Spring 2012 www.engineering.ualberta.ca

U of A Engineer

Keeping in Touch with Alumni

Rebuilding SLAVE LAKE

Through Old Testament torment to a miraculous rebirth, Brian Vance has been calm in the eye of a storm

Right on Track: Edmonton's LRT

Tapping into Unbridled Creativity

Engineering the Earth

Message from the Acting Assistant Dean External Relations

Connections count

Developing and maintaining relationships is the cornerstone of everything we do in the Faculty of Engineering's External Relations Office. For many years, we have had the privilege of getting to know many of you, our alumni and industry partners and friends, through numerous events and activities planned throughout the year. Our events are designed to bring people together, keep everyone up-to-date about the faculty and encourage your involvement in various aspects of the work being done at the Faculty of Engineering.

Engineers have a strong, long-standing tradition of expressing professional pride. This spirit continually inspires us to find new and better ways of maintaining our relationships with you and of offering new opportunities for you to stay connected to your former classmates and current colleagues.

This year, the University of Alberta Alumni Weekend 2012 will be held on campus from September 20 to 23 and we encourage all of you to attend the festivities. The weekend is open to all graduates from all years, as well as those celebrating a milestone graduation anniversary (that is, a graduation year that ends in a "2" or "7"). More details are listed on pages 10 and 11 of this issue.

In addition to the many U of A campus-wide events scheduled for Alumni Weekend 2012, we welcome you to attend the many engineering-specific events we have planned for you during the weekend, such as the Dean's Reception, Engineering Expo, engineering department tours, interesting lectures and information sessions and much more. Historically, our engineering alumni have been well represented and we are looking forward to a similar turnout this year.

And as always, with the assistance of our local alumni hosts, we will continue hosting our annual engineering alumni receptions in more cities than any other faculty. I encourage you to watch your mailbox or check out our engineering events calendar at www.engineering.ualberta.ca for dates of receptions near you.

The growth of the Faculty of Engineering over the past 104 years, and particularly in the last decade, would not have been possible without the advocacy and support of our alumni and industry partners and friends. You play a key role in the success of the Faculty of Engineering, the university, your profession and your communities. The External Relations Team appreciates every opportunity we have to meet you, work with you and respond to your needs as alumni.

I look forward to seeing you at our events throughout the year, and I hope you enjoy this issue of the *U of A Engineer*.

Laurie Shinkaruk
Acting Assistant Dean, External Relations

UofA Engineer
Spring 2012 Issue 32

U of A Engineer is the Faculty of Engineering alumni magazine. It is published twice a year by the Dean's Office and is distributed to Faculty of Engineering alumni, friends, students and staff.

Dean of Engineering
David T. Lynch
(PhD Chemical '82), PEng

Acting Assistant Dean, External Relations
Laurie Shinkaruk

External Relations Team
Nena Jocic-Andrejevic, Linda Kelly, Corinne Longoz, Leanne Nickel, Cindy Spears, Trevor Wiltzen

Publisher/Managing Editor
Richard Cairney

Copy Editor
Karen Sherlock

Art Direction
Halkier + Dutton Strategic Design

Contributing writers and photographers
Andrea Collins, Isabelle Gallant, Jimmy Jeong, Larry Johnsrude, Judy Monchuk, Richard Siemens

Send Comments to:
Richard Cairney
Faculty of Engineering
E6-050 Engineering Teaching and Learning Complex
University of Alberta
Edmonton, AB T6G 2V4
Tel: 780.492.4514 or 1.800.407.8354
Fax: 780.492.0500
email: richard.cairney@ualberta.ca
Website: http://www.engineering.ualberta.ca

Change of address:
cindy.spears@ualberta.ca

Publications Mail Agreement
No. 40051128

Return undeliverable Canadian addresses to:
Faculty of Engineering,
University of Alberta
E6-050 Engineering Teaching and Learning Complex
Edmonton, AB T6G 2V4

UNIVERSITY OF ALBERTA

FACULTY OF ENGINEERING

VISION To be one of the largest and most accomplished engineering teaching and research centres, a leader in North America.

MISSION To prepare top-quality engineering professionals, to conduct world-leading research and to celebrate the first-class reputation and outstanding accomplishments of alumni.

VALUES Dedication, integrity, professionalism and excellence in teaching, research and service to the global economy and community.

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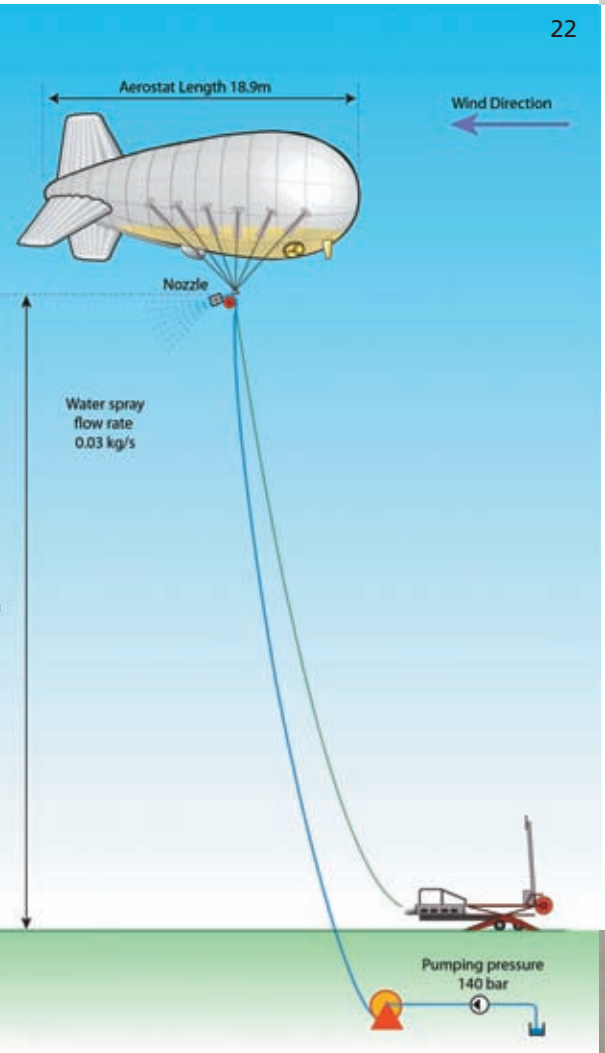
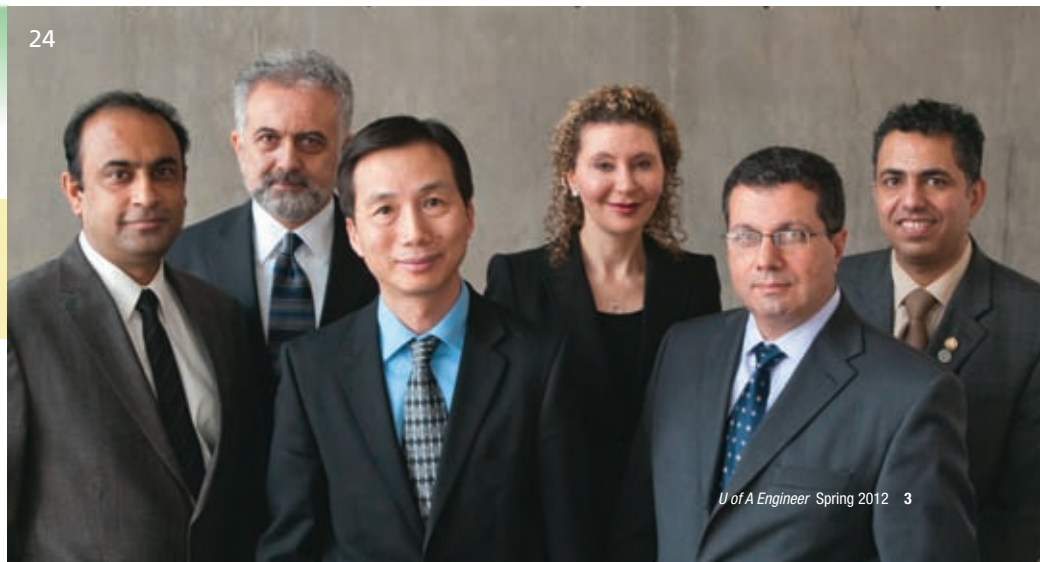


COVER STORY



DEPARTMENTS

On the cover:
Brian Vance (Mechanical '81) tours a Slave Lake neighbourhood being rebuilt after a wildfire ravaged the town.
Photo by Jimmy Jeong.

Message from the Editor

To boldly go...

The word "courage" doesn't leap to mind when people think about engineering. But if this edition of *U of A Engineer* has any subtext whatsoever, it is this: sometimes it takes a little courage to be successful in engineering and sometimes our courage requires a little engineering.

Getting to the point: our main feature stories spotlight engineers involved in projects that are challenging, risky and unconventional. Fresh out of her final year of studies at the U of A, Hilary Costello (Mechanical [Co-op] '10) began working towards her PhD at the University of Cambridge. This in itself is a bold move, but to then become involved in a controversial geoengineering research project takes a certain amount of spine. There aren't many engineering projects that help develop your debating skills, but Costello jumped at the chance to be involved in something big.

When a wildfire swept into his hometown of Slave Lake, Alberta, last summer, Brian Vance (Mechanical '81) stayed in town while his family fled to safety in a mass evacuation. As chief administrative officer, Vance holds the town's highest unelected office and shows, along with his fellow residents, that rebuilding is a quiet, dignified demonstration of courage.

In today's political climate, the difficult road to travel is not in posturing and pointing out problems, but in rolling up our sleeves and finding solutions. This is especially true with emotionally charged energy and environmental issues, and four of our six new NSERC Industrial Research Chairs featured in this edition are involved in projects aimed at reducing the petroleum industry's environmental impact. The discoveries they make and the knowledge they share will have profound impacts far beyond their labs.

The other two new research chairs are revolutionizing the construction industry with research on modular construction, which is having a jaw-dropping impact on waste reduction and efficiency, and in leading-edge research developing intelligence tools that are helping construction managers make better decisions.

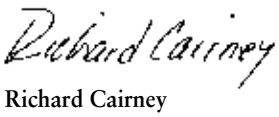
Our partners in these initiatives are also demonstrating a little chutzpah. Not willing to settle for the status quo, bold—even outrageous—steps toward innovation are being taken by our partners in industry and government.

Which brings us neatly to the subject of governance and politics. Who among us has the courage of conviction to run for public office? Three engineering alumni who have served as members of Parliament talk about their experiences in office and consider the unique skill set engineers bring to public service. This threesome also ponders the reasons there are so few engineers in public office. It's surely not a lack of courage. They serve as role models for us all; it matters not where you stand politically but what you do to serve your community.

The same can be said about engineering. As one of our fourth-year engineering students recently said: "I know I can do my engineering job but I also know I can do more than that. I can use my skills to make things better for others."

It's what so many of you do—make things better for others.

Enjoy this issue of *U of A Engineer*. If you have any story ideas, comments or questions, email me at editor@engineering.ualberta.ca.



Richard Cairney
Editor

picture PERFECT

Send us your submissions for the Faculty of Engineering's 2013 wall calendar. The theme for this year is ***Engineering Defined***. Send us photos that define, for you, what engineering is all about.

Submission deadline is May 1, 2012.
Send your submissions to editor@engineering.ualberta.ca.

To receive your copy of the 2013 wall calendar, sign up at www.engineering.ualberta.ca/wallcalendar.

Dave Clark (Mechanical '87)

Rebuilding Slave Lake

Richard Siemens, U of A Creative Services

Brian Vance (Mechanical '81) holds the town of Slave Lake's highest unelected office—and is helping steer a massive recovery as his hometown re-emerges from a natural disaster.

Through Old Testament torment to a miraculous rebirth, Brian Vance has been calm in the eye of a storm

By Judy Monchuk

Brian Vance was struck by the surreal silence as he drove through the streets of Slave Lake, Alberta, in the twilight before dawn on May 17, 2011. Navigating through the smouldering ashes of homes and businesses, the destruction of his hometown was so complete it seemed to have been obliterated by a bomb.

"It just seemed so eerie," recalls Vance (Mechanical '81), chief administrative officer for the town of 6,782, nestled in the boreal forest 200 kilometres northwest of Edmonton. "There was just a sense of disbelief that it was all gone—a feeling that it can't be real."

Facing a massive task of short-term survival and long-term rebuilding,

many people simply would have been overwhelmed by the situation. Not Vance.

"I think it's part of my engineer's mind. We're problem solvers," he says. "We look at the problem and think of the resources we need to solve it. Then we determine what the best solution is and get the best people you can find."

Sounds simple. But that was an enormous order, given the devastation Slave Lake encountered in 2011. It began with an inferno so hot that homes literally evaporated in minutes. With little warning, wildfires whipped by 100-km/h winds howled through the area with ferocious speed, incinerating homes, businesses and municipal buildings, leaving a third of the town in utter ruin. Communication channels fell apart one after another: power lines were destroyed; cellphone service was overloaded; 92.7 "The Lake" FM, the voice of the community for 27 years, fell silent. The heat was so intense that chrome melted off bumpers in the firestorm.

