very well received and subsequently led to Council’s approval of the plan. The plan, which is available on our website (www.peo.on.ca/index.php/ci_id/33751/la_id/1.htm), defines the steps to begin the change process and outlines what is required to overcome current limitations that impact our ability to change. It is essentially an operational plan to fix deficiencies that urgently need attention. Although it is not a comprehensive road map to a new PEO, it lays the founda-

ALTHOUGH IT IS NOT A COMPREHENSIVE ROAD MAP TO A NEW PEO, IT LAYS THE FOUNDATION FOR CHANGE AND PROVIDES THE FIRST CRITICAL



STEP ON OUR ROAD TOWARDS TRANSFORMATION. THIS INCLUDES ADDRESSING THE RECOMMENDATIONS RELATED TO OUR LICENSING PROCESS, WHICH WAS IDENTIFIED AS THE HIGHEST PRIORITY.

ation for change and provides the first critical step on our road towards transformation. This includes addressing the recommendations related to our licensing process, which was identified as the highest priority. Given the complexities of this issue, a transition strategy that is controlled and measured will need to be developed. In the short term, we’re streamlining, simplifying and reducing subjectivity on a number of fronts to stabilize and prepare the system for change.

Given the plan’s operational slant, Council’s role will be to trust—but verify—that progress is being made.

INNOVATION

The theme of this issue of *Engineering Dimensions* is innovation, which reflects the area in which I practise. As a patent agent, I practise at the intersection of engineering and law.

It is interesting to note that the engineering sector does not use the patent system as much as other sectors. This is a missed opportunity. When engineers come up with a new and useful art, process, machine, manufacture or composition of matter or any new and useful improvement thereof, there is a potential that they could get a patent. In my perfect world, the engineer would at least consider whether it makes business sense to consider obtaining a patent.

At a recent meeting of the Intellectual Property Institute of Canada, it was reported that companies that obtain intellectual property (IP) protection are more likely to be successful.

I hope that engineers will consider developing an IP strategy as a tool for use as they develop their innovation and work to create wealth in Ontario. [e](#)

NEW FEDERAL PROGRAMS HELP INTERNATIONALLY TRAINED PROFESSIONALS BECOME LICENSED

By Adam Sidsworth

In a bid to help internationally trained professionals (ITPs) become licensed and employed in regulated professions, the federal government is funding two new programs to help make licensing and job-seeking easier for ITPs.

Maryam Monsef, minister of international development and minister for women and gender equality, made the announcement on August 26 in Vancouver on behalf of Patty Hajdu, minister of employment, workforce development and labour. The \$8.4-million initiative, which also includes \$600,000 in funding for Vancouver-area youth, was approved prior to the announcement and took effect immediately.

Funding includes \$3.9 million towards the Foreign Credential Recognition (FCR) Loans Project, an eight-year program managed by the Vancouver-area non-profit agency S.U.C.C.E.S.S. that offers ITPs loans of up to \$15,000 to cover the costs of taking qualifying courses and regulatory exams. The loans can also be used to help with travel costs, child care and other barriers to licensure. According to Isabelle Maheu of the Media Relations Office of Employment and Social Development Canada, the loans will help ITPs for up to four years, after which ITPs have an additional four years to repay the loans. "The loans initiative is national in scope," Maheu says, "with 11 organizations across Canada receiving federal funding." Ontario non-profit organizations administering the loan program include the World Skills Employment Centre in Ottawa, Ontario, for ITPs in the Ottawa area; and the Centre for Education & Training (CET) in Mississauga, ON, an organization that provides loans to ITP applicants in the greater Toronto and Hamilton areas. CET's website further details the program, stating that applicants must be eligible to work in Canada, have obtained their education outside Canada and are seeking to have their credentials recognized by a provincial or territorial regulator. ITPs:

- Don't require a credit history;
- Receive repayment terms of between one and four years;
- Are helped with the credential application process with the appropriate regulator;
- Receive help finding interim employment opportunities; and
- Get guidance practising and preparing for job interviews and developing their resumes.

The FCR program can be accessed by international engineering graduates. Although FCR does not work directly with PEO, Maheu states that FCR "has a long partnership history with Engineers Canada, [which] is supportive of FCR policy objectives and works collaboratively with its provincial counterparts in facilitating the integration of internationally trained engineers into the profession."

The second announced program, which is also managed by S.U.C.C.E.S.S., is the Active Career Connect and Engagement Project (ACCEP), a three-year project operated in Vancouver and Toronto. The \$3.8-million program will help ITPs find paid work placements, develop a personalized career action plan, develop their networking skills and integrate into the Canadian workplace culture. According to Maheu, the program is being provided in Vancouver and Toronto because they "are highly populated by skilled newcomers." However, she notes that "ACCEP services can also be accessed by newcomers outside these two metropolitan regions through online technology and virtual platforms."

Maheu adds that the loans project originated in a 2012–2015 pilot project that tested how to best provide loans and support services to skilled newcomers undertaking the credential recognition process and are part of 11 projects gradually implemented since 2017.

The funding announcement comes as ITPs find themselves underemployed or, more often, unemployed in their fields. According to the Government of Canada, recent immigrants aged 15 to 64 have a lower employment rate (62 per cent) compared to non-immigrants (72 per cent), and newcomer women in visible minority groups have a higher unemployment rate (14 per cent) compared to their male counterparts (10 per cent). "Our success depends on everyone getting a fair chance at success—including newcomers," Minister Hajdu said in a press release announcing the new programs. "Helping them gain access to professional experience in Canada will benefit our economy and our people. Through this investment, we are making sure no untapped talent is left behind."

The new funding is timely for international engineering graduates (IEGs), who face systematic challenges becoming licensed in Ontario and across Canada. As reported last year in *Engineering Dimensions* (see "Institute for Canadian citizenship releases report on barriers faced by international engineering graduates," November/December 2018, p. 7), the non-profit Institute for Canadian Citizenship reported in 2018 that IEGs:

- Face higher unemployment rates and persistent wage gaps;
- Must fight systematic barriers to licensure and employment from various stakeholders, including regulators, government and employers;
- Become licensed only 15 per cent of the time; and
- Are underemployed because employers prefer native talent.

CONSTRUCTION ACT UPDATES INCLUDE NEW ADJUDICATION PROCESS

By Adam Sidsworth

Effective October 1, Ontario's engineers working in the construction industry who find themselves in payment disputes can now go through an adjudication process anticipated to be speedier and less costly than litigation.

The changes were ushered in by Ontario's *Construction Act*, which received royal assent in December 2017 and introduced multiple amendments to the previously named *Construction Lien Act* and applies equally to both the private sector and government.

The amendments introduced both a prompt payment schedule and a speedy adjudication process and follow amendments introduced by the act on July 1, 2018, that modernized construction lien and holdback rules. With the new adjudication process, parties to construction contracts will receive a binding decision from an adjudicator with experience in the construction industry within about six weeks, subject to agreed-upon extensions. Under the new rules, all construction projects procured or entered into after October 1 will be affected by the following rules:

- Once a proper invoice is delivered, the owner must pay the head contractor within 28 days;
- Upon receipt of payment, the head contractor must pay its sub-contractors within seven days, and these sub-contractors must pay their sub-sub-contractors within a further seven days;
- If a sub-contract does not contain conditional payment provisions, a contractor remains responsible to pay its sub-contractors, regardless if the contractor receives payment or not;
- Certification or approval of the proper invoice cannot act as a contractual precondition to payment;
- Should a contractor not receive payment on time, it must submit a notice to its sub-contractors that it will not be receiving full payment due to non-payment by the owner;
- Owners must provide a notice of non-payment to the contractor within 14 days of receipt of the proper invoice;
- All payers not meeting the prompt payment deadlines are subject to mandatory interest charges;
- The ability to suspend work can occur only if the payer doesn't respect the adjudicator's decision within 10 days; and
- The contractor must refer the matter to adjudication within 21 days of notifying its sub-contractors.

The Ministry of the Attorney General named ADR Chambers as the authorized nominating authority, formally called the Ontario Dispute Adjudication for Contracts (ODACC), for the adjudication process. In that role, the ODACC will be responsible for training and certifying adjudicators. Additionally, the ODACC will also nominate adjudicators when parties are unable to agree on an adjudicator. In a bid to assure impartiality, adjudicators cannot be named until after the dispute has arisen and cannot be named in the contract.

Under the *Construction Act*, adjudication must adhere to the following schedule:

- All parties must agree to an adjudicator within four days or allow the ODACC to choose one with an additional seven days;
- The notifying party must provide the named adjudicator with a notice of adjudication, a copy of the contract or subcontract and any other documents within five days;
- The adjudicator must make a decision within 30 days of receiving the documents; and
- The entire process must be concluded within 46 days.

Judicial reviews of the adjudicator's decision are limited, with a motion to be filed within 30 days of the adjudicator's decision.

"The *Construction Lien Act* hadn't been looked at holistically since the 1980s," explains Sharon Vogel, LLB, a partner with the law firm Singleton Urquhart Reynolds Vogel (SURV), which specializes in construction and infrastructure law and alternative dispute resolution. She, along with partner Bruce Reynolds, LLB, drafted *Striking the Balance: Expert Review of Ontario's Construction Lien Act*, which was commissioned by the ministries of the attorney general and economic development, employment and infrastructure. "[We] were retained by the Ontario government to do a review...and look at modernization, prompt payment efficiency and dispute resolution." Vogel and her team conducted consultations with various stakeholders and, based on their input, made 101 recommendations, of which the government accepted 98 into the updated *Construction Act*. Vogel notes that the new adjudication process is "a swifter mechanism of conflict resolution. The adjudication is binding on an interim basis...if the parties don't like it, they can litigate or if the contract allows for arbitration, arbitrate, but in the meantime, cash flows because the adjudicator has made a decision within 39 to 46 days, which is faster than under the current regime. If an adjudicator determines an amount has to be paid, it has to be paid within 10 days, or the contractor has the ability to suspend work."

Vogel and her team looked at international jurisdictions that already use the prompt payment and adjudication process, including the United States, Australia and New Zealand, and adapted a plan to fit Ontario's needs. "It's a global phenomenon," Vogel asserts. "In Ontario, specific industry groups, including Prompt Payment Ontario, advocated for change for years." (On its website, Prompt Payment Ontario calls itself a coalition of contractor associations, unions, suppliers, general contractors and pension trust funds.) "It was the Liberal government that passed the legislation," Vogel says, "but in the legislature, when the bill passed, it received unanimous support."

STUDENTS LEARN ABOUT RAPIDLY CHANGING PROFESSION AT PEO-STUDENT CONFERENCE

By Anastasiya Mihaylova

PEO and the Engineering Student Societies' Council of Ontario (ESSCO) hosted undergraduate engineering students from ESSCO's 16 member universities and colleges for the annual PEO-Student Conference (PEO-SC) from September 13 to 15 at Carleton University in Ottawa, Ontario. The conference, with its theme "World of opportunity," focused on the pathways open to graduating or recently graduated students in today's rapidly changing technological world and emerging niche engineering fields by offering students the opportunity to network, participate in workshops and engage with engineering industry leaders. Conference speakers included representatives from PEO and the Ontario Society of Professional Engineers (OSPE), as well as recent engineering graduates, public policy advocates, a military engineer, a former ESSCO executive and an Ottawa-area MPP.

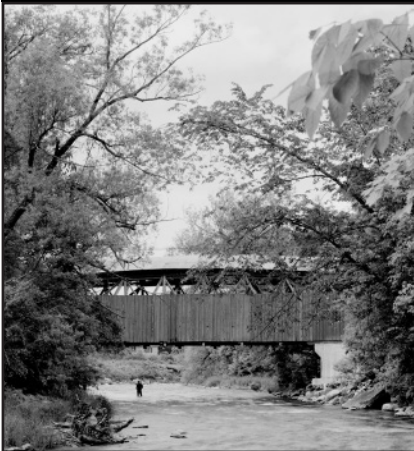
The conference is organized by the host school's co-chairs, with PEO, the conference's primary sponsor, providing sig-

nificant financial assistance. It is a professional development conference that introduces delegates to the work of PEO and its role as the provincial engineering regulator. Attending students are educated about the licensing process and PEO's Student Membership Program. Additionally, attendees listen to speakers discuss the future of the engineering profession in Ontario and have the opportunity to participate in activities designed to gather their ideas regarding the challenges and problems currently facing the profession.

Delegates heard from PEO representatives Tracey Caruana, P.Eng., Sami Lamrad, EIT, and Jeannette Chau, P.Eng., and OSPE representative Jaismine Wadhwa on the importance of licensure in Ontario and the advocacy work being done on behalf of students, engineering interns and licensed engineers. Further, students heard from Howard Brown, PEO's government relations consultant and president of Brown & Cohen Communications & Public Affairs, on his work to help amend

continued on p. 10

BITS & PIECES






Built in 1861, Powerscourt Covered Bridge is a wooden covered bridge that still stands on its original stone foundations in Elgin Township, Huntingdon County, Québec, carrying traffic across the Châteauguay River. It is thought to be the only remaining McCallum inflexible arched truss bridge in the world. Photo: National Park Service

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The ESSCO executive team, conference co-chairs and planning committee, student delegates, representatives from PEO and OSPE and Ottawa Centre MPP Joel Harden pictured at the 2019 PEO-Student Conference at Carleton University in Ottawa. Photo: Eric Pond

continued from p. 9

the *Professional Engineers Act* to facilitate change as well as innovative ways for engineering students to overcome barriers they may encounter when launching their careers.

Conference sessions kicked off with a workshop from talent acquisition coordinator Joël Vautour of marketing communications company Vision7 on employment and personal branding, where students learned techniques to understand the current employment market and how to market themselves to employers, from initial application to final interview. Next was a presentation from Lieutenant-Colonel Peter Cianfaglione, CD, P.Eng., a reservist in the Canadian Armed Forces and vice president of Benchmark Electronics in his civilian career, who spoke about his background working in the Canadian military and his personal stories from his time in the field.

The conference continued with a session on resumes, cover letters and networking from Carleton University graduates Julia Dalphy, EIT, Erin Hemm, EIT, Jamie Barresi, P.Eng., and Cassie Cullimore, EIT. Later, Santiago Vera, ESSCO's 2018–2019 vice president of finance and administration, talked about his transition from being involved in student politics and his school's engineering society to full-time work and how he transferred his skills and experiences to the workforce. Vera also stressed the importance and benefits of participating in extracurricular activities for students' well-being and professional development. Carleton University aerospace engineering student Johan Prent also led a session about best practices on being a mentor and promoting self-development in school and in the workplace.

Following the day-long sessions, New Democratic Party MPP Joel Harden (Ottawa Centre) hosted the students and professionals at the closing banquet, during which he encouraged students to shape

their environment by persuading and influencing others, especially government officials and members of parliament.

On the final day of the conference, speakers Caruana, Dalphy, and Carleton University associate professor of mechanical and aerospace engineering Cynthia Cruickshank, PhD, EIT, spoke about the different paths they took as women working in engineering. This panel and previous-day sessions promoted discussion on prominent issues that engineering students face, as well as possible solutions. The conference closed with a tour of Ottawa and ByWard Market, giving students a chance to explore the capital city and reflect on the important lessons and discussions of the weekend.

Anastasiya Mihaylova, ESSCO's vice president of communications, is a third-year geological engineering student at the University of Waterloo.

NEW CONSULTING ENGINEERS OF ONTARIO BOARD TO PREPARE STRATEGIC PLAN FOR 45TH ANNIVERSARY

By Adam Sidsworth

Consulting Engineers of Ontario (CEO) announced its 2019–2020 board of directors at its annual general meeting on September 13 in Acton, Ontario. The announcement comes in advance of the board's strategic planning exercise this month to develop a new strategic plan to replace CEO's 2016–2020 strategic plan, set to expire in March 2020.

"As CEO approaches the final year of our current strategic plan," Chair Christine Hill, P.Eng., told the AGM, "we are proud to report that we have achieved many of the goals and objectives we set for ourselves. CEO has been an extremely nimble organization, and over the last four years, CEO has evolved and adapted to meet and respond to the challenges that have occurred." Joining Chair Hill on the board are Chair-elect Bill Allison, P.Eng., Treasurer Joe Sframeli, P.Eng., Past Chair Rex Meadley, P.Eng., and Chair of the Governance Committee Karen Freund, P.Eng. In addition, the board consists of directors Steve Dyck, Matthew Eades, P.Eng., Christopher George, P.Eng., Don Holland, P.Eng., Ben Huner, P.Eng., Steve Pilgrim, P.Eng., and Mark Tullock, P.Eng.

Founded in 1975, CEO, which will celebrate its 45th anniversary in 2020, represents approximately 170 consulting engineering firms employing over 21,000 Ontarians. Member firms, which range in size from sole proprietorships to large multinational engineering firms, provide wide-ranging engineering services to government and private-sector clients, and the accumulated gross revenues of

consulting engineering firms across the country contribute approximately \$31 billion to the economy annually.

"Every AGM is an interesting opportunity to recap the year past and look at the year ahead," CEO Chief Executive Officer Bruce Matthews, P.Eng., told *Engineering Dimensions*. He notes that CEO saw significant improvement in advocacy, business practices and member engagement, which were CEO's three pillars from its 2016–2020 strategic plan. "On advocacy...we've developed a good relationship with the new government," Matthews notes, demonstrated by "the announcement by the minister of infrastructure of a market update to the project pipelines for major infrastructure projects, and by Ehren Cory, who's the president (and chief executive officer) of Infrastructure Ontario, who announced policies and approaches to procurement that echoed what we had been telling the government...This makes it so much easier for our members to plan their resources; it proves [the government] is listening."

In relation to business practices, Matthews notes: "We now have a response service that allows us to provide feedback to municipalities regarding the problematic language in requests for proposals, and this past year, we've provided such feedback on 35 proposals to suggest alternative language to address business risk issues and to

continued on p. 13

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• THE AWARDS •



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This award recognizes a team of engineers who have conceived of, designed and executed an outstanding project or achievement that has had a significant, positive impact on society, industry or engineering. *See page 18 for more information.



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Nominations are due by 4 p.m. EST on **Wednesday, February 26, 2020.**

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continued from p. 11

[allow municipalities] to form good relationships with the consulting engineering firms they retain.”

In addition, earlier this year, CEO added an affinity insurance program available to all member firms through BMS Canada Risk Services. In the area of member engagement, Matthews states: “We strengthened and increased the number of committees to include one for young professionals and another for women in STEM (science, technology, engineering and math), and we now have a level of engagement at 35 per cent, up from 25 per cent the prior year.”

Matthews was hesitant to predict the length of the next strategic plan, but he suggested it will be shorter than the current four-year plan to allow CEO to remain up to date with the quickly changing consulting engineering environment. “We’re entering our 45th year, and there’s no doubt that the business environment for consulting engineers today is very different than it was 45 years ago,” Matthews points out. “I would say it’s measurably different than it was 15 years ago.” Matthews points to the recent changes to the *Construction Act*, which introduced an adjudication and prompt payment scheme on October 1 (see p. 8). “One of the things we’ve been doing this past year is holding seminars on prompt payments and adjudication and their effect to our member



CEO's 2019–2020 board of directors and staff (from left to right) Matthew Eades, P.Eng., Rex Meadley, P.Eng., Bill Allison, P.Eng., Bruce Matthews, P.Eng., Steve Dyck, Don Holland, P.Eng., Christine Hill, P.Eng., Karen Freund, P.Eng., Ben Hunter, P.Eng., Joe Sframeli, P.Eng., Mark Tulloch, P.Eng., and Steve Pilgrim, P.Eng.

firms,” Matthews adds. “Our member firms are often involved in contract administration and payment certification, so the new legislation, which defines a proper invoice, sets out a payment timeline that is of great interest to them.” Matthews also recognizes that “there are many consulting engineering firms that may choose to get involved in [the adjudication process as adjudicators].” Despite the anticipated initial confusion surrounding the October 1 implementation, Matthews is confident in the changes: “It’s a good step forward because it creates a legal framework around prompt payment,” he says. “Our member firms have some horror stories about trying to get paid. This framework sets up some hard timelines, and if they aren’t being followed, there’s a process to go to adjudication, and there are consequences for project owners and others who aren’t following the rules.”

