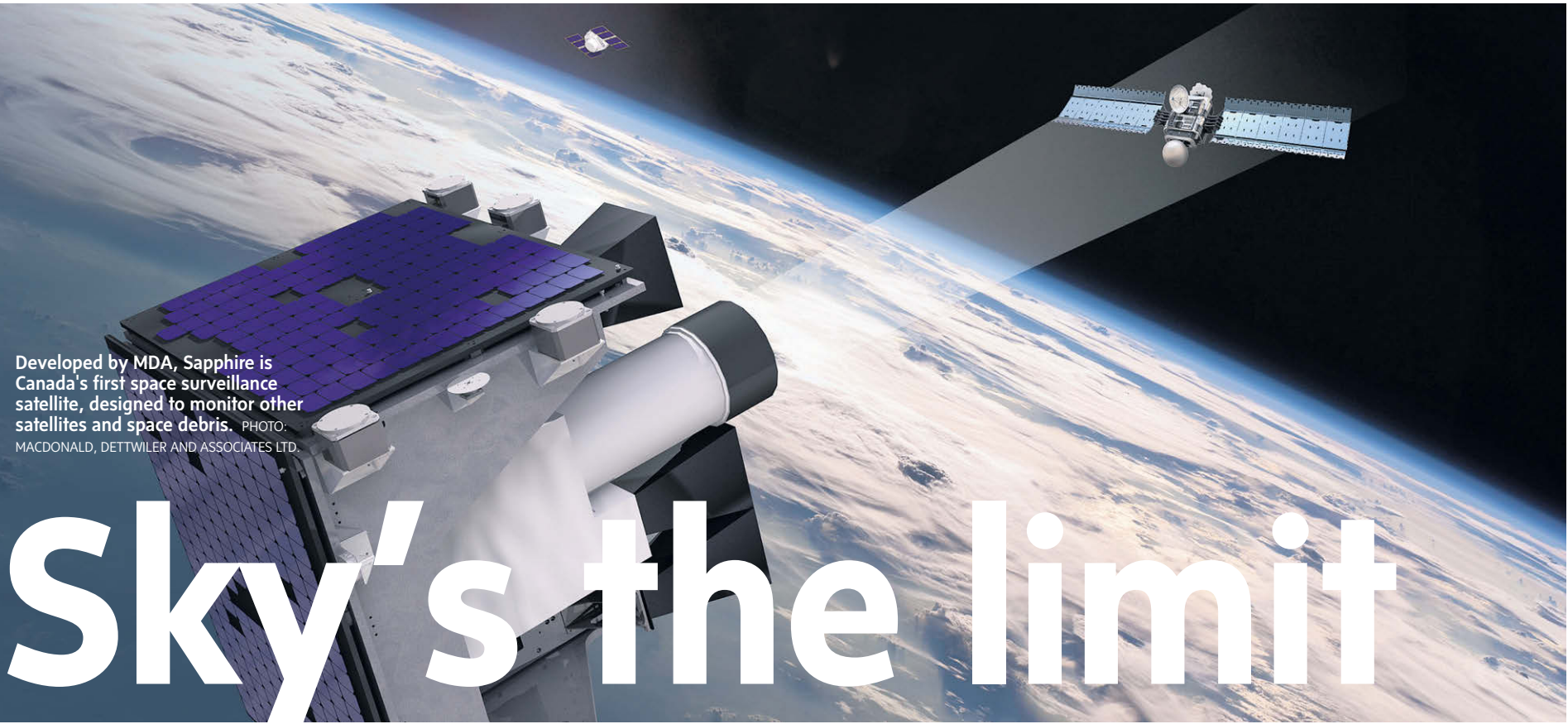


Special

Engineering in Canada



Developed by MDA, Sapphire is Canada's first space surveillance satellite, designed to monitor other satellites and space debris. PHOTO: MACDONALD, DETTWILER AND ASSOCIATES LTD.

Sky's the limit

In the realm of engineering, Paul Accchione has seen it all. And that says a lot.

A professional engineer as well as president and chair of the Ontario Society of Professional Engineers, Mr. Accchione has a ringside view of the multitude of ways that Canadian engineers are playing increasingly influential roles in society.

Working at the intersection of technology and innovation, engineers bring their expertise to an array of applications – from developing the technology behind the smartphones we can't live without to revolutionizing health care and monitoring potentially harmful space debris.

No matter what the sector, however, engineers must collaborate with colleagues in highly specialized fields to find solutions to complex problems.

"Think of the BlackBerry – it can't just be created by one person who knows about electronic hardware," says Mr. Accchione. "It's a seemingly simple product bring-

ing together innovations in many areas, including software design, integrated chip design, communication protocols, and signal conditioning and analysis – all of which require specialized skills. There's a lot of expertise required to bring a device like this to life."

Engineers are also using their technical expertise to drive innovations in health care. Mihaela Vlasea, a doctoral mechatronics engineering student in the Multi-Scale Additive Manufacturing Laboratory at the University of Waterloo, is collaborating with surgeons and pathologists from Mount Sinai Hospital Toronto, material scientists from the University of Toronto and a veterinary surgeon from the University of Guelph on a breakthrough approach to joint replacement.

Her three-dimensional printer uses a calcium-based ceramic powder to print, layer by layer, a bone implant that matches the patient's unique requirements as determined by a CT scan.

"We had to address many engineering challenges, includ-



Doctoral student Mihaela Vlasea has developed a 3D printer for creating customized bone implants. PHOTO: BRYN GLADDING

ing redesigning the 3D printer to accommodate multiple powder types and developing an injection mechanism to create internal porous qualities in the implants that mimic those found in bone,"

she says.

Animal trial results are promising and the next stage will be to test the implants in humans.

"The customized implants are designed for patients with

cartilage defects who are not yet candidates for a complete joint replacement," says Ms. Vlasea. "The implant is ultimately reabsorbed by the body and replaced with bone, so ideally the joint will not need replacing in the future."

