

To where it bent in the undergrowth,

Then took the other, just as fair,

And having perhaps the better claim,

Because it was grassy and wanted wear,

Though as for that the passing there

Had worn them really about the same,

And both that morning equally bare,

In leaves no step had trodden black.

Oh, I kept the first for another day!

Yet knowing how weary leads on to wear,

I doubted if I should ever come back.

I shall be telling this with a sigh

Somewhere ages and ages hence:

Letters to a Young Engineer

Two roads diverged in a wood, and I—

I took the one less travelled by,

And that has made all the difference.



Letters to a Young Engineer

2021

Eighth edition, 2021.

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Hymn Of Breaking Strain

By Rudyard Kipling, 1935

Note: This poem is often recited at events where the profession of engineering is celebrated.

The careful text-books measure
 (Let all who build beware!)
The load, the shock, the pressure
 Material can bear.
So, when the buckled girder
 Lets down the grinding span,
The blame of loss, or murder,
 Is laid upon the man.
 Not of the Stuff, the Man!

But, in our daily dealing
 With stone and steel, we find
The Gods have no such feeling
 Of justice toward mankind.
To no set gauge they make us,
 For no laid course prepare,
And presently o'ertake us
 With loads we cannot bear:
 Too merciless to bear.

The prudent text-books give it
 In tables at the end,
The stress that shears a rivet
 Or makes a tie-bar bend,
What traffic wrecks macadam,
 What concrete should endure,
But we, poor Sons of Adam,
 Have no such literature,
 To warn us or make sure!

We hold all Earth to plunder,
 All Time and Space as well
Too wonder-stale to wonder
 At each new miracle;
Till, in the mid-illusion
 Of Godhead 'neath our hand,
Falls multiple confusion
 On all we did or planned,
 The mighty works we planned.

We only of Creation
 (Oh, luckier bridge and rail!)
Abide the twin-damnation,
 To fail and know we fail.
Yet we, by which sole token
 We know we once were Gods,
Take shame in being broken
 However great the odds
 The Burden or the Odds.

Oh, veiled and secret Power
 Whose paths we seek in vain,
Be with us in our hour
 Of overthrow and pain;
That we, by which sure token
 We know Thy ways are true,
In spite of being broken,
 Because of being broken,
 May rise and build anew.
 Stand up and build anew!

Foreword

By Daniel Hoornweg

“Perhaps all the dragons in our lives are princesses who are only waiting to see us act, just once, with beauty and courage. Perhaps everything that frightens us is, in its deepest essence, something helpless that wants our love.”

- Rainer Maria Rilke

“Go into yourself and see how deep the place is from which your life flows.”

From 1903–1908 Rainer Maria Rilke wrote to young, would-be poet, Franz Xaver Kappus. Rilke’s *Letters to a Young Poet* offered no criticism of Kappus’s work, but rather suggested how a poet, an artist, a craftsman or craftswoman—a professional—should feel, love, and live their lives in search of truth and understanding.

Letters to a Young Engineer attempts to provide similar encouragement to you, the recent graduate engineer, as you strive for greater and greater things. Poets, professors, politicians, parents, communicators, corporate CEOs, and you, the soon-to-be engineer, we are all in this together. The world is changing fast, and you will be called upon to learn, to lead, and to live with integrity and aptitude.

We write to you, the graduate. You are the future. In you we trust the profession and much of the planet’s future well-being.

Engineers tend to shy away from hyperbole and sensationalism. We take comfort in the facts of science and of perceived certainties as we apply this knowledge. We design the future but only to the extent that the laws of science permit and society allows. We are bound by rules, and hopefully, by professional ideals.

As engineers you will be called upon to build and service even bigger cities, to develop and tame new technologies. You will be challenged as events unfold faster and with greater intensity.

The letters in this book are given freely but not without cost. In our careers we have seen inadequate gains in the provision of basic services such as water, sanitation, health, education and security for all; a billion people still live in extreme poverty; the planet’s ecosystems are severely strained; we must now respond to pandemics such as COVID-19 and other threats that can appear at our door without warning.

Many of us that went before have doubts: did we try hard enough, were we brave enough in protecting the vulnerable, did we include all the known considerations in our calculations, and what remains unknown? We will be judged by you—as it should be. We will be found wanting. But you will also find that we possess indomitable optimism and passion to make things better.

Our optimism in you is warranted, and for as long as we are able, we will work with you. We also take to heart and pass to you with unequivocal force of persuasion, the idea that now more than ever, engineering is a team effort. Engineers must work with other professionals, the public, politicians and within planetary limits. A professional engineer must engender trust. This trust is earned through honest humility and openness. Seek to understand and strengthen that most valuable coefficient of public support.

We urge you to take an active role in governance and management of your communities, countries and international institutions, as well as, of course, your homes. On average, as a profession we have not risen sufficiently to the challenge of governance. This must be achieved through active participation and more forceful advocacy of the need for, and adherence to, evidence-based policies and clearly measured progress. Our pragmatism for action is urgently needed.

Much has transpired since the first enactment of Rudyard Kipling’s

1925 *Calling of an Engineer*. Respond to the call, and be proud that you are an engineer; but also be mindful that you now have a weighty responsibility. The following letters are written with hope and a smattering of suggestions for your upcoming careers. Please accept them in the spirit they are given; enjoy the journey.

The Class of 2021 and COVID-19

This edition of *Letters to a Young Engineer* comes during the turbulence brought about by COVID-19. Most letters were drafted before the first case of COVID-19 surfaced. You the Class of 2021 are graduating into a 'post-covid' world. For many of you, your last year of education was disrupted; delayed convocations and virtual Iron Ring Ceremonies. As engineers many of your careers will be part of society's response to the long emergency. Hopefully you will build more bridges than walls.

'We build too many walls and not enough bridges.'¹ As communities emerge from COVID-19 and start to re-build infrastructure and social programs, there will likely be calls to erect taller and wider walls.

Fortress cities within their walls, behind drawn bridges, provide important lessons. An empire's power was once defined by the fortifications of the strongest, most strategic city. But cities grew beyond their walls. For example, the last vestiges of Paris' walls were built-over in the 1920s and a stronger Germany emerged after the Berlin Wall fell in 1991. The strength of countries and empires is now defined by the weakest; it is here that we need to build bridges.

Progress in public health is likely the most notable gain of the 19th Century. These improvements were brought about through a durable partnership between the medical and engineering professions.

In 1854 London's Metropolitan Commission of Sewers dispatched engineer Edmund Cooper to investigate the alarming increase

in deaths from a virulent cholera outbreak. Cooper mapped the location of deaths, new sewer works, previous graves and water sources, but the cause of death remained a mystery. Physician John Snow combining Cooper's data and detailed community interviews, published London's 'ghost map' tracing the cause of deaths to a contaminated water hand-pump. The science of epidemiology was born. Clean water, safer cities, and rapid declines in cholera deaths and other communicable diseases followed.

The 20th Century ushered in the age of electricity and with that, taller buildings, mechanization and eventually new technologies like communications and the digital economy.

For the remaining 80 years of the 21st Century, COVID-19 will help renew the focus on public health, but today public health is broader as it is dependent on planetary health. We need to build upon progress in public health and build public well-being for all. Engineers will need to seek broader partnerships. Today's threats to public health are systemic, crossing borders and continents. Walls will not keep them at bay. More bridges are needed. As political and economic decentralization increases bridges need to be built between communities, between professions, and across provinces. The strongest bridges are those that build trust.

COVID-19, climate change, loss of biodiversity, local and global inequality; complex problems require solutions that are rarely exact or complete. Problem solving skills of engineers are now measured in best-fit efforts, trends, strength of partnerships, and adaptability. These skills are predicated on trust worthiness, humility, and optimism.

You, the graduate engineer need to be part of the discussions now underway to as we re-build after COVID-19. Together we need to build public well-being for all. Remember history and the facts of science, and never forget the importance of community support. Give strength to the weakest. Enjoy the journey.

¹ Often attributed to Sir Isaac Newton.

Cristina Amon

I want you to think back to the first time you set foot on your campus.

Back then, the road that has led you to today must have seemed long. There is no denying that the journey has at times been challenging. Much was expected of you. And you are now an engineer because you rose to the challenge. My warmest congratulations to you.

Before you head out into a world that urgently needs your expertise and wisdom, I would like to offer a few words about two polar opposites: disassembly and creation. Together, they have informed the arc of my career and have helped me to understand what gives me joy and fulfillment. I share this with you in the hope that it might inspire you to make the same discovery.

When I was a child, my parents had a radio. It was, to me, a magic box filled with music and hundreds of voices—singing, talking, laughing. I loved the little people in that box. I wanted to meet them.

One day, when my parents were out, I took the radio apart so I could see the amusing people inside. But there was no one home, only tubes, resistors, capacitors and wiring. My little heart fell. It was my first great research disappointment.

The experiment had not gone as planned.

Then my parents came home.

It was not a good day in the lab.

I learned that day that I liked to take things apart and to understand what makes them tick or, in the case of the radio, talk. I wanted to get to the essence of things, to learn the rules of nature and the ways we humans can learn from and reshape the natural world.

Of course, I did not know that as a little girl. I was just curious. I looked at devices as if they were made of glass, and I could see the cogs and gears, understand the systems, feel the patterns. I knew this curiosity was something that set me apart. I did not understand, back then, that it was also a great responsibility. That would come later.

But I burned with that curiosity. We, as humans, and as engineers, begin to answer the question “Why?” by taking things apart. It is the first stage of creation and innovation. “What is” is broken down into its parts and “what is to be” stands proudly in its place.

So I began my curious career, or my career of curiosity, with disassembly. But I soon learned I could build. I was interested in building and creating things which can help people.

Years later, when my loving, lovely parents had forgiven me for the radio, they encouraged me to attend the Universidad Simón Bolívar in Venezuela. I revelled in the give and take of the issues and debates, and found boundless opportunities in the innovation I saw all around me. But I had to choose between the practical and the theoretical, inquiry or creation. I was attracted to engineering, despite the allure of science, because I wanted to create things that could have a direct, immediate impact on society and on people’s lives. Maybe if I had been less impatient, I would have been a scientist. But I was restless, and I was passionate about learning, and about creating and changing what was into what could be.

I am delighted I chose engineering.

I also began to understand that the love of my parents, my luck, and my aptitude for engineering came with the mantle of responsibility. I was gaining the power to change the world, just as you are now. It is a power all engineers earn and bear, and a power of which we must always be mindful.

You are, in a very real way, stewards of the world. Keep it well and sustain it with your creativity and innovation.

Reach out to the diverse network you have forged while at university, and look for solutions beyond your formal disciplines. Collaborate for success by seeking different opinions, building and engaging multidisciplinary teams, and remembering that diversity is at the heart of creativity and innovation.

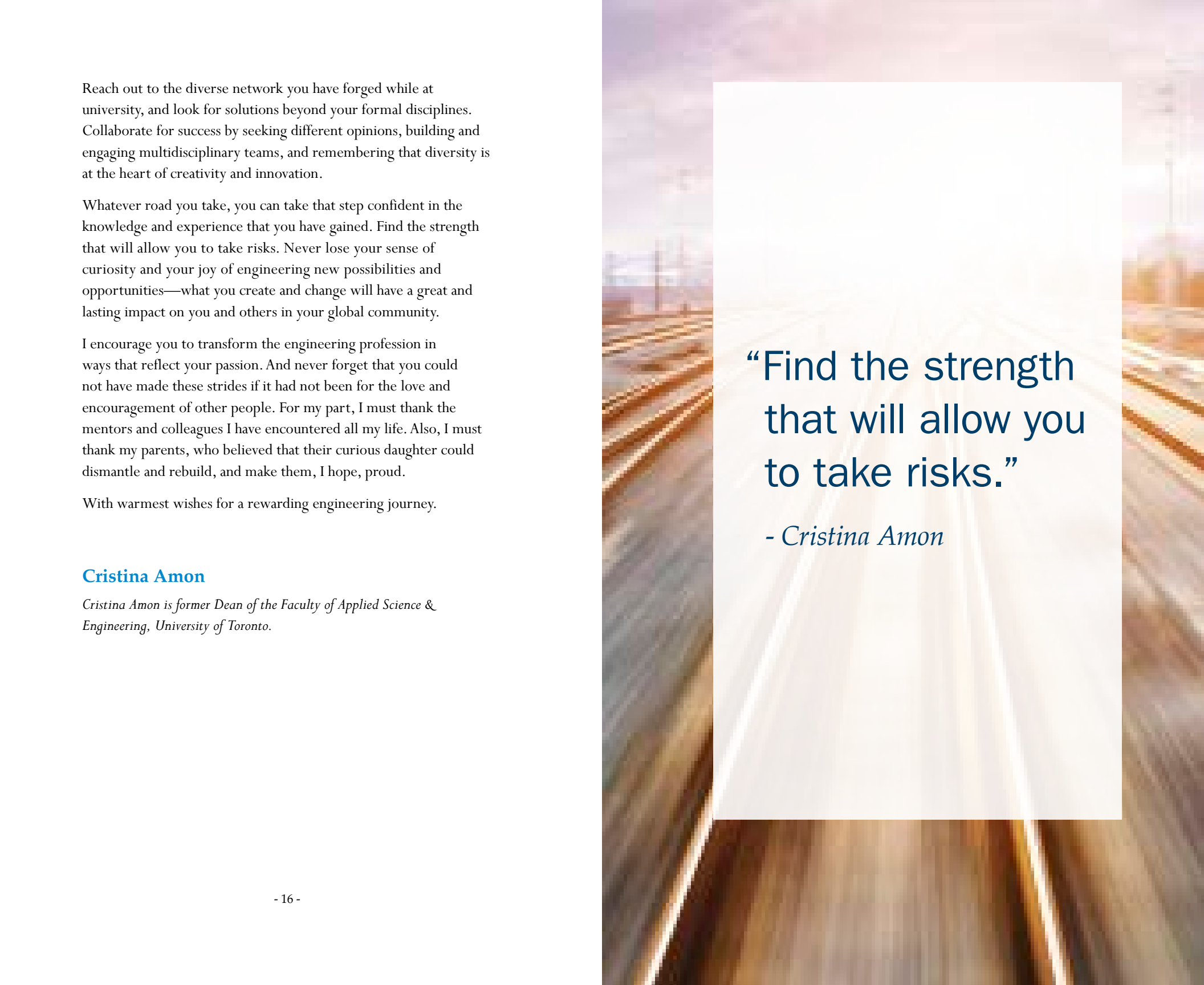
Whatever road you take, you can take that step confident in the knowledge and experience that you have gained. Find the strength that will allow you to take risks. Never lose your sense of curiosity and your joy of engineering new possibilities and opportunities—what you create and change will have a great and lasting impact on you and others in your global community.

I encourage you to transform the engineering profession in ways that reflect your passion. And never forget that you could not have made these strides if it had not been for the love and encouragement of other people. For my part, I must thank the mentors and colleagues I have encountered all my life. Also, I must thank my parents, who believed that their curious daughter could dismantle and rebuild, and make them, I hope, proud.

With warmest wishes for a rewarding engineering journey.

Cristina Amon

Cristina Amon is former Dean of the Faculty of Applied Science & Engineering, University of Toronto.



“Find the strength
that will allow you
to take risks.”

- Cristina Amon

Robert Bailey

I presume you're reading this because either you've just graduated in Engineering or you are curious as to what people like me would say to a recent Engineering graduate.

Full disclosure...despite the fact that some of my best friends and colleagues are engineers (and they tell me constantly that they have taught me a lot) and the historical oddity that I served as Dean in a mostly Engineering Faculty, I am not, and never will be, an Engineer. My undergrad and grad work was in biological science...as my late father, a paediatrician, used to say, I am a "doctor of clams". So take everything I say with a boulder of NaCl.

Challenge the Stereotype – From the 70s, when I first had a notion of what Engineering was, to the present, the best Engineers I've known have challenged the stereotype of the Engineer as a soulless adherent to formulae and specs, great at math and the parameters used to describe concrete (are there parameters that describe concrete?) but not so great at having a engaged conversation, especially if it involves listening to other views about...what the parameters describing concrete might be. They're often white males (like me) who sometimes have difficulty understanding the privilege that comes along with that, and struggle to create and value an environment where diverse perspectives and backgrounds result in better outcomes. Whatever your perspective, whatever your background...challenge the stereotype in a way that makes people like me...and fellow Engineers...change what they think an Engineer is or can be.

Make a Difference – Such a common but trite thing to say in this kind of piece! Even the most illustrious contributors to this book have spent years barking up the wrong tree, doing something just to survive, wishing they had done something differently, failing miserably (yes, even me, many times me!). I love to read autobiographies, not just to get the 20-20 hindsight of somebody recalling the highs and lows of their life, but to try to understand the universal experience of adversity. One of my favourites is the playwright Neil Simon's memoir *Rewrites*. Simon is one of the most successful playwrights ever, with many Broadway hits that continue to be regularly produced decades after their first successful run. He talks about the trials and tribulations behind writing and producing what became hit Broadway shows (e.g. *The Odd Couple*). Tons of uncertainty, failure, self-doubt, and listening to others when listening is absolutely the last thing he felt like doing. So if you're going to make a difference it isn't just a matter of preparation (the great education you've had), experience (your first few years as an Engineer), or planning (mapping out what you want to do with your life). It's important to develop what I think of as *engaged resilience*...being resilient to the challenges of any project, job, or life choice, but also being engaged so that you're learning from the failures and setbacks and putting that learning into practice next time out. You've got some of that through completing your undergrad...now get more!

Get a Life – In perusing earlier editions of *Letters to a Young Engineer* I've noticed many people encouraging you to do things beyond your engineering career. I bet your response is "yeah, right, as soon as I get established in a career, start a family, etc, etc". Let me add my voice to the chorus though. I happen to love theatre, and have been heavily involved in it for the last couple of decades. People at work always say "It's great that you have time to do that". What they're really saying is "It's great that you can slack off from your day job and your family responsibilities and get away with it". But I think whether it's theatre or music or sports or service groups

or whatever, having that other life, separate from work and family, makes you a better person and, maybe ironically, better at your day job. So when I say “get a life” I’m encouraging you to get a whole life with many dimensions, because each will strengthen and be strengthened by the other.

Thanks for Listening – To the recent Engineering graduates (I refuse to say “young” since that would be ageist!) I thank you for listening to this non-Engineer and thank you for pursuing a career with so many opportunities to make a difference and have a fulfilling life. Have fun!

Robert Bailey

Robert Bailey has served at Ontario Tech University as Interim President, Interim Provost, Associate Provost, Acting Dean of Business & Information Technology, and yes, Interim Dean of Energy Systems & Nuclear Science. He is a Professor in the Faculty of Science at Ontario Tech.

“I’m encouraging you to get a whole life with many dimensions, because each will strengthen and be strengthened by the other”

- Robert Bailey

Daniel Bartsch

Congratulations on successfully completing your program and graduation!

You learned that hard work and perseverance has its rewards. You learned that it took your individual effort to be successful. In every exam you competed against your peers and proved that you were competent and competitive. And now, you have to unlearn these skills in the real world.

In the real world it is only about teamwork. Yes, you are smart. You understand the science. You understand how to apply the science. But as a working engineer you will not be the person on the tools making it happen. There will be skilled workers, both men and women, who will have to take your plan and make it work.

In the real world you will learn about humility. You will receive feedback from the work site about your plan. You will learn quickly that the plan was flawed even though in your own mind it was perfect when it was issued. Your skilled workforce will not hesitate to tell you how it can be better. After your bruised ego has healed, you will see that they are right. You will soon learn that many minds, regardless of education, work experience, or culture are better than one.

In the real world you will learn about continuous improvement. Life as a professional engineer is a life path of continuous improvement. You will learn in courses. You will learn from reading resource books. You will learn from the internet. Most importantly you will learn from your co-workers. And as you get older you will look back on your graduation day and wonder how you thought you were so smart when you realize that you have so much more to learn.

In the real world you will learn how to be a better human being. You will learn about social responsibility. You will learn that as an engineer that you are one of the few individuals who can make a real impact in this world. You will learn that only you can design and use work methods that protect our planet and make it a better place.

In the real world you will make mistakes. It is okay to make mistakes as long as you learn from them. In the real world you can only be successful if you learn how to manage your own ego that you have so successfully nurtured and cultivated these last four or five years.

In closing, listen to those around you, learn from them, pursue the truth, and be humble.

Daniel Bartsch, P.Eng.

Daniel Bartsch is an expert in the energy and production industry and graduated from University of Alberta (Mechanical Engineering '85).

Azin Behdadi

Graduating with a degree in engineering is a major accomplishment.

As you move through your career, you will face new life choices. You may be in the middle of searching for a job where you can employ your newly earned skills. You may already be hired and wondering what working with your new manager will be like. You may be pursuing graduate studies to enhance your skills and contribute more knowledge to the engineering field. You may be looking to add specific skills to your work experience so that you can one day add professional engineering licensure to your list of credentials. Or, you may be exploring a field not directly linked to your academic background at all.

Throughout my career, I occasionally wished that I could time travel to ask my future self for advice. I felt sure that in few years I would know exactly how to make the best decision for me when facing a difficult situation. I shall write out the advice I would have given myself, in hopes that you as a young engineer starting out on your career may find some benefit. When I started my undergraduate studies in engineering nearly 14 years ago, I was told that whatever I learn in university will be of little use later in life. After nearly 10 years since graduating, I have a completely different opinion.

During my first year in engineering, we had a course in English. I thought “Why do we need to learn this language?” Today, I write many articles, reports and letters. I write study plans and analysis on various industry topics. I need to be correct, concise and lucid. I give presentations in conferences on a regular basis. Language is so important in my daily work: Nearly half my job is communication.

When we had a course in physics I always thought that an engineer

would never actually use it. Fortunately, during my engineering experience in a petrochemical company and during my graduate studies I dealt with heat conduction, convection and radiation and other aspects of physics. During this time I went back again and again to my basics in physics. Then we had mathematics, which is used almost every day during my career. I use Fourier transforms, arithmetic and geometric series and many other mathematical tools in developing algorithms. I sometimes need to open that engineering mathematics textbook from first and second year. One of the most neglected subjects was engineering economics. We hated it, ridiculed it and completely dismissed it. “We are engineers, not accountants”, we told ourselves. I know now that in designing any engineering project cost is often the most important aspect.

I am now regularly using more than 90 per cent of what I learned in my undergraduate studies. What you learn can actually be used later in life.

If you are a young woman in engineering realize your potential. When I started working at a petrochemical company after graduation, I noticed that being a young woman in a team of men—who often don’t look, talk or act as you do—can be isolating at first. Fear not, in a few months, your hard work and your skills will earn their respect and you’ll be a key part of the team, and banter, before you know it. Last but not least, I encourage you to take charge of your own learning. Between classes, job duties, internships, and personal life, if we don’t take the time to learn about the things we want to learn, we never will. Make time to learn. This is the beginning, you are off to a great start, enjoy.

Azin Behdadi

Azin Behdadi received her PhD in Nuclear Engineering from McMaster University, Ontario.

Carl Bodimeade

Now that you have graduated, you may have lined up an exciting job and have very definite ideas of what you want to do in that job and in your future, perhaps right to the end of your career. Or you may not have any idea what comes next. That's fine too; everybody finds their own path eventually. Whatever path you decide to take, my advice to you is the same.

As opportunities present themselves... take them! Even if they are outside your comfort zone. Each is a chance to do something different, learn something new and meet a new (and hopefully interesting) set of people.

Use new opportunities to grow and learn. If you are enthusiastic and work hard, you will get noticed by your superiors and peers, and then even more opportunities will come your way.

Treat other people and companies as you and your organization would want to be treated. Those individuals and companies who are not honest and fair in their dealings soon get a reputation.

Remember that we are very lucky to be living in one of the best countries in the world. Many people do not have the quality of life and the freedom that we have here in Canada. Every time you get frustrated with what seems to you a major problem or inconvenience, try to remember that there are people in this world who are much less fortunate than you.

Some of you may decide on very technically oriented and challenging paths. You may not be in the public spotlight but will contribute to

society by technological advancements. Many of you will be dealing with members of the public, elected officials and government staff on an occasional, or possibly frequent, basis. You will find then that the skills you need may not be the engineering techniques you learned in class, but softer skills, such as listening and empathy. In fact, over time, you may hardly use that 'hard' engineering knowledge. That's fine... these days, being an engineer is not just about projects, but can have a wider viewpoint, benefiting society and developing communities through a number of means, including projects. Therefore, one should be aware of the broader issues in order to successfully meet those needs.

Finally, good luck and have fun! You have chosen a great profession, make the most of it.

Carl Bodimeade, P.Eng.

Carl Bodimeade is a Senior Vice-President of Hatch. He obtained his BSc (Hons) in Engineering Geology from the University of Newcastle-upon-Tyne in the UK and his MSc, DIC in Soil Mechanics from Imperial College, University of London.

JoAnne C. Butler

You have completed a tough and challenging assignment and you are now ready to move forward to a big world of opportunity and adventure! You have a wonderful journey ahead of you and let me tell you why...

Let's go back—way back—to 1978 and the choices awaiting me as one of handful of female civil engineering graduates from Queen's University. At the time, I recall being driven by two overwhelming desires. First, I was very keen to master my chosen field. I wanted to continue to test myself and prove to myself and to my peers that I was in the right career. I have to admit there was also a small amount of gender pride. Unlike arts, law and medicine, engineering was... and largely still is... a male domain. And secondly, I was seeking adventure. I wanted to see and work in different lands and I was prepared to make the sacrifices to do so. So I left Ontario and began a career that took me to Alberta, Texas, the United Arab Emirates, back to Alberta, Mexico and then home to Ontario, almost 30 years later.

Along the way, I met some great people, compiled some fantastic memories and achieved what I set out to do in 1978—which was to find opportunity and adventure. Not every profession gives you those opportunities and I have never looked back. So take the chance. The ability to move around this planet has never been better. Learn a second language. Get your hands dirty by

understanding the operations at a nuts and bolt level. There is so much to learn in those early days and later in life, you will understand that all problems are best solved at an operational level—and you will have the understanding to solve them.

When I graduated, engineers were supposed to be introverted, wore pocket protectors, didn't care about people and couldn't spell. How wrong those stereotypes were then and even more so now. We need to continue busting those myths. We contribute to the overall good of society in so many and diverse ways. And our work ethic is almost unmatched.

University was plain, hard work—no doubt about it. I remember the endless mornings of classes and the endless afternoon of labs. It was the first time that I realized that I was not the top of the class anymore—that there were a lot more people smarter than I was and that they had come from more privileged socio-economic levels and education. It was the first time that I knew that I had to compete. But engineering was the equalizer—I knew that if I could get through the program, I could get through anything. It prepared me for those endless nights testing gas condensate wells in the Sharjah desert, or when my head was about to explode from the stress of trying to explain in my stilted Spanish how to open up a new business and build electricity generating stations. I was prepared for the hard work.