Meanwhile, 1,200 emergency workers from the region and across the province scrambled to help save the community.

To many Canadians, mentioning Slave Lake conjures up images of disaster and heartbreak: a barren, burned-out swath of destruction; lineups of vehicles trying to evacuate, stymied by fire blocking three escape routes; neighbourhoods reduced to row after row of scorched foundations. In July, torrential rains and flooding reminded residents that life would not return to normal without a struggle. To top it all off, at the end of the year, word that arson was being investigated as the cause of the catastrophe salted the town's wounds.

The grim spectre of Old Testament torment was not the scenario Vance imagined when he signed on in March 2011 as CAO for the town he grew up in. After years travelling the globe working as an engineer, Vance brought his wife and four children home to the community where his grandparents settled and his parents still live.

As soon as the flames were extinguished, the scope of physical and emotional ruin was overwhelming: 369 houses and six apartment buildings destroyed, 732 families homeless, and more than 8,000 area residents evacuated. Gone were the new library and town office, including all the paper and computer files of town administration. Luckily, the hospital, schools and local college were spared. Miraculously, there were no deaths.

"One thing a lot of people can't imagine, and firefighters said they'd never seen, was how complete the burning was," says Vance, 53. Houses, including the home his grandparents built in 1945, dissolved in the flames. "I'm used to seeing when there's a fire, there's a frame left. The section of town that was burned was just flat. It literally melted things: melted metal."

The financial tally was astonishing: $700 million in insurance damages, with the Alberta government pledging another $289 million to cover wildfire response and to help rebuild the community. But few outside Slake Lake are aware of the colossal extent of the cleanup and recovery. Mayor Karina Pillay-Kinnee says Vance's ability to stay calm in the immediate crisis and during the unprecedented rebuilding and restoration process has been extraordinary.

"He was so new in the post. CAOs have one of the toughest responsibilities in the community," she says. It's a job that comes with a steep learning curve in the best of circumstances, never mind throwing in a crisis. And this was one for the ages. Vance's engineering education and skills turned out to be a godsend in a situation with no blueprint to follow.

"Brian's very calm, cool and logical. He was truly outstanding at keeping focus and following the procedures we did have in place: being strong when we needed him to be," says Pillay-Kinney. "He also likes to think things through before he acts."

Vance shrugs off the compliment.

"I guess I'm an optimist. I knew we'd eventually get through it. I knew we'd get the resources to finish it. We had such a tremendous group of resources and talent. We had the mayor working with the people, all the emergency people who were experts at logistics. One of the best things I could do was ask for help and accept it because it was there."

And ask he did. Vance's connections enabled him to quickly find the key people to help with the situation. Offers of aid poured in. Contacts in the engineering world offered assistance, while 65 people from other municipalities came to help for up to two weeks at a time, from administration to operations to planning. Vance enlisted pulp industry veteran Tom Boughner from British Columbia to oversee the demolition and cleanup. A critical move was bringing in his predecessor, Betty Osborne, who had moved to the town of Sylvan Lake, Alberta, to handle Slave Lake's regular CAO duties for a month. This allowed Vance to concentrate on other crises and issues that needed urgent attention.

"That decision spoke volumes," Pillay-Kinnee says. "There was so much to focus on and Brian was able to recognize that he needed help. Betty was key because she had experience with our staff and our council."

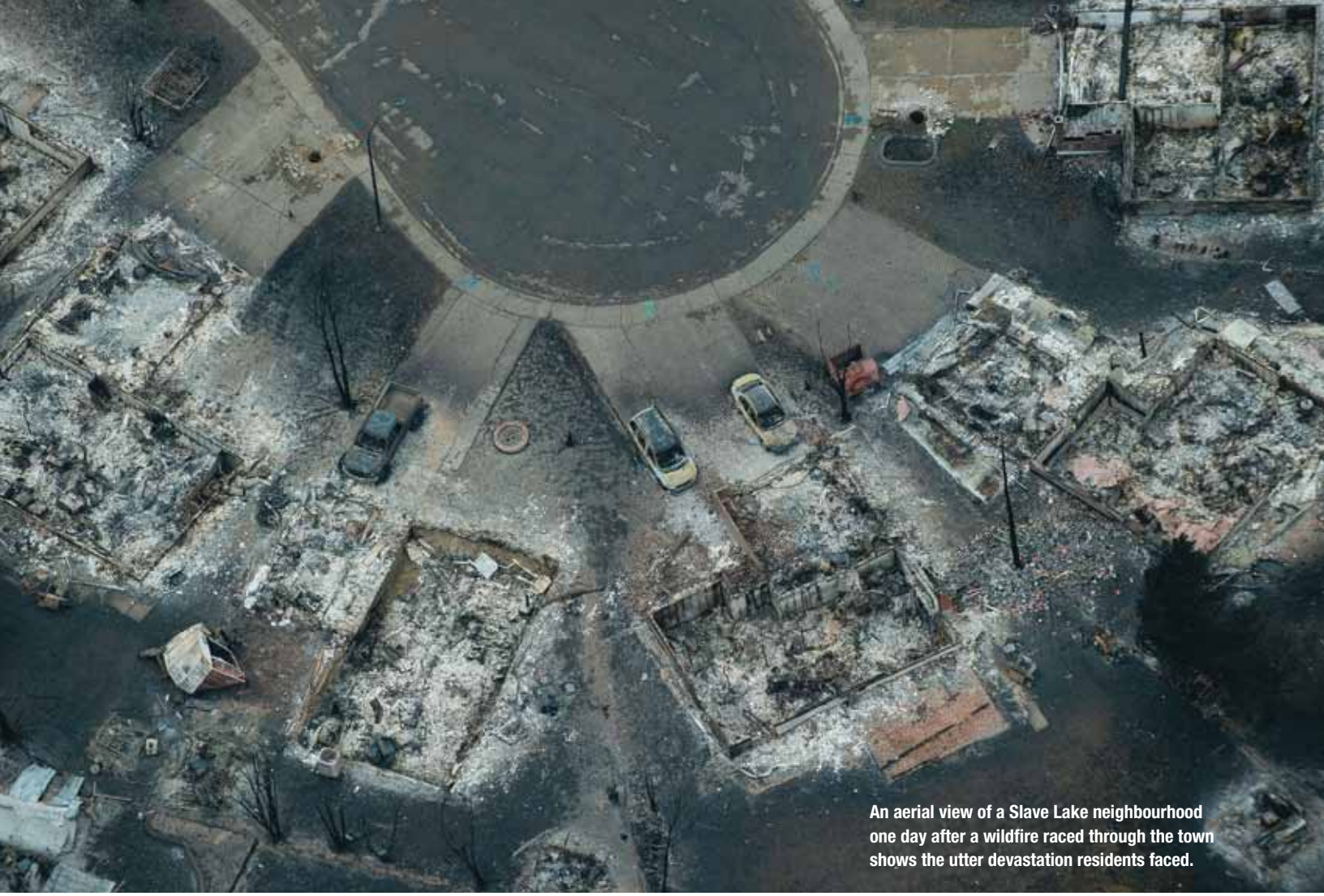
The nation chipped in. Benefit concerts were held for the town, and the Duke and Duchess of Cambridge even visited the town, raising morale.

The sheer scope of the Slave Lake recovery was staggering. Huge parcels of the municipality's infrastructure were burned out, with all the electrical and power lines needing to be replaced. Daily meetings with stakeholders continued into September to discuss updates on the status of utilities, clean-up, demolition, landfill and the logistics of planning for three subdivisions of temporary homes, including new sewer lines.

Practical considerations, such as what to do with the mountain of rotting food that residents would return to after evacuation, needed an immediate plan. "The decision was that the fridges and freezers would be sacrificed," says Vance, adding that disposal kits were created for each household. A staggering 4,500 refrigerators and freezers,

Jimmy Jeong

"I'm used to seeing when there's a fire, there's a frame left. The section of town that was burned was just flat. It literally melted things: melted metal."— Brian Vance



An aerial view of a Slave Lake neighbourhood one day after a wildfire raced through the town shows the utter devastation residents faced.

wrapped with duct tape, were set out on the streets for pickup, with 1,000 units brought to the local landfill in one day. The demand on the local landfill was unprecedented. Within the first five days, the equivalent of four months of waste was dumped, even with metals and concrete diverted out of the garbage flow. Remains from the fire and later flood damage brought a year's worth of waste to the landfill in just 10 weeks.

Among the many people Vance turned to for the rebuild were fellow U of A engineering alumni Jeff Fetter (Civil '95) and Chris Skowronski (Civil '88) at Associated Engineering, a firm that has been working with the town since 1986.

Fetter's initial look at the destruction came in the early days after the flames were out. "The first reaction was, 'Holy crap,'" he says. "Then, after the first four to eight hours, it was, 'Really, they got off very lucky.'"

Most of the major systems—the water treatment plant, wastewater treatment facilities and sewage pumping stations—were generally unaffected. That's a good thing from an infrastructure and engineering standpoint. Says Fetter: "The first step was, if we're bringing people back, where can we start putting them?"

A key logistical problem was determining how to procure materials and manpower in a province that was already in building overdrive and screaming for labour. Notes Vance: "How could you bring in a workforce of 1,000 people to build homes? Where would they go?"

Things were hectic enough before the disaster. Slave Lake was a hub of development activity, with Vance overseeing the development of a $13-million multipurpose recreation centre and a new water reservoir project. To address concerns that the area would face in the aftermath, a special tri-council secretariat of the Town of Slave Lake, the municipal district and the Sawridge First Nation was created to oversee $64 million in broader recovery projects for the region. Vance represents the town's administrative interests in more than a dozen projects, adding a slate of responsibilities akin to running another entire municipality.

Vance, Fetter and Skowronski all stress that the leadership and communication skills they learned at the University of Alberta have been key in co-ordinating unexpected scenarios. Project management has been the biggest part of making the rebuilding process of Slake Lake a success.

"A lot of people don't understand that what really helps engineers and their clients is connection. Most people don't really take engineers as communicators. Usually it's engineers who provide that communication," says Fetter, adding that it's all part of building a strong team. And in Slave Lake, a large and diverse team had to pull together to solve environmental, structural, regulatory and logistical concerns.

"Your engineering undergrad years provide you with fundamental problem-

solving skills and understanding the benefits of working as a team, finishing tasks as a team," says Fetter. "Those foundational skills you learn give you basics of building your career. Generally, you don't realize it. What you appreciate over time is that you have to take your education for the basics: problem solving, working in teams and working to solutions."

With so much work needing to be done so urgently, a sort of administrative triage system kicked in. Approvals were fast-tracked and red tape cut wherever possible. Skowronski said it generally takes about a year to examine an area, design what's needed and put an application process in place. "We had to do that in about a month," he says. "It was very much compressed. We also had to free up people to do that. So we did."

Where most years the Town of Slave Lake issued about 10 building permits for new houses, more than 150 were given out in 2011. By early 2012, 160 new homes were under construction, with hopes that some families will move in later this spring.

Town administrators were concerned that the frenetic work pace in a pressure-packed timeline could leave Slave Lake with a nightmare legacy of building-quality problems. Although it's ultimately the contractor, insurance company and homeowner who are responsible for any new construction, the town hired a temporary employee to inspect elevations of homes and water and power connections.

"The town can't overly interfere," says Vance. "We can put all the processes in place and try to enforce them, but it is a business relationship between the homeowner and a contractor. We can't address that."

By the Numbers

8,000
Residents of Slave Lake and area evacuated for more than two weeks

732
Families left homeless

369
Homes destroyed in Slave Lake

6
Apartment blocks destroyed

3
Churches destroyed

It isn't as if he has room on his plate. The 12-hour days of the last year are likely to continue for the foreseeable future, says the mayor.

The town is sticking to its goal of eliminating all temporary housing within two years. Yet the human cost of this transition tempers the positive success story. One in three staff in local schools lost their homes, as did half of the town council and 11 of the town's 13 doctors. Residents who chose to remain in Slave Lake have struggled to deal with the personal aspects of living. Family turmoil has meant increased demand for police and social services.

"By three years from now, we'd have to look pretty hard to find any remains," Vance says of the recovery and rebuilding process. "By then, a lot of the social issues will have settled out, as well. People will have dealt with their losses. But I'm thinking by the time they get back into their new homes… they'll be in a lot better shape. I think that will follow the physical rebuilding by about a year."

Still, as Slave Lake approaches the first anniversary of the wildfires, the physical rebirth of the community is striking. Driving through the southeast sector of the town, the new two-storey homes replacing burned-out 1970s bungalows generates a sense of excitement.

"It's impressive when you go through there now, to see how far we've come in just months," says Vance.

"When we looked at it before, it was discouraging. There was nothing but destruction. Now it's all new. There's new activity. People are starting to get happy about their houses. You can see it coming together."