Whether designing a BlackBerry or a new bone, someone needs to oversee the integration of all the specialized components embedded in the product.

Rob Leitch, P.Eng., filled this role in his work as chief systems engineer for MDA's Sapphire Mission Program, Canada's first satellite for the surveillance of space. Developed for Canada's Department of National Defence, the Program is supported by a dedicated ground segment infrastructure primarily located in Western Canada. MDA was the prime contractor for the Program.

As we increasingly rely on satellites for communications, data collection and GPS technology, we need to ensure they are safe from collisions with each other and orbiting space debris.

"The goal of Sapphire is to keep the space around the earth safe for use," says Mr. Leitch. "It tracks the more than 23,000 objects currently orbiting earth – satellites, bits of debris from space launch activities and satellites that have broken up in orbit. It's like a traffic cop, monitoring what's out there and reporting into a space surveillance system that's used to predict if a collision might occur with other satellites, particularly those that are operational. Satellite operators can then move their satellites if needed."

Mr. Leitch explains that a major challenge was to pack as much capability as possible into a very small space. The dishwasher-size satellite was developed at a fraction of the size and cost of its U.S. counterpart.

Nearly six years of work culminated on February 25 with the launch of Sapphire.

"It was a very exciting moment after putting so many years into the engineering, and with so much work riding on this one event," he says. "There are always risks with a launch, so there's an incredible feeling when it's successful and you get first contact with the satellite in orbit."

Perhaps even more moving was the moment when the team received the first images from the satellite.

"We were huddled around a computer, waiting for the first image to be processed, which would prove that the system was working and that we had a mission. And there it was: the image of a starfield. It was an incredible experience for all of us on the team, a once-in-a-lifetime event."

AID

Applying engineering skills to social issues leads to sustainable change

For Engineers Without Borders, it takes more than technical skills to address serious issues affecting Sub-Saharan Africa, such as poverty and limited access to clean water.

To making lasting change, the non-profit organization takes a step back to look at the bigger picture, before tackling the problem head on.

In the area of clean water, for example, that means looking at the broader water and sanitation sector and seeing where EWB can make the most difference before building wells.

"When we started out 12 years ago, we often worked in a very technical way," says James Haga, EWB's portfolio manager of advocacy. "But over time, as we became more familiar with challenges in developing countries, that's shifted. We now look at the deeper systems that contribute to problems – such as access to water or inefficient agricultural markets – and then apply an engineering perspective to those systems that affect people's livelihoods."

Mina Shahid, the junior fellowship program manager with EWB, says that "an engineering degree is a degree in problem solving and systems change," making engineers well equipped to work on both technical systems, like wells, and broader human systems.

With a degree in mechanical engineering, Mr. Shahid did not originally set out to do international work. It was while volunteering as a student with Engineers Without Borders that he became inspired by the idea that he could use his problem-solving skills to "do something that would be more meaningful



EWB staff member Lauren Dodds works with project staff in Uganda to identify opportunities in the input value chain to benefit the market system. SUPPLIED

"Our strategy is to work in partnership with communities and adjust the system so that people will have greater opportunities for a good and reasonable life."

James Haga is Engineers Without Borders portfolio manager of advocacy

than improving the efficiency of a manufacturing process by half a per cent."

Mr. Shahid has worked on several EWB projects in Ghana and Uganda, working alongside government ministries, NGOs and the private sector to suggest systemic changes to agriculture processes and markets.

In Uganda, for example, EWB partnered with USAID on a project to increase the competitiveness of Ugandan-grown maize and coffee in the regional marketplace. EWB's role was to assess the project's capacity to create changes in the market system

that would benefit the poor.

"We worked alongside local Ugandan project staff, identifying the capacity gaps that needed to be addressed so they could better implement the project and produce real systems change for coffee and maize farmers. We work with project staff because they are the change creators, whereas we see EWB's role as one of enabling change."

In Ghana, Mr. Shahid consulted on a project aiming to increase soil fertility for small-scale farmers, enabling them to grow higher-quality produce and move beyond subsistence farming.

It's an approach that identifies leverage points in the system – areas where even small shifts in behaviour or actions can have a significant impact.

"People in the developing world are often caught in a system that's not working in their favour," says Mr. Haga. "Our strategy is to work in partnership with communities and adjust the system so that people will have greater opportunities for a good and reasonable life. It's a longer-term project and it's more complex, but we think it's the best way to solve what might seem to be intractable problems."

INSIDE

Hands-on programs expose young Aboriginal students to the engineering profession [Page EC 2](#)

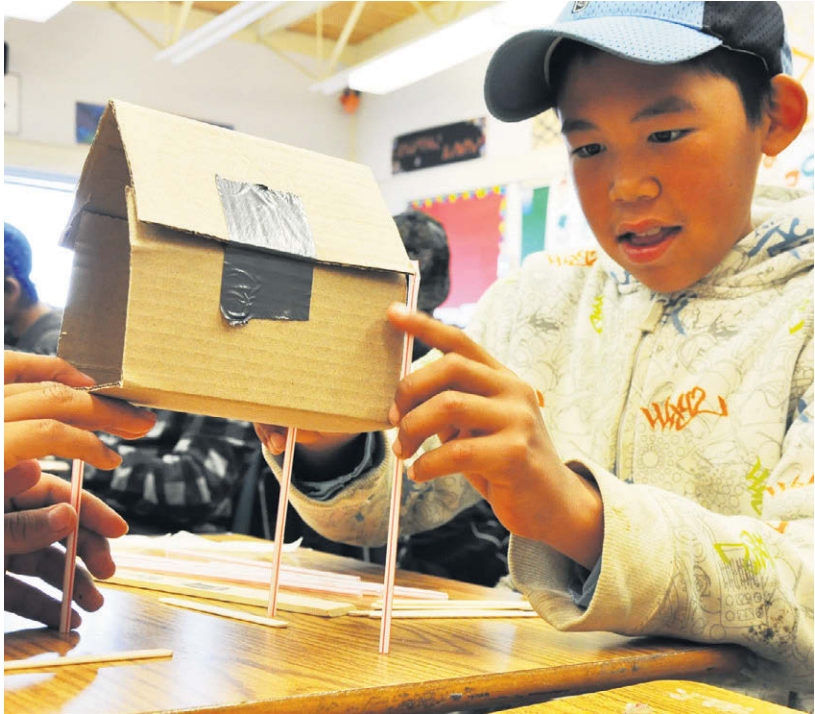
Clean technology and green energy are two areas with a growing demand for engineers [Page EC 3](#)