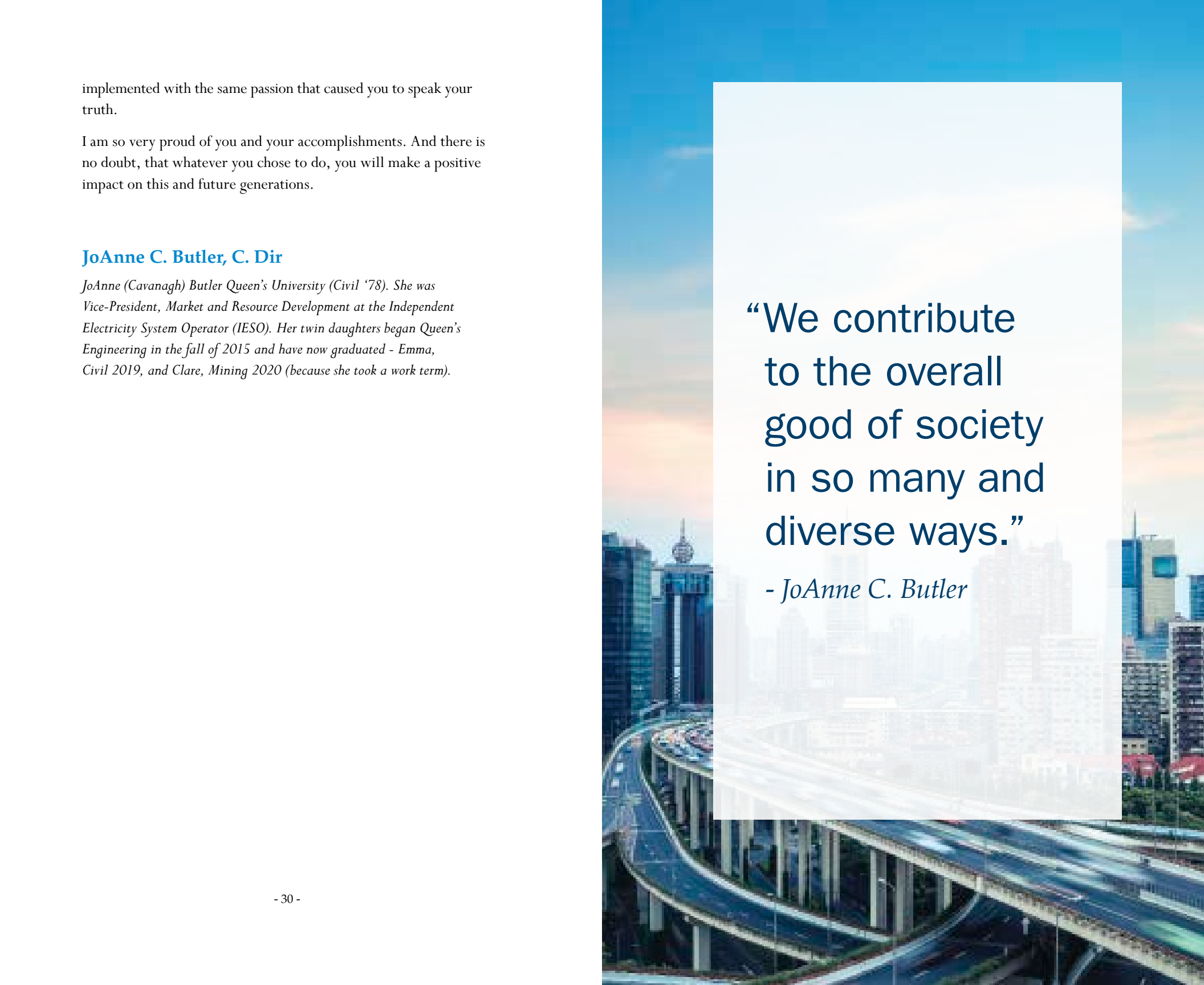
And if you get a chance, it is very rewarding to be in the public service. It is a way to give back and a way to use your expertise for the benefits of so many who have not had those opportunities that you had. Never be afraid to speak your truth—it is to no one's advantage to simply tell someone what they want to hear. The emperor sometimes does not have clothes and there are respectful and appropriate ways to say that. However, we also need to be mindful of the broader considerations and tradeoffs that must be made in government, and those decisions, once made, need to be

implemented with the same passion that caused you to speak your truth.

I am so very proud of you and your accomplishments. And there is no doubt, that whatever you chose to do, you will make a positive impact on this and future generations.

JoAnne C. Butler, C. Dir

JoAnne (Cavanagh) Butler Queen's University (Civil '78). She was Vice-President, Market and Resource Development at the Independent Electricity System Operator (IESO). Her twin daughters began Queen's Engineering in the fall of 2015 and have now graduated - Emma, Civil 2019, and Clare, Mining 2020 (because she took a work term).



**“We contribute
to the overall
good of society
in so many and
diverse ways.”**

- JoAnne C. Butler

Tim Christie

For most of you, the coming months will involve a giant-step change—leaving your 18-year education career behind, and starting your work career.

And while I'm sure it seems unfathomable now, this work career is going to last twice as long as your education career, and will most likely involve several different jobs and maybe even a few different professions. But for now, congratulations on your accomplishment. Completing an engineering degree is no small feat, and now it's time to reap the benefits (which will initially manifest themselves in positive cash flow and regular sleeping hours).

You must now continue with the task of selling yourself and selling your ideas. You must find novel ways to cut through the noise and make your voice heard. Applying for a job? So is everyone else—after all, there's little more than a button click standing in the way. You have to distinguish yourself from the pack and prove that you want and deserve it. And the sales pitch doesn't end once you're in the door. Wherever you work, be it corporate or public service or something else entirely, you will use your engineering mindset to find improvements and efficiencies and generate completely new ideas and products. It's what you've been trained to do, but no matter how well you do it, you always need to ensure that you are heard.

I know that the engineering curriculum is packed with science and mathematics, and there just isn't much time for humanities and social sciences. You're going to have to do that on your own. Take a night class, volunteer for a local theatre group, or even just join a book club—but keep developing your critical-thinking skills.

In your engineering education, so much is presented as fact for you to accept and digest. You can't debate the merits of Ohm's Law or challenge Dalton by developing an alternative theory on partial pressures. But where 95 per cent of your engineering education was black and white, that ratio is going to be flipped in the working world. All of a sudden you're going to have to look critically at ideas and proposals and find areas where they can be improved, or reworked entirely. And that's the value that you will add.

A sound foundation in theory coupled with communications and critical thinking skills will send you far. Good luck!

Tim Christie

Tim Christie is Director, Energy System Planning at the Ontario Ministry of Energy.

Rui De Carvalho

Congratulations on the successful completion of your formal studies and on obtaining your degree in engineering. To draw on the often used but appropriate cliché, this does not just mark the completion of your undergraduate studies, but rather the start of a wonderful journey. By now you must have read some of the very inspiring messages that have been written. I have, and even after nearly 40 years since my graduation, I am still inspired by the challenges and noble causes that abound and that call upon us, both here in Canada and throughout the world.

With the completion of the formal requirements for the degree, as specified by your school and approved by the Canadian Engineering Accreditation Board, it is now acknowledged that you have the science-based knowledge of technology, systems analysis, and problem solving required to advance to the next steps. In the coming years as you work in industry, government or academia, you will gain the necessary practical experience to be granted the license as a Professional Engineer.

The studying does not end as there is the need to remain current with the ever accelerating pace of change in technology. As someone who began with a slide ruler as my personal computer, I can very much relate to this. In my opinion, however, the ability to deal with changes in the technical world will be one of the easiest challenges that you will face as an engineer. The science-based knowledge that you have obtained will serve you well as the fundamental stepping

stone to continually develop and enhance your problem-solving abilities and adapt to changes in technology.

The most important of the challenges will be to effectively work with the most complex and fascinating of all 'systems' that you will encounter as an engineer: the people around you. Your success in confronting the many fascinating challenges of cities, infrastructure deficits, world poverty, climate change, and so on will be dependent not on how well you will apply your knowledge in the sciences and mathematics, your brilliant capacity in the analysis of problems, or your savvy ability with the latest and most powerful computer or gadget, but rather on how well you will understand, empathize, engage, communicate and interact with people.

The technical knowledge that you have gained and will continue to develop will be only the canvas for your work of art as an engineer. It's the intangible, the softer skills that will set you apart. It's your ability to engage and motivate not only your immediate peers, but also the professionals from other disciplines, regulators, policy makers, and all those with whom you will interact on a daily basis. This will be the artistic talent that you will draw upon in creating your masterpiece! Your colour palette will have a wide spectrum of honesty, integrity, humility, service, co-operation and, most important of all, respect for all human beings with whom you interact.

Keep in mind that our ability and capacity to respect will be especially challenged when there are differing or conflicting points of view, opinions, and approaches to the resolution of problems. This challenge can be greatly accentuated as we move out as a professional into the vast and complex world. Continually seek to understand the people whom you will be called to work with.

A challenge that previous generations of engineers, including my own, has yet to fulfill is to become fully engaged in society as a noble professional whose opinion is sought out by the public, the media and decision makers on issues where an engineer's perspective would be not only relevant but also important. I am confident that you and

your peers will make great strides in realizing this objective.

Best wishes on your journey as an engineer and when you arrive at the various destinations, may you look back and appreciate the positive change that you have helped to achieve.

Rui De Carvalho, MEng, P.Eng.

Rui De Carvalho is Senior Vice-President of R. J. Burnside & Associates Limited.

“It’s the intangible,
the softer skills
that will set you
apart.”

- Rui De Carvalho

Fred Dermarkar

“Start with the end in mind.” Great words to live by, whether you are solving a problem, starting a project or even embarking upon a career.

When I was graduating, ‘the end’ I was aiming for was to retire young with enough money to do almost whatever I wanted; ‘Freedom 55’ as the television commercials of the day used to call it. As I near the twilight of my career and am much closer to ‘the end,’ I realize you don’t have to wait until 55 to get your reward. The real achievement is being able to look back and feel you’ve lived a life rich in meaning. Life is much more about the journey than the eventual destination.

So, what characterizes a life rich in meaning? For me, there are unquestionably two elements.

A calling

The first is a strong sense of purpose, a calling. And there are three things that transform an ordinary job into a calling: competence, commitment and character.

By *competence*, I mean having a strong drive to continually improve your technical skills. The best way to do this is to take on job assignments that stretch you and to have a hunger for excelling in each and every one of those assignments. *Character* means never compromising your integrity; it means holding yourself to the highest standards of technical rigour; it means embracing feedback from others as a gift that you can use to improve yourself; and it means acting with maturity and diligence. And it all comes together through *commitment* to organizational goals and objectives, to your co-workers and to your own personal aspirations.

Meaningful relationships

The second element of a life rich in meaning is one that is rich in relationships, both in the work place and with your family and friends. This starts with a positive attitude, an ability to build trust and a willingness to give of yourself without expecting anything in return. These attributes are infectious, and foster a positive environment for healthy relationships. When you hit a bump in the road, and you inevitably will many times over your career, the relationships you have cultivated, both at home and at work, will help you to get through the bump, and they will make those relationships stronger and enrich you emotionally.

Leadership

Leadership introduces another dimension to relationships. As you mature in your career, there is a good chance you will eventually move into a leadership position. As a leader, you will have an even greater ability to influence the work environment, the resultant relationships between you and your team and amongst the team members.

Great leaders do three things well. First, they have to be excellent managers. This means modelling and teaching high standards; effectively deploying resources to achieve the desired outcomes on-time and on-budget; and measuring, and where necessary, correcting performance. Second, great leaders earn the trust of their team, not by being nice and easy-going, but by being fair and honest; by holding each team member accountable to their performance; by recognizing those who do well; and by demonstrating competence in their role. Finally, great leaders inspire their teams by creating a compelling vision; by being passionate and positive; and by empowering their team.

“A leader is best when people barely know he exists, when his work is done, his aim fulfilled they will say: we did it ourselves.”

Lao Tzu (~550 BC)

When you have transformed your work into a calling, and you have built strong relationships in all aspects of your life, work and life no longer need to be balanced: they become a continuum leading to a life rich in meaning. This is ‘the end’ to strive for!

Fred Dermarkar

Fred Dermarkar, P.Eng. is President and CEO of Atomic Energy of Canada Limited.

A man wearing a blue hard hat and a blue work shirt is looking at a tablet computer. He is standing in a factory or industrial setting with various equipment and structures visible in the background. The lighting is bright, and the overall atmosphere is professional and focused.

“There are three things that transform an ordinary job into a calling: competence, commitment and character.”

- Fred Dermarkar

Mila Freire

Your diploma confirms a successful learning experience, an enormous persistence and perseverance, a commitment to rigor, and capacity to solve problems, small and large.

You may wonder what life will bring you. Maybe you have already found the dream job you have fought for, or maybe you have yet to make decisions among alternative jobs, further education or new adventures. Regardless of what and where you are now, believe me, you are headed for a new phase of life filled with surprises, challenges, adventures and sudden turns that will test your resilience, your learning, and your faith in yourself and others. In a couple of decades, when you look back on your career, you will realize that everything happened, as it should, in line with your passions, vision and vocation. Opportunities will come and go, people will show up and leave, you will learn more, change opinions, test beliefs, and grow as a human being and educated individual. Throughout your journey the fundamental pillars of your profession will help you: the rigor of analysis and calculation, the transparency of results, the unstoppable curiosity and the search for answers.

Forty years ago, I had to decide between being an engineer and an economist. I chose the latter and am a proud economist who has worked from macroeconomics to public finance, poverty alleviation, human capital and development. I had to make choices between living in my native country or abroad, between academic

life and development practice. I am happy with my decisions. I have been fortunate to work with some of the most motivated and honest people in this planet. I have listened to the pleas of the poor, and tried to understand how human beings who own so little, can still be so grateful and hopeful. But I still remember how difficult it was to choose between the profession of Edison and Leonardo da Vinci and a profession dealing with more abstract concepts of markets and personal preferences.

When I look back to what engineers do and what engineering is, I can not help but marvel: from constructing the pyramids of Egypt, to the colonnade of the Parthenon, to the water systems of Rome, to the great mysteries of domes and cathedrals, your predecessors worked hard, took notes, experimented, questioned and when they got the answers, they just continued trying new concepts and facing new challenges, not stopping even when they faced superstition, ignorance, or greed.

You are now at the forefront of a new generation of professionals that have conquered so much in terms of science and applied concepts. Throughout the last two millennia, engineers helped human beings build cities and infrastructure, conquer the space, build prostheses, and make these achievements available to everyone. Engineers continue to study far reaching issues as reverse-engineering the brain, making solar energy cost-competitive, engineering better medicines, providing access to clean water, securing cyberspace. Together with other professions, they help us understand the intricacies of coping with climate change and the urgency of concerted action. You will be one of these professionals, sharing your curiosity and skills and contributing to the betterment of our society.

My personal advice is to follow your passion. Be kind, share your blessings, fight for what you believe is important, look back at what you have learned and the giants that have built the highways before you leading to this point in your career. Then experience the empowerment, which is yours.

Mila Freire, PhD

Mila Freire graduated from the Technical University in Lisbon and got her doctorate in Economics from the University of California, Berkeley (the first Portuguese woman to obtain a PhD in Economics from a US university). Mila teaches Urban Economics and Policy at the School of Advanced International Studies, Johns Hopkins University.

“Be kind, share your blessings, fight for what you believe is important.”

- Mila Freire

John P. S. Froats

Getting to this point is not easy. You should feel a sense of pride and accomplishment. The academic program is challenging. You have demonstrated you have the intellectual ability needed to do the work of the engineering profession and that you have the determination to achieve a tough goal—two of the necessary ingredients to be a professional Engineer.

When I was in the role of Chief Nuclear Engineer the question I'd get asked most often was, "What does it take to be successful in Engineering (and to be able to get a job like yours)?" I think the answer is easy: find something you love to do, work hard at it, become good at it and opportunities will find you.

Success in the Engineering profession is a combination of **head** (intelligence and logic) and **heart** (drive, values and moral compass). Professional engineering is a choice of lifelong service—a focus on contributing to the benefit of humankind. Being smart and having an honest work ethic are only two of the necessary characteristics you will need to excel in engineering as a chosen vocation. There is no substitute for hard work. Perhaps of even more importance is that there is neither any substitute for having the right values and attitude to carry the grave responsibility that goes with calling yourself a Professional Engineer. The oath you took to wear your ring spoke to that part of the requirement.

Always place the health and safety of those you work with and those you serve as your first priority. Be a steward of our environment. Throughout your career, place large value on adherence to codes, standards and regulations. These codify the lessons learned by our ancestors. Ignore them at great peril. Think you are smarter than the rules and you will fail. Embrace them with energy, always striving to make them the best framework to help you and guide

others. Always provide margins in your design work for those things that you are uncertain of. They are many. Give of your knowledge selflessly and accept advice from others with an open mind. Our profession is a journey of lifelong learning that will never end. That makes the journey you are about to start on, both daunting and tremendously exciting. You will never be bored a day in your life if you chose to embrace the opportunities.

To be a professional engineer and a leader you must have a strong moral compass and the courage to stand for what is right, even when those positions are not popular. Listen to that little voice inside that guides you in those times of indecision and challenge. You know deep inside what is right. Be guided by that voice. When in doubt, stop and ask for help. Better to do what's right and weather the storm, than having to live with the knowledge that you were party to harm, caused by poor conduct of your engineering work. As humans we are fallible. To think we are infallible is foolish. To admit that we are human and need the support of our colleagues and teams builds confidence and respect.

The industrial disasters of this generation are a constant reminder that we are only one mistake away from horrific consequence. Never forget that and fully commit to make it a better future. Your signature is your personal sign of your quality standard—don't give it easily. Make it mean something special—a symbol of quality, and of all the noble qualities that our profession stands for.

Remember, you are smart enough and you are willing to work hard, now get out there and make the world a better place. Wear your ring with pride. I'll sleep well tonight, knowing that the future of my children and grandchildren is in good hands!

Best wishes for a bright future,

John P. S. Froats, P.Eng.

John Froats is an Associate Professor and Nuclear Engineer in Residence at Ontario Tech University.

Erica Lee Garcia

Engineers of tomorrow, welcome to the rest of your lives.

As of this moment, you are no longer students at an institute of higher education, but co-creators of this world. You may have noticed: it's a world full of problems, full of breakdowns, full of inconsistencies and contradictions—systems that do not work the way they were supposed to, people who have been let down, things that need to be better than they are.

That iron ring you're placing on your finger could be many things; a symbol of your victory over academic onslaught or an entrance into an exclusive club of engineering professionals. But we believe it's also a call to action. You are being called on to build bridges, but not the type that you can build out of concrete and steel. You are being called upon to bridge the gap between the disappointments of the past and the ever-present hope for the future.

You are being called upon to imagine the world that your heart wants to live in, that your sense of right and wrong says there should be, and then to find yourself a way to help change that idea into a reality. You are being called upon to use your skills for good—not just for your own enjoyment or profit but also to benefit and take care of others. You are being called upon to contribute to something you believe in, as a member of this professional community and as thinking, feeling citizen of the world.

How will you choose? However will you accomplish this lofty and vaguely defined goal? How will you know what to do with no one to tell you? Where will you start? The same way you would walk a journey of 10,000 miles: one step at a time. You'll need your creativity and imagination every bit as much as your mad math skills. You'll need your intuition and empathy as much as your

analytical prowess, and your heart as much as your head.

Up until this moment you were a consumer of knowledge, a navigator of systems, a follower of orders, a passer of really tough examinations. Your parents and professors seemed to know more than you; always seemed to have the upper hand. It may be a while before you assume positions of formal power and influence, but make no mistake: you are now one hundred per cent in charge of you. You will never stop learning and growing, but using your curiosity, you will keep creating your own education. You may not have infinite job offers in your hands, but your inner wisdom will always bring you to the opportunities that are perfect for you. You may have no idea where you fit in, but your courage to speak up and take courageous action will guarantee that you will never be alone.

Take that job you're not quite sure you can handle; it's character-building to fail. Try that volunteer opportunity that has you work with people who think nothing like you do; learning to honour differences rather than hating them is one of the toughest and most useful skills you'll ever learn. Making diversity into fuel for innovation and revelation is really the only alchemy you will ever need. It's the perpetual-motion machine of this world. Do that thing you're scared to do that gives you goosebumps. Try. Risk telling your truth. Open your ears when others do the same. Dig deep to make a difference, however you can, whenever you can.

What do you want to do? The future, in so many ways, depends on you. We are so glad you're here!

Erica Lee Garcia, P.Eng.

Erica Lee is Venture Lead with Engineers Without Borders Canada, and a founder of Engineer Your Life.

Chantal Guay

Toutes mes félicitations ! Cela aura pris persévérance et courage pour compléter ton baccalauréat en génie. Sois fière et réjouis-toi.

Cette page importante de ta vie maintenant tournée, quel sera le sentier que tu choisiras pour continuer à avoir du succès?

Mais qu'est-ce que le succès? Inventer un nouvel algorithme qui facilite la télémédecine, aider un village à accéder à de l'eau potable, construire sa maison hors réseau, devenir partenaire dans une compagnie, être millionnaire? Seul toi pourra répondre à cette question. Et je te souhaite que peu importe la réponse, tu feras ces choix avec confiance et passion et que tes valeurs te guideront.

Peut-être as-tu choisi le génie par intérêt pour les sciences appliquées et la résolution de problèmes, pour être au service de la société ici et ailleurs ou encore pour te donner une excellente formation donnant accès à tous les domaines. Sache que tu es en bonne compagnie. Nous sommes plusieurs centaines de milliers à œuvrer au Canada et ailleurs dans le monde dans tous les domaines. Les opportunités sont infinies, à toi de tracer ton chemin.

Sur la route, il y aura des rencontres qui changeront ta direction et ton progrès. Il y aura celles et ceux qui t'aideront à gravir les embûches et celles et ceux qui te feront faire plusieurs pas en arrière. Dans les deux cas, ces rencontres te permettront d'apprendre et de grandir comme personne et comme professionnelle – va pleinement à la rencontre de l'autre. C'est la seule façon de se connaître soi-même et de savoir quel type de personne tu veux vraiment être. Au cours de ces nombreux

entretiens que tu auras le long de ton parcours, je te souhaite de découvrir des amitiés et des partenaires de vie. Sur ton chemin recherche l'authenticité, la générosité, l'humilité et l'empathie et tu ne seras pas déçue.

Change le monde soit, mais n'oublie pas de prendre soin de toi et des tiens. Tout au long de ta vie tu auras besoin de ta santé physique et mentale alors ne te néglige pas, nourris-toi sainement, va jouer dehors, prends le temps de refaire le plein d'énergie et développe un solide réseau social.

Tu passeras probablement une bonne partie de ton temps au travail alors choisis avec soin l'équipe à laquelle tu contribueras – qu'elle soit accueillante, bienveillante et te permette de grandir comme individu et professionnelle.

Je sais aussi que tu voudras faire une différence dans ta communauté, au Canada et dans le monde et je t'en remercie, pour ma fille et ses enfants à venir. Notre profession a grandement aidé les sociétés à se développer et à améliorer la santé, la sécurité et le bien-être des populations mais hélas souvent au détriment des écosystèmes et de l'environnement. Je t'en prie fais ta part, agis localement tout en pensant aux enjeux climatiques globaux. Aie l'audace de rendre possible ce qui le semble peu et d'aider l'humanité à faire face aux défis grandissant d'une planète surexploitée et malmenée. Courage et persévérance chère collègue, tu y arriveras.

Chantal Guay, ing. P.Eng.

Directrice générale, Conseil canadien des normes

Ralph Haas

“A Fork in the Road” is the title I chose for this letter to a young Engineer. It is based in part on a Convocation Address I gave to Engineering graduates at The University of Alberta in June, 2018. My Alma Mater for a Bachelor’s Degree many years ago was the U of A and then I became a “new” graduate at U of A with a DSc (Hon) in 2018. My life as a young engineer was followed by six decades as an educator, researcher and practitioner. It has been one of good fortune and opportunity to observe and participate in an incredible amount of change in our profession, and indeed in our society. You will face even more changes in your career over the coming years.

So why the title of A Fork in the Road? To start, Yogi Berra, the great baseball Hall of Famer, is reported to have said “when you come to a fork in the road take it”. Steve Jobs, Co-Founder of Apple, and Beverly McLachlin, Retired Chief Justice of the Supreme Court of Canada effectively said the same., as I will point out.

As for Yogi Berra, some thought it was just a Yogi’ism, but he became a successful manager of The Yankees after his playing days; Steve Jobs was a genius in creating devices that people wanted, and Beverly McLachlin wrote seminal judgements for the Supreme Court. They all really talked about opportunity and decision time.

A personal example is my first job after high school, which was unloading box cars of farm and construction materials. One night, in the town pool hall, a buddy told me they had just fired a guy from the survey crew – the next day I had a new job. Now I understand what Steve Jobs meant in a commencement address at Stanford University when he said “Have the courage to follow your heart and intuition”

Another personal fork in the road, 8 years later, was a decision to go to University. I well recall the opening welcome for frosh when the Associate Dean of Engineering, Professor Gads, warned that only one out of every three of us would eventually graduate – that scared the heck out of me, but I did make it and with the encouragement of Dean Govier went on to do graduate work.

Then came a fork in the road which changed my life and career. It started with a Sunday morning call from Dr. John Ruptash, Dean of Engineering at Carleton University in Ottawa – who said I hear you are looking for a job and I am offering you one – I asked if I could think it over, and he replied sure call me back tomorrow morning.

A month later my wife and I with two small kids, pointed our 11 year old Chevy east, and headed for Ottawa – that could not have been a better decision, and Dr. Ruptash, who I found later had actually been a gold medalist in Engineering at Alberta, was a superb mentor.

After three years in Ottawa I joined the University of Waterloo, did my PhD and embarked on another stage of being a teacher, researcher and practitioner over the next decades. Those years involved a great array of activities, initiatives and very importantly many many undergraduate and graduate students who can justifiably take pride in their achievements; me too! As I write this letter after more than two decades of supposedly being retired, I continue to do research, supervise students and stay involved with the Transportation Association of Canada, The US Transportation Board, The Royal Society of Canada, and others. In fact, I was the founding Director of The Center for Pavement and Transportation Technology.