Alumni Weekend 2012

Thursday, September 20, through Sunday, September 23

Momentum is growing as we prepare for an exciting gathering of our alumni!

Each year, the Faculty of Engineering's External Relations team works with the U of A's Office of Alumni Affairs to put on a great weekend of activities for engineering alumni to enjoy. This year we are preparing to celebrate special anniversaries for anyone who graduated in years ending with "2" or "7," as well as welcome all of our alumni back to our beautiful green-and-gold campus.

As with last year, the U of A's Office of Alumni Affairs will not be mailing out a full brochure with event information—all information will be posted on its website. However, to ensure you have all the information you need for events hosted by the Faculty of Engineering, we will be mailing out an Engineering Alumni Weekend 2012 brochure in June to all alumni celebrating special anniversaries, as well as to all local alumni, regardless of their graduation year.

We hope you attend the many great events we have designed particularly for you during this very special time on campus. Those who come are glad they do!

External Relations Team Contacts – Alumni and Individual Class Reunions

In addition to the Faculty of Engineering special events planned for all engineering alumni and those celebrating a milestone anniversary year, many engineering reunion classes will be holding private class dinners, social evenings or other events throughout Alumni Weekend. For specific information on individual engineering class events, please contact the External Relations department facilitator as noted below or visit our alumni web page for more information at www.engineering.ualberta.ca.

Chemical, Materials, Metallurgical, Mineral

Contact: Leanne Nickel 780-492-4159 or leanne.nickel@ualberta.ca

Civil, Environmental, Mining, Petroleum

Contact: Trevor Wiltzen 780-492-4004 or trevor.wiltzen@ualberta.ca

Electrical, Computer, Engineering Physics

Contact: Corinne Longoz 780-492-6192 or corinne.longoz@ualberta.ca

Mechanical

Contact: Linda Kelly 780-492-4160 or linda.kelly@ualberta.ca

Faculty of Engineering Alumni Special Events

Note: All Engineering Alumni Weekend events are FREE to alumni and their guests. Unless otherwise noted, all our events will take place in the Solarium, located on the 2nd floor (Maier Learning Centre) of the Engineering Teaching and Learning Complex (ETLC).

Friday, September 21

Class of 1952 Engineering Alumni Luncheon 11 a.m. to 2 p.m.

Faculty Club, Papaschase Room

All engineering graduates from the Class of 1952 and their guests are invited to celebrate their 60th anniversary and reminisce with their classmates at a private lunch hosted by David Lynch, dean of engineering. Graduates from before 1952 are also welcome!

Dean's Engineering Reception 4:30 to 7 p.m.

Dean David Lynch invites all engineering alumni and their guests to kick off Alumni Weekend by joining him at his annual evening reception in the Solarium. Along with enjoying complimentary *hors d'oeuvres* and refreshments and a brief formal program beginning at 5:30 p.m., this event provides a great opportunity to reconnect with old classmates and friends, professors and professional colleagues.

Saturday, September 22

Dean's Engineering Alumni Brunch 9 to 11 a.m.

All engineering alumni who graduated in 1967 or earlier, along with their guests, are invited to attend a complimentary hot brunch hosted by Dean David Lynch. Reunion class photos will be taken during the brunch.

Engineering Expo 10 a.m. to 3 p.m.

ETLC (Engineering Teaching and Learning Complex)

The Faculty of Engineering welcomes alumni, prospective students, parents and guests to Engineering Expo 2012. Take in displays from our Engineering departments and student groups and attend free lectures on topical engineering-related subjects. Tours of the engineering buildings will be available. For tour times, visit www.engineering.ualberta.ca or phone 780-492-7050 after June 1.

Engineering Cocktail Reception 5:30 to 6:30 p.m.

Shaw Conference Centre

If you are attending the University of Alberta's Alumni Dinner and Dance (ticketed event) on Saturday evening, plan to come a little earlier for the complimentary Engineering Cocktail Reception. It's a great place to socialize with other engineering alumni prior to sitting down with your classmates for a great dinner.

Class Reunion Organizers

The engineering alumni below have enthusiastically volunteered to be class reunion organizers for Alumni Weekend 2012. If you are a member of one of the classes listed below, you may already have received a call or email regarding plans for the reunion of your class. If not, please contact Leanne Nickel at 780-492-4159 or **leanne.nickel@ualberta.ca** to find out how to get in touch with your class organizer. If your class is not listed, you may want to consider volunteering to help ensure you don't miss a great opportunity to get together!

1952 Chemical Engineering
Bill Laureshen

1952 Civil Engineering
William (Bill) Boytzun

1952 Electrical Engineering
Robert (Bob) Choate

1957 Chemical Engineering
Fred Otto

1957 Civil Engineering
(Jasper - October 2012)
John Burrell, Douglas Ferrier, Bill Lee

1962 Electrical Engineering
James Spalding, Rick Kampjes

1962 Mechanical Engineering
Walter Germaniuk

1967 Chemical Engineering
David McNeil

1967 Civil Engineering
John McDougall, Ron Neuman, Peter Rivers

1967 Electrical Engineering
Peter Van der Zee

1972 Chemical Engineering
James Smith

1972 Civil Engineering
(Jasper - April 2012)
James Pyesmany

1977 Mechanical Engineering
Ed Howes, Paul Humphreys, Claus Littmann

1977 Mineral Engineering
Bernie Goruk

1982 Civil Engineering
Gary Evans

U of A engineers are behind an unprecedented period of expansion for Edmonton's LRT system

BY ANDREA COLLINS

right on Tr

When Edmonton's Light Rail Transit system opened in 1978, it was the first system in North America in a city with a population of less than one million. Built to accommodate the crowds attending the Commonwealth Games in Edmonton that year, the LRT was as much a cause for civic pride as hosting the Games.

Fast forward 30 years and the LRT didn't look all that different. The original north-south line—which ran from Belvedere to the Coliseum and Commonwealth Stadium and on to two underground stations downtown—had a few kilometres of track added and a few new stations installed, but the next major expansion wasn't until 1992, when the system was extended across the North Saskatchewan River to the University of Alberta.

This was a complex engineering challenge that required tunnelling below the surface to the deepest depth in the system and matching the variable grades between the river's north and south banks.

That feat will be replicated when another major LRT bridge is constructed from the east side of downtown across the North Saskatchewan to a point near the Muttart Conservatory. It is the pivotal project in a major southeast-west artery that will stretch from Mill Woods in the city's southeast to Lewis Estates in the far west end.

"This bridge is part of an LRT megaproject," says Nat Alampi (Civil '03), engineering project manager for this LRT section. "There will be a lot of geotechnical investigation required to ensure the stability of the banks, and value engineering will be performed to no end. We will need to determine the optimal bridge length, the best point of entry into the north bank and the options that are the most effective, while at the same time keeping costs in check.

"Initial field data collection required for preliminary engineering of Phase 1 is expected to take four to six months, so it will be a while before work begins on design concepts.

Jimmy Jeong

ack

Nat Alampi (Civil '03) and Adam Laughlin (Civil '00) are in deep on LRT projects in Edmonton. The two are playing major roles in unprecedented expansions of the city's public transit system.

"We always develop several concepts for consideration," Alampi says. "One option being considered is to remove the pedestrian/cyclist footbridge now linking the Muttart Conservatory and Louise McKinney Park, and replace it with a dual-purpose LRT and pedestrian/cyclist bridge. In that model, we would be taking an existing transportation corridor and modifying it in order to minimize our environmental footprint."

"A single LRT line has the capacity to accommodate the equivalent of six lanes of vehicular traffic."

— ADAM LAUGHLIN

The bridge and the southeast-west artery are only part of the massive plan for LRT expansion encapsulated in the City of Edmonton's LRT Network Plan adopted in June 2009. The long-term plan defines the size, scale and operation of the LRT system to 2040, part of a new vision for transportation that includes neighbourhoods modelled around LRT stations, complementary parking and bus service, bicycle lanes and pedways—all aimed at reducing residents' over-reliance on vehicles.

"The current LRT expansion is about much more than moving people; it's part of a bigger vision for our city," says Adam Laughlin (Civil '00), until recently the director of facility and capital planning for the City of Edmonton. That vision is contained in *The Way Ahead*, the city's strategic plan, and detailed in the transportation master plan approved by city council in 2009, which "balances our long-term transportation needs with a commitment to grow green and create a compact, more integrated urban environment where roads move goods and transit moves people."

The plan calls for an urban LRT design with frequent train stops that are integrated into the surrounding area. The tracks primarily will be dedicated surface lanes that will not mix with traffic, except when crossing intersections, with speeds consistent to roadway speed limits. Why not use elevated lines like the Monorail in Seattle or an underground system like the New York Subway? Cost, safety and convenience are the factors cited by Laughlin. "An underground system would cost five to 10 times more to build and an elevated system, three to five times as much. Both add a level of separation that is inconvenient for riders."

Other features include low-floor train cars that accommodate bicycles, baby strollers and mobility aids and LRT tracks designed to minimize noise and vibration. Train stops will incorporate visual elements that minimize intrusion, maximize openness of space and reflect the culture of the neighbourhood. This means engineers and planners such as Laughlin also need to be well versed in landscaping, streetscaping and architectural features such as art and street furniture.

"A single LRT line has the capacity to accommodate the equivalent of six lanes of vehicular traffic," says Laughlin. "A train can carry approximately 700 people a long distance in a short time span. That means less traffic congestion, shorter commuter travel times, cleaner air and reduced costs for road repairs. We want to become a transit-oriented city based around neighbourhood transportation hubs where people meet, visit, shop and live."

The current LRT expansion began with the construction of 8.2 kilometres of new track, starting with an expansion from University Station to the University of Alberta Hospital in 2006 and then heading south, ending at Century Park (23 Avenue), where major residential and commercial services are being built on the old Heritage Mall site. Completed in 2010, the new south line has three major LRT hubs: University of Alberta, Southgate Mall and Century Park, which is designed to be a transit-oriented residential and service complex. Convenient bus-LRT connections can be made at all three sites. When opened in 2010, the new south route instantly proved itself with higher-than-anticipated ridership, which was resolved quickly by adding more train cars. The number of weekday LRT boardings increased from 74,400 in 2009 to 93,600 in 2010.

City of Edmonton

These renditions show a proposed LRT station near the Muttart Conservatory, south of the North Saskatchewan River; and right, a view of the planned LRT route along Stony Plain Road.

LRT expansion will see a new line running along 102 Avenue.

Anticipating use is one of the big challenges for LRT planners and engineers. As Alampi points out, "We need to design for the number of riders we'll have in 30 to 40 years, and make the infrastructure durable enough to last 100 years. You can't build enough roads to accommodate a major influx of vehicles as a city grows, but you can add train cars and frequency. That's the beauty of LRT: it can expand or contract as needed."

Building frequent stops into the design will encourage use outside of rush hour. "People with flexible schedules or who don't work are more likely to use the LRT midday if it's right around the corner," says Alampi. "The LRT has to be accessible, comfortable and convenient for people to want to ride it." It's also important to integrate into the design park-and-ride locations, express bus connections and links to pedestrian and cycling corridors.

Determining which leg of expansion comes first is another major decision. "Our initial evaluation for each project is broad based; it needs to consider land use, movement of people and goods, the natural environment, the feasibility of constructing the proposed route, the impact on parks and the river valley, and the social environment," says Laughlin. For example, the new south line was chosen as the initial project in the expansion plan because the land for the LRT end destination was in place and the proposed route was relatively level and barrier-free.

The second major LRT project, now under construction, is a downtown expansion northwest from the Churchill Station to NAIT, scheduled for completion in 2014. Though it adds only an additional 3.3 kilometres of track to the system, it presents several technical challenges. It needs to link downtown's underground system to an above-ground system and it bisects an area dense with businesses, highrise residential buildings and post-secondary institutions.

One unique aspect of the design is the tunnel below the recently constructed EPCOR Tower. City staff worked with the tower developer to jointly design and build their respective portions of the infrastructure—the LRT will pass between the foundation's support piles—resulting in construction efficiencies and mutual cost savings. The line begins to emerge from this tunnel as it approaches the MacEwan University station, where it is still partially below ground. It then rises to the surface for stops at the Royal Alexandra Hospital and Kingsway Mall before reaching NAIT.

Churchill Station will remain the major LRT downtown interchange that connects the existing system to its future branches. The plan calls for the station to be revamped with elevators, escalators, stairs,

well-lit platforms and security systems for people coming to and from street level. This station and others on the line will have additional amenities such as bike lockers for cyclists.

The next project will be the southeast-to-west LRT line managed by Alampi. Preliminary engineering is now underway and scheduled for completion in 2013. Phase 1 will see the line cross the North Saskatchewan River from near the Shaw Conference Centre to the Muttart Conservatory and then on to Bonnie Doon Mall. It will then continue south on 83 Street, passing through the residential communities of King Edward Park and Avonmore and a large industrial area, to a major transit centre at Whitemud Drive and 75 Street. This station will include Edmonton Transit's operations and maintenance facility for the new LRT system, and a regional park-and-ride facility. The line will then continue into Mill Woods.