ACEC president John Gamble speaks to the importance of investing in infrastructure and training [Page EC 5](#)

ENGINEERING IN CANADA



Actua staff travel to remote communities, including Baker Lake and Whale Cove in Nunavut, to offer week-long camps that expose students to opportunities in engineering, science and technology. SUPPLIED



OPINION

Outreach program attracts Aboriginal youth to careers in engineering



By Jennifer Flanagan, President and CEO, Actua

If innovation is to shepherd Canada's industries forward, our country's economic prosperity will rely on talent with a niche set of skills and knowledge rooted in engineering. To meet this demand, young Canadians will need to prepare today for the wealth of economic opportunities of tomorrow.

As Canada's fastest-growing population, our country's Aboriginal youth will play an important role in bolstering this highly skilled workforce. Their role as young engineers, leading innovation and creating sustainable infrastructure to support a

ABOUT

Actua is a national leader in the delivery of life-changing experiences in science, technology, engineering and mathematics. Founded by a small group of engineering students 20 years ago, Actua has grown to represent a network of 33 members located at universities and colleges across Canada. These members share a commitment to inspire all youth – no matter their location, ability, gender or socio-economic situation – to fulfill their critical role in the country, and in the world. Undergraduate engineering students lead the delivery of in-school workshops and week-long camp experiences. Annually, Actua reaches 225,000 youth in 500 communities nationwide.

resource-based economy, is vital. The challenge lies in ensuring Aboriginal youth connect with the many related careers in engineering at an early age.

In 2000, we launched the National Aboriginal Outreach Program, a transformational, barrier-breaking program that now engages 30,000 Aboriginal youth each year in over 200 Aboriginal communities. Many of the communities we reach are northern, some are remote. All have limited access to education outreach programs.

Participating in Actua's camps and workshops, Aboriginal youth learn about regional economic development opportunities and careers in engineering. Through design and build challenges they discover the engineering that goes into construction on permafrost or the design of an arctic ice runway for a jet. They learn about the mining industry and the engineering involved in

exploration and extraction of minerals and land restoration. Local mentors introduce them to a wide range of engineering careers – from environmental to civil to mechanical and electrical. They discover their role in shaping the economic future of their communities, of their country.

To be successful, the programming we offer needs to be culturally relevant. This happens when we build partnerships with Aboriginal communities and actively involve Aboriginal Elders, professionals and volunteers. They work with us to provide a safe and positive learning environment for Aboriginal youth. We

also collaborate with First Nation organizations, friendship centres and hamlet offices to facilitate the sharing of traditional knowledge, connecting Aboriginal ways of knowing with engineering and science, and connecting community leaders with the outreach team and instructors.

An excellent example of this is an on-the-land experience that happened in Nunavut. Campers were learning about GPS technology while engaged in a geocaching activity. An Elder accompanied the youth, discussing traditional ways of navigation using the stars and inukshuks. One camper said, "these GPS units are great, but the inukshuks work way better when the batteries run out!"

The benefits of these experiences are also passed on to the instructors who build their understanding of Aboriginal culture. They then carry their experiences forward in their professional and personal lives.

This duality of experience is key. As much as we have to offer Aboriginal communities, they too give back to us. At the end of the day we need to learn from each other, bringing the best of what everyone has to offer to solve tomorrow's innovation challenges.

Our model also relies on our partnerships and connections with industry and with post-secondary institutions that make it possible to connect youth to current innovations in engineering. This, combined with our connections to communities and local economic development, plays a key role in our ability to support the development of an in-demand future workforce.

Our impact, as measured by the changes in youth's confidence and attitudes toward future education, is strong and the empirical evidence of these shifts is clear.

However, if it takes a village to raise a child, it takes a multisector, long-term commitment on the part of industry, government and local organizations to raise the next generation of innovators.



Students at U of T's DEEP summer academy explore the world of research and engineering. PHOTO: LIZ DO

CAREERS

Seeing engineering in new ways brings greater diversity to the profession

A desire to bring greater diversity to the profession – including the goal of increasing the number of women who choose engineering as a career – is driving efforts to position engineering as a fundamentally creative endeavour that serves humanity.

While female students are now the majority in medical and law schools, engineering programs are still dominated by men. In 2010, women accounted for only 17.7 per cent of engineering undergraduates and 10.5 per cent of registered professional engineers in Canada.

"This is an issue because engineers are trying to solve complex, difficult and important problems," says Susan McCahan, the University of Toronto's vice-dean undergraduate for the faculty of applied science and engineering. "If we can increase the diversity of engineers, we'll have greater potential to develop better solutions – ones that would not emerge if only one sort of person was addressing the problem."

Engineering associations, universities and other organizations believe they can achieve this goal by changing perceptions. They want young people to know that their technical skills in math and science can be used to do creative work for the benefit of society.

Erica Lee Garcia, P.Eng., runs a consulting engineering practice and oversees the outreach initiatives of Engineers Without Borders' Global Engineering Outreach Venture. She says one of Global Engineering's goals is to show how the engineering skill set can be applied to areas not typically associated with the profession.

"It's an approach that seeks to create a new type of engineer, one who brings together technical skills and analytical abilities with the desire to solve large-

scale problems, like poverty, environmental issues and access to clean water."

