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CANADA'S DIRTY SECRET

By Nicole Axworthy

ENGINEERING DIMENSIONS

Engineering Dimensions (ISSN 0227-5147) is published bimonthly by the Association of Professional Engineers of Ontario and is distributed to all PEO licensed professional engineers.

Engineering Dimensions publishes articles on association business and professional topics of interest to the professional engineer. The magazine's content does not necessarily reflect the opinion or policy of the Council of the association, nor does the association assume any responsibility for unsolicited manuscripts and art. Author's guidelines available on request. All material is copyright. Permission to reprint editorial copy or graphics should be requested from the editor.

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Engineering Dimensions is a member of Canadian Business Press.

Indexed by the Canadian Business Index and available online in the Canadian Business and Current Affairs Database.

US POSTMASTER: send address changes to *Engineering Dimensions*, P.O. Box 1042, Niagara Falls, NY, 14304.

CANADA POST: send address changes to 40 Sheppard Avenue West, Suite 101, Toronto, ON M2N 6K9. Canada Publications Mail Product Sales Agreement No. 40063309. Printed in Canada by Renaissance Printing Inc.

SUBSCRIPTIONS (Non-members)

Canada (6 issues) \$28.25 incl. HST

Other (6 issues) \$30.00

Students (6 issues) \$14.00 incl. HST

Single copy \$4.50 incl. HST

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Approximately \$5.00 from each membership fee is allocated to *Engineering Dimensions* and is non-deductible.



Most of us probably don't realize the enormity of our waste problem. Our municipal waste management programs work so efficiently that the average person

doesn't see how much of it there is, or where it goes to die (or sometimes to be reborn).

The last time Toronto caught a glimpse of the reality of its citizens' garbage habit was during the five-week municipal workers' strike in 2009, when garbage collection was brought to a halt and many of the city's parks and outdoor sports rinks became buried up to four metres deep in stinking refuse. As a downtown condo dweller at the time, I remember it well and was particularly struck by the volume of it all, sitting in heaps in the park I used to walk through, creating a stench that the July temperatures only made worse. The short-lived Toronto strike painted a clear picture of the nightmarish relentlessness with which our waste keeps piling up and its need for a place to go.

All of this echoes the persistence of the country's garbage production as a whole. Despite what we might think about Canada's oft-cited environmental ambitions, the country currently leads the developed world in per-capita waste production. In other words, we're among the world's champion garbage creators, and that's not something to be proud of. Worse, still, Canada seems to lack a coordinated way to deal with it all, because less than one-third of that waste is diverted from landfills into recycling, composting or other facilities. Plastics

are a particularly challenging part of municipalities' waste management programs. In "The problem with plastics" (p. 28), Associate Editor Adam Sidsworth speaks with engineering and waste management experts to explore the difficulties dealing with plastic—a waste material that, if not recycled, breaks down into microplastics and is prevalent in landfills and waterways. The sheer enormity of the problem provides significant opportunity for technological changes and specific engineering innovation.

Associate Editor Marika Bigongiari writes about an equally problematic issue in "Tackling our food waste and loss crisis" (p. 34), in which she uncovers a startling statistic: More than half of the food produced in Canada is lost or wasted annually. While all stakeholders have a role to play in reducing food waste, engineering solutions are essential at every point along the food supply chain.

This issue also includes coverage of association business, such as the hiring of our new registrar (p. 17) and changes to By-Law No. 1 that were approved by Council at its February meeting (p. 42). Notably, once confirmed, the bylaw changes give PEO the ability to implement without member confirmation its first P.Eng. licence fee increase since 2008. Finally, PEO's 2019 Annual General Meeting weekend and accompanying Order of Honour (OOH) gala is fast approaching. On May 3, PEO will induct 13 individuals into the OOH, an honorary society that recognizes outstanding service to the engineering profession. For more on this year's inductees, see page 12. [e](#)

THIS ISSUE Our focus is on waste management. Although Canada is a world leader in environmental protection, we are not perfect: We annually lose or throw out 35 million tonnes of food, and many plastics in this country are not recycled, instead going to landfill or, worse, escaping the waste management system and contaminating our ecosystems. In this issue, we examine engineering solutions to food management as well as developing a circular lifespan for plastics in Canada.



PEO RENEWAL: IN THROUGH THE OUT DOOR

By David Brown, P.Eng., BDS, C.E.T., IntPE, MCSCCE



As I look back on my past year as PEO president, I reflect on the challenges facing the association, its future and what's required to position ourselves as an effective engineering regulator as we move into the third decade of the 21st century.

In my July/August 2018 column, "Is it time to self disrupt?" (p. 6), I examined the growing public distrust in many professional regulators' ability or will to effectively oversee their licence holders. I pointed to several media and government investigations of Canadian regulators—lawyers, doctors, nurses and engineers—that suggest some regulators are perceived to be less than transparent in their regulatory processes, notably those around complaints and discipline. This growing distrust reflects increasing public attitudes that many regulators are not taking the privilege of self-regulation seriously and are more concerned with protecting their members than the public. I posited the idea that PEO should disrupt itself now while we're not under the microscope—ensuring we're doing all we can to confirm our regulatory processes are sound and transparent—before outsiders do it for us.

Unfortunately, that time has come sooner than expected; we are now facing scrutiny thanks to November 2018 letters to Ontario Attorney General Caroline Mulroney from Consulting Engineers of Ontario (CEO) and the Ontario Society of Professional Engineers (OSPE). The letters charged that PEO Council is too preoccupied with day-to-day operations than the strategic direction of the organization. They also suggested PEO has lost its regulatory focus and spends too much time and resources on non-regulatory activities that are not aligned with the objects set out in the *Professional Engineers Act* (PEA).

Now that PEO is officially "on the radar" of our boss, the attorney general, the need for change is urgent. We must get our house in order and refocus on our regulatory role before we're ordered to do so by government—as has happened to our engineering regulatory colleagues in Quebec and British Columbia. As I suggested in my July column, PEO is currently undertaking a regulatory performance review that will assess PEO's performance against our statutory mandate and legislative requirements, our internal policies and the standards of good regulation across our core regulatory functions (licensing and registration; complaints; discipline; compliance and enforcement; and professional standards.) The review is being led by Harry Cayton, an international advisor to the United Kingdom-based Professional Standards Authority, an organization recognized for their expertise in developing international standards for regulatory effectiveness and applying them to professional regulatory bodies around the world. The review will



WHATEVER MODEL WE ADOPT, IT MUST BE DRIVEN BY PUBLIC DEMAND. AMID ALL THE EMERGING DISCIPLINES CREATING NEW TECHNOLOGIES, THE PUBLIC INTEREST MUST REMAIN PARAMOUNT.

provide an honest appraisal of our regulatory effectiveness to ensure we perform them well. We owe it to ourselves and the public we protect to measure our performance and bridge any gaps that are identified.

The review will take four months to complete, with a final report issued in June. The report will be made public on the PEO website.

While we lay the groundwork for regulatory renewal, we must also start seriously thinking about the future of engineering in all its forms and PEO's ability to oversee it all. In my last column, I noted PEO's regulatory focus on licensure and enforcement is proving limited in its capacity to regulate the full gamut of engineering in Ontario, especially in an age when technology is advancing exponentially. In our current form, we simply can't enforce licensure and exclusive rights to practice in a time when new disciplines and technologies are emerging regularly.

Regulating engineering in this new environment will likely mean exploring new regulatory models, such as the entity regulation model now gaining traction among Canadian legal regulators. That model focuses more on regulating the entity providing professional services, in addition to regulating the individual professional, and requiring the entity be accountable under the PEA.

Whatever model we adopt, it must be driven by public demand. Amid all the emerging disciplines creating new technologies, the public interest must remain paramount. If the public doesn't see a PEO logo on the bottom of an organization's website, they will look elsewhere to those who do—confident that the P.Engs they're dealing with abide by a code of ethics, providing product or work with honesty and integrity and are ultimately accountable to PEO.

PEO is approaching 100 years regulating engineering, and it's time for renewal. I believe the regulatory review is our starting point—a cornerstone on which to build a PEO that's up to the task of regulating modern engineering. I'm proud of having achieved this first step, but it's now up to incoming presidents and Council—as well as PEO licence holders—to build from here. **e**

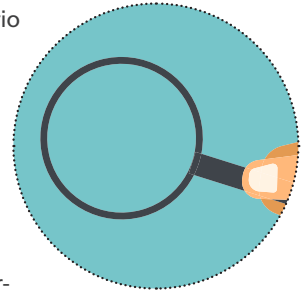
PEO's EXTERNAL REGULATORY REVIEW STILL IN PROGRESS

By Adam Sidsworth

Harry Cayton, international consultant to the United Kingdom-based Professional Standards Authority (PSA), and his team conducted a series of meetings with PEO staff, volunteers and external stakeholders in Toronto, Ontario, between January 31 and February 8 as part of their external regulatory performance review of the engineering association. Their final report and recommendations are to be submitted to PEO Council in June.

As reported in the January/February 2019 issue of *Engineering Dimensions* ("PEO undergoes external regulatory review," p. 8), Cayton and his team, including Ontario's own Deanna Williams, who has held senior positions with the Ministry of Health and Long-term Care, College of Denturists of Ontario and Ontario College of Pharmacists, reviewed the *Professional Engineers Act* (PEA) in December 2018 and, in a series of meetings in January and February, Cayton and his team met with Council members, committee volunteers, PEO staff and external stakeholders—notably the Ontario Society of Professional Engineers, Consulting Engineers of Ontario and Assistant Deputy Attorney General, Policy, Agency and Tribunal Relations Irwin Glasberg—to measure the performance of PEO against the PEA and the standards for regulators as developed by PSA. These standards were adapted by Cayton's team in their preliminary meetings with PEO in January to fit PEO's unique mandate and role as defined by the PEA. However, Bernard Ennis, P.Eng., PEO director of policy and professional affairs, is quick to note that the high standards for regulatory excellence established by PSA were in no way compromised, and Cayton's final report will reflect the same level of intense scrutiny that he and PSA apply to all regulatory reviews. During this same timeframe, Cayton and his team also observed a Council meeting and several non-regulatory and regulatory committees.

The external review is perhaps the highlight of the mandate of PEO President David Brown, P.Eng., BDS, C.E.T., whose presidency ends this May. Throughout Brown's tenure, he has remained committed to increasing PEO's transparency and efficiency, especially in light of a recently elected Progressive Conservative government that campaigned under a platform of less regulation and red tape. Additionally, other Ontario regulators—notably the Ontario College of Trades—are either being legislated out of existence or are having their regulatory performances scrutinized. Across Canada, PEO's sister engineering regulators are having their authority challenged by their respective provincial governments: Quebec's engineering regulator, l'Ordre des ingénieurs du Québec, was placed under a two-year government trusteeship that ended last month; and in British Columbia, Engineers and Geoscientists BC's authority will eventually be placed under the provincially appointed superintendent of professional governance, along with other BC natural resources regulators, as scheduled by the November 22, 2018, passing of the *Professional Governance Act* by the BC legislature (see "Professional reliance review targets BC natural resource regulators," *Engineering Dimensions*, September/October 2018, p. 10).



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ENGINEERING SALARIES: IS PAY MIX SHIFTING?

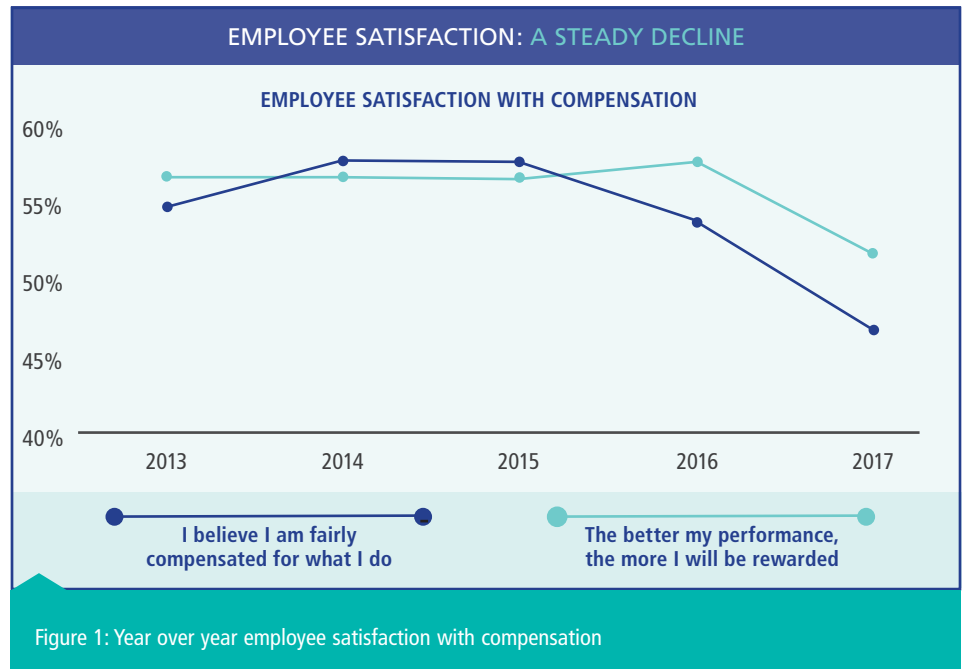
By Liz Elliott

Globally, employees express an increased desire to work for companies that have a strong sense of purpose, invest in careers and development for their employees and provide flexible work arrangements, among other things. However, they also show us that compensation is still their top priority and, according to a recent employee engagement report by Mercer Sirota, employees are less and less satisfied with their compensation. Between 2016 and 2017 both satisfaction with fairness of pay and the connection between pay and performance decreased by about 10 per cent (Figure 1). It's no wonder employee retention and attraction are solidly surpassing economic concerns as top of mind for Canadian organizations when research continues to show that overall employee satisfaction with compensation is on the decline.

So, how are employers reacting to these challenges? The data presented in the 2018 Mercer OSPE National Engineering Compensation Survey—produced by Mercer and the Ontario Society of Professional Engineers (OSPE)—along with additional Canadian and global data collected by Mercer, can provide insight into the changes employers are making locally to compete in an incredibly tight talent market, particularly for the technically skilled and specialized engineering profession.

OVERALL, TOTAL COMPENSATION IS RISING

Though there's not much to talk about in terms of base pay increases, the narrative does get more interesting when we look at the total compensation package. The 2018 national



engineering survey results show an increase for engineers in total compensation over the past several years in select industries. Engineers within mining and metals, energy and other non-manufacturing sectors are all receiving higher levels of pay than their counterparts outside of these industries. Take note, however, that higher pay is being delivered in the form of variable pay, either short- or long-term incentives, both of which are heavily reliant on performance.

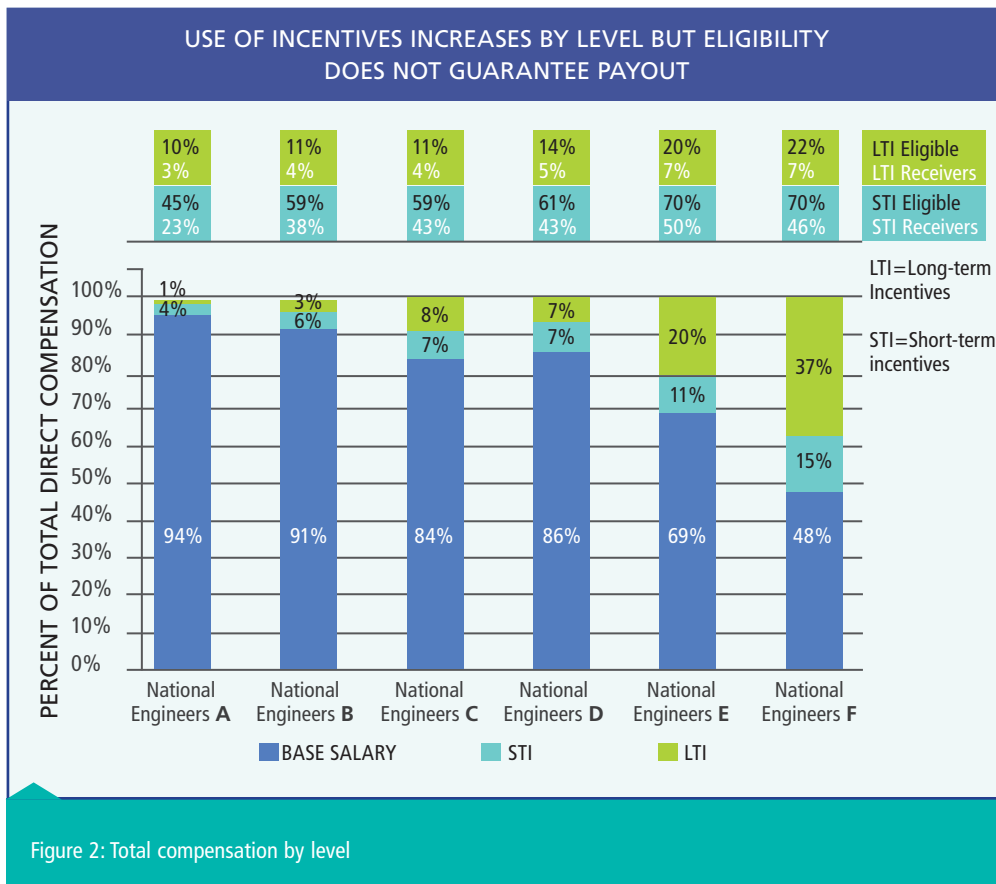
WHAT TYPE OF PERFORMANCE?