"There will be more than one generation of engineers who will work on it..."

— NAT ALAMPI

There are two major technical challenges in this project: the river crossing, where both the bridge and tunnel sections must be designed to accommodate the differences in grades between the higher north river bank and lower south bank, and another significant bridge-and-tunnel section crossing Argyll Road, Mill Creek Ravine, 75 Street and the CN and CP rail tracks. Although this phase represents only one-third of the length of the total 27-kilometre leg of the LRT expansion, it is by far the most technically difficult.

Phase 2, the west line, will be built from downtown to Lewis Estates, crossing through the Stony Plain Road Business District to West Edmonton Mall, where its only elevated section will deposit riders on the second level of the mall and the Misericordia Hospital.

Trouble spots need to be identified early to avoid problems. For example, in the southeast-west LRT project, one option being considered is to run the new downtown segment of the line past the Citadel Theatre and Winspear Centre. Sound quality is essential to both performing arts centres, and the Winspear contains a recording studio. Planning engineers may need to develop alternative track structures to minimize noise and vibration, and, while doing so, consider the noise and activity expected in future, not just today.

More growth will follow: expansion of the new south line to Ellerslie Road at the outskirts of the city; extension of the northeast line to developing areas; extension of the north line beyond NAIT to serve the City Centre Airport redevelopment, northwest Edmonton and the City of St. Albert; and perhaps, in future, a line into Sherwood Park.

Will the LRT be extended as far as the airport?

Not at this time, says Laughlin. But Leduc County is operating a bus service from Century Park to Nisku, Leduc and the Edmonton International Airport during peak hours and it is probable that express transit service from the airport to Edmonton will be added. Indeed, the LRT plan includes premium bus service with dedicated lanes to offer express service to and from LRT stations during peak hours. The park-and-ride stations at the major interchanges will be a boon, not only to people in the suburbs, but also to people coming into Edmonton from neighbouring communities such as Devon, Sherwood Park, St. Albert or further afield.

Though the vision is exciting, it has come with a price. There has been frequent controversy when proposed routes are planned through mature neighbourhoods. The LRT planning engineers are often drawn into the maelstrom and the emotional discussions with community members. They support city council by providing technical rationale and justification for options under consideration.

"We develop different concepts and take the one approved by council out to the community for extensive consultation," says Laughlin. "This consultation process can take as long as three years for each project; it is only after it's over that we can begin to zero in on the engineering design elements."

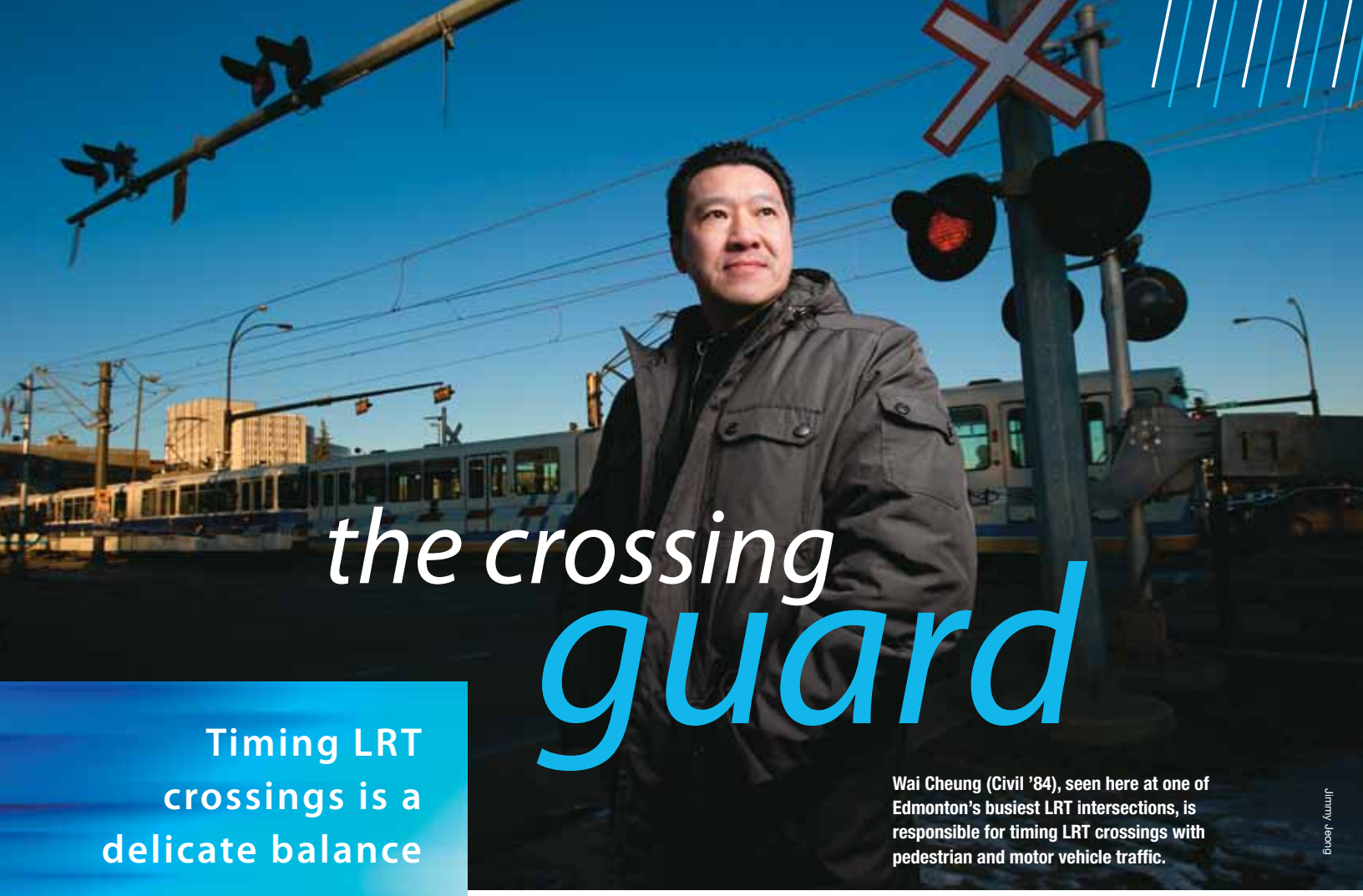
The cost is always under scrutiny by taxpayers. Each kilometre of LRT runs an average of $100 million, which includes everything from planning to construction to the purchase of land and trains (now running at $4.5 million per car). Where the work is more complex, such as the tunnel and bridge over the river, costs are even higher. There is no long-term funding source in place, meaning each stage of development requires separate funding approval.

The investment of time is also high. Take the new southeast-to-west line, for example. It has taken three years to get corridors and concept plans for the project approved, and Phase 1 will absorb another three years in design and construction procurement, and another four years for construction before the line becomes operational. Funding for construction still needs to be approved and can cause further delays. Even if funds were in place today, this new line would take until 2017 to complete. Although there are many factors that can accelerate or slow plans, planners are optimistic that the LRT network plan will be completed by its 2040 target.

For now, there is more than enough to occupy the engineers who plan and manage the complex projects in the current LRT plan, and the many others who focus on specialized functions of the design, such as acoustical engineering (noise and vibration studies are incorporated at the planning stages).

The end result is expected to be worth the investment of time and money.

"Even though I won't still be a practising engineer by the time the LRT expansion is finished, I will have had the opportunity to see many of the sections designed and constructed," says Alampi. "What I'm working on today is a legacy project. There will be more than one generation of engineers who will work on it and even more generations of people who will ride it. It's satisfying to know I'm helping to lay the groundwork for something that will benefit many people, including my own children and grandchildren."



the crossing guard

Timing LRT crossings is a delicate balance

BY ANDREA COLLINS

Wai Cheung (Civil '84), seen here at one of Edmonton's busiest LRT intersections, is responsible for timing LRT crossings with pedestrian and motor vehicle traffic.

Jimmy Jeong

Watched pots never boil, red lights never turn green and, for motorists in Edmonton, LRT crossings are always busy.

When Edmonton's South LRT line was under development, Wai Cheung (Civil '84) of the city's modelling group was given a challenge: evaluate the sequencing and timing for the crossings of vehicles, pedestrians and LRT trains and co-ordinate them in the most efficient way possible.

No pressure there, right? To get the job done, Cheung collected data he'd need and ran it through a special software package to simulate different traffic scenarios.

"We took information provided by Edmonton transit regarding the anticipated speeds and stops for the LRT trains, in conjunction with what we knew about buses, trucks, automobiles and pedestrians, and put them into our model," says Cheung. "That data was fed into the simulation and was used to co-ordinate the traffic lights and LRT crossing gates so the new LRT line would have minimal impact on traffic flow."

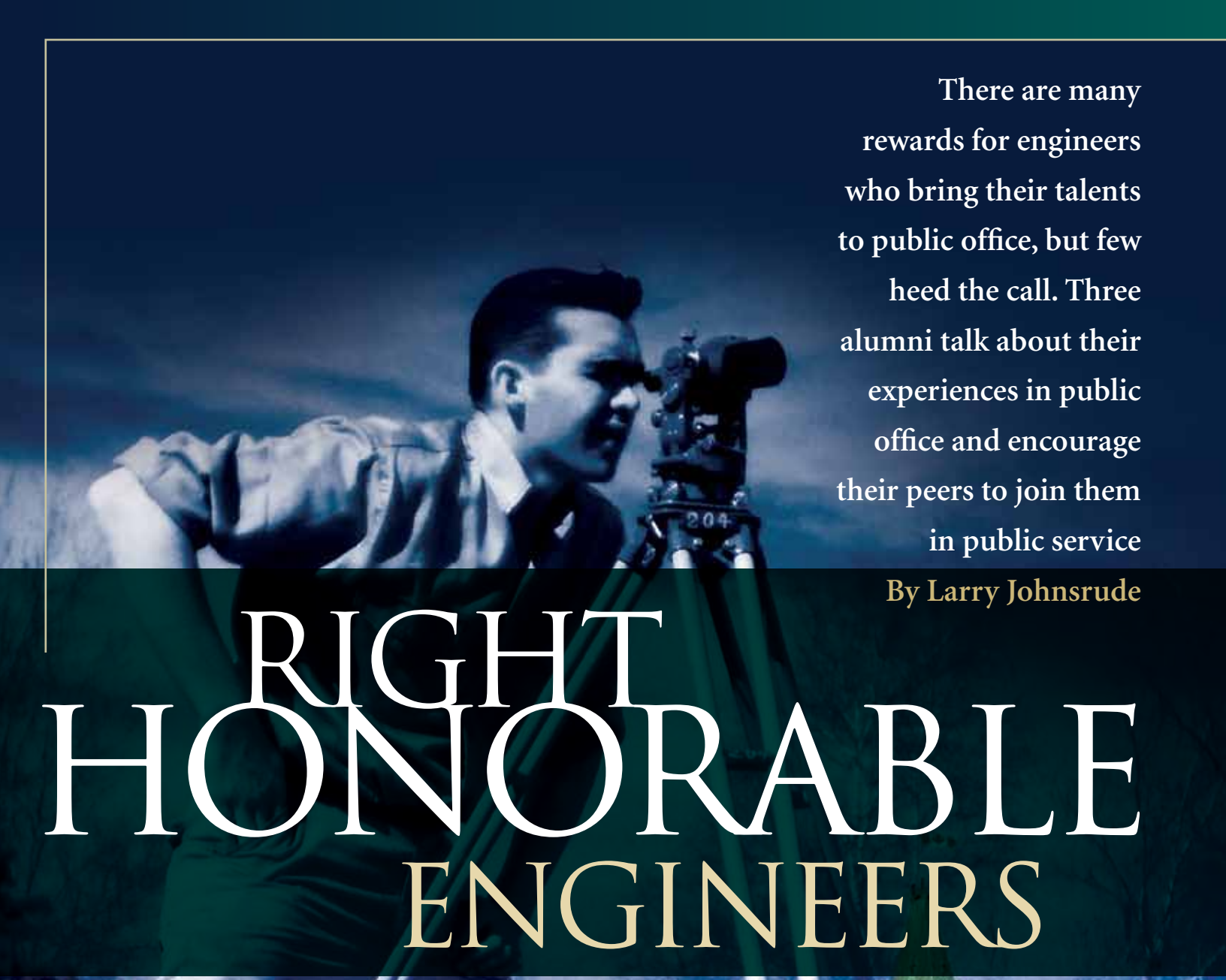
That process worked, in theory. But once the new south line opened, there was a glitch. The unexpectedly high usage of the south LRT meant that at peak times it took longer than anticipated to load and unload the train. The LRT's speed and frequency changed, resulting in a long wait for the gates to lift for vehicular traffic—sometimes as much as 15 minutes at the 51 Avenue crossing.