In March 2013, Engineers Without Borders partnered with Professional Engineers Ontario and the Ontario Association of Certified Engineering Technicians and Technologists to run 142 events for National Engineering Month in Ontario, promoting the message that engineering is essential to the health, safety and happiness of society, and positioning engineers as capable problem solvers interested in benefiting humanity.

Ms. Lee Garcia describes a young girl approaching her after an event to say that "engineering sounds like a great job because you use your imagination to help others."

Engineering outreach programs reinforce this message. The University of Toronto hosts a range of outreach initiatives, some specific to young women, and all aiming to raise awareness of the innovative work being done by engineers.

Dr. McCahan is particularly proud of DEEP, an enriched summer program that immerses gifted students in research and engineering. There is also a junior DEEP program for younger students and one open to girls only.

She points out that expanding the profession's diversity is essential to ensuring engineers fulfill one of their fundamental roles – designing services, products and systems. "Whether you're talking about medical instruments or subway systems, the input of a diverse group of people will help make technology work better for a broader range of users."

Ms. Lee Garcia agrees. "Our profession should be as diverse as the population we're serving. This is what will make engineers better able to serve society."



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By the numbers

66,057

Number of undergraduates enrolled in engineering in 2011

17.7%

Percentage of undergrad engineering students who are women

41.1%

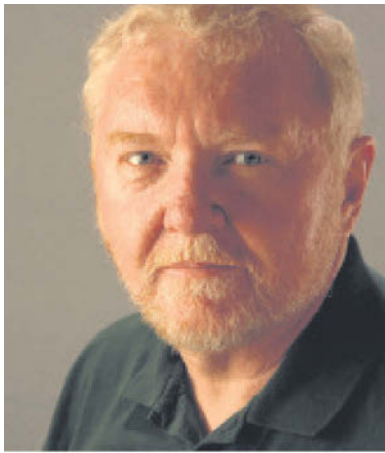
Percentage of students in environmental engineering programs who are women

10.1%

Percentage of students in mechanical engineering programs who are women

Source: Engineers Canada, 2012

What Have Trade Unions Done For You Lately?



BY DON MACKINNON
President
Power Workers' Union

Sometimes we get so used to our institutions we forget how important they are to us. We take democracy for granted in Canada, but a moment's thought about life in countries without it should be enough to convince you of the importance of a democratic political system. Absent democracy, "might makes right" — tyranny and inequality prevail. If our democratic institutions aren't preserved, we risk falling back into a state of affairs where people live politically impoverished lives.

Trade unions have been around longer than representative democracy in this country. It's easy to take them for granted and, particularly now when they are under persistent public attack, to forget why they are important for all of us. Here's a reminder.

First, trade unions transformed workplaces for the better. Before trade unions, working conditions were often deplorable and workplaces dangerous, and this in the most prosperous countries in the world. Twelve or even sixteen hour workdays without breaks in workplaces that were literally a threat to the lives of workers were not unusual. There was no minimum wage, medical coverage, insurance, or workers' compensation. A worker could have wages cut, be laid off or fired without warning or explana-

tion. Women were paid less than men doing the same job and children were put to work in dangerous conditions.

Once working people formed trade unions, however, workplace conditions improved. Unions struggling to achieve these gains, which we now take for granted, had to fight against many employers and governments, who claimed that any improvement to the lives of workers was unaffordable and would render industry uncompetitive. Unions persevered, however, to the point where people came to see their bene-

Trade unions have been around longer than representative democracy in this country. It's easy to take them for granted and, particularly now when they are under persistent public attack, to forget why they are important for all of us.

fits for everyone and governments decided to acknowledge and regulate their existence by legislation. Unions, traditionally democratic organizations, were now required to be democratic by law and to represent all workers fairly. By the same token, all workers in the workplace were required to pay dues to the democratically selected trade union because they all got the equal benefit of the union's representation (the "Rand formula"). But the benefits of union activities went beyond the workers they represented to all workers: minimum wage

rules, health and safety laws, eight hour workdays, mandated breaks and paid time off are all the direct or indirect result of the union movement and its commitment to better the lives of all working people, whether or not they are union members.

Even more, the union movement benefited the economy as a whole. One reason for the establishment of labour laws in the early part of the 20th century was to promote economic expansion by increasing the purchasing power of workers. What ensued was a long period of great prosperity through to the late 20th century in which the middle class expanded, sharing in the wealth it helped create, but also spending its new income and so driving economic expansion. The expansion of unionization parallels the expansion of the middle class and the reduction of income inequality, the improvement in private pension and benefits plans, and the better treatment of women and minorities in the workplace.

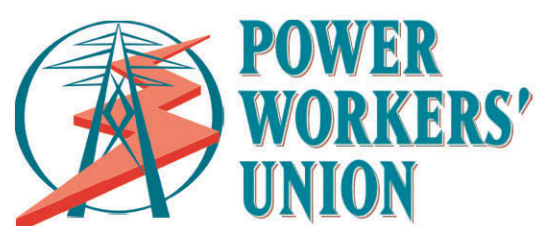
The last 20 years or so have seen a rapid increase in the income of the wealthiest people in the country and a decline of the middle class. It's not a coincidence that this has been a period of sustained attack on trade unions, culminating in "right to work" laws in many US states. Unions tend to equalize wages among workers and ensure that fewer people are left in low paying jobs. They protect the vulnerable and ensure that workplaces are safe and that workers are treated fairly. As long as there is unionization in an industry, non-unionized employers can't afford to fall too far behind in the treatment of their workers.

In the short run, some might believe that reducing wages and benefits will increase profits, but this ignores the long run: lower paid workers have no money to spend in the economy and as the middle class disappears, so does prosperity for everyone, including business.

Those who live through a period of history often don't reflect on it while it's happening, and don't realize what they've got until it's gone. This is why it is important to look back and understand.