BITS & PIECES



A dizzying view from Cloudraker Skybridge, one of the highest elevation suspension bridges in the world. The Whistler, British Columbia, bridge spans 427 feet (130 metres) and is suspended from Whistler Peak to the West Ridge and crosses 164 feet (50 metres) above Whistler Bowl. Its placement atop a mountain range puts it at 7156 feet (2181 metres) above sea level. Photo: Ruth Hartnup

ALBERTA'S NEW FAIRNESS LAW AFFECTS ITS ENGINEERING REGULATOR

By Adam Sidsworth

The Association of Professional Engineers and Geoscientists of Alberta (APEGA) has expressed concerns with the six-month deadline for interim decisions for all new licences required of all Alberta professional regulators under the province's *Fair Registration Practices Act* (FRPA), which received royal assent on June 28.

The new law, ushered in by the United Conservative government just two months after their election victory, introduces the yet-to-be implemented Fair Registration Practices Office (FRPO) in an apparent bid to speed up the application process for internationally trained professionals (ITPs) seeking licensure in Alberta. "Many newcomers are underemployed and unable to practise their skills, because licensing procedures can be needlessly complex and can take years," the Alberta government stated in a press release announcing the passage of the act. "Speeding up this process will maintain Alberta's high professional standards while getting Albertans back to work." Although regulators must meet the specific six-month interim decision timeline, there is no deadline in the act for a final decision other than to "make registration within a reasonable time that does not exceed any applicable maximum time prescribed in the regulations" of the regulatory body.

Under the FRPA, all regulators—including APEGA—must make an interim decision on all licence applications within six months or face fines of up to \$50,000. However, according to Matthew Oliver, P.Eng., APEGA's chief regulatory officer, APEGA has historically lacked an interim decision process. "It's been a final registration decision every time," Oliver says of APEGA's application process. "We think we can get most of our decisions done within six months without a lot of effort, but my concern is, what do we do with these complicated applications that we can't deal with within six months? The other thing the bill imposes is an appeal from the interim decision, which is interesting, because if you don't like the interim decision, you can appeal it, but it's only an interim decision, so it's perplexing why they would [add it]."

Oliver notes that APEGA is caught in a catch-22 because APEGA moved its application process to a competency-based assessment (CBA) at the urging of a previous provincial government. Although more labour intensive, the CBA is more helpful for internationally trained engineering graduates, who are more likely to have atypical profiles. "[The government] paid for half the implementation," Oliver notes, adding that under CBA, "you ask [a candidate] specific questions about competency independently, like, 'How have you used codes and standards?' and 'How have you applied it?' It's better at assessing unusual experience and foreign experience because it contextualizes the job [experience] better."

The act also does not take into account that application processes are not universal across all self-regulating profes-

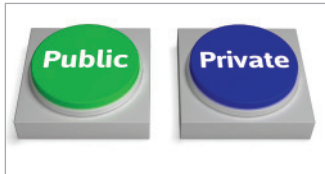
sions. Oliver notes that regulators for physiotherapists, doctors and dentists have a national academic process in which ITPs' academic credentials are assessed prior to applying to the provincial regulator, putting APEGA at a disadvantage. "We're like PEO," Oliver asserts. "We do the whole process back to back, so how will the six months be [counted] for us when the dentists make their decisions in far less time than six months because their academic assessments have already been done? There's so much uncertainty because what do the six months mean to us? How is the fairness act fair to all when some regulators use a national system?"

IMPLEMENTING A NEW INTERIM STEP

APEGA is considering several models to integrate an interim step into its registration process. The one making most sense is leveraging APEGA's consent agenda. Under APEGA's current system, all applications go before a risk assessment, with low- and medium-risk applications going before the consent agenda. "We're thinking that our consent agenda can be the basis of our interim decision because there hasn't been a case overturned in two years," Oliver explains. "And if it almost always stays, we can send a letter saying, 'Here's your interim decision,' and if they want to appeal, we can say that the appeal is the final decision." APEGA is also creating new staff positions to help meet the six-month deadline for applications received after June 28.

Alberta's FRPO will be similar to Ontario's Office of the Fairness Commissioner, ushered in by Ontario's 2006 *Fair Access to Regulated Professions and Compulsory Trades Act*. The act, to which PEO and all other Ontario regulators must comply, sets out "to ensure that regulated professions and individuals applying for registration by regulated professions are governed by registration practices that are transparent, objective, impartial and fair." However, Oliver notes that Ontario's act specifically mentions "internationally trained individuals," while Alberta's act makes no comparable mention. And once Alberta's FRPO is running, Oliver fears Alberta's minister of labour and immigration, to whom the office will answer, will have overreaching powers. "There's a whole bunch of unresolved questions," Oliver says. "The [FRPO] doesn't even exist yet, and they're the ones implementing and bringing in the audit process and issuing compliance orders on behalf of the minister."

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Make, Think, Imagine: Engineering The Future Of Civilization, by John Browne, 2019: Amidst rising technology backlash and fear, an engineer and former CEO of British oil giant BP explores balancing the risks and rewards of progress

An Elegant Puzzle: Systems of Engineering Management, by Will Larson, 2019: A look at balancing the structured principles and human-centric thinking to help leaders create more effective and rewarding organizations for engineers to thrive in

IN MEMORIAM

THE ASSOCIATION HAS RECEIVED WITH REGRET NOTIFICATION OF THE DEATHS OF THE FOLLOWING MEMBERS
(AS OF SEPTEMBER 2019).

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BAKER, Duane John Matthew
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**BARRETT, George Francis
William**
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BELL, Trevor Alexander
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BELLOSILLO, Simplicio Bitoon
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BLAND, Douglas John
Dunwoody, GA

BOND, Austin Caswell
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BOOLER, Andrew Peter
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BOWERS, Thomas Lawton
Mississauga, ON

BOYD, Derek Ian
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BRYENTON, Earl Leslie
Ottawa, ON

CHADLER, Ernest Wilfred
Comox, BC

CHYC, Henry
Cambridge, ON

CONRAD, James Ralph
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DEY, Sudhin
Aurora, ON

DEYS, Eric Bert
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DILAVER, Mustafa
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DUNCAN, Stephen Edward
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FINE, Manuel Albert
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FLECK, Rodolphe Mathias
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FLEMING, Stephen Harold
North Gower, ON

FOWLER, James Augustine
Guelph, ON

GEBARA, Amal Hassib
Toronto, ON

GERRITSEN, Egbert Dirk
North York, ON

GRANT, William Alexander
Ottawa, ON

GRZESIK, Edward
Mississauga, ON

GUDGEON, Keith B.
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KUZMENKO, Gregory
Brantford, ON

LABA, Jan Tadeusz
Windsor, ON

LAKHANPAL, Adarsh
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Nepean, ON

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LAPPAN, Howard Leonard
Belleville, ON

**LEITZINGER, Jennifer
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LESTER, Peter Dominic
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LEUNG, Benson Chok-Yin
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LINDA, Gustav
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LIU, Yee
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LLOYD, Kenneth Bertram
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**MACDONALD, Arthur
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**MACNAMARA, William
Stafford**
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Roland**
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Waterloo, ON

MCCABE, Edmund Joseph
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MCCANN, William James
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MCDOWELL, George Wilson
Windsor, ON

MCKELVIE, Stephen Allan
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Deep River, ON

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**SISSINGH, Robert Alexander
Peter**

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SMIT, Robert

Beaconsfield, QC

SMYTHE, Eric Weldon

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Sarnia, ON

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The Ontario Professional Engineers Awards (OPEAs) are now considering submissions for the 2020 Award for Engineering Project or Achievement, which pays tribute to an endeavor that has made a significant, positive impact on society, industry and/or engineering and that was conceived, designed and executed with significant input by Ontario engineers. Recipients are honoured annually in November at a black-tie gala hosted jointly by the Ontario Society of Professional Engineers and Professional Engineers Ontario.

Previous recipients of the award include Hands-Free Mooring, by the St. Lawrence Seaway Management Corporation; the Dual Education Program, by Siemens Canada; the 2nd Concession Project, by The Regional Municipality of York; and the Bombardier Global 7500 Business Jet.

WINNER OF THE 2019 OPEA FOR ENGINEERING PROJECT OR ACHIEVEMENT BOMBARDIER GLOBAL 7500 BUSINESS JET

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- A flight deck with next-generation fly-by-wire technology that blends advanced avionics with exceptional ergonomics.



FOR MORE
INFORMATION,
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NOMINATIONS
ON PAGE 12

THE PURPOSE OF THE PROFESSIONAL ENGINEER'S SEAL

By José Vera, P.Eng., MEPP

The professional engineer's seal is the distinguished mark of the engineering profession and an indication that the content of sealed documents was prepared by or under the personal supervision of a professional engineer. Proper use of the seal is essential, not only for complying with the *Professional Engineers Act* but also for assuring the public that the seal represents the profession's commitment to standards of care and excellence. This article provides practitioners with background information on the purpose of the professional engineer's seal and the concept of reasonable reliance from the perspective of different jurisdictions.

THE PURPOSE OF THE PROFESSIONAL ENGINEER'S SEAL IN CANADA

Consider this example: The province of British Columbia hires contractor ABC and engineering firm XYZ to work on a highway extension project. After the project is completed, ABC alleges that they lost money due to engineering design errors found in the drawings produced by XYZ. Consequently, ABC decides to sue both XYZ and their employee engineers, who sealed these drawings, for negligent misrepresentation.

The case goes to the Supreme Court of Canada (SCC), which holds engineering firm XYZ liable. However, the SCC dismisses the case against the individual engineers, noting that the purpose of the seal is to indicate that a qualified professional engineer prepared a document, not to indicate that an engineering document is accurate.

This example is based on a well-known SCC decision that establishes the purpose of the seal in Canadian law. Below are two key paragraphs from the decision:

From page 212: "The situation of the individual engineers is quite different. While they may, in one sense, have expected that persons in the position of the appellant would rely on their work, they would expect that the appellant would place reliance on their firm's pocketbook and not theirs for indemnification; see *London Drugs*, supra, at pp. 386–87. Looked at the other way, the appellant could not reasonably rely for indemnification on the individual engineers. It would have to show that it was relying on the particular expertise of an individual engineer without regard to the corporate character of the engineering firm. It would seem quite unrealistic, as my colleague observes, to hold that the mere presence of an individual

engineer's seal was sufficient indication of personal reliance (or for that matter voluntary assumption of risk)."

From page 222: "The only basis upon which they (the individual engineers) are sued is the fact that each of them affixed his seal to the design documents. In my view, this is insufficient to establish a duty of care between the individual engineers and Edgeworth. The seal attests that a qualified engineer prepared the drawing. It is not a guarantee of accuracy. The affixation of a seal, without more, is insufficient to found liability for negligent misrepresentation. I agree with the courts below that the action against the individual defendants should be struck." (*Edgeworth Construction Ltd. v. N. D. Lea & Associates Ltd.*, [1993] 3 S.C.R. 206, <https://scc-csc.lexum.com/scc-csc/scc-csc/en/item/1046/index.do>)

THE PURPOSE OF THE PROFESSIONAL ENGINEER'S SEAL IN THE TEXAS ENGINEERING PRACTICE ACT AND RULES

PEO's Professional Standards Committee (PSC) is currently developing proposed amendments to add clarity to the use of seal regulations. As part of this project, the PSC sought to find out if the purpose of the seal appears codified in other acts from neighbouring jurisdictions and conducted a jurisdictional scan of use of seal regulations in North America. During their research, the PSC found that the *Texas Engineering Practice Act and Rules* contains a codified (i.e. statutorily legislated) purpose of the professional engineer's seal under Subchapter B: Sealing Requirements, as follows.

137.33 Sealing Procedures

- (a) The purpose of the engineer's seal is to assure the user of the engineering product that the work has been performed or directly supervised by the professional engineer named and to delineate the scope of the engineer's work.
- (b) Licence holders shall only seal work done by them, performed under their direct supervision as defined in §131.81 of this title, relating to Definitions, or shall be standards or general guideline specifications that they have reviewed and selected. Upon sealing, engineers take full professional responsibility for that work. (*Texas Engineering Practice Act and Rules*, <https://engineers.texas.gov/downloads/lawrules.pdf>)

Note that the above requirements found in the Texas engineering act are similar to those contained in PEO's practice guideline *Use of the Professional Engineer's Seal*, which states, "The engineer, by affixing the seal, assumes responsibility and is answerable for the quality of the work presented therein."

AFFIXING THE SEAL IS AKIN TO ASSUMING PROFESSIONAL RESPONSIBILITY

The information covered up to this point allows us to conclude the following:

1. The purpose of the professional engineer's seal is to identify that a professional engineer performed specific work; and
2. The purpose of the professional engineer's seal has no connection to civil liability;

3. Instead, affixing the professional engineer's seal is a proxy for assuming professional responsibility.

Consequently, the myth that professional engineers could be held personally liable in a civil lawsuit only because they sealed a document is, simply that—a myth. After all, as the SCC case above notes, parties place reliance on an engineering firm's pocketbook, not on individual engineers for indemnification. Rather, the use of seal emblemizes professional responsibility.

REASONABLE RELIANCE ON SEALED ENGINEERING DOCUMENTS IN ONTARIO

Consider this example: Major hotel chain DEF engages engineering firm GHI to design an addition to their airport hotel. After construction, during a site investigation, another engineering firm, JKL, discovers the addition has serious structural deficiencies; consequently, the hotel must be closed due to safety concerns. The original design engineers admit their design was negligent, and their employer, engineering firm GHI, settles the claims brought against it. Furthermore, DEF sues the municipality, MNO, claiming their building department should not have approved clearly deficient plans and, therefore, MNO is partly responsible for the damages. However, in the Ontario Court of Justice (OCJ), the action is dismissed because MNO was held to be immune to tort liability due to their policy of reasonable reliance on sealed engineering documents requiring only cursory reviews from their building department.

This example is based on an OCJ decision that establishes the concept of reasonable reliance by another regulator on sealed engineering documents in Ontario law. Below are two key paragraphs from the decision:

From page 18: "It is generally agreed that the stamp and seal of an engineer communicates to the building official and to the public that the contents of the document sealed reflected professional knowledge and care; and that applicable statutes, standards, codes and regulations have been followed."

From page 24: "Section 2.5.1 of the code mandates that the design and general review of buildings be undertaken by an architect and professional engineer. It is not unreasonable for the city to adopt a policy in reliance upon their expertise. The policy adopted, the cursory review, reflected a true policy decision based upon a consideration of economic factors, being the allocation of resources—both human and financial. The policy was imple-

mented in a consistent and reasonable manner." (*Hilton Canada Inc. v. Magil Construction Ltd.*, [1998] O.J. No. 3069, www.peo.on.ca/index.php/ci_id/33416/la_id/1.htm)

Following are some conclusions relating to reasonable reliance on sealed engineering documents that we can draw from this OCJ case:

1. The seal of an engineer communicates to other regulatory authorities and to the public that the contents of sealed documents reflect professional knowledge and care and that responsible provisions have been made in the preparation of those documents to comply with applicable statutes, standards, codes and regulations;
2. Consequently, it is not unreasonable for regulatory authorities to adopt a policy of reliance upon the expertise of engineers;
3. However, such a policy of reliance by a regulatory authority upon engineering expertise would have to be implemented in a consistent and reasonable manner.

Based on the above, it follows that regulatory authorities can choose to adopt a policy of reasonable reliance on engineering documents bearing the seal of a professional engineer that will not attract liability in tort as long as it is applied consistently.

To gain a better understanding of the use of the professional engineer's seal, practitioners should:

- Read the *Use of the Professional Engineer's Seal* guideline (www.peo.on.ca/index.php/ci_id/22148/la_id/1.htm);
- Watch the *Use of the Professional Engineer's Seal* webinar (www.youtube.com/watch?v=5ZTXPaerUY); and
- Consider participating in the upcoming public consultation to revise the *Use of the Professional Engineer's Seal* guideline (likely to occur in 2020).

Finally, PEO's practice advisory team is available at practice-standards@peo.on.ca and is happy to hear from practitioners looking for general information on their professional obligations, such as the use of seal. However, practitioners looking for assistance on resolving legal or civil liability problems occurring in specific, concrete situations should always contact their lawyer, who can best address with the practitioner who is called to exercise his or her professional judgment in particular, factual circumstances and advise on the interplay between civil liability and regulatory facets of sealing. **e**

José Vera, P.Eng., MEPP, is PEO's manager of standards and practice.

GUIDELINE REMINDER Did you know? PEO offers useful guidelines for practitioners. For a complete list of resources, visit www.peo.on.ca/index.php/ci_id/1834/la_id/1.htm



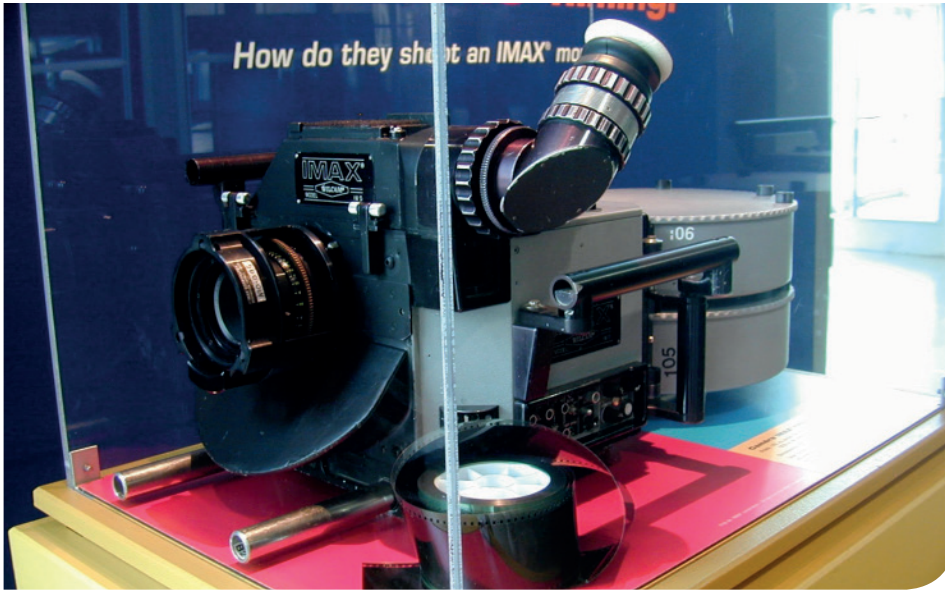
LOOKING BACK

5 ingenious inventions that were made in Ontario

Since PEO began regulating Ontario's engineering profession in 1922, its members have proven themselves resilient, entrepreneurial and innovative. From the large, jaw-dropping images of IMAX movies to the tiny yet groundbreaking pacemaker, we explore five historical innovations that put Ontario engineers on the map and paved the way for today's technologies.

By Adam Sidsworth and Natalya Anderson

Ontario Place's Cinesphere in Toronto, Ontario, was the world's first permanent IMAX theatre.



An IMAX cinema camera on display at the Bradford, UK, National Media Museum

IMAX ENGINEERS INCREASE MOVIE RESOLUTION



When engineer and Oscar winner William Shaw, P.Eng., told *Engineering Dimensions* in 1990 that “a motion picture is an illusion; nothing moves, [sic] it’s just a series of stills” (see “Lights! Camera! Engineering!” *Engineering Dimensions*, March/April 1990, p. 31), he was being modest about his accomplishments. The onetime PEO member and senior vice president of IMAX, who died in 2002, accepted the Academy of Motion Picture Arts and Sciences’ scientific and engineering

award in 1985 for IMAX’s development of large-format film technology. In addition, Shaw won an Ontario Professional Engineers Award in 1988 in recognition of his engineering accomplishments.