"The software is exacting," says Cheung. "But it can only model on the assumptions you enter, like anticipated speed and acceleration rates of each type of vehicle, or the frequency of LRT crossings. We were told that the trains on the south line would run five minutes apart and stop for 30 seconds at each station. When the high usage changed things, the south- and northbound trains passed within a few minutes of each other and that meant that the gates didn't always have time to come up between trains. The quick fix was to have the traffic signal team adjust the timings and they resolved the situation quickly. However, having this problem enabled our team to learn more about transit operations and all the parameters that need to be factored in when modelling for a new line."

Today, Cheung is working on the new LRT line that will connect downtown to NAIT, a line he expects will have fewer problems. The busiest downtown sections of the line are underground, and once the line emerges to the street level, LRT stops will be at dedicated platforms or train and transit centres built apart from roads.

"However, we've tried to consider every conceivable thing that could affect LRT speed and stop times," says Cheung. "For example, we've looked at how long it takes each conductor to walk from one end of the train to the other when they need to reverse direction at the end of the line, and we will use a range from the slowest to the fastest turnarounds in our computations."

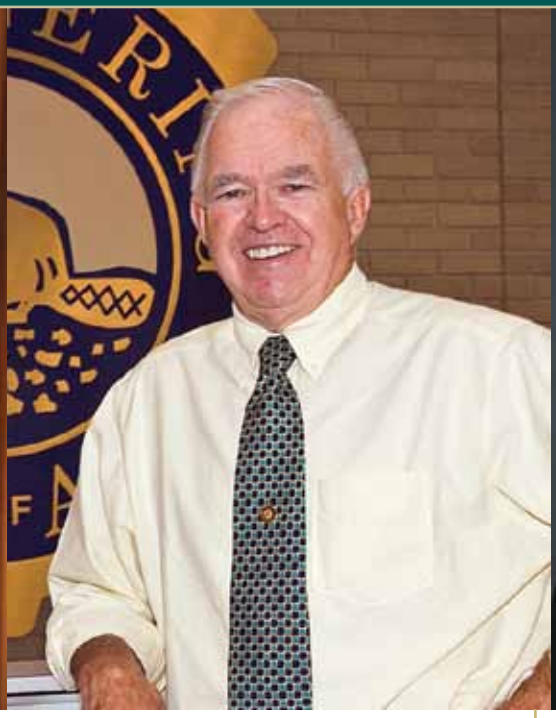
As for the next big challenge, Cheung expects it to be the southeast-to-west surface line, which is currently in the planning stage. "It's a long line with numerous surface crossings. We're looking for the optimal system for that one; good modelling will be crucial."



There are many rewards for engineers who bring their talents to public office, but few heed the call. Three alumni talk about their experiences in public office and encourage their peers to join them in public service

By Larry Johnsrude

RIGHT HONORABLE ENGINEERS



(Left to right): Harvie André (Civil '62, PhD '66) served as an MP for Calgary Centre for 21 years. Tom Siddon (Mechanical '63) served as MP for Burnaby-Richmond-Delta from 1978 to 1993. Bernard Trottier (Civil '88) was elected as MP for Etobicoke-Lakeshore in the most recent federal election.

In the satirical novel *The Best Laid Plans,* a cantankerous engineering professor strikes a Faustian deal to run for the House of Commons on the condition that there is no hope he can win. His opponent, the sitting MP in an Ottawa-area riding, is a young and good-looking cabinet minister riding a wave of local popularity. The reluctant challenger spends the campaign out of the country, refusing to debate, meet with voters or give media interviews. A recipe for failure, it would seem. But in fiction and politics (spoiler alert!) things don't always turn out as planned.

Novelist Terry Fallis's whimsical tale isn't lost on real-life engineer Bernard Trottier (Civil '88). The 46-year-old University of Alberta engineering alumnus scored a dark-horse victory of his own in the 2011 federal election with his win over Liberal leader Michael Ignatieff in the Toronto riding of Etobicoke-Lakeshore. While Cinderella-story electoral upsets like this obviously do happen, they are rare. Even more rare, however, are members of the engineering profession making the jump to elected office.

Trottier is one of only 10 MPs in the entire 308-member House of Commons who can put the initials "P. Eng" behind their names. In an environment dominated by lawyers, business people and academics, engineering is one of the least-represented professions, not just at the federal level but in provincial legislatures, as well. For some reason, engineers don't heed the call to public office in the same numbers as those in other professions. Pity that. With their instinct for building, solving problems and making things work, engineers should be a natural fit for political life.

"I don't know why more engineers aren't in politics," Trottier says, with equal amounts of disbelief and regret in his voice. "People with an engineering background do have a lot to offer. We're the kind of people who like to get things done. You present us with a problem, we review the science and gather the facts and come up with a solution. That's the kind of approach that would be very helpful in the running of our government."

> **"PEOPLE WITH AN ENGINEERING BACKGROUND HAVE A LOT TO OFFER. WE'RE THE KIND OF PEOPLE WHO LIKE TO GET THINGS DONE."**
>
> — BRIAN TROTTIER

The question puzzles other engineers-turned-politicians, as well. With his experience as a retired engineering professor, MP and cabinet minister, Harvie André (Chemical '62, PhD '66) offers some personal observations. He served as MP for the Alberta riding of Calgary Centre for 21 years. By inclination and training, he says, engineers tend to see the world in black and white, in ways that can be proved or disproved, without much wiggle room in between. But public life is more nuanced in varying shades of grey, which can be difficult for scientific purists to reconcile, he explains.

"When you're an engineer, your nature and your training is to judge things based on science and fact," he says. "In politics, it's all about compromises. Engineers find that frustrating. To be successful in politics, you have to see it from both competing points of view."

A contemporary of André's, former MP Tom Siddon (Mechanical '63), agrees. "Everything in politics is about trade-offs driven by public expectations for solutions that don't cost anything," says Siddon, also a U of A alumnus and engineering professor before entering politics. "We stand by our principles that we know are right. And that can be a hard sell when you're around a cabinet table."

That isn't to say that as engineers they weren't effective at bringing their perspectives to government. On the contrary. André, 71, who received his PhD in chemical engineering from the U of A in 1966, rattles off a list of science-based

accomplishments in his various posts in the Brian Mulroney cabinet, including service as associate minister of national defence, minister of regional industrial expansion and overseer of Canada Post, turning the money-losing mail service into a profitable Crown corporation.

"We stand by our principles that we know are right. And that can be a hard sell when you're around a cabinet table."

— Tom Siddon

One of André's earliest experiences in the triumph of science over emotion at the government level came with his introduction of controversial patent-drug legislation, which raised fears of higher drug costs. "With my background, I knew that extending patent protections was the right thing to do based on the evidence and the facts," he says. "But it became a very heated discussion because there were concerns about rising drug costs. We had to make decisions based on our analysis of the science that would also satisfy public concerns. We were able to do it but it took a certain amount of political sensitivity."

Siddon's CV from his time in Ottawa (he served as MP for the B.C. riding of Burnaby-Richmond-Delta from 1978 to 1993) weaves a pattern of scientific and political accomplishments. As minister of state for science and technology in the Mulroney cabinet, he laid the groundwork

Top: Tom Siddon, then serving as Indian affairs minister, signs the Agreement in Principle to establish the northern territory of Nunavut with Paul Quassa, president of the Tungaviq Federation of Nunavut, and Dennis Patterson, government leader of the Northwest Territories, in April of 1990. The agreement was the basis of the final settlement to create Nunavut, which Siddon concluded in 1993.

Middle: Freshly minted MP Bernard Trottier, who defeated former Liberal leader Michael Ignatieff in the 2011 federal election, is serving his first term in the House of Commons.

Bottom: Harvie André with cabinet colleagues Otto Jelinek, left, and former Mulroney finance minister Mike Wilson.

for the Canadian Space Agency and signed the international space station agreement with the U.S., making Canada a partner in space exploration. Closer to home, he engineered the creation of the new northern territory of Nunavut. He tackled the armed standoff at Oka as Indian affairs minister, and as defence minister, he piloted the controversial EH101 helicopter purchase, which was ultimately killed when the Liberals swept to power in 1993. Also in the engineering vein, the Confederation Bridge to Prince Edward Island was built under Siddon's watch.

"I've always had an instinctive interest in how things work and what keeps things running," he explains. Growing up in Drumheller, Alta., his early interest was in cars, which drove him to earn his undergrad degree from the U of A, and then a master's and PhD from the University of Toronto, before becoming a professor at the University of British Columbia specializing in acoustics and aerodynamics. "I think it prepared me quite well for politics," he says with a chuckle, "because politics is all about acoustics, noise and turbulence."

Unlike other professions, there is no direct career path for engineers to get into public life. In law, for instance, it's not much of a jump to go from arguing legal points in court to using the same oratorical skills to shape laws in Parliament, or for political science grads to adapt their academic skills to real life, or for business and salespeople to press the flesh with voters.

Engineers usually follow a circuitous route into public life. Trottier says his initial interest in politics goes back to when, as an 18-year-old growing up in St. Paul, Alta., he participated in a parliamentary internship program at the House of Commons. "I experienced a side of politics long before I was ever elected, so the idea of running for office wasn't foreign to me," he says. After graduating from the U of A in 1988, he earned an MBA from the University of Western Ontario in 1992 before going into business.

André, originally from Edmonton, became politically active in the early 1970s in a group of young Conservatives surrounding Peter Lougheed, elected as Alberta's premier in 1971. A professor at the University of Calgary's engineering faculty at the time, he won one of the city's federal seats the following year and has been a local political institution ever since. (He sold a 16-year-old Alison Redford, now Alberta's premier, her first Conservative membership.)

Siddon marched in campus protests at the U of A in the 1960s and entered elected politics through the municipal route in B.C. before jumping to the federal scene in the 1978 election.

Getting today's crop of engineers interested in political life remains a challenge. And it's not just a Canadian one. A study by *The Economist* magazine found that worldwide, the engineering profession ranked ninth in its representation in government, while lawyers were most likely by far to be in elected politics.

"We have got to cultivate role models so they [students] know it is an important part of a career and emphasize to them that public service is a worthy and worthwhile expectation in an engineer's education."
— Tom Siddon

As a political newcomer, Trottier isn't entirely convinced the exacting mindset required to be a successful engineer is too uncompromising for politics. "There's always a recognition among engineers that you can't always have 'perfect' but sometimes have to live with 'good enough,'" he says. "They are very principled people but I don't believe they always have to think in terms of black and white."

In his short time in office, Trottier says he has come to experience both the rewards and the frustrations of public life. He has drawn on his educational background to work on the government's copyright legislation, aimed at preserving intellectual property rights in the Internet age. But he acknowledges: "There are some days where I roll my eyes and think there must be better ways to use our time, and I wonder why someone has to make a 20-minute speech when he can say the same thing better in two minutes—that it's not about content but all about performance."

All three would like to see engineering students encouraged to learn about and take part in community service and public life. Siddon says students could be required to take classes on citizen responsibility or work on community service projects. "We have got to cultivate role models so they know it is an important part of a career and emphasize to them that public service is a worthy and worthwhile expectation in an engineer's education."

André wants to cut through the cynicism many young people have about politics and make it more attractive. "Nothing else out there compares to it," he says. "In politics, you're either elated or depressed. You're never bored."

U of A engineering students have opportunities to get involved in community service and governance through the Engineering Students' Society, the Students' Union and elective courses such as Science, Technology and Society. The U of A student chapter of Engineers Without Borders (EWB) provides students with opportunities to develop leadership skills, support international development and even influence foreign policy. Late in 2011, Canada signed the International Aid Transparency Initiative committing to more effective Canadian aid; EWB student and professional chapters had been encouraging the federal government to become a signatory to the document.

André says if politicians thought more like engineers, and if people in engineering, science and business had a broader understanding of how politics works, they might be better at solving problems before they happen. He cites the recent decision by the Obama administration in the U.S. to delay TransCanada's Keystone XL pipeline, and says all levels of business and government should have been better prepared for the environmental backlash.

"The technology of the project was pretty strong but the politics wasn't," he says. "They (TransCanada) thought it was a good project, and from an engineering standpoint, it was. But they would have played it a whole lot different if they hadn't thought it was going to be a slam-dunk. There are concerns out there—the kind of political reasons that have nothing to do with logic."

ENGINEERING THE EARTH

Geoengineering is a relatively new concept that pushes technical and ethical boundaries. That's why Hilary Costello is so passionate about her PhD project. BY RICHARD CAIRNEY

Jason Franson

Hilary Costello (Mechanical [Co-op] '10) remembers the engineering ethics sections of her Engineering 100 and 400 courses but never imagined she would one day be part of a research project that is embroiled in controversy. Now working towards her PhD at the University of Cambridge as a Churchill Scholarship recipient, Costello is part of an interdisciplinary, multi-university project established to assess the viability of geoengineering the Earth's climate. The Stratospheric Particle Injection for Climate Engineering (SPICE) project is investigating the feasibility of pumping reflective particles into the stratosphere to cool down global temperatures. The project is rife with technical and ethical challenges—and those are precisely the reasons Costello chose to take part in it.