Another personal fork in the road was whether I could contribute something meaningful to the University of Alberta in recognition of my own positive experience as a student and in subsequent years as an alumnus. The initiative undertaken was a partnership between

myself and Stantec to create an endowment in support an early-in-career professor. It epitomizes in many ways chief Justice Beverly McLachlin saying “There’s always another page to turn, and you turn it”


Now, do my personal examples mean that I always made the right decision – not at all. I recall in that sense, one of the longest serving Deans of Engineering in Alberta, Dr. R.M. Hardy, A prominent geotechnical expert, who was reputed to have made many mistakes – but not the same one twice. You too will come to many forks in the road. You will make mistakes, but hopefully also not repeat them.

I would like to finish with a personal perspective that if one has any kind of a legacy it should be based on being, above all, a decent person. All the better if you add generosity, integrity, courtesy and contributions to your community, society and your profession. I hope this will be an integral part of your future, as proud alumni of this great University.

Ralph Carl George Haas

Ralph Haas is the Norman W. McLeod Engineering Professor and Distinguished Professor Emeritus at the University of Waterloo, and past chair of The Department of Civil and Environmental Engineering.

A Member of the Order of Canada, Dr. Haas is also a Fellow of the Royal Society of Canada, the Canadian Academy of Engineering, the Engineering Institute of Canada, the American Society of Civil Engineers and the Canadian Society of Civil Engineering. In 2002 he received the Queen’s Golden Jubilee Medal and in 2012 the Queen’s Diamond Jubilee Medal. The University of Waterloo officially named “The Ralph Haas Infrastructure and Sensing Analysis Laboratory” in his honour in 2014.



“You too will come to many forks in the road. You will make mistakes, but hopefully also not repeat them.”

- Ralph Haas

Peter Halsall

You have completed the part of life where your performance is measured by marks.

From now on it's up to you to define what success means. My recommendation is to try to find a definition of success that you can apply to all of them.

The ability to calculate an answer by applying formulae has made you technically competent. You may start out your career doing that. To develop that into engineering requires learning how to apply technical skills and resources to address physical, social, ecological, economic and political issues.

In these, you choose the types of decisions you want your work to be recognized for. This can range from the best possible decisions incorporating appropriate knowledge from available experts, or the most convenient ones using convenient information or assumptions. Only the first path will create long term value.

From material selection to climate change mitigation, engineers are tasked with delivering an answer on budget, on schedule and within scope. This makes it very easy for businesses to define success as efficiently repeating the same set of solutions to whatever problem shows up.

However, applying this short-term approach will not successfully resolve the key problems we face today. Instead, consider how your actions can result in communities with plants where there would conventionally be pavement, reductions in or absence of health-diminishing pollutants, thriving life-supporting ecosystems, and, ultimately, reductions in extreme weather event frequencies. Being prepared to seek out these sorts of solutions in everything that you

do is not the easiest path to take. But it is the leadership opportunity your education has given you.

Experience shows that the path to the best solution starts with accepting that there are always many “right” solutions to a problem. Getting the best one requires you to understand the different processes that define the outcomes, how they interact and how the stakeholders in the problem perceive the issues. This involves having the right team engaged in the process.

So I suggest to you that being a successful engineer is ultimately being a successful team builder who happens to have good problem-solving skills. Like school, it involves learning and it involves far more collective listening than talking. But from now on, the problems you tackle and the team you work with to achieve success are your choice. Where you choose to work defines the team you work with and whether or not you will create a positive impact for generations to come.

The next generations are hoping and depending on you to be successful.

Peter Halsall, P.Eng., MASC, FCAE

Peter Halsall began his career in structural engineering before completing a Master's degree and working in biomedical engineering. He is former Executive Director of the Canadian Urban Institute and Chairman of Synergy Partners, a building engineering firm.

Glenn Harvel

So now you have arrived! A successful graduate from an engineering program. Congratulations on completing the first step of your long journey. We have all been waiting for you.

There are many doors open to you now, and challenging choices await! Which path will you travel? Where will you go? The path forward is up to you. Despite all you have learned, it will not be an easy one, nor will it be as difficult as you might believe. The true challenge you face is recognizing the problem to be solved in the first place. Many times in your future, you will be asked to solve a problem, or lead others toward a solution. Yet when you catch time to reflect, you will end up asking yourself why everything is happening the way it is. You see, your challenges will not be only technical or engineering, they will be much more. You will face people challenges, community challenges, ethical challenges, and yes, even fear. Fear to act and fear not to act. Do not worry about the fear. You already have many of the skills you need to succeed and there is a lot of support waiting to help you. Seek it out as you need it and take the time to reflect.

For the first few years, you will enjoy what you expect to. You will work with other engineers, perform engineering type calculations, write reports, and in general do something very helpful. This next phase of your journey is an important one. It is your time to cement your learning into a solid core of capability. Work hard, listen hard to your peers, and yet never forget your personal life and your community. Developing the work-life balance at the beginning of your career will make your journey much more enjoyable.

Later in your journey, you will realize a truth. Excellence is rewarded with more challenges. The tasks will change. The responsibilities will change. The more you embrace engineering, the more it embraces you. Do not fear the change. It is important to you. Change is what helps you think more openly about ideas. Change is what helps you find solutions you could not see before. Change brings different perspectives and meeting different people.

Read the Act. Yes, you need to be conversant with the law. Yet the Professional Engineers Act gives you insight into what it means to be an engineer. Not just the technical side, but what is expected from a person who acts with professionalism and integrity. That professionalism and integrity is yours to keep and yours to lose. When the work is done and you get to relax, it will be you and your own soul that will judge you most harshly.

Seek the truth. Most problems are actually not complex. They appear that way due to confusion and misunderstanding. Always look for the facts that truly define what is required.

Listen to others. Everyone has something to say. No one is always right. By listening we understand. By understanding we get to the root of the problem and we get the better solution.

If possible, work as internationally as you can. You do not have to leave your home or country, yet working with people from around the world broadens your world. You will obtain insight into how people think and what ideas people believe are important. This insight into others will improve your ability to work in a team and your ability to find a solution acceptable to a broader community.

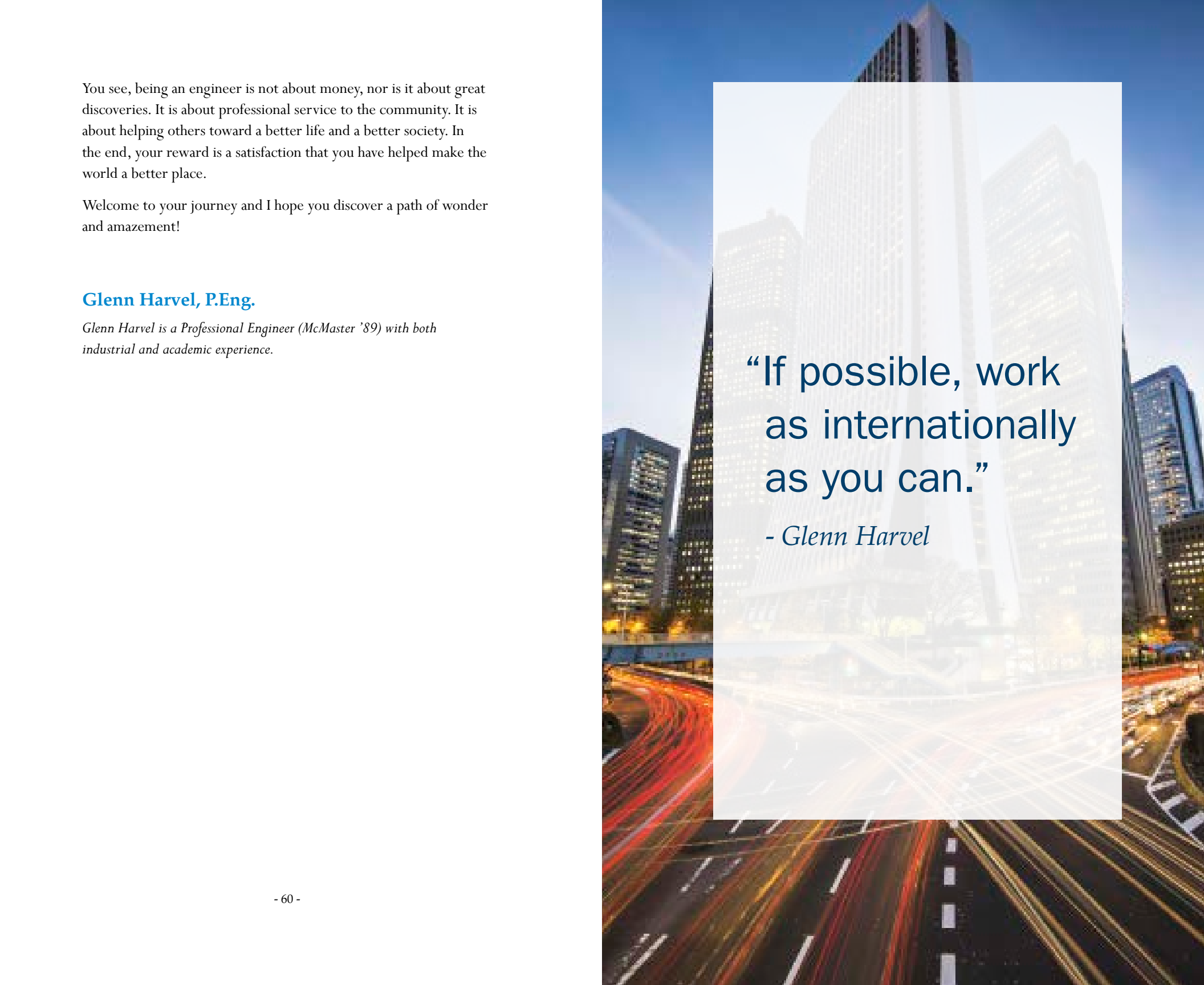
Be prepared to develop those skills you thought were unimportant. You will be amazed that you will become a source of non-engineering advice or be repeatedly asked to work in areas where you do not feel qualified.

You see, being an engineer is not about money, nor is it about great discoveries. It is about professional service to the community. It is about helping others toward a better life and a better society. In the end, your reward is a satisfaction that you have helped make the world a better place.

Welcome to your journey and I hope you discover a path of wonder and amazement!

Glenn Harvel, P.Eng.

Glenn Harvel is a Professional Engineer (McMaster '89) with both industrial and academic experience.



“If possible, work
as internationally
as you can.”

- Glenn Harvel

Alec Hay

Have you ever paused during your studies to ask what engineering is and what role you will play?

Have you discussed what the professional practice of engineering actually means? I know that you may have thought about it in general terms, as you enrolled in your respective programs, but have you wondered what the profession will be like in ten or twenty years' time? This question is challenging professional associations and institutions around the world. It is worth giving some thought to.

Technology, particularly Information & Communications Technology (ICT), has fundamentally changed the way we live, work and play. It is also changing the professions, challenging the very foundations of the "Grand Bargain" that established the great professional institution in the 19th Century. Society trusted the professions to act selflessly in the public interest, applying complex and specialist knowledge practicably and ethically. Many of the routine functions are increasingly automated and the general public enjoys ever greater access to professional knowledge at any time without even engaging a professional. This is informing increased demands for professional accountability and growing expectations of value service. We see this in law, medicine, finance and design, both architectural and engineering. It doesn't mean that professions will disappear, but rather that they will need to change to remain relevant and valued in a rapidly changing world. This is the world that you will practice in, and will only bear a passing resemblance to the world in which I and my peers developed our skills. You will be writing the future of the engineering profession as you progress through your career. It's an exciting time with similar challenges and opportunities to those discussed in a London coffee shop in

1818, which led to the first professional engineering institution.

There are other changes afoot that will influence how you practice. Climate Change is presenting entirely new societal challenges, not just in littoral areas, as well as negating many of the existing design codes of practice and the received wisdom. All of these changes will require competency at its most fundamental level, the ability to work from first principles and recognise when the codes are inadequate for the task. You will need to build the tools to solve the problem that you identify, rather than define the problem by the tools that you already have. It also means that engineers will need to be better at communicating to peer and lay audiences, and be capable of working in other disciplines and professions. Learn and use the language of your other project team members, from operations, finance, risk and others.

Don't retreat into a routine process, but keep abreast of the changes around you and recognise what those changes mean for you and the beneficiaries of your work. Dare to imagine new solutions that are practicable and adhere to the laws of physics. Your work needs to retain value through its life and that demands an intelligent assessment of these trends in climate, technology and society. If you can do this, you can address the problems of today and tomorrow. Don't rely on technology to innovate the problems away; technological advances simply change the problem set. Trust in yourself and build on the knowledge and skills that you have gained so far. This is only the beginning of your education.

So when you next pause to consider what engineering is and the role that you will play in or with the profession in the future, give some thought to the value that it represents in society and the value that you can contribute. Your greatest quality is your intelligent imagination. Don't lose it. It is what will define your success in this most exciting of professions amid the challenges ahead.

Alec Hay

Alec Hay is the founding Principal at Southern Harbour Ltd.

Jacquie Hoornweg

The road to greatness is best travelled with collaborators.

We are living in a time of unprecedented exploration. Unlike centuries ago, we are not discovering new lands. Instead, we are revealing new dimensions to our world and ways to sustain it rather than simply mine it. And, we are unlocking mysteries about our bodies and our minds that are literally changing what it means to be human. Some even believe time travel is no longer out of the realm of possibility.

By the time you've graduated as an engineer you have collected at least a few keys to unlocking the mysteries of the galaxy. You understand how things work and hopefully you have an idea, and a passion, for how to make them work better.

Engineers are the innovators and inventors. They play an important role in forwarding mankind to the next frontier.

Whether your contribution to the world is a sustainable way to manage your community's garbage, build hydrogen trains, develop low-carbon energy systems or create a remote surgery robot, there is one critical ingredient you require—a social licence. You need the trust and acceptance of the communities affected by your project. You need society's leaders to understand your vision and believe in its value for them and their constituents.

You may be tempted to think that if people just understood your project the way you do, they would come to the same conclusion about its value. A social licence seems just a website or brochure away.

Experience shows this is not the case. The people who fight infrastructure projects hardest, in courts, regulatory hearings, city hall and in the media, know the facts as well as the engineers who design them. But they disagree with the value proposition. And, they work hard to ensure others will too.

As engineers you have the training to solve the world's most wicked problems. But the world is not a paper exercise. It is multi-dimensional. In it, people make decisions with both intellect and emotion based on their perception of how a project will affect them and how it aligns with their values. Earning a social licence means acknowledging people's feelings, working with them to address their concerns and gaining their trust. This might mean modifying your design long before the brochure is written.

By seeking out and incorporating the input of others into your design, you greatly improve the probability your ideas will integrate smoothly into the environment where it will be used. Not only will you have improved your chance of gaining social permission, chances are you will have developed a more optimum solution.

Some tips for the journey:

- Seek out and incorporate the feedback of communities with an interest in your project during the design phase; not after it's done. Let diverse inputs make your project stronger;
- Respect and collaborate with the communications professionals on your team. Just as you have spent your life strengthening your technical expertise, communicators have studied how to engage people and open pathways for meaningful dialogue that will address intellectual and emotional interests; and
- Make sustainability principles a cornerstone of your work.

As engineers, you have the power to change the world. When you allow others to share your power, what you achieve together can be limitless.

Jacquie Hoornweg

Jacquie Hoornweg is a professional communicator and policy advisor. She works as part of multi-disciplined teams that help build sustainable infrastructure for a better world.

A group of four people, likely engineers or construction professionals, are gathered around a table on a construction site. They are wearing hard hats and safety vests. One person is pointing at a large set of blueprints spread out on the table. The background shows a clear blue sky and some construction equipment.

“Engineers are
the innovators
and inventors.”

- Jacquie Hoornweg

Nadine Ibrahim

Congratulations! You have arrived at an important milestone in your life. It took a lot of effort to get here, and you persevered! When you look around at all those graduating with you, you are similar for having almost the same résumé, taken the same courses, written the same exams, and learned and applied the same skills. This is far from the truth – you are not all the same! I want to show you how diverse you all are. You are unique!

Throughout a very rigorous and structured engineering program, you likely had to carve out time for your interests, extracurricular activities that you wanted to sign up for, events you wanted to participate in, or competitions you wanted to join. For each one of these activities, you created a new network of friends, discovered a new found ability, strengthened an existing talent, and added a new skill to your skillset. Keep doing these! Every club you led, every event you organized, or every talk you attended gave insight into a new perspective and put you in front of new people. Keep doing these!

It's the sum of all that you do outside your classes that complements your technical knowledge, builds character, and shapes you into the unique leader you are today. Leadership lies in the ability to plan, initiate, communicate, and influence. More often than not, you'll find that you demonstrate leadership without the title of "leader" because leadership belongs to all those who are giving and motivating, creative and confident. Engineers have the ability to influence, and therefore a responsibility to lead. You can lead from any position you find yourself in. Your impact is what makes you unique, and that's what sets you apart, and how you stand out.

Within a very structured engineering program, you also have flexibility in the choice of specializations and options. This may have gotten you to choose electives outside your department or faculty, or combining parts of engineering knowledge on a co-op job or on a design project. There's a lot of excitement in the boundaries between disciplines. You create lightbulb moments when cooperating with others who are different from you and accepting new viewpoints that are also different from yours. May you have lots of these throughout your professional careers. The special space within and among disciplines breeds the interdisciplinary knowledge and collaboration that sparks innovation. Inspired by Nissani (1994) on "Fruit Salads and Smoothies: A Working Definition of Interdisciplinarity," where he creates an analogy using food to bring meaning to interdisciplinarity, which implies: if monodisciplinary is an apple, multidisciplinary is a fruit bowl, interdisciplinary is a fruit salad, and transdisciplinary is a smoothie. May you always have colourful careers that keep you inspired and engaged.

I find that interdisciplinary knowledge to be the most fascinating. If I were to chart my career pathway, you would see that it is a meandering path, both in disciplines and in geographies. Drawing from my own undergraduate experience at the University of Toronto (UofT), my starting point is as a structural engineer. I was interested in civil engineering because of my interest in structures. A new "Collaborative Environmental Program" was being started in the late 90s at UofT, and only offered to civil, chemical and mechanical engineers, which I chose, and added environmental engineering to my toolbox. Also, while in undergrad, a Certificate of Preventive Engineering and Social Development was offered to those interested in the cross section of engineering, technology and society, which I pursued, and added preventive engineering and social development to my toolbox. While continuing on to grad school, I was motivated to continue to work in the structural labs in the Galbraith and Sandford Fleming buildings, which involved

research on the performance of new repair materials. I wanted to include the economics of these new fibre-reinforced polymers, so I learned what I could about life cycle cost analysis to support decision-making for repair vs replacement options, and with that, I added economics and decision-making to my toolbox.

With two degrees then, and a desire to see the real world and join the workforce, my dreams took me to explore working in Egypt, but my dream of working on a construction site did not materialize. Instead, and much to my surprise, I came to know that Egypt, like many other countries in the developing world are recipients of financial assistance for development projects. I embarked on what became 6 years of environmental consulting in the Middle East and North Africa Region, working with multilateral organizations like the United Nations Development Program, and bilateral organizations such as the Canadian International Development Agency (CIDA, now Global Affairs Canada). What I did was reach into my toolbox and bring out the environmental engineering tools, but what I put into my toolbox was so much more, including international development, consulting, and business development, and an appreciation for local knowledge and the developmental challenges in many cities and communities.

Later back to Canada, and back for a PhD, I had become a “T-shaped” engineer holding breadth of knowledge from other disciplines that rests on the foundational engineering knowledge at the base of the T. With a new found interest in global challenges and climate change, my research focused on climate change action in global cities, while keeping a job in asset management working alongside municipalities in Southern Ontario as they planned for growth, maintenance, repair and replacement of municipal infrastructure, and investment decisions within the constraints of municipal funding. Thanks to great mentors and bosses, I loved the ability to simultaneously acquire academic and industry experience. I had reached into my toolbox for climate change skills, economics theories, and my passion for cities, and put into the toolbox climate

action costing, sustainable cities, and urban infrastructure.

A postdoctoral opportunity comes next, and puts into action the saying, “hard work puts you where good luck can find you.” A project was just starting up at UofT, and the team reached out to me asking me to join “Engineering Education for Sustainable Cities in Africa.” My response: engineering education is my calling, sustainable cities is my expertise, and Africa is in my heart. I had reached back into my toolbox for the skills from the developing world experience, and the global sustainability efforts, and within 3 years added to my toolbox urban infrastructure challenges that are magnified on the African content, rapid urbanization and population growth, and 13 amazing African countries explored.

As I carried my toolbox everywhere I went, I wondered who would be interested in these combinations of tools and skills, or more concerning to me, is whether I would be able to find a career where I can use them all, because I love them all, and it would be hard to have to choose some and let other tools rust. And there it was, the career I now lead at the University of Waterloo as the Turkstra Chair in Urban Engineering is one that demands my academic training and values my industry exposure. In this role, I create opportunities for industry-academic engagements, and lead new educational attitudes around sustainable cities to ensure the civil engineers of tomorrow are the new urban leaders, entrusted by society to achieve a sustainable world, while ensuring better quality of life. My hope is to build a community of engineering leaders and to foster urban sustainability literacy among students to enable them to traverse beyond their disciplines to create livable futures. These efforts aim at increasing the role of civil engineers in urban governance and empowering engineers in decision-making in cities. You are the new generation of city leaders.

There's always something to add to your toolbox everyday when you keep your mind open to opportunities. Wherever you go, ask yourself: What can I add to my toolbox? When faced with new opportunities and endeavours, do not doubt yourself, reach into your toolbox, you're going to find something there that gets you started, and trust that you'll always put back so much more. And always question if what you are chasing adds value to your skillset. Move intentionally towards your goals, while keeping an eye out at what lies outside your boundaries and comfort zones. A meandering career pathway is an exciting one, with curves and bends that are evidence of a life well-lived and an unbounded curiosity.

This is a letter about how structural engineering created a pathway to sustainable cities, safe communities, resilient infrastructure, and inclusive space. Tell your story as you weave all the skills in your skillset together, and how you built your career using all the tools in your toolbox.

Nadine Ibrahim

Nadine Ibrahim is a Lecturer in Civil & Environmental Engineering at the University of Waterloo, and holds the Turkstra Chair in Urban Engineering. She is also the chair of the Engineer of 2050 Special Interest Group at the Canadian Engineering Education Association.

“Engineers have the ability to influence, and therefore a responsibility to lead.”

- Nadine Ibrahim

Waguiah Ishak

You are now armed with a great education and ready to take your degree, this blunt instrument, and build something bold and important with it; something that will make you proud and make this world a better place. We are all counting on you to use your education, creativity, judgment and technical competence to work hard to solve problems that matter; problems that, when solved, will have a large and positive impact on the community and on the environment.

In my opinion, the three primary things that people want are good health, good (and ubiquitous) communications and good entertainment. There is still so much to be done in the field of healthcare, it is one of the areas ripe for your innovation. We want to live longer and have a healthier life. We want to be able to go to the doctor and have them diagnose our disease on the spot and prescribe a personalized medication without any side effects. But why should we have to physically see a doctor? Why not diagnose our diseases over the Internet? Better still, why can't we use our phones or tablets to do all the necessary tests to diagnose our diseases accurately?

People always want to be connected and entertained. Universal communicators with speech recognition, fantastic displays, infinite bandwidth, unlimited storage and seamless interaction with home, office and car equipment would allow people to carry just one universal device that could purchase the products they want at the click of a button, re-stock products automatically and keep me

up-to-date with family, friends and the outside world. We want good entertainment at home, in our automobiles and on airplanes, with high definition, on-demand video and quality games—without fees or restrictions.

Who will invent, design and implement these technologies? ENGINEERS.

We are counting on you to help us broaden connectivity, to entertain us and to improve and clean the environment for future generations.

As you begin your career, surround yourself with innovators; learn and absorb information and ideas from them. Find a good mentor; shadow them and don't be intimidated by people who are more knowledgeable than you. In fact, for those of you who will hire and manage people: hire people who are better than you are. Their success will reflect well on you too.

Engineers are responsible for inventing a safe and healthy future for all of us. Remember that you spent four years of hard work preparing to contribute to society and to be part of a community that will solve problems and create a better world together.

Waguiah Ishak

Waguiah Ishak is Vice-President and Chief Technologist at Corning Incorporated, Palo Alto, CA. He is a Faculty of Engineering alumnus from McMaster University.

Julie Johnston

When I hit physics in Grade 11, I knew I was never going to become a scientist of any kind.

All those pulleys and magnets and prisms, oh my. I survived one year of chemistry, but that eluded me, too. I used to stand in awe of classmates who “got” advanced chemistry, who grasped the nature and properties of matter and energy, and who understood good old electricity. I liked biology, but it wasn’t taking me anywhere either.

I became a humanities major in university and trained as a French and outdoor education teacher. But my big crush in Grade 13 (ah, did I just give away my age?) went into engineering at the University of Toronto, and so for a time, I swirled about in the satellite world of engineering students.

Fast forward a handful of decades (and do listen to all of us oldsters who implore you to seize the day, or at least the week—as a physics drop-out, I could never figure out how it was the world kept spinning faster and faster the older I got, but then one day I realized it was actually a mathematical question), I left French teaching behind and concentrated on outdoor education, which morphed into environmental education, which has become sustainability education.

I tell you all this to assure you that I know nothing about engineering, but I do know a lot about what’s going on in the world. And that’s where my rambling is headed.

From 2005 to 2007, I was privileged to serve as the first co-ordinator of environment and sustainability programs at a big independent school in Toronto. That’s where I ended up back in the orbit of the world of engineers, working with graduates who

had careers in science and engineering to develop a sustainability curriculum. I was pleased to find that engineering faculties were way ahead of every other field in the teaching of sustainable development principles and practices.

Please don’t ever think it’s possible to have ‘too much’ sustainable development in engineering or engineering education. You’re the ‘doers’ in this world, so it’s up to you to ‘do’ sustainable development. Indeed, any development that isn’t deliberately designed to be sustainable is, by default, most likely unsustainable. Worse, as Dennis Meadows (co-author of *The Limits to Growth*) has concluded, it might be too late for sustainable development. He knows how urgent the climate change emergency is, and says we need to be focusing now on survivable development.

So let me leave you with three requests. First, invite people into your orbit. Reveal some of the mysteries of engineering to the general public. Find ways to help the rest of us understand—and appreciate—what your profession does.

Next, please always remember that life comes first—that life trumps physics, chemistry, electricity—because life is all of these combined, in ways we will never fully comprehend. Be proud to be and become ecologically literate, to include ecological concerns in your engineering deliberations.