Shaw was one of four founders of IMAX and the only one who was an engineer. (The others were filmmakers and businessmen.) It was Shaw’s engineering ingenuity that led to the development of IMAX’s original projection system; in fact, he personally held a number of patents critical to IMAX’s success, notably the rolling loop mechanism (1978), which was crucial to IMAX film projection, and other patents relating to IMAX projectors, cameras and peripherals. And it was due to his leadership that IMAX would subsequently develop the IMAX 3D (1985), IMAX Solido (1990), IMAX Magic Carpet (1990) and IMAX HD (1991). And although many Toronto, Ontario, residents may associate IMAX with Ontario Place’s Cinesphere, the world’s first permanent IMAX theatre, with its large, golf ball-shaped design and screening of epic-themed documentaries, IMAX has expanded its presence into scripted Hollywood movies—the 2008 superhero movie *The Dark Knight* did it first when it shot some action scenes on IMAX’s 70mm filmstock and cameras, which, paired with the film’s analogue editing, raised the scenes’ resolution up to 18,000 lines. And along with IMAX’s expansion into Hollywood, IMAX’s digital projection has a significant presence in 1500 theatres in more than 80 countries.

“At IMAX, everything is based on the final performance in the theatre,” asserts Brett Chmiel, P.Eng., FEC, a mechanical engineer at IMAX. “The engineering and optical science behind [IMAX products] feeds into that final experience. There are a lot of IMAX employees who were around in the film days and in the early development of IMAX. These are people who are experts in imaging and sound.”

Chmiel, who was hired to help develop the IMAX Commercial Laser Projection System (ICLPS), wasn’t surprised to learn that Shaw told *Engineering Dimensions* in 1990 that at IMAX, “all engineering disciplines are involved,” including chemical, electrical and mechanical engineering; optics; and thermodynamics. “There has to be a close relationship between the technical and the creative in the film,” Shaw added. Chmiel notes that ICLPS, which has been phased into IMAX theatres over the past year and a half, was developed collaboratively. Chmiel estimates that as the new system was being developed, “we had at least 25 people in mechanical engineering, 23 people in software and at least eight people in electrical [engineering].” The engineering skills of Chmiel and his colleagues were crucial in developing the final product envisioned by IMAX’s research and development (R&D) team: “I would get the optical prescription from the R&D team, and then I’d engineer the system around it,” Chmiel explains. “Almost everyone on our R&D team has a master’s degree or PhD in optics or imaging. These are research scientists who understand optics. They provide the optical schematic that defines the optics and layout of the system, so as an engineer, I use tolerance information and ensure that my engineering is performing to the right specifications to keep the optics and mechanisms in the right range.”

Chmiel feels lucky to be able to combine his love of engineering with moviemaking. “It’s about performance uniformity and image quality, and everything I design has an effect on that,” he observes. “Everything rests on what the engineer does, and as an engineer, I am focused on what the system needs to be able to do.” IMAX is continuing to enhance filmmaking, stating on its website that “from the introduction of stadium



A SCR-536 US military "handie talkie," the first hand-held walkie talkie, which was developed three years after Hings'

Ironic, given the vast range of communication and technological opportunities Hings provided when he created the first portable radio signaling system in 1937, when he was employed by the Consolidated Mining and Smelting Company of Canada (CM&S, known today as Teck Resources Limited). Although many other inventors of the period were toying with similar ideas, it has been widely documented that Hings' device, which he branded the "pack set," was the original prototype for what would become the walkie talkie, and his patent was in production via CM&S at least one year earlier than his competitors.

Created by Hings as portable field radios to allow CM&S's bush pilots to communicate while working in remote areas, the devices proved so efficient that the Canadian Department of National Defence asked Hings' employer to loan him out in order to redevelop the sets for use in battle when the Second World War broke out in 1939. He developed a variety of new models for use in the army, and the new Model C-58 Pack Set (or "walkie talkie," as it was coined by war reporters at the time) was hugely successful and was shipped overseas for application in vehicles and on tanks. Approximately 18,000 models were built and shipped overseas, saving the lives of Canadian and Allied soldiers in Europe.

"The design was revolutionary," reported the *Vancouver Sun* on the day of Hings' Order of Canada ceremony, "allowing wireless communication between troops in battle." That statement alone attests to how much engineering groundwork Hings laid for the future of telecommunications both in Canada and internationally. Considering that these first devices included variable antennas, versatile power supplies for use on battle fields, a voice scrambler to thwart eavesdropping enemies, and a noise filter to eliminate combat sound, it is impossible to imagine today's endless array of mobile technologies, smart-wearables and GPS devices without tracing their evolution back to Hings. "He was one of the great pioneers in the field," Hings' grandson Morgan Burke told the *Vancouver Sun* in the same report, attesting to his grandfather's unflinching modesty, which was tied, he said, to the man's passion for his work. "It was so new. He just made it up as he went along."

Hings was a professional engineer in both British Columbia and Ontario, and he worked on his inventions and patents beyond retirement until he was physically unable to do so. Upon reflection during his award ceremony, it was his time in the

seating to developing the highest-resolution camera in the world to our laser projection technology and our partnerships with the world's best filmmakers...IMAX is determined to continue pushing movie technology forward."

THE WIDE-RANGING IMPACT OF THE WALKIE TALKIE

Radio check. Read you loud and clear. Come in. Stand by. Roger that. If this language is familiar, you've probably owned a walkie talkie in your lifetime. The beloved two-way radio might conjure memories of playground antics, expeditions in the woods or being housebound with siblings on a rainy day. But this now-82-year-old device was far from fun and games when it was invented in 1937 by a British-Canadian engineer. And it saved the lives of tens of thousands of soldiers in our country's darkest hours.

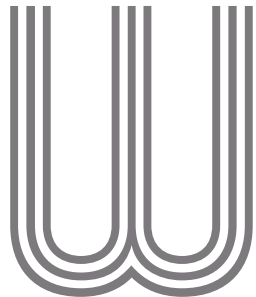
"[It] means a tremendous amount," said Donald L. Hings, upon receiving the Order of Canada in 2001. But the former professional engineer, whose legacy included 55 patents to his name when he passed away at the age of 96 in 2004, was referring not to the award itself but to how much he appreciated then-Governor General Adrienne Clarkson having travelled from Ottawa to Hings' home province of British Columbia to make the presentation. Travelling, he said at the time, was "a little out of my range of capabilities."



A replica of the CF-105 Arrow, which was developed in Malton (Mississauga), ON, by a team of engineers, many of whom were licensed by PEO

field exploring at the farthest reaches of Canada that most impacted his outlook. "If you've ever stood on a frozen mountain where the sun never sets, and you're being bombarded with gamma rays from outer space," said Hings to the *Vancouver Sun*, "then you realize just how big you are."

JETLINER AND ARROW CANCELLATIONS LEAD TO NASA MOON LANDINGS



hen the Aerospace Industries Association of Canada awarded its annual 2014 James C. Floyd Award for aerospace excellence, the engineer for whom the award was named after was celebrating his centennial birthday.

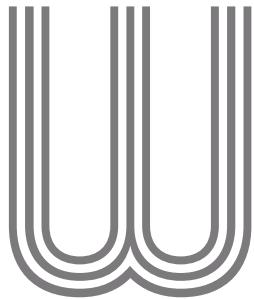
Floyd was a long-time PEO member, and his accomplishments are well documented by *Engineering Dimensions*. For Canadians, Floyd's name may be most recognizable through his engineering work with Avro Canada, most notably its famed CF-105 Arrow at its Malton (now Mississauga), ON, facility. "As a 14-year-old in England, I was fascinated by the activities of aviation record-makers," Floyd told *Engineering Dimensions* in 2003 (see "Jim Floyd, P.Eng.: One straight arrow," *Engineering Dimensions*, March/April 2003, p. 39), citing Charles Lindbergh, Amelia Earhart and Kingsford Smith as heroes. In 1930, at the age of 14, the United Kingdom-born Floyd jumped at the chance to work at Avro's North Manchester, England, plant. The machines were noisy and the factory covered in whale-oil lubricant, but Floyd began his career making thousands of small bolts for the equivalent of one dollar a week. However, Floyd was soon able to move up to new jobs: "I installed an electrical system in a new biplane from a layout handed to me by my foreman on a postcard!"

he noted. Although Floyd eventually earned his engineering diploma at the Manchester University College of Technology, he stated that "the time I spent in every department of the company... resulted in a better understanding of the essential interface between design and production than what would be received by graduates coming directly out of university."

Although he eventually became chief project engineer at the Avro satellite plant in Yorkshire, England, Floyd's historical reputation developed after he was transferred to Avro's Canadian operations following the company's purchase of Canadian-owned Victory Aircraft company; he then relocated to Ontario, where he received his engineering licence in 1948. Floyd designed the Avro C-102 Jetliner, which, when it made its maiden voyage on August 10, 1949, became North America's first jetliner and the second in the world. Capable of exceeding 800 kilometres an hour, it made the first international jet-transport flight in North America, and although it was considered an engineering marvel and caught the attention of the US Air Force, it never went into production because the government-owned Trans-Canada Airlines (now Air Canada) halted production. Instead, Avro shifted focus to the CF-100 Canuck, which the Royal Canadian Air Force hoped to use in Korea and eventually deployed in Europe. Floyd appeared to have remained more bitter about the Jetliner's cancellation than the Arrow, for which he was vice president of engineering, telling *Engineering Dimensions*: "I know of no military aircraft in service today that would fully meet the specifications laid down for the Arrow in 1953. But while the complexity, and therefore, the cost of the Arrow program...was probably the cause of its demise, there was no such reason for the Jetliner. It was cancelled when we were negotiating a contract with National Airlines for an initial fleet; when Howard Hughes had offered to fund 30...."

The engineering marvel and subsequent cancellation of the Arrow needs no rehashing. However, 33 Avro engineers who worked on the Jetliner and Arrow left Canada for NASA, working on its Mercury, Gemini and Apollo missions. This includes Jim Chamberlin, the Arrow's chief of technical design, who became Gemini's program manager and a later champion of the lunar-orbit rendezvous used on the moon landings. Chamberlin was joined by Owen Maynard, who designed an early prototype of the lunar module; and Bryan Erb, an aerodynamicist on the Arrow who would later help develop heat shields for the Apollo rockets. Others who were part of the brain drain include Denis Fielder, Tecwyn Roberts, P.Eng., John Hodge, David N. Brown and Bruce Aikenhead, most of whom once held PEO licences.

PACEMAKER INTRODUCES ENGINEERS TO MEDICINE



When John "Jack" Hopps, P.Eng., earned his electrical engineering degree from the University of Manitoba in 1941 and accepted a job at the National Research Council of Canada (NRC) in Ottawa, ON, to work on wartime radar, he probably didn't imagine that he would one day be lauded as a biomedical engineering pioneer.

In 1949, with the war a memory, the NRC assigned Hopps, who died in 1998, to the University of Toronto (U of T), where medical

doctors William Bigelow and John Callaghan were researching hypothermia's effects on dogs, cooling their hearts and clamping off the veins draining into their heart in a hope to perfect open heart surgery. When Bigelow used an electrical probe to zap the sinoatrial node—the heart's natural pacemaker—to restart one dog's stopped heart and found success, the doctors asked Hopps to develop a machine to restore heartbeats. Although the U of T doctors weren't the first to notice the relationship between the heartbeat and electrical pulses, they were the first to work with an electrical engineer. "In those days," Hopps told CBC in 1984, "there wasn't much rapport between engineering and medicine, and I think that was one of the real problems in our research: The medical people didn't know the potential of engineering to assist them, and we knew nothing about medical problems." By 1950, Hopps developed a microwave-sized machine that could insert a catheter through a vein and send impulses to the heart. And with the inventions of transistors and lithium batteries, by 1958 the pacemaker was small enough to be placed within patients to stabilize arrhythmia—abnormalities of the heart's electrical system. With his success, Hopps would become the founding president of the Canadian Medical and Biological Engineering Society.

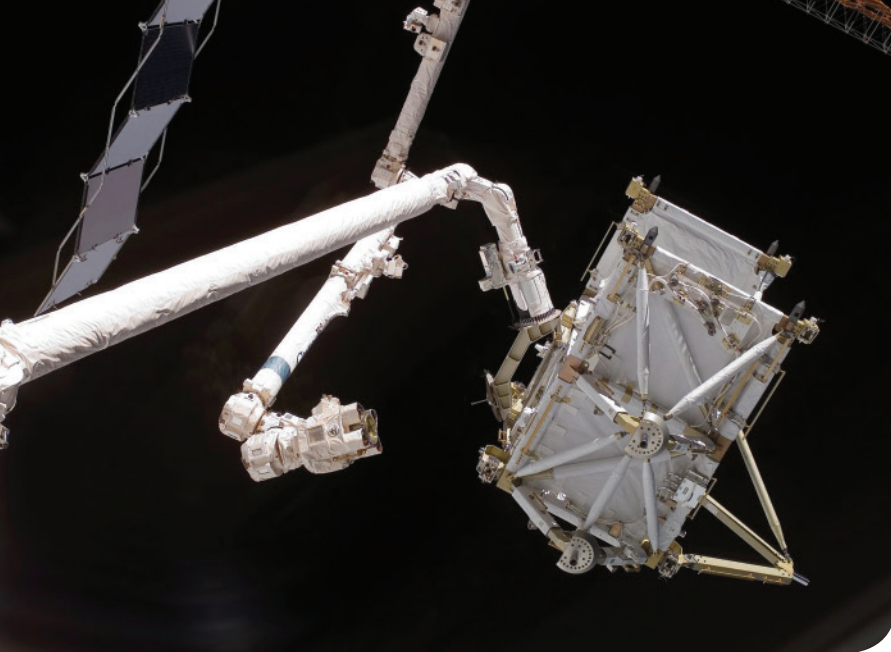
"It's a couple-hour procedure," says Stephanie Liddle, P.Eng., CCE, manager of biomedical engineering at the University of Ottawa Heart Institute (UOHI), referring to the implanting of standard pacemakers inside patients. "Patients are not tied to an electrical outlet after the procedure like they would have been in the early '50s. The technology has changed quite a bit; there are a number of

different pacemakers available depending on the type of arrhythmia the physician is trying to treat. Although John Hopps first developed the pacemaker in 1950, it wasn't until 1958 that it became feasible for medical use.



different pacemakers available depending on the type of arrhythmia the physician is trying to treat. It's pretty cool that you can implant a device the size of a quarter...and the patient is returning to their normal activities within a few weeks. Follow-up is periodic to non-invasively interrogate the device to ensure it's working correctly." Although the pacemaker operation is now standard, it is a complex machinery that ushered in the necessity of engineers in Ontario hospitals. Although sterile pacemakers are now shipped directly to hospitals by manufacturers, Liddle explains that "a pacemaker implanted in an electrophysiology room, equipped with all sorts of monitoring equipment as well as a fluoroscopy system (a system to take x-ray movies) to ensure leads (wires) are going into the right place," and these environments require engineers.

The device has since evolved into smaller and more efficient innovations. In 2016, Health Canada approved a new pacemaker that doesn't require leads connecting to the heart. This new pacemaker, the size of a vitamin capsule, is implanted via a catheter through the femoral vein and uses grapnel hooks to connect directly to heart tissue. Twenty times smaller than a traditional pacemaker, it takes up much less space and has a longevity of 12 to 13 years. However, because the technology is new, according to UOHI's Calum Redpath, PhD, MD, who performed the hospital's first leadless pacemaker operation in March 2018, it is typically reserved for patients who require a single-chamber pacing solution.



Space shuttle Discovery's Canadarm prepares to give a truss to the International Space Station's Canadarm II.

CANADARM REACHES FOR THE STARS

In 1974, a humble engineer from Alberta was named project manager to what would become perhaps Canada's most significant robotic and technological achievement in space—the Canadarm. The Canadarm had a 30-year career with NASA's Space Shuttle Program, and, even in retirement, the robotic arm motions to an ever-expanding horizon of technological possibility. "When NASA invited Canada and other nations to participate in the space shuttle program, it was decided that the NRC should be the lead department," recalls Garry Lindberg, P.Eng., about how he was eventually named project manager of the Shuttle Remote Manipulator System (SRMS), or Canadarm. "The initial invitation was made in 1969, but it was several years before Canada decided to participate."

The remote-controlled robotic arm made a myriad of duties possible, including deploying, capturing and repairing satellites, moving astronauts around, transporting cargo and maintaining equipment. It debuted in space on November 13, 1981, and its creation is responsible for a number of evolutionary devices. With the Space Shuttle Program's final mission in July 2011, the Canadarm was retired, but the historic achievement in robotics confirmed our country as a primary innovator in space technology and paved the way for a plethora of Canadian robotics (including the Canadarm II) successfully implemented on the International Space Station. "The Canadarm project was the first government project where the design authority and prime contractorship was vested in Canadian industry," says Lindberg about how he brought his engineering skills to the potentially daunting project. "The NRC project office had the responsibilities to manage the prime contractor and all the industrial

work, and to manage the interfaces with NASA and within government. The many challenges faced included negotiating an agreed set of requirements with NASA and contracts with the Canadian industrial team."

In 1982, as a guest on CBC's *Front Page Challenge*, Lindberg said that nearly 200 Canadian engineers had been involved in building the Canadarm. Although he was not directly engaged in the robotics intricacies of engineering, his industry skills were invaluable in other ways. He recalls how the vast team of specialists were connected through their work. "The engineers and technologists working for the prime contractor SPAR Aerospace and its sub-contractors possessed a strong array of space engineering skills," Lindberg explains. "In addition to using these space engineering skills, the SPAR-led team had to expand their capabilities to design the Canadarm since there was no way the complete system could be tested here on Earth." Lindberg says this also required the development of intricate computer models that simulated the complexities of the arm, as well as specialized testing facilities such as the air-bearing test support, which enabled two-dimensional testing of the assembled arm and the creation of a simulator dubbed Simulated Forward Air Controller (SIMFAC). SIMFAC allowed engineers to establish control system requirements and astronauts to train to operate the arm in space.

And so the stage was set for the future of Canada's involvement in space, as well as for the future of industrial returns on Canadian robotics. A total of five subsequent Canadarm systems were built in the successful series—one was donated and the remaining four were sold to NASA. This achievement also led to sales of robotics to Japan and Europe.

Today, the Canadarm's influence is widespread. "The Canadarm was our first foray into human space flight," Lindberg says. "Canadarm led directly to the Canadian Astronaut program and to Canadarm II, our involvement with the International Space Station. Canada is now committed to the Lunar Gateway, the NASA-led project to return humans to the moon." Additionally, the inclusion of the Canada Wordmark on the Canadarm led to the iconic first photos of the Canadarm deployed in space.

As for the future, the Canadarm's flexibility extends beyond imagination. "We are just starting the next major human space endeavour in co-operation with NASA and other nations where we will soon see humans going back to the moon. In the future we will undoubtedly see humans voyaging to Mars." **e**

DECISION AND REASONS

In the matter of a hearing under the *Professional Engineers Act, R.S.O. 1990, c. P.28*; and in the matter of a complaint regarding the conduct of WILLIAM TESSLER, P.ENG., a member of the Association of Professional Engineers of Ontario, and SONTERLAN CORPORATION, a holder of a certificate of authorization.

This matter came before a panel of the Discipline Committee of the Association of Professional Engineers of Ontario (the association or PEO) for hearing on November 19, 2018, at the offices of the Association of Professional Engineers of Ontario, 40 Sheppard Avenue West, Toronto, Ontario.