"When I first arrived at Cambridge, I really didn't know exactly what I'd be doing. My supervisor offered me other opportunities on other projects, but this one, just in terms of its technical aspects and the theory involved, was challenging because I'm interested in aerodynamics and dynamics and then, on top of the engineering, it is an interesting project in terms of the ethics and politics," she says.

"I can tell anyone what I'm working on and get into a discussion about it, whether it's technical or not. The research encourages people to think about climate change."

Costello is part of a large research initiative: SPICE is a collaborative effort involving the universities of Cambridge, Oxford, Bristol and Edinburgh and the private-sector firm Marshall Aerospace. Succinctly put, SPICE is investigating the possibility of using a balloon to lift a pipeline 18 to 20 kilometres above the Earth's surface and release small particles into the stratosphere to reflect solar radiation and cool the Earth's temperature by perhaps 2 C. The project is inspired by naturally occurring events, specifically volcanoes, which spew sulphate particles into the stratosphere. In 1991, Mount Pinatubo in the Philippines erupted, releasing 10 million tonnes of sulfur into the stratosphere, cooling the Earth's surface the following year by 0.5 C on average.

SPICE represents a monumental engineering task. Costello, for her part, is studying the dynamics of the pipe, which would also serve as the balloon's tether. Specifically, she is investigating ways to reduce drag on the tether by using non-cylindrical shapes. While solving some problems, using aerodynamic shapes potentially introduces other issues, such as flutter.

"There is another PhD student working on the (pipe) material—he is investigating the use of a fibre similar to Kevlar, and I am looking at the dynamics and vibrations: for example, how the tether interacts with the environment and with the internal flow."

Costello says the research group expects to conduct a technology test in the near future. A tethered balloon will lift a 1.3-centimetre-diameter hose one kilometre above the ground at an abandoned air field north of Cambridge University. Over the course of a week, about enough water to fill a bathtub would be pumped up through the hose. The test would serve to validate Costello's mathematical models and allow

researchers to observe the way the hose and balloon behave over time and in changing weather conditions.

But given the controversial nature of the project, the test, originally scheduled for October 2011, has been postponed to allow for further public consultation. This turn of events illustrates the sensitive nature of the research and the importance of public consultation.

"There are so many different facets of academia involved in the project—climatology, engineering, chemistry—and there are a lot of social scientists, as well, because there is a big public-engagement aspect to the project," Costello says, adding that she has attended focus groups to discuss SPICE with members of the public. This aspect of SPICE is conducted by social scientists, adding to the interdisciplinary nature of the work.

"They choose their words very carefully so that they are not asking questions that are loaded or weighted to either side of the case," she says. "The stakeholder-engagement portion of the project is really interesting but also sometimes frustrating because information can be easily twisted or even just misunderstood—especially with something that is so controversial. It is really easy for people to quickly say 'no' or 'yes' but I don't think geoengineering is a yes-or-no question. I can see both sides of the argument.

"A lot of people are concerned that we are doing this research because we want to do geoengineering, when in fact, we are doing it to determine the positive and negative effects of geoengineering and answer questions such as, 'Is this feasible?' And 'Do the positive effects far outweigh the negatives?' "

Those opposed to engineering the climate cite a variety of reasons for their position. One argument Costello feels presents the most valid point is the fear that if geoengineering works and mitigates the warming effect of CO_2 emissions, individuals and industries will feel they have "permission" to follow a business-as-usual approach to greenhouse gas emissions.

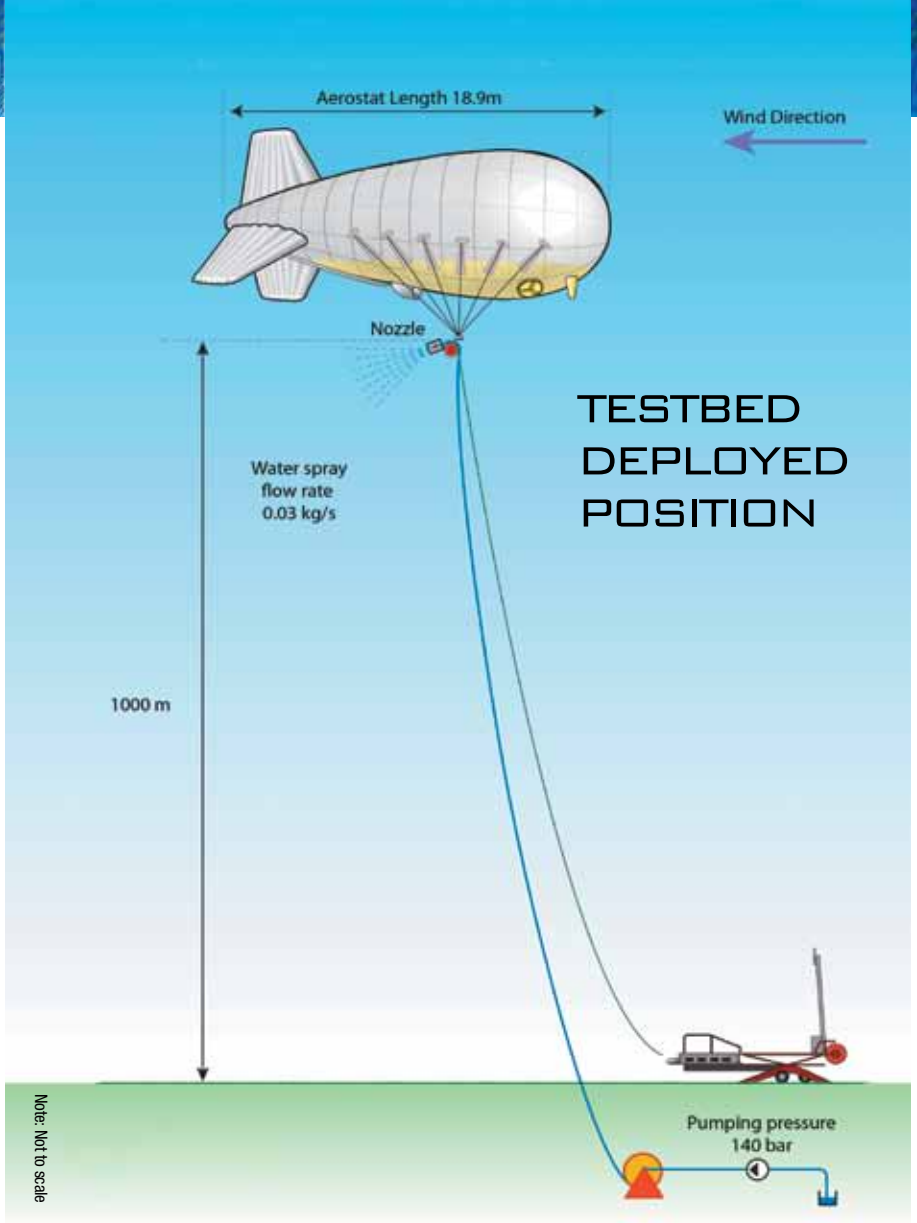
She dismisses the argument that geoengineering research shouldn't be done at all because it is an "enabling" technology—that the research per se will somehow cause geoengineering to be put into practice.

"None of the people involved in this are advocates of geoengineering," says Costello. "We are advocates for researching geoengineering. None of us is saying 'Let's go out and do this tomorrow.'

"The project itself is trying to deem if this is something that is safe. If unabated climate change is likely to cause catastrophic change and coastal cities will disappear, then, potentially, something like this might be important to do. I don't think it would be an ultimate solution, but some people argue it [the research] is ethically wrong."

For the next two years, Costello will continue to wrestle with the complex technical challenges the SPICE project presents while pondering its complex ethical dimensions. All in all, she says, it's a perfect combination.

"Especially in terms of doing a PhD, it is an opportunity for me to step out of my comfort zone and try something that is different," she says. "It has technological challenges but also encompasses some of those ethics we covered in the ENGG 100 and ENGG 400 courses."



A week-long technology test for the SPICE project would see a balloon lift a hose one kilometre above the Earth's surface to release water droplets. The test would help validate mathematical models designed by Hilary Costello (Mechanical [Co-op] '10) and give researchers a chance to observe the system at work over time and under changing weather conditions. A Churchill Scholarship recipient, Costello is working on her PhD at the University of Cambridge.

tapping into unbridled creativity

The Faculty of Engineering makes history with six new NSERC Industrial Research Chairs

BY RICHARD CAIRNEY

Richard Siemens, U of A Creative Services

Faculty of Engineering professors Subir Bhattacharjee, Tayfun Babadagli, Biao Huang, Aminah Robinson Fayek, Mohamed Al-Hussein and Mohamed Gamal El-Din have been appointed as NSERC Industrial Research Chairs.

The Faculty of Engineering made history last fall by announcing the establishment of six new industrial research chairs, capitalizing on research and teaching leadership in areas as diverse as oil sands water treatment and decision-making tools for the construction industry.

The research chairs are funded through a unique partnership involving the Natural Sciences and Engineering Research Council of Canada (NSERC), the university and industrial and government partners, representing a total investment of $14.2 million.

The announcement brings the number of NSERC research chairs in the U of A Faculty of Engineering to 16, a figure that on its own tops any other entire university in the country.

Dean of Engineering David Lynch says these kinds of partnerships are the key to having a successful "triple bottom line" that considers the environment, the economy and society.

"It is through these kinds of collaborations that these three elements come together," he says.

decidedly radical decision-making

Attention to detail and precision are the gold standards of any engineering pursuit. From planning and designing a project—whether it's a car, house or a spaceship—calculations are checked and rechecked, plans drafted and revised, until a team is confident everything has been accounted for.

Civil engineering professor Aminah Robinson Fayek is conducting important research that can bring a new level of precision to construction projects by accounting for intangible aspects of a project, such as the motivation and skill of a work crew, the quality of project teams and even a company's organizational structure.

Robinson Fayek, who holds the NSERC Senior Industrial Research Chair in Strategic Construction Modeling and Delivery, is a leading researcher in "fuzzy logic," which incorporates aspects of planning and construction often overlooked because they lack hard-and-fast values.

"Traditionally, we deal in binary values. But not all values are binary," says Robinson Fayek. "Temperature can be measured in degrees, but it can also be expressed linguistically. It can be hot to an extent and simultaneously cold to an extent, and what is hot for one person may feel cold to another.

"Fuzzy logic is a great modeling technique to handle uncertainty that is not random or statistical in nature but is due to subjectivity, approximate reasoning and natural language. We can now look at all the factors that affect productivity: tools, materials, attendance, training and skill level of the workers, and other intangibles like how motivated people are, because with different levels of motivation you can get vastly different results."

Robinson Fayek is uniquely positioned to have an impact on the construction industry. She is a professor in the Hole School of Construction Engineering in the U of A Department of Civil and Environmental Engineering. Last year, she was awarded the Canadian Society for Civil Engineering's Walter Shanly Award for her contributions to the development and practice of construction engineering in Canada. She also holds the Ledcor Professorship in Construction Engineering.

Robinson Fayek's industry partners represent construction owners, contractors, labour groups and their respective associations, who are coming together in a unique research relationship.

"For the first time, we have all three parties coming together in a formal collaboration to address issues that are significant to the construction industry," she says.

Aminah Robinson Fayek applies fuzzy logic to bring a new level of productivity to the construction industry.