When determining how to measure performance in order to distribute variable pay rewards (either in the form of short- or long-term incentives) companies typically consider a variety of factors. Participants in the 2018 national engineering survey indicated that although over 73 per cent use individual (employee) performance to determine awards in bonuses, 41 per cent also use some indicators of corporate performance of a parent company and 29 per cent use corporate performance of a subsidiary. Additional measures of performance indicated by participants include team or department, or division or site.

USE OF INCENTIVES INCREASES WITH EXPERIENCE

As an engineer moves from one level to the next, he or she is typically gaining responsibilities along with discretion and authority. With those changes, the ability to impact performance outcomes also changes; increased responsibility and use of discretion typically goes hand in hand with a more direct impact on the positive or negative performance outcomes of the individual, the team or department, the site or even the company. Accordingly, companies tend to use variable pay tied to performance more frequently at higher levels.

As we can see in the 2018 national engineering data, engineers are being offered some pay in the form of short-term incentives (i.e., a bonus or annual incentive) from the beginning of their career (Level A), although the usage is more significant starting at Level E where the award shows as around 5 per cent of base pay up to a little over 15 per cent in Level F as reported by national participants (Figure 2). Long-term incentives are used but not until the highest levels of engineer and incentive eligibility does not guarantee that the targeted value will be paid out and only a portion of those



eligible for long-term incentives receive incentives in any given year.

In the 2018 national engineering survey we also see that the use of incentives varies among industries (Figure 4). Nationally, energy, mining and metals, and consumer goods and services are making the greatest use of incentives. Of particular interest is the fact that the two industries most emphasizing variable pay are also those with greater inherent variability in performance due to factors outside an employee's control, such as crude oil and metal prices. These industries also face the largest variation in head count through economic cycles emphasizing a correlation between risk and reward.

With Ontario's tight labour market and reports of national dipping employee satisfaction with compensation, it's more important than ever for employers in Ontario continued on p. 10

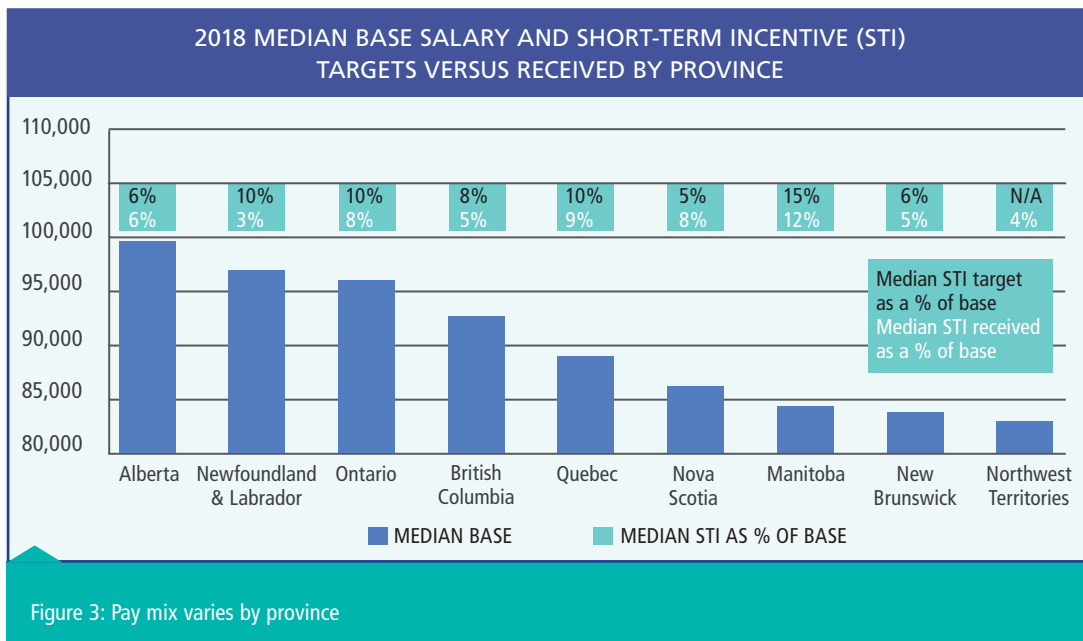


Figure 3: Pay mix varies by province

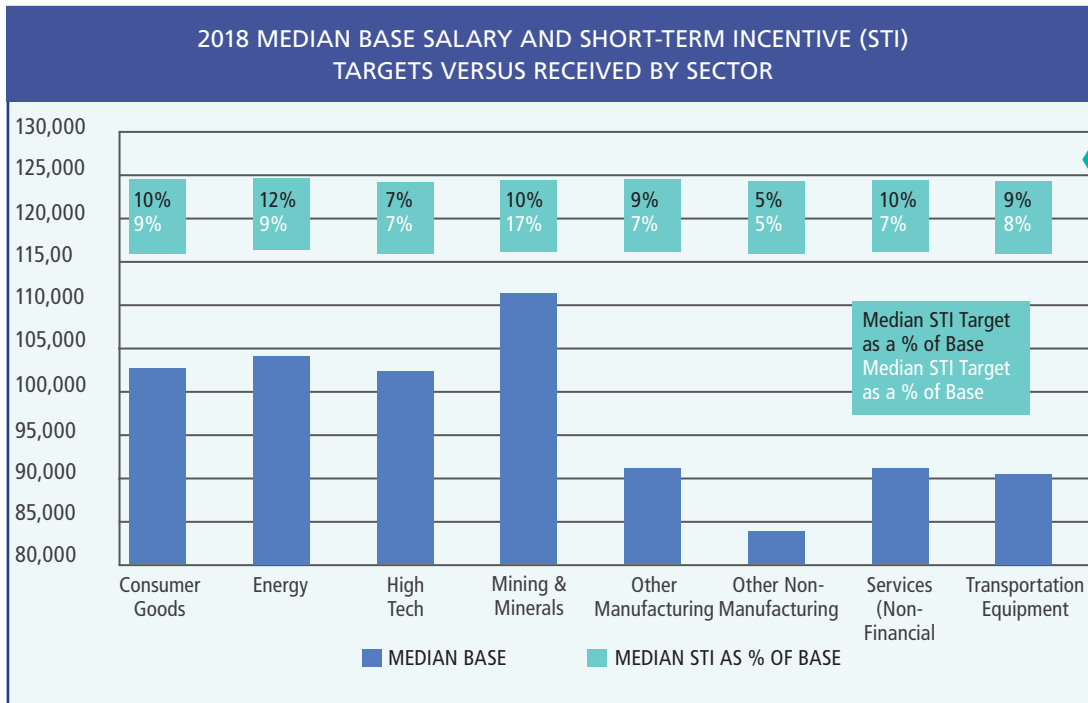


Figure 4: Bonus determination depends on performance in industry

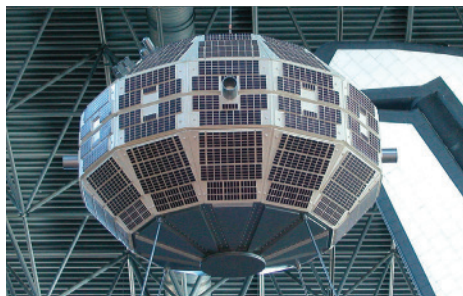
continued from p. 9 and nationwide to be thoughtful in how they establish their compensation packages to attract and retain the best and the brightest in the industry.

The Mercer-OSPE National Engineering Compensation Survey helps establish meaningful criteria for engineering pay levels for the benefit of both engineers and employers. Compensation and workforce metrics data for over 16,000 engineers nationally, across six engineering responsibility levels and 14 job types, were collected from 183 organizations in both the private and public sector. The survey results are available in PDF and in an online format through Mercer WIN. This information allows employers to assess their organization's competitive position and analyze market data. The design and implementation of the survey was overseen by an advisory committee comprised of representatives from industry, as well as the engineering and human resources communities. The

committee ensures that the survey remains a current and reliable resource on compensation for engineers across Canada. Employers can order the 2018 Mercer OSPE National Engineering Compensation Survey by contacting Mercer at imercer.com/engineering, 800-333-3070, or info.services@mercer.com. OSPE members can access a complimentary copy of the member market compensation summary online at www.ospe.on.ca/engineering-compensation-survey.

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BITS & PIECES



With the launching of Alouette I in 1962, Canada became the third nation in space, behind the USSR and US. The Alouette satellites were renowned for their reliability and longevity in the hostile environment of space.



The meticulous design of the Alouette satellite antennae, known as STEM (storable tubular extendible module), set new global standards and was a progenitor of the Canadarm, a remote-controlled mechanical arm that serviced the NASA shuttle program for 30 years.

PEO ATTENDS PRE-INQUEST MEETING FOR RADIOHEAD CORONER'S INQUEST

By Adam Sidsworth

PEO attended a November 2018 pre-inquest meeting for an upcoming coroner's inquest into the June 16, 2012, temporary stage collapse at Downsview Park in Toronto, Ontario, a disaster that occurred just hours before rock band Radiohead was scheduled to perform. The collapse claimed the life of Radiohead drum technician Scott Johnson, 33, from England, and injured three others, leading to the laying of charges against an engineer and others by the Ontario Ministry of Labour.

PEO Director, Policy and Professional Affairs Bernard Ennis, P.Eng., represented PEO at the pre-inquest meeting. He notes that, if requested, PEO will most likely be given standing at the coroner's inquest, which he expects will explore the events leading up to the stage's collapse, including the inspection and oversight of the temporary stage construction, the roles of key players and the regulatory requirements for such structures. Ennis, who says that "staff will be subpoenaed to give expert opinion on PEO standards and guidelines," in addition to practice standards for engineers in such situations, adds that Council will have to approve PEO's standing.

Although the coroner's office would not confirm to *Engineering Dimensions* the beginning date of the coroner's inquest, some media outlets are reporting that the inquest is set to begin on March 25, 2019. Roger Skinner, regional supervising coroner for Central Region, originally announced the inquest on November 30, 2017. The inquest is considered mandatory, as Johnson's death occurred at a construction site.

As reported in the September/October 2017 issue of *Engineering Dimensions* ("Trial in fatal stage tower collapse could be in jeopardy," p. 7) as well as the March/April 2018 issue ("Inquest small comfort to P.Engs concerned about regulatory shortcomings," p. 9), the Radiohead stage collapse has been mired in controversy. The original trial was scheduled to end by January 2017; however, in June of that year, the presiding judge ordered a mistrial when he was appointed to the Ontario Superior Court and lost jurisdiction of the case. A new trial was scheduled to begin in September 2017 and continue into early 2018, but the new judge stayed the charges, citing the defendants' right to a timely trial.

Former engineer Domenic Cugliari, concert promoter Live Nation and contractor Optex Staging were charged with 13 offences under the *Occupational Health and Safety Act* by the Ministry of Labour in June 2013, after ministry engineers alleged several causes that led to the collapse of 27,000 kilograms of equipment. Notably:

- The weight of the stage's suspended roof grid system was miscalculated;
- Devices used to weigh components were insufficient;
- The construction did not adhere to the design;
- Sixteen ballasts were not installed correctly, including three not connected to any stage component;
- Locking pins were not installed in some upper sections of the scaffolding; and
- The pick-up trusses, which were intended to hold the stage roof structure and lighting in the air, failed.



Downsview Park in Toronto, Ontario, is where the stage collapse took place.

The lack of any findings from the court system clearly frustrated Radiohead and Johnson's family. During the first of Radiohead's back-to-back performances in Toronto in July 2018—their first appearance in Toronto since the stage collapse—lead singer Thom York addressed fans, stating: "Six years ago, we wanted to do a show in Toronto. The stage collapsed, killing one of our colleagues and friends. The people who should be held accountable are not being held accountable. The silence is...deafening." And Radiohead drummer Philip Selway spoke about his guilt, telling *CBC News*: "When the collapse happened, it happened at four in the afternoon. Our soundcheck was due to start at four, and I actually should have been where Scott was...That is an incredible weight, and personally, I can't let this lie. I want to see a proper conclusion, something that is respectful to Scott." Addressing the stayed charges, he added: "We're appalled that this has been allowed to conclude in this manner. I feel angry about it." Ironically, Johnson's father, Ken, is a scaffolder who audits the annual safety report for the United Kingdom's National Access and Scaffolding Confederation. "Some errors are fairly obvious because of the nature of my role," he told *CBC News*. "It just wasn't strong enough. There's no getting away from it. If it was strong enough, it would have stayed up."

PEO HONOURS 13 THROUGH 2019 ORDER OF HONOUR AWARDS

By Nicole Axworthy

This year, PEO will induct one Companion, six Officers and six Members into its Order of Honour. The Order is an honorary society that recognizes professional engineers and others who have rendered outstanding service to the engineering profession in Ontario, primarily through the association. The honorees will be recognized at a ceremony on Friday, May 3, held in conjunction with PEO's annual general meeting in Toronto, Ontario.

COMPANION

David Robinson, P.Eng., FEC, will be inducted as a Companion. A civil engineering graduate from Queen's University and career-long PEO volunteer, he was first recognized as a Member for his 30 years of service to the North Bay Chapter. In 1971, he spearheaded the chapter's first Professional Engineers Day conference, which has since become an annual tradition aimed at raising local awareness of PEO and professional engineers. Similarly, he has been involved in education outreach programs promoting science and engineering to schools, including career days, the North Bay Regional Science Fair and bridge-building contests. As chair, he contributed to the chapter's growth and served on its Government Liaison Program Committee. Today, he continues to assist the chapter, especially in times of need—filling in as a last-minute keynote speaker for the 2015 Student's Night and auditing the chapter's financial statements in 2016 and 2017. He also provides mentoring and guidance for the current chair and chapter executive. Robinson has also been a motivational force as a member of several PEO committees, including the Awards and Discipline committees.

OFFICERS

Peter John Broad, P.Eng., FEC, C.Eng., MIMMM, will be inducted as an Officer. A graduate of the University of Manchester's metallurgical engineering program, he has been an active volunteer with the association since 1995, serving at both chapter and provincial levels.

While working in the mining industry in northern Ontario, Broad began volunteering with the Porcupine/Kapuskasing Chapter, serving both on the executive and as chair from 2001 to 2003, ensuring that the concerns and interests of smaller northern chapters were adequately discussed at Chapter Leaders Conferences. In 2004, he moved to London and planned the annual general meeting "Partner Program" hosted by the London Chapter in 2005. At the provincial level, Broad chaired both the Enforcement Committee, and the Repeal of Industrial Exception Task Force, as well as serving a year on the Professional Standards Committee. A strong advocate for increasing the number of professional engineers in industry, he has participated or chaired subcommittees on Enhanced Enforcement for Industry, the Enforcement of Business Names, the Definition of Engineering, and spearheaded a proposal to replace the *Guideline for Pre-Start Health and Safety Reviews* with an enforceable performance standard.

John Douglas Glover, P.Eng., FEC, will be inducted as an Officer. A graduate of the University of Toronto's bachelor of applied science program, he has served as a PEO volunteer at both chapter and provincial levels for almost 30 years—including 26 years as a member of the East Toronto Chapter board, where he served as chair from 1992 to 1995 and from 2007 to 2010. After being inducted as a Member

of the Order of Honour in 2002, Glover has been a constant fixture on the East Toronto Chapter executive, serving as vice chair, chair and past chair. During this time, he helped organize over 100 seminars, more than 30 technical or social tours, many chapter licence certificate ceremonies and several annual general meetings. At the provincial level, Glover has served in several capacities including as the East Central Region representative on the Chapter Boundary Task Force and moderating the PEO president's town hall meetings and several PEO Council election debates. For over a decade, he has been a member of the planning committee for the annual Engineering Innovations Forum.

Gordon Ip, P.Eng., FEC, will be inducted as an Officer. Since his induction as a Member of the Order of Honour in 2011, he has doubled down on his volunteer efforts. In 2012, Ip co-created and organized York Chapter's first Engineering Project of the Year award to celebrate excellence in engineering projects in the York Region business community. In 2016, as chapter chair, he created a Business Liaison Committee to continue to foster the engineering business relationships first established by the award; and he leveraged the committee to organize the chapter's Engineering Technology Symposium on Industry 4.0, increasing attendance to over 300 delegates. To address voter apathy in PEO Council elections, in 2017, 2018 and 2019, Ip organized an East Central Region All-Candidates meeting to engage members in association governance and improve voter turnout. Ip has also served on several PEO committees. Leveraging his experience in computer, software and communications infrastructure engineering, he has provided guidance to the Experience Requirements Committee to interview engineering candidates in these disciplines. He joined the Enforcement Committee in 2018 to help with enforcement activities, with a special interest in these emerging disciplines.

William Elliott (Bill) Jackson, P.Eng., FEC, will be inducted as an Officer. A graduate of the bachelor of engineering program at McMaster University and the master of engineering program at the University of Ottawa, he has served on a wide range of PEO committees, subcommittees and task forces since 1984. Jackson began volunteering on PEO's Professional Practice Committee in the mid-1980s, helping to develop standards of qualification and practice for the profession. He ultimately chaired two related subcommittees, where he helped develop two influential guidelines: *The Use of*

Computer Software Tools by Professional Engineers and the Development of Computer Software Affecting Public Safety and Welfare and Professional Engineers Providing Communication Services. Jackson has also been a long-time member (since 2000) of the Enforcement Committee, where he's shown outstanding leadership in expanding PEO's enforcement activities, including the development of the regulator's policy in this area. As an Experience Requirements Committee (ERC) member, he has tirelessly advocated for practitioners in emerging disciplines such as communications and software engineering, promoting licensure of qualified candidates practising in those fields. As a member of the joint ERC-Academics Requirements Committee (ARC) group formed in 2015, he helped develop the limited licence application process.