THE ALLEGATIONS

The allegations against William Tessler, P.Eng., and Sonterlan Corporation were set out in the Statement of Allegations attached to the decision of the Complaints Committee, both of which were dated April 4, 2018. The updated allegations are contained in the Agreed Statement of Facts in the next section.

AGREED STATEMENT OF FACTS

Counsel for the association advised the panel that the parties had an Agreed Statement of Facts, which was signed by the member and the certificate of authorization holder on October 9, 2018, and by the association on October 16, 2018. The agreement was filed at the hearing. None of the parties called any witnesses.

The Agreed Statement of Facts provides as follows (without attachments):

This Agreed Statement of Facts is made between the Association of Professional Engineers of Ontario (PEO) and the respondents, William Tessler, P.Eng. (Tessler) and Sonterlan Corporation (Sonterlan) (collectively, the parties).

1. Tessler is a licensed professional engineer with PEO. At all material times, Sonterlan held a certificate of authorization (C of A) with PEO, and Tessler was the designated individual taking responsibility for engineering services provided under the C of A.
2. In or about August 2015, Sonterlan was retained by Innovative Civil Constructors Inc. (ICCI) to design the cantilevered formwork and falsework to be used for the Remus River Bridge No. 1 Rehabilitation (the project) in New Brunswick. The project was owned by the New Brunswick Department of Transportation and Infrastructure (NBDTI).
3. The complainant, James V. Wood, P.Eng., is a senior structural engineer at Hilcon Limited (Hilcon), the engineering firm that was retained by NBDTI to perform project oversight and design review on the project. Attached as Schedule "A" hereto is a copy of the complaint, without attachments.
4. On or about September 4, 2015, the respondents submitted an initial design signed and sealed by Tessler. Hilcon reviewed the design and advised NBDTI and ICCI that the design was unacceptable and required revision to address the cumulative deflection of the formwork and falsework. Attached as Schedule "B" is a copy of a letter sent to NBDTI by Hilcon dated September 14, 2015 containing Hilcon's comments and concerns relating to the initial design.
5. Between approximately September 16 and 22, 2015, the respondents submitted additional signed and sealed revised drawings and calculations following Hilcon's and NBDTI's requests. Hilcon was not satisfied that the respondents' revisions adequately addressed the shortcomings of the proposed design, and suggested that a conference call be arranged to discuss the unresolved issues relating to the proposed design.
6. On September 22, 2015, Tessler, Hilcon staff, NBDTI and ICCI participated in a conference call, in which Hilcon's concerns were discussed. Tessler defended the design. Among other things, he maintained that the formwork design satisfied deflection requirements. Attached as Schedule "C" hereto is a copy of the minutes of the conference call meeting. Attached as Schedule "D" is a copy of a letter dated September 22, 2015, from Hilcon to NBDTI in which Hilcon recaps its concerns. Attached as Schedule "E" is a copy of a letter dated September 24, 2015, from Hilcon to NBDTI, summarizing its concerns in relation to the respondent's revisions signed and sealed on September 22, 2015.

ENFORCEMENT HOTLINE Please report any person or company you suspect is practising engineering illegally or illegally using engineering titles. Call the PEO enforcement hotline at 416-224-1100, ext. 1444 or 800-339-3716, ext. 1444. Or email enforcement@peo.on.ca. Through the *Professional Engineers Act*, Professional Engineers Ontario governs licence and certificate holders and regulates professional engineering in Ontario to serve and protect the public.

7. Following receipt of the letter dated September 24, 2015 (Schedule “E”), NBDTI instructed ICCI not to install the formwork until the issues were resolved. ICCI determined that they could not wait until the design issues were resolved and retained another engineering firm to complete an alternate design. ICCI further advised NBDTI that they would no longer use Sonterlan and Tessler on any further projects in New Brunswick.
8. PEO sought an opinion from an independent expert. The expert confirmed that the respondents’ design work contained serious deficiencies, concluding that:
 - a. The design failed to comply with a number of applicable codes and standards;
 - b. The design was missing critical details;
 - c. The design drawings contained numerous errors and other deficiencies, including the incorrect application of engineering principles; and
 - d. If built according to the respondents’ design, the formwork and falsework structure could have collapsed.

Attached as Schedule “F” is a copy of the expert’s report dated July 13, 2017 (the report).

9. Following receipt of the report, the respondents advised that the reporting letter from Art Engineering Inc. did not include any calculations or computer-generated analysis to support the conclusions documented and elected to perform an in-house design evaluation using SAP 2000 software. As a result of this evaluation, the respondents advised PEO, by email sent on September 6, 2017, that they concurred with the conclusions reached by the independent expert. They acknowledged “that the final design was flawed and would have failed under a full loading condition when the concrete was still in its plastic state.” The respondents explained that, due to time constraints, they had not followed their established protocol, which requires that an independent design review be performed by a member of staff prior to the release of any sealed drawing. The respondents further advised:

“We are fully cognizant of our responsibilities as professional engineers to uphold the requirements of clause 77.2.i of the

Code of Ethics of the association as it related to the welfare of the public.

“An independent engineering review is currently performed by either a member of our staff or third party checking engineer prior to the release of any sealed drawings or documents to ensure that the welfare of the public and our clients is paramount.”

10. The respondents have been previously convicted of professional misconduct. Attached as Schedule “G” hereto is a copy of the Discipline Committee decision in connection with the previous conviction dated October 18, 2004.
11. For the purposes of this proceeding, the respondents accept as correct the findings, opinions and conclusions contained in the report (Schedule “F”). The respondents admit that they failed to meet the minimum acceptable standards for engineering work of this type, and that they failed to maintain the standards that a reasonable and prudent practitioner would maintain in the circumstances. The respondents further admit that, by virtue of the errors in their design, they failed to make reasonable provision for the safeguarding of life, health or property of persons who might have been affected by the work for which they were responsible, and that they failed to make responsible provision for complying with applicable statutes, regulations, standards and codes.
12. By reason of the aforesaid, the parties agree that the respondents are guilty of professional misconduct as follows:
 - a. Acting or omitting to act in carrying out their work in a manner that constitutes a failure to maintain the standards that a reasonable and prudent practitioner would maintain in the circumstances, amounting to professional misconduct as defined by section 72(2)(a) of Regulation 941.
 - b. Failing to make reasonable provision for the safeguarding of life, health or property of a person who may be affected by the work for which they are responsible, amounting to professional misconduct as defined by section 72(2)(b) of Regulation 941.
 - c. Failing to make responsible provision for complying with applicable statutes, regulations, standards, codes, bylaws and rules in connection with work being undertaken by or under their responsibility, amounting to professional misconduct as defined by section 72(2)(d) of Regulation 941.
 - d. Engaging in conduct or an act relevant to the practice of professional engineering that, having regard to all the circumstances, would reasonably be regarded by the engineering profession as unprofessional, amounting to professional misconduct as defined by section 72(2)(j) of Regulation 941.

The respondents have had independent legal advice or have had the opportunity to obtain independent legal advice, with respect to their agreement as to the facts, as set out above.

The panel noted that the complainant and the structure that Tessler and Sonterlan designed were all located in New Brunswick. The panel inquired as to its jurisdiction and was referred to section 28(1) of the *Professional Engineers Act* by counsel for the association. The panel noted that the association also provided a previous discipline panel decision in the matter of *PEO v. Michaels A. Schor P.Eng. and M.A. Steelcon Engineering Limited* that involved the work of a member of the association outside of Ontario. The panel was convinced that it had jurisdiction.

PLEA BY MEMBER AND BY THE HOLDER

William Tessler, P.Eng., a member of the Association of Professional Engineers of Ontario, and Sonterlan Corporation, a holder of a certificate of authorization, both admitted to the allegations set out in the Agreed Statement of Facts. The panel conducted a plea inquiry and was satisfied that both the member's and the holder's admission was voluntary, informed and unequivocal.

DECISION AND REASON

The panel considered the Agreed Statement of Facts and finds that the facts set out in paragraph 8 of the agreement and the conclusions in the report (by Art Ivantchouk, P.Eng., dated July 13, 2018) support a finding of professional misconduct. The panel finds that William Tessler, P.Eng., a member of the Association of Professional Engineers of Ontario, and Sonterlan Corporation, a holder of a certificate of authorization, are guilty of professional misconduct as set out in paragraphs 12 a., b., c. and d. of the Agreed Statement of Facts.

JOINT SUBMISSION ON PENALTY

Counsel for the association advised the panel that she had a Joint Submission as to Penalty and Costs, which was signed by the member and the certificate of authorization holder on October 9, 2018, and by the association on October 16, 2018. The joint submission was filed at the hearing. None of the parties called any witnesses on penalty.

The Joint Submission as to Penalty and Costs provides as follows (paragraphs numbered 1 and 2 are introductory and are not included):

3. The PEO, Tessler and Sonterlan make the following joint submission as to penalty and costs:
 - a) Pursuant to section 28(4)(f) of the act, Tessler and Sonterlan shall be repriman-

ded, and the fact of the reprimand shall be recorded on the register permanently;

- b) Pursuant to section 28(4)(b) of the act, Tessler's licence shall be suspended for a period of three (3) months, commencing on December 1, 2018;
- c) Pursuant to sections 28(4)(d) and 28(4)(e) of the act, it shall be a term, condition and restriction on Tessler's licence that he shall not be the supervising engineer under section 17 of the act and section 47 of Regulation 941 (Supervising Engineer) for any holder of a certificate of authorization;
- d) Pursuant to sections 28(4)(d) and 28(4)(e) of the act, it shall be a term, condition or restriction on Sonterlan's certificate of authorization that every final structural engineering document issued or released by Sonterlan shall bear the signature and seal of Sonterlan's supervising engineer;
- e) Pursuant to section 28(4)(h) of the act, the respondents shall pay a fine in the amount of five thousand dollars (\$5,000) within three (3) months of the date of the Discipline Committee's decision on penalty;
- f) Pursuant to sections 28(4)(i) and 28(5) of the act, the reasons for decision, including the findings and order of the Discipline Committee shall be published in summary form in PEO's official publication, with reference to names; and
- g) There shall be no order as to costs.

Tessler and Sonterlan have had independent legal advice, or have had the opportunity to obtain independent legal advice, with respect to the penalty set out above.

Counsel for the association reminded the panel that the purposes of penalty are the protection of the public, to maintain the reputation of the association in the eyes of the public, for general and for specific deterrence and for rehabilitation. Counsel pointed out that this was Tessler's second offence, which was an aggravating factor to take into account. Counsel proposed that the penalty was a reasonable and appropriate set of penalties under the circumstances.

Counsel for the association put forth that the public would be protected, since Tessler would no longer be able to take responsibility for designs involving the protection of the public, and that another professional engineer would have to take responsibility for designs produced by Sonterlan.

Counsel for the association put forth that the reputation of the association would be maintained by the fine, which demonstrates the seriousness of the association in matters of the protection of the public; and the reprimand and the suspension, which demonstrate that serious misconduct results in serious penalties.

Counsel for the association put forth that the proposed penalty would provide specific deterrence through the combination of a fine, suspension and reprimand for the member, and through the limitation on the certificate of authorization for the holder.

Counsel for the association put forth that the proposed penalty would provide general deterrence by demonstrating to the members of the association that issues of public protection are taken very seriously. This will encourage the members to take the time and to produce correct designs.

Counsel for the association put forth that there is no rehabilitation in the proposed penalty, as none is needed, since Tessler would no longer be able to take responsibility for a design that involves the protection of the public.

Counsel for the association cited *PEO v. Gregory J Saunders P.Eng. and M.R. Wright and Associates Co. Ltd*, *PEO v. Michaels A. Schor P.Eng. and M.A. Steelcon Engineering Limited*, and *PEO v. Michael M. Cook P.Eng.* to show that the proposed penalty falls within the reasonable range of penalties based upon previous decisions of the Discipline Committee.

Counsel for the association said that a mitigating factor was that the member accepted responsibility for his actions during the investigation, and that the two aggravating factors were the serious risk to the public posed by the design by the member and the holder and the fact that this was a second offence for Tessler.

Counsel for the member and the holder noted that Tessler has worked hard to resolve this matter and believes that his design should have been to a higher standard.

In response to questions by the panel, the parties said that the term “documents” in the proposed penalty was intended to be interpreted as broadly as possible.

Independent legal counsel to the panel cited from *R v. Anthony-Cook 1016 SCC 43* as the leading case on accepting joint submissions as follows:

5. ...The test he should have applied is whether the proposed sentence would have brought the administration of justice into disrepute, or work otherwise be contrary to the public interest.

PENALTY DECISION AND REASONS

The panel accepts the Joint Submission as to Penalty and Costs and makes the following order:

- a) Pursuant to section 28(4)(f) of the act, Tessler and Sonterlan shall be reprimanded, and the fact of the reprimand shall be recorded on the register permanently;
- b) Pursuant to section 28(4)(b) of the act, Tessler’s licence shall be suspended for a period of three (3) months, commencing on December 1, 2018;
- c) Pursuant to sections 28(4)(d) and 28(4)(e) of the act, it shall be a term, condition and restriction on Tessler’s licence that he shall not be the supervising engineer under section 17 of the act and section 47 of Regulation

941 (Supervising Engineer) for any holder of a certificate of authorization;

- d) Pursuant to sections 28(4)(d) and 28(4)(e) of the act, it shall be a term, condition or restriction on Sonterlan’s certificate of authorization that every final structural engineering document issued or released by Sonterlan shall bear the signature and seal of Sonterlan’s supervising engineer;
- e) Pursuant to section 28(4)(h) of the act, the respondents shall pay a fine in the amount of five thousand dollars (\$5,000) to the minister of finance within three (3) months of the date of the Discipline Committee’s decision on penalty;
- f) Pursuant to sections 28(4)(i) and 28(5) of the act, the reasons for decision, including the findings and order of the Discipline Committee shall be published in summary form in PEO’s official publication, with reference to names; and
- g) There shall be no order as to costs.

The panel concluded that the proposed penalty is reasonable and in the public interest and, as set out in the legal test, the panel specifically found that the joint submission did not bring the administration of justice into disrepute, or work otherwise contrary to the public interest. William Tessler, P.Eng., co-operated with the association and, by agreeing to the facts and a proposed penalty, has accepted responsibility for his actions and has avoided unnecessary expense to the association. The panel also took into account that the penalty reflects the aggravating factors of the seriousness of the deficiencies with the design produced by William Tessler, P.Eng., and Sonterlan Corporation, and the fact that this is the second offence for Tessler.

The panel suggests that the Association of Professional Engineers and Geoscientists of New Brunswick be notified of this decision and these reasons.

Jag Mohan, P.Eng., signed this Decision and Reasons for the decision as chair of this discipline panel and on behalf of the members of the discipline panel: Rishi Kumar, P.Eng., Lew Lederman, QC, Glenn Richardson, P.Eng., and William Walker, P.Eng.

INNOVATING THE FUTURE:

5

INDUSTRIES THAT ARE TAKING OVER



BY MARIKA BIGONGIARI
AND
NATALYA ANDERSON

When the film *Minority Report* was released in 2002, who would have guessed we were just a few short years away from the ubiquitous touch screens, voice commands, facial recognition and vehicles travelling at high speed that made that film seem so futuristic? And yet those innovations are now part of our daily lives. Here, we explore five intricately woven technologies that draw heavily on classical engineering disciplines, are becoming increasingly difficult to regulate and are changing the world as we know it.



1

THE INTERNET OF THINGS

You don't need to look far to see how many of the things we use everyday are connected to one another. Everything

from your thermostat to your refrigerator can talk to your phone or watch. The Internet of Things (IoT) is a network of devices or "things" that connect to the internet and talk to each other, and the proliferation of broadband internet, cloud computing and Wi-Fi has thrown the door wide open for the technology. The expanding smart infrastructure needed to support rapid advancements in wireless communication and connect trillions of sensors with intelligent devices requires highly skilled personnel, and Marin Litoiu, PhD, P.Eng., an associate professor in both the School of Information Technology and the Lassonde School of Engineering at York University, is determined to give his students the tools they need to step up to the plate.

In 2018, Litoiu received a Natural Sciences and Engineering Research Council Create grant to lead a new program at York that focuses on applications of IoT and promises to prepare future engineers for jobs in smart infrastructure. The Dependable Internet of Things Applications (DITA) program provides interdisciplinary training and research in software engineering for a broad range of IoT platforms and applications. And the new program is a timely one. *The Internet of Things* report by Business Insider Intelligence forecasts that there will be more than 64 billion IoT devices by 2025—up from approximately 10 billion in 2018—and predicts transformative growth in an IoT market that's expected to grow to over \$3 trillion annually by 2026. Given such explosive growth, Litoiu aims to address the tremendous challenges posed to both education and training by these emerging engineering software-intensive systems. He stresses a critical need for end-to-end security, privacy, robustness and reliability assurances, which are difficult to achieve given the massive scale and diversity of IoT systems. "Now more than ever, considering human factors, societal, regulatory and ethical constraints and nuances, it is essential for building trust and successfully building and deploying useful IoT-intensive systems," Litoiu explains. "Considering these challenges, a multidisciplinary approach is needed, where engineers and academic educators from complementary fields work together to develop new approaches to address the hard questions of those complex systems."

According to Litoiu, IoT is an important area of study because its associated technologies, like artificial intelligence (AI) and machine learning, are becoming the key enablers for building context-aware applications in a variety of domains, such as autonomous vehicles, smart cities and buildings and personalized healthcare. "Designing and evolving such ecosystems is challenging and requires a new generation of professionals equipped with technical skills, interdisciplinary knowledge, ethical principles and social awareness," observes Litoiu, who also says there is a perceived skills gap in industry that translates into thousands of positions. "The goal of the DITA program is to equip the trainees with a comprehensive, holistic and interdisciplinary perspective that will enable them to analyze, architect, design, develop and/or evaluate dependable IoT systems that effectively fulfill individual and societal needs; bridge the gap between the academic and the industrial perspective through internships to immediately appreciate and evaluate the developed theoretical knowledge in industrial practice; and create an environment where trainees can develop highly sought-after professional skills, such as communication, collaboration, leadership and entrepreneurship," Litoiu explains. The program is aimed at software engineers and includes students and professors (many licensed engineers) from computer science, information technology, engineering, architecture and health. "It is our belief that future IoT systems are software intensive but also pose the problem of integrating great numbers of vastly heterogeneous sensors, networks, clouds, analytics, algorithms and actuators to form useful software ecosystems, requiring a strongly integrative and multidisciplinary perspective," Litoiu explains. "Canada and Ontario are well positioned to take a lead role in this, given the engineering talent and the strength of its academic institutions."



2

AUGMENTED, VIRTUAL AND MIXED REALITY

As early as the 1930s, writers and scientists toyed with ways in which augmented reality (AR), virtual reality (VR) and mixed reality (MR) might become part of our world. Through science

fiction stories and “mad scientist” inventions, these early dreamers were making blueprints for what seemed beyond reach at the time. Today, AR, VR and MR still maintain that initial spirit of making an imaginary place feel alive, and the lines between fact and fiction have opened a realm of possibility in the technological environment. From building industries, to health and sports training platforms, to the ever-popular world of gaming, AR, VR and MR are very much becoming a part of “real” life.

ARTIFICIAL INTELLIGENCE IS A TECHNOLOGY WITHOUT WHICH COUNTLESS OTHER NOVEL TECHNOLOGIES WOULD NOT BE POSSIBLE.

“The base technology of AR/MR is 3D positioning and orientation, which is needed to overlay digital information over the real world,” says Ernest Yap, P.Eng., co-founder and CEO of Shapetrace, which used AR and MR to pioneer field tools to help construction workers prevent errors using visualization and mapping with smartphones. Over the past decade, Yap has observed how the engineering industry has been immersed in AR, VR and MR to varying degrees: “For the engineering and construction industry, there is a strong case for AR/VR/MR visualization to help field professionals ‘see before you build,’” Yap explains. “Given 3D design had already been practised by designers for some time, AR/MR provides a means to take those 3D designs into the field for the purpose of coordination. For example, the installation of a commercial building’s mechanical system is prone to human error, given the HVAC, plumbing and fire protection systems are built in tight spaces on top of each other by different field teams. Then, 2D drawings do not easily convey 3D spaces. AR/MR can show a field worker why, how and even when a design should be installed in the field.”