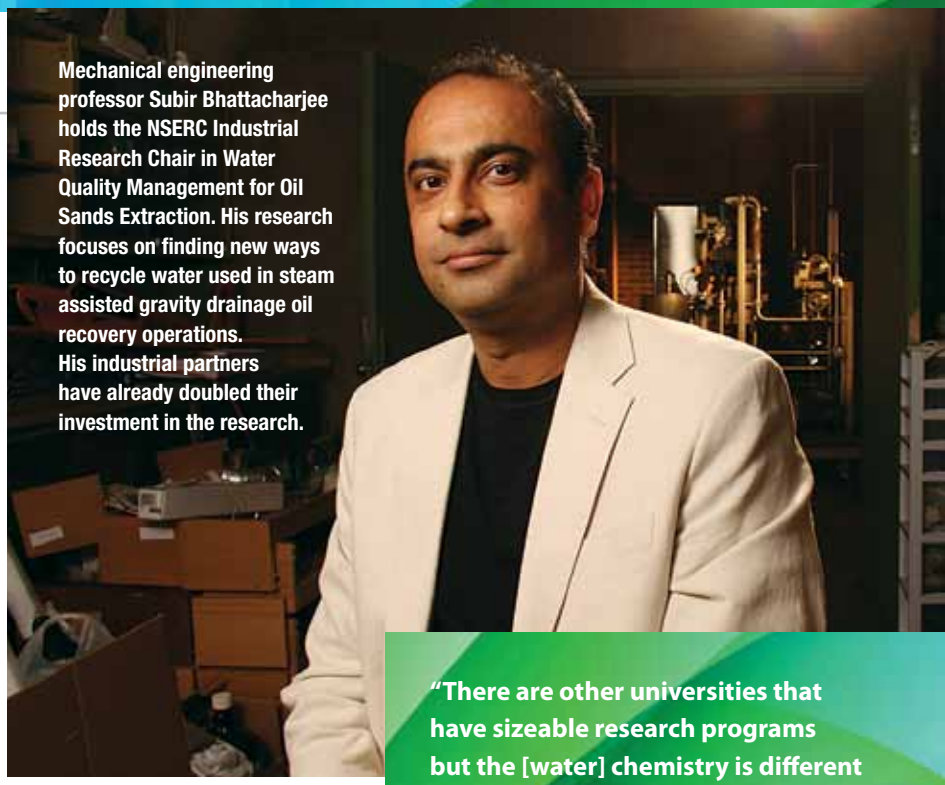
Richard Cairney

"We can now look at all the factors that affect productivity: tools, materials, attendance, training and skill level of the workers, and other intangibles like how motivated people are, because with different levels of motivation you can get vastly different results."
— AMINAH ROBINSON FAYEK

"We have owners, contractors and labour groups contributing their perspectives. This provides us with a tremendous opportunity to learn from them, and it means that the solutions we come up with will likely be better solutions because of the fact that we have input from all parties and we have looked at a problem in a more inclusive and holistic fashion."

ideas about water are flowing

It's a sunny morning on the U of A campus and Subir Bhattacharjee has assembled supporters from Suncor Energy and Kemira Oil and Mining to review progress being made by his lab, on the sixth floor of the National Institute for Nanotechnology at the U of A.



Mechanical engineering professor Subir Bhattacharjee holds the NSERC Industrial Research Chair in Water Quality Management for Oil Sands Extraction. His research focuses on finding new ways to recycle water used in steam assisted gravity drainage oil recovery operations. His industrial partners have already doubled their investment in the research.

Jason Franson

Bhattacharjee is investigating new ways to recycle water used to extract bitumen buried too deep below ground to be mined. The process used to coax this heavy oil to the surface, called steam assisted gravity drainage (SAGD), involves heating water to more than 240 C, injecting steam deep underground to warm the bitumen deposits and then pumping the oil and water back up to the surface. Sensitive to greenhouse gas emissions and water use, the oil sands industry recycles 90 per cent or more of the water used in the process but strives to improve its performance. If water can be recycled without continually cooling and then reheating it, the operation becomes more efficient and has less impact on the environment.

Bhattacharjee, a professor in the Department of Mechanical Engineering who holds the NSERC Industrial Research Chair in Water Quality Management for Oil Sands Extraction, is being asked to "clean up water of quite poor quality for the most demanding purpose imaginable," says David Pernitsky (Civil '91, MSc Environmental '93), a senior engineer with Suncor Energy's in-situ technical services.

The research would not be possible without financial support through partnerships with Suncor, Kemira, Outotec (an international equipment manufacturer with mining industry operations), the Alberta Water Research Institute and NSERC. And what the industry partners have seen since the research chair was established two years ago has impressed them immensely—the companies have doubled their contributions to the five-year research program, from $150,000 a year each for the next three years to $300,000 per year each.

It's great news, but it prompts the question: why do global corporations with their own research and development departments and expertise turn to university researchers to help solve urgent problems?

Based in Helsinki, Kemira has four high-level research centres around the world. The company serves customers in water-intensive industries, including mining and oil. But, says Kemira's vice-president of business development, Tuomas Törmänen: "One company cannot do it all alone. We plug in external resources in collaboration with our internal resources as a way to innovate across multiple technology areas in order to create real breakthroughs."

The U of A has an important history of oil sands discovery. In the late 1920s, U of A engineering professor Karl Clark developed the hot-water separation process that led to today's oil sands separation technologies. His knowledge has been passed along and improved upon by successive generations of researchers.

Pernitsky observes that there are water researchers working on different problems around the world, and some partnerships make better sense than others. His own PhD research into drinking water was partly funded by Kemira, he says, and in this case, working with the U of A is a natural fit.

"There are other universities that have sizeable research programs but the [water] chemistry is different here because we're talking about oil sands. It's heavier oil than elsewhere . . . Other researchers will tell you there are shortcuts you can take but they don't have the very heavy oil and high temperatures that we're working with."
— DAVID PERNITSKY

"There are other universities that have sizeable research programs but the [water] chemistry is different here because we're talking about oil sands. It's heavier oil than elsewhere. We are trying to maintain the heat of these fluids, and other researchers will tell you there are shortcuts you can take but they don't have the very heavy oil and high temperatures that we're working with," Pernitsky says.

"Researchers need to know the conditions that exist in our cold region, and you also have all this cold-climate engineering work that has been done here at the U of A. Just the fact that people live here through our winters helps them understand it more clearly."

controlling the oil sands

As a newly appointed NSERC Senior Industrial Research Chair in Control of Oil Sands Processes, Biao Huang feels the IRC program is making a real difference in Alberta's oil sands industry.

Biao Huang, who holds the NSERC Senior Industrial Research Chair in Control of Oil Sands Processes, sees the bigger picture in controlling oil sands operations.

Jason Franson

His research on process control—using computer control systems to automatically operate key oil sands processes—is making the industry more efficient and environmentally friendly.

Huang's research focus is aiming for a big impact through the cumulative effect of many small gains in efficiency.

"Helping the industry become more sustainable and environmentally friendly and recover more oil is an important issue," he says. "If we can improve recovery a little bit, even 0.1 per cent, it translates to a huge impact."

Huang explains process control by comparing it to driving a car, where the car is the process and our brain is the controller.

"To control the car we need to have some sensors, such as eyes to see what's going on in front of us," says Huang. "At the same time, you also need to operate the car, so you have actuators to make sure the car moves. In this case, they include your hands and feet."

"If we can improve recovery a little bit, even 0.1 per cent, it translates to a huge impact."
— BIAO HUANG

Huang and his team of graduate students are working on the control of oil sands mining, extraction and upgrading processes.

One example of Huang's work is on the primary separation vessel, or PSV, used in the extraction process. It's a large tank used to separate oil from sand using hot water. Heavier particles like sand settle toward the bottom of the tank while bitumen rises to the frothy surface. The bitumen and froth are skimmed from the surface but the process is not always precise. Huang is researching ways to minimize the amount of bitumen that is lost to the tailing stream that comes out of the PSV.

For this job, sensors are a key component—they can tell how much bitumen is in the tailings and how much water is in the froth. This makes it possible to optimize PSV operations.

Reducing the amount of bitumen in tailings improves the recovery of oil and reduces the industry's environmental footprint.

"We solve problems by reducing the environmental impact and improving production, in real time," says Huang.

One challenge industry faces in process control is the fact that the vessels and pipes are hostile environments—sensors can foul and provide inaccurate data. Huang and his team are using an algorithm called dynamic Bayesian inferencing, which uses accurate information inferred from hardware sensors to make informed decisions about oil sands processes.

"We look at relationships over time," says Huang. "For example, if you are driving from Edmonton to Calgary and you are in Red Deer, one minute later I know that you are still driving towards Calgary and you are near Red Deer."

The algorithm, he says, means industry doesn't have to spend more money on more sensors. "You can use information that you already have to calculate something which you do not know. You don't have to buy new equipment or dig a new hole or install a new sensor," he says. "It is a soft sensor—an algorithm."

Besides the satisfaction he gets from knowing he's helping make such a vital industry reduce its impact on the environment, Huang also enjoys the technological challenges of helping equipment and instruments operate more reliably in harsh conditions. He's happy to be in a partnership with such a unique industry.

"You cannot find the same solution anywhere else. You cannot just borrow and buy; it's impossible. You really have to do the groundwork to have these innovations."

Huang says the role of industry partners is indispensable in the support they provide.

"The funding is mainly used to educate the high-quality personnel—the students," he says.

– With Isabelle Gallant

rebuilding the building construction industry

A U of A engineering professor's research is at the forefront in a construction revolution that would move most construction workers into factories—dramatically improving work quality and productivity and reducing waste and environmental impact.

By designing a process in which five three-storey student dormitories were built in 51 days at a U.S. college in 2005, Mohamed Al-Hussein of the Department of Civil and Environmental Engineering and his industrial partners proved there are enormous efficiencies to be gained by prefabricating buildings and constructing them modularly. Entire sections of the student dorms at Pennsylvania's Muhlenberg College in Allentown—from flooring and fixtures to exterior brick finishes—were assembled at a factory more than 100 kilometres from the construction site, delivered to the campus and then lifted into place with cranes.

Now, Al-Hussein, who holds the new NSERC Senior Industrial Research Chair in the Industrialization of Building Construction, is working on ideas that will revolutionize the industry, prefabricating to a greater extent in a sort of assembly-line fashion.

"The efficiencies come from the manufacturing philosophy that, instead of moving people to the construction site, you bring the work to where the people are. In the factory, the same philosophy applies: you stay where you are and the work comes to you," he explains.

One of Al-Hussein's biggest supporters is Edmonton's Landmark Group of Builders. CEO Reza Nasseri calls industrialization "a game changer" for his company and the industry. The company's goal is to develop net-zero buildings by the year 2015, and Al-Hussein's research is bringing that goal closer to reality.

Construction sites are "incredibly wasteful," says Nasseri, but industrialization virtually eliminates material waste.

"It would sound like an exaggeration if I told you how much waste we have eliminated," he says. "In our factory, waste has disappeared."

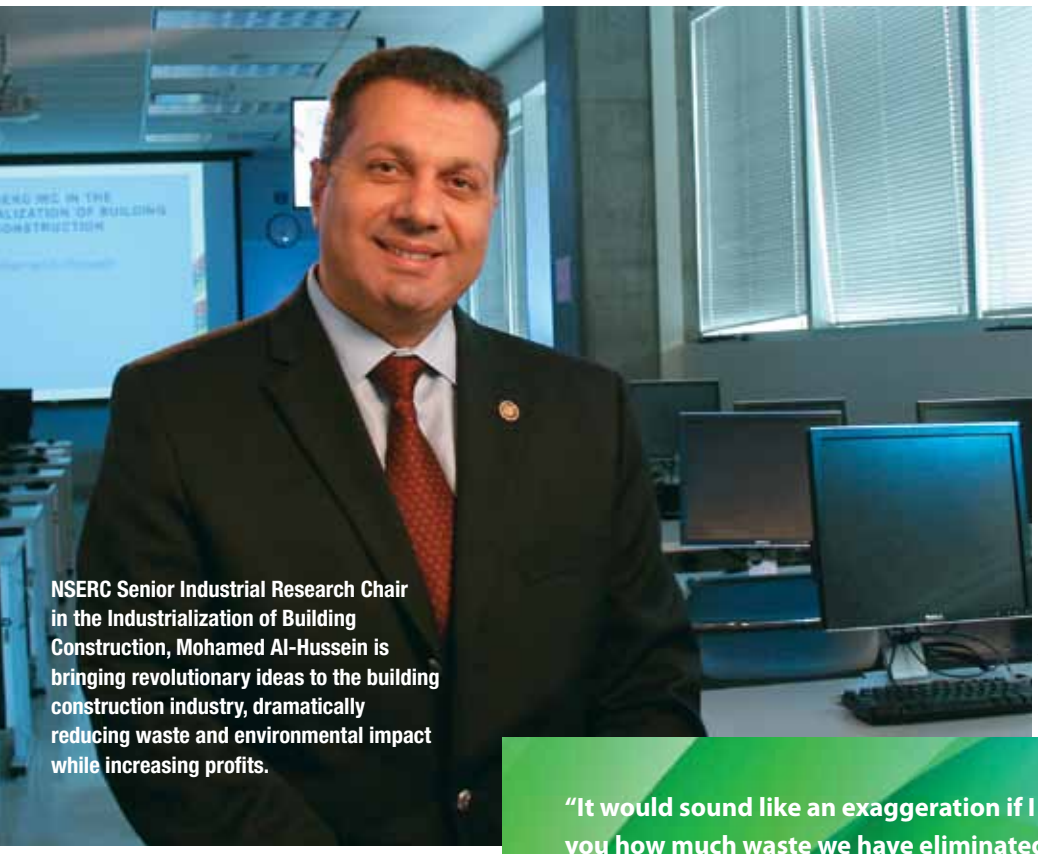
His firm estimates that Al-Hussein's process has eliminated five tonnes of CO_2 emissions per home by eliminating nearly 200 vehicle trips to each construction site—just to complete the framing and roofing.

Al-Hussein says industry supporters are both drivers of and contributors to the research process.

"They are really interested in applying this research and they are demanding more of it," he says. "This type of research needed industry and the industry came forward. They provide our students with a place to access information. . .these companies are working on a daily basis with my students."

One of his upcoming projects is the construction of a 34-storey apartment building in Brooklyn, New York—in less than 90 days.