We are again hearing that business can't afford good wages and working conditions, pensions and benefits. It wasn't true a century ago and it's not true now. "Right to work" laws do not create jobs — they diminish the quality of existing jobs by stripping workers of the benefit of trade union representation. In a race to the bottom, the worker and society as a whole always lose — and income inequality returns. Just as a country that attacks its democratic institutions courts political poverty, one that attacks the democratic institution of trade unionism courts economic poverty.

So what have trade unions done for you lately? They've protected good jobs, wages, benefits and working conditions for you and your children. They've ensured that all people, including women, minorities and the disabled — you, your friends and family, are treated fairly in the workplace. They've fought against growing income inequality and for the preservation of the middle class — the only sure way of guaranteeing economic prosperity for all of us in the future.



ENGINEERING IN CANADA

ENVIRONMENT

Growing demand for engineers challenges cleantech sector

The renewable energy sector is among the most exciting for engineers, given its ever-changing technology and potential for growth.

Yet the industry is faced with a shortage of experienced engineers, particularly in strategically important areas such as clean technology, according to Sustainable Development Technology Canada (SDTC).

Rick Whittaker, SDTC's vice president, investments and chief technical officer, says the renewable side of the business needs to attract more engineers during what he calls a "truly exciting time."

"The engineering discipline has seen many evolutions over its history," he says. "From its civil and industrial roots to aerospace and information and communications – clean technology is the next wave of this evolution."

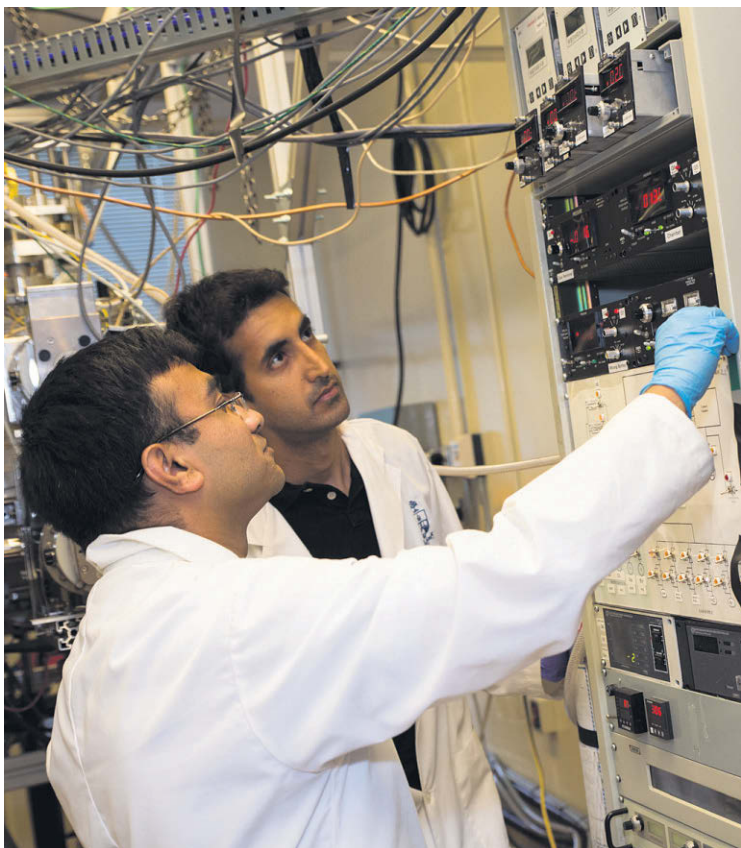
Funded by the Government of Canada, SDTC is a not-for-profit corporation that finances and supports commercialization of clean technologies. Recently, through SDTC's SD Tech Fund, 23 cleantech projects across Canada were awarded \$61.8 million in funding.

Noting that Ottawa's most recent budget also flagged clean energy as a key priority, Mr. Whittaker says the technology, at its core, is about market transformation.

"We've found that the best way to find, and grow, qualified engineers is to foster opportunities from within traditional sectors," he says. "For example, forestry engineers are now becoming biomass energy engineers. And SDTC's funding to innovative companies enables that to happen."

Paul Accchione, president and chair of the Ontario Society of Professional Engineers (OSPE), says he has noticed a growing interest in engineering jobs that contribute to improved environmental performance and quality of life.

Yet while the interest may be there, the specialized training re-



U of T engineering students work in the Advanced Photovoltaics and Devices Lab on using nanotechnology to improve solar cell efficiency. PHOTO: SARA COLLATON

“Unless businesses re-engage in providing on-the-job training for their specialized skills needs, we will continue to have under-employment in the engineering profession as well as unfilled specialized jobs. That’s a mismatch that hurts our profession and the national economy.”

Paul Accchione is the president and chair of OSPE

quired for some of these jobs can be hard to come by. He says that analysis by Engineers Canada and OSPE shows that businesses have been getting out of on-the-job training for engineers.

With global competition drying up discretionary funds, training budgets tend to be the first to go. Yet companies still require engineers with specialized skills to help drive innovation and to capitalize on the opportunities in the cleantech sector, which he says has tremendous promise as a job-creating, productivity-enhancing industry.

"New graduates and engineers from other declining sectors simply can't meet the tight employment specifications for those specialized jobs," says Mr.

Accchione, who is also chair of OSPE's energy task force.

"Unless businesses re-engage in providing on-the-job training for their specialized skills needs, we will continue to have under-employment in the engineering profession as well as unfilled specialized jobs. That's a mismatch that hurts our profession and the national economy."

Mr. Whittaker says SDTC seeks to ensure that the right skills are matched to the right projects. "We are a resource and network for cleantech entrepreneurs as they staff their organizations," he says.

Reza Irvani, a professor in the department of electrical and computer engineering at the University of Toronto, says undergraduate electrical engineering programs, in the context of "renewable energy integration," are not formally offered by universities.

"This is a major knowledge and expertise gap that young graduate engineers have to bridge themselves to readily get jobs in the field of renewable

energy," says Dr. Irvani. "Large employers, such as electric power utilities, in collaboration with universities, could plan 'continuing education courses' in this area to upgrade the expertise of practising engineers and provide training in the field for recent graduates."