Roger Jones, P.Eng., LSMIEEE, FEC, will be inducted as an Officer. A graduate of Imperial College, London University, he began volunteering for PEO in 2010, with service on the Professional Standards Committee and Emerging Disciplines Task Force. Since then, Jones has shared his talents across a wide variety of regulatory activities. Both during and after his six years on Council as councillor-at-large, he served as a member and chair of the Finance Committee and also as a member of the Central Election and Search Committee, the

OSPE-PEO Joint Relations Committee, the Council Composition Task Force, the Continuing Professional Competence Program Task Force and the Public Information Campaign Task Force. As Council liaison to the Emerging Disciplines Task Force, Jones brought a deep understanding of licensure for engineers in newer, high-tech fields thanks to his background in electronics and control systems engineering. He has been instrumental in contributing material for both the communications infrastructure and nano-engineering sub-groups and assisted in formulating Council motions and notes to ensure councillors understand the challenges around regulating emerging disciplines.

Don Lewis (Don) Marston, P.Eng., JD, FEC, will be inducted as an Officer. He graduated from Queen's University in both engineering and law. He has been a registered professional engineer for more than 50 years and a lawyer for more than 40 years. Early in his law career Marston was asked by the University of Toronto to teach an engineering law course, which he did for more than 20 years. In the course of his teaching, Marston wrote the textbook *Law for Professional Engineers, Canadian and Global Insights*. In the 1980s, PEO implemented its professional practice examination program. Marston was asked to set the program's law examination and arrange for its marking, and he continues to do so. In 1993, Marston was

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asked to join a task force reviewing licensing requirements for government, industry and consulting engineers. This led to Marston reporting and making recommendations to PEO Council on proposed changes to the definition of professional engineering. He recently co-chaired a subcommittee reviewing whistleblower protection. This work culminated in PEO's *Guide to Enforcement Reporting*, published in 2018. He is also a former member of the Ethics Committee and a 12-year member of PEO's Enforcement Committee.

MEMBERS

Joseph Lawrence Adams, P.Eng., FEC, will be inducted as a Member. A mechanical engineer with degrees from Kettering University and Western University, he has served many roles on the London Chapter executive and contributed to committees for licence certificate presentations, education outreach and government liaison. Adams helped establish the chapter's Government Liaison Program (GLP) Committee in 2008, and, as committee chair, he was instrumental in building strong relationships with all six MPPs within the chapter's boundaries. Under his leadership, the committee staged several town hall meetings bringing together local politicians and engineers to discuss topics of relevance for the engineering profession. His commitment to service extends to the provincial level, where he has been an active member of the Enforcement Committee, which is charged with advising Council on issues related to enforcement of the *Professional Engineers Act*.

Narayana Pillai Asogan, P.Eng., FEC, will be inducted as a Member. A mechanical engineer educated at the University of Ceylon in Sri Lanka, he has been a strong presence at the Scarborough Chapter, serving many roles including secretary, chair and certificate coordinator. As chair of the chapter's Government Liaison Program Committee, he was involved in numerous government relations activities, including organizing all-candidates debates and participating in MPP events such as Take Your MPP to Work days to build strong relationships with government decision makers. During a provincial by-election in 2013, Asogan organized a last-minute, all-party candidate's debate that received much attention from the local press. During his tenure as chapter chair, Asogan led education outreach activities in local schools, including the popular mathletics and bridge-building competitions and introduced Mechatronics to help educate students about engineering careers. A strong believer in succession planning, Asogan left the chapter board in 2017 to provide opportunities for younger volunteers to lead; however, he continues to contribute as a member.

Rabiz N. Foda, P.Eng., FEC, ICD.D, will be inducted as a Member. An electrical engineer with a bachelor of technology honours degree from the Indian Institute of Technology, Bombay and a graduate diploma in management from the University of Bombay in India, he has been a diligent Experience Requirements Committee volunteer since 1998. His global engineering experience has been invaluable in assessing international engineering education and experience for foreign-trained applicants—a significant contribution

to PEO's regulatory mandate. Thanks to his engagement with government and corporate bodies, Foda was also instrumental in the successful application by India for accreditation of many of its engineering degrees through the Washington Accord. A devout advocate for engineering graduates seeking licensure, he worked with the Toronto Regional Immigrant and Employment Council to create a mentoring program for new immigrants and has been an outstanding mentor to engineering graduates from different academic and cultural origins. Foda was also one of the few professional engineers appointed by an Order in Council by the lieutenant governor of Ontario to serve on the Ontario Ministry of Health and Long-term Care's Health Professions Appeal and Review Board.

Wayne Peter Kershaw, P.Eng., will be inducted as a Member. A mechanical engineer with a bachelor of engineering (aerospace) from Ryerson University, Kershaw began volunteering with the Hamilton-Burlington Chapter, serving in a variety of roles including chair, vice chair and Government Liaison Program Committee chair and actively encouraging volunteer participation at all levels, fostering a positive and supportive culture. He also made great efforts to encourage collaboration with neighbouring chapters, including the Niagara Chapter, which he later joined as an executive member. As a key participant on the Niagara executive, Kershaw organized numerous activities, including technical tours at Niagara College, member appreciation events, annual general meetings and educational outreach events. During a period of transitional leadership at the Niagara Chapter, he stepped in as vice chair, providing valuable advice and direction to keep the chapter moving ahead. Kershaw has also provided leadership to the profession as a councillor-at-large on PEO Council from 2011 to 2013. He has offered his expertise to several PEO committees and task forces, including the Enforcement Committee, Legislation Committee, Council Composition Task Force, Repeal of the Industrial Exception Task Force, and the Western Regional Congress Committee.

Sardar Asif Khan, P.Eng., MSc, MBA, FEC, PMP, will be inducted as a Member. An electrical engineer with a bachelor of science in engineering degree from the University of Engineering and Technology, Lahore, a master of science in engineering degree from Wayne State University and a master of business administration degree from Central Michigan University, Khan has accomplished much since he began volunteering in 2006. An expert in lean manufacturing concepts in his professional life, he was instrumental in initiating the Windsor-Essex Chapter's successful Learn to Leverage Lean Subcommittee, which provides free talks and tours to educate the public and engineering community about the benefits of lean. The group eventually worked with the University of Windsor engineering school to create a lean principles course for graduate students. He also developed the chapter's very successful annual "Innovation Station—Engineering Your Life" event that showcases engineering to the public and students through booth demonstrations and

school outreach by local engineers. The event won the top award at PEO's Chapter Leaders Conference in 2015 and 2016. Currently Windsor-Essex Chapter chair, Khan has also been active on the Chapter Leaders Conference and Planning Committee; as a mentor with the Licensure Assistance Program; and as a judge for the Windsor Regional Science, Technology and Engineering Fair.

Luc Roberge, P.Eng., FEC, will be inducted as a Member. A mechanical engineer with a bachelor of science from Queen's University, Roberge has been an active PEO volunteer serving on the executive committees of the Porcupine/Kapusking, North Bay and Algoma chapters since 2004. From 2012 to 2013, he served as vice chair and chair with the North Bay Chapter, where he was instrumental in reviewing and updating its communication strategy with members. He also chaired the Engineers Day and Bridge-building committees and served on the majority of the chapter's event committees. He rejuvenated the chapter's bridge-building event for local students and greatly increased student participation, notably from francophone schools. A strong volunteer leader, Roberge encourages others to take on chapter leadership roles and is always ready to guide and mentor chapter colleagues. Currently chair of the Porcupine/Kapusking Chapter, his passion and enthusiasm for the engineering profession and inspires and motivates others to participate and step into leadership roles.

PEO ANNOUNCES RECIPIENT OF 2019 G. GORDON M. STERLING ENGINEERING INTERN AWARD

Kaela Shea, EIT, has been named this year's recipient of the G. Gordon M. Sterling Engineering Intern Award. Currently a PhD candidate at the University of Toronto's Institute of Biomaterials and Biomedical Engineering, Shea is researching rehabilitation and assistive devices solutions to help overcome communication and physical challenges faced by children with disabilities. Her work includes the development of an innovative brain-computer interface that incorporates natural language processing, bringing the user context-relevant messages for face-to-face communication. As a student, she is known for her strong leadership and communication skills and high aptitude for assimilating knowledge across multiple disciplines—including engineering, kinesiology and neuroscience.

As an undergrad in the University of Guelph's engineering program, Shea volunteered as a peer helper, assisting fellow students in learning key course concepts and problem-solving strategies. She also co-founded the first Canadian chapter of Engineering World Health, an organization committed to inspiring the biomedical engineering community to improve healthcare delivery in the developing world. After the chapter was established, she worked to build its presence at the university, planning and leading activities for fellow students.

As a PEO volunteer, Shea is an engineer-in-residence at Toronto's Queen Victoria Public School, where she engages with students on engineering topics and the profession itself. Shea represents a new breed of socially conscious engineers. Although she possesses great technical ability, it's her potential to profoundly influence the profession that stands out for her instructors, mentors and peers.

2018 A RECORD YEAR FOR NEW ENGINEERING LICENCES

By Adam Sidsworth

The past year witnessed the highest number of new engineering licences issued in PEO history. Of the 2649 licences issued in 2018:

- 1719 were granted to graduates from Canadian Engineering Accreditation Board (CEAB)-approved post-secondary engineering programs; and
- 930 were granted to graduates of non-CEAB programs.

The total number represents a 19 per cent increase over 2017 and a 41 per cent increase over 2016 figures. Michael Price, P.Eng., PEO then-deputy registrar of licensing and registration, recognized the dedicated efforts of staff in overcoming previous resourcing issues due to staffing shortages and an upgrade of the association's database system while working with an increase in the number of licence applications.

Price told *Engineering Dimensions* that the 2018 numbers are a continuing trend of both an increasing number of issued licences and overall applications submitted. However, he also notes that, other than recording whether an applicant graduated from a CEAB-approved engineering program in Canada or a non-CEAB-approved program within or outside Canada, PEO does not track any specific applicant demographics. (In previous years, PEO received statistics from the Ontario Ministry of Citizenship and Immigration regarding international engineering graduates coming to Ontario from overseas, but those numbers haven't been reported since 2008.)

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NUMBER OF LICENCES ISSUED, 2008–2018

Licences Issued	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
CEAB	1200	1234	1483	1165	1480	1315	1655	1619	1284	1496	1719
Non-CEAB	1174	1097	997	665	812	707	830	830	596	724	930
Total	2374	2331	2480	1830	2292	2022	2485	2449	1880	2220	2648

NEW APPLICATIONS, 2008–2018

New Applications	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
CEAB	2238	2278	2361	2594	2596	3428	2708	2829	3120	3247	3279
Non-CEAB	2211	1835	1595	1734	1772	2810	1716	1814	2182	2098	2563
Total	4449	4113	3956	4328	4582	6238	4621	4916	5452	5345	5842

The number of applications received has witnessed, for the most part, typically a 5 per cent annual increase over the past decade, with one large spike in 2013, when the provincial government announced its intention to repeal the industrial exception, which would have required operators of professional engineering or production equipment and machinery to possess an engineering licence. Price also notes that the number of new applicants doesn't necessarily correlate with the number of new licences issued within the same calendar year, as some candidates, particularly non-CEAB candidates, have their academic credentials reviewed by PEO's Academic Requirement Committee, and, depending on the committee's decision, may have to complete a number of technical examinations before their licence can be granted. In addition, PEO must verify that all candidates have completed the 48 months of work experience, of which 12 months must be completed in Canada; and have successfully completed the Professional Practice Examination.

The record number of new licences for PEO comes as traditional engineering fields require more licensed engineers. Engineer Canada's *2015 Engineers Canada Labour Market Study* predicts that by 2025, there will be "a large and growing need to replace retiring engineers as they exit the workforce. This is particularly relevant for civil, mechanical, electrical and electronic engineers as well as computer engineers." It also comes at a time when engineering is expanding into new—and often unregulated—fields, forcing Canada's engineering regulators to adapt and perhaps expand the meaning of an engineering licence. As PEO President David Brown, P.Eng., BDS, C.E.T., noted in the January/February 2019 issue of *Engineering Dimensions* (p. 6), licensed engineers "are well educated and experienced, abide by a code of ethics responsible for safeguarding life, health and public welfare and are accountable to a regulator." However, Brown says that although the *Professional Engineers Act's* primary objectives—protecting the public interest through licensure and setting and enforcing standards of knowledge, practice and ethics—are broad enough to capture emerging disciplines such as computer, environmental and software engineering, we are not doing enough to stay ahead of the game. "If we're going to close our regulatory gaps—gaps that are widening every year—we need to change the way we look at licensure," he said.

PEAK TURNS TWO

By Marika Bigongiari



PEO's voluntary Practice Evaluation and Knowledge (PEAK) program was implemented in March 2017 and will embark on its third year on March 31. As the program moves forward, PEAK organizers are making plans to add enhancements and improve the user experience.

The PEAK program is voluntary, but completion statuses are made public on PEO's online directory—and they are reset every year on the anniversary of licence renewal. At that time, licence holders (professional engineers and limited licence holders) are reminded to participate in the program and are directed to the PEAK section of PEO's member portal (secure.peo.on.ca/ebusiness/home) to declare their practice status and watch the next available ethics module video.

PEAK's third year will see a new ethics module added to the video library. Modules are designed to cover the professional and ethical obligations of professional engineers, accompanied by real-life examples of scenarios an engineer may encounter in his or her professional life. "The plan is to develop more ethics modules to cover different refresher topics that would benefit licence holders," says Arden Heerah, P.Eng., PEO's PEAK program coordinator. As more ethics modules are added year to year, some key concepts from earlier modules may be repeated for emphasis.

Reflecting on the previous year, PEAK statistics for the period of March 31, 2018, to February 21, 2019, indicate:

- 21 per cent of licence renewals include practice declarations, of which 79 per cent are practising and 21 per cent are non-practising;
- 72 per cent of those who have completed practice declarations have watched the ethics module; and

- 86 per cent of those practising have completed the practice evaluation questionnaire.

PEO continues to update the program for a better user experience. Question-and-answer sessions are offered upon request—an employer, management or professional group need only request one, and arrangements for a presentation can be made. Several employers, PEO chapters and government groups have already made use of the Q & A offering, with representatives from human resources departments often sitting in to learn about PEAK so they can incorporate it into their professional development programs. Benefits to firms that employ engineers include

recognition that their workforce is continuously modernizing its engineering skills and knowledge and keeping PEO updated on the details of their practice and continuing competence efforts. In addition, firms are using PEAK participation as a marketing tool to appeal to new clients, and engineers appreciate employers that provide PEAK-aligned professional development opportunities.

The PEAK program's ongoing goal is to serve and protect the public and, in the spirit of continuous improvement, it welcomes community feedback. Licence holders are welcome to provide feedback via email, phone or at Q & A sessions. All feedback is logged, and key points are incorporated into upgrade projects. The PEAK program team is also available to answer questions via email at peoPEAK@peo.on.ca and phone at 416-224-1100 or 800-339-3716.



PEO APPOINTS LONGTIME STAFFER JOHNNY ZUCCON AS REGISTRAR

By Marika Bigongiari



Johnny Zuccon, P.Eng., FEC, was named PEO's new registrar on February 5.

PEO has appointed longtime employee Johnny Zuccon, P.Eng., FEC, as registrar effective February 5. Zuccon has served as interim registrar since February 2018, leveraging his long tenure at PEO to help facilitate a seamless

transition following the departure of Gerard McDonald, P.Eng., who moved on to become CEO of national engineering organization Engineers Canada (see *Engineering Dimensions*, January/February 2018, p. 20).

Zuccon, who has been with PEO since 1995, brings considerable executive experience to the role in addition to a wealth of PEO-specific knowledge. Previously serving as deputy registrar of tribunals and regulatory affairs, he has been a member of the senior management team for 15 years, also serving as deputy registrar, standards and regulations; director of professional affairs; and manager, external relations. He holds a master of applied science and a bachelor of applied science, both in mechanical engineering, from the University of Toronto and has been licensed to practise engineering since 1986.

As registrar, Zuccon will be responsible for PEO's administration of the *Professional Engineers Act*, under whose authority PEO licenses professional engineers and sets standards for and regulates engineering in Ontario so the public interest is served and protected. "As interim registrar, Johnny demonstrated sound leadership, communication, relationship management, accountability and decisiveness," said President David Brown, P.Eng., BDS, C.E.T., on Zuccon's appointment. "We trust the transition will be seamless. At the same time, we trust that Johnny will be able to champion change and renewal initiatives, addressing processes, systems and culture at all levels of the organization."

At the February 8 Council meeting, Zuccon thanked members of Council for his selection as registrar. "I'm honoured and excited for the challenges and opportunity that lie ahead as we move forward to usher in unprecedented change," Zuccon told Council members. "I am buoyed by your vote of confidence and your decision to promote from within the PEO ranks, as it sends a powerful message to all our staff, who give and continue to give to this organization. They are our primary resource, and I wish to formally extend my thanks and gratitude to all of them. I remain deeply indebted to many of you for my success at PEO."

NOTICE OF ANNUAL GENERAL MEETING

In accordance with section 20 of By-Law No. 1, which relates to the administrative affairs of PEO, the 2019 Annual General Meeting (AGM) of the Association of Professional Engineers of Ontario will be held on Saturday, May 4, 2019, commencing at 8:30 a.m. at the Hilton Toronto Hotel, 145 Richmond Street West, Toronto. No registration is required.

As noted in section 17 of By-Law No. 1, the AGM of PEO is held for the following purposes: to lay before members the reports of the Council and committees of the association; to inform members of matters relating to the affairs of the association and to ascertain the views of the members present at the meeting on matters relating to the affairs of the association. Officers of PEO and other members of both the outgoing and incoming Councils will be in attendance to hear such views and to answer questions. PEO President David Brown, P.Eng., BDS, C.E.T., will preside and present his annual report to the AGM. The president-elect, officers and councillors for the 2019–2020 term will take office at the meeting.