And finally, think like an ancestor. Really, that’s what sustainable development is all about. It’s an intergenerational golden rule. Let your life and your career be a gift to future generations. Oh, and enjoy! Because if it isn’t fun, it isn’t sustainable.

For the Earth, the future and the children—of all species,

Julie Johnston

Julie Johnston is a teacher on the west coast of Canada and a sustainability education consultant with GreenHeart Education (greenhearted.org).

Chris Kennedy

Over the past few years, you have learned some important skills—problem solving, quantitative analysis, communication, decision making, etc.—that will set you up for a fulfilling career.

Another thing you should have come to realize is the huge responsibility of engineers. The contributions that engineers have made to society have been fantastic, supporting a high quality of life in many places. There are, however, huge global environmental challenges that engineers need to wrestle with—and these are what I will discuss in my letter to you.

Before I summarize some of the issues of global climate change, biodiversity loss, interference with the nitrogen cycle, etc., you might ask: “Are engineers really responsible for addressing such large overwhelming challenges?” These are problems that engage many professions—scientists, economists, planners, and others -- but without doubt engineers have a huge role to play. In fact, in many jurisdictions the engineers’ responsible stewardship for the global environment is enshrined in legislation. For example, in the Professional Engineers Ontario Guidelines for Professional Practice (Section 16.3; #3) it states:

“A professional engineer ... should

- 3.1 recognize that humanity is dependent on the ecosystem of this planet and that the planet has a finite assimilative capacity;
- 3.2 ensure that environmental evaluations begin at the earliest planning stages of an initiative and provide the basis for project life cycle environmental management.”

Discussion about climate change receives a lot of media attention—and rightfully so—but concerns over biodiversity loss and production of active nitrogen are possibly as alarming. Scientists believe that an atmospheric CO₂ concentration of no more than 350 parts per million is required to have a good chance of keeping temperature rise to within 1.5 or 2°C. The planetary boundary that is being most overstretched according to Rockström and colleagues (Nature, Sept. 24, 2009) is however, loss of biodiversity. Species diversity is important for maintaining healthy ecosystems, making them resilient to disturbance and therefore less prone to collapse. This is important because the very existence of ecosystems provides services to humans and supports other planetary subsystems. Scientists have estimated that there is a natural, safe rate of biodiversity loss of less than ten extinctions per million species per year, but the current rate of biodiversity loss is about 10 to 100 times higher. With the nitrogen cycle, it is crudely estimated that industrial and agricultural fixation of nitrogen should be limited to about 35 million tonnes per year to avoid eroding the resilience of terrestrial, freshwater and coastal ecosystems. Yet the current rate of nitrogen fixation is about 210 million tonnes per year.

Engineers design many of the things that give rise to the global environmental stresses. Power plants, buildings, transportation vehicles and waste management facilities are some of the primary sources of GHG emissions. Loss of biodiversity is complex, but some of the causes include habitat fragmentation due to transportation corridors, bioaccumulation of toxins in the food chain, and destruction of habitat in the clearing of land for agriculture and other developments. Active nitrogen is released into the environment through a variety of mechanisms including combustion of fossil fuels, discharge of waste water and agricultural runoff.


Some progress has been made in developing technologies that help in response to global environmental stresses. Engineers have been active in the design and construction of green buildings,

low emissions vehicles, urban transit systems, renewable energy plants, advanced water treatment facilities, etc. In many respects these are the arenas where passionate engineers looking to make a difference can have the greatest impact. There are some exciting technologies under development, like next-generation photovoltaics and low-cost battery storage. Much of the work involves making incremental progress—gradually improving upon designs, bringing costs down and helping sustainable technologies to out-compete 20th-century approaches.

There is also a new type of engineer evolving—the industrial ecologist. Actually, industrial ecology is more of an interdisciplinary field in which engineers significantly contribute. Industrial ecology takes a high-level perspective on the design of sustainable systems, tracing the energy and material flows of products and processes to their environmental impacts. Studying the life-cycle impacts (as noted in the PEO Guidelines) is an important part of industrial ecology, but the aim is to be bolder than this. Rather than evaluating the impacts of products and processes using yesterday’s industrial and power systems, the forefront of industrial ecology is understanding how to redesign these systems so we can continue to prosper within the planetary boundaries. It’s a challenge that young engineers—like you—can help with.

Chris Kennedy

Chris Kennedy is Professor & Director of Industrial Ecology Program, Civil Engineering Department at the University of Victoria, British Columbia.



“...the forefront of industrial ecology is understanding how to redesign these systems so we can continue to prosper within the planetary boundaries.”

- Chris Kennedy

Warren Knowles

Congratulations! While completing your degree, you have learned so much.

Your knowledge and skills, along with the connections you have made, will form the foundation for your developing career. It is my pleasure to provide a bit of advice to help you with your career - take it for what it's worth.

All the engineers I know have a strong desire to achieve and to make a difference in the world. In order to make the most of your career, many more steps will still be required as you begin working, and the best guide that I can provide is to encourage you to learn the habit of constant reflection and appreciation of your progress.

As a simple, but effective way to help with your progression, I suggest you ask yourself three questions at the end of each workday.

1. Did I bring value?
2. Did I learn something?
3. Did I have some fun?

Did I bring value? Whether it be to your clients, colleagues, your community, or yourself, it's important to consider the value your efforts brought to those you are trying to help.

We often focus on the immediate problem or task in front of us. But what is the nature of the help that each of those around us needs? How do their needs fit in with the bigger picture or vision of what we are trying to achieve? To hone your efforts in meeting these needs, you first have to listen, learn and consider what you and the team you are working with are trying to achieve.

Understanding the overall objectives will make you much more effective at executing your tasks in a way that serves a larger purpose, and you will be a valued member of the team.

Bringing value starts with making it easy for those around you to succeed. Whether this means taking on relatively simple tasks to free up more senior staff time, anticipating the needs of your colleagues, or spending a bit of your own time to do a bit of extra legwork. The appreciation shown to you for these efforts may not always be apparent, but chances are that if you are bringing value and helping those around you succeed, you will find that you will become busier and busier. The best and brightest young engineers are in the greatest demand and are often the busiest. Strive to be one of those engineers.

Did I learn something? I often joke that it takes two years for a newly graduated engineer to become useful. This is not actually true but it is a means of encouraging newer graduates to take some time to learn about their job. Completing your engineering degree is a huge accomplishment, but it is one step of many. You now have an opportunity to the apply science and skills you have learned in a manner that people really appreciate.

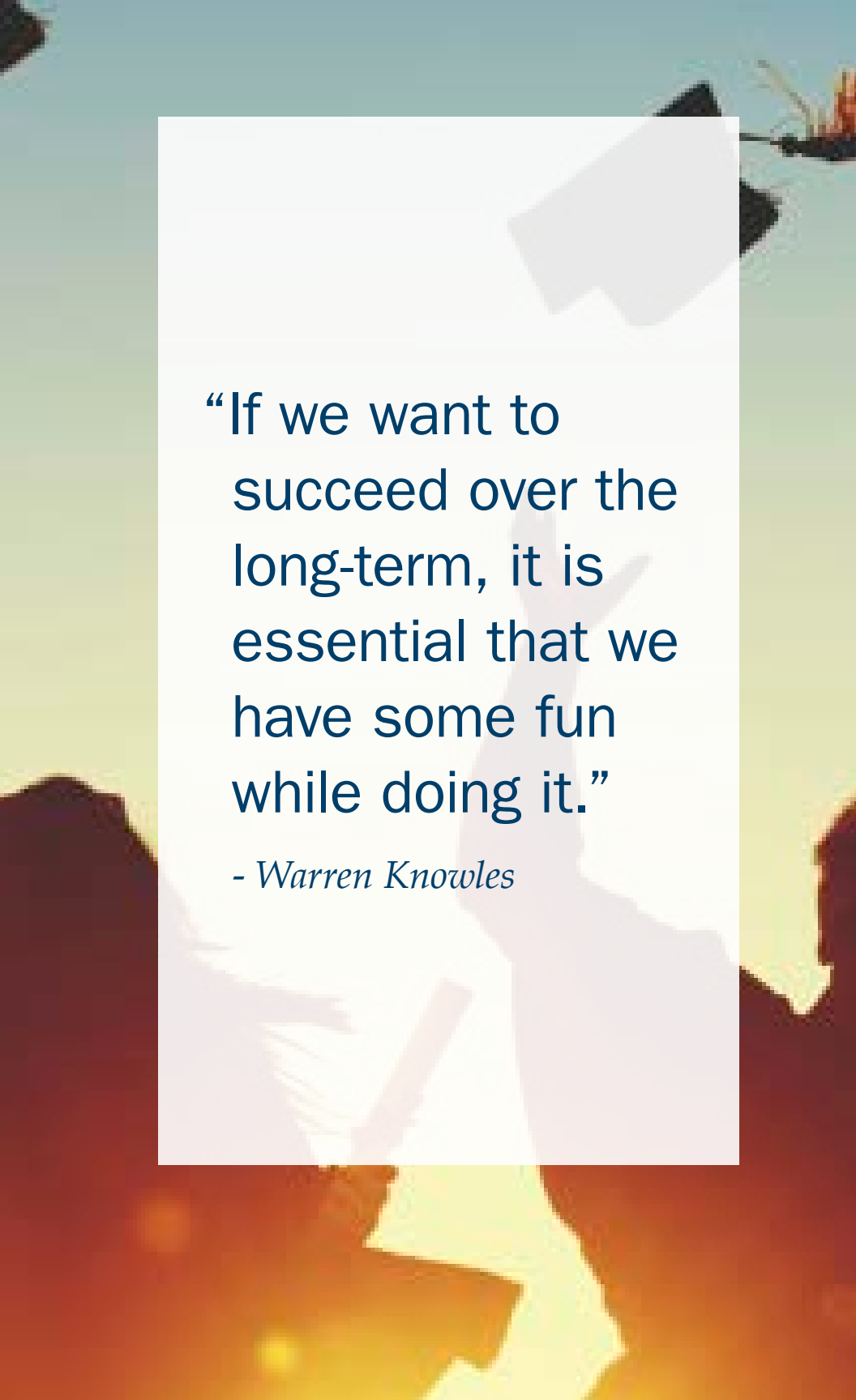
There is a significant benefit to learning a wide variety of things in your first couple of years of employment, including operations-oriented tasks such as processes and procedures. This time will provide you with the opportunity to learn new skills to help your company succeed and, most importantly, identify which of those skills or areas of work you are most passionate about. As you progress in your career, your focus on these areas will help you make the biggest impact, regardless of your current role. Gaining this foundation and finding the way in which you can best contribute takes time. Enjoy this time, particularly since it will help define your career.

Did I have some fun? Some of the best advice that I've received was not during work, but while taking a course on how to be a better youth sports coach. An inspirational basketball coach taught us an effective means of assessing if we ran a good practice. She suggested that at the end of every practice, we look around at the players. If you see red faces and big smiles, it was a good practice. This is a simple philosophy that applies not only to our extra-curricular activities, but also to our day (ok, and sometimes evening) jobs. As engineers, we work hard and spend a lot of time at work. If we want to succeed over the long-term, it is essential that we have some fun while doing it. It will never be all fun, all the time, but there has to be some fun, every day. If there isn't, try to find out why work isn't fun for you, and how you can change that. You can only improve your day, your workplace, and the overall effectiveness of your team by doing so.

We need your help and talents to tackle the many challenges ahead. Good luck and have fun with the next steps in your adventure.

Warren Knowles, P.Eng.

Warren Knowles is Managing Principal, Senior Building Science Specialist at RDH Building Science Inc.



“If we want to succeed over the long-term, it is essential that we have some fun while doing it.”

- Warren Knowles

Sri Krishnan

As you prepare to embark on your professional career, I urge you to take a moment to enjoy what you have achieved

so far. Your journey through your challenging academic program was not easy, but through hard work, motivation, perseverance and commitment, you did it. This is truly a special moment, full of personal triumph and mysterious expectations, so please take a moment to enjoy it—you've earned it!

Your choice of engineering as a career is commendable. There is no other profession I can think of that makes such an immense difference in the world. Engineers protect the environment. We strengthen infrastructure. We make our transportation systems better. We find new ways to detect and combat disease. In short, engineers are responsible for ensuring that life on this planet is sustainable.

I encourage you to embrace this view of your profession. Take pride in what you do. Hone your skills. Expand your knowledge. Develop a business plan. Turn your ideas into reality. Help make our lives better, longer, healthier and safer.

Engineering is knowledge made tangible. It is innovation, problem-solving and being able to think outside the box. It's about connecting the missing dots, predicting the right outcomes and calculating the right decisions. But most of all, engineering is about

humanity. I urge you to always remember this in your work. You hold in your hands the promise of making a tangible difference in the future of humankind.

The world is waiting for your ideas. We can't wait to see what you can do!

Sri Krishnan, PhD, P.Eng.

Sri Krishnan is a Professor in the Department of Electrical and Computer Engineering and an Associate Dean (Research and Development) for the Faculty of Engineering and Architectural Science, Ryerson University. He also holds the Canada Research Chair in Biomedical Signal Analysis.

Lianne M. Lefsrud

Rather than reimagine what I wish I had known; I asked my students what advice they would like to receive. Their wise words are an inspiration and a reminder that the answers we seek are often within ourselves!

Perseverance is the epitome of success. Keep striving even after you've fallen numerous times. The end is in sight and you will achieve your aspirations. Sanah Dar, M.Eng, P.Eng., Project Specialist, Alberta Innovates.

Don't be afraid to admit you don't remember or understand something technical well (even if it was something you took an entire course in it during undergrad). It's perfectly ok to ask for help or a suggestion on resources. Most engineers in industry don't remember all of their technical fundamentals and it is normal to have to review things, relearn things or have someone who excels in that area explain something to you. There can be a lot of intellectual elitism and imposter syndrome in the engineering field, don't let it make you feel less than or like you can't master something. Amanda Sistilli, Senior Risk Engineer, Enbridge Gas.

Read complex case studies. Hiring Managers frame questions through ongoing problems in their respective companies rather than asking straightforward questions. It enables you to showcase your technical prowess, communication skills, ability to examine an issue, and most important, how to tackle any risk or uncertainty, which is pivotal today because of the ongoing disruption caused by the pandemic. Honey Bhatia, E.I.T. in Advanced Manufacturing,

Magna International.

Don't dwell on rejections, mistakes, or failures as that time can be better spent on personal development, seeking new opportunities, and most importantly, slowing down to take care of yourself. Sua Lee, Process E.I.T., Nutrien.

Be open to learning new technologies. Tech is industry enabler. Varun Sharma, Transportation Engineer, CN Rail.

Remember to be humble, curiosity is key! Don't be afraid to ask questions, especially when you are first starting out in your new careers. People want to help you and see you succeed. University has taught you the theory but be aware of what you don't know, there is so much more to learn and be exposed to. Make connections and good impressions, part of getting a job is about who you know. Think about your final user when you are designing equipment. If you can, go to the site to physically see the set up and chat with the folks who will be using the equipment. Engineering is a fantastic career that allows for life-long learning while solving problems, you will be challenged and rewarded for your hard work. Kathleen Baker, P.Eng., Production Engineer, Suncor Energy.

Own the projects and tasks at work and put your best into them, it is the best way to build up credibility. What you learn in school is just the tip of the iceberg, be open minded and be willing to learn. You may need to experiment a few jobs until you find out where your passion lies and where you want to build up a career. What everyone eventually remembers from a colleague is not how perfectly they did a task but it is how they treated others and dealt with disagreements. Afrooz Farjoo, PhD, P.Eng., Senior Policy Analyst, Emerging Resource Policy | Resource Development Policy Division, Alberta Department of Energy.

Don't fear making mistakes, understand your strengths and weaknesses, and improve them. In addition to your technical knowledge, enhance your soft skills as they are needed for

having a successful career and life. Mona Ahmadirad, PhD student, Transportation Engineering.

You have put in your best in the past few years and have come out as a successful young engineer, about to face a new world of endless opportunities and perhaps privileges. However, the truth is that nothing really prepares you for the reality of an economic downturn or a global pandemic. This is not to deter you in anyway but to prepare your already strong mind for a little bit more that may be needed on the journey to becoming a practicing engineer. It will be helpful to have some goals whether there are big or small, short term or long term. Identify your main objectives and what related achievements would look like. Break them down and create a plan for attaining them. Have a realistic plan and celebrate every little win and step that is taken towards achievement. For targeted job search, identify the right network for such engineering opportunities like professional associations, websites, and media, and engage with these. It will give you access into the hidden job market and opportunities. As we set out to put our plans into actions, it is important to note that regardless of the outcome we may see, we should remain focused on what we hope to achieve. Finally, never ever give up on yourself and opportunities. That is why goal setting is important, and the professional networks that we have built will help to keep us engaged, keep the dream that we have alive, and be excited about the future that we want to see. Remember that quitters do not win, and winners never quit. Anne Nkoro, MEng. MSc. E.I.T, Project Manager, Constructing Futures (EMCN).

Lianne Lefsrud

Lianne Lefsrud is an Assistant Professor of Engineering Safety and Risk Management and Director of Outreach, Department of Chemical and Materials Engineering, University of Alberta. She is ridiculously proud of her students and how they are making the world a better place.

**“Surround yourself
with those who
lift you up to be
your best self.”**

- Lianne Lefsrud

Patrick Lane

Convocation address, University of British Columbia, 2013.

Back in early December of 1958 I was 19 years old, living with my wife and baby boy in a two-room apple-picker's shack a few miles down the road from here. I had a job driving a dump truck for a two-bit outfit that was working on a short stretch of highway just down the hill from where this university was built so many years later. I remember leaving the shack and walking out to stand by the highway in the wind and snow. I stood there shivering in my canvas coat as I waited to be picked up by the grader operator in his rusted pickup truck. The sky was hard and grey. Its only gift that winter day was ice disguised as a fragile, bitter snow. As I stood there in the false dawn I looked up for a moment and as I did an iridescent blue butterfly the size of my palm fluttered down and rested on the sleeve of my coat just above my wrist. It was winter, it was cold and I knew the Okanagan Valley where I had lived most of my young life did not harbour huge, shiny blue butterflies, not even in summer. I remember stripping off my gloves and cupping the insect in my hands, lifting that exquisite creature to the warmth of my mouth in the hope I could save it from the cold. I breathed upon the butterfly with the helplessness we all have when we are faced with an impossible and inevitable death, be it a quail or crow, gopher, hawk, child, or dog. I cupped that delicate butterfly in the hollow of my hands and ran back to the picker's shack in the hope that somehow the warmth from the morning fire in the wood stove might save it, but when I reached the door and opened my hands, the butterfly had died.

I do not know what strange Santa Ana, Squamish, or Sirocco jet-stream wind blew that sapphire butterfly from far off Mexico, Congo, or the Philippines, to this valley. I only know the butterfly found its last moments in my hands. I have never forgotten it and I know the encounter changed me. There are mornings in our lives when beauty falls into our hands, and when that happens, we must do what we can to nurture and protect it. That we sometimes fail must never preclude our striving. The day the beautiful creature died in my hands, I looked up into the dome of the hard, cold sky, and I swore to whatever great spirit resided there in the dark clouds that I would live my life to the fullest and, above all, I would treasure beauty. I swore, too, that I'd believe in honesty, faithfulness, love and truth. The words I spoke were the huge abstractions the young sometimes use, but I promised them to myself and, now, more than half a century later, I stand here in front of your young minds, your creative spirits, your beautiful lives, and I can tell you that I have tried.

I told myself that year, and in the subsequent years, in the sawmill crews and construction gangs I worked with, that I would become a writer, a poet, a man who would create an imagined world out of the world I lived in, that I would witness my life and the lives of others with words. The years went by filled with the tragedies and losses that all our lives are filled with. My brother's early death, my father's murder, my divorce and the loss of my children did not change the promises I made. There were times I lived a dissolute, irresponsible, and destructive life. There were times too when I was depressed and wretched, but I continued to believe in spite of my weaknesses and fears. I wandered the world, and as I did I wrote of the lives that shared my times. And I wrote of this Okanagan Valley, its lakes and hills, its stones, cacti, cutthroat trout, magpies, rattlesnakes, and, yes, its butterflies.

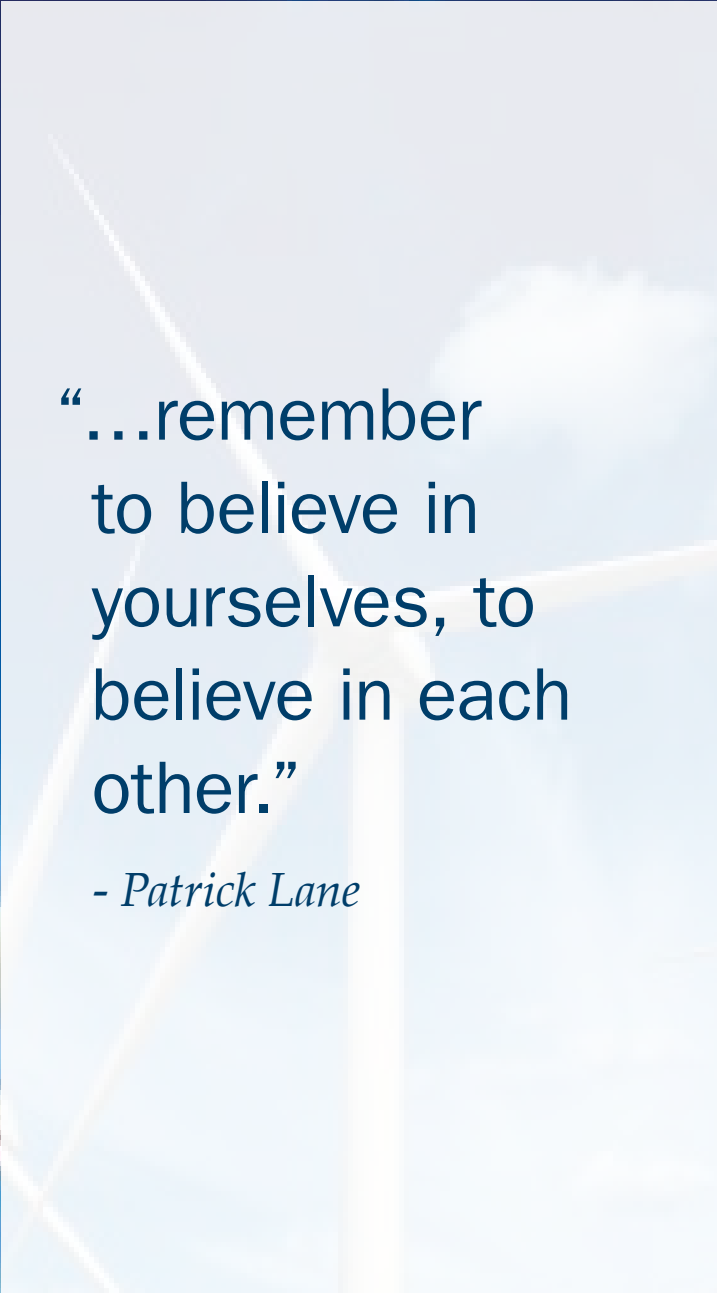
What I have told you is a story. It arose from my life for where else but from a life can a story come? What I promise each of you is that there will come a day or night, a morning or evening when

something as rare and fine as a blue sapphire butterfly will fall into your hands from a cold sky, a fearful child will climb into your bed and cleave to you, a woman or man will weep, will laugh, will lie with you in the sure belief that the one they abide with is governed by a good and honest love. No matter the degrees you have earned and the knowledge you have accumulated, remember to believe in yourselves, to believe in each other. In a world as fearful as our present one I ask that you not be afraid. Today is merely an hour. Remember in the time ahead of you to hold out your hands so that beauty may fall safely into them and find a place—however briefly—to rest.

Patrick Lane

Patrick Lane was an award-winning Canadian poet. He was named an officer of the Order of Canada in 2014. He passed away March 7, 2019.

Reprinted with permission and appreciation. This convocation address and Mr. Lane's enthusiasm inspired 'Letters to a Young Engineer'.



“...remember
to believe in
yourselves, to
believe in each
other.”

- Patrick Lane

Brent Lewis

Your hard work, perseverance and dedication have paid off. Your family is so very proud of you. Your degree is a tremendous personal accomplishment, which opens the door to many opportunities including a promising career and the rewards that this achievement can bring to your personal life.

What is key is that you will now build on the shoulders of past generations of engineers who have given society so much for what we sometimes take for granted today—power/electricity, transportation, security and a daily comfort and convenience. As an engineer, you have a responsibility to ultimately protect the public while recognizing an important respect for your colleagues and for society in general.

Indeed your knowledge and education will serve you well. However, as an engineer, your trade is more than just the embodiment of knowledge and supporting analyses. It requires the exploitation of an idea grounded in the physical laws of nature, science and mathematics. This can be developed, evolved and applied through the proper use of tools, a judicious selection of materials, and the employment or conversion of different forms of energy as part of the realization to build and construct. Ultimately, your work must respect the safety of the public with the aim to benefit society in a safe, effective, and economical fashion. Your challenge is sometimes formidable and difficult but the possibilities endless. As a young engineer, I remember an important quote of Archimedes as to the power of the human mind. He said: “Give me a firm place to stand and I will move the Earth.” As such, I believe that one can accomplish much given the right environment, tools, talent, knowledge and

dedication. There is so much promise for you and an excitement that you can look forward to. At the other end of your career, it is indeed important, fulfilling and satisfying to have made your mark in life.

In my own profession as a nuclear engineer, safety and professionalism is paramount. I am very proud of my profession and I look to you, as one of a new generation of engineers, to carry on from what our predecessors and my colleagues have accomplished and built. Indeed, I challenge you to add to this important foundation. You should be strong and confident as you apply your knowledge in order to test your creativity for the betterment of society.

As I near the end of my own career, I am proud to have been an engineer. I hope that your career is as rewarding as mine. I wish you the very best of luck as you accept this new challenge.

With best wishes, and “may the force be with you.”

Brent Lewis, P.Eng., PhD

Brent Lewis is an Emeritus Professor of Nuclear Engineering at the Royal Military College of Canada and the former Dean of the Faculty of Energy Systems and Nuclear Science at Ontario Tech University. He graduated with a BSc in Physics, a MEng in Fusion Engineering and PhD in Nuclear Engineering all from the University of Toronto.

Marilyn Lightstone & John Mackinnon

This is such an exciting and special moment in your life.

We remember this time from when we were undergraduate engineering students. Although we had achieved much during our four years at Queen's University, we had suddenly moved from a highly structured life filled with projects, assignments and exams to what felt like a wide-open space of possibilities. While at Queen's, Marilyn recalls overhearing a final-year student say to another student: "I'm afraid that I am not going to graduate on time, but I am also afraid that I will graduate on time." We thought that statement was very telling about the challenges and uncertainty that come when reaching a milestone in your life and it certainly captured our own feelings at the time.