He says he sees the need for more specialized engineers in the cleantech area.

"Based on numerous inquiries I receive from companies, I do notice the gap based on the type of expertise they are focusing on," says Dr. Irvani, whose research addresses issues related to integrating renewable energy into electrical supply systems.

"The need for more engineers equipped with the appropriate knowledge and expertise for the renewable energy sector is obvious," he says. "The proposal is to set up a joint university-industry committee to identify the needs and then design a set of 'continuing education' courses to equip practising and graduating engineers for this emerging field."



Technology developed by SWITCH Materials will allow drivers to control the tint of their windows with the flick of a switch. SUPPLIED

PROFILE: SWITCH MATERIALS

Test driving the smart window

Drivers could soon control the tint on their car windows with the push of a button, thanks to a new technology being developed by chemists and engineers at a small B.C.-based firm.

Now in development with several major auto makers, SWITCH Material's technology promises to improve driving comfort, while at the same time reducing a vehicle's energy consumption.

SWITCH is developing a transparent film-based material for lamination into windows that darkens when exposed to sunlight. The consumer can also brighten the windows to allow more light in by flicking a switch to apply a small electric charge to the film.

"Our product brings together many innovations in materials, mechanical and electrical engineering," says Jonathan Sargent, SWITCH's vice president of R&D. "On top of the challenge of integrating our proprietary molecules into thin film coatings, we needed to achieve very high optical

quality and ensure the film could withstand the high temperatures and pressures of the glass manufacturing process."

This smart window technology has many applications, but SWITCH is currently concentrating on the automotive market, which is looking to reduce energy use and solar heat gain in vehicles. The film keeps vehicle interiors cooler by reducing the amount of sunlight entering the vehicle, decreasing the energy required for air conditioning.

With prototypes in hand, the company is working with glass manufacturers and has programs with four car manufacturers wanting to incorporate the material into test vehicles.

"The initial technology was discovered at a Canadian university, developed in a Canadian company and supported by Canadian venture capital and government funding programs," says Doug Wiggan, CEO of the company. "It's a made-in-Canada solution that we're building to sell to the global market."



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By the numbers

16,000
Number of new engineering jobs due to investments in resource and infrastructure projects, between 2011 and 2020

95,000
Number of engineers that will retire by 2020

Source: Engineers Canada, 2012

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OPINION

Investments in infrastructure and training essential



Q&A with John Gamble, P.Eng., president of the ACEC

How are changing demographics affecting the consulting engineering industry?
The industry has an acute demographic challenge and is facing something of a demographic hole. Back in the recession of the early 1990s, there was significant contraction, leading to many lost jobs and diminishing enrolment in engineering programs. This has created a gap in the number of senior staff available to take on leadership positions. It's quite a challenge, as there are fewer people than needed to mentor junior staff and facilitate knowledge transfer.

What are engineering firms doing to address this challenge?
This is a capacity problem that we're working through. The current leaders of firms are asking junior staff to take on more responsibility, earlier in their careers. There's also a focus on professional development. You know, many senior managers remember the recession all too well. And unless people have confidence in the business environment, they can be reluctant to invest in recruitment and in training and retaining employees – be they junior or senior, domestic or foreign trained.

Does the current business environment inspire confidence?
Well, we have a commitment to a 10-year infrastructure program with the renewal of the Building Canada Fund in the 2013 budget. It was renewed for 10 years, which was quite significant – that's a long horizon for a government program. This will help enormously in giving firms confidence to invest in employee training and development. The continuing strength of our resource sector is also very important.

There is temptation in times of financial austerity to try and cut costs up front. However, making the investment in the conceptualization and engineering design of projects can generate significant savings over the life of the project.

Your organization advocates for investments in infrastructure. Why is this important?
Public infrastructure benefits everyone, and investing in infrastructure is vital to our country's prosperity. We tend to think of infrastructure in terms of individual projects – a road here, a bridge there – but it's more than that. Collectively, it's what enables economies and connects communities.

Can you offer an example?
Take the Detroit-Windsor border crossing. The trade that crosses the Ambassador Bridge on a daily basis is equivalent to the entire US trade volume with Japan. That shows the sensitivity and vulnerability of infrastructure. If that bridge was unavailable to us for whatever reason, you can imagine the economic consequences. Similarly, in the resource sector, companies need to access resources, extract them in a socially and environmentally responsible manner, and get them to market. That can't be done without infrastructure. Governments at all levels are starting to recognize that we need to see infrastructure as an investment rather than an expense.

What role do engineers play in infrastructure development?
Engineering is a critical part of the life cycle of any asset in terms of cost, durability, lifespan and long-term operating and maintenance costs. Yet on any individual project, engineering costs represent less than one per

cent of total life-cycle costs and five to ten per cent of total capital outlay.

As much as infrastructure is an investment in prosperity, engineering is an investment in the long-term success of the project. There is temptation in times of financial austerity to try and cut costs up front. However, making the investment in the conceptualization and engineering design of projects can generate significant savings over the life of the project.

Any last thoughts?
Canada is respected globally for the capacity and expertise of its engineers. We're the world's fifth-largest exporter of engineering services. Our reputation is built on doing really great work, and that's what's given us influence on a global scale.

ABOUT

The Association of Consulting Engineering Companies (ACEC) is a not-for profit organization that has been the voice of Canadian consulting engineering companies since it was founded in 1925. ACEC represents the commercial interests of businesses that provide professional engineering services to both the public and the private sector. Its nearly 500 members are independent consulting engineering companies that are responsible for planning, designing and implementing all types of engineering projects, and providing independent advice and expertise in a wide range of engineering-related fields.