PROCESS FOR MAKING SUBMISSIONS TO THE 2019 AGM

Submissions by members at PEO's AGM are a vehicle for members in attendance to express their views on matters relating to the affairs of the association, but are not bind-

ing on Council. A member submission should clearly describe the issue being addressed and indicate how it advances the objects of the *Professional Engineers Act*, which define the mandate and responsibilities of PEO. To ensure member submissions receive proper consideration at the AGM, members must submit typed submissions to Registrar Johnny Zuccon, P.Eng., FEC, by no later than 4:00 p.m., Friday, April 19, 2019. Submissions must be signed by the mover and seconder, either of whom must be present at the meeting. Submissions will only be accepted by email to agmsubmissions@peo.on.ca. A guidance document on the content and format of submissions is available from the AGM page of the PEO website at www.peo.on.ca. Submissions received by the April 19, 2019, deadline will be published on the AGM page of the PEO website and included as part of the registration package.

Member submissions will be referred to the Executive Committee or Council for consideration after the AGM. The mover and seconder of a member submission will be invited to address the submission at the meeting at which the submission is to be considered.

Johnny Zuccon, P.Eng., FEC, Registrar

PROCEDURES FOR ADDRESSING SUBMISSIONS AT 2019 AGM

DURING THE MEETING

PEO's 2019 AGM will be conducted on Saturday, May 4 from 8:30 a.m. to 12:30 p.m. and continue, if necessary, from 2:30 p.m. to 3:00 p.m. Consideration of member submissions will begin at approximately 9:30 a.m. Submissions will be published on PEO's website before the meeting and included in members' registration packages.

The president will chair the portion of the meeting dealing with member submissions and manage the discussion. His direction must be respected.

The mover and/or seconder of a submission will be given up to five minutes to present their submission to the AGM. When time permits, members at the AGM may make comments of up to two minutes on the submission. The mover and/or seconder of a submission will be allowed two minutes for a closing statement. Members will then vote on the submission as an expression of the views of those present at the meeting.

In circumstances where the overall time allocation will not permit the above timing, the total amount of available time for submissions will be divided evenly among the number of submissions, and movers and seconders of submissions will be informed.

FOLLOWING THE MEETING

Member submissions will be referred to the 2019–2020 Executive Committee or Council to consider whether to initiate any action on them. The mover or seconder will be invited to address the submission in detail at the meeting at which the submission is to be considered.

All submissions to the 2019 AGM will be considered during the 2019–2020 year, and their disposition reported to Council and at the 2020 AGM.

Disposition of submissions to the 2019 AGM will be published on the PEO website and updated periodically, if necessary. Progress on 2019 submissions will also be published in *Engineering Dimensions* following the 2020 AGM. **e**

ENGINEER DISCOVERS HER LEADERSHIP POTENTIAL

By combining her engineering skills with her desire to change the world for the better, Erica Lee Garcia, P.Eng., has created a career that educates her fellow professionals on team building and operational excellence.

By Natalya Anderson

In her early industry work as a manufacturing engineer, the opportunity to oversee an employee suggestion program sparked the entrepreneurial spirit of Erica Lee Garcia, P.Eng., chair of PEO's Grand River Chapter and founder of Erica Lee Consulting. "It contributed to my belief in democracy of good ideas," Lee Garcia says. "Anyone can have a good idea."

Nearly a decade later, that desire to foster creativity and improvement has made Lee Garcia a leader in both volunteer work and operational excellence in industry. Her consultancy firm, which helps companies improve their performance through Lean, Six Sigma and Kaizen methods is thriving, and Lee Garcia insists that attention to the human factors is key to her success. "If you're not taking people into the equation, you're doing it wrong," Lee Garcia says. "Let's get back to what we're supposed to be doing. It's finding our north star again, for the engineering profession, too."

But for Lee Garcia, finding her own career direction was not always easy, and her path became clearer only as her identity shifted within what she calls the "strong culture" of engineering. "From studying engineering at Queen's University to working in the industry—my first jobs were in automotive manufacturing doing process design and quality control—it was a bit of an uphill battle," Lee Garcia explains. "I fought to find my place, and to believe that I could be a good engineer."

That meant earning her P.Eng. and her Six Sigma Black Belt, which strengthened an interest in team building and rediscovering the purpose of her work. "Six Sigma is all about improvement in teams," Lee Garcia says. "I started to love statistics, which I hadn't enjoyed in my undergrad, but once I got into industry, I really saw that they were amazing tools. And then there was the business aspect of it—that we were saving this amount of money for a company. Through Six Sigma I got to know the financial side as well."

SHAPING ENGINEERING THROUGH OUTREACH

From automotive engineering, Lee Garcia became an improvement specialist in the gold mining industry. It was then that she was given a life-changing assignment. "I was sent to South America to coach other people on the improvement activities I'd been doing...in Spanish," she explains. "They do replace you when you go on international assignment, which is something I hadn't thought



Even outside her consulting work, Erica Lee Garcia, P.Eng., supports a wide range of mentoring, social enterprise and non-profit work.

of, so a few years later that led to me leaving the company and traveling for a while."

During that break, Lee Garcia volunteered at a wildlife reserve in Ecuador and had a kind of epiphany. "In the jungle, I realized that I can use my engineering brain, not just to make rich people richer but toward anything I want; I could help people," Lee Garcia says. "That's the main reason why and how I started my consultancy company." Her initial clients were automotive and mining companies, and that emphasis on human context persisted. Soon, Lee Garcia was visualizing more ways of shaping engineering on a larger scale. "I got inspired, then sort of sidetracked, and ended up starting a not-for-profit organization that involves talking to kids about engineering. That's Engineers of Tomorrow."

The organization, which aims to educate young Canadians about the power of engineering, worked on Ontario's National Engineering Month campaign from 2011 to 2018, tripling the number of events, and encouraging innovative outreach. It has also taken on PEO's Engineer-in-Residence (EIR) program, having managed it since 2014, comprising relationships with over 200 EIR volunteers and teachers. Originally under Engineers Without Borders Canada, Engineers of Tomorrow spun off as its own organization in October 2018, with Lee Garcia as its founder and Rebecca White as chief executive officer.

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In 2017, the Canadian Centre for Women in Science, Engineering, Trades and Technology (WinSETT Centre) hired Lee Garcia as part of their national team of women's WinSETT leadership course facilitators. Again, Lee Garcia thrives on the experience of inspiring people doing technical work. "In my consulting, it's almost like being a translator," Lee Garcia says. "I enjoy showing how engineering is for solving problems that benefit people. I translate the value of people being heard. With WinSETT, I'm very honoured to be part of that team. It's an amazing, very accomplished, knowledgeable group of women. Their courses run coast to coast and are so well researched, evidence based, and well tuned to the gender factors specific to the women in SETT (science, engineering, technology and trades)."

WELCOMING NEW VOLUNTEERS

The year 2017 also saw Lee Garcia taking on the position of chair of PEO's Grand River Chapter,

having started as a volunteer with the chapter in 2013. She feels that her observations and suggestions have been well received from fellow board members. "My legacy, I think, is going to be our volunteer recruitment," Lee Garcia says. "I was told when I started that 'we can never find volunteers.' I said, 'I think we can; we're just not executing properly.' We now do an annual event, kind of like a draft night. We invite our whole list of P.Engs and engineering interns to come in and hear about what we do. The committee chairs stand up and give a little pitch about what their committee is up to, what they need and what their goals are. It's about making people feel welcome. I'm happy to report we have a healthy supply of new volunteers now."

Looking forward, Lee Garcia intends to continue outreach work with Grand River, with a view to expand their vision. "We've taken the youth side of outreach side a long way," she says. "I'm excited to be carrying on outreach, but being more strategic about it, where we're not just talking to kids. Maybe we talk to grown ups as well, and companies." **e**

THE VOLUNTEER FACTOR
LIFTING COMMUNITIES

In honour of National Volunteer Week (April 7-13, 2019), PEO thanks its devoted volunteers—councillors, committee and task force members as well as chapter volunteers—for lifting the engineering profession in support of fellow licence holders, students and the public. Your ongoing support is appreciated and valued.

 Professional Engineers Ontario

Volunteer Service RECOGNITION 

AN ENGINEER'S OBLIGATIONS WHEN PERFORMING ENGINEERING WORK OUTSIDE REGULAR EMPLOYMENT

By José Vera, P.Eng., MEPP

Performing engineering services outside of regular employment is a complicated issue for employee-engineers. There are a number of possible issues that could impact the professional obligations of employee-engineers if they were to perform engineering work outside of regular employment.

Consider this example: Andrew, an engineer, has worked his entire professional career for the biomedical engineering department of a well-known hospital in Ottawa, Ontario. As a side interest, he owns a commercial building in nearby Kanata. For some time now, Andrew has been considering selling the building to fund his early retirement plans. Andrew's realtor believes this is a good time to sell but recommends investing in renewable energy to cut the building's energy costs, thereby making the building more appealing to buyers. With this goal in mind, Andrew hires Contractor ABC to install a solar collector array on the roof of his commercial building. Contractor ABC then engages Structural Engineering Firm XYZ to perform the structural design of the installation. Contractor ABC obtains a building permit for this solar collector project.

Once the installation is completed, Andrew offers to sell the building to Jane, whose software company is a long-time tenant in the building. Jane is interested in buying the building. However, Andrew's realtor informs him that the building permit remains outstanding and this issue needs to be addressed before selling. Andrew contacts the municipality for more information and a building inspector advises him that the municipality requires a project completion notice from a professional engineer confirming that general review has been carried out in accordance with the *Professional Engineers Act*.

Andrew contacts Michelle, the owner of Contractor ABC, and asks if Structural Engineering Firm XYZ provided general review of construction services. Michelle explains that Structural Engineering Firm XYZ was only engaged to do design and that no one performed a general review. She says: "Andrew, aren't you an engineer? Why don't you prepare the project completion notice? After all, it will be cheaper for all of us." What should Andrew's answer to Michelle be?

COMPETING INTERESTS AND INDEPENDENT REVIEW

Engineers have an obligation to provide independent opinions and to disclose or avoid conflicts of interest. This obligation is spelled out in Regulation 941, specifically section 77 which states:

3. A practitioner shall act in professional engineering matters for the practitioner's employer as a faithful agent or trustee and shall regard as confidential information obtained by the practitioner as to the business affairs, technical methods or processes of an employer and avoid or disclose a conflict of interest that might influence the practitioner's actions or judgment.

Engineers shall avoid or disclose a conflict of interest that might influence their actions or judgment. Andrew, as the owner of a building, has an interest in the outcome of a general review. Furthermore, the building inspector may raise doubt that Andrew can perform a reasonably independent review. Consequently, Andrew may choose to avoid the situation altogether by recommending another engineer perform the general review, or he may decide to disclose his interest as owner of the building to the appropriate parties, such as the contractor, the municipality and prospective buyers.

Engineers also have an obligation to only undertake work they are competent to perform. This obligation is spelled out in Regulation 941, specifically section 72 which states:

- (2) For the purposes of the act and this regulation, "professional misconduct" means, ...
 - (h) undertaking work the practitioner is not competent to perform by virtue of the practitioner's training and experience...

Based on the above, Andrew, as an engineer who has worked in biomedical engineering projects his entire career and has never worked on structural engineering projects in buildings, could be reasonably perceived as being unable to undertake projects for general review of construction. Consequently, Andrew may have a duty to inform Michelle how he obtained the competency required to undertake this work or decline altogether.

CONSIDERING COMPETENCY

For the sake of argument, what if Andrew had worked for a structural engineering department of a public housing agency and had performed general review of construction for similar buildings in the past? What should Andrew's answer to Michelle be then? In other words, if Andrew was competent to undertake general review, could he simply say yes? Or does Andrew need to obtain a certificate of authorization (C of A) from PEO to do this work?

A C of A is required to offer professional engineering services to the public. The public is anyone other than the practitioner or the practitioner's employer. In the above example, Andrew, as the owner of the building, would be providing professional engineering services to himself not to the public. Therefore, Andrew would not require a C of A for this project. In contrast, Structural Engineering Firm XYZ, by providing structural engineering design services to Contractor ABC, is providing services to the public and therefore does require a C of A. However, is the fact

that Andrew does not require a C of A a determining factor in his decision to undertake this work or not?

AN ENGINEER'S OBLIGATIONS

Based on the above example, performing engineering services outside of regular employment is a complicated issue for employee-engineers. We've addressed the issue of competing interest and independent review, the issue of competency, and whether a C of A may or may not be required. However, are these the only considerations? When complicated issues arise, it is important that we, as professionals, ask the right questions. Otherwise, we may miss key facts that should have been considered during the decision-making process, and the decision made may be challenged.

One important question to ask is: What are Andrew's obligations to his engineering employer, if he is considering practising engineering outside of regular employment?

PEO's Code of Ethics contains requirements for employee-engineers considering performing professional engineering work outside of regular employment:

77(5) A practitioner who is an employee-engineer and is contracting in the practitioner's own name to perform professional engineering work for other than the practitioner's employer, must provide the practitioner's client with a written statement of the nature of the practitioner's status as an employee and the attendant limitations on the practitioner's services to the client, must satisfy the practitioner that the work will not conflict with the practitioner's duty to the practitioner's employer, and must inform the practitioner's employer of the work.

From the above, it follows that Andrew needs to inform his employer of the work he intends to perform, even if the work is for his own building, since it is "professional engineering work for other than the practitioner's employer." Furthermore, Andrew must ensure the work will not conflict with his duty to his employer. Finally, while contractual disputes are outside of the *Professional Engineers Act*, it is worth noting as an employee Andrew should familiarize himself with his employer's policies or contractual restrictions regarding working outside of regular employment, which may have an impact on their contract. The purpose is to manage conflicts if these arise by using disclosure.

Another issue to consider is if an engineer does not require a C of A, is there no requirement for professional liability insurance either? C of A holders are required to carry professional liability insurance as laid out in the regulations under the *Professional Engineers Act*. However, as previously noted, Andrew does not require a C of A for performing engineering work in his own building; therefore, it follows that Andrew is not required to carry professional liability insurance either. Yet again, are we asking ourselves the right questions? Rather than asking if carrying professional liability insurance is a requirement, Andrew should be asking himself: Is carrying professional liability insurance a good idea in this case?

AVOIDING POTENTIAL RISKS

A key fact is that Andrew wants to sell his building to Jane and use the profits for early retirement. By performing general review of construction in his own building, Andrew assumes both professional responsibility and liability for his work. If something were to go wrong with his work, like all engineers, Andrew, being accountable for his work, could face a complaint or civil liability. However, unlike engineers working for their employer, Andrew could also face a personal lawsuit, since he is not doing work under a corporation, which could protect him from personal liability. By contrast, if Contractor ABC engaged Structural Engineering Firm XYZ to perform general review of construction, it would be Structural Engineering Firm XYZ who assumes professional responsibility and liability. Engaging Structural Engineering Firm XYZ might be a costlier solution initially, but it might be a less risky one in the end.

Due to these potential risks, if Andrew decides to undertake the work he may consider obtaining professional liability insurance for this project as well as legal advice to minimize these risks. What if no insurance company is willing to provide professional liability coverage to Andrew for this project? Yet again, are we asking the right questions? As someone who is considering early retirement, should Andrew be considering assuming these potential risks at this point in his career? Or is it simply better to engage Structural Engineering Firm XYZ and accept that the costlier option might be the less risky one in this case?

Employee-engineers need to understand their professional obligations if they choose to perform engineering work outside of their regular engineering employment. In this article, we covered requirements involving independence, disclosure, competency, as well as C of A requirements, and requirements to inform the employer. However, a potentially overriding factor to consider is legal risks and civil liability employee-engineers may assume when working outside of regular employment.

PEO's practice advisory team is available by email at practice-standards@peo.on.ca and is happy to assist employee-engineers looking for more information on their duties when working outside regular employment. However, engineers looking for assistance on resolving legal problems occurring in specific, concrete situations should always contact their lawyer. **e**

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

SUMMARY OF 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 ALEXANDER COLAS, P.ENG., a member of the Association of Professional Engineers of Ontario.

The panel of the Discipline Committee met to hear this matter on November 5, 2018, at the Association of Professional Engineers of Ontario at Toronto.

THE ALLEGATIONS

The Statement of Allegations against Alexander Colas (Colas), as stated in the Statement of Allegations referred by the Complaints Committee, was dated February 14, 2018.