You should be proud of what you have accomplished in your undergraduate degree. Engineering programs are tough and require hard work and many late nights. In addition to the advanced technical skills you have received in your specific discipline, you have also learned to become a good problem solver and critical thinker. These skills will serve you well in the many different career paths that are open to you.

Spend time reflecting on how you wish your career to develop. Follow your passions, but also be prepared to work outside of your comfort zone. Seek opportunities to help others; this will help you to learn more broadly about the industry you are in. Invest your own time in your career development and keep learning. The early career years can form the basis of your career trajectory and give you an opportunity to learn and to grow. You are in charge of your own career.

You will experience success but you will also face times when things have not gone your way and you will make mistakes. Take ownership of the failures and learn from them. Develop resilience and grit. It is through these types of challenges that we become better people.

Find a mentor to help you navigate the challenges and opportunities that you will face. This person must be someone you trust; who will always give you honest advice. Remember that helping you means bringing to your attention that which will support your development and thinking, not necessarily what will make you feel happy at that moment. Be gracious in your receipt of this feedback.

A successful career is not just built through excellent technical skills. Good communication and superb interpersonal skills are critical for success in the workplace. Treat everyone in the workplace with respect: "The difference between how a person treats the powerless versus the powerful is as good a measure of human character as I know". Focus on establishing a positive culture wherever you work. Strive for collegiality, trust, and collaboration.

When faced with a frustrating or perplexing interaction or response from a colleague, remember that things are much more complicated than they appear from the outside. There are multiple points of view and complexities in interactions with people. It is important to engage those who are involved in an issue and try to understand their point of view before reaching a conclusion. Whatever the circumstances turn out to be, remember that you cannot control other people, but you can control your response to them. Take the high road but also stand up for what is important.

Be your own best friend. Accept that you will fail and have self-doubt. Treat yourself with the same love and support as you would those closest to you.

Looking back on our careers, the most meaningful impact we have had is through the people we have taught and worked with and through the relationships we have developed. As you progress

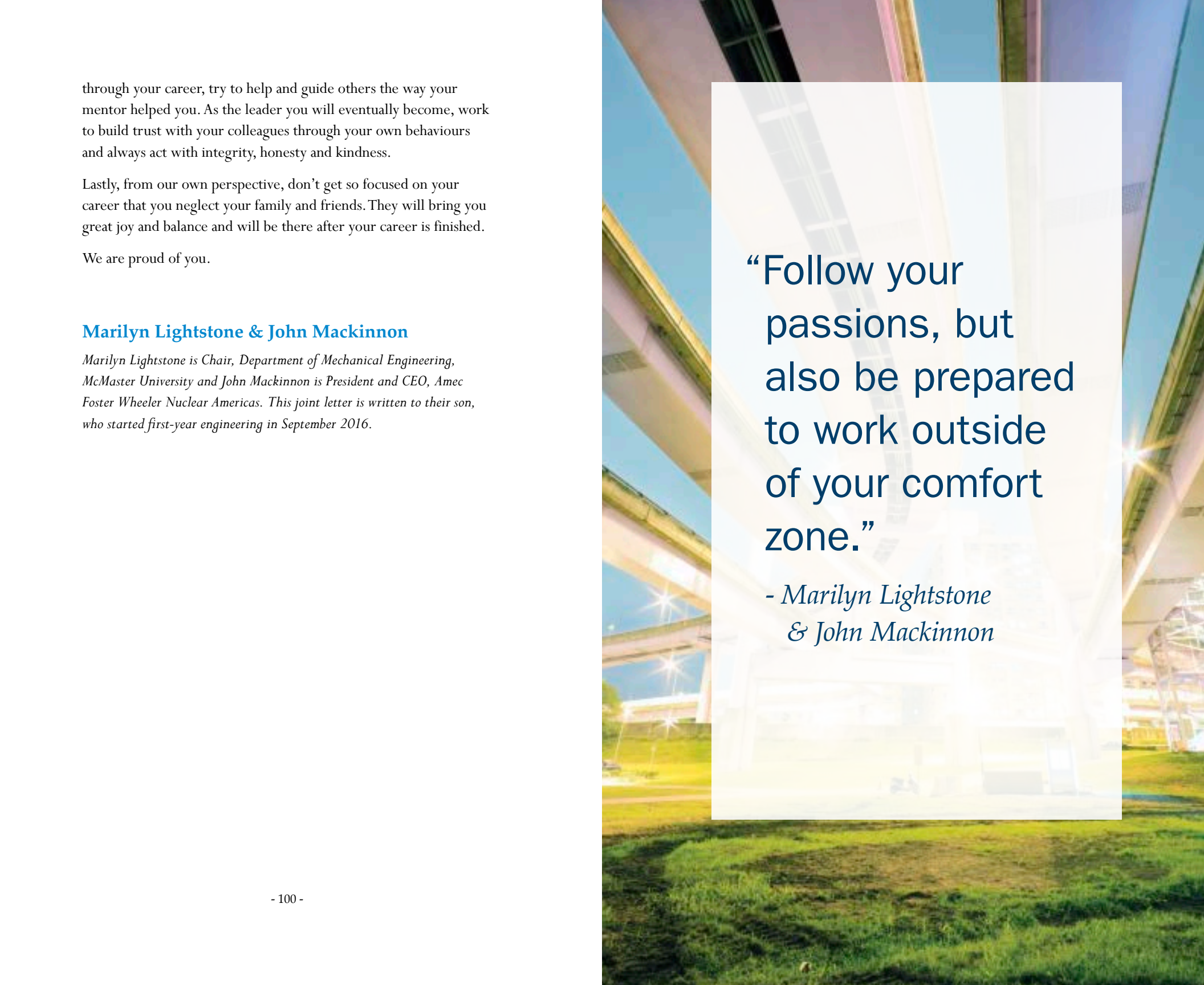
through your career, try to help and guide others the way your mentor helped you. As the leader you will eventually become, work to build trust with your colleagues through your own behaviours and always act with integrity, honesty and kindness.

Lastly, from our own perspective, don't get so focused on your career that you neglect your family and friends. They will bring you great joy and balance and will be there after your career is finished.

We are proud of you.

Marilyn Lightstone & John Mackinnon

Marilyn Lightstone is Chair, Department of Mechanical Engineering, McMaster University and John Mackinnon is President and CEO, Amec Foster Wheeler Nuclear Americas. This joint letter is written to their son, who started first-year engineering in September 2016.



“Follow your passions, but also be prepared to work outside of your comfort zone.”

*- Marilyn Lightstone
& John Mackinnon*

Richard Marceau

How does one transform ordinary, everyday efforts... day after day... into extraordinary outcomes?

This is often the question that young engineers ask themselves as they stand on the threshold of their careers. To answer this question, let me begin by telling you a story...

Some 30 years ago, a well-known researcher named Richard Hamming, formerly from AT&T Bell Labs, and who had made pioneering contributions to information theory, gave a talk sponsored by the Institute of Electrical and Electronics Engineers to students at the University of California at Berkeley. In his presentation, he observed that he had met some 50 people of Nobel calibre in his life. Through careful observation, he believed that he had identified patterns common to people who accomplish great things. In his talk, he summarized these patterns in eight easy lessons.

Let me take you through each of these points, one at a time.

Plan your future

Neither chance nor intrinsic potential are enough to accomplish great things. It's not a disadvantage to have a high IQ, but it's not enough. Even a brilliant mind can get caught in a rut!

To accomplish great things, the first thing you need is a map, like a traveler, otherwise you're going nowhere! You have the right to change your mind: only fools don't! But you have to make up your mind on where you're headed, so you need a plan. But how do you choose the first step?

Do what you love

Your intellect, motivation and passion will integrate far more easily when you do what you love! Let's put it another way: your ability to learn, think and do, when wedded to the joy of something you really love, will rapidly turn you into a leader!

Give yourself clear objectives

Young engineers often need to master many types of tools to be good at their profession. Because of this, many engineers spend a lot of time preparing themselves to solve problems they have yet to confront. This is good, but with the amount of knowledge and tools available today, you could spend your whole life preparing yourself, without having done anything!

On the other hand, when you have a clear objective, are motivated to achieve this objective, and need a tool that you haven't mastered yet, isn't it amazing how quickly you learn knowledge from a book, how to use a new instrument, or how to master a new software? In other words, you don't have to know everything to begin to solve problems or to achieve your goals. You have to learn to be brave, embrace the risk of learning as you go, and take on your goals!

Knowledge and know-how are like compound interest

Consider what happens when you invest your money at 10 per cent a year: your investment doubles in seven years.

Now, suppose that you invest your time rather than your money, for example, to get better at your profession, at 10 per cent more than your neighbour, amounting to an hour a day. The consequence is that every day, at the end of this extra hour, you will know a few more things and have a slightly deeper understanding of your profession so that, by the next day, you have increased your level of awareness of things which, in turn, makes you a little more effective than the day before. As you do this, day after day, over many years' time, you

build on the platform that you constructed the day before and end up compounding your knowledge and know-how of your profession.

Now, if you continue to invest your time at 10 per cent more than your neighbour over a number of years, I can't promise you that you'll know twice as much as he or she in seven years, but I do promise you that you'll know a whole lot more! Knowledge and know-how are like compound interest!

Invest your time wisely

When you have a problem to solve, you should never move forward until you have thought things through and identified a winning strategy. Otherwise, you're wasting your time. As mentioned before, planning is key.

In problems containing significant potential for emotionally-charged situations or stress, always avoid rapid, emotional responses. If you bring too much emotion into a professional situation, rather than being part of the solution, you become part of the problem.

Now, when you have moved on what you thought was a winning strategy, but you've hit a point of diminishing return where every small step requires an inordinately high investment, you have to find the strength to put it aside and go on to something else until you have found a new path forward. In other words, it's important to know when to invest, but it's equally important to know when to pull out, at least temporarily or even 'cut your losses,' and put your time elsewhere: both decisions are difficult, and take real courage.

In the end, remember that tenaciousness and stubbornness are two sides of the same coin: when you succeed, people say that you've been tenacious. When you don't, people say you were just plain stubborn!

Trust yourself

When you are working on large projects and you are ultimately the one accountable for success, you have to learn to trust yourself, both your reasoned judgment and your intuition. In the end, your success rides on your own decisions, no one else's, and you have to take ownership of them, even when you ask for advice! If and when you fail, learn to admit it, forgive yourself, and learn from it. Success is a harsh mentor: it can lull you into complacency, in either the next project or the next life situation. But when you fail, you know exactly why. Be a class act, make things right, and move on!

Practice your creativity

According to Hamming, creativity is the ability to think thoughts that no one has thought before! But to achieve this, you have to practice it! For example, when you have a problem, don't begin by asking your neighbour for their solution or by searching the Internet. Force yourself to see how, according to your own knowledge and experience, you might come up with a solution. Once you have come up with your own solution, only then compare to other people's: they may be better, but you'll never know unless you try it, and you might surprise yourself!

Creativity is a complex instrument within each and every one of us, one which we can only learn to master through practice!

Finally,

To do great things, you have to work on great problems

For Richard Hamming, this is the single most important piece of advice that he can give: don't waste your time on things that anyone can do, do things that no one else dares to do! If you bring all of the previous lessons to bear on this one, this is the one that brings it all together.


I saw Richard Hamming's presentation in a video in 1988. This moment changed my life: I came to the conclusion that, though my days were full, I wanted to do more. Between the ages of 37 and 40 I completed my PhD. Since then, I've worked in four different university institutions, gradually taking on several senior executive roles. This would not have happened had I not followed his advice!

I sincerely believe that these eight lessons transform ordinary, everyday efforts into extraordinary outcomes. I do hope that you'll find them as useful as I have.

I offer you my very best wishes for a wonderful, meaningful career!

Richard Marceau, P.Eng., FCAE

Richard Marceau was the former President of the Canadian Academy of Engineering and Vice-President (Research) at Memorial University of Newfoundland. Richard passed away September 2016.



“...knowledge and know-how are like compound interest.”

- *Richard Marceau*

Edward A. McBean

The opportunities for engineering, to develop sustainable cities are incredibly challenging.

Your engineering education provides you with some of the tools to assist, and society needs all types of engineering disciplines.

Climate change, however, is the enemy of sustainability. Climate change has enormous implications to water supply security and infrastructure issues around the world. Complicating matters is the dramatic increase in population with the concomitant need to feed the hungry mouths of the future. It follows that water security and infrastructure issues will be some of the most important challenges of the 21st century.

The implications of climate change are many, including sea level rise, severe storm surges, landslides and debris flows (many of which are initiated by severe storms) and flooding. One dimension, however, is very important—we cannot simply rebuild what has been destroyed. New York spent 30 billion dollars to recover from Hurricane Sandy. Forty per cent of the world's population lives within 100 km of the coast on just 1 per cent of the earth's land surface. A sea-level rise of between 0.3 m and 1.22 m is predicted by 2100 (from current conditions, a factor which includes the thermal expansion of water and the progressive melting of major ice sheets and glaciers). Instead of rebuilding what has been destroyed, we need to develop new strategies, as opposed to respond by reconstructing what was present prior to a disaster.

Engineers must search out and evaluate an entire range of new approaches and opportunities, to assist with the responses to these challenges. We can't simply build walls high enough to keep out

the storms and sea level rise of the future. We must include, for example, dimensions of green energy to slow the rates of climate change. We need to provide emergency power for when a disaster occurs, and to envision electrical network systems that can respond to the climate impacts to come. We need entire new sets of thinking, and alternatives, to help the human populations and cities to adapt to the challenges of climate change.

The list is endless, but the opportunities for engineers to make real contributions are also endless. The future awaits, and there are many needs. Be imaginative in what you undertake as in many respects, the future relies on you.

**Edward A. McBean, PhD, P.Eng, P.E, FCAE,
D.WRE., FCSCE, FEIC**

Edward A. McBean is Professor of Water Resources Engineering and Canada Research Chair in Water Supply Security at the University of Guelph

Tim McTiernan

I have spent a great deal of my life around engineers. I married the daughter of an engineer. One of my two brothers is also an engineer. It has had an effect.

I can joke about recognizing an engineer by how they think about a problem and it's true. I can recognize the work of an engineer when I come across a well-designed work-flow process or set of operating procedures. I have learned in all of my different work places that the analytical skills and knowledge of engineers translate well whenever they are applied beyond the traditional boundaries of professional practice, whether that practice is civil, mechanical, chemical, or some other speciality. As a broad discipline, engineering offers each new generation of students a powerful set of mental tools. When these are put to good use our economies thrive, our communities grow and our health and safety is improved. Engineering as a practice puts good minds to good work.

Let me get back for a moment to the two engineers I mentioned in the first paragraph of this letter. There is a 46-year age gap between them. My father-in-law was a civil engineer who worked most of his life for the City of Limerick in Ireland, responsible for the city's water infrastructure. My brother is a chemical engineer who has worked in a series of multinational companies in Ireland, the US, the UK and Ghana, and who currently lives in Dubai, works for a multinational headquartered in England and, among other things, manages an R&D facility in Bangalore. Two very different people with very different sets of experiences.

If I were asked to say one striking thing about my father-in-law, the thing that comes to mind is the story told often by his family of the time he spent on the north river embankment of the Shannon River.

During a winter night storm when a high tide and an Atlantic gale led to a breach in the river dyke, the neighbourhood behind the dyke was threatened by flooding. He worked tirelessly alongside his crews to fix the break in the protective berm and stayed with it until it was done. If I had to say one striking thing about my brother, it would be that at a couple of points in his career he consciously chose to do the right thing, at the expense of the expected thing, in order to protect the interests of colleagues he was working with. It cost him, but he thought he had no other choice.

Two different engineers, two things in common: a moral compass and a sense of obligation to others.

When you put on your iron rings, be proud of your accomplishments achieved and to come, but also be proud that you have taken on the obligation to not only do well, but to do well by others. I am proud of my father-in-law and what he stood for in his professional and personal life. I am proud of my brother, not because of his successes—I'm a little jealous there—but because I know that fairness and fair play is at the core of how he deals with the world. It makes one confident that engineers, as a profession and as a global community, share the improvement of the human condition as a core value.

Tim McTiernan, PhD

Tim McTiernan was President and Vice-Chancellor of Ontario Tech University from 2011 to 2017.

Murray R. Metcalfe

I want to talk with you today about a vast topic – your role as global engineers. I

note the words of the late John Gardner, which – although not stated specifically about engineers – I believe define our unique contributions: “We are all faced with a series of great opportunities brilliantly disguised as unsolvable problems.” That is where you come in!

I and others at UofT have been exploring the significance of globalization for the education of engineers. As we explored the meaning of the term “global engineer,” I found it useful to think about four dimensions of the context of work we do as engineers. As engineers you will work with a dizzying proliferation of new technologies. But this advance of technology will not be as extreme as the changes in the context of engineering work that each of you will need to understand over the next 50-plus years of your career.

The first dimension of globalization and engineering relates to environmental and sustainability considerations and the use of energy. Once primarily the domain of civil engineers, these topics now permeate every field of engineering. How do we look at product lifecycle through a sustainability lens – the so-called cradle-to-cradle design paradigm? The energy consumption of products will be perhaps the most integral and cross-disciplinary element of all engineering design. And importantly, engineers will play a key role in understanding and controlling the impact of growth on the world’s environment and climate.

A second dimension of context of engineering work is the stage of economic development of the setting where the engineering system will be used. In an engineering school’s teaching and research almost

all of our thinking concerns the developed, advanced economies. A broader view would include poor, less developed countries – what are engineering requirements for them? What if you have electricity but on an intermittent basis, as is the case in many parts of the world?

The pressing problems in the poorest countries, at the so-called base of the pyramid, capture the imagination of many of us, faculty and students alike. There are emerging models of what engineering approaches work best in the developing world. Some approaches involve radical re-engineering of products, such as drip irrigation systems, to simplify and cut costs by a factor of, say, 50 times! Is there also a role for the most advanced technology?

The third dimension of global engineering is the type of organization that is developing and implementing the engineering system. We usually think of engineering graduates working for large corporations or government bodies or for the consulting engineering firms that support them. But there are many types of organizations, many of them highly innovative, populating the world. There are small, entrepreneurial, high-technology companies, as well as not for profits, organizations led by “social entrepreneurs,” multi-lateral organizations and new breeds of entrepreneurial government agencies driving change. Some of the innovation in these organizations is driven by technology itself, for example, the Internet and advanced communications and information systems.

The fourth and final dimension of global engineering will be the revolutionary change in competitors and partners that engineers work with. Not all of you will choose to work in international development – but I’d expect the great majority of you will work in or with organizations that have major operations in India, China – and of increasing importance in Africa. In many cases, you will work in diverse cross-border teams on a collaborative basis.

As an example that brings together these four dimensions of global engineering I point to RETScreen – a software package for designing renewable energy systems. The RETScreen system started as a

master's thesis and has gone on from there to become a Canadian entrepreneurial success story. The highly collaborative RETScreen software has been downloaded for free by 650,000 global users. And what is the organization behind this innovation? The Canmet Energy lab, a small, innovative, entrepreneurial unit of the Canadian government!

So graduates, looking forward from today, you will be global entrepreneurial engineers – or global engineering-driven entrepreneurs – concerned with sustainability, aiding those at the base of the pyramid, and collaborating and competing broadly from within a diverse group of innovative organizations.

There is an opportunity to shape global engineering in the 21st century, and as of today you are the leaders of that charge! We look forward to the great opportunities that you will brilliantly create from what seem to the rest of us to be unsolvable problems. All the very best to each of you!

Adapted from a Convocation speech to engineering graduates, University of Toronto, 2009; revised 2020.

Murray R. Metcalfe, PhD

Former Professor, Globalization, University of Toronto

“There is an opportunity to shape global engineering in the 21st century, and as of today you are the leaders of that charge.”

- Murray R. Metcalfe

Kathy Milsom

You worked hard, hopefully enjoyed yourself, and you are now an engineer— You can change the world!

Savour your accomplishment. Look around you. Look out the window. There aren't many things that you see that haven't been created through, made possible with, or positively impacted by the efforts of an engineer. Can you think of any other profession that can make a similar claim? Also consider the extent to which we enable other professionals to do their jobs. How much more effective is a doctor or a surgeon at saving lives because of the medical devices, diagnostic equipment and state-of-the-art treatment facilities we have made possible?

What we do runs the gamut of driving economic growth and prosperity, to enhancing quality of life and leisure, to protecting health and safety. The sphere of our influence is vast. This also means that nothing is outside the realm of the possible. It's an exciting prospect but also a great responsibility. It's not by happenstance that Rudyard Kipling entitled his work for the Iron Ring Ceremony, *The Ritual of the Calling of an Engineer*, for engineering is much more than a job. It is a calling.

Much has changed since the first Iron Ring Ceremony in April 1925, but the underlying principles of engineering have not. If anything, there is an even greater weight of responsibility placed upon us. The possibilities through engineering ingenuity may now be limitless, but the outcomes—if we fail—are far more significant. Consider the possible consequence of the failure of a combustion engine with that of a nuclear plant. Or a glitch in a software program versus an ethical or trustworthiness failure in artificial intelligence.

With greater opportunity comes greater responsibility. Never waver from doing the right thing, doing it well, and doing it with the highest standards of ethics and integrity.

You will make mistakes. We all do. Learn from your mistakes and do your best to ensure you don't make the same mistake twice. Know that regardless of how smart you might be, you will never have the best idea or the right answer all the time. Rely on your peers and colleagues, and appreciate the value and importance of teamwork. If you choose to go into management, know that your most valuable resource is your team. You will succeed if you are able to create a work environment that is conducive to high morale and performance, and employee engagement. Remember to always focus on the positive, and be a leader, mentor, coach and sounding board to your team members. Be consistent and be inspirational.

I smile when I think of the predictions made when I was starting out that by now we would have shorter workweeks and more leisure time. It seems we are trending in the opposite direction—getting busier all the time. The work will be demanding and, for most of us, we will not hold the type of job that will allow us to walk away at the end of the workday and not take the work home, at least in thought if not in deed. It's the nature of what we do, but don't lose sight of what is important. Strive to maintain a positive work/life balance. Make the time to enjoy your family and friends. After all, work will always be there and, if you have balance, you will be more effective in all aspects of your life.

Use your knowledge, your passion and your innovation to make a difference. Be proud, be diligent, be compassionate, be ethical and make the world a better place! I truly hope you gain as much enjoyment and satisfaction from your chosen career as I have from mine.

Kathy Milsom

Kathy Milsom is the past Chair and current Chair of the Governance Committee of the Standards Council of Canada.

Tom Mitchell

Engineering is the art of applying science to the benefit of mankind.

Yes—an art. To be an engineer is to create—but within the boundaries placed by physical laws.

It is not an abstract form of expression. It is one that deals squarely with reality. The bridge must not fall down. The electrons must move and the light go on. The jet engine must push the plane. The constraint of physical laws is what sets this art of engineering apart. The artist's sketch on paper or on the screen must actually carry vehicles or fly.

There is a tendency in modern life to reduce all activities to rigorously defined processes. This brings a degree of certainty through codes and standards and requirements. And it is invaluable in passing forward the knowledge of the engineers who have gone before. But this process can also reduce the creative reflex—the essence of challenging the status quo and finding the more elegant but less expensive solution that is the real creator of progress and society's wealth.

I make a distinction between being a 'technician' and being an 'engineer.' Without reducing the value of either, I believe the distinction is the creative element. That is the ability to synthesize new materials, new approaches and new ideas into practical solutions.

Equally important as the creative dimension is the moral dimension of engineering. In my view, it is a duty of the engineer to develop solutions that benefit mankind—that raise living standards, reduce negative impacts, grow opportunities. The moral code of the engineer must match that of a doctor—to do no harm.

This constraint on the creative process is fundamental and can be overlooked in the adrenaline rush of the creative process. Does an engineered solution produce an unintended societal consequence? Can it be misused? A high value today is placed on 'disruptive' technologies. What are the ethical issues this economic driver imposes on engineering?

Years after the long nights of studying physics and mathematics, enduring the thorough professional registration process, and revelling in the thrill of a new job in an exciting field are gone, it is these questions—the creativity and the moral implications—that keep the art of engineering a fascinating vocation and lifetime career of rich interest.

Come, join the journey with us!

Tom Mitchell

Tom Mitchell is retired CEO of Ontario Power Generation.

Steven Murphy

My job as a university president is hugely informed and assisted by my time as a hockey official and supervisor.

In many ways, refereeing defines how I see the future for graduating engineers.

A referee establishes order amid the pace of a hockey game. That requires timeworn techniques like crisp whistles, confident body language and clear hand signals. To interpret new rules and disrupt emerging conflicts, however, good refs must also become great communicators, trusted teammates and quick thinkers.

That's why I think new engineers can learn a few things from the perspective of a hockey referee.

1) You need to keep your head up and stay aware of what's happening around you. The tailor or shoemaker of the 1800s found their world changed irrevocably by the water and steam power of the First Industrial Revolution. The Second Industrial Revolution used electric power to create mass production. Then the Third used electronics and information technology to automate production. Now the Fourth Industrial Revolution—digitization and artificial intelligence—is disrupting industries. Think of the impact of Airbnb on hospitality and the effect of Uber on public transportation.

Disruption creates anxiety in some, but offers opportunity to those like you who remain bold and aware. So keep your head up and your peripheral vision clear—both literally and figuratively—so that you see what's happening in your field and in your workplace.

2) You need to jump when the puck zooms your way.

According to a study by U.S.-based research firm Future Workplace, 91 per cent of millennials (defined as those born between 1977 and 1997) expect to stay in a job for less than three years. That means they would have as many as 15 to 20 jobs throughout their lives. What does this mean for you? Well, you aren't likely to have a job for life, but your education gives you portable skills that will be welcomed worldwide. Take advantage of opportunities when they arise, whether within or outside Canada. Also continue to hone your skills; remember your education doesn't stop with your degree.

3) You need to support your team. No good referee works alone; ours is as much a team effort as it is for the players shooting the puck. To that end, the privilege of receiving an engineering degree comes with responsibilities: you will be asked to give back, maybe even to the place where you started your learning. Think about what has happened in Scandinavian countries, where people in the workforce get welcomed back to post-secondary institutions to learn new skills. You and your colleagues may be just the people your university draws on, not just for your financial support as alumni, but to share your acquired leadership experience with future students and with retraining workers. In short, your education journey might lead you from learner to teacher—and, take it from me, that can be both invigorating and fun.