Consulting engineers contribute their expertise on major infrastructure projects that improve the flow of goods, connect communities and strengthen the economy. SUPPLIED

CAREERS

Transforming oil sands overburden into a sustainable ecosystem

To visit the South Bison Hills in Fort McMurray, Alberta, is to be impressed by towering aspen and spruce trees, and ponds that support diverse wildlife. Yet just more than a decade ago, this 1,000-hectare area was part of Syncrude Canada's bitumen mine operation.

"The area was a large shale overburden dump that was reclaimed in the late 1990s," says Lee Barbour, a civil engineer and geoscientist at the University of Saskatchewan who was recently named Chair in Hydrogeological Characterization of Oil Sands Mine Closure Landforms. "It's remarkable to see the landscape recover to the extent that it has in less than 15 years."

Dr. Barbour, whose \$2.6-million industrial research position is funded jointly by the federal Natural Sciences and Engineering Research Council and crude oil producer Syncrude Canada, has spent a significant part of his career studying how land disturbed by oil sands mining can be transformed back into sustainable ecosystems.

With his latest appointment, Dr. Barbour is tracking the quantity and pathways of water flowing through the hills of clay shale – also known as overburden – that are created and left behind by oil sands mining. To track the water, Dr. Barbour and his team have developed a catalogue of

"water signatures" that can help researchers pinpoint where the water came from.

"Depending on its origin, water has varying ratios of different types of isotopes," explains Dr. Barbour. "So water pumped from the Athabasca River would have one signature, shale water would have a different signature and snow melt water would also have its own signature."

Understanding the amount and movement of water through overburden dumps will help oil sands miners create better plans for closing and reclaiming their sites, says Dr. Barbour.

"They'll be able to design a plan based on how much water will be moving through the landscape, as well as what chemical loadings will be delivered to surface water."

Dr. Barbour says his work is "one small piece of a very large puzzle" and that other researchers are tackling various aspects of the problem, including characterizing the chemistry of oil sands water and coming up with the best water treatment options.

"With Alberta's oil sands underlying more than 140,000 square kilometres of land, the challenges are enormous," he says. "We've shown that we can rebuild deforested land, but we need tools to understand how the landscape evolves and recovers to a sustainable condition."



Five members of Urban Systems' office in Nelson, B.C. The engineering firm has been named one of the Best Workplaces in Canada for eight consecutive years. SUPPLIED

CAREERS

In a competitive labour market, engineering firms find creative ways to recruit employees

When it comes to attracting and retaining employees in the highly skilled engineering sector, the key is finding people who will fit the company's corporate culture.

For engineering services firms such as Halsall Associates, one way to do that is through an employee referral system, which helps to find people that the existing staff want to work with.

"Our belief is that good people know good people," says Heather Kleiman, Halsall's manager of career development.

"It's a win-win on both sides: having an employee refer someone who they believe will fit our culture is beneficial to the company long term. Plus, the candidate knows the kind of work environment to expect, based on knowledge and insight they receive from someone who works here."

It's one of a number of incentives companies are using to attract and retain employees at a time when demand for engineering jobs is high and competition fierce. The need for these skilled professionals is also expected to increase in the years ahead, as the workforce ages and more employees are needed in growing Canadian sectors such as oil and gas and mining.

At Halsall, employees are rewarded between \$1,000 and \$5,000 for referring any new hire that stays on with the organization past a three-month probation period.

The company, which employs about 375 people across Canada, has a strong corporate culture,

"The ripple effect of hiring people who don't fit and leave is quite significant, so we also do everything we can to make sure that the potential hire has a realistic preview of how we work."

Theresa Foley
is the human resources adviser at Urban Systems

interesting clients, leading-edge projects and a passion for sustainability, all of which also help to attract and retain talent, says Ms. Kleiman.

Other incentives include attractive pension and profit-sharing plans, as well as a generous health-spending account that ranges from \$500 to \$4,500 annually, depending on an employee's years of service and responsibilities.

At Urban Systems, which has 350 employees in offices across Western Canada, the company also invests time in building relationships and networking to find the best potential new hires.

Theresa Foley, the company's human resources adviser, says current employees also have some say in new hires to help ensure the person is a good match for the team.

"The ripple effect of hiring people who don't fit and leave is quite significant, so we do everything we can to make sure that the potential hire has a realistic preview of how we work," says Ms. Foley. "It's very important because all of our work is done through collaboration and teamwork."

Urban Systems also likes to hire people straight out of school, as part of a program they call "Grow Our Own."

The program enables the company to train and develop its employees for the long term.

"If we plan way ahead of time," says Ms. Foley, "we can have a pipeline of people that will be with us for years to come."



Lee Barbour (left) and colleague Jim Hendry are part of a team working to restore land that has been mined for oil sands development. SUPPLIED

ENGINEERING IN CANADA



Engineers Canada Awards 2013

Presented annually since 1972 to recognize outstanding Canadian engineers, teams of engineers, engineering projects and engineering students, the Engineers Canada Awards highlight engineering excellence, as well as the contributions of Canadian engineers to their profession, their community, and to the safety and well-being of Canadians.



GOLD MEDAL AWARD
Elizabeth Cannon, FEC, P.Eng.
APEGA
A prominent leader in engineering and technology in Canada and around the world, Elizabeth Cannon is the University of Calgary's president, and is a former dean of the Schulich School of Engineering. Her research and teaching in the area of satellite navigation for land, air and marine applications have garnered Elizabeth an impressive reputation as a leading engineer in this area.



NATIONAL AWARD FOR AN ENGINEERING PROJECT OR ACHIEVEMENT
BC Place Revitalization
GENIVAR (Glenn Hubick, P.Eng., principal engineer)
APEGBC
BC Place is the largest event facility of its kind in British Columbia. Its revitalization posed significant challenges to the engineering teams and represents a number of technical achievements. These include the design and construction of the largest cable-supported retractable membrane roof structure in the world, the first of its kind in North America.