SUMMARY OF AGREED STATEMENT OF FACTS

1. Alexander Colas is a professional engineer licensed pursuant to the *Professional Engineers Act* since 2002. Colas graduated from the University of Toronto in 1995 with a Bachelor of Applied Science in Mechanical Engineering.
2. Colas' training in structural engineering is limited to some undergraduate courses and examinations for a Building Inspector licence. Colas does not have sufficient training or experience to practise in the area of structural engineering.
3. Colas was the owner and operator of Pure Logic Homes Inc. (Pure Logic) from 2007 until at least October 2014. Pure Logic is described on its website as a private corporation providing home renovation solutions to a variety of residential clients throughout the Greater Toronto Area. Pure Logic Renovations was a division of Pure Logic and was "a full-service design and construction company" that included structural assessment and planning among its offered services. At all material times, neither Colas nor Pure Logic held a certificate of authorization.
4. In or about July 2014, the complainant, Susan Qing Tan (Tan), retained Colas to provide structural engineering services in relation to a renovation at 510 Ontario Street in Toronto. The renovation involved adding four new dwelling units, balconies and a detached parking garage to an existing 12-unit apartment. Tan had found Pure Logic and Colas on kijiji.ca.
5. Colas and Tan exchanged various sets of drawings, including structural drawings, during July 2014. Tan paid Colas \$1,271.25 on August 2, 2014. Colas signed and sealed final drawings, including structural drawings for the project (the Drawings), on August 3, 2014. The Drawings were marked with the notation: "Release for Permit."
6. The Drawings were deficient for several reasons, including (but not limited to):
 - a. Inaccurately indicating two floors, whereas the building plans indicated three;
 - b. Indicating structural features that did not comply with the Ontario Building Code, including inadequacies in the footings, floor slabs, foundation wall, floor joists, built up lintel and plywood sheathing; and
 - c. Omitting connection details, guard details, framing elements and design loads.
7. Colas and Tan met with Richard Chiu, a plan examiner at the City of Toronto, on August 15, 2014, to discuss the Drawings and to determine what was required in order to allow the issuance of a building permit for the project. By email dated August 15, 2014, Colas summarized the city's concerns. He subsequently promised to follow up and to provide the required updated drawings. Tan made extensive efforts thereafter to contact Colas to resolve the deficiencies in the Drawings. By early September 2014, Colas stopped communicating with Tan. Colas never took any steps to resolve the deficiencies in the Drawings.

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.

8. Tan made her complaint to PEO on October 27, 2014. The chronology attached to the complaint sets out Tan's many attempts to contact Colas. The complaint was sent by PEO to Colas. On November 11, 2014, the same day he advised PEO that he had received the complaint, Colas emailed Tan to advise her that he had not responded to her because he had commenced work at the City of Toronto as a building inspector on September 15, 2014.
9. PEO retained Steven Adema, P.Eng., as an independent expert to review the work done by Colas. His report concluded as follows: "After reviewing the drawings, we have the following conclusions:
- 1) The drawings as submitted contain serious structural flaws.
 - 2) These flaws, if constructed as indicated, would pose grave risk to the safety of the occupants.
 - 3) The risks are, but not limited to:
 - a. Complete collapse of the garage structure roof framing under occupancy loads.
 - b. Collapse of the foundation wall under lateral soil pressure (likely during backfilling operations).
 - c. Collapse or excessive deflections of the existing framing under the new third floor/roof enclosure.
 - d. Failure of the exterior stair framing under occupant loading.
 - e. Failure of the upper level exterior guards under occupant loading.

This leads us to state the following:

- 1) Colas failed to be aware of, consider or comply with standards and codes as outlined in the report above.
 - 2) Colas' work included errors, omissions and deficiencies that a reasonable and prudent practitioner should have identified in the circumstances.
 - 3) As such, Colas failed to meet the standard of a reasonable and prudent practitioner."
10. For the purposes of this proceeding, the respondent accepts as correct the findings, opinions and conclusions contained in the expert report

referred to above. The respondent admits that he failed to meet the minimum acceptable standard for engineering work of this type, and that he failed to maintain the standards that a reasonable and prudent practitioner would maintain in the circumstances. The respondent further admits that he is not competent, by virtue of his training and experience, to practise structural engineering.

11. By reason of the aforesaid, the parties agree that the respondent, Alexander Colas, P.Eng., is guilty of professional misconduct, as follows:
- a. Signing and sealing structural drawings that failed to meet the standard of a reasonable and prudent practitioner, amounting to professional misconduct as defined by section 72(2)(a) of Regulation 941;
 - b. Signing and sealing structural drawings that failed to make reasonable provision for the safeguarding of life, health or property of a person who may be affected by the work, amounting to professional misconduct as defined by section 72(2)(b) of Regulation 941;
 - c. Signing and sealing structural drawings that failed to make responsible provision for complying with applicable statutes, regulations, standards, codes, bylaws, amounting to professional misconduct as defined by section 72(2)(d) of Regulation 941;
 - d. Offering and providing professional engineering services without a certificate of authorization, amounting to professional misconduct as defined by section 72(2)(g) of Regulation 941;
 - e. Undertaking work he was not competent to perform by virtue of his training and experience, amounting to professional misconduct as defined by section 72(2)(h) of Regulation 941; and
 - f. Providing engineering services in an unprofessional manner, amounting to professional misconduct as defined by section 72(2)(j) of Regulation 941.

The respondent had independent legal advice with respect to his agreement as to the facts, as set out above.

PENALTY

The parties submitted a written Joint Submission as to Penalty and association counsel provided oral submissions as to the appropriateness of the Joint Submission as to Penalty. In support of the penalty agreement, counsel for the association referred to two previous decisions: *Association of Professional Engineers of Ontario v. Bruce D. Crozier, P.Eng.*, and *Association of Professional Engineers of Ontario v. Michael A. Schor, P.Eng.*

In the Crozier case, the engineer had submitted a letter to a building official discussing construction work in progress without reviewing the work on site and had later submitted a deficient sketch to the same

official while using his stamp improperly. In the Schor case, the member had provided inadequate designs for a lifting device that later was found by his client to be deficient.

In both cases, the penalties were similar to the penalty agreement before this panel, except the previous penalties had invoked, respectively, a two-month and six-week suspension of licence, rather than the one month proposed here. However, in the Crozier case, the member had denied guilt and hearings took place. In the present case, the member has admitted guilt, avoiding the cost of a full hearing. In the Schor case, the member also took responsibility for his actions and pleaded guilty, and his suspension was accordingly reduced. Schor also received a permanent prohibition on the practice of structural engineering, except under the direct supervision of another professional engineer, which is essentially the same as the penalty in the current matter.

Counsel for the association advised that the agreed plea satisfies the four purposes of penalty as follows:

- a. The permanent prohibition on Colas practising structural engineering ensures protection of the public;
- b. Suspension of the member's licence to practise in concert with publication of the results of the hearing indicates that the reputation of the profession is taken seriously;
- c. Suspension of the member's licence to practise is a serious penalty that provides specific deterrence to the member and general deterrence to other members of the association and the public;
- d. Reprimanding of the member and recording the reprimand on the register for two years will enhance the rehabilitation of the member.

The panel accepted the Joint Submission as to Penalty and accordingly, ordered:

- a. Pursuant to section 28(4)(f) of the act, Colas shall be reprimanded, and the fact of the reprimand shall be recorded on the register for a period of two (2) years;
- b. Pursuant to section 28(4)(b) of the act, Colas' licence shall be suspended for a period of one month, commencing on November 5, 2018;
- c. Pursuant to section 28(4)(i) and section 28(5) of the act, the finding and order of the Discipline Committee shall be published in summary

form in PEO's official publication, with reference to names;

- d. Pursuant to section 28(4)(d) and section 28(4)(e) of the act, there shall be a permanent term, condition limitation and restriction placed on Colas' licence, prohibiting him from engaging in the practice of structural engineering; and
- e. There shall be no order as to costs.

The panel concluded that the proposed penalty was reasonable and in the public interest. Colas has co-operated with the association and, by agreeing to the facts and proposed penalty, has accepted responsibility for his actions and has avoided unnecessary expense to the association. To ensure that Colas does not practice structural engineering in the future, there will be a permanent limitation on his professional licence in this regard. The panel considered that the two previous Discipline Committee decisions referred to by counsel for the association were similar to the current matter and provide reasonable guidance with respect to penalty. In the present case, a suspension of one month, rather than two, is reasonable given the co-operation given by the member.

The panel was concerned about the potential that the member might have previously practised structural engineering in other projects, given that his company had been in business for a number of years. The member, thereby, testified that he had used section 9 of the Ontario Building Code, which does not require structural engineering, to determine structural aspects for almost all his projects. However, he did practice structural engineering for one project when he made calculations regarding the structural integrity of a steel beam. He offered to provide PEO with a copy of these for its review. Counsel for the association advised that it will follow up on this, confirm that this work was done correctly, and ensure that public safety was not compromised. The results of this review will not affect the current matter.

The Decision and Reasons was signed on December 10, 2018, by the panel chair, Albert Sweetnam, P.Eng., on behalf of the panel, which included Paul Ballantyne, P.Eng., Michael Wesa, P.Eng., Nadine Rush, C.E.T., and Robert Willson, P.Eng.

AMR ROBAH AND REVIVAL DESIGN AND MANAGEMENT GROUP INC. FINED \$27,500 FOR UNAUTHORIZED USE OF PROFESSIONAL ENGINEERS' SEALS

On December 6, 2018, and January 2, 2019, Amr Adel Moustafa Robah and Revival Design and Management Group Inc., were convicted of breaching the *Professional Engineers Act* by the Ontario Court of Justice at Toronto and Whitby, respectively, and fined a total of \$27,500.

In or about 2016, Revival was retained to provide design services for second-storey additions for two residential properties in the City of Oshawa. In or about 2018, Revival was retained to provide design and construction services for interior alterations and basement finishing for a residential

property in Pickering. For each of the projects, Robah submitted documents to the respective city's building department containing a professional engineer's seal without the engineers' knowledge or consent.

Robah and Revival were each convicted of three offences relating to use of the seals, with Robah fined a total of \$7,500 and Revival fined a total of \$20,000.

Nick Hambleton, associate counsel, regulatory compliance, represented PEO in these matters.

MOHAMMED ABUZOUR AND GEOTECH ENGINEERING CORPORATION FINED \$18,500 FOR MULTIPLE BREACHES OF THE PROFESSIONAL ENGINEERS ACT

On January 12, 2019, Mohammed Hasan Abuzour and Geotech Engineering Corporation were convicted of breaching the *Professional Engineers Act* by the Ontario Court of Justice at Toronto and fined a total of \$18,500.

In May 2017, Geotech Engineering Corporation was incorporated in Ontario without the consent of Professional Engineers Ontario (PEO) to use "engineering" in their corporate name. Between June 2017 and September 2017, PEO advised Geotech and Abuzour in writing of its objection to the use of "engineering" in their corporate name without the required consent.

In February 2018, Abuzour submitted project proposals on behalf of Geotech that offered to complete geotechnical engineering investigations. These services required the application of engineering principles to evaluate, advise and report on the properties and behaviour of earth materials. Further, the proposals concerned the installation, reconstruction and rehabilitation of public works that related to the safeguarding of life, health, property and the public welfare.

The proposals also used terms, titles and descriptions that would lead to the belief that Geotech and Abuzour are authorized to provide professional engineering services to the public, including use of the corporate name "GeoTech Engineering Inc." and its statement that it was a "full-service engineering consulting firm."

His Worship Justice of the Peace Rizwan Khan convicted Abuzour and Geotech of three offences each, with Abuzour fined a total of \$3,500 and Geotech fined a total of \$15,000.

Nick Hambleton, associate counsel, regulatory compliance, represented PEO in this matter.

30 BY 30 TASK FORCE WORKS TOWARD GENDER PARITY IN ENGINEERING

PEO is moving forward on its commitment to implement the Engineers Canada–led initiative to encourage more women to seek their engineering licences. Less than one-sixth of Ontario’s licensed engineers are women, even though they make up more than half the population. *Engineering Dimensions* spoke with PEO’s 30 by 30 Task Force members to learn what they’ll be doing to meet PEO’s goal of having women represent 30 per cent of newly licensed engineers by 2030.

By Adam Sidsworth

PEO’s 30 by 30 Task Force, which had its action and work plans approved by Council in September and November 2018, is continuing in the first of its two-year mission to increase the number of newly licensed women engineers in Ontario.

Engineers Canada launched the 30 by 30 initiative in 2011 to raise the percentage of newly licensed women engineers to 30 per cent by 2030. A “newly licensed” engineer is an engineer who obtained her engineering licence the previous calendar year. In Engineers Canada’s own words, “the 30 per cent figure is widely accepted as the threshold for self-sustaining change.” Thirty per cent may seem small, but consider that at the end of 2017:

- Only 13 per cent of the almost 296,000 licensed engineers across Canada were women;
- A scant 17 per cent of newly licensed engineers across Canada and 19 per cent in Ontario were women;
- Only 48 per cent of Ontario’s 2013 engineering-program graduates had obtained their engineering licences by 2017, an unfortunate number, given the increasing number of women studying engineering; and
- Other licensed professions, notably medicine and law, have already achieved parity (see “International Women in Engineering Day reminds us of work still ahead,” *Engineering Dimensions*, September/October 2018, p. 16).

All 12 provincial and territorial regulators across Canada have adopted the initiative, and although the Ontario Society of Professional Engineers initially championed the initiative in its role as Ontario’s engineering advocate, it became apparent that PEO, in its licence-issuing role, also needs to participate. So, in September 2017, Council approved the formation of a task force to develop an action plan. Helen Wojcinski, P.Eng., FEC, task force chair and PEO’s 30 by 30 champion for Engineers Canada, is thankful to PEO Past President Bob Dony, PhD, P.Eng., FEC, one of the task force’s four members, who, in his then role of president, was instrumental in bringing the 30 by 30 mandate to Council’s attention. “He’s a strong advocate and brought this issue forward by providing me with the podium to speak to Council about the 30 by 30 initiative and then further made the case to Council over the course of his presidency,” Wojcinski notes.

The task force’s other two members are Christian Bellini, P.Eng., FEC, an Engineers Canada director on PEO Council; and Lola Mireya Hidalgo, P.Eng., a PEO Western Region councillor. The task force is now developing a communication and engagement strategy to identify stakeholder groups with whom it can work to meet the initiative. “We’re a time-limited task force, and we’re a small task force,” Bellini notes. “It’s the role of the task force to engage the champions who will carry the 30 by 30 forward... We’ve already identified groups of stakeholders—institutions, regulators, and private and public businesses—and each of these require a different approach.”

Past President Dony adds: “Christian [Bellini] has an Engineers Canada perspective, Lola [Mireya Hidalgo] has that connection with Council and Helen is so committed. This is fundamentally important to PEO. We need

movement to get rid of the gender gap and [get to that] critical mass to be reflective of society and people. It’s an ambitious plan to get this as part of PEO’s and Ontario’s engineering culture.”

TAKING ACTION

PEO’s 30 by 30 action plan aims to help women engineers enter leadership positions on Council, task forces, committees and chapters. “Over the years I’ve met incredibly talented and hard-working female engineering students and recent graduates who not only excel in their academics but also flourish when taking on additional workloads and volunteer leadership opportunities,” Mireya Hidalgo says. “[Hopefully] these women will become licensed and stay in the engineering profession.”

But Wojcinski adamantly asserts: “Women are not a diversity group; rather, we make up half the population. Within half the population you have diversity. It’s not only the right thing to do but is also smart business. It’s about changing attitudes.”

Wojcinski and Bellini state that the task force is still in the process of defining its metrics so the success of the program can be tracked. “The 30 by 30 can’t simply be a slogan but an actual goal that we measure annually to evaluate the progress we’re making and the efficacy of our efforts,” Wojcinski adds. A key component of the strategy is to transfer the responsibility for implementing the plan to the appropriate stakeholders along the pathway to licensure.”

Wojcinski is proud that the 30 by 30 Task Force has members in positions of decision-making, given the enormous stride for gender equality in engineering. Both Dony and Wojcinski reiterate the unconscious bias against women in engineering, and there is more work to be done to address this underlying issue.

The task force is scheduled to complete its mandate by June 2020 but will provide an update to Council this fall. [e](#)



THE PROBLEM WITH PLASTICS

Plastics are a challenging and problematic part of Ontario municipalities' waste management programs. *Engineering Dimensions* spoke with engineering and waste management experts to explore the havoc plastics play on our planet.

By [Adam Sidsworth](#)



Picture this: In November 2018, a rotting 9.5-metre-long sperm whale carcass was found beached in Wakatobi National Park in Southeast Sulawesi, Indonesia. Employees of the park's conservation authority identified roughly 5.9 kilograms of plastic in the animal's stomach, including 115 plastic bottles, 25 plastic bags, two flip-flops, a nylon sack and over 1000 other pieces of plastic. World Wildlife Federation Indonesia stated that the whale's cause of death was undetermined, although one representative described the scene as "truly awful."

Think about this: A 2015 study published in the *Proceedings of the National Academy of Sciences* journal reported that nine out of 10 seabirds most likely have pieces of plastic in their guts, with albatrosses and shearwaters seemingly most prone to eating plastic pieces. Once ingested, the plastic is lodged in birds' digestive tracts, interfering with their ability to eat. And if they regurgitate to their young, they too face the same fate. The study's author, Denise Hardesty, PhD, of Commonwealth Scientific and Industrial Research Organization's Ocean and Atmosphere, used computer forecasting to predict that 99 per cent of seabirds will have plastic in them by 2050. The areas of greatest concern are in the southern hemisphere, particularly Australia and New Zealand, which have the greatest number of bird species.

The location may seem surprising, given that EcoWatch reported that 60 per cent of marine plastic comes from just five countries, all in east and southeast Asia: China, the largest producer; the Philippines; Thailand; Vietnam; and Indonesia. Roughly 8 million metric tonnes of plastic end up in the ocean every year, of which 236,000 metric tonnes are microplastics, tiny pieces of plastic smaller than a human fingernail. Synthetic fibres have been found as deep as 11 kilometres below the ocean's surface—70 per cent of ocean plastics are at the bottom of the ocean—and by 2050, there will be more plastic than fish by weight in the oceans. And there are the five known gyres of plastic, large islands of plastic swarming around the oceans. The Great Pacific Garbage Patch, perhaps

the most famous, exists at the meeting of circular ocean currents formed by the planet's wind currents, which move in a clockwise direction over a 20-million-square-kilometre area. The 80,000-metric-tonne gyre, three times the size of France, contains 1.8 trillion pieces of plastic, most microplastic sized (less than five millimetres long) and is 80 per cent derived from land activity in Asia and North America.