"I think that what we are seeing today is just scratching the surface," he says. "I'd like to see it grow to 20 or 40 or 50 per cent of the Canadian industry moving to this method."



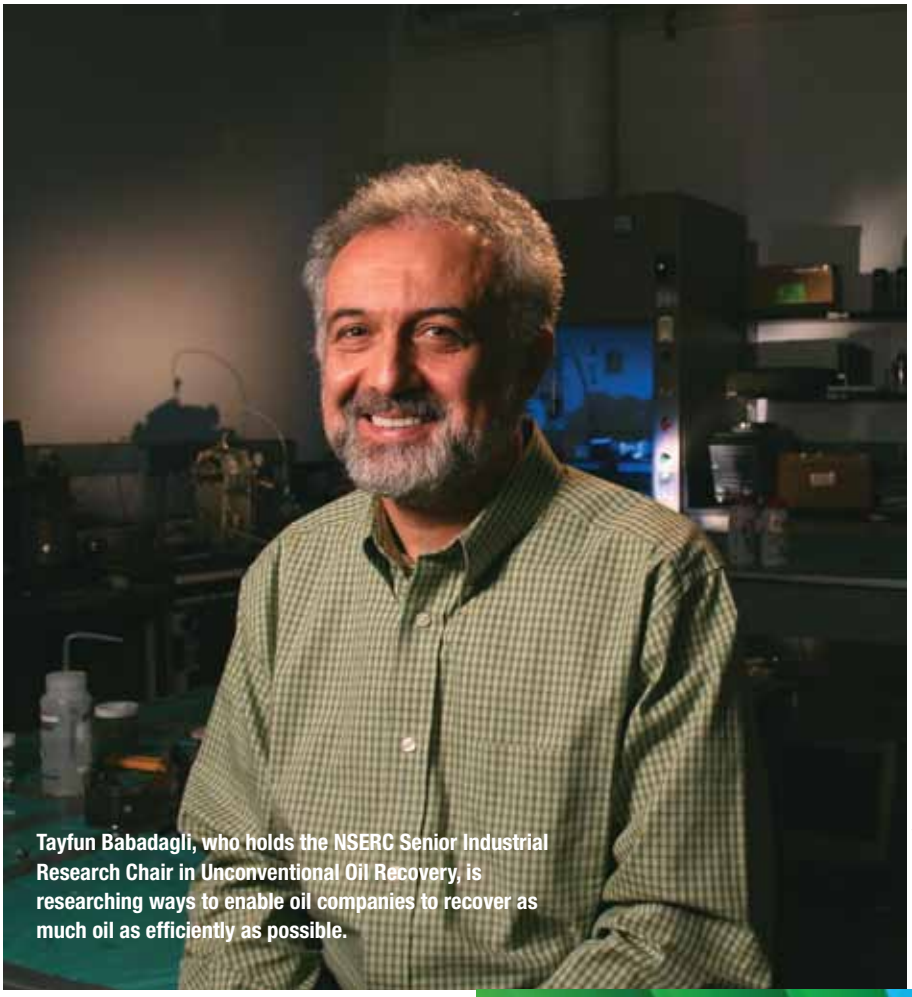
Richard Cairney

NSERC Senior Industrial Research Chair in the Industrialization of Building Construction, Mohamed Al-Hussein is bringing revolutionary ideas to the building construction industry, dramatically reducing waste and environmental impact while increasing profits.

"It would sound like an exaggeration if I told you how much waste we have eliminated. In our factory, waste has disappeared."
— Reza Nasseri

taming the unconventional

Unconventional oil such as heavy oil and bitumen found in Alberta's oil sands is more difficult to coax from the ground because it has a thick consistency—and sometimes even forms rock. Oil companies in Alberta and around the world are trying to get the most out of these challenging reservoirs.



Tayfun Babadagli, who holds the NSERC Senior Industrial Research Chair in Unconventional Oil Recovery, is researching ways to enable oil companies to recover as much oil as efficiently as possible.

Richard Cairney

The steam-assisted gravity drainage (SAGD) method commonly employed to pump this oil from the ground involves injecting steam or solvents into the ground, causing heavy oil to flow more freely and making it easier to bring to the surface. Tayfun Babadagli, who holds the NSERC Senior Industrial Research Chair in Unconventional Oil Recovery, is researching ways to improve this technique, enabling oil companies to recover as much oil in as efficient a manner as possible.

SAGD can be "a very difficult technology," says Babadagli. Heat (in the form of steam, air or electrical heating) or solvents are used to get the thick, heavy oil to flow more freely.

"Our job is to optimize these techniques to minimize the costs and maximize recovery," says Babadagli, a professor in the U of A Department of Civil and Environmental Engineering's School of Mining and Petroleum Engineering. "You want to find ways to use the least amount of steam or the least amount of solvents. Our main goal is to find ways to reduce the reservoir oil that gets left behind."

Another challenge for the industry is the fact that up to 25 per cent of Alberta's heavy oil is trapped in carbonate minerals—no one has yet devised a way to flush the oil from these tightly packed rock formations. It's another challenge Babadagli and his team are investigating.

Babadagli has patented a recovery technique that alternates the use of steam and solvents to make bitumen more easily accessible. Variables, such as the temperature, length of time spent heating the oil and the strength of a solvent, can be experimented with.

"Injection times, waiting times and the strength of the solvent are all critical elements. Sometimes you might be heating for two weeks but maybe one week is enough."

"Our job is to optimize these techniques to minimize the costs and maximize recovery."
— Tayfun Babadagli

clearing the path to clean water

Oil sands mining operations use hot water to help separate bitumen from the soil, creating ponds of toxic tailings. One of the major challenges the industry faces is finding ways to remove contaminants from the tailings water so the water can be recycled for other oil sands uses or discharged safely into the environment.

Richard Cairney

Mohamed Gamal El-Din, NSERC Senior Industrial Research Chair in Oil Sands Tailings Water Treatment, is working to develop water treatment technologies that recycle or safely discharge oil sands process-affected waters into the environment.

Mohamed Gamal El-Din, a professor in the U of A Department of Civil and Environmental Engineering, is meeting the challenge head-on. As the NSERC Senior Industrial Research Chair in Oil Sands Tailings Water Treatment, Gamal El-Din's goal is to develop and assess different water-treatment technologies and strategies to recycle or safely discharge water affected by the oil sands process into the environment.

He admits the task is technically daunting. Tailings water contains suspended solids, salts, organic and inorganic compounds, ammonia, chloride and trace metals, and other contaminants at concentrations that are toxic to many living organisms, including aquatic biota such as invertebrates and fish, as well as mammals.

"There is not going to be a quick, easy solution," he says. "To come up with treatment systems and approaches will take some time, and you need to consider that there may be residuals coming out of the treatment processes themselves—how do we manage these residuals?"

Gamal El-Din says the NSERC Senior Industrial Research Chair Program is also helping to establish one of the best water management education and research programs in Canada, and perhaps in the world, positioning the U of A as a leader in water treatment and management research and innovation.

Realistically, Gamal El-Din knows the oil industry will continue to grow as global energy demands increase.

"I have a young family and I want to be sure my kids are living in a healthy and sustainable environment. It's not only treating water; it is about protecting both the environment and public health."
— Mohamed Gamal El-Din

"It's important to ensure that as the oil sands industry grows into the future, that it does so in a sustainable manner," he says.

"We can't just keep storing this water forever. You have to treat this water—you have to be sure there won't be any adverse effects."

Gamal El-Din hopes that this water could one day be reused for irrigation or industrial applications, or it could eventually be safely released to the environment.

While there's a lot of hard work ahead, Gamal El-Din believes the end result is well worth the effort. As the saying goes, failure is not an option.

"I have a young family and I want to be sure my kids are living in a healthy and sustainable environment. It's not only treating water; it is about protecting both the environment and public health."

Kudos

Taking pride in achievement

DANIEL, PATRICK PEng
(Chemical '68, LLD Hon. '10)

Has been named Canada's Outstanding CEO of the Year by the Caldwell Partners. Pat Daniel is the outgoing president and CEO of Enbridge Inc. and has more than 30 years of experience in the energy sector.

KVISLE, HAROLD (HAL) PEng
(Civil '75)

Has been appointed as an advisory board member with Canada's Outstanding CEO of the Year, operated by the Caldwell Partners, Business News Network and *National Post*. A former TransCanada Corporation CEO, Kvisle was recognized as Canada's Outstanding CEO of the Year in 2008. In 2009, he received the Canadian Business Leader Award and in 2010, he received the Distinguished Business Leader Award.

MARTIN, DEREK PEng

Has been awarded the Engineering Institute of Canada John B. Stirling Medal for leadership and distinguished service at the national level. Martin is a professor in the Department of Civil and Environmental Engineering.

MARQUEZ, HORACIO PEng

Has been appointed as a Fellow of the Engineering Institute of Canada for exceptional contributions to engineering in Canada. Marquez is chair of the Department of Electrical and Computer Engineering.

OSPINA, CARLOS PEng
(MSc Structural '96, PhD '01)

Has been named a Fellow of the American Concrete Institute. Members of the ACI are elevated to Fellows in recognition of contributions to "production or use of concrete materials, products, and structures in the areas of education, research, development, design, construction, or management" or significant contributions to ACI through service on committees at the local chapter level. Ospina is a senior engineer with BergerABAM, working in Panama and Colombia.

RAJARATNAM, NALLAMATHU PEng

Has been appointed as a Fellow of the Engineering Institute of Canada for exceptional contributions to engineering in Canada. Rajaratnam is a professor in the Department of Civil and Environmental Engineering.

TAYLOR, DONALD PEng
(Civil '58, MSc Civil '60)

Has been appointed as a member of the Order of Canada, one of the country's highest honours, for his contributions as an "innovative entrepreneur and generous philanthropist." Taylor is president of the Calgary heating, ventilating and air conditioning company, Engineered Air.

ZUO, MING PEng

Has been appointed as a Fellow of the Engineering Institute of Canada for exceptional contributions to engineering in Canada. Zuo is a professor in the Department of Mechanical Engineering.

In Memoriam

The Faculty of Engineering sincerely regrets the passing of the following alumni and friends.

Andy Barnes, Mining '57, in October 2011

Glenn Brant, Petroleum '51, in December 2011

Norman Budgen, Electrical '55, in August 2011

Leonard Checknita, Chemical '78, in January 2012

Victor Cox, Civil '49, in October 2011

James Dunn, Chemical '48, MSc (Chemical) '52, in October 2011

Gordon Duthie, Civil '55, in August 2011

Douglas Ells, Civil '48, in January 2012

Terry Engelhart, Electrical '62, MSc (Electrical) '71, in September 2011

Brian Gerbrandt, Civil '89, in January 2012

A. Ralph C. Hargrave, Civil '43, in April 2011

Thomas Horn, Chemical '59, in September 2011

Stanley Jones, Eng Physics, '50, in November 2011

Allan Lovlin, Mechanical '61, in October 2011

David Lozinski, Electrical '70, in September 2011

Fred McBean, Petroleum '52, in November 2011

Robert O'Brien, Mining '46, in October 2011

Victor Pedscalny, Electrical '58, in January 2012

George D. Raitt, Chemical '40, in September 2011

Lyman Sortland, Chemical '60, MSc (Chemical) '62, in August 2011

William Wanat, Chemical '50, MSc (Chemical) '51, in June 2011

Reginald Williamson, Electrical '71, in December 2011

Russell Zaharko, Petroleum '63, in December 2011

The Faculty of Engineering was recently made aware of the passing of the following alumni more than a year ago:

Henri D. Bonnet, Mining '44, in May 2010

Harvey Elbe, Civil '64, in January 2011

Robert Westendorf, Mechanical '62, date unknown

Do you have news to share? Send your news of awards, appointments and other successes to engineer.alum@ualberta.ca.

Staying in touch just got easier

Want to be informed about what's going on in the Faculty of Engineering? Want to hear about other alumni, students and professors?

Become a fan of the U of A's Facebook page—you'll get news, photos and videos about the faculty, students and alumni sent directly to your own Facebook account.

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Take the plunge

The Engineering Student Life Enhancement Fund (ESLEF) recognizes that successful engineers need not only technical skills, but also well-developed skills in teamwork, communication, management, and creativity. While these skills are learned through their formal engineering education, they are more often honed through hands-on activities outside the classroom.

The ESLEF provides funding for extracurricular projects and student activities that focus on the non-academic qualities of a successful engineer. The fund supports our student vehicles projects – helping to fund teams through the phases of designing, building, and taking their vehicle to competition. The fund also helps improve student learning and study spaces; supports our varsity-level athletes through the U of A's Adopt-an-Athlete program; and provides financial assistance for engineering students to attend technical, leadership, and professional development conferences and competitions.

You can read about building an underwater robotic vehicle in a textbook—or you can build one yourself. Support from the Engineering Student Life Enhancement Fund enables students to apply the knowledge gained in the classroom to real-life challenges.

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