YOUNG ENGINEERING ACHIEVEMENT AWARD
Goldie Nejat, Ph.D., P.Eng.
PEO
An assistant professor in the Department of Mechanical and Industrial Engineering at the University of Toronto, Goldie Nejat is the founder and director of the Autonomous Systems and Biomechatronics Laboratory. She is researching the development of intelligent assistive robotic aids that can help find victims in disaster scenarios, improve the quality of patient-centred care and transform the function of hospital wards and nursing and veteran homes.



MEDAL FOR DISTINCTION IN ENGINEERING EDUCATION
Arindom Sen, P.Eng.
APEGA
An associate professor in the Department of Chemical and Petroleum Engineering at the University of Calgary's Schulich School of Engineering, Arindom Sen engages his students and helps them understand difficult engineering concepts. His interactive classroom environment promotes learning, whether by playing a game of catch to understand the concept of diffusion with reaction, using LEGO to describe enzyme kinetics, or getting students to act as molecules to exemplify the behaviour of gases.



AWARD FOR THE SUPPORT OF WOMEN IN THE ENGINEERING PROFESSION
Josephine Hill, P.Eng.
APEGA
A professor and the Canada Research Chair in Hydrogen and Catalysis at the University of Calgary's Schulich School of Engineering, Josephine Hill is a volunteer, mentor, educator and researcher with a great passion for teaching young women about the engineering profession. She is also the faculty liaison for the Cyber-mentor program, an Alberta-wide mentoring program that matches teenage girls with female engineers and scientists.



MERITORIOUS SERVICE AWARD FOR PROFESSIONAL SERVICE
M.G. (Ron) Britton, FEC, FCAE, P.Eng.
APEGM
A leader in establishing the Canadian Engineering Education Association, Ron Britton's tireless voluntary efforts and passion for excellence in engineering education delivery have been integral to the rebirth of engineering design instruction in Canadian engineering schools. An APEGM volunteer for many years, he served six years on Council, seven years on the Board of APEGM Foundation Inc. and one year as president. He also served on the Engineers Canada Board from 2003 to 2006, which included terms on the awards and audit committees.



GOLD MEDAL STUDENT AWARD
Breanna Borys
APEGA
A Schulich Scholarship recipient, Breanna Borys is a student member of APEGA and a second-year biomedical engineering student at the University of Calgary. As team lead for the university's Global Engineering team, she works to educate the community about global engineering and opportunities to implement change for affecting true social impact. Breanna plans to specialize in organ regeneration and rehabilitation to improve people's quality of life, particularly for children to enjoy the gift of sport.



MERITORIOUS SERVICE AWARD FOR COMMUNITY SERVICE
Mohinder S. Grover, FEC, Ph.D., P.Eng.
PEO
A remarkable electrical engineer, Mohinder Grover has spent over 30 years helping immigrants transition to Canadian life and has enhanced society through his tireless volunteer work. He has guided international engineering graduates to licensure in Ontario through 13 years of volunteering on PEO's Experience Requirements Committee. He has also been a mentor for newcomers to Canada since 2004 through Skills for Change, helping immigrants and refugees access and fully participate in the workplace.



AWARD OF JOURNALISM EXCELLENCE IN ENGINEERING
Tyler Irving
A science writer for *Canadian Chemical News* (*L'Actualité chimique canadienne*), Tyler Irving's award winning article "Nature's Industrialists" offers accurate, informative and engaging science journalism. It focuses on advanced research in biotechnology as applied to engineering challenges, specifically the use of microbial biotechnology to create 'forest biorefineries.' A chemical engineering graduate from Queen's University and the University of Toronto, Tyler's engineering research was related to bioprocessing and biotechnology.





Engineers Canada gratefully acknowledges the sponsors of the 2013 Engineers Canada Awards:



For more information on the program, award recipients and eligibility criteria, visit www.engineerscanada.ca



The Engineers Canada scholarship program

Launched in 1973 with five \$2,000 scholarships, the Engineers Canada scholarship program has grown to seven annual cash prizes totalling \$70,000 awarded to Canadian professional engineers who are building on their engineering background by returning to school to pursue advanced academic studies.

Three Engineers Canada-Manulife Financial scholarships, valued at \$12,500 each, provide financial assistance to engineers returning to university for further study or research in an engineering field.

Three Engineers Canada-TD Meloche Monnex scholarships, valued at \$7,500 each, support further study or research in a field other than engineering that favours knowledge-enhancing performance in the engineering profession.

The Engineers Canada-TD Meloche Monnex Léopold Nadeau scholarship, valued at \$10,000 and created in honour of the late Léopold Nadeau, past executive director of Engineers Canada, is awarded for further study or research in the area of public policy development.

The scholarships are presented at a ceremony in Ottawa each October.

For more information on the program and its eligibility criteria, visit
www.engineerscanada.ca/e/pr_awards_2.cfm.



APPOINTMENT NOTICE

W. James Beckett, FEC, P.Eng.



Engineers Canada is pleased to announce the election of W. James Beckett, FEC, P.Eng., as its president for the 2013-2014 term. In the coming year, Mr. Beckett and the Engineers Canada Board will support the organization's constituent associations to advance the engineering profession and its self-regulation in the public interest.

Mr. Beckett was born and educated in Edmonton, Alberta. He attended the University of Alberta, where he obtained a B.Sc. (with distinction) in electrical engineering. He was a member of the university's Board of Governors and the university's Engineering Advisory Board, and has been the Alumni Association's president, vice-president and faculty advisor.

Jim spent more than 37 years working with the ATCO Utilities Group, rising to the position of executive vice-president, regulatory and chief regulatory officer, and is now principal at Beckett Consulting.

He is a life member of the Association of Professional Engineers and Geoscientists of Alberta, was the Association's president in 2009-2010 and has represented the Association on the Engineers Canada Board since 2010. He has been a member of the Engineers Canada governance and audit committees, and is currently a Board representative on Engineers Canada's Canadian Engineering Accreditation Board, and a member of the organization's Executive Committee, Finance Committee and the Canadian Engineering Leadership Forum.

www.engineerscanada.ca