Understanding the difference in the three techniques is key to how and if an industry might combine them for their needs. AR takes real-world elements and overlaps digital elements for uses such as “heads-up displays” where digital information follows a moving vehicle or person, such as in new car windshields or military aircraft helmets. VR allows users to fully engage in a pretend world through use of headsets and imagery, as demonstrated throughout the gaming industry. MR allows a user to both immerse oneself in the real and virtual world, manipulating both environments with their hands and feet.

Yap says his company was an innovator in the application of AR and MR for use in mapping and construction. “Shapetrace was started initially to test if a smartphone could be used to create an accurate 3D map using its camera images and SLAM (simultaneous localization and mapping) techniques,” he explains. “If yes, then we could build software to compare this 3D map against the BIM (building information modeling) model and help workers detect errors between the design and the actual build. However, the more customer development and field testing we did,

it became apparent that customers wanted error prevention more than error detection to save the extensive cost of rework.” As customers demanded real-time visualization using their smartphone to see if the BIM model overlaid their actual space, the solution was a combination of AR and MR. As the company experimented, they also realized that use of these techniques is evolving by the second, and today they are not as useful in more efficient mapping on their own. Yap says a combined effort with artificial intelligence and robotics will be essential going forward.

However, aside from use in construction, a variety of VR techniques are used in other industries. Healthcare professionals use surgical simulations for training purposes; the film and television industry uses a vast array of simulated sets and immersive visual environments to enhance filmgoers’ experience; and the sports industry trains athletes via VR programs such as STRIVR to huge success.

While his company is now emerging from working with the construction industry, Yap does have great insight into the future of AR and MR as techniques. “AR/MR will be part of construction’s future for sure,” he predicts, “but perhaps not how Shapetrace conceived it and likely not as quickly as many had predicted. For one, we learned that AR/MR is only the means to access information no different than a smartphone or laptop. Thus, AR/MR in general will need to become singular with machine learning so that a computer is smart enough to learn a physical space, learn the objects in it and recognize the space even if it’s changing constantly.”



3

ARTIFICIAL INTELLIGENCE

AI is a technology without which countless other novel technologies would not be possible. Machine learning and deep learning, subsets of AI, are being put to work by engineers every day to optimize supply chains across multiple industries from food to finance,

THE CURRENT SUCCESS OF MACHINE LEARNING IS PRIMARILY DRIVEN BY COMPUTER SCIENTISTS WHO FOCUS ON THE DEVELOPMENT OF NEW ALGORITHMS, AND ALTHOUGH THIS LEAVES THE APPLICATION OF THE TECHNOLOGY LARGELY UNTAPPED, ENGINEERS HAVE ACTIVELY ADOPTED MACHINE-LEARNING TECHNIQUES IN THEIR DOMAINS IN EVERY FIELD: ELECTRICAL, COMPUTER, MECHANICAL, BIOENGINEERING, CIVIL AND MATERIAL ENGINEERING.

increase profits for businesses by facilitating automation and streamlining logistics and even saving lives in hospitals by making the processing behind predictive analytics possible. Chi-Guhn Lee, PhD, P.Eng., a professor in the department of mechanical and industrial engineering at the University of Toronto, specializes in supply chain optimization and the theory and application of machine learning. In addition to his work to optimize food supply chains, Lee drew on his industrial engineering background and machine learning skills to predict the quality of water at the Mtendeli refugee camp in Tanzania in collaboration with Doctors Without Borders. "We have applied deep reinforcement learning (deep learning and reinforcement learning) to optimize financial trading, optimal control of multiple HVAC systems in a large grocery store, clustering of power generation units according to reliability features, adaptive deep learning to estimate the remaining useful life of jet engines, sequential pattern mining from maintenance work order records and so on," Lee observes. "A student of mine, who is also a full-time employee at a steel company, implemented a deep learning-based quality inspection module leading to a \$2-million cost savings for his company."

Lee points out that while machine learning is not new, it's gaining attention at an unprecedented rate, and he attributes its recent successes to the availability of a large amount of data and ever-increasing computing power. "The trend will continue and even accelerate," he says after discussing the topic with his students. "Machine learning is about extracting valuable information from data and applying the information to decision making. Since information extraction and decision making can be generally applied to a wide range of domains, machine learning will impact every corner of our lives: politics, the economy, environment, health and society at large."

The current success of machine learning is primarily driven by computer scientists who focus on the development of new algorithms, and although this leaves the application of the technology largely untapped, engineers have actively adopted machine-learning techniques in their domains in every field: electrical, computer, mechanical, bioengineering, civil and material engineering. "Electrical and industrial engineers are particularly active due to the nature of their fields," Lee says. "Those who work in areas such as speech recognition, machine vision and image processing are now turning their attention to machine learning, and others are working to develop specialized hardware for efficient machine learning. At the same time, industrial engineers are traditionally interested in system-level efficiency and optimization theories. As such, they are both contributing to and utilizing machine learning; contributing to it by developing new optimization techniques to improve machine learning performance and utilizing it by adopting machine learning to improve the efficiency of a system (production system, supply chain, healthcare, etc.) of their interest."

As an industrial engineer, Lee recognizes that AI and machine learning are heavily rooted in the mathematical and statistical fields that are the main toolboxes of industrial engineering and points out that optimization, mathematical programming, linear algebra, probability and statistics all play a prominent role, and AI and machine learning share much of the same language, methodology and toolsets. "Optimization, especially, and its applications in many real-world problems are the bread and butter of industrial engineering, as well as one of the key components of AI and related technologies," Lee says. As the problem-solvers of the world, he sees engineers playing an ever-increasing role in AI and related fields going forward. "AI and machine learning have roots in engineering and find ample application domains in the engineering fields," Lee says. "Engineers are uniquely positioned to understand and apply the technology to address real-life issues. Engineers are the interface between this new technology and the world."



CYBERSECURITY

Transferring money online, sending sensitive messages to a confidante via email,

4

texting critical medical information to a loved one—the ways in which we exchange highly personal, deeply private information is multifaceted and constant. Frighteningly, the ways in which criminals can access our electronic data is just as prevalent. But engineers are helping to thwart the unauthorized use of electronic data through innovative approaches in automation, robotics and AI. It's the reason Rodney Howes, P.Eng., is so passionate about his job.

"In my work, the cybersecurity issue is multifaceted and covers many domains of knowledge that require an overarching view of these domains," says Howes, e-security portfolio director, Canadian Safety and Security Program, Centre for Security Sciences, Defence Research and Development Canada. "Ultimately, the complex cyber problems require one to acquire the technical skills, while concurrently using other engineering skills [such as] critical thinking, problem solving and communications skills."

Howes's work reaches Canadians troubled by the need to protect, detect, respond, restore and recover from cyber-attacks through a broad spectrum of infrastructure that most of us never consider. The 10 Canadian critical infrastructures (CI)—including health, food, finance, water, information and communication technology, safety, energy and utilities, manufacturing, government and transportation—impact so many individuals on a second-to-second basis, and Howes uses his engineering skills at light speed to keep hacking to a minimum.

"As a country, our well-being requires smooth operation of the 10 Canadian CIs," Howes says. "These CIs are adapting to using the modern electronic equipment that are increasingly internet-connected devices to operate, communicate and store or move data. The reason for the change is the efficiency and capabilities of using these IP (internet protocol) devices. They are all susceptible to cyber-attacks from different threat actors whose motives may be monetary, fame or disruption (foreign actors)."

Innovative cybersecurity techniques in the areas of automation, robotics and AI are constant. Achieving faster methods of decryption, more accurate detection of foreign actors and rapid-fire auditing of configurations—essentially honing computer power to beat hackers at their own game—is a race against time for engineers in this specialized area. Howes says a delicate equilibrium between efficacy and safety is the goal as engineers assist in the development of these inventions.

"As new modern equipment is being implemented into the CIs, they are increasingly utilizing automation, robotics and AI," Howes says. "The development of the equipment should be balanced with a level of built-in security. The difficulty becomes how much security to build in, as this is costly, and without much monetary return. The question then is, should there be a regulatory requirement of a standard of security? Then that leads to how much regulation, and should these be cross-border standards? The list goes on. Also, the technology progresses as fast as standards and regulations can be made."

Howes says that he sees engineers thriving in the area of cybersecurity, as there is an inherent excitement in working so quickly and yet so intricately. "Engineers are also builders," he explains. "Technology is another word for a building block. Every technology was built on a previous set

of technologies and this will carry on. Innovation is what we strive for. It gives us the challenge we seek to work on."

Going forward, the future involves a quantum leap. "The future is unfolding very quickly," Howes explains. "One area of huge innovation in automation, robotics and AI will be in the quantum world. Examples are Quantum computing, quantum encryption and quantum sensing. With the laws of physics being different at the quantum level, the cybersecurity also requires rethinking. Things like big data analysis, augmented reality and virtual reality are the tip of the iceberg for cybersecurity professionals in the future."



5

HYPERLOOP TRANSPORTATION

In 2013 white paper *Hyperloop Alpha*, Elon Musk, a former Queen's University student and founder of PayPal, Tesla, SpaceX and The Boring Company, introduced the world to a radical idea when he proposed hyperloop—a technology he called a new mode of transport that seeks to change the existing paradigm by being both fast and inexpensive. Musk envisioned a form of transportation that would be safer, more convenient, immune to weather, sustainably self-powering, resistant to earthquakes and not disruptive to inhabitants

ACHIEVING FASTER METHODS OF DECRYPTION,
MORE ACCURATE DETECTION OF FOREIGN ACTORS
AND RAPID-FIRE AUDITING OF CONFIGURATIONS—
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TIME FOR ENGINEERS IN THIS SPECIALIZED AREA.

THE TECHNOLOGY MAY BE UNPROVEN AT THIS STAGE, BUT IT'S BEING TAKEN VERY SERIOUSLY—NOT ONLY BY ENGINEERING STUDENTS BUT BY COUNTLESS STARTUPS GLOBALLY, INCLUDING TORONTO, ONTARIO'S OWN HYPERLOOP STARTUP, TRANSPOD.

along its route. In addition, he made the hyperloop an open source design concept and put a call out for feedback from the engineering community he hoped would advance its design and bring it from concept to reality. In 2015, further to his goal of making hyperloop a reality, Musk's SpaceX announced the Hyperloop Pod Competition; its aim was to support the development of functional prototypes and encourage (primarily) student engineering teams to design and build the fastest pod. Hundreds of engineering student teams from around the world sought to compete to bring hyperloop to fruition. The University of Waterloo's team, Waterloo, was among an initial group of 30 finalists to compete at SpaceX headquarters in Hawthorne, California, where teams were given the opportunity to present their designs and test their pods on a one-mile test track.

The technology may be unproven at this stage, but it's being taken very seriously—not only by engineering students but by countless startups globally, including Toronto, Ontario's own hyperloop startup, TransPod. In a press release, TransPod revealed plans to build a test track in Limoges, France, with construction set to begin in 2020 and plans to start high-speed testing soon after.

Even the Canadian government is getting in on the action. In fact, Transport Canada has requested the services of a transportation consultant to investigate the feasibility of hyperloop as a new mode of transportation. In a separate initiative, a proposed Toronto-Ottawa-Montreal route is one of 10 finalists chosen in the Hyperloop One Global Challenge, hosted by Virgin Hyperloop One—a front-runner in this new industry and the first company to build a test track, located in the Nevada desert. The winning hyperloop route bid came from the AECOM Canada-led HyperCAN team, whose proposed Ontario-Quebec route would see a ride from Toronto to Montreal taking as little as 39 minutes across Canada's most densely populated region, if the pod can achieve its projected faster-than-supersonic speed.

Design challenges must be overcome in order to make Musk's dream a reality, and this is where engineers in every field come in. One look at the recruitment pages for companies actively working to make hyperloop happen reveals

that the skills needed to solve its design challenges and build a working track and pod involve every engineering discipline, from electrical engineers to engineers specializing in the fields of electromagnetics and thermodynamics. The proposed capsule design, not unlike the fuselage of a plane, would be suspended in a sealed reduced-pressure tube, which would be supported by columns like a bridge or a highway overpass above ground, or located in enclosed underground tunnels where geographically necessary. Proposals for the propulsion system range from Musk's originally proposed compressed air method to using passive magnetic levitation or electromagnetic levitation in an environment that's approaching a vacuum.

Mohammed E. Nassar, PhD, EIT, a lecturer in the department of electrical and computer engineering at the University of Waterloo, explains how hyperloop works: "The technology will transport people and cargo in wheel-less pods floating in a vacuum tube at ultimate speeds that can [theoretically] reach over 1100 kilometres per hour." Nassar reflects on Newton's first law of motion and says the challenge for engineers in making hyperloop work as imagined is overcoming opposing forces like friction and drag. "In hyperloop, the pods travel through steel tubes with most of the air removed, and thus the drag force is minimized. In addition, the pods are floating inside the tubes using air-flow or magnetic levitation, which minimizes friction losses. Therefore, the energy needed to propel pods through the tube is significantly reduced...The absence of these opposing forces will allow the pods to reach ultimate travel speeds that could not be achieved through conventional transportation. People will travel long distances swiftly at a lower energy cost." Nassar expects the technology will make commutes faster and more comfortable; reduce traffic, congestion and pollution; make access to educational, cultural and health services that are normally out of reach possible; and alleviate strain on infrastructure, thus having significant economic, demographic and social benefits. [e](#)

MONTREAL REMEMBERED 30 YEARS LATER

By Adam Sidsworth



A plaque on the exterior wall of Polytechnique Montréal commemorating the slain victims of the December 6, 1989, massacre that targeted women engineering students

Nathalie Provost is a survivor. Provost was an engineering student at Polytechnique Montréal (then called École Polytechnique de Montréal) on December 6, 1989, when a man armed with a semi-automatic rifle and a hunting knife entered her classroom, ordered the men to leave and began shooting the women. In total, 14 people—all women, most engineering students—were killed, and 14 other people were injured before the man killed himself. The shooting spree remains the deadliest in Canadian history, and although Provost, who was brave enough to verbally confront the gunman, was shot four times, including in the forehead, she survived and eventually earned her engineering degree, started a career, had a family and became an advocate for gun control. Although the killer left hints to why he targeted women engineering students, Provost told the *Globe and Mail* in 2009, “It took me a year of asking, ‘Why, why, why?’ Then at one point I said, ‘Because.’”

This December marks the 30th anniversary of the Montreal Massacre, and it’s a number not lost on Helen Wojcinski, MBA, P.Eng., FEC, chair of PEO’s 30 by 30 Task Force, which is tasked with supporting PEO’s goal of reaching 30 per cent of newly licensed engineers who are women by 2030. (In 2017, only 19 per cent of newly licensed engineers in Ontario were women.) “Thirty per cent doesn’t come out of nowhere,” Wojcinski says. “It’s a number that’s well researched to attain critical mass. So, although we’ve made significant progress since that horrific day in Montreal, we have more work to do...to make sure women feel welcomed in the profession.”

Wojcinski remembers the day of the massacre clearly: “Ironically, I was an engineer at the Ministry of Transportation, and we were at a women-in-engineering conference. There were enough [of us] to fill only a boardroom table.

That’s all we had.” Wojcinski had received her PEO licence just three weeks before, when just 2 per cent of engineers were women. And although Wojcinski is hopeful that more women will become leaders in the engineering profession, she reiterates that “the first step as a regulator is to get more [women] licensed. The second step is to get them to hone their engineering skills so they can progress to be role models and leaders and inspire even more women to pursue an engineering career.”

INCREASING DIVERSITY

PEO President-elect Marisa Sterling, P.Eng., FEC, also clearly remembers that day: “I was on the University of Toronto (U of T) campus; I was a [third-year] chemical engineering student. I was playing football with my friends on the field when lots of media started showing up. We hadn’t yet heard the news, as this was before social media. I remember students collecting in Convocation Hall, and thinking, ‘Why would somebody come to an engineering school and attack women just like me, and what does that mean for us being female students at the exact same time?’” Sterling recalls that “there wasn’t open dialogue in the classrooms about this event. We gathered with friends, but there wasn’t anything brought forward to say, ‘Let’s figure out what this means.’” But that has changed: Sterling is now the assistant dean and director of diversity, inclusion and professionalism at U of T’s faculty of applied science and engineering, and many other engineering faculties across the country are creating similar positions. Sterling hopes that equity, diversity and professionalism will remain a part of PEO’s vision when she takes over Council’s presidency in 2020. “It needs to be an embedded component,” she says. “The research shows that if you’re looking for excellence, if you’re looking for the best possible results, gender diversity helps,” and 30 by 30 is a critical first step. “Women are not a minority group but an underrepresented percentage of the engineering population. And we’re not singular individuals...By focusing on those who identify as female, you’ll support those who identify as different races, different sexualities and so forth.”

WOMEN AS ENGINEERING ACTIVISTS

Evangeline Philos, P.Eng., is a business process engineer who recently received her PEO licence. And although she has no living memory of the massacre, she understands the importance of increasing women’s visibility in engineering, which is why she helped create the Toronto chapter of the United States-based Society of Women Engineers (SWE). SWE Toronto has numerous networking and social events, including its monthly coffee club, designed to help foster a community among women engineers, and Philos is currently serving as its first past president.

Although most women who attend SWE Toronto events are in the early stages of their careers, Philos is cognizant of the trailblazing women who came before her, including Wojcinski, Marilyn Spink, P.Eng., a PEO councillor who was an early advisor to SWE Toronto, and Márta Ecsedi, P.Eng., FEC, who was the first chair of PEO’s Women in Engineering Advisory Committee in 1986. (The committee received initial support from PEO’s first woman president, Claudette MacKay-Lassonde, P.Eng., and has since moved to the Ontario Society of Professional Engineers.) Philos says she was lucky that both Spink and Ecsedi helped her navigate her licence application process with PEO, but not all women and women-in-engineering groups are lucky to have such mentors. **e**

P.ENGs, ENGINEERING FIRMS AND STUDENTS WIN AWARDS AROUND THE GLOBE

By Marika Bigongiari

PEO successfully nominated two Ontario engineers for the Governor General Sovereign's Medal for Volunteers, which were awarded by Governor General of Canada Julie Payette, ing., and bestowed at the Engineers Canada meeting of members.

Chris Roney, P.Eng., FEC, a past president of Engineers Canada and former lieutenant governor-appointed member of PEO Council, was recognized for his extensive volunteer work with both PEO and Engineers Canada. **Jeanette Southwood, P.Eng., FEC**, vice president of Engineers Canada, was honoured for her two-decade-long volunteer career with PEO and for her championing of sustainable development.

Elizabeth Edwards, PhD, P.Eng., has been appointed to the rank of university professor at the University of Toronto (U of T), the university's highest academic rank given in recognition of exceptional scholarly achievement and expertise in a field of knowledge. Edwards, a Canada research chair in anaerobic biotechnology and principal investigator at Biodegraders Research Group, is a pioneering researcher in bioremediation, which is a field that employs micro-organisms to degrade and destroy toxic pollutants in soil and groundwater. She is also the founding director of BioZone, a centre for applied bioscience and bioengineering within U of T's faculty of applied science and engineering, and a previous recipient of the Killam Prize in Engineering.