4) You need to always do the right thing. Referees may wear black and white, but they know the world seldom works that way. As you manage the exigencies of science and technology you must also be aware of moral and ethical issues and pitfalls. In other words, you need to become practitioners of what I like to call “technology-with-a-conscience”.

For example, big data creates opportunities for computational research but poses threats to privacy. When advanced

manufacturing experts develop the next new product they must also discern how the product gets recycled upon its obsolescence. Our planet cannot tolerate more garbage.

Another example: artificial intelligence promises fast learning—far greater than human abilities can muster. Humans, however, build these systems and machines, and built-in biases can infect AI systems that get amplified as algorithms evolve. Even if the system you build seems bullet-proof, you need to think carefully about what might transpire.

Your careers will achieve business goals and translate abstract ideas into concrete reality. As leaders in applied science I know you will become champions of technology-with-a-conscience—thinking ethically as well as productively.

Your engineering training has instilled the principles and practices underlying futuristic developments like fusion reactors, underwater cities and Martian colonies. Like a referee, I hope your education as a professional engineer will develop skills like teamwork, communication, negotiation and building trust. It is a truism to say that you will use these so-called softer skills the most, during field work, while leading a project team or even on the happy day you take your company public. These human skills will also help you identify and adapt to changes in your industry.

Like a good hockey referee, you, as an engineer, will enjoy a place firmly at the centre of all that is going on around you. Remember to stay aware, to jump when opportunity comes, to give back, and to do the right thing.

It will be hard work and will test your courage as a professional and as a person. Suffice it to say I look forward to braving the future with you.

Steven Murphy

Steven Murphy is President and Vice-Chancellor, Ontario Tech University.



“Your careers will achieve business goals and translate abstract ideas into concrete reality.”

- Steven Murphy

Roy Neehall

As engineering graduates, you're now well equipped with the critical-thinking and problem-solving skills to meet the challenges that await you in society and turn them to opportunities. It's about this notion of society, in essence how you practice your skills in your new environments, that I'll share some thoughts. As you live and work in new environments outside the bubble of academia, I encourage you to consider these two observations.

First, your technical knowledge will not be applied in isolation. Rather, it will be applied in the context of interactions with colleagues, clients, service providers, regulators... and various segments of the public. It is on adapting as recent graduates to performing in an environment where you're open to scrutiny by the public, including members of the engineering fraternity, that attention needs to be placed. Attention to how your actions and what you may propose, recommend, or design impact the social and/or political environment in which you work. The consideration of social impacts and influences will, at times, seem contrary to efficient paths to solutions and delivery of outputs, but therein is a reason for failure of initiatives that are technically sound, the lack of consideration of the social context in which they exist or are to exist.

The second observation I share with you relates to the time-challenged societies in which we live today. Clarity and succinctness in your communication of ideas, solutions and opinions, as much as your technical knowledge, will significantly influence growth in your chosen field. Pay attention to providing easily understood

and salient information in a timely manner. Today, in many areas in which you'll work, time is indeed money and decision-makers at all levels will appreciate your understanding of the importance of clarity and succinctness.

In the spirit of succinctness, I'll end at this point with a simple thought: Your relevance to the environment in which you operate will be dependent on your ability to understand the social, environmental and economic influences as well as you understand the technical and scientific solutions.

Roy Neehall, P.Eng.

Roy Neehall is General Manager, Waste RE-solutions in Edmonton, Alberta.

Daniel A. Nolasco

Thank you for choosing such an exciting career. Our world needs engineers.

With all the educational options available nowadays, most of which requiring less time and effort than an engineering degree, choosing to be an engineer involves a considerable level of commitment. Much about engineering has to do with commitment. Commitment to excellence. Commitment to society. Commitment to continuous professional improvement. Commitment to high standards of professionalism, integrity, and ethics. You will not regret the effort.

Engineers are fast learners, deep thinkers, team players and hard working. They are well-trained professionals who can adapt to working in business, management, finance, and even in medicine. Throughout your career, you will likely find multiple opportunities to move into other fields. When offered to choose among other career paths, I decided to remain in engineering, but regardless what your choice is, you will likely approach new challenges and opportunities with an engineer's mind. And will likely stand out by doing so!

If I were to suggest something to you, it would definitively be to join one or more professional associations early in your career. It could be an association related to the work you do, or your area of expertise, or the field where you would like to gain expertise in. Regardless of the type of association you join, make sure to be active within it. Early in my career as an engineer and following the advice of my supervisors and mentors, I joined two professional associations related to my professional interests. Over the years, I have participated in conferences, workshops, and seminars organized by these groups, not only attending them, but also as a

volunteer organizing events, giving presentations, writing papers, and participating in discussion groups. I learned a lot while doing so.

Currently, I am at the Board of Directors of two of the professional associations I joined 30 years ago, when I had just graduated. This has allowed me to travel extensively, meet extraordinary people, learn new skills, live awesome experiences, expand my professional network, and establish a fantastic synergy with my day-to-day engineering business. Every drop of effort volunteered to these professional organizations has paid back tenfold: both in business as in life experiences.

I would like to wish you all the best in your career as an engineer. Whether you remain strictly within our field, or decide to take on any of the multiple opportunities that you will certainly encounter.

Daniel A. Nolasco, MEng, MSc, P.Eng.

Daniel A. Nolasco is Director of the International Water Association and President of NOLASCO y Asoc. S.A.

Feniosky Peña-Mora

The current state of architecture, design and engineering is at the crossroads of exciting times.

Engineers must respond to the changing needs of an increasingly globally-connected and diverse population. Projects must blend functionality with aesthetically pleasing design and must cater to a variety of criteria to keep progressing the way society interacts with buildings and infrastructure. Having just completed university, your generation has natural affinity to technology different from my generation, who was not afforded the native familiarity with the web and interconnected devices that you possess. Use it to your advantage and don't be afraid to push the limits of design with the tools that you have at your disposal.

There are five lenses that the New York City Department of Design and Construction (DDC) uses to consider the libraries, cultural facilities, firehouses, roadways, police precincts, and plazas that we build in order to enable education, safety, transportation and recreation; all of which define New York City's neighborhoods: growth, resiliency, sustainability, equity and healthy living.

Superstorm Sandy from 2012 demonstrated the vulnerability of New York City infrastructure and neighborhoods, particularly along the shorelines. DDC's design and construction projects enabled communities to overcome devastation and emerge stronger than ever from that storm. A project such as the federally funded Staten Island bluebelt, a series of storm drains that uses natural landscape and vegetation to defer rainwater out from streets and public spaces and into catch basins, is an example of the sort of engineering that the department strives to provide to New York City residents in order to ensure sustainable and resilient public spaces. Global warming has been contested time and again by different groups,

but we are finally at a point in which green design is common and lauded when incorporated in architecture. This is a development that your generation has the power to continue. Advancements in technology are marrying design aspects that have not coexisted before. I encourage you to explore these combinations and contribute to the resiliency and sustainability of the world in ways that we still cannot fathom.


DDC makes it a priority to ensure that all projects welcome the growth and diversity in New York City. Times Square plaza, sometimes referred to as 'the crossroads of the world', is a project that the department designed to meet the needs of a literally global population. This plaza provides space for all people to participate in multi-cultural diffusion, which grows the city as a forefront of global connectivity. Additionally, since the plaza spans multiple city blocks and is an open space for pedestrians to traverse, the project satisfies our last building lens: healthy living. The plazas, stairways and bike lanes that DDC builds help New Yorkers to be fit, active and healthy. Engaged minds and healthy bodies promote a high quality of life for city dwellers, and the engineers in our halls keep are conscious of this when designing our infrastructure and building projects.

While your university experience provided guiding principles of functional architecture, there is no comparison to planning projects intended to be used by real people on a daily basis. A fundamental value in public design is to create spaces and infrastructure that are accessible to all people regardless of age, physical ability or socio-economic status. When planning these projects, the architect takes on the role of artist and subject simultaneously. It is important to keep in mind that your plans must allow for equity in order for structures to be enjoyed and used to the fullest by all. Trust your gut and your intuition when planning for other people, and don't be afraid to ask questions to colleagues when you join the work force—they have a wealth of experience and knowledge that is available to you upon inquiry!

Have no doubts about yourself. You've earned a degree in engineering, which means you've challenged yourself to think critically and logically. If you maintain these skills in the workplace, and keep an open mind when trying to find solutions to problems, you'll be successful in planning projects. I encourage you to learn from your mistakes as well as your successes as you reach for the stars. You are the builders of the future! Once again, congratulations on graduating and I look forward to reading about the great work you do to make a better place for all of us to live and work.

Feniosky Peña-Mora

Feniosky Peña-Mora is past Commissioner of the New York City Department of Design and Construction and is now a Professor of Civil Engineering at Columbia University.



“Green design is a development that your generation has the power to continue.”

- Feniosky Peña-Mora

Maryvonne Plessis-Fraissard

In your life time, the human population will crest, and the world will decarbonize.

Welcome, young engineer, welcome when humanity needs you most.

Times are unprecedented, and especially so for engineering and engineers. You need to live by the long-held principles of rigor and excellence of your peers. Yet you must reinvent engineering to deliver new generations of smart and sustainable goods and services accessible for all.

Be proud of the contribution of the elders, and reflect on their achievements: acknowledge the water at the tap, the light in the bulb, the speed in the computer; be thankful to see the clouds down from a plane, when many gave their lives to the exploration of flying machines. Engineers built pyramids, aqueducts and bridges that stand through the ages. They pushed the norms of comfort and safety; they delivered the instruments of unimaginable productivity and efficiency with diminishing environmental costs; they contributed to the scientific approach; and to governance by providing the technology for city life. They exemplify rigor and ethics because they sanction the rules of physics that cannot be cheated nor bribed. They epitomize modernity and progress.

Yet, while you uphold this glorious heritage, be sure to forget history when you forge the way forward.

You may no longer rely on trends to forecast future needs: demographics and lifestyles are redefining service demand and mobility patterns; urbanization and technology are engendering new governance expectations; climate change is shifting

infrastructure specifications and sea level threatens human settlements; competition is challenging value added chains; real-time metadata are accelerating technology potentials faster than legislative bodies can regulate; and globalization of markets redefine the relationship between rich and poor people across state boundaries. The 'bottom billion' of humanity remains unserved.

The combination of these many mutations, today require engineers to embrace their traditional values tighter and reinvent the world faster.

And how would you embrace traditional values tighter?

Some engineering projects have faltered for lack of attention to their social, economic, and environmental impact. This was found to be associated with engineers running projects all by themselves, and being all from the same select and rare background. Nothing wrong, of course, with being white or a man, yet the challenges of today are hugely more complex, and demand diverse teams, healthy mix of women and men, young and less young, diverse geographical and cultural backgrounds. The best engineering projects wholesomely fuse the ecology, sociology, economics, finance, and politics into the decision making.

Emulate the engineer's exactitude, timeliness, and drive for the public good, and embrace team work with an open mind: you can expect to hear, throughout your career: "Thank goodness for engineers!"

And how would you reinvent the world?

Embrace disruptive change since incremental improvements will not suffice for a safe transition to a footprint-free urbanized society. Focus on transforming the fossil fuel-based economy into a clean energy world. Challenge the engineering know-how to effectively serve each of the 9.7 billion people of your generation; harness the metadata to work not for privileged interests, but for individuals

and with tailored immediacy. Be curious, be humble, and listen to those who emerge from unrecognized backgrounds. Work on smart services, livable settlements, on sustainable food production, and inclusive and transparent information.

In sum, be traditional, and be iconoclastic!

Enjoy life and your work, and give it all you can.

The wellness of my grandchildren, in part, depends on you, and for that—thank goodness for engineers—you have my trust and gratitude.

Maryvonne Plessis-Fraissard

Maryvonne Plessis-Fraissard retired after 26 years from The World Bank in 2007 and is now the Director of MPF Consult, an independent consultant on safe, clean and affordable transportation for development.



**“Be traditional,
and be
iconoclastic!”**

- Maryvonne Plessis-Fraissard

Gary Polonsky

When I was in Grade 7 in Isabella School (now defunct), in Fort William, Ontario (also defunct), the boys were sent a half day per week to another school for 'Shops'.

There we toiled in the design and fabrication of two lifelong mementos—an upholstered wooden footstool and a tin dustpan—unless you were my best friend, Martin Rezitnyk, who was so good that he had months of spare time to create other pieces of beautiful furniture and who was arguably the best student our teacher, Mr. Maki, ever had.

I, on the other hand, was undoubtedly the worst. So bad, that after showing me countless times how to take the most mundane of baby steps, Mr. Maki finally blew up and flung an inanimate object the size of a grapefruit at my head, barely missing me. I was as petrified as he was apoplectic but given that student rights, Parent Councils and ubiquitous lawsuits were decades away, we both pretended it didn't happen. My classmates, of course, kept their hands busy and their eyes down.

The months droned on and I eventually completed the bare minimum of the assigned projects, both pathetic, and my efforts earned me a D. For a student who had already skipped two grades, you might think I'd be mortified. In fact, I was relieved, as my greatest concern was that I'd get an F and have to repeat the course, fearful that neither Mr. Maki nor I could survive a second round.

About 15 years later, I had occasion to take a series of eight aptitude tests and scored well in five. I was surprised at my below-

average score in Mechanical Reasoning but the real kicker was in Spatial Relations and Depth Perception where I scored in the first percentile. In other words, I was tied with a few others for being WORST IN THE WORLD in the ability to visualize what most 'normal' people take for granted, explaining why I have spent a life time being singularly unable to open stuff, fix stuff or build stuff... you get the picture.

For years, I refused to accept this fate, experimenting with various creative means to make me whole but each time failed as miserably as the last. Finally, well into adulthood, I simply gave up and looked to my wife, kids or friends for a nearby, quick fix.

How ironic, therefore, that my first employer, Confederation College (in Northwestern Ontario) chose me as the Founding Chair of Trades Programs and that my last employer, the Board of Governors of Ontario Tech University, chose me as its Founding President to conceptualize and launch "The M.I.T. of the North", as Premier Harris dubbed us (albeit with some encouragement).

At the first planning meeting with the architect, engineers, general contractor, campus planner, time/cost consultant and my colleagues, I opened with three points: a) we had to build the university in two years instead of the usual five; b) we had three criteria for success—finish on time, on budget and to rave reviews; and c) I couldn't read a blueprint to save my soul so that they'd have to TALK me through everything.

And they did. Everyone was terrific—respectful, values-driven, collaborative, efficient, humble, honest, brilliant, all the right things. From Don Schmitt of Diamond-Schmitt and his architect and engineering colleagues, to Geoff Smith and everyone at Ellis-Don, to Phil Weinstein and Brad Johnson of The Planning Group, to other advisors and my own team, everyone worked around the clock for two years and together, we batted three for three: on time, on


budget and to rave reviews. We even won awards, such as the 2006 American Library Association Award for the Best Designed Library of any size and any type IN THE WORLD.

And all of this chaired by someone in the first percentile of key aptitudes.

I have shared this story with you, the next crop of professional engineers in Canada, for an obvious reason: you will face a broad array of mandates and challenges throughout your career, some as wacky as the circumstances that created Ontario Tech. However, by staying resolute, respectful and smart, we will all be richer through your achievements—your colleagues, your partners, your clients, your community, your country and your world.

Gary Polonsky

Gary Polonsky is Founding President and Vice-Chancellor, Ontario Tech University.



“...by staying
resolute,
respectful and
smart, we will
all be richer
through your
achievements.”

- Gary Polonsky

Kevin Pope

Recognize where you are, leaving the comforts of being a student, the known and familiar.

You're ready to venture into the next chapter as a new and eager engineer. This exciting life junction can come with considerable apprehension. Similar to leaving elementary for high school, and high school for university, each new phase brings both excitement and trepidation. This next step likely comes with a greater degree of these feelings as you step into a world of possibilities.

Now more than ever, balance should be emphasized: work and personal life, responsibility and personal health, creativity and innovation, humility and confidence, realism and optimism. You completed a rigorous education, full of responsibilities, challenges and demands. You should feel proud of your success and personal growth. Take some time to savour your accomplishments, and then, as you enter the workforce be ready and willing to bring your imagination and ideas to centre stage. The world is ready for your vision, insights and eagerness for improvement. I'm sure you are up to the challenge.

At eight years old, I was a proud member of Beavers, a precursor to Boy Scouts. On a camping trip with my troop, we were visited by a local First Nations chief. He explained similarities between his beliefs and common western practices, and also a key difference. His tribe, among others, believes all decisions should consider the effect that choices will have seven generations away. He spoke of impact and future responsibility. This advice is immensely important for engineers. The choices engineers make can provide huge advantages for people: bringing essentials, comforts and opportunities for advancement in societies around the globe.

However, the choices engineers make can also bring challenges to future generations.

In the 21st century, a time when anything seems possible, technology has connected us through instant communication, put people on the moon, and genetically engineered organisms. Yet one challenge that technology has not solved is scarcity. Limited food, water, fuel and time place huge burdens on us. As we race to innovate methods to solve problems, new challenges often arise; sometimes as a direct result of previous solutions. I urge you to be optimistic about humanity's abilities to overcome. Led by the spirit of innovation and duty, we will overcome the world's major problems. We will continue to solve obstacles of scarcity and invent new methods to alleviate environmental pressure. This will be led by passionate engineers like you.

Kevin Pope

Kevin Pope is an Associate Professor and Deputy Department Head of Mechanical Engineering at Memorial University of Newfoundland.

Kim Pressnail

It does not seem so long ago that I was where you are now—a recent graduate of a rather demanding engineering program.

These last four years have likely passed as quickly for you as they did for me. Just yesterday, you were a first-year student knocking on my door. You were bright-eyed, enthusiastic and in awe of the world around you. Today and tomorrow, too, I hope you never lose that enthusiasm! It will carry you far beyond the doors of engineering school.

As I have helped you along the education trail, I have found great satisfaction, watching as you developed new confidence and skills. Teaching you has been rewarding, in part, because teaching is a two-way street. Just as I have influenced you a little, you have, in turn, influenced me. I realize that this might seem strange, but just as I have challenged you to think more deeply, you have challenged me to think more deeply too. It is this exchange that keeps me fresh and brings what I hope is a renewed richness to the classroom.

As my work with you comes to an end, your work is just beginning. As an educator, seeing that you have been prepared for a life independently led is a measure of my own success. It is a matter of pride to see you go into the world and to take on the challenges, confident that you can change the world.

Now that you are independent, my role is now diminished to one of a guide. As you ponder the many paths before you, know that choosing may be easier if you follow your heart. Seek out the things that bring you satisfaction. It's a lot easier to do well when you enjoy the work that you are doing! When you find the paths that make you smile, strive for excellence. There will always be a place for those who do.

When you strive for excellence, remember your family and your friends and the memories you have made together—for they bring true richness to your life. Your family and friends have shared in your accomplishments, and you have made them proud. Just as you have made them proud, think of the people in the future too. I hope that your accomplishments will make them proud too.

Looking back along my trail, I realize that I was wealthier than I once believed. Some of my family and friends were more than just friends; they were mentors too. They were gently guiding me—ever so gently. It was only when they were gone that I realized the gifts I'd been given. These gifts I can never repay, but I can pass them along.

So go now and use the gifts that you have been given and know that as an engineer, you have the power to shape the world around you. Your world, our world, is changing faster than ever before. Global climate change and the depletion of inexpensive carbon-based energy are two related challenges that loom before us. Although these challenges may seem daunting, I have often noted that “although the past has been written, the future is yours to write”.

Seek to make the part of the world that you can influence better—better for the people of today and tomorrow too. As an engineer, you do have the power and the responsibility to build a better future and to lead us into treading more lightly on this earth. When you do, I look forward to learning of your great work.

Finally, a parting thought: one day, a first-year engineering student may knock on your door seeking answers. When you hear the knock, open the door: it will be your turn to influence the next generation of engineers and to help them along the trail.

Onward and, as always, upward!

Kim Pressnail

Kim Pressnail is a wooden canoe builder and former Associate Professor of Civil Engineering at the University of Toronto.

Lisa A. Prime

As someone without engineering credentials, I am honoured to have been invited to write to you because it truly represents how far we have come. This is the basis of my contribution.

My education is that of an Environmental Planner, Bachelor's degree from University of Waterloo and Master's from York University. My entire career has been consumed with engineering. My experience over 25 years has taken me from dealing with land-based environmental impacts of engineering projects, to building specification, improving the environmental performance of engineering in buildings and infrastructure, to smart solutions that support sustainability and our biggest challenge, addressing resiliency for climate change. This provides evidence that the education you have obtained is not necessarily a narrow spectrum of what you might do and what you might influence.

In fact, perhaps the opposite, it may be a reflection of where you began your journey and a light towards all the opportunities that await you.

In this context, the emphasis of my advice is the importance of what you should have learned in school regarding the importance of collaboration and the imparity to address the critical issue of climate change through the work that we do. Fundamental to this perspective is the consideration of Integrated Design Process (IDP) and Innovation Process, in how we do our work and how we work with others.

As an engineer, you are part of a much bigger project, no matter what key part you deliver. We have learned over the past 25 years, that we still have much work to do to truly maximize the benefits of working together in an integrated format with other disciplines. We have also learned that the solutions to climate change need to be actionable and intentional in all that we do.

A true approach to IDP requires a multidisciplinary team of designers and experts working with stakeholders throughout the design process and making use of specialized expertise when required, in order to consider a variety of design options and select those that optimize environmental performance while meeting all other design objectives. This is done using a charrette approach. There are a number of benefits of IDP that result in design efficiencies, cost saving and improved performance for any project, and sustainability.

The use of IDP more known but not necessarily implemented well in all cases. Innovation Process, requires open expectations and access to all the options and considerations in working through a project. We will find the best solutions through use of action and outcome-based tools such as IDP and Innovation Process. These will be the projects we can hold up as signature in moving the market to achieve a triple bottom line benefit: economic, social and environmental.

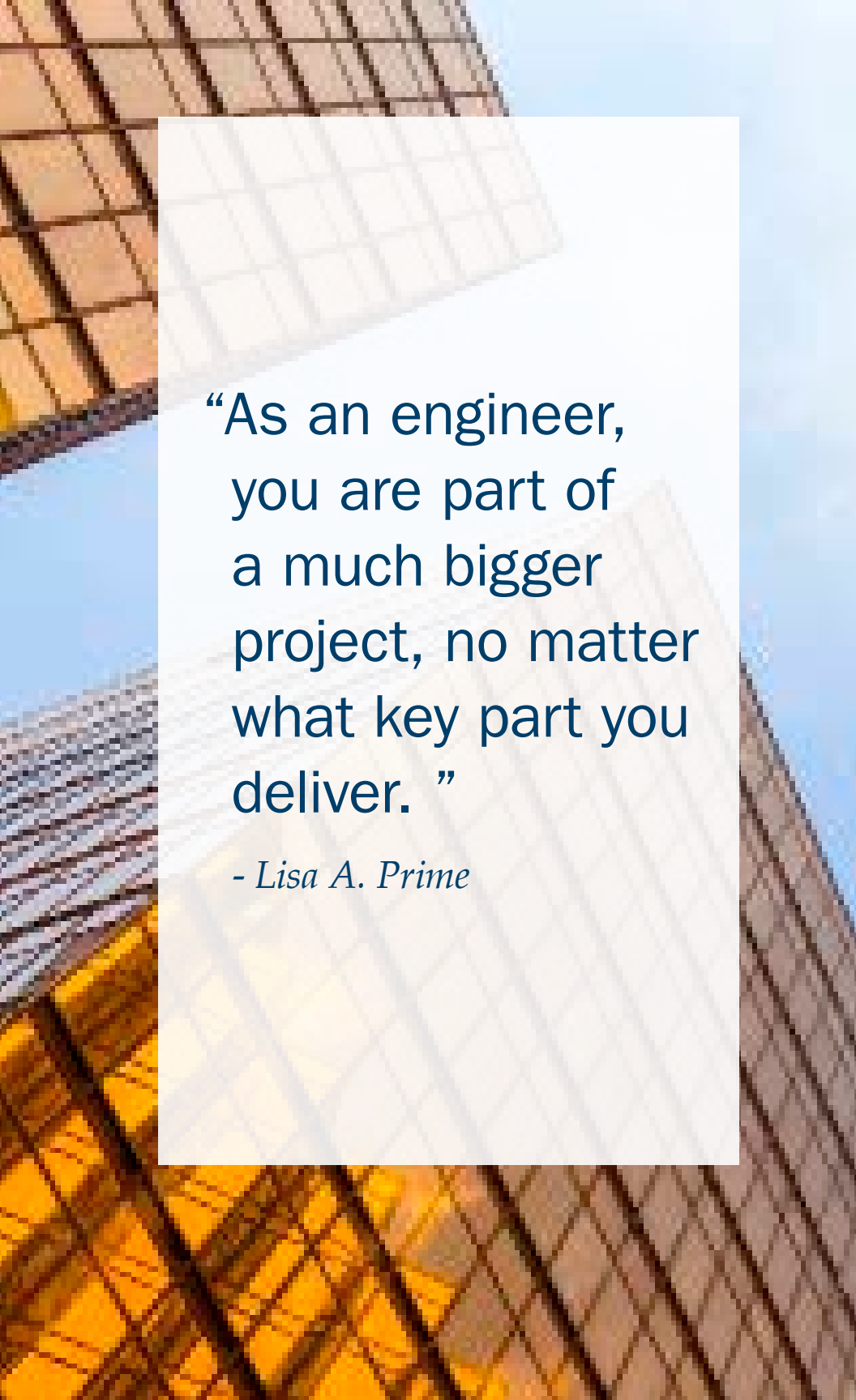
These processes are not limited to traditional design processes. There are many lessons that can be applied in any engineering project or impact-assessment approach. I challenge you to learn more about IDP and Innovation Process as you head out in your career. Look for opportunities to bring alternative approaches forward and work hard to continue to advance the integration of disciplines for any project, to achieve a real triple bottom line benefit. Get to know your planners, architects, project managers, local experts and other engineering specialists, to name a few.

These are the people with whom you will, together, make the changes that you look forward to as a new graduate.

Only when we are all effectively all working in this way will we truly achieve sustainability and solve climate change. I look forward to crossing paths with you and the projects that are your successes.

Lisa A. Prime, MCIP RPP LEED AP

Lisa Prime is Principal, Prime Strategy & Planning Inc.



“As an engineer,
you are part of
a much bigger
project, no matter
what key part you
deliver. ”

- Lisa A. Prime

Ishwar K. Puri

Welcome to the next phase of your life.

If you think that you've already found yourself, question that. Don't be hamstrung by a singular passion. Be open. Be curious. Explore. Know that your passions and interests will change over time.