As one study noted, it means that most of the ocean's plastic "is not abandoned fishing gear but plastic bags, milk and water bottles and consumer goods like flip-flops dumped into waterways and washed out to sea." It's problematic on multiple levels: The plastics leach out and absorb pollutants; they block sunlight from reaching plankton and algae, which are at the bottom of many food chains; and, of course, many marine animals apart from birds—think turtles and seals—eat them, mistaking brightly coloured plastic pieces for zooplankton. The problem isn't limited to just animals: A study presented at the 26th United European Gastroenterology Week in Austria in October 2018 reported that people have microplastic in their defecation.

CANADA HAS ITS PLASTIC CONCERNS, TOO

The developed world—Canada included—may have more stringent and enforced environmental protection and waste management policies, yet Canada isn't immune to the plight of plastic. Take this into consideration:

- The Canadian Council of Ministers of the Environment (CCME) notes that only 11 per cent of plastics in Canada is recycled;
- A study led by Peter Ross, PhD, head of the Ocean Pollution Research Program at Vancouver Aquarium Marine Science Centre, discovered plastic in one out of every 34 copepods (small crustaceans) and one in every 17 euphausiids (krill) on Canada's Pacific coast, meaning that juvenile salmon in the Strait of Georgia may be ingesting up to 91 particles of microplastic per day and a humpback whale 300,000 particles;
- Ocean Wise gathered water samples from the waters outside Vancouver's Canada Place and discovered 1258 particles of plastic in one cubic metre of saltwater, 95 per cent of which were fibres, notably polyester, rayon and modified cellulose, which are ingredients in textiles, clothing, curtains and carpets; and
- In Ontario, a University of Toronto research group led by ecologist Chelsea Rochman, PhD, audited the outflow of Toronto's Don River in the summer of 2018 to catalogue the more than 650 kilograms of plastic that annually enters Lake Ontario, counting 21,000 pieces of Styrofoam, 12,500 large plastic fragments, 4000 water bottles, 2700 bottle caps, 1300 food wrappers, 1100 balls and over 900 straws. Rochman noted that with numerous rivers feeding into Lake Ontario, it's important to stop these plastics upstream and prevent them from breaking down into smaller pieces before they enter the Great Lakes and St. Lawrence Seaway.

Although plastic was initially developed at the beginning of the 20th century, it wasn't until after the Second World War that it was mass produced and widely marketed. Since then, the production of plastic has increased exponentially, from roughly 1.5 million metric tonnes globally in 1950 to roughly 335 million metric tonnes globally in 2016. The Canadian Plastics Industry Association (CPIA), an industry advocacy organization, reports that plastics is a \$24.3 billion industry employing 82,000 people across the country.

Most plastics produced today are fossil fuel-derived polymers, usually carbon combined with oxygen. The problem is it doesn't biodegrade; instead, it breaks down into smaller and smaller pieces, becoming microplastics. But plastics pose challenges unlike other waste material not only because it doesn't biodegrade but also because there isn't one single kind of plastic. Polyethylene terephthalate (PET) and (HDPE) are typically recycled by most municipal recycling programs, yet polyvinyl chloride (PVC) and low-density polyethylene (LDPE)—think of your standard plastic shopping bag—can be recycled but typically aren't for a variety of reasons, including market demand and municipal sorting technology.

"Rigid plastics like PET and HDPE, used for laundry detergent or beverage containers, are valued, as they have more applications for recyclers," says Jo-Anne St. Godard, executive director of Recycling Council of Ontario (RCO), a 40-year-old non-profit organization whose members represent the "entire value chain of production, manufacturing, retailing, distribution and consumers." RCO specializes in policy development, research and programs that bring awareness to waste issues and works with private and public organizations to create solutions. RCO began with a focus on recycling operations in the 1980s and expanded its mandate to "support governments [in developing] more effective policies that focus equally on reduction as they do with recycling."

St. Godard speaks further of the difficulty dealing with plastic: "Most of the plastic on the market today is derived from fossil fuels, which is a non-renewable resource." She recognizes the diversity of plastic material in so many everyday items and points out that the lack of recycling options for some plastic types has made them prevalent in landfill and as litter in waterways. Although CPIA says that the light weight of plastic makes it more fuel friendly to ship than other products, St. Godard notes the energy- and resource-intensive nature of plastic production and observes that the solutions to plastic waste should include reduced consumption, as well as designing products and packaging with material that can be successfully collected and recycled. In other words, reduce, reuse, recycle, in that order of preference.

MUNICIPAL WASTE MANAGEMENT IN ONTARIO

The same versatility in plastic observed by St. Godard has also been observed by Jon Arsenault, P.Eng., director, waste management services for the Region of Waterloo. "Glass, metal and aluminum can be challenging, but they're very [broadly speaking] similar to collect and recycle," he says.



Plastics break down into smaller pieces—microplastics—which are eaten by animals and, if amassed in the ocean, block sunlight from reaching algae and plankton.

Arsenault notes that plastics are far more complex and can be put into seven broad categories. “Anything derived from ethanol tends to repolymerize and is more easily recyclable, but there are others that are much more difficult,” he explains. “The challenge for us is that although we promote the collection of certain types of plastic, we receive many more kinds of materials because the consumer sees the mobius loop on the plastic packaging and assumes it’s readily recyclable, so we do our best to separate by hand or machine. Within the different types, such as PET, there are different colours, like black, making it more difficult to market, or reducing the demand for the material. Or it reduces the price because some of these types of plastic are considered contamination by some processors. It’s a real challenge.”

Because he’s using words like “price” and “demand,” Arsenault may sound like he’s running a business more than a municipal waste management service for a medium-sized Ontario municipality. That’s because municipal recycling and businesses have a symbiotic recycling relationship, with municipalities collecting recyclable materials from residences and contractors bidding to buy them as a source of product material. “Because we market our own materials, anything we tell our residents can be recycled we make sure we have a market for the material, even if it’s a negative market, meaning in some cases we pay processors to recycle it properly,” Arsenault says. “But it’s better than ending up in the landfill.”

Nadine Kerr, P.Eng., manager, processing operations, for the City of Toronto, concurs. Kerr notes that Toronto “accepts all non-black plastic containers, bottles, jugs, films and expanded polystyrene in the recycling program,” including plastic tubs, and lids, food containers, bottles and jugs, foam expanded polystyrene and film plastic. Kerr adds that Toronto sends its recyclables to a private contractor, which sorts and bales the plastics into the following commodities:

- #1 PET (e.g. rigid drink bottles, food jars, clamshells);
- #2 HDPE (e.g. rigid milk and juice containers, shampoo bottles, laundry detergent bottles);
- #4 LDPE (e.g. plastic bags, overwrap);
- #5–7 MRP, or mixed rigid plastics (e.g. all remaining rigid plastics, such as yogurt and margarine containers); and
- #6 FEP, or foam expanded polystyrene (e.g. packaging, some food service containers).

The values of PET and HDPE are fairly consistent. However, “the value of rigid plastics will depend on the makeup of the bales,” Kerr says. “Currently there is a higher percentage of polypropylene

in those bales, making that product more sought after by re-processors.”

Kerr says there is no feasible reason why most, if not all, plastics can’t be recycled. However, “before it can be added to the recycling program, there needs to be a market willing to buy it,” she says. “Only then can the question of collection and sorting be visited and the cost analyzed.” The problem is also partially the sorting technology: “Some plastic products are difficult to separate from other recyclables,” she explains. Plastic film—grocery bags—are one. “The city’s program is a single-stream recycling program, so all recyclables go into one bin and are then separated into the various commodities at material recovery facilities that employ both people and technology to sort products,” she says. “A vacuum system is used to sort film plastics. As it runs on a conveyor belt, sorters pick it up and throw it up to the vacuum system; however, there is a lot of film, piece wise, so sorters are not able to capture all the film as it goes by. Film can then end up further down the system and get wrapped around machinery. It’s also flat and light and may flow in with paper product and becomes a contaminant for paper bales.” But there is another reason plastic bags aren’t typically recycled: demand. “Finding markets can be a challenge for some lower-value plastics, such as expanded polystyrene and film,” Kerr says.

A PLASTICS RE-PROCESSOR’S PERSPECTIVE

Eadaoin Quinn is the director of business development at EFS-plastics, a re-processor located in Listowel, Ontario, that specializes in recycling mixed rigid plastics and—notably—plastic film. EFS-plastics buys plastic from municipalities from across North America; once municipalities sort their recycling materials by type into industry-standard bales, EFS-plastics buys them to process into useable plastic goods. EFS-plastics is one of a few post-consumer recyclers capable of accepting plastic film to develop into a recycled consumer product. “We have the physical capacity to recycle

An example of how plastics are placed into bales in preparation for recycling. Re-processors want plastics sorted into seven broad categories of plastic. In Ontario, PET and HDPE are widely recycled, but PVC and LDPE are not.



The mobius loop found on many plastic products, which, according to Jon Arsenault, P.Eng., can mislead consumers as to which plastics are accepted in their municipal recycling program.

more plastic bags, but we just don't have enough demand from film producers to include post-consumer recycled content in their bags," Quinn explains. "If we want to see more plastic bags getting recycled, the demand from bag producers needs to grow."

Quinn notes that EFS-plastics has the flexibility to accept plastic bags and other plastic film because they, unlike many others in their industry, keep almost everything internal: EFS-plastics uses a mostly automated wet wash system that minimizes manual labour and speeds up their recycling process, making EFS-plastics perhaps more efficient than many of its competitors. "We have a team [with an engineering background] here to design and upgrade our equipment (as market demands change)," Quinn explains. "Of course, there are small components that we buy from other places, but our system is unique." In fact, EFS-plastics has two operating lines, one for rigid plastics and one for plastic film. And because EFS-plastics is largely automated, it can produce recycled plastic pellets in a wide colour spectrum, making the plastic they do sell more profitable.

"There are thousands of types of plastic; however, there are the seven broad categories of plastic [used by the plastic packaging industries]," Quinn notes. "Although they do represent some commonly used plastic types, these designations are somewhat arbitrary. It isn't technically harder to recycle one material compared to another; rather, it's market demand. The ability to recycle a particular type of plastic comes down to demand. For example, many manufacturers use recycled PET to make new water bottles, but there are very few using recycled LDPE to make new plastic bags. It's demand that makes water bottles more 'recyclable' than plastic bags."

Quinn thinks the ability to make the plastic industry truly circular may be a shift in attitude. "There's always a way to melt [plastic down] and turn it into a reusable form," Quinn observes. "It's just comes down to who's going to pay for it and who's going to purchase it. We're always trying to get out that message for big companies looking to recycle more to buy more recycled product. If we don't have an end market for what we're making, we can't process it. It's important to think of that full circle."

So long as the circular movement of plastics remains tied to profits, there may not be a 100-per-cent environmentally friendly solution to plastics. Kerr notes that from a municipal waste management perspective, the biggest concern is contamination, but she acknowledges that re-processors (buyers) expect and forgive some contamination. "If the PET container has a lid on it made of HDPE, the PET buyer

may categorize this as a contaminant in the bale," she explains. "Fortunately, PET buyers expect to receive some PET bottles with the HDPE cap on. But what if the producer of the bottle changes the lid to metal? At the re-processor's facility, it could cause problems. Producers are changing packaging at an ever-alarming rate and rarely consult the waste management world to determine if the new packaging can be realistically collected, sorted, re-processed and ultimately recycled."

THE RESPONSIBILITY OF THE PLASTICS PRODUCER

In Ontario, most waste management is conducted at the municipal level, with municipalities collecting waste from residents but typically not from the private sector. And this may limit waste management professionals' influence. "We can't influence to the degree that the province or the federal government can," Arsenault adds. "[We have to] put the onus on the producers to be responsible for designing of the packaging right through to end use, with the expectation that they design for the environment, and for efficiency and for the marketplace. Municipalities are the last line of defence. If they come to us, and we say, 'This isn't recyclable; this is litter,' it's not an easy decision or necessarily a popular one to make. There's this whole thing of greenwashing where a product is introduced, and it has a label on it that says it's recyclable when it's not, or if it is, would cost too much money to recycle."

Arsenault, who sits on the board of directors of the Ontario Waste Management Association, which represents companies and organizations in both the private and public sectors, is also a member of the Regional Public Works Commissioners of Ontario and the Association of Municipalities Ontario. These organizations, Arsenault says, have been advocating that producers should be responsible so that taxpayers aren't left on the hook to deal with the

EFS-plastics produces plastic pellets in a wide variety of colours, as pictured here.



EFS-plastics is in Listowel, Ontario, and recycles post-consumer plastics and re-processes them into pellets for manufacturers. EFS-plastics is capable of recycling plastic film, using its fully automated system.

products, with limited to no ability to control how to deal with them.

At present, the cost to fund recycling is shared 50/50 between municipalities and producers of some items, including plastic packaging. However, both Arsenault and Kerr are encouraged by the success of the province's introduction of the *Waste Free Ontario Act*, which consists of the *Resource Recovery and Circular Economy Act* and *Waste Diversion Transition Act* and encourages Ontario to move towards a circular economy. "The heart of this is having producers be responsible for the end-of-life management of their products and packaging," Kerr says. Arsenault also looks beyond the province, noting that the CCME, the umbrella organization of federal, provincial and territorial ministers of the environment, introduced its Strategy on Zero Plastic Waste in November 2018. The initiative aims to, among other things, influence plastic product design for greater durability and reuse, significantly increase the responsible use of single-use plastics and expand collection systems to keep all plastic products in the economy and out of the environment. Nationally, the federal government seems ready to bring the awareness of plastics to a national platform. In June 2018, Prime Minister Justin Trudeau used his presidency of the G7 to introduce the Ocean Plastics Charter, which aims to work with industry to move towards a completely reusable and recyclable plastic industry by 2030, significantly reduce single-use plastics, increase recycled content in all plastics to at least 50 per cent by 2030 and reduce the leakage of plastics into the environment. Unfortunately, it's non-binding and wasn't endorsed by the United States and Japan.

THE RESPONSIBILITY OF ONTARIO'S ENGINEERS

PEO recently updated its *Solid Waste Management Guideline* for professional engineers who are involved in solid waste management projects and/or



those retaining engineering services in solid waste management, principally the planning, design, construction, commissioning, operation, monitoring and/or closure of non-hazardous waste. It is a thorough document that helps engineers navigate Ontario's environmental laws, notably the *Environmental Protection Act* and *Environmental Assessment Act*, but, importantly, aside from providing engineers with sage advice, it also reminds them of their obligations: "The duty to report is an essential component of an engineer's commitment to professionalism. In fact, most engineers are fulfilling this duty daily when they identify designs, processes and procedures that are unsafe, unhealthy or uneconomical (which is detrimental to the public welfare), and then act to correct these problems."

Plastic doesn't have an easy solution, and given its prevalence, it's unlikely to disappear anytime soon, so innovation may lie in maintaining a circular life for plastic while making sure it doesn't leak into the environment. Arsenault observes the innovative role of engineers: "It goes beyond plastic. It's not just about one type of product. It's about life-cycle analysis studies, and that's something that engineers look at all the time in different areas. At a municipal level, it can be challenging, as we're balancing keeping ratepayers' taxes low while trying to keep up with innovation. It's hard to pinpoint specific innovation, and there are plenty of plastics that are recyclable, but it can come at a huge cost. Being the home of the blue box—it started in Kitchener—we've tried streamlining our sorting plants so we can react to the continuing changes in the marketplace, but this is a significant challenge. However, there's a significant opportunity for technological changes, specifically for the major producers of plastic products." [e](#)



TACKLING THE FOOD WASTE AND LOSS CRISIS

Fifty-eight per cent of food produced in Canada is lost or wasted annually across the food supply chain due to a variety of factors. While all industry stakeholders have a role to play in reducing waste, engineers are key when it comes to providing solutions at every point, from food production through processing, manufacturing and beyond, and putting any inevitable waste to effective use.

—BY MARIKA BIGONGIARI—



Food is vital. It's the common thread that connects us all, and yet, with food loss and waste becoming the growing problem it is, we need to radically change how we think about it. "Canada produces all this amazing food, enough to feed over 50 million people," says Lori Nikkel, CEO, Second Harvest, Canada's largest food rescue organization and an authority in perishable food recovery. "There are 37 million people in the country, and four million of them are food insecure. We waste more food than we consume. We have devalued food entirely."

Food loss is distinguished from food waste by where it occurs in the food supply chain. Food loss is defined as food that is discarded in the early segment of the supply chain, from harvesting through storage, processing and manufacturing, while food waste refers to food that is discarded at the distribution, retail and consumer level. Both refer to food that wasn't used for a variety of different reasons, have social, environmental and economic ramifications and are directly connected to food security.

The world's human population is expected to reach 9.8 billion by 2050, and we won't have the resources we need to feed everyone, according to the United Nations (UN) report *World Population Prospects: The 2017 Revision*. In Canada and much of the developed world, the prevailing thought is that food is plentiful, and that attitude results in food being viewed as expendable, leading to wasted food. Also consider that as food is lost, so are the resources and energy that went into producing it. Food requires land, healthy soil, fertilizer, water, labour and a phenomenal amount of energy and resources before it can get to anyone's plate. As concerns for food security and the environment grows, experts say we can't afford to continue to let food fall through the cracks.