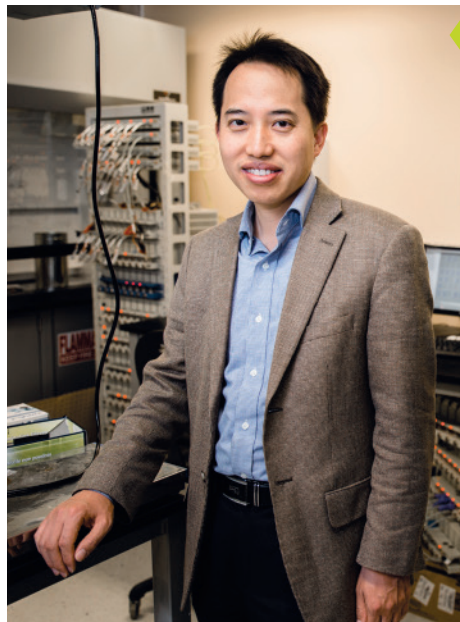
Two professors at York University's Lassonde School of Engineering are among a group of the school's researchers who have collectively been awarded over \$700,000 in funding. **Professor John Gales, PhD, P.Eng.**, of the civil engineering department will receive \$118,135, and **Professor Pouya Rezai, PhD, LEL**, of the mechanical engineering department will receive \$140,000. The provincial funding is given to facilitate research projects and helps cover equipment costs via the Early Researcher Award program and the Ontario Research Fund.

Three consulting engineering firms were recently honoured with awards at the International Federation of Consulting Engineers (FIDIC) awards ceremony and gala in Mexico City. The FIDIC project awards recognize outstanding engineering projects and celebrate the work of member consulting engineering firms. **Kerr Wood Leidal Associates Ltd.** was recognized with an Award of Merit for its Squamish Integrated Flood Hazard Management Plan project in Squamish, British Columbia. **Stantec**

and **Tetra Tech Canada Inc.** were honoured with an Award of Special Merit for their Inuvik Tuktoyaktuk Highway project in the Northwest Territories.

The Royal Society of Canada (RSC) and its members have elected this year's new fellows and named the incoming class of its College of New Scholars, Artists and Scientists. Ninety-three new fellows in the academies of arts and humanities, social sciences and science have been elected for outstanding scholarly, scientific and artistic achievement, including **Zhongwei Chen, PhD, EIT**, Canada research chair in advanced materials for clean energy, and professor, department of engineering, at the University of Waterloo. Chen was inducted as a new fellow in the Academy of Science's division of applied sciences and engineering. The RSC also welcomed 46 new members of the College of New Scholars, Artists and Scientists, including **Zheng Hong (George) Zhu, PhD, P.Eng.**, York research chair, inaugural academic director of Research Commons, and professor, department of mechanical engineering, at York University. "The Royal Society of Canada is extremely fortunate to welcome these exceptionally talented scholars, artists and scientists as new members of the society," RSC President Chad Gaffield said. "They have made outstanding contributions to their fields and to Canada's intellectual and artistic breadth and are making a tremendously positive impact on the world. We recognize them for all that they have done, and indeed will continue to do, to advance scholarly and public life in Canada and around the world."

The Canadian Academy of Engineering inducted 49 new fellows and five new international fellows. Among them are **Pascale Champagne, PhD, P.Eng.**, Canada research chair in bioresources engineering, professor in the departments of civil engineering and chemical engineering at Queen's University and director of Beaty Water Research Centre; **Katherine Crewe, P.Eng.**, chair, TEC-Canada; **Kevin J. Deluzio, PhD, P.Eng.**, dean and professor, faculty of engineering and applied science, Queen's University; **Stephen Howe, P.Eng.**, executive vice president and chief technology officer, Bell Canada; **Peter Huck, PhD, P.Eng.**, professor and Natural Sciences and Engineering Research Council chair in water treatment in the department of civil and environmental engineering at the University of Waterloo; **Milos Popovic, PhD, P.Eng.**, professor at U of T's Institute of Biomaterials and Biomedical Engineering and institute director of KITE at the Toronto Rehabilitation Institute; **Weiming Shen, PhD, P.Eng.**, principal research officer, National Research Council of Canada; **Sarah Shortreed, P.Eng.**, member of the board of governors, Western University; **Gina Succi, P.Eng.**, executive vice president, Westhill Innovation Inc.; **Pearl Sullivan, PhD, P.Eng.**, professor and dean, faculty of engineering, University of Waterloo; **Lihui Wang, PhD, P.Eng.**, chair and professor of sustainable production systems, KTH Royal Institute of Technology; **Frank Wheeler, P.Eng.**, retired senior consultant, iron and steel, FMW Consulting; **Carole Wilson, P.Eng.**, Ford OEM field manager, Ontario, AutoAlert, LLC; **Q. Jonathan Wu, PhD, P.Eng.**, University of Windsor engineering professor and Canada research chair in automotive sensor and information systems; **Chunbao Charles Xu, PhD, P.Eng.**, professor, department of chemical and biochemical engineering, Western University, director,



Peter Huck, PhD, P.Eng. (left), professor and Natural Sciences and Engineering Research Council chair in water treatment in the department of civil and environmental engineering at the University of Waterloo, was inducted as a new fellow by the Canadian Academy of Engineering.

Zhongwei Chen, PhD, EIT, Canada research chair in advanced materials for clean energy and professor, department of engineering, at the University of Waterloo, has been inducted as a new fellow in the Royal Society of Canada.



Stantec and Tetra Tech Canada Inc. were honoured at the International Federation of Consulting Engineers awards with an Award of Special Merit for their Inuvik Tuktoyaktuk Highway project in the Northwest Territories.



Pedram Mortazavi, P.Eng., a PhD candidate in the department of civil and mineral engineering at the University of Toronto, has been awarded the Donald Jamieson Fellowship by the Canadian Society for Civil Engineering.

Industrial Bioproduct Laboratory, and co-editor-in-chief, *International Journal of Chemical Reactor Engineering*; and **Halim Yanikomeroglu, PhD, P.Eng.**, professor, faculty of systems and computer engineering, at Carleton University.

U of T's Myhal Centre for Engineering Innovation and Entrepreneurship was recognized with a Toronto Urban Design Award in the public buildings in context category. The award, given by the City of Toronto, recognizes contributions to the local community through the shaping of the physical environment. The building, which opened in 2018, is the newest addition to the university's engineering faculty. "The Myhal Centre is a shining beacon of innovation in engineering education and the site of collaborative research and learning," Professor Emeritus Ron Venter, chair of the building's project planning committee, said. "This award is a wonderful acknowledgement of its key role in bringing together world-leading thinkers at the centre of Toronto's Discovery District."

Pedram Mortazavi, P.Eng., a PhD candidate in the department of civil and mineral engineering at U of T and president of its Earthquake Engineering Research Institute student chapter, has been awarded the Donald Jamieson Fellowship by the Canadian Society for Civil Engineering. The fellowship is awarded annually to graduate structural engineering students at Canadian universities. Mortazavi, a professional engineer with a particularly keen interest in safety, specializes in the resilient design of structures and earthquake engineering. Earlier this year, he was awarded the prestigious GJ Jackson Fellowship for his current research.

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AWARDS

The University of Toronto's Myhal Centre for Engineering Innovation and Entrepreneurship was recently recognized by the City of Toronto with a Toronto Urban Design Award. The building, which opened in 2018, is the newest addition to the university's engineering faculty. Photo: Roberta Baker



The Canadian Academy of Engineering welcomed University of Waterloo Professor and Dean Pearl Sullivan, PhD, P.Eng. (above), as a new fellow.

Elizabeth Edwards, PhD, P.Eng. (far left), a pioneering researcher in bioremediation, is visited in the lab by Minister of Science and Sport Kirsty Duncan. Edwards has been appointed to the rank of university professor at the University of Toronto. Photo: Laura Pedersen

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STUDENT AWARDS

The 2019 Schulich Leaders have been announced. Fifty students are selected each year to receive \$80,000 or \$100,000 to pursue an undergraduate degree in science, technology, engineering or math. The Ontario engineering students within this year's group of recipients are McMaster University's **Arielle Ainabe** and **Arjun Snider**, University of Ottawa's **Ellen Perry**, Queen University's **Andrea Stachow** and **George Trieu**, U of T's **Adam Glustein** and **Thomas Moffat**, University of Waterloo's **Evangeline Dryburgh** and **Shahed Saleh**, Western University's **Liam Israels**, and York University's **Kathryn Chin**. Since 2012, 370 Schulich Leaders have been awarded these prestigious scholarships across Canada.

U of T mechanical engineering undergraduate student **Katrina Cecco** has been selected to be

the Canadian Engineering Memorial Foundation (CEMF) Ambassador for Ontario. As an ambassador, Cecco will visit local schools to talk about the profession of engineering and how to become licensed as a professional engineer. Also among this year's CEMF award winners are: **Kritika Mehta**, biomedical engineering, University of Waterloo, who was named a Nellie Giffin Ambassador; **Margo Rooks**, civil engineering, U of T, who received the Dillon Award; and **Emily Shepherdson**, aerospace engineering, Ryerson University, who won the Claudette MacKay-Lassonde award. CEMF is a charitable organization dedicated to attracting women to the engineering profession through its annual scholarship awards program. [e](#)

MINUTES OF THE 97TH ANNUAL BUSINESS MEETING

SATURDAY, MAY 4, 2019

PRESIDENT AND CHAIR: DAVID BROWN, P.ENG., BDS, C.E.T.

President David Brown thanked the participants and attendees of Friday's Volunteer Leadership Conference. He then acknowledged the 13 inductees into PEO's Order of Honour, as well as the President and Sterling Award recipients, all of whom were honoured during a gala ceremony the prior evening.

President Brown announced that the keynote speaker during the AGM luncheon would be Nora Young from CBC Radio and that the 527th meeting of PEO Council would be held following the luncheon. The president invited delegates of the AGM to participate in social media conversations using #PEOAGM.

The president advised that because proper notice for the meeting had been published in *Engineering Dimensions*, as provided for under section 20(i) of By-Law No. 1, and a quorum was present, the meeting was officially called to order.

INTRODUCTION OF COUNCIL

The president introduced the members of the 2018–2019 PEO Council who were in attendance and acknowledged those who were not. President Brown also acknowledged Registrar Johnny Zuccon, P.Eng., FEC, and introduced PEO's directors to Engineers Canada for 2018–2019.

Special guests and other office holders in attendance were recognized, as follows:

- Annette Bergeron, MBA, P.Eng., FEC, president, Engineers Canada;
- Grant Koropatnick, P.Eng., FEC, CEO and registrar, Engineers Geoscientists Manitoba;
- Ann English, P.Eng., CEO and registrar, Engineers and Geoscientists BC (EGBC);
- Marisa Sterling, P.Eng., FEC, president and chair, Ontario Professional Engineers Foundation for Education;
- Jonathan Hack, P.Eng., president and chair, and Sandro Perruzza, CEO, Ontario Society of Professional Engineers (OSPE);
- Jane Welsh, president, and Aina Budrevics, executive director, Ontario Association of Landscape Architects;
- Walter Derhak, senior vice president and treasurer, Ontario Association of Architects;
- Bruce Matthews, P.Eng., CEO, Consulting Engineers of Ontario;

- David Thomson, CEO, and Greg Miller, C.E.T., president, Ontario Association of Certified Engineering Technicians and Technologists;
- Santiago Vera, vice president of finance and administration, Engineering Student Societies' Council of Ontario; and
- Zen Keizars, P.Geo., president, Association of Professional Geoscientists of Ontario.

IN MEMORIAM

The president asked all present to stand for a moment of silence in remembrance of those PEO members who had passed away in 2018.

ADOPTION OF MINUTES

MOTION

To adopt the minutes of the 2018 AGM, as published in the November/December 2018 issue of *Engineering Dimensions* and as distributed at the meeting, be adopted.

Moved by Roger Jones, P.Eng., seconded by Joe Podrebarac, P.Eng.

Motion carried

BUSINESS ARISING FROM THE MINUTES

President Brown reviewed the actions taken by Council on three submissions made at the 2018 AGM.

Leadership Development Program

PEO Council was asked to form a task force to develop a comprehensive Leadership Development Program to support the succession planning and term limits provisions adopted by Council and make this program available for all practitioners, with a focus on PEO's current and future volunteers. The submission requested that a program be designed to effectively build high-performing leadership capacity as volunteers advance in their volunteer careers with PEO.

This submission was to be considered at the September 2018 Council meeting but was deferred until November and then until June 2019.

Advertising Chapter Events

PEO has taken the necessary steps to allow chapters to be able to advertise chapter events with cost of attendance allowed in the email, including, if necessary, getting a second legal opinion or asking the CRTC for a ruling.

To comply with Canada's anti-spam legislation, or CASL, PEO began collecting licence holder consent to receive chapter email communications in November. The process started with an eblast to all licence holders inviting them to visit PEO's member portal to indicate whether they would like to receive any information from their chapter by email. Since then, all fee renewals and new registrations have also included a request to make such a selection.

After 12 renewal cycles, or months, covering all PEO licence holders, there will be two distribution lists available for each chapter: a "yes" list of those who have consented to receiving any chapter

emails—including those advertising a fee-based event—and a “no” list whose recipients are restricted to receiving chapter information by mail only. This solution satisfied the chapters and Regional Councillors Committee (RCC), and no legal opinion was necessary.

Webmail Accounts for PEO Volunteers

PEO Council was asked to pass a motion allowing PEO volunteers to be able to request and receive webmail accounts.

This submission was on the agenda at the September Council meeting, but it was referred back for further work. At the November meeting, Council rejected the submission due to concerns related to PEO’s 2019 operating budget.

FINANCIAL REPORT

The auditors’ report and financial statements were published on PEO’s website prior to the meeting. It was distributed as part of the meeting registration package and will be printed in the May/June 2019 issue of *Engineering Dimensions*. An abbreviated version of the statements appears in the 2018 Annual Review, which was included in the registration package as well as being available on the publications table.

The president highlighted the *Questions and Answers on PEO Operations* booklet, which addresses common questions on PEO operations and was included in the registration package.

In response to a question, Chetan Mehta, director of finance, advised that full-time salaries and benefits were reduced, and it was therefore necessary to hire contractors to offset this. He also explained that the line item called “volunteer expenses” captures the information related to Council meetings, etc.

Responding to a query, President Brown advised that approximately 43 per cent of Engineers Canada’s overall budget is paid for by PEO. Engineers Canada receives \$10.21 per registrant (i.e. an individual registered with PEO, with the exception of applicants and students), and this formula has remained unchanged since 2006.

It was noted that investment income has dropped from \$287,341 in 2017 to \$64,460 in 2018. Chetan Mehta advised that there were certain accounting rules in place wherein PEO is required to put unrealized gains or losses through its income statement.

In response to a question about the portion of PEO’s overall expenditures spent on non-regulatory activities, President Brown replied that this is still to be determined and something that Council will start to address over the coming year in conjunction with the recent regulatory performance review of the organization.

Regarding the recent fee increase, President Brown advised that the 20 per cent increase was intended to bring fees into alignment with the rate of inflation over the past 10 years.

A question was raised regarding the 4.95 per cent interest rate for the building. Chetan Mehta advised that this rate was the rate obtained 10 years ago when prevailing interest rates were about 7 per cent. The interest rate obtained during the recent refinancing is 3.47 per cent with a five-year amortization, at which time PEO will have full ownership of 40 Sheppard Avenue West. The lower interest rate will result in a savings of about \$70,000 per year.

It was noted that transaction fees cost PEO over \$0.5 million on an annual basis, and it was asked how PEO was working to reduce these fees and what could members or chapters do to contribute to a reduction. President Brown replied that Council is looking at ways

to address this. Chetan Mehta advised that paying through PC banking, which PEO is set up for, would go a long way to help save on credit card commission and transaction fees. Making payments using debit cards would also reduce fees.

MOTION

To receive the financial statements as presented.

Moved by Warren Turnbull, P.Eng., seconded by Michael Chan, P.Eng.

Motion carried

APPOINTMENT OF AUDITORS

President Brown advised that the Audit Committee recommended the firm of Deloitte LLP be reappointed.

MOTION

That the firm of Deloitte LLP be appointed auditors of the association for the 2019 financial year.

Moved by Chris Roney, P.Eng., seconded by Bruce Matthews, P.Eng.

Motion carried

REGISTRAR’S REPORT

Johnny Zuccon, the new registrar, was introduced and gave a report. He noted that his mandate, working with Council and staff of the organization, is to lead PEO through a period of unprecedented change.

The Regulatory Environment and PEO’s Regulatory Mandate

Registrar Zuccon provided a brief environmental scan. He noted that regulated professions are generally required to demonstrate higher levels of public-interest accountability. PEO’s counterparts in Quebec and BC have experienced government intervention head on. PEO has received notice from the Ontario Fairness Commissioner’s office that they are challenging PEO’s Canadian experience requirement. Government involvement in the regulated health professions is already well established, and the Government of Ontario recently announced plans to dismantle the Ontario College of Trades.

Registrar Zuccon also noted that PEO’s current regulatory structure is based on an exclusive scope of practice act that dates to 1984. Since then, the advancement and proliferation of technology has engulfed our world; increased globalization has virtually eliminated traditional geographical borders. These external forces have necessitated significant change within the engineering profession, as it has been forced to evolve. It will be

necessary to ask if PEO's regulatory model is sufficiently reflective of how engineering is currently being practised and whether the public interest is being appropriately served. In addition, PEO needs to consider if the public interest is better served through an exclusive scope of practice or through a broader regulatory model.

Licensing and Registration Statistics

Registrar Zuccon then provided a review of the previous year: 2649 new P.Eng. licences were approved, a 19 per cent increase over 2017. Of these, 65 per cent had a Canadian Engineering Accreditation Board (CEAB) educational background (1719) while the balance (930) were from non-CEAB backgrounds, which included international engineering graduates and others. Additionally, 82 per cent were male (2178) and 18 per cent were female (471). This 18 per cent compares positively against the overall ratio in the total licence holders in the register, which is approximately 11 per cent.

There were 83,775 P.Engs in 2018, compared to 81,951 the previous year. The number of engineering interns (EITs) rose from 13,900 in 2017 to 15,003 in 2018, an 8 per cent increase.

There was an increase of 163 certificates of authorization (Cs of A), for a total of 5753, which is typical growth. There was a decrease in consulting engineers (908 in 2018; 1001 in 2017) and a marginal increase in limited licences (343 in 2018; 320 in 2017). The number of provisional licences at 28 remained constant and 97 temporary licences were issued in 2018, compared to 83 in 2017. Registrar Zuccon shared a graph showing a demographic breakdown of P.Engs by age as of December 31, 2018.

Professional Development

Registrar Zuccon outlined the highlights of the Practice Evaluation and Knowledge (PEAK) program, which was instituted in 2017. It was established as a voluntary program to improve PEO's data about licence holders' practice profiles while encouraging continuing knowledge development. Year 2 ended on March 31, 2019. This program has four components:

1. Practice Declaration: Simply answer whether you practise or not;
2. Practice Evaluation: For those who declare they are practising;
3. Knowledge Reporting; and
4. Ethics Module: Everyone needs to complete the ethics module

The two-year results are as follows:

Year 1: 33 per cent, or 25,500, completed the practice declaration, with 75 per cent declaring that they were practising.

Year 2: 21 per cent, or 17,200, completed the practice declaration, with 79 per cent declaring that they were practising.

Year 1: Of those who declared they were practising, over 90 per cent completed the practice evaluation.

Year 2: Of those who declared they were practising, 85 per cent completed the practice evaluation.

Year 1: 22 per cent, or 4000, of those who received a recommended number of hours of continuing knowledge activities reported back.

Year 2: 47 per cent, or 5500, of those who received a recommended number of hours of continuing knowledge activities reported back.

Year 1: 60 per cent, or 15,400, of the overall participants viewed the ethics module.

Year 2: 72 per cent, or 12,300, of the overall participants viewed the ethics module.

Next steps include bringing a detailed report to Council. Council will then provide direction for how to proceed with PEAK. This will include discussions on whether to make it mandatory in some manner.