You're multi-dimensional. You could do many things next. Re-evaluate your priorities. There may be greater joy in doing something other than what you think you want to do.

When I entered university, I wanted to be a philosophy major, considered economics, joined a pre-med program and finally entered engineering.

To help support myself during an internship term, I drove a cab on weekends. I interned as a photographer's assistant one summer. I wrote and published poetry, participated in debates, wrote opinion pieces, participated in student politics. I worked in a co-operative bookstore and wrote a cookbook from which my sons use recipes even today.

After graduating as a young engineer, I joined an MBA program, but left it to pursue a PhD in Engineering Science. It was then that I found my passion (and the love of my life, my wife, at the same time).

Life is a journey. As you experience life, learn from it. Your journey will be more important than your destination. It will help define who you will become. You'll become wiser and stronger.

Don't accept unfair pay, or do meaningless work, or tolerate a boss who demeans you, or participate in a toxic work culture, or be loyal to an organization that doesn't value you.

Speak up when you feel bullied; you cannot become a passive victim. Speak up if you think that a bad decision is being made.

Don't settle for less. Have your resignation letter and a strong r sum  ready. Use them when your working conditions become less than bearable.

Leave if you are passed over for promotions that you deserve. Don't be a doormat. Explore the world of opportunities out there.

However modest or lofty your job is, treat everyone well. Be kind and courteous. Respect those who don't have as much authority as you.

Provide honest feedback. Be straightforward. Others should know where you stand and how they can measure up to your expectations.

Have high standards but don't be too hard, on others or on yourself. Perfection is for the eyes of gods alone.

Experience the world first-hand. Travel locally. Travel nationally. Go abroad.

Build community. Surround yourself with friends from different races, cultures, ethnicities, religions, nationalities and experiences. Support them and ask them to support you. Celebrate your shared success and overcome adversity with them.

Life will place enough limitations on you. Don't let your mind fabricate many more of them. Overcome your fears and self-doubt.

Grand plans are one thing. Acting on them is another. Accept that you will become frustrated sometimes. Learn from your failures so that you can chart your accomplishments.

Be comfortable with yourself. You're going to spend a lot of time together, you and yourself.

Think big. Have a purpose. Solve problems that matter.

Ever think about running a start up? Will you be able to facilitate

social good through a non-governmental organization? Are you the innovator who will change an industry? Will you lead a company? Are you the researcher who will move science forward? Will you be the inventor who will produce amazing new products?

Be humble and give to your community. There are many different ways to do so.

How will you pay it forward? How will you give back? Will you be an advocate for sustainability? Will you help the less fortunate among us to educate themselves and their children? Will you advance public policy? Will you be a mentor?

Know that you can change the world, definitely the part that surrounds you. Leave whatever you touch better and more interesting than what you first found.

Together, reflect on all this with your family, friends and community.

Ishwar K. Puri

Ishwar K. Puri is Dean of Engineering, McMaster University.

“Know that you
can change
the world...”

- Ishwar K. Puri

George Rocoski

This is not the end of your time of learning, just the beginning of a new phase.

To get here, you have obviously mastered all of the mathematical, scientific and technical skills necessary to get an engineering degree. But for engineers today, in my opinion, that is but the price of admission to our profession.

Throughout my career, I found that many of my engineer colleagues spoke a language that was not understandable to most people in a room or meeting. This usually resulted in a great deal of blank stares or eye rolling by those people. What we as engineers have a habit of doing in these circumstances is to reassure ourselves that those non-engineers are the ones who “don’t get it.” Unfortunately, more often than not, I found that it was the engineers that “didn’t get it.”

Yes, the real world out there works in, on and through technology and your training is key to humanity and civilization moving forward. But, too often, we as engineers fail to understand and grasp that it takes more than technically correct answers to move most issues forward.

While you may work in groups of other engineers and technical people, many who will be using your services are not engineers. For example, you may need to convince politicians why your project or proposal is the one that should be selected. These non-engineers could be weighing the merits of a water treatment plant expansion against road safety improvements. Each of these choices has significant importance and carries multimillion-dollar implications. In my experience, relying exclusively on numbers and facts rarely won the day or argument.

Those softer skills that we laughed at when in school (those artsy

things) are as important as the technical skills you learned. As engineers, you will have to be able to communicate your thoughts, ideas and recommendations to a variety of audiences, most of which do not have your technical training.

Furthermore, most of these audiences (at least in North America) are distrustful of engineers and scientists. After all, have we as engineers not given the world the atomic bomb, Love Canal (toxic waste dump in New York State), Bhopal (chemical spill that killed many people in India), and the crude oil spill in the Gulf of Mexico (that released close to five million barrels of crude oil over a period of several months)? There are many more examples, and these are but a few of the more recent events. While we as engineers also rose to the occasion to fix these problems, people most often remember the problem, not so much the solution.

Know your audience. If you are speaking to your engineering peers, then let all the technical phrases and jargon fly. If, however, you are speaking to a less technically sophisticated crowd, think about what they are interested in hearing. This could be in a public meeting or a town council deputation or even with a client. They will probably not be interested in knowing how you solved that particularly difficult differential equation which led to your position on some matter. They will want to know, in simple terms, what is the impact of your recommendation. They will ask questions like “Is it safe?”, “How does it really work?”, “What will the real impact be in my community?”, and “Why should I buy this thing?”.

Your engineering education did not really prepare you for this. It's not anyone's fault. The workload to get through engineering does not allow time to learn and develop these other skills.

As hard as learning engineering was, I found developing these skills to be equally difficult. A manager of mine many years ago, at the beginning of a meeting that involved a particularly complex topic, would remind us that he would like to hear our analysis and recommendations in language his 89-year-old grandmother could

understand. His challenge to me and others was to explain the issue in such a way that anyone could understand without oversimplifying the topic or talking down to the audience. If you think this is easy, then how successful do you think you would be if you had to right now explain the fluid mechanic principles on how ketchup flows out of a bottle to a Grade 1 student in language they would understand?

If you choose a career path of pure engineering, then you may not have to work as hard on these communications skills. Several of my colleagues from university have had very successful careers working in primarily technical areas. If, however, you see yourself moving into management ranks or choosing a career that requires marketing of your skills, services or knowledge, then being able to convince your audience that you are the right person will need more than what you can get from a calculator. If you think of it another way, by mastering these communications skills, in addition to all those great engineering skills you obtained from your formal education, you will also acquire all of those things the artsies learned while they were at university too.

Think about living the motto of the gold-medal winning 2010 Canadian Olympic Men's Hockey team: Leave no doubt that...

- This is our time.
- Every day counts.
- Every meeting matters.
- Each one of us will rise to every occasion.
- Nothing can distract us.
- Nothing will stop us.
- Our determination will define us.

Now go out and change the world like you and I both know you will.

George Rocoski, MEng, P.Eng.

George Rocoski is the former Assistant Deputy Minister for the Ontario Ministry of the Environment's Environmental Programs Division.

“This is not the end of your time of learning, just the beginning of a new phase.”

- George Rocoski

George Roter

This next decade is potentially the most important decade of your life.

In the next decade, you will establish patterns in how you work, how you volunteer, how your life is constructed and what you value. It will hold a lot of success, and many failures, which is actually a really good measure of your personal progress. A decade can define the rest of your life.

So the question that I would like to pose to you is “what choices will you make in this next decade?”

Not much more than a decade ago, I was sitting where you are. Happy, proud, excited, and probably a little bit anxious about the future. I had some ideas about the path I would take, but nothing was certain. I had spent the time in school preparing: accumulating good marks, being involved with student clubs, sports, working for a new company on each of my work terms, and so on.

That strategy—accumulating the prerequisites—worked for the first two decades of my life. We’re all the product of a school system that defines success for us religiously and rewards us as we go through and check off all the boxes.

It took me my first decade after school to realize that in school you’re rewarded for your performance, but in life you’re rewarded for your choices.

Some people never learn this, and some people never realize the immensity of choices they have in front of them. I hope you will.

You are privileged to even have these choices, more than you might be able to imagine. You are the recipient of an engineering degree at University. Already this puts you in the top 0.5 per cent of the planet in terms of education and opportunity.

Compared to most of the world, your choices are almost unlimited. But it might not feel like that—and indeed for me when I graduated it sure didn’t seem to be so.

I had to search deep inside to realize that my choices were restricted only by my own fears. My own fears of failure, my own fears of defying the path that my friends, my parents, society had laid out for me, explicitly or implicitly.

What I’ve learned is that being willing to identify and confront your own personal fears will allow you to see the choices and opportunity in front of you. When I was in your position, the fear of failure was central. And so I set out on a traditional path. Get my master’s, get in to medical school or have a fallback of a career in industry. These were ambitious, for sure. And ironically, it wasn’t until I experienced failure in a few of those areas that I started seeing the true range of choices and freedoms in front of me.

When I finally decided to choose a focus on Engineers Without Borders—more or less a hobby until then—all of a sudden I opened myself to judgement. All of a sudden it mattered. And that was a new set of fears and discomfort.

I put the challenge to you to find out what makes you slightly uncomfortable, what makes you slightly afraid. And go after that. Because it’s only when you’re slightly afraid, when your friends and family are questioning some of the choices you’ve made, and when you’re questioning yourself that you’ll uncover your core values. And that will lead you to discovering your passion.

Now some people will tell you that the very idea of passion is adolescent, even naive. That it will distract you from responsibility, from personal security, from what is sensible. Ignore them.

Perhaps you’ll permit me to illustrate this with a story.

It’s the story of a trip I took to Ghana a few years ago. But it’s actually not a story about me, it’s a story about a young girl. Her name is Iddrisu. She’s from Northern Ghana, an expansive, hot Savannah.

I met her in 2006, this bright nine-year-old girl. She was one of four or five people in the 1,000 person village—adult or child—who could speak to me in English. She told me that her great ambition in life was to finish Grade 6.

I don't know if she made it. Her parents are both dead, and she's being raised by her aunt. She has likely been sick from poor water and unable to attend school. Maybe she's working at the market, or getting married off as a second wife to work the land for the next 30 or 40 years.

That's one path.

But I have hope, because what I saw in her eyes was passion. I saw her struggling by the light of her flashlight, practicing her math homework, practicing her English late into the night. In this second path, she has graduated Grade 6, gone on to junior high, high school, maybe even university.

While I don't know the outcome, I do know the only way Iddrisu had a chance to overcome her extremely challenging circumstances was because of hope and passion.

Now Iddrisu's life, and her narrow choices, might seem quite far away. Morally important, but not practically relevant. I assure you it is relevant. Her narrow choices and our numerous choices and privileges in the world are inextricably linked.

Why?

Because we are at a crucial time in human history. We are collectively faced with some of the most profound challenges and injustices humanity has ever confronted. Climate change. An aging population. Global water scarcity. An economic system that is proliferating inequality. Extreme poverty. This list goes on.

The common thread between all of these challenges is that change is slow and negative consequences are quite far into the future. As humans, we are not good at dealing with problems of this nature. It's hard for us to see the slow trends. And it's even harder for us to marshal the resources and desire to act. We simply get used to living with these challenges.

And this is where it all comes together for you: the choices you have in front of you, the courage to confront your fears, the ability to discover and act on your passion, and what you know about global challenges, the poverty of choices exemplified by Iddrisu's life as one of them.

Here's my main request of you: Work on problems that matter.

Whether the problem that matters is around finding solutions to promote greater global justice. Whether the problem that matters is something as enormous as a low carbon transportation system, or something as important as improving health records in our strained health care system. Whether the problem that matters is in Canada or Cambodia or Kenya—please, work on problems that matter.

The nice part is that, as an engineer, you're ideally suited to this cause. Your engineering courses trained you to understand and solve tough problems. You are entering a profession that is charged with serving the public and society, to tackle the issues of greatest importance.

I return to where I began: "What choices will you make in the next decade, potentially the most important decade of your life?"

I hope that you will choose courage and passion and a little bit of fear.

Because with fear comes challenge, with challenge comes freedom, with freedom comes choice, and with choice comes that underlying passion that I saw in Iddrisu's eyes and that I know you have inside of you.

Please, go work on problems that matter.

George Roter

George Roter is the former CEO and Co-Founder of Engineers Without Borders Canada.

Michael R. Sanio

Congratulations, you have successfully completed a major milestone! Celebrate your accomplishments, take pictures, and thank your family and teachers for their commitment to your success.

You have become an engineer likely because of your curiosity and unique skill to understand how things work, and how they can be improved. Everything from your mother's mobile phone, to how your friend's car can be fixed!

As engineers, we make a commitment to use our skills to make the world a better place for everyone. With a world population over seven billion, two thirds in the developing world—Africa, Asia, South and Central America—moving to cities from rural areas all looking for a better quality of life, we have much to contribute to society.

We are fact based, rigorous, and frustratingly rational. We are driven to use what we know, to make things better.

Let me challenge you to work in your community, in your city, state and government, to proactively find ways to improve how we deliver services—everything from telephones to food, transportation, energy and water. With a growing population, the drive to improve quality of life and economic growth, our planet is shrinking! We cannot accommodate all the demands on our natural environment—air, lakes, rivers, streams, forests—something will have to give.

Be the best that you can be in your paid work, be confident to show what you know, and share! Find ways to actively contribute! Take the lead!

Volunteer for your professional organization. It is the best place to meet engineers at all stages of their career, from recent graduates to CEOs of companies. They are your peers; you will learn leadership skills and likely meet your next employer. More importantly, you will be a member of a much larger community, and you will have the opportunity to shape your profession and lead society.

Become involved in the political process. Volunteer for your city council, advisory committee, planning department, become active nationally and internationally. We often hear that we get the government we deserve. By understanding the process, we learn how and why compromises are made and how we can get the best outcome.

The world is a better place for everyone because of engineers; get involved, and share what you know.

I wish you every success in your personal and professional life.

Michael R. Sanio

Michael Sanio is Executive Advisor on Sustainability with the American Society of Civil Engineers.

Shoshanna Saxe

When I was 24, and first leaving school, I faced what felt like a fundamental crisis of choice.

My sense was that whatever choice I made next was “the choice”. The choice that would determine the path of my career and, by extension, life.

This put a huge amount of pressure on what job to take or grad school to go to.

I see this same angst every year in graduating students, a sense that they must choose “right” on what to do next.

My advice to a young engineer is this.... life is full of choices, at 20 at 30 at 40 and on. Your career and life are not set by your first job or second. You can change your mind, loop around, go in a different direction.

Shoshanna Saxe, PhD, P. Eng.

Shoshanna Saxe is an Assistant Professor, Canada Research Chair in Sustainable Infrastructure, and Dean’s Spark Professor in Sustainable Infrastructure, Department of Civil and Mineral Engineering, University of Toronto.

“Life is full of choices...”

- *Shoshanna Saxe*

Amir Shalaby

I have happily used my education as a professional engineer for nearly 40 years.

In that time, I have accumulated a wealth of experience and not-a-few scars. But I'm afraid that I have little advice to give you.

That's because I have concluded that advice from those who lived and worked in a different era has its limitations. You will not be living in the world in which I lived and your experiences will necessarily be different.

In that generalist spirit, then, allow me to offer some thoughts. It won't be advice, exactly, but I hope it will be durable enough that it will have value even as the world changes dramatically.

Knowing where you live

I learned the value of getting a good feel for the community in which I was living. Perhaps because I am an immigrant to Canada but I always placed a value on appreciating the history and ambitions of the place where I was working. I wanted to know more about its people, its politics and its traditions. And I wanted to know how all that linked to the work I was doing.

Making a contribution

You won't have to force a situation where you feel you are making a difference. The opportunities will always be there. What's important is to keep an open mind so that you see them and keep yourself in a state of readiness to seize them.

Interpersonal relations

One of the joys of a gathering in a workplace every day is that you get to mingle with colleagues—what we sometimes call our “work family.” You will bond with some people instantly. Others you'll never quite figure out. But don't underestimate the importance of trying to get along with everyone. Err on the side of being patient and understanding.

Attitude

Appreciate the value of having a positive attitude. Join in anything that contributes to team spirit. You will be rewarded with better lines of communication and, more importantly, you will feel a part of something bigger than yourself.

Policy

Contribute to discussions of policy. With your training and experience, you are more likely to bring pertinent facts and analysis to the table. But be careful not to over-estimate your contribution. It is important to appreciate what other people are saying.

I suppose this may not sound like much to offer you but I have found this focus has been immensely valuable to me over the years. I continue to enjoy working as a professional engineer and I wish you a long and fruitful career. And perhaps when you have accumulated some experience, you will consider writing a letter to a young engineer.

Amir Shalaby

Amir Shalaby is the former Vice-President of Power System Planning for the Ontario Power Authority.

Tarlochan Sidhu

The value of your degree lies not in the knowledge of how to solve a long equation, or in the ability to sweat a little less when faced with calculus.

The value of being an engineer lies in knowing how to think like a problem-solver. Engineering is not something you do in a nine-to-five job; it's a mindset and a group of values for how to approach and solve problems, be they technical, managerial or even ethical.

Some things to keep in mind:

Don't fear failure: Do you remember that elation in solving a tough problem after pondering for hours? That rush doesn't go away, and in many ways having an interesting career is about chasing that rush. Try new things and continue to push yourself and your thinking. Don't be afraid to take on hard problems, and don't expect to get them right the first time. In the real world, the first solution is almost never the perfect one.

Don't define engineering as a job: Your degree is about more than getting a job. An engineer's problem-solving techniques can be applied broadly. Look at entrepreneurs like Michael Bloomberg, the former Mayor of New York City, who graduated as an electrical engineer from Johns Hopkins. Or think of Julie Payette, a McGill and U of T engineering grad and the first Canadian to visit and to work aboard the International Space Station. And even "Mr. Bean"—Rowan Atkinson—studied electrical and electronics engineering at Newcastle University before getting his master's in engineering at Oxford. Engineers possess the kind of diligence, skill and intelligence that can make them a success in many fields. And

that includes playing a role in public service—whether by joining community groups, coaching your children's sports teams or even running for public office.

Think and act globally: As an engineer your career may land you in dozens of countries where you will apply your skills in countless ways. As you expand your career, however, remember to improve the quality of life and the environment of the places you work. We share this planet; it's up to you to think and act globally.

Innovation often comes from unlikely places: Keep an open mind when it comes to what inspires you. Innovation and breakthroughs come from unusual sources. Never be too quick to dismiss a person or an idea—you never know where brilliance is hiding.

Create a well-balanced mind: The American writer Mark Twain said "Never let your schooling interfere with your education." That's true during your studies, but it's also true during your careers. Be sure to read broadly, travel widely and give back to your community. Pursue interests outside of engineering and stay well-balanced. I've found that enjoying the world outside of engineering clears my mind and offers new approaches to solving problems.

From now on it is not the formulas you memorized that will matter. What really matters is how you decide to think and act while using your skills to benefit society. That's what I really hope you learned in the past few years.

Tarlochan Sidhu, PhD, P.Eng.

Tarlochan Sidhu is the former Dean of Engineering and Applied Science at Ontario Tech University. Prior to joining the university he served as Chair of the Department of Electrical and Computer Engineering at Western University.

Wit Siemieniuk

I have never really stopped to think, “if I had my career to do all over again would I do the same thing?” How much was pure luck, how much was hard work, and how much was a bit of both? What would I want to know now, and what if anything could be of use to you?

The first piece of advice I recall being given that shaped my career was by one of those guest lecturers in an environmental engineering course who gave an overview of where one might want to work. In simple terms, three options were given:

1. **Government** provides low pay, job security and an opportunity to work for the public good
2. **Private sector** provides high salaries, minimal challenges and job insecurity
3. **Consultant** provides greatest variety of work—usually working for government or private sector, with salaries and security between the two.

To this one must now add the following:

Non-governmental organization trades off working on society’s priority challenges, with the lowest pay, and job insecurity, but perhaps the greatest job satisfaction.

From that insight, I made the decision to take the consultant route, figuring that a variety of challenges trumps pay and stability. I have worked 30 years in the consulting field and have never regretted it. However, I can confirm that my friends in the oil industry have made more money, my friends in government have a better pension and my NGO friends not only make me feel guilty, but they are

probably the most interesting conversationalists of us all at a party. So as you read this... you pick where you want to be.

My first boss gave me one of the greatest pieces of advice for career success. Set up a professional network of 10, I was told, and continue to revisit and update this list every year. Nurture and cherish this network always. This group of ten will consist of some of your peers from school or those met on the job as you start your career—imagine where some of them will be in 10 or 20 years from now as you all progress and get promoted over time. This group may include a mentor at work who is willing to share, a professor, or family friend. Develop a personal relationship with all 10, and be the catalyst for maintaining the relationships. Some of those on the professional list may become personal friends—all the better because as opportunities arise, you become the first to know. True friends usually go the extra mile for their friends in order not to disappoint. This translates into getting a great reference and that new job that no one else knows about, or work contracts awarded because you will go the extra mile to deliver results, ultimately making all parties look good. Six degrees of separation definitely applies as this group can be drawn on to pretty well reach anywhere and anyone.

Sustainable development is definitely the burgeoning area of focus to apply engineering skills. Opportunities available to you will be diverse and many. The reason for this is that the business concept of infinite returns (higher profits quarter on quarter) from a finite resource (planet earth) will at some point be debunked... or we will reach a point of no return as a species, so the argument will be moot.

Optimistically three shoots of opportunity are presenting themselves. The first is to address the issues associated with all human activities of today—improve operations of existing manufacturing facilities, plants and the like. The second shoot of opportunity is to engage in solving emerging issues such as climate change and global warming. The third is to redress the problems of

the past, the legacy issues such as contaminated sites and polluted water (that we do or don't yet know about) that continue to adversely affect the baseline carrying capacity of where we live. Against this backdrop of opportunity, be aware the rich will always move when it gets too bad, the middle class will always pay and the poor will be the most affected.

Corporate social responsibility is the concept of the future for engineers. There are three general groups of companies. There are companies that only meet the bare minimum of what is required and expected and are just one change in regulation or society view from bankruptcy. These companies are not really profitable and have nothing to reinvest. There are those companies that are two changes away from regulation and society view, and they invest what they can. Finally there are companies that embrace corporate social responsibility and reinvest a portion of their profits into making the world a better place to live—some will do it willingly, and some will do it grudgingly so that the optics of being greedy are managed. Historically these progressive firms used to just cut a cheque to a charity whereas more and more there is a linkage to overall business objectives. This money is managed by the senior management team of a firm.

No matter whom you work for, a basic understanding of corporate social responsibility and how to access and use these funds will come in handy sometime over your engineering career. There are four main reasons for investing corporate social responsibility funds, and understanding the four reasons will improve the success rate of accessing these funds for your projects. The first reason is to generate a **rate of return on money invested**—make money from money. The second reason is to build **political capital** to possibly enhance approval for core parts of the business by decision-makers—do a good thing here if it helps gets permits over there. The third reason is to build **symbolic capital** to offset a negative impression from another core part of the business. The fourth reason is to build **intellectual capital** (research) that can be

used at some point to improve competitiveness of the core business.

Your attitude will be the key to success when applying skills. Arrogance is a terminal disease, while confidence is integral to success. All too often those with degrees in any profession discount those who do not. Be confident enough in your abilities to accept input from anyone and everyone. Theoretical knowledge does not translate into successful practical application or as we more commonly know it, book smart is not the same as street smart. Engage, listen, and listen some more as you move forward in your own personal career. This was reinforced to me in countries with centrally planned economies where national approaches to the engineering of local solutions were undertaken. It just never seemed to work out quite right.

My first boss also introduced me to the 10-80-10 rule, which I would like to pass on to you. Ten per cent of the people where you will be working will be the ones generating the ideas and securing the business. Eighty per cent of the people where you will be working will wait for project work and ideas to be given to them—these are the worker bees that do the long division of project delivery. Ten per cent of the people should be fired immediately. You need to decide where you fit in whichever situation you are in because it will have a direct impact on how happy and rewarding your career will be.

Everyone is different.

Finally, university has taught you how to think critically. Apply it to what you have just read!

Wit Siemieniuk

Wit Siemieniuk is Project Manager/Environment Specialist with Agriteam Canada in Calgary, Alberta.

Ry Smith

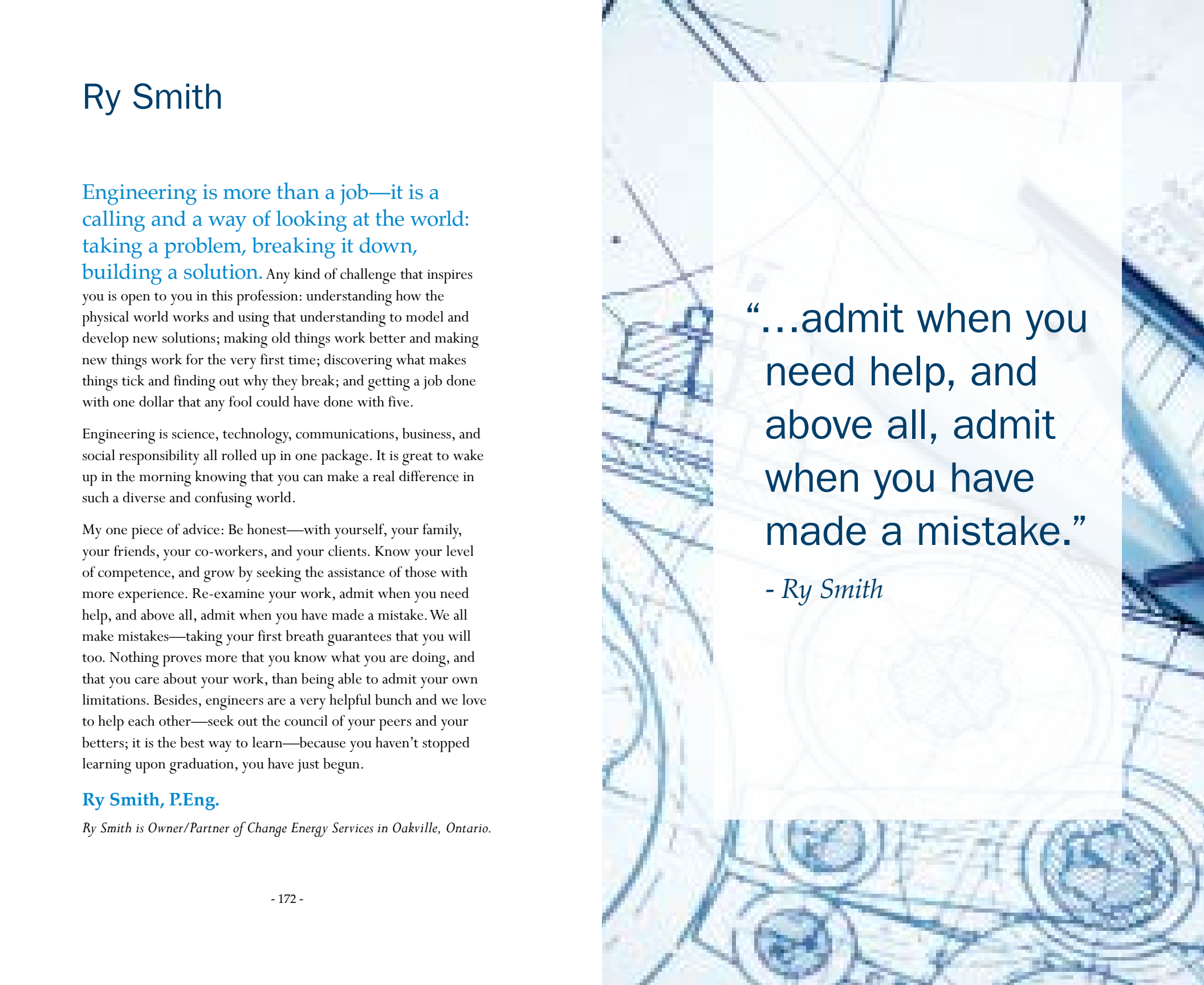
Engineering is more than a job—it is a calling and a way of looking at the world: taking a problem, breaking it down, building a solution. Any kind of challenge that inspires you is open to you in this profession: understanding how the physical world works and using that understanding to model and develop new solutions; making old things work better and making new things work for the very first time; discovering what makes things tick and finding out why they break; and getting a job done with one dollar that any fool could have done with five.