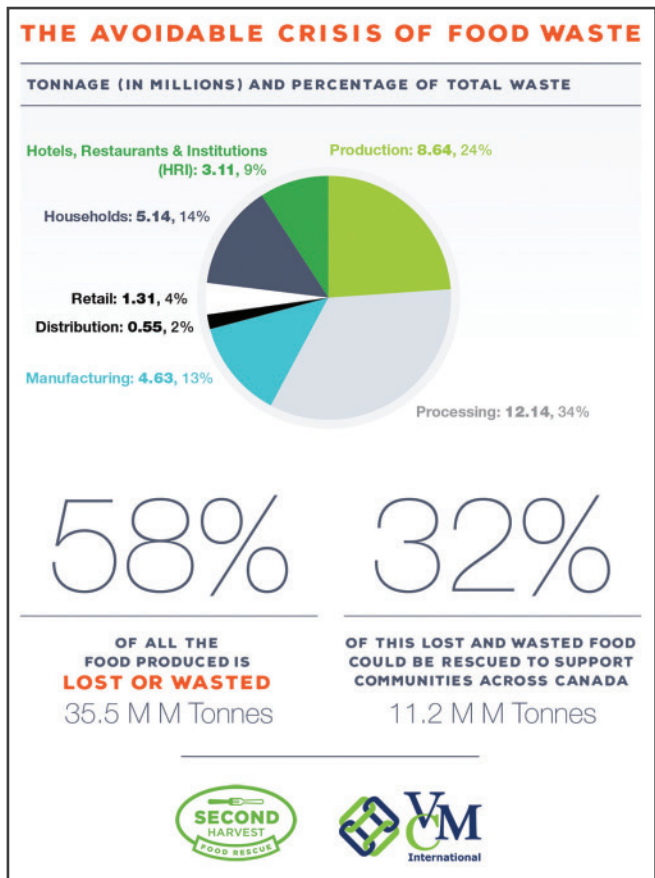
The Avoidable Crisis of Food Waste, a recent report produced in Canada, sheds light on the magnitude of the problem at home and reveals some surprising truths about where most of the waste occurs. The report uses frontline, primary data from the entire food supply chain, including input from 700 food industry leaders, and is the result of a year-long project undertaken by Value Chain Management International (VCMi)—a leading voice on food waste working to raise awareness of the opportunities and solutions surrounding food waste reduction—in partnership with Second Harvest. The report found that a staggering 58 per cent of the food produced in Canada—the equivalent of 35 million tonnes, with a value of nearly \$50 billion—is lost or wasted annually. The report also estimates that 32 per cent (11 million tonnes) of that is avoidable. That's food that could be on the plate of someone who needs it instead of in the garbage.

Although food gets wasted at all points across the supply chain, the report found that most food loss occurs early, during food production and processing, where almost five million tonnes of food is lost annually. Nikkel says they weren't surprised to learn most of the loss occurs further up the food chain than most previously thought: "We implemented Foodrescue.ca, which is an online system that will match a food business with a social service agency, like a meal program, a school or a food bank or somewhere that's supporting people with food relief, and we noticed a lot

of food that was being rescued and distributed to people in need. We noticed a lot of food that was being rescued and distributed to people in need. We noticed a lot of food that was being rescued and distributed to people in need.



Food loss and waste occurs at every point along the food supply chain.



The distribution of food waste and loss by tonnage shows the majority occurs during production, processing and manufacturing.

of the food being rescued is much further up the supply chain—and because nobody had measured it that way before, we had no idea.”

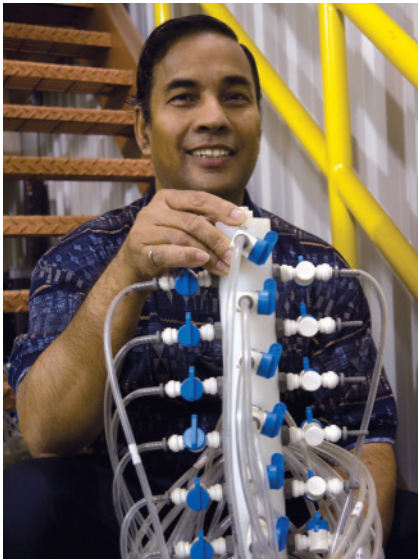
Several factors contribute to food being thrown away. Produce may be blemished by harvesting equipment and discarded due to unrealistic expectations for it to be aesthetically perfect at the retail and consumer level. Grain may be stored improperly and succumb to mould or become infested with vermin. Grocery stores can end up with too many items about to reach their best-before dates, and because of confusion about what best-before actually means, they’re discarded to make room for more products. Best-before refers to optimal freshness and is not an expiry date. “Food doesn’t suddenly go bad at midnight,” Nikkel explains. “We need to figure out the best-before system, because it’s broken, and it’s causing a lot of food to go into landfill—and it’s an unnecessary problem.”

The VCMI report also reveals wasteful practices like apples being left to rot under trees during labour shortages, surplus milk poured down the drain, thousands of acres of produce being plowed under when orders are cancelled and fish that don’t match quota thrown back into the water to die. The report also points the finger at methane created by food in landfill, imparting a significant environmental impact, creating an estimated 56 million tonnes of carbon dioxide-equivalent emissions in Canada annually.

SMART TECHNOLOGY AND OPTIMIZATION

Avoidable food loss and waste can occur at any stage of the food supply chain, from harvesting to sorting and storage to transport, or it can occur at the retail and consumer level. Although all stakeholders along the food supply chain have a part to play in reducing food loss and waste, engineers are playing a key role in minimizing it.

Digvir Jayas, PhD, P.Eng. (Manitoba), FEC, is the interim president, Natural Sciences and Engineering Research Council of Canada; vice president, research and international, and distinguished professor, University of Manitoba; and former Engineers Canada president and was recently named to the Order of Canada for his ground-breaking work on food storage. He explains how waste can occur from the time of harvest up until it reaches the consumer, where it can end up in the bin: “At the harvest, improperly set machinery can cause damage to food,” he says, explaining that further damage can occur during the handling process, and once the product reaches the storage site, it can be spoiled by mould or insects. For fruits and vegetables, inadequate control of humidity and temperature can result in damage. Fresh produce is an extremely perishable product and highly susceptible to spoilage if the right environment is not maintained, and improper storage can leave fruit and vegetables vulnerable to microorganisms. “Engineers play a significant role in designing the proper machinery for harvesting and handling food, as well as the processing of food and the proper storage systems, so spoilage does not occur,” Jayas says.



Digvir Jayas, PhD, P.Eng. (Manitoba), FEC, holds a device that measures static pressure at different points in stored grain to validate an airflow distribution model.

Proper storage is critical to preventing food loss. In the case of grain, if it is dried properly and kept at a low temperature, grain is a stable commodity that can last for a long time. Sometimes a seemingly small shift in thinking can have a big impact. “Traditionally, grain is dried by forcing air through it vertically, and the resistance to air flow is very high,” Jayas explains. “But when you force the air horizontally, the resistance to air flow is cut almost in half. I’ve seen whole bins spoiling because of an improper aeration system or improper monitoring of the grain—and that’s in Canada and the United States—that can happen anywhere. Engineers are always looking at solutions to these problems; for example, we are developing digital sensors for detecting insects in grain. With early detection, you can treat a small quantity of the grain rather than having it infect a larger portion or all the grain in a grain-handling facility.”

Digital sensors and other smart technologies are being harnessed across the food supply chain. Jayas, who co-authored a soon-to-be-published report on how emerging technology is being used in the industry, *Smart Technologies for Agri-Food Industry*, outlines the rise of tech that also includes the use of the Internet of Things, cloud storage and computing, big data analytics, machine learning and artificial intelligence. Smart tools are becoming part

of everyday operations in the precision agriculture and food processing industries and are helping food producers optimize their operations to not only avoid food loss but meet the demands of increased future production. Working collectively in real time, these interoperable tools process and coordinate massive amounts of data to analyze crop and soil health, diagnose plant disease, continuously monitor temperature during transportation and optimize ordering and merchandizing. With data available in seconds rather than days or weeks, critical decisions and interventions can be made sooner, and this can be the difference between saving a batch of food or losing it.

Chi-Guhn Lee, PhD, P.Eng., professor, department of mechanical and industrial engineering, University of Toronto (U of T), specializes in supply chain optimization, machine learning theory and the application of machine learning. He’s working on a food supply chain project funded by U of T’s Centre for Global Engineering as part of their food and nutritional security engineering initiative; its mandate includes reducing food loss and waste. Lee’s project focuses on solving a common supply-chain optimization problem involving a fleet of vehicles delivering perishable food out of a centralized warehouse. Using milk as an example, he explains how he approached the problem of determining the simultaneous optimization of storage conditions at the warehouse and the way milk is distributed among multiple customers—while considering the given demand and quality requirements—using engineering optimization methods. Considering factors such as the cost of power, minimum acceptable food quality and food loss, his team determined, for example, what the storage temperature of the warehouse should be and how food should be delivered to customers.

Preventing milk from degrading below an acceptable threshold during transportation is trickier, but outbound logistics can also be optimized, Lee explains: “The sequence of delivery is important. Every time there are trucks stopped at a customer, that truck must open its storage section, and that will increase the temperature of the product loaded in the truck—so we try to minimize the number of stops as well.” Optimizing the number of trucks also makes an impact. “A larger number of trucks allows you to shorten the transportation route, so it takes much less time to ship to the last customer,” Lee says. “That will increase the quality of the food at the end of the route.”

All logistical factors are expressed as a mathematical system, and optimization techniques are used to find the best combination of the number of trucks, how many customers need to be served, the amount of milk required, etc. “We were able to solve this very complex mathematical optimization problem successfully, so we could reduce the percentage of perishing food,” Lee says. “We are the scientists and engineers of a better practice; we improve performance by optimizing the way things are being done.”

Lee explains how incentive alignment comes into play with food loss and waste: “Some players in the supply chain may find ditching the food to be more economical than transferring it to the next player along the supply chain. Imagine yourself as a truck driver with milk in your truck, and you have to go to the last customer, who is 50 kilometres away, but the milk you’re delivering is a small amount. If you go there, you’re not gaining a lot of additional revenue. If you don’t have a contractual obligation, you might just ditch the food and go home, and in doing so, you can save a lot of transportation cost with very small penalty. This is a simple example, but this can happen at a large-scale distributor and, for some products, rather than moving the food to the next stage in the supply chain, sometimes they find it’s more economical to scrap



Surplus food that would otherwise be wasted arrives at Second Harvest, Toronto, where it will be distributed to those in need. Photo: Ian Gibbons

them. When you understand all these incentives and how they align with each other, you can see where optimization can be applied to change the structure of the supply chain, so we can influence the operating cost of transporting the food item.”

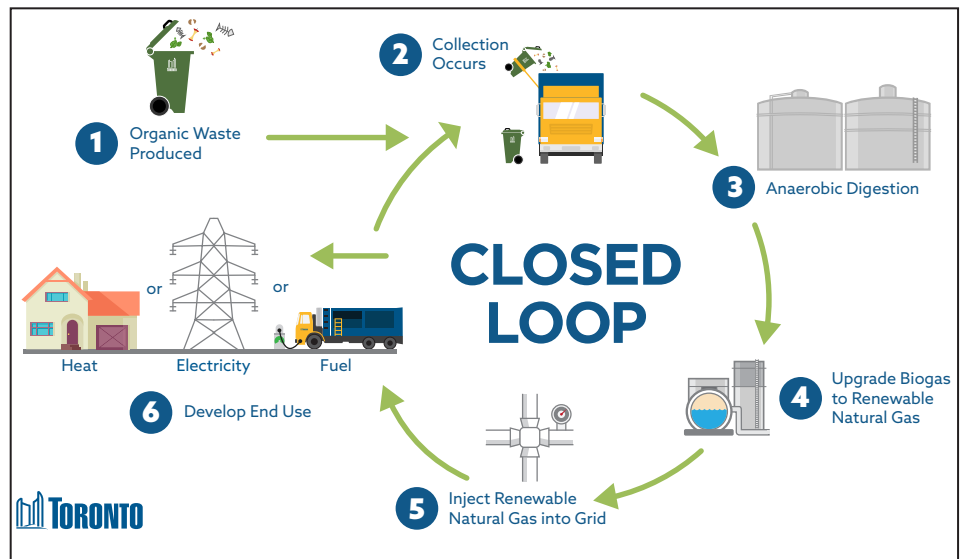
Lee is passionate about using his engineering skills to mitigate food loss: “Food waste is a serious problem around the globe. If you go to a developing country, having food or not is a life-and-death factor. According to a recent UN report, there are 800 million people starving daily, and yet, about one-third of the food produced globally ends up being wasted. That’s shameful. We need solutions—engineering, economic and political solutions—to solve this nonsense situation.”

WASTE MANAGEMENT INITIATIVES

Waste management is a hybrid discipline in which all engineering streams come together under the same roof, explains Neil MacDonald, P.Eng., manager of capital delivery, infrastructure and development services, solid waste management services for the City of Toronto. “Some of the biggest engineering projects going on are related to waste management,” MacDonald says. “There are enormous engineering efforts going into these facilities.”

While the primary goal is preventing food waste from occurring, some is unavoidable. Items like bones, vegetable peelings, seeds and pits, egg shells, tea bags and coffee grounds are not edible. When this type of waste occurs, diverting it from landfill and into a program such as the City of Toronto’s green bin program mitigates significant environmental damage—caused by methane gas, which is created when organic waste breaks down—and it presents opportunities to create value from unavoidable food waste that would otherwise be disposed of with the trash.

Vincent Sferrazza is the director of policy, planning and support for solid waste



The City of Toronto’s closed-loop organic waste collection system, in which its waste collection vehicles are fueled by the very waste they pick up at the curb. Photo: City of Toronto

management services at the City of Toronto. His unit is responsible for developing communication and educational campaigns and tools aimed at helping consumers reduce waste and comply with the green bin program, so organic waste doesn’t end up in landfill. Programs such as the city’s partnership with the National Zero Waste Council to run the Love Food Hate Waste campaign aims to educate and provide tips on how to reduce food waste. The city also implemented the Urban Harvest program, which aims to reduce food waste by collecting locally grown fruits and vegetables from private gardens in the community and redistributing it to local food programs in need. Sferrazza thinks education is key to reducing food waste, and that if people were made aware of how much food waste is generated, it would influence their consumption and improve compliance with the green bin program. “Over one-third of the waste that’s being collected in the residential garbage stream could be defined as organic waste that could have been diverted through the green bin program,” says Sferrazza.

The city’s green bin program consists of the collection and processing of separated organic waste, including food waste, so it’s diverted from landfill and processed into a compost material that can be land-applied. After organic waste is collected, sorted and processed, it is sent to anaerobic digesters, where microorganisms break down the organic material in the absence of oxygen to produce digester solids and biogas. Biogas can be converted into renewable natural gas (RNG). Digester solids are sent to contractors for processing and can be turned into high-quality compost that can be used in parks and gardens.

The City of Toronto also aims to make effective use of organic waste with its closed-loop RNG initiative, partnering with Enbridge Gas Distribution Inc. to develop a system that captures the methane gas that is generated, refines it and converts it into natural gas, which city waste collection vehicles operate on. The city will begin installing new biogas upgrading equipment at its Dufferin solid waste management facility this year; current estimates suggest it will produce approximately 3.2 million cubic metres of RNG per year, enough to power the majority of the city’s solid waste collection fleet. The project supports the city’s long-term waste management strategy to move towards a circular economy by using a closed-loop approach where organics collection trucks are ultimately powered by the waste product they collect—which will allow the city to reduce fuel costs for its fleet of collection trucks and significantly reduce its carbon footprint. “Consider the organic component of waste—that’s all biodegradable, and when it breaks down it produces gas that is nominally 50 to 60 per cent methane,” says MacDonald. “That methane component is energy. The organic waste we collect in the green bin—and that is still present in garbage bags—is an energy resource, and the city is moving to capitalize on that resource and recover that from waste. It’s a fantastic closed-loop system that we’re very excited about. The idea of people putting their green bin waste out to the curb to be collected by a truck that is fueled by that very green bin waste—we think that’s very cool.” [e](#)

Events

April 2019



APRIL 2-3
International SMR & Advanced Reactor Summit, Atlanta, GA
nuclearenergyinsider.com/international-smr-advanced-reactor

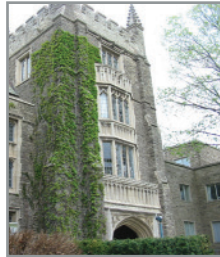
APRIL 3-5

2019 Mach Conference, Annapolis, MD
machconference.org



APRIL 5-7

E-Fest North, East Lansing, MI
efests.asme.org



APRIL 9

ECE Expo, McMaster University, Hamilton, ON
eng.mcmaster.ca/ece/ece-expo#The-Next-Event

APRIL 9-10

Joint Rail Conference, Snowbird, UT
event.asme.org/Joint-Rail-Conference

APRIL 8-11

IEEE International Systems Conference, Orlando, FL
ieeesyscon.org

APRIL 29

8th Annual Smart Water Systems Conference, London, England
smi-online.co.uk/utility/uk/smart-water-systems

APRIL 30-MAY 1

Partners in Prevention Conference & Trade Show, Mississauga, ON
app.wsps.ca/pip/pip_home.php



May 2019

MAY 3

PEO Order of Honour Gala, Toronto, ON
www.peo.on.ca



MAY 5-8

Canadian Conference of Electrical and Computer Engineering, Edmonton, AB
ccece2019.ieee.ca

MAY 26-31

10th Annual Canadian Water Summit, Collingwood, ON
watersummit.ca

Books



Junk Raft: An Ocean Voyage and a Rising Tide of Activism to Fight Plastic Pollution, by Marcus Eriksen, 2017: Eriksen aims to end throwaway culture in this thought-provoking book about the growing problem of plastic pollution in the world's oceans.

Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming, edited by Paul Hawken, 2017: This *New York Times* best seller gathers leading scientists and policy-makers to present the 100 most effective solutions to global warming.