External Regulatory Review

In September 2018, Council approved a motion to undertake an external regulatory review to identify any gaps between the association's current practices and the processes, procedures and policies required for effective regulation. Led by international regulatory expert Harry Cayton, the review will assess PEO's performance against its statutory mandate and legislative requirements, internal policies and the standards of good regulation across PEO's core regulatory functions:

1. Licensing and registration;
2. Complaints, discipline, compliance and enforcement; and
3. Professional standards.

PEO has committed to releasing the final report publicly.

Registrar Zuccon reminded the AGM that PEO's 2018–2020 Strategic Plan focuses on nine strategic objectives covering three priority areas: protecting the public interest, engaging stakeholders and advancing PEO's mission. He reported that notwithstanding Council's decision to defer implementation of the plan due to budget constraints and cost-reducing measures, progress has been made on several related initiatives, most notably PEO's website redesign project, the Public Information Campaign Task Force, the external regulatory performance review and the 30 by 30 Task Force.

Fee Adjustments

Registrar Zuccon advised that Council approved an increase to all PEO fees, effective May 1, 2019, by approximately 20 per cent to account for accumulative inflation since 2008. Council also approved changes to the Financial Credit Program (FCP) by shifting the credit for the application fees paid to the back end as opposed to the existing front end. Eligible FCP applicants now have the application fees they paid, as well as the fee for the first year of participation in the EIT program (if registered), credited towards payment of their registration and initial P.Eng. licence fees when approved for a licence.

Legislative and Regulatory Changes Affecting PEO

PEO received cabinet approval in 2018 for three sets of changes to Regulation 941 pertaining to Council term limits, fees transfer to bylaw and a French translation of the regulation itself. On July 1, regulation changes came into effect that implement councillor term limits. In general, the changes place a cumulative limit of six years for an individual to be on PEO Council, regardless of what position they have held. This is followed by a minimum waiting period of six years before seeking election for another Council position. However, a former Council member can run for vice president or president-elect immediately. A president is now limited to one term of office, and a vice president must wait another 10 years before running for the same position. The changes were applied to the 2019 Council elections nominations.

In response to a question about the term limit, Registrar Zuccon replied that although the regulation deals only with councillors, Council has also extended the policy to committees, with the exception of statutory committees. Most committees have rewritten their terms of reference to capture term limits.

Registrar Zuccon explained that several years ago, PEO initiated a review of all legislation in Ontario that made reference to the term "professional engineer" or had something to do with the engineering industry in terms of using seals, etc. The Legislation Committee undertook to create the Regulations Conflict Program. Ministries are on notice from PEO that any time they are embarking on a change in their regulation where PEO has identified issues it may have with that particular legislation, a letter is sent to the particular ministry, with a copy to the attorney general, with suggested changes, etc. This is in the spirit of the co-regulator model.

Three change letters were sent as part of PEO's Regulatory Conflict Program as follows:

- Ministry of Environment, Conservation and Parks
O. Reg. 359/09—Renewable Energy Approvals
PEO co-operated with the geoscientists on this one.
- Ministry of the Environment and Climate Change
O. Reg. 1/17—Registrations under Part II.2 of the act,
Activities Requiring Assessment of Air Emissions
- Ministry of Labour
Regulation 851—Industrial Establishments

New Practice Guideline

In February 2019 Council approved publication of the new practice guideline *Assuming Responsibility and Supervising Engineering Services*. The guideline defines best practices for engineers who assume responsibility for professional engineering work of unlicensed persons, and for engineers who supervise engineering services in consideration of the *Professional Engineers Act*.

Financial Matters

There was a small surplus in the amount of \$123,081, with revenues of \$25,091,738 minus expenses of \$24,968,657. There is \$9.6 million in cash reserves. Registrar Zuccon noted that PEO has the lowest P.Eng. fees in all of Canada, having had no increase since 2008. PEO also has the highest ratio of members to employees. A breakdown of the \$220 P.Eng. licensing fee was provided. It was confirmed that the 20 per cent fee increase applied to all fee categories. The forecasted year-end amount as a result of the fee increases is expected to be approximately \$2.4 million. It was suggested that in light of this PEO might revisit the programs that were cut in the 2019 budget.

In response to a question about the discipline breakdown for EITs becoming professional engineers in the past year, Registrar Zuccon replied that this information is not tracked and that PEO does not have a discipline specific model.

Conclusion

Registrar Zuccon expressed thanks to all PEO staff who contributed to PEO successes over the past year. He also extended special thanks to those who worked tirelessly in the background to make the 2019 Annual General Meeting and the Volunteer Leadership Conference happen.

INTRODUCTION OF ASSOCIATION GUESTS**Engineers Canada**

Engineers Canada President Bergeron extended greetings from Engineers Canada and thanked PEO for the invitation to attend the AGM. She also congratulated David Brown for his accomplishments and his contribution as president of PEO and thanked him for his service.

Engineers Canada has also been busy in the past year, making significant progress on all of its strategic priorities. Under the Accreditation Improvement Program, Engineers Canada has partnered with Armature and is readying to deploy the new accreditation data management system, Tandem. Engineers Canada has also made significant improvements around other accreditation processes surrounding training, communication and consultation and is looking forward to delving into work on accountability in accreditation in the coming months. In addition to this work, a competency-based assessment has been adopted by PEO and in Saskatchewan, with more to come. Consultations on national action plans to reach 30 by 30 have also been held. On the latter of these, PEO's 30 by 30 Task Force and its chair, Helen Wojcinski, MBA, P.Eng., FEC, have shown tremendous leadership in the advancement of this critical goal.

PEO continues to play a central role in the well-being of the engineering profession in Canada. Bergeron thanked both outgoing Engineers Canada directors David Brown, previously mentioned; and

Rakesh Shreewastav, P.Eng., FEC, who has served as chair of the Finance Committee, vice chair of the Bridging Government and Engineers Committee and member of the Awards Committee. She also thanked Engineers Canada board member Danny Chui, P.Eng., FEC, who chairs the Audit Committee and is a member of the Funding Task Force; as well as Christian Bellini, P.Eng., FEC, who is the director representative on the Qualifications Board. She welcomed incoming president Nancy Hill, P.Eng., LLB, FEC, and incoming Engineers Canada directors Kelly Reid, P.Eng., and Changiz Sadr, P.Eng., FEC, who will collectively make valuable additions as they move into their roles.

Ontario Society of Professional Engineers

OSPE President Hack noted that PEO is the regulator for engineering in Ontario, and OSPE is the advocacy body.

OSPE's AGM will take place on May 8, 2019, in Kingston, ON, where OSPE would be unveiling its new strategic plan, which seeks to more broadly engage a younger engineering demographic, embrace internationally trained engineering graduates and address issues of critical importance to the profession.

OSPE has worked with PEO leadership in addressing issues of importance to the profession over the past year, and they look forward to continuing that discussion in the coming year.

PRESIDENT BROWN'S OUTGOING REPORT

President Brown stated his belief that PEO is on the cusp of being disrupted as the exponential development of technology continues to change the face of the world we live in by the fourth industrial revolution, with artificial intelligence to follow. In addition, he said that the status quo for regulation was no longer acceptable. He stressed the need for PEO to understand that:

- Self-regulation is a privilege;
- Council needs to focus on its fiduciary role as a regulator in the public's interest, rather than the profession's interest;
- The scope of engineering as it is defined in our act is expanding and will continue to expand, yet we are unprepared and insufficiently resourced to regulate it properly;
- PEO's regulatory framework needs to adapt to the reality of what lies ahead, a reality that other regulators have already faced;
- As he said last year, the relevancy of our licence needs to be considered, as does the issue of what PEO needs to ensure the licence remains relevant; and

- Also as he said last year, PEO needs to choose between internal disruption, which we initiate; or external disruption, over which we exercise no control.

President Brown highlighted a few positive developments, in particular:

- The hiring of Zuccon as PEO's registrar. Zuccon is a former deputy registrar who has accepted the challenge of implementing unprecedented change in PEO's organization. Registrar Zuccon is a competent leader with a deep understanding of engineering regulation, enabling him to reform and modernize the work of PEO as a regulator; and
- Council engaged Harry Cayton, international consultant to the United Kingdom's Professional Standards Authority. Cayton is considered a leading authority in regulatory excellence and has carried out a regulatory performance review of PEO. This report has been submitted to Council and its recommendations will be considered over the next few months. Ultimately, the report will be made public. President Brown encouraged members to review it and absorb its findings.

President Brown expressed his hope that this year's board, under President Hill's leadership, will continue the work of bringing focus to PEO's role as a regulator and segregate itself from being member-centric—concentrating instead on the public interest.

President Brown also recalled that at the 2018 AGM, Mark Abbott, P.Eng., of Engineering Change Lab provided an example of what happens when an organization refuses to accept that the world around it is changing. He illustrated two companies—Netflix and Blockbuster—that took very different paths. PEO must immediately accept that significant change is necessary or follow the path of Blockbuster.

In conclusion, President Brown expressed his passion for the engineering regulation and its future and in particular the future of the young engineers attending the AGM. He also thanked his wife, Liza, the senior management team and PEO Council.

MEMBER SUBMISSIONS

As per section 17 of By-Law No. 1, PEO's annual general meeting is held:

- to lay before members reports of the association's Council and committees;

- to inform members of matters relating to the affairs of the association; and
- to ascertain the views of the members present on matters relating to the affairs of the association.

Member submissions are not binding on Council, but Council considers the issues raised at AGMs important and addresses them as expeditiously as possible.

Barriers for Licensure in Emerging Disciplines, etc.

Peter Green, P.Eng., identified a number of issues:

- Overseas applicants are unable to satisfy the Canadian experience requirement;
- There is a wide spectrum of people who are not able to achieve professional engineering status, notably computer engineers. The work they do is public interest. There are safety concerns with software engineers working on autonomous vehicles. Airplanes are falling out of the sky. There is software in everything now, and there are potential impacts on public safety. These emerging disciplines have to be brought into the fold. Government will step in to regulate if PEO does not; and
- There are engineers trying to get over the hurdles of becoming a professional engineer but are unable to find a professional engineer who can supervise them.

MOTION

WHEREAS Objective 2 of PEO's 2018–2020 Strategic Plan states that "PEO will better understand where, how and by whom professional engineering is being performed in Ontario, and under what conditions";

WHEREAS many EITs are performing professional engineering work, often in critical safety areas with no means to be directly supervised by a licensed professional engineer;

WHEREAS the difficulty of engaging a local professional engineer to act as a voluntary monitor is particularly aggravated in the case of EITs working in emerging and non-traditional disciplines;

WHEREAS finding a local professional engineer to act as a voluntary monitor for an EIT, supervising them in their workplace for 30 hours a month and assuming responsibility for their engineering work is not a feasible, viable or scalable solution to the growing issue;

WHEREAS the 2018 National Membership Report by Engineers Canada estimates that only "approximately 47.7 per cent of the 2013 cohort proceeded along the path to licensure and became licensed in 2017";

WHEREAS Engineers Canada's Monitoring Report on the Educational Credential Assessment Project (2015) found that "currently only 15 per cent of engineering immigrants apply for licensure in Canada";

WHEREAS Objective 8 of PEO's 2018–2020 Strategic Plan states that to "create a seamless transition from student member to EIT to licence holder, PEO will establish coordinated and integrated systems and outreach programs to allow engineering students to seamlessly proceed through the licensure process";

WHEREAS The Institute for Canadian Citizenship (ICC) report on barriers to licensure for international engineering graduates (IEGs) observed that "the path to licensure is long and frequently opaque" and recommended "competency-based assessment processes like EGBC's pilot program, the Canadian Environment Experience Requirement Project, should be adopted by regulators across Canada to satisfy the Canadian work experience requirement";

WHEREAS Objective 2 of PEO's 2018–2020 Strategic Plan states that, to "augment the applicant and licence holder experience, PEO will address any perceived barriers and friction points between itself and its applicants and licence holders, and build "customer satisfaction" into all its regulatory processes and initiatives";

THEREFORE BE IT SUBMITTED THAT PEO Council form a task force to assess and report on barriers for licensure in emerging/non-traditional disciplines and develop an equitable and sustainable process for EITs and IEGs, including those who are not directly supervised by a licensed professional engineer, to satisfy the Canadian work experience requirement defined in the *Professional Engineers Act*, Regulation 941, section 33.4. The report and recommendations should be presented to Council for approval no later than the end of 2020.

Moved by Peter Green, P.Eng., seconded by Guy Boone, P.Eng, FEC

Motion carried

Responding to Technological Change

Peter DeVita, P.Eng., FEC, stated that PEO is out of touch with technology, even though engineers are responsible for much of the technological change the world is experiencing. PEO does not do a good job of embracing a new discipline. There are well over 30 engineering practices, more than there are members of Council. Evolving technology impacts the engineering profession differently than other professions.

MOTION

WHEREAS the following four principles appear to apply and that will continue to more significantly impact the evolution of engineers and applied scientists at least in Ontario

Principle #1: the members of a given professional practice are in the best position to understand and effectively govern their practice;

Principle #2: the only justification for a licence is that it is necessary to serve and protect the public interest;

Principle #3: human knowledge and understanding of science and technology will continue to expand;

Principle #4: science and technology will expand at an increasing rate;

THEREFORE BE IT SUBMITTED THAT PEO Council create a task force, with some urgency, to explore the implications of the accelerating pace of technological change and new scientific discoveries on the regulation, licensing and governing of engineers and applied scientists in Ontario and that PEO convene a general meeting of the members forthwith to determine a course of action that the profession may consider as a result of the task force's considerations.

Moved by Peter M. DeVita, P.Eng., FEC, seconded by Guy Boone, P.Eng., FEC

Motion carried

Election Process

Peter Cushman, P.Eng., stated that PEO members and former PEO candidates expressed concerns that the election process lacks security precautions and that recent changes to the nomination process makes it far from democratic.

MOTION

WHEREAS there have been election complaints after several of the recent PEO elections, and

WHEREAS there appears to be a growing sense that our election methods and security precautions are lacking, and

WHEREAS it is a commonly accepted principle in democratic societies like Canada that those who run an election are expected to be publicly disinterested in the election results; and

WHEREAS PEO members need to perceive the elections are run fairly and securely;

THEREFORE BE IT SUBMITTED THAT Council consider the following proposals to reform our Central Election and Search Committee (CESC):

1. No member of the current Council shall sit on the CESC;
2. A CESC member cannot stand for PEO Council elections while on the CESC and for at least one year after they have resigned/retired from CESC;
3. The CESC shall consist of nine members, one-third of whom are to be elected for a three-year term each year by secret ballot of those members in attendance at the PEO AGM;
4. Members in good standing who wish to be considered for CESC office may do so by submitting a Letter of Interest to the president and the secretary of PEO with a cc to the chief of PEO staff (to ensure communications are not lost); there is no other nomination process required.

Moved by Peter Cushman, P.Eng., seconded by Roger Jones, P.Eng., FEC

Motion defeated

MEANING OF "EIT"

Michael Martin, P.Eng., introduced Centennial College graduate Vanessa Raponi, EIT, who was surprised to discover that an EIT is an intern and not an engineer-in-training. She stated that she completed 28 months of co-ops and internships during her undergraduate degree, only to be referred to as an intern for three additional years after graduating from that program, despite her high level of experience, before she was eligible to have the title of engineer. She noted that this also affects many people with international education and much more experience than she has as a graduating student.

MOTION

WHEREAS: the meaning of "EIT" is well known as "engineer-in-training," and little known as "engineering intern"; and

WHEREAS: the title of "intern" is assumed by the public to be a student who has not yet graduated; therefore, this title is detrimental to an individual's credibility; and

WHEREAS: the title is ultimately detrimental to promoting new entrants into the profession and conflicts with promoting Engineers Canada's 30 by 30 goals;

THEREFORE BE IT SUBMITTED THAT PEO defines an "EIT" as an "engineer-in-training," and ceases the use of "engineering intern" immediately.

Moved by Michael Martin, P.Eng., seconded by Arthur Sinclair, P.Eng.

Motion defeated

Rights for EITs

Raponi noted that only professional engineers are entitled to vote for Council, even though EITs pay fees, too. Moreover, she was not permitted to put her name on the submission that she wrote, because she was not a professional engineer.

MOTION

WHEREAS: Currently, an EIT is not eligible to vote in PEO Council elections; and

WHEREAS: the goings on of PEO Council directly impact EITs; and

WHEREAS: passionate EITs should be encouraged to engage with PEO;

THEREFORE BE IT SUBMITTED THAT PEO allow EITs to vote in PEO Council elections commencing in the calendar year 2019 or in the calendar year as soon thereafter as can be implemented by PEO, and in all subsequent PEO Council elections.

Moved by Michael Martin, P.Eng., seconded by Arthur Sinclair, P.Eng.

Motion carried

Webmail Accounts for Chapters

Ray Linseman, P.Eng., stated his desire to improve communications between the chapters, committees, Council and staff, noting that email is a commonly used communication tool. When there is a webmail account, there is information that is maintained by staff, such as global distribution lists. He noted that although his chapter has a webmail address, most do not, and his motion was to provide a webmail account to each chapter as a starting point.

MOTION

WHEREAS a motion was submitted at the 2013 PEO AGM to create generic webmail accounts for key chapter positions such as chair, vice chair, secretary, treasurer, past chair, etc., and unanimously passed;

WHEREAS the 2013 motion was rejected by PEO Council;

WHEREAS at the 2015 AGM a motion was passed to allow active PEO volunteers to be able to request and receive a PEO webmail account;

WHEREAS a cost estimate of total one-time costs equal \$10,600 and total outgoing costs equal \$18,000 per year for 1000 volunteers was provided to Council;

WHEREAS Council directed the motion to the ITEG (Information Technology Emerging Governance) subcommittee of the Regional Councillors Committee for consideration and recommendation;

WHEREAS the ITEG subcommittee has not generated a reply nor have they met in probably close to two years;

WHEREAS at the 2018 PEO AGM a repeat motion to allow active volunteers to be able to request a PEO webmail account was again passed;

WHEREAS the cost estimate to provide up to 1000 volunteers with a webmail account has ballooned to a one-time cost of \$360,578 and ongoing of \$402,000 per year;

WHEREAS Council was looking at a deficit budget of approximately \$4.5 million for 2019 and it was decided to defer the item on the Council agenda to revisit the briefing note to add benefit information to the request and to look at a reduced scale to get Council support;

WHEREAS the main benefit of the webmail account is to gain access to the global default database information, which provides contact information for staff, staff-maintained distribution lists and to be able to find email addresses for other volunteers with limited information using the search capabilities.

THEREFORE BE IT SUBMITTED THAT Council approve the change of the 36 generic chapter email addresses that are an "alias" address to a

PEO webmail account and to provide the password to the relevant chapter chairs and to have the appropriate PEO staff provide self-training information in a document to be stored on www.chapters.PEO.ON.ca

Moved by Ray Linseman, P.Eng., seconded by Ahmad Khadra, P.Eng., FEC

Motion carried

Electronic Voting and Paper Ballots

Gregory Wowchuk, P.Eng., stressed the importance of the restoration of members' democratic control of the profession, consistent with protecting the public interest. Central to any democracy is the accessibility, integrity and transparency of the electoral process. It is disappointing that seven out of eight members do not vote for Council, especially so in these challenging times. Moreover, concerns have been expressed about several large spikes in the voting volume every Monday and Tuesday during the election process. People have asked: "Are legitimate electors doing the voting?" and "Are particular candidates benefitting from this voting or suffering from this burst of energy?" The problem with electronic voting is that there is no way to determine if multiple votes have been cast by a person or persons.

MOTION

WHEREAS:

- Serious questions have been raised about certain anomalies in the recent electronic Council elections;
- In a member-directed, self-regulated profession, democratic expression via ballot is of paramount importance, trumping all other considerations;
- Electronic elections are inherently unreliable, prone to hacking, personation and loss of secrecy;
- Electronic elections are virtually impossible to scrutineer, verify or audit, as there is no physical manifestation of mouse clicks;
- All elections must not only be open, accessible, secure and fair, but be perceived to be so by both candidates and electors.

THEREFORE BE IT SUBMITTED THAT PEO return to its traditional, secure, paper-ballot election format, beginning with the 2020 elections.

Moved by Gregory Wowchuk, P.Eng., seconded by Peter Cushman, P.Eng.

Motion defeated

PRESENTATION TO OUTGOING COUNCILLORS

President Brown congratulated retiring members of the 2018–2019 Council, who worked diligently to move the profession forward. President Brown expressed his personal appreciation to all for their collaboration, support and encouragement throughout the year and that it was a pleasure serving as president and chair.

In recognition of their service, President Brown presented certificates, name badges and desk plaques to retiring members of Council: Past President Bob Dony, PhD, P.Eng., FEC, Councillor-at-Large Kelly Reid, P.Eng., Councillor-at-Large Roydon Fraser, PhD, P.Eng., FEC, Eastern Region Councillor Ishwar Bhatia, P.Eng., FEC, and East Central Region Councillor Thomas Chong, P.Eng., FEC. Outgoing West Central Region Councillor Lola Hidalgo, P.Eng., who was unable to attend, was recognized as well.

INSTALLATION OF NEW PRESIDENT

Past President Brown administered the oath of office to Nancy Hill as president for the 2019–2020 term and presented her with the gavel of office.

INTRODUCTION OF INCOMING MEMBERS OF COUNCIL

President Hill then introduced the 2019–2020 members of Council: Past President Brown; President-elect Marisa Sterling, P.Eng., FEC; Vice President Christian Bellini, P.Eng., FEC; Councillors-at-Large Sandra Ausma, PhD, P.Eng., Leila Notash, PhD, P.Eng., FEC, and Gregory Wowchuk, P.Eng.; Eastern Region Councillors Guy Boone, P.Eng., and Randy Walker, P.Eng.; East Central Region Councillors Keivan Torabi, PhD, P.Eng., and Arthur Sinclair, P.Eng.; Northern Region Councillors Ramesh Subramanian, PhD, P.Eng., FEC, and Serge Robert, P.Eng., FEC; Western Region Councillors Gary Houghton, P.Eng., FEC, who was unable to attend, and Wayne Kershaw, P.Eng., FEC; West Central Region Councillors Warren Turnbull, P.Eng., FEC, and Lisa MacCumber, P.Eng., FEC; and Lieutenant Governor-in-Council Appointees Michael Chan, P.Eng., FEC, Lorne Cutler, P.Eng., Qadira Jackson Kouakou, LLB, Tim Kirkby, P.Eng., FEC, Lew Lederman, LLB, Tomiwa Olukiyesi, P.Eng., Nadine Rush, C.E.T., and Marilyn Spink, P.Eng.

CLOSING REMARKS BY PRESIDENT HILL

President Hill expressed her excitement and gratitude as she assumed her new role. She stressed that she brought a lot of experience with PEO to the role. She thanked her colleagues in the room who have helped her and her pride in the changes that have been made. She was especially proud of changes with regard to the *Professional Engineers Act* to include harassment as a matter of misconduct, putting Ontario in the forefront of taking on that issue for engineers across the country. She was also proud of recent changes regarding term limits, which will allow PEO to seek out new voices and provide renewal for the Council.

President Hill stated that her theme for the coming year—It will be a time of change—is very similar to that expressed by Registrar Zuccon and Past President Brown. She noted that the rate of change in technology is phenomenal, and PEO needs to address that and respond to it. For years the regulators have flown under the radar, but that day is over, and it is apparent, with so many articles that appear in the newspapers about many of PEO's sister regulators, notably the Law Society of Ontario. The crucial issue is whether the regulator exists to protect the public or to protect the profession—an issue that arises whenever

there is an article about a regulator in the newspaper. PEO, too, has attracted publicity with regard to the Elliot Lake mall collapse and more recently the coroner's inquiry into the stage collapse at the Radiohead concert and must consider how well it functions in light of its regulatory obligations. Governments have already looked at engineering regulators in British Columbia and Quebec, so it is not an option for PEO to try to fly under the radar.

President Hill also noted that at a recent Chapter Leaders Conference, there was discussion regarding resiliency generally and how to deal with that individually and also as a profession. One of the statistics cited was that 85 per cent of the jobs that will exist in 2030 haven't yet been created, so PEO needs to create regulations that can address engineering in the future as well as now. Some of the motions introduced at the AGM also addressed that concern, as does the strategic plan passed by Council.

President Hill referred to the *Professional Engineers Act*, the principal object of which is for the association to regulate the practice of professional engineering and to govern its members in order that the public interest may be served and protected. It goes on to define the practice of professional engineering as any means or act of planning, designing, composing, evaluating, advising, reporting, directing or supervising that requires the application of engineering principles and concerns the safeguarding of life, health, property, economic interest, the public welfare or the environment or the managing of any act. President Hill said that PEO's marching orders are encompassed in that and that although what is being done now is regulatory, she feels there is a bigger portion that PEO should be doing. The question is not just how PEO adapts to change but how it leads that change.

President Hill noted that PEO has already started to address some of the changes that are needed. The strategic plan has identified a number of strategic objectives. She stressed two in particular: Strategic Directive 8, which is to create a seamless transition from student member to EIT to licence holder; and Strategic Directive 6, which is to augment the applicant and licence holder experience. She also noted that Registrar Zuccon's job description was prepared based on consultation with a lot of members and stakeholders who unanimously accepted the need for change—so clearly Registrar Zuccon has that mandate. So does Council, and President Hill is ready, willing and interested in trying to effect some of these changes. She also stated her belief that engineers, PEO Council, the PEO community and staff are all interested in improving how we regulate.

President Hill concluded by saying that she looks forward to working with everyone during the upcoming year and to making some of the changes that are needed.

ADJOURNMENT

President Hill declared the annual general meeting concluded.

Johnny Zuccon, P.Eng., FEC
Registrar

COUNCIL APPROVES ACTION PLAN TO IMPLEMENT RECOMMENDATIONS OF EXTERNAL REVIEW

By Nicole Axworthy

529TH MEETING, SEPTEMBER 19–20, 2019

At its September meeting, Council approved an action plan to implement the 15 recommendations in the final report of PEO's external regulatory performance review (see "Council to discuss external review action plan," *Engineering Dimensions*, September/October 2019, p. 7). The independent review—prepared by Harry Cayton, international consultant to United Kingdom-based Professional Standards Authority—was conducted following a Council decision in September 2018 to undergo an external regulatory review to identify any gaps between PEO's current practices and those exhibited by the best regulators. It assessed PEO's performance against its statutory mandate and legislative requirements, internal policies and the standards of good regulation across its core regulatory functions: licensing and registration; complaints, discipline, compliance and enforcement; and professional standards. The review's final report was received by Council at its June meeting, when Council instructed CEO/Registrar Johnny Zuccon, P.Eng., FEC, to initiate a high-level action plan based on the report's feedback for Council to consider at its September meeting. At the same meeting, Council approved a motion to make the report public on PEO's website (www.peo.on.ca/index.php/ci_id/33534/la_id/1.htm).

Over the summer months, Zuccon and PEO's senior management team worked to develop the three-year action plan, which outlines the organizational transformation required to implement the recommendations while ensuring that a steady state in PEO operations is maintained. It maps out each of the 15 recommendations, taking into account the organization's existing capacity and promotes evidence-based decision making. The plan includes a change vision; guiding principles; the identified problems, objectives and key steps for each recommendation; and criteria for setting priorities and timelines for action, including short-, medium- and long-term activities.

Essentially, the approved plan is meant to provide direction for change while respecting the distinct authorities of Council and the registrar, focus on what can be implemented within PEO's current capacity, and bolster the organization's agility and capacity to manage change in the future.

Since the action plan was approved, Zuccon has communicated the plan to staff and stakeholders and is currently working to develop a tool

for assessing the regulatory purpose of the activities of all PEO committees, chapters, subcommittees and working groups for Council's approval. He is also working to maximize efficiencies within the existing infrastructure by addressing issues such as the security risks related to paper files, the inventory of aging licence applicant files, automation of the professional practice exam and online renewals of certificate of authorization. The action plan can be found at www.peo.on.ca/index.php/ci_id/33751/la_id/1.htm.

BYLAW CHANGES

Council approved a motion to make amendments to By-Law No. 1 that relate to the inclusion of additional fees and other changes proposed by the Legislation Committee. The first amendment included replacing the word "registrar" with "CEO/Registrar" except where the phrase "deputy registrar" is used. This change follows a June 2019 Council decision to change the title of PEO's registrar to CEO/registrar and was necessary because it applies to association business and contracts. Four other amendments were also made that relate to updated fees for licence certificate replacement (\$60), temporary licence fee for new Ontario P.Eng. collaborator (\$120), and a self-inking seal replacement (\$70).

Earlier this year, PEO contracted lawyer Richard Steinecke to draft required changes in By-Law No. 1 relating to PEO's recent fee increases, and those changes were submitted to the Legislation Committee for initial evaluation. The committee reviewed the draft and recommended that Council approve the changes with the exception of three current fees: the current fee for an academic course taken in lieu of the first technical exam, pending a recommendation by the Finance Committee; EIT fee remission, which will be revisited at Council's November 2019 meeting; and the fee for a print subscription to *Engineering Dimensions* for non-members, which is not a regulatory fee.

VOLUNTEER CODE OF CONDUCT

At its September meeting, Council approved a new Code of Conduct for Volunteers, a tool that promotes an understanding of good professional behaviour, including acceptable and unacceptable conduct, and stresses that volunteers have a responsibility to be ambassadors of PEO. It also includes sections about conflict of interest and breaches of the code of conduct. The code is similar to PEO's Staff Code of Conduct.

At its March meeting, Council passed a motion that directed the Regional Councillors Committee to develop a process to ensure the safety and security of volunteers and participants who engage with PEO's various outreach activities. The code was then referred to the human resources department for further work and peer-reviewed by Councillor Lisa MacCumber, P.Eng., FEC, and the Advisory Committee on Volunteers. The requirement to adhere to the Code of Conduct for Volunteers will be communicated to all current and future volunteers and Council members. It will also be posted on

PEO's website. The code will be reviewed annually and updated to maintain compliance with applicable legislation.

AGM SUBMISSIONS

Council considered four member submissions that were made at the 2019 Annual General Meeting in May. The first submission related to barriers to licensure and asked Council to approve the creation of a task force to assess and report on licensing barriers in emerging and non-traditional disciplines, such as software engineering, as well as propose an equitable process for obtaining the licensing requirements for engineering interns (EITs) and international engineering graduates, including those who are not directly supervised by a licensed professional engineer and who must satisfy the Canadian work experience requirement. Council referred this submission to the CEO/registrar to review the identified issues as part of the action plan recommendations from the external regulatory review.

The second submission related to the rapid pace of technological change, which will have an impact on the evolution of the engineering profession and its regulation, licensing and governance. The submission proposed a task force to explore the implications of the accelerating pace of technological change and new scientific discoveries on the regulation, licensing and governing of engineers and applied scientists in Ontario. Council referred this submission to the CEO/registrar to review the identified issues as part of the action plan recommendations from the external regulatory review.

The third submission asked Council to consider amending the *Professional Engineers Act* (PEA) to allow EITs—who are currently voiceless at the Council table—to vote in Council elections. The motion directed the registrar to provide a policy intent briefing note for an act change to allow EITs the right to vote, using PEO's act change protocol. After discussion about the wording of the motion and whether EITs have the necessary experience to make an informed decision, Council voted to refer the submission to the registrar to consider it as part of the action plan recommendations but that motion was defeated. The motion was ultimately withdrawn, with the expectation that the wording of the original motion will be updated and brought back to a future meeting.

The fourth submission asked Council to convert 36 generic chapter email address that are an "alias" address to a Microsoft Exchange email account that can be accessed via webmail. This would allow users of the email system to access PEO's global address book and distribution lists.

After discussion that the issue is operational and should be referred to staff, the motion was voted on and defeated.

WHITE PAPERS SUBMITTED

Two white papers were submitted for Council's review, both of which ended with a defeated vote for further action. The first white paper proposed an articling engineering certificate to applicants for licensure who fulfill the academic requirements and pass the professional practice exam. The purpose is to empower applicants and give them a sense that they are moving ahead as they fulfill each requirement for licensure. The second white paper proposed chapter reform to enable and transform chapters to become a valuable regulatory resource and operate as branch offices delivering regulatory outreach programs.

MODERNIZING THE INDUSTRIAL EXCEPTION

At its September meeting, Council approved a motion to direct the CEO/registrar to draft a report and recommendations regarding a need to modernize the industrial exception and narrow its scope, with specific reference to its application to the nuclear industry. The industrial exception refers to section 12(3)(a) of the PEA, which permits unlicensed individuals to perform engineering "in relation to machinery or equipment, other than equipment of a structural nature, for use in the facilities of the person's employer in the production of products by the person's employer." Although the motion does not seek to repeal the industrial exception, its intent is to simply restrict misuse of the existing exception in certain industries, specifically the nuclear industry. The aim is to limit and clarify the scope of the exception, focusing on the issue where the consequences of nuclear accidents would spill over to the public domain. PEO staff will research and develop the necessary policy implications and report back to Council at its June 2020 meeting for a decision on how the industrial exception could be modernized with respect to the nuclear industry.

PEAK REFERENDUM

Council defeated a motion to hold a member referendum on PEO's Practice Evaluation and Knowledge (PEAK) program, which was proposed to be conducted during the 2020 Council elections, to determine members' will on continuing with the voluntary program, making it mandatory or terminating it altogether. The PEAK program was launched on March 31, 2017, to provide the association with an accurate and up-to-date regulatory profile of its licence holders, helping meet the public's ever-increasing demand for accountability among profession regulators. It was expected that member approval would be obtained prior to such a program being implemented. However, since its launch, member participation in the program has not been mandatory, but if a licence holder does not complete the program's elements, it is publicly noted on PEO's online directory of practitioners.

For this meeting's full agenda, minutes and disposition of motions, visit the Council section of PEO's website, at www.peo.on.ca/index.php?ci_id=1835&la_id=1. **e**

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Deadline for January/February is November 20, 2019. Deadline for March/April is January 23, 2020.

Raising public awareness about the P.Eng.

M. Morgan, P.Eng.,
Newcastle, ON

I have read the article "Protecting the P.Eng.," by Adam Sidsworth, in the July/August 2019 issue of *Engineering Dimensions* with great interest, and I agree with it. However, on page 47, where it lists "Exceptions to the rule," at least two other job classifications were missed, namely marine engineers on ships, probably controlled by federal regulations; and military engineers, probably also controlled by federal regulations.

A couple of years ago, a letter of mine was published in *Engineering Dimensions* expressing this same concern. When we tell a member of the public that we are engineers, they have no idea who we really are. Although I am now 80 years old and long retired, I am still very proud of my profession and the hard work it was to get my education and subsequent registration as a P.Eng.

I think that PEO must do a lot more to educate the public that P.Engs are very different from the other "engineers." Perhaps some TV ads could be created, very similar to what the accountants did a few years back to show the public that professional accountants were much different than other number-crunchers. Perhaps we should be stressing the significance of the P.Eng. designation much more actively so that the public is made more aware of the major difference between it and those other "engineers."

A clear definition of engineering

Duncan H. Barber, PhD, P.Eng.,
Deep River, ON

Is professional engineering adequately defined in the act? I was not surprised by the following statement in *A review of the regulatory performance of Professional Engineers Ontario* (see *Engineering Dimensions*, September/October 2019, p. 7): "It is not therefore immediately obvious what engineering is within the regulatory scope for PEO."

In computer science, I learned that a variable became defined when given a value or when assigned the value based on other defined variables, parameters or values. A definition needs to include what is within scope and exclude what is outside the scope using defined terms. I have come across PEO, its staff or publications asserting that "professional engineering" is defined for Ontario in the *Professional Engineers Act* (hereafter "the act"). The act contains a list of actions, the requirement that engineering principles be applied and that the activity safeguards the public interest. With no definition of "engineering principles," the definition (so-called) of "professional engineering" in the act is not definitive. The answer from a then-registrar of PEO

was that it would be up to the courts to decide. How would cases get to court? PEO would apparently use the "I know it when I see it" precedent of Justice Potter Stewart in the United States case of *Jacobellis vs. Ohio* related to the [definition of obscenity] and the suitability of a movie for public showing. He wrote: "I shall not today attempt further to define the kinds of material I understand to be embraced within that shorthand description...But I know it when I see it...."

It has been argued that "engineering principles" are those learned during an engineering education. Much of an engineer's university education is (or could be) at the hands of scientists, mathematicians and arts or non-technical elective professors or instructors. To exclude the non-engineering practice of an applied scientist, one must realize that, as examples, conservation of mass, energy, momentum and angular momentum and relativity of mass and energy cannot be "engineering principles" as they have been taught in science courses for over a century. In first-year university, 11 out of 12 half-courses could have been common with other faculties (four maths, four sciences, computer programming in Fortran, engineering drawing and two arts electives). Only engineering drawing had engineering in its title. Was it the only course to teach engineering principles in first year?

When PEO asks whether a practitioner practises professional engineering, there may not be a clear answer, free of subjective bias. If PEO's PEAK program is to become mandatory and a question as to whether one is practising professional engineering in Ontario is asked, an unambiguous definition of "professional engineering" is required if practitioners are expected to provide consistent answers. If a practitioner cannot honestly answer the question, that person is unable to complete the PEAK process.

Also, if PEO charges an applied scientist for practising what it perceives to be engineering, one defense might be that the act does not clearly define "professional engineering" and should be struck down as unenforceable.

What Cayton's report doesn't consider

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PEO, as the regulator of engineering practice in the province of Ontario, is bound by both statutory obligations and ethical responsibilities to protect the public when the practice of engineering is involved. Because most engineering work in companies is performed in teams with individual engineers assigned to subtasks or pieces of the design with no role in the overall management or policies of the company, they have no direct role or responsibility in protecting the public from any outcome of the company's product. Section 12 of the *Professional Engineers Act* also lists exceptions to the licensing and authorization requirements commonly known as the industrial exception. Hence, in the preparation of designs for construction, enlargement or alterations of certain types of buildings and industrial processes within the enterprise, the work does not have to be performed by a P.Eng.

PEO protects the public by setting standards for technical competence and professional conduct of engineers, and ensuring all licensed professional engineers meet these standards. For the purpose of carrying out its principal objective, the association has the following additional objectives:

1. To establish, maintain and develop standards of knowledge and skill among its members;
2. To establish, maintain and develop standards of qualification and standards of practice for the practice of professional engineering; and
3. To establish, maintain and develop standards of professional ethics among its members.

Does PEO have the staff and resources with the necessary technical knowledge to perform these tasks, especially in emerging disciplines such as 6G wireless, AI and nanotechnology?

Many engineering graduates are innovators, and to commercialize their product, they become entrepreneurial and create a business venture. They comply with standards such as the ISO 9000 quality standard. Often, they are not P.Engs, nor are any of their employees. When the company starts selling the product in Canada and the United States, what action can PEO take on the company to ensure protection of public safety?

Currently, only 40 per cent of engineering graduates in Canada are finding engineering jobs and work in companies. Hence, they will either find work in other fields other than engineering or start their own companies. How will PEO fulfill its mandate and objectives in regulating work performed by these engineering educated professions?

Cayton's report (see *Engineering Dimensions*, September/October 2019, p. 7) has not covered the rapidly changing role of engineers where traditional employment of engineers in companies is vanishing, and engineers have to be innovative and become entrepreneurs to create their employment for the economic benefit of Ontario and Canada. What will be the role of PEO under these circumstances?

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