The Death and Life of the Great Lakes, by Dan Egan, 2017: Egan documents the history of the Great Lakes, its canal systems, invasive species, unsafe drinking water and climate change in this eye-opening book.

No One at the Wheel: Driverless Cars and the Road of the Future, by Samuel I. Schwartz, 2018: The author, a transportation expert and former New York City traffic commissioner, presents a comprehensive study of driverless cars.

Websites



Globalspec.com: News, tools and community for engineers

Howstuffworks.com: Insight into the way many things work

Scientificamerican.com: Accompanying website to the American popular science magazine

Interestingengineering.com: Ideas and community website connecting like-minded engineers around the globe

P.ENGs AND ENGINEERING FIRMS HONOURED WITH PRESTIGIOUS AWARDS

By Marika Bigongiari



SNC-Lavalin's award-winning John Hart Generating Replacement Project, an innovative underground power station in Campbell River, Vancouver Island.

SNC-Lavalin won the Outstanding Project Award from the Canadian Hydropower Association in partnership with BC Hydro for their work on the John Hart Generating Replacement Project in Campbell River, Vancouver Island. The hydro power station is built underground, replacing what was previously on the surface—something more often seen with



University of Waterloo Professor Xuemin Shen, PhD, P.Eng., was recently honoured by school alumni, who established a scholarship in his name.

University of Waterloo Professor Keith Hipel, PhD, P.Eng., has been named to the Order of Canada.

Several engineers have been named to the Order of Canada. Queen's University Professor **R. Kerry Rowe, PhD, P.Eng.**, an expert in engineered containment of contaminants, was honoured, along with University of Waterloo professor **Keith Hipel, PhD, P.Eng.**, a systems analysis expert who designs environmental engineering solutions. Also, **Digvir Jayas, PhD, P.Eng. (Manitoba), FEC**, University of Manitoba vice president (research and international), vice president of the Natural Sciences and Engineering Research Council of Canada and former Engineers Canada president, was recognized for his promotion of research in Canada and advancements in agriculture and food supply chain optimization worldwide. Those named to the Order will receive medals in an upcoming ceremony with Governor General Julie Payette, in g. The Order of Canada recognizes community-shapers, innovators and trailblazers who make extraordinary contributions to the nation. All Canadians are eligible to be appointed to the Order of Canada.

University of Waterloo alumni have established a scholarship in the name of **Xuemin Shen, PhD, P.Eng.**, to show their gratitude for the electrical and computer engineering professor's dedication to his students, as well as his extraordinary achievements in telecommunication research over the years. In total, \$100,000 was donated to fund the Xuemin Shen Graduate Scholarship in Communications to benefit future electrical and computer engineering students.

traditional stations. The project was noted for its innovative underground construction methods and environmental safeguards, all of which reduced the project's environmental footprint.

GHD has been named one of the 2019 Waterloo Area's Top Employers, an annual competition and special designation organized by the editors of Canada's Top 100 Employers. It recognizes forward-thinking, industry-leading employers in the Kitchener-Waterloo and Guelph area offering an exceptional and progressive work environment. Employers are evaluated on the following criteria: physical workplace; work and social atmosphere; health, financial and family benefits; vacation and time off; employee communications; performance management; training and skills development; and community involvement. GHD's new Waterloo facility houses a team of more than 500 people and is an engineering hub in the region.

Three projects based at the York University Lassonde School of Engineering, department of earth and space science and engineering, were awarded a total of \$600,000 in funding by the Canadian Space Agency (CSA). Among those involved in the winning projects are professors **Regina Lee, PhD, P.Eng.**, and **Franz Newland, PhD, P.Eng.**, for the

Reflected Global Navigation Satellite System Signals project; Professor **John Moores, PhD, LEL**, for the Mars Atmospheric Panoramic Camera and Laser Experiment; and Professor **Jinjun Shan, PhD, P.Eng.**, for the In-Flight Assessment of the Spatial Heterodyne Spectroscopy Instrument project. The CSA's Flights and Fieldwork for the Advancement of Science and Technology funding initiative supports space research in Canadian post-secondary institutions.

CALL FOR ENTRIES

Entries open on March 28, 2019, for the James Dyson Award, which aims to celebrate and inspire the next generation of design engineers. The award is given to a product design that solves a problem, has a significant and practical purpose, is commercially viable and designed with sustainability in mind. The international competition is open to current university students of engineering, product design and industrial design, and those who have graduated within the last four years, who have studied in Australia, Austria, Belgium, Canada, China, France, Germany, Hong Kong, India, Ireland, Italy, Japan, Malaysia, Mexico, the Netherlands, New Zealand, the Philippines, Russia, Singapore, South Korea, Spain, Sweden, Switzerland, Taiwan, the United Arab Emirates, the United Kingdom or the United States. The award is bestowed as follows: National winners will be awarded \$3,200, with international runners up receiving \$8,200 and \$50,000 going to the student or student team representing the international winner plus an additional \$8,200 for the university affiliated with the winning team. To read more about the award, visit www.jamesdysonaward.org. **e**



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COUNCIL APPROVES POLICY INTENT TO INCREASE ALL PEO FEES

By Nicole Axworthy

524TH MEETING, FEBRUARY 8, 2019

At its February meeting, PEO Council approved a repeal of section 59 of By-Law No. 1, removing—effective immediately—its automatic obligation to seek member confirmation to increase fees, and a policy intent to increase all PEO fees, including annual licence-holder fees, in the bylaw by 20 per cent to catch up with inflation since 2008. The repealed section of the bylaw reads as follows:

59. Council shall seek confirmation by the members of the association of a bylaw passed by the Council pursuant to the act pertaining only to annual fees for licence holders

Section 59 was repealed since it infringed Council's authority to decide on whether any bylaw it passed needed member confirmation.

At its November 2018 meeting, Council had reduced its projected operating budget deficit in part by approving a 20 per cent increase to application and examinations fees to catch up with inflation (see *Engineering Dimensions*, January/February 2018, p. 51). Increases to the annual licence, certificate of authorization and consulting engineer designation fees were not considered at that time. Council now applied the same 20 per cent increase to those remaining fees, providing a net revenue increase of \$1.5 million for 2019. Currently, 62 per cent of PEO's projected 2019 operating budget revenue is derived from the annual P.Eng. licence fee, and 28 per cent is derived from all other regulatory fees.

PEO had not increased its annual licence-holder fee since 2008, and revenue from the growth in the number of licence holders, applications and examinations had not been adequate to keep pace with operating expenditures, which have increased over 16 per cent since 2009 due to inflation. PEO's annual licence fee is also the lowest fee among regulated professions in Ontario and other engineering regulators across Canada.

With section 59 repealed, Council retains its full authority to decide on passing future bylaw changes, with or without seeking a member confirmation to vote. Council has the authority under section 8(2) of the *Professional Engineers Act* (PEA) to pass any bylaw within its bylaw-making powers, effective immediately, unless under section 8(3) Council specifies that the bylaw be confirmed by a majority of the members voting on the bylaw.

A draft of the new bylaw will be presented and confirmed by Council at the March meeting. Once confirmed, the fees will be increased for the remainder of 2019 on a one-time basis by approximately 20 per cent to catch up with inflation and will be billed to members on their respective renewal date.

GOVERNANCE AND REGULATORY CONCERNS

At its February meeting, Council was presented with a motion from Consulting Engineers of Ontario (CEO) Chief Executive Officer Bruce Matthews, P.Eng., and Chair Christine Hill, P.Eng., and Ontario Society of Professional Engineers (OSPE) CEO Sandro Perruzza and President Jonathan Hack, P.Eng., regarding governance concerns at PEO, including PEO's lack of focus and its scope of non-regulatory activities. The concerns cover PEO Council's size, effectiveness and election process; its "club" mentality rather than public-interest focus; and its bureaucracy of non-regulatory committees; all of which, according to CEO and OSPE, have weakened PEO's role as a regulator and the value and relevance of the P.Eng. licence. These concerns were also raised in recent letters sent from CEO and OSPE to the Attorney General of Ontario.

The motion put forward to Council asked that Council consider extending the scope of its external regulatory performance review (see p. 7) currently being undertaken by Harry Cayton, international consultant to the United Kingdom-based Professional Standards Authority, to include a second phase looking specifically at governance issues and a review of all PEO activities through the lens of regulatory governance and objects under the PEA. The motion also asked that Council stand down its Governance Working Group Phase I and apply its \$40,000 budget towards the cost of the proposed second phase of the regulatory review; make the reports from all phases of the review public as soon as it is received by PEO; and adopt and begin implementation of the review recommendations within three months of receipt of the report to address the policy, bylaw, regulation and statutory changes necessary to fulfill the recommendations.

At its meeting, Council considered instructing the registrar to prepare a Request for Proposal (RFP) to conduct an external governance review of PEO with oversight from the chair of the Governance Working Group Phase I and to bring back the completed RFP to Council at its March meeting. However, Council ultimately voted to table the decision with regard to the motion until after the report of the current external review is received by Council. **e**



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LETTERS

PEO must be better recognized

Changiz Sadr, P.Eng., FEC,
Willow Beach, ON

While watching the PEO Council candidates' debate broadcast from January 7 to 9, 2019, I noticed PEO is indirectly pushing the membership fee increase through the moderator by asking questions about the fee and comparing it to the fees of other regulators such as The Law Society of Ontario and The College of Physicians and Surgeons of Ontario, and so on.

Talking about the fairness of PEO's membership fee and comparing it to other regulators' fees is fair when they are comparable, but we are comparing apples to oranges here. There are many factors that differentiate PEO from other regulators and make this comparison moot. A few differences are:

- No other regulator has as many members as PEO;
- No other regulator has as many non-practising members as PEO has, or at all; and
- Most importantly, there is the matter of public awareness, enforcement and "industry exception."

If you go to a remote village and ask someone if they are ready to be visited by an unlicensed doctor, they would refuse. But for engineers, you do not need to go to a remote village, just the middle of a megacity like Toronto. There are many people, even within government, who do not even know engineers need a licence and have never heard of PEO.

I use the term "industry exception" not as the specific clause that was added to the *Professional Engineers Act* in 1984 under pressure by industry—which no other engineering regulator in Canada has—but am using it to refer to the

general control that industry holds over PEO and engineering practice. We have not forgotten the building certificate that was required on top of the P.Eng. licence not too long ago. Fortunately, in that matter PEO won, and that requirement was cancelled.

We are seeing that many organizations affiliated with government do not hire P.Eng. licence holders for their engineering positions. We are also seeing many companies involved in the design of different engineering products and services that are not members of PEO and do not carry a certificate of authorization.

And on top of it all, we are seeing people who use the engineer title on social media and their documents, and some even practise engineering without a P.Eng. licence.

We can compare our membership fee to other regulators when we are valued and accepted by the public and industry in an equivalent way to members of those other regulators. In 2015, when I was on Council and also an executive officer, at an Executive Committee meeting, I brought up the matter of enforcement and questioned the registrar on that subject. I stated that I am ready to be the first to pay \$1,000 or more as my membership fee if we address these issues and achieve the position in the public eye we should have.

In the end, I hope that instead of having a PEO that is the global leader in engineering regulation, we have a PEO whose mandate and members are recognized by all people and organizations in Ontario.

Embracing software engineering

Michael Wearing, P.Eng.,
Peterborough, ON

In the recent issue of *Engineering Dimensions*, President David Brown, P.Eng., BDS, C.E.T., refers to a statement in the September/October 2016 issue by former PEO president George Comrie, P.Eng., FEC, in which he said, "The net result of our tardiness in embracing software engineering as a regulated engineering discipline allowed non-engineers to dominate the field, and to this day it remains essentially unregulated" ("Engineering is growing exponentially. Can we keep up?" January/February 2019, p. 6).

I started my engineering career as an apprentice in the aircraft industry and ended up in the avionics design department while going to school to qualify as an engineer. I had a very good grounding in the engineering process. I later moved into the IT business, where I worked for several companies writing computer code for 25 years until I retired.

Computer programming is the process of writing code to control a machine. Controlling a machine is engineering. Yet the majority of IT managers I encountered did not have an engineering background and did not see programming as an engineering process. They would typically give you a specification in the morning and expect you to start coding that afternoon. They had no inkling of the need to

review the specification for completeness, correctness and lack of ambiguities nor the need to design a solution and test the design thoroughly before committing it to code. The result was programmers would code for weeks without doing any incremental testing and only start testing when they had finished coding. Then they would spend weeks renovating the code to repair design errors and, frequently, requirements. If we built airplanes or bridges that way, our employers would soon be bankrupt.

I was once asked to take responsibility for a new system that was being moved to production. I asked for a copy of the design and was told to read the code. That is, I was expected to reverse engineer the code to find out how the system worked. Amazing. The system was a massive failure and was fortunately abandoned. So, luckily, I got out of that scary assignment.

When I programmed, I would follow an engineering process and spend time designing and testing the design; often in my own time at home to resist pressure from my boss to start coding. The last two programs I wrote using a new design process worked on the first machine test and never (as far as I know) failed in production. My boss said that was a fluke, and I was shortly transferred to another department and never allowed to code again.

It is no wonder that IT systems go overtime and over budget and fail in production.

Thus, I suggest we re-consider embracing software engineering as a regulated engineering discipline.

Discipline should reflect PEO's mandate

Elio Comello, P.Eng.,
Camlachie, ON

In the January/February 2019 issue of *Engineering Dimensions*, to my mind, the value of publishing the Gazette has hit a new low in the over 40 years I've read its blue pages. The clear majority were about a very narrow segment of engineering practice and, for the most part, what most would consider a disciplinary slap on the wrist, almost always requiring the completion of the Professional Practice Exam (PPE) but not covering PEO costs.

The case in point, adjudicated by the Discipline Committee (four professional engineers and one lawyer) would suggest that the member, a designated consulting engineer, the certificate of authorization holder, a company and joint submission penalties and costs can be anonymous.

Please correct me if I'm wrong, but am I to understand that it is possible to get what might be considered a free pass when you admit to having committed professional misconduct and fail to meet the standard of professionalism expected of practitioners? As a penalty, all you will be required to do is suffer an anonymously reported reprimand on record for six months and complete the PPE within 14 months. If you fail to do so, licence suspension is 10 months with no order for costs. There is no mention of a further look into the holder or the member's general standards.

I fail to understand how this even remotely reflects PEO's mandate to protect the public or how it reinforces our profession's value.

LETTERS TO THE EDITOR are welcomed, but must be kept to no more than 500 words, and are subject to editing for length, clarity and style. Publication is at the editor's discretion; unsigned letters will not be published. The ideas expressed do not necessarily reflect the opinions and policies of the association, nor does the association assume responsibility for the opinions expressed. Emailed letters should be sent with "Letter to the editor" in the subject line. All letters pertaining to a current PEO issue are also forwarded to the appropriate committee for information. Address letters to naxworthy@peo.on.ca.

Hamilton road safety accolades undeserved

David Valentine, P.Eng.,
Peterborough, ON

I was particularly interested to read "Hamilton: A community exemplifying Ontario's road safety" (*Engineering Dimensions*, January/February 2019, p. 34).

I believe the accolades are undeserved, illustrated by this passage [quoting City of Hamilton Director of Roads and Traffic Edward Soldo, P.Eng.] (p. 39): "Soldo adds that there is a direct correlation between speed and safety: 'The greater the speed, the greater the impact, the more severe the impact,' he explains. 'By reducing the speed, it reduces the severity of the collisions and consequently the severity to pedestrians.'"

Hamilton is and has been notorious for imposing unrealistically low speed limits on rural roads. Speed limits should relate to the road circumstances, not across the board.

Although I live in a rural area of the new City of Hamilton, most of my driving is in Burlington and Halton, where traffic control and speed limits appear to be set according to established criteria. In Hamilton, speeds on rural roads appear to be set at the request of adjacent landowners or councillors. Without reason and/or strict enforcement, lowered speeds just create more lawbreakers, weaken respect for road signage and do nothing for safety.

Many of Hamilton's low speed limits are on rural roads, whose characteristics of width, vision, shoulder adequacy, horizontal and vertical alignment, accesses and intersections would make a higher maximum speed appropriate. City streets with bikes and pedestrians are, of course, a different game entirely.

I have been driving on Flamborough and Hamilton rural roads for some 20 years and have never seen any evidence of volume or speed recording. I do see these on Halton roads, and when I query a new regulation, they are able to support it with traffic data and council policy. Hamilton, on the other hand, appears to set traffic regulation according to landowner and political pressure and seat-of-your-pants justification.

Roads are not just people movers. They are the arteries for delivery of goods and services, including urgent and critical services. Speed, on its own, is not a killer. Inappropriate speed is. I agreed that speed increases the severity of accidents.

For a good study on rational municipal speed limits, see the Hatch Mott MacDonald study for the Town of Niagara-on-the-Lake of November 2013. It summarizes current thinking, including the Transportation Association of Canada's guidelines: <https://notl.civicweb.net/document/4509>

From the above report: "The balance between mobility and road safety objectives is best served by a system of speed limits which are consistent with the safe speed perceptions of a majority of road users, thus promoting credibility and compliance. A broadly accepted measure of the safe speed perceptions of road users is the 85th percentile speed of free-flowing traffic under good conditions. Speed studies to determine 85th percentile speeds were used extensively in developing study recommendations.

"It should be noted that artificially low signed speed limits, imposed in an effort to improve safety, or as a preventative measure, often fail to achieve their aims, as they generally result in poor compliance, despite sustained enforcement. Poor compliance often causes wide travel speed variations, resulting in more conflicts and collisions than might otherwise have occurred under a higher, but more accepted and respected, speed limit."

Hamilton is also one of the municipalities that uses four-way stops as traffic calming devices, ignoring the traffic, environmental and behavioral aspects of the locations.




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