Engineering is science, technology, communications, business, and social responsibility all rolled up in one package. It is great to wake up in the morning knowing that you can make a real difference in such a diverse and confusing world.

My one piece of advice: Be honest—with yourself, your family, your friends, your co-workers, and your clients. Know your level of competence, and grow by seeking the assistance of those with more experience. Re-examine your work, admit when you need help, and above all, admit when you have made a mistake. We all make mistakes—taking your first breath guarantees that you will too. Nothing proves more that you know what you are doing, and that you care about your work, than being able to admit your own limitations. Besides, engineers are a very helpful bunch and we love to help each other—seek out the council of your peers and your betters; it is the best way to learn—because you haven't stopped learning upon graduation, you have just begun.

Ry Smith, P.Eng.

Ry Smith is Owner/Partner of Change Energy Services in Oakville, Ontario.

The background of the right side of the page is a vertical strip of technical drawings. It features various blue-toned sketches, including what appears to be a gear mechanism at the bottom, a structural frame or piping system in the middle, and other abstract technical lines and shapes. The drawings are rendered in a light blue color against a white background, creating a professional and engineering-oriented aesthetic.

“...admit when you need help, and above all, admit when you have made a mistake.”

- Ry Smith

Peter Stoett

As I write this, I am flying in a jet-fuel propelled steel tube hurtling across the Eurasian continent; a marvel of modern engineering spewing carbon and other greenhouse gases, chasing the Asian sun as we eclipse time zones and approach Singapore, where I am attending a symposium as a lead author for the United Nations Global Environmental Outlook (GEO). The UN's GEO, now in its 6th Edition, is a flagship publication that tries (invariably failing, given the sheer weight of the issues and political influence involved) to capture the state of the global environment. And that state is a dire one.

I'm acutely conscious of the irony here. I'm sitting in a high-tech instrument of transportation infamous for its capacity to pollute in order to attend a symposium where the world's severe ecological problems will be front and centre for a few troubling days before we all get back on our jets to go home.

I'm at an event where we'll use high-speed internet to connect with colleagues around the world and ignore the massive consumption inherent of the digital age—the pursuit of precious metals that fuels wars, the mountains of electronic waste, and the energy burnt pursuing such frivolities as bitcoin mining and pornography. We will discuss technological solutions to environmental problems but we will also conclude that they are, on their own, insufficient, and that we need greater policy designs and stronger commitments from governments and citizens alike to avoid the great calamities associated with climate change in particular—accelerated species decline, human health threats, rising sea levels, ocean acidification and coral reef destruction, extreme and deadly weather events—you get the picture.

And you know where I am going with this by now, I imagine: We need you to think seriously about these problems and to design technologies that can allow humans to flourish and travel across the world to attend to important matters without making things worse in the process! We need you to contribute to the Herculean task of reducing our ecological footprints in the modern age.

You already know that engineers have a responsibility to protect the natural world as they advance their mechanical designs and computational prowess. There are social and environmental implications that must be calculated, registered, and approved, lest we slip into some form of AI-based authoritarian technocracy or demonstrate blind faith in climate geoengineering as a tempting but environmentally and socially hazardous solution-without-sacrifice.

But I'm hoping that you will go beyond that and adopt a noble life mission. Dream big, but try to dream green in the process. There will come a time when letters will be written to past engineers, not just future ones. Will they be scathing indictments, lamenting lost opportunities, or will they be tales of heroic efforts to provide physical solutions that embraced the human spirit and our collective needs? An old adage borrowed from indigenous perspectives: Try to think seven generations ahead, because seven generations from now I don't want people looking back and thinking that I flew all this way just to add pollution to the atmosphere. I don't want them thinking that your generation, equipped with unprecedented and varied and deep scientific knowledge, wasted it developing the next distraction from the great challenges of our time.

Be innovators, be disruptors, but most of all, be heroes to future generations.

Peter Stoett

Peter Stoett is Dean of the Faculty of Social Science and Humanities at Ontario Tech University. He is an expert in global environmental politics and his research includes work on transnational environmental crime, climate justice, and Canadian-American environmental relations.

Susan Tighe

Diverse Teams Lead to Great Solutions

Congratulations! You have completed an undergraduate engineering degree which is no easy task. The problem solving skills you have learned will help you navigate your professional and personal lives.

When I first graduated I was immediately thrust into the exciting and fast moving world of construction. Although I was a graduate engineer, it was clear to me that I had a lot to learn. So, I worked hard to learn as much as I could from others, I tried to share my knowledge with others (although I felt what I had to share was limited) and every day I went to work with a positive attitude. I knew I had to work hard to learn the business and I also needed to work as part of a team. Initially I was struck at how diverse our team was. On the surface we had little in common, yet when we all put our heads together we accomplished great things. We had diverse backgrounds, perspectives and experience. As time went on, I realized this team of diverse individuals was strong and effective as there was a genuine respect for each team member and brainstorming solutions was challenging but rewarding. I also saw first hand that by having a diverse and inclusive environment, great things could be achieved. Each person brought a truly different perspective to the problem at hand. This helped develop effective and efficient solutions to handle technically complex problems. Each person was free to provide a proposed solution and every idea regardless of what it was, was valued. So I encourage you to work with others who are different, be a team player and build a culture of respect where all are welcome to freely participate in the discussion. This will from time to time pose challenges but it creates the type of environment that fosters innovation and creativity.

In the engineering world it is necessary to listen so that you can understand the problem or situation. There are many ways you can listen, whether it is through traditional communication routes or whether it is being observant to your surroundings. It is necessary to think about how things are currently working. Can they be better? Is there something that can be done that dramatically improves the process/service/product? What should we stop doing? Can something completely different be done here? In essence, it is important to be a thinker and see both the small and big picture. It is a balance of understanding the details of the situation at hand, but also imperative to see how the work you are doing can advance strategic goals or the bigger picture. Think about how your work has impact. Use good quality data and effectively use whatever tools you have available to develop a solution. Do not be afraid to test new ideas. With rapid advances in the access to information, do your best to stay current and be technically sound. Know how your work impacts quality of life and the environment. Continue to be involved with your profession and community as these interactions will ensure you remain relevant.

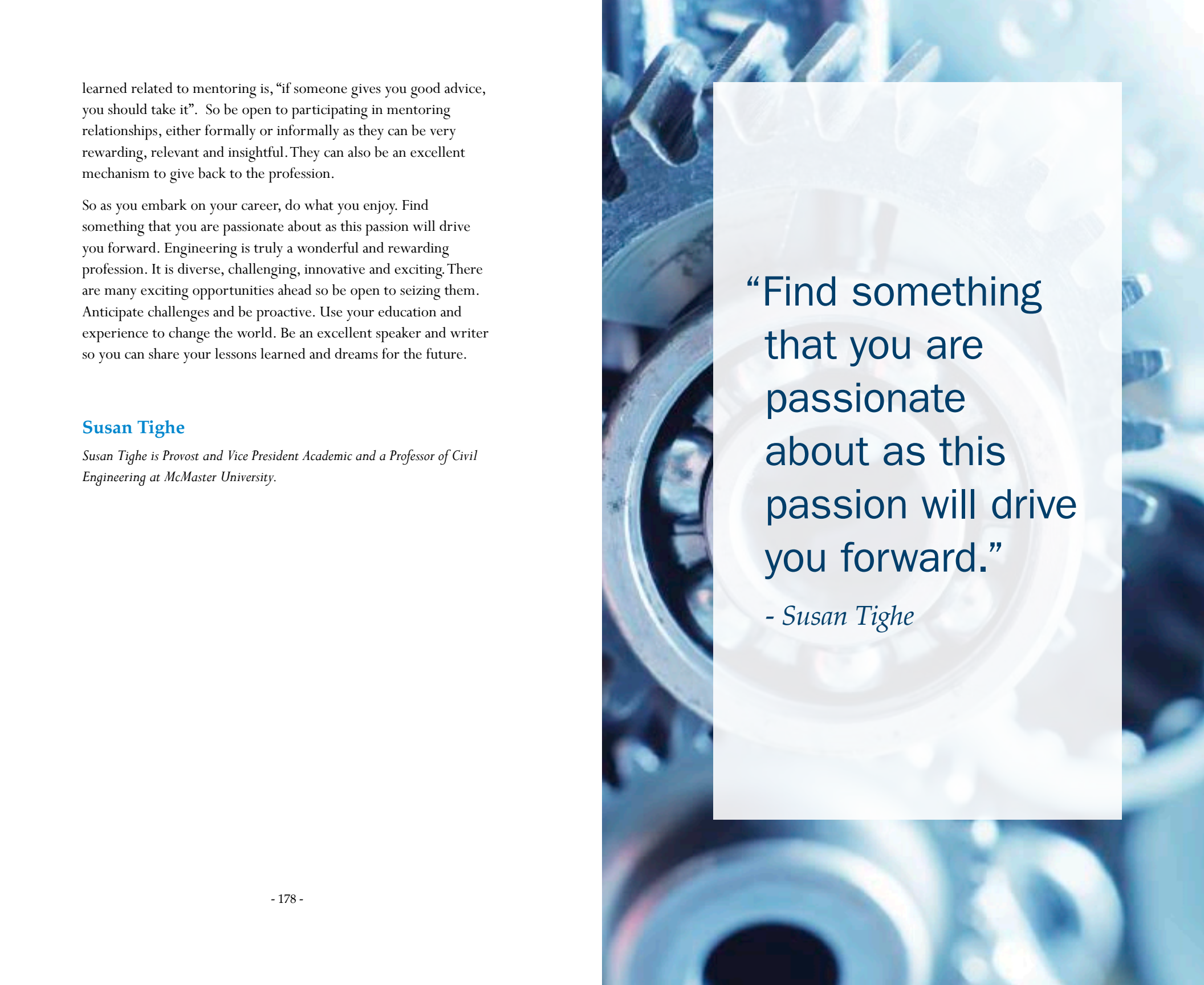
Another important lesson related to listening involves mentorship. To be a good mentee you need to be open minded to feedback. To be a good mentor, you need to listen and provide feedback that is helpful. Participating in mentor/mentee relationships throughout your career, can be very rewarding, helpful and a great way to learn. Mentors can provide valuable guidance and can be an excellent sounding board. They can provide a much needed reality check to provide perspective and the unbiased advice can help you navigate situations. This is particularly important as you move into different roles and grow as a professional. As a mentor you can also learn from your mentees in a way that is insightful and refreshing. Mentees provide perspective on how your organization is working or how people perceive decision making processes and management. In effect, both the mentee and mentor can learn from each other. But perhaps the most impactful thing I have

learned related to mentoring is, “if someone gives you good advice, you should take it”. So be open to participating in mentoring relationships, either formally or informally as they can be very rewarding, relevant and insightful. They can also be an excellent mechanism to give back to the profession.

So as you embark on your career, do what you enjoy. Find something that you are passionate about as this passion will drive you forward. Engineering is truly a wonderful and rewarding profession. It is diverse, challenging, innovative and exciting. There are many exciting opportunities ahead so be open to seizing them. Anticipate challenges and be proactive. Use your education and experience to change the world. Be an excellent speaker and writer so you can share your lessons learned and dreams for the future.

Susan Tighe

Susan Tighe is Provost and Vice President Academic and a Professor of Civil Engineering at McMaster University.



“Find something
that you are
passionate
about as this
passion will drive
you forward.”

- Susan Tighe

Akira Tokuhiro

Be cognitively flexible—observe/listen, anticipate changes, self-reflect, adjust.

As a young engineer, realize early, and often, that one has to be cognitively flexible. Aspects of your technical capabilities might not always be the differentiator between yourself, your peers and your supervisor.

Make yourself unique; develop the differentiator.

Take some time each weekend, each month, each quarter and each vacation period to dedicate yourself to life-long learning. Read books that inspire you, that make you feel connected. Stay away from the easy temptations of social networks, but if you must, follow authors online such as Tanmay Vora who write about the organizational and leadership skills you need to have to deliver business value in the working world. Keep building yourself up and adding to your resume through courses, workshops, certificates, software, project management, green-to-black belt status, etc. Create the credentials you need to move toward your “next position”.

Develop your “people skills”; get to know experienced engineers.

Attend social networking opportunities that may have a professional connection. Developing your “people skills” may turn out to be just as—or more—important than your technical skills. Take the time to broaden your world view and meet new people to generate options and possibilities for yourself.

Consciously make an effort to seek out engineers who look like they have had 30+ years of professional experience and engage with them. Ask them questions—about how they got to where they are today,

what inspired them, what surprised them the most, what their biggest mistake was—and do so at every opportunity. Listen, learn and practice the advice and insights they may provide.

Connect the dots; develop the big picture.

The professional engineering world is large and diverse. You will be expected to contribute individually but also to a team. You may be part of a team that is one piece of a 1000-piece puzzle. Further, you may develop a specialization or have responsibilities such that you know the ‘tail’ of the elephant. Thus, you must develop an understanding of the bigger picture, the entire elephant, and learn how to communicate effectively with all the pieces.

Akira Tokuhiro

Akira Tokuhiro, PhD, is Dean of the Faculty of Energy Systems and Nuclear Science at Ontario Tech University. He is a noted international expert in nuclear reactor engineering, design and safety.

Carl Turkstra

Congratulations. You are about to enter a wonderful career as a graduate engineer. I have been an engineer for over 50 years and I can safely say I have never regretted my choice of a career.

I have had an unusual history. I studied and taught in six universities including many years as a McGill Professor, stints at American universities and graduate studies in business management. At the end of my career I ended up running a large corporation. As Sir William Dawson, the founding Principle of McGill said, “the success of a university is measured by the success of its graduates in later life.” I did a lot of research during my academic life, but my colleagues and I always remembered that we were professional engineers and our primary job was to maintain the profession and turn out competent, well educated professionals.

I am a structural engineer and I still find it fascinating. You can travel the world and be amazed at the incredible genius of people ranging from the ancient Egyptians, the far eastern temple builders to the romans and modern bridge builders. Generations of engineers have upheld the ancient dictum “When we build let it be such that our children will hold it sacred that our hands have touched them,”

During your career you will find that your education has a profound effect on your life. You will probably find that you instinctively try to understand everything. Why do machines work? Why do people do what they do? Why does the climate change so dramatically?

You have been taught to be an analyst and you can not turn it off.

One of the best aspects of a career in engineering is the opportunity to take responsibility for decision making. Whether you are

responsible for the design of sophisticated equipment or supervision of a major construction project the ability to say “I did it” is a wonderful thing to be able to say. In Europe the highest praise you can give a project is to call it “state of the art.” Not science, but art!

In the process of building your career you will learn many things. In particular, there is often more than one good way to get things done. Managing conflicting opinions will be one of your major challenges. You will find that verbal and political skills are often as important as technical knowledge.

Perhaps best of all you will be able to make a good income in a responsible job.

Carl Turkstra

is a structural engineering educator and consultant. He is a licensed engineer in Ontario and Quebec. Carl holds a BSc (1958) from Queens University, MSc (1960) from the University of Illinois, and a PhD (1963) from the University of Waterloo, in addition to diplomas from Université de Montreal (1979), and McGill University (1980). His academic career started as a Lecturer at University College at London University (1963-1965), and came back to Canada as an Assistant Professor (1965-1971), Associate Professor (1978-1982), and Professor (1978-1982) at McGill University. He then moved on to become a Professor of Structural Engineering at Polytechnic Institute of New York in Brooklyn in 1982, in which he was also the head of the Department of Civil and Environmental Engineering 1982-1985. Among the leadership positions he held, Carl was the President of Montreal Structural Engineers, Chairman of the Canada Masonry Research Council, fellow of the Canadian Society of Civil Engineers and its Chairman in 1978-1979 (Montreal Section), and the American Society of Civil Engineers winning the State of the Art award in 1988. He currently lives in Dundas, Ontario.

Ekaterina Tzekova & Marianne Touchie

You have graduated at an interesting time where you will face many challenges!

Populations and city centres are growing at unprecedented rates, and our impacts on the environment, both local and global, are larger than ever. How do we sustain the continual development, which is often synonymous with success and prosperity, in a world with finite resources? How do we protect these precious resources for future generations?

We have been extremely fortunate to travel to several continents around the world. We have seen some amazing cultures and landscapes that take your breath away. This type of education is just as, if not more, important than the theories and formulas you have learned in your formal engineering education.

As engineers, it is our obligation to safeguard society to the best of our abilities; however, we believe this obligation also extends to the environment. Imagine a place that has truly impacted you... for us, they are the west-coast forest extending to the ocean in Vancouver and the vibrant underwater world of Australia's Great Barrier Reef. Now imagine those places gone or completely altered, such that you, your children and grandchildren can no longer enjoy them. Will we have done our job right if these places only exist in pictures and memories? With so many of us growing up in cities, we hope that you will take the time to develop strong connections to your environment, because understanding the importance of places like these is the first step to safeguarding them for future generations.

As you move through your career, you will be faced with an ever-increasing speed of communications and interactions. How do we keep from getting lost amongst the thousands of emails we receive? How do we navigate through this constant state of information overload and not forget the truly important things in life? We feel the key is reflection. Make sure you take the time, regularly, to reflect on what you have done and how you have done it. How have I impacted my fellow humans and our collective environment? Are there unintended consequences? How can I improve? How can I enlighten others? With this reflection you start to assess the impacts of all you do, beyond the "me" and "now," to consider future generations.

Although you are all young engineers, you must also have the courage to speak up for what you feel is right for our current and future world. Taking a leadership position is never easy, especially at a young age. However, we want you to take comfort in knowing that you are not alone. More experienced engineers are struggling with the same challenges as you are but, if we each do all we can within our own sphere of influence, together we can drive change.

The road ahead may seem daunting, but you have passion, desire and youth on your side. Now go out there and make a difference!

Ekaterina Tzekova, PhD

Ekaterina Tzekova is Low Carbon Buildings Manager at the Toronto Atmospheric Fund.

Marianne Touchie, PhD

Marianne Touchie is Assistant Professor jointly appointed in Civil & Mineral Engineering and Mechanical & Industrial Engineering at the University of Toronto.

Heinz Unger

An engineer friend once told me about basic principles of engineering, like “water doesn’t run uphill” or “you can’t push a rope,” but the most memorable—and most important one to me—was “a three-legged table won’t wobble”. This is a great example of a statically determinate system since all you need are three legs, and any more points of support could cause a wobble, the lesson being: keep systems simple and don’t overdesign, but make sure you have a solid base on which to build your work.

For this letter, however, I thought to use this concept to talk about the three basic principles on which good engineering practice should rest so that it won’t be wobbly, but stable and well supported. Engineers sometimes get caught up completely in the technical aspects of engineering, such as the beauty and elegance of design, the quest for innovation, the details of construction, or the economics and the cost-effectiveness of projects, but tend to overlook the importance of environmental, social and ethical principles that must be considered in engineers’ work. I’ll talk about each of these ‘legs’ of good engineering in turn to highlight their importance.

One real test of good engineering design is whether it avoids, or at least minimizes, impacts on the environment. In the past, engineers acquired a poor reputation for projects that ignored negative environmental impacts due to ignorance, arrogance, or a mistaken belief that such impacts were unavoidable and were a cost of doing business. The more recent legal requirements for environmental assessments (EAs) and resultant environmental management and

mitigation actions have helped to force engineers to consider how a particular project affects the environment. But too often such EAs are done perfunctorily and only after the design process has been completed, just to satisfy existing laws and regulations. Engineers must consider early on in the concept stages what the short- or long-term impacts of a project could be, and how they could be avoided by building environmental considerations right into the design process, such as green roofs on buildings, various energy-saving features, buildings and roads that enhance the natural beauty of a landscape, materials that can be recycled, and many other such ‘green’ features. Ideally, what we do as engineers should be good for the environment and should protect natural resources and beauty.

Engineers sometimes seem to forget that the real purpose and goal of any engineering works is for the use and benefit of people, whether directly or indirectly. Too often we’re caught up in the intricacies of design, cost issues, construction problems and the technical details of projects right from the start, rather than first and always thinking of the social and human dimensions of engineering works. We must communicate with all people concerned, potentially affected, and benefiting from our projects. And then we must ask questions, think deeply about human needs and weaknesses, listen carefully, and try to understand what people want and need and how we can best meet those expectations. To achieve such better understanding of our clients, we should study and know the local history and culture wherever we work as engineers—ignorance of local conditions may cause our technical work to be less beneficial, and it may not be used or maintained properly. Outreach to communities, starting at local schools, to explain what we do, how we do it, and why is an important part of the social aspect of engineering.


Ethical behaviour in our daily lives means no cheating, no lying, no stealing and similar rules about actions that we were taught as children are sinful, bad or just not acceptable in society.

Unfortunately, once we are working as professional engineers there may be pressures or temptations, often in corporate settings, to forget these simple tenets of ethical behaviour. This may be because somebody who would never think of stealing from a friend or neighbour, might think that taking something, like intellectual assets from a faceless company, is not really unethical because no person is directly affected. Engineers potentially face many situations where they may be induced to behave in an unethical manner, such as: bribery, for example, paying commissions, to get an assignment or a contract award; knowingly specifying substandard materials; submitting exaggerated statements on petroleum reservoir potential; hiding important information (especially with regard to public safety) to protect business interests; industrial espionage, not disclosing essential information on negative environmental and social impacts; and many other such actions that may seem to be in the interest of the company one is working for. Behaving ethically can come at a high price because an apparent lack of support for achieving business goals at all costs may mean the loss of a job, or least no more promotions. The engineering profession is one of the few established professions with an ethical code, and ethics is as important for engineers as the best math and science.

Respecting environmental, social and ethical principles may not always make our work as engineers easy, but it does enable us to build our work on as solid well supported foundation that will never wobble. Please work hard to be a “complete engineer.”

Heinz Unger, P.Eng.

Heinz Unger's degree took him from Europe first to Canada and then all over the world in the practice of engineering; now retired, he applies his experience in his work with local NGOs.



“...ethics is as important for engineers as the best math and science.”

- Heinz Unger

Rumina Velshi

I remember encountering my engineering heroine for the first time.

I met her in the words of a yellowed newspaper clipping – a story about an American woman from the 19th century who oversaw construction of one of the world’s great engineering achievements decades before women were even allowed to vote.

Emily Warren Roebling was not educated as an engineer. She was a student of history and astronomy. But when her husband, Washington, took to his sick bed for several years, she stepped in and – against all odds and in defiance of gender roles at the time – managed through to completion the building of one of the defining landmarks of her time: the Brooklyn Bridge.

Emily began as a secretary of sorts to her ailing husband – relaying instructions and guidance to the construction crews. Over time, she began ordering materials, negotiating contracts, and meeting with politicians on her own. In the words of one of her biographers, Emily eventually became the project’s “surrogate chief engineer,” spending her days at the bridge site as her husband watched through binoculars from their apartment.

It was later written of her contribution to the project: “I don’t think that the Brooklyn Bridge would be standing were it not for her.”

It took 14 years to build that marvel of steel wire and granite – the world’s first suspension bridge. I remember being utterly amazed by what Emily Roebling had accomplished. With that newspaper clipping in my hand, I felt as though the universe was sending me a message: I was going to be an engineer. It was as simple as that. It was meant to be.

At graduation, new Canadian engineers attend a closed ceremony known as the Ritual of the Calling of an Engineer. They are presented with an Iron Ring, which fits the little finger of one’s working hand. It can be a powerful moment.

The ring itself is simple, modest. But it serves as a symbol of the obligations and ethics of our profession. It is a constant reminder of our shared commitment to high standards of excellence.

I see it as something even more than that. I see it as a reminder of all that’s been accomplished in the world by engineers – and all that still can be achieved through hard work, diligent preparation and commitment to our craft.

Young engineer: You have chosen to enter what the Queen herself once described as a “noble profession.” You will have the opportunity to use your skills and education to improve the lives of people and communities. Make sure you make the most of this opportunity.

But engineering is about more than formal credentials and technical aptitude. These so-called “hard skills” are important, essential. But so too are what some describe as the “soft skills” – the ability to communicate and empathize, the willingness to work in harmony with others, the determination to inspire and encourage.

Again, Emily Roebling led the way. To oversee construction of what was then called the Eighth Wonder of the World, she needed to be fiercely intelligent. But Emily was also renowned for her strong character, her charm and her “superb diplomatic skills.” She negotiated with elected officials. She served as the liaison to the project’s board of trustees. She kept up morale among bridge workers who faced the risk of injury and death on a daily basis.

My advice to you? Put those “soft skills” to work.

Be willing to listen – really listen – and to change your mind.

Make sure people know that their voices have been heard. That’s how you earn the trust of others and demonstrate your ability to lead.

Be bold and fearless in your ambition. But make sure you take the time to communicate your vision. This is essential if you want others to buy in and join you on your journey.

Be steadfast in searching for ways to innovate and improve. Even after overseeing the Brooklyn Bridge, Emily kept improving herself as a person and as an intellect. She went on to study law in New York and argue for equality in marriage. We owe it to ourselves and our profession to never stop learning, never stop growing.

Be willing and able to adapt. The COVID-19 pandemic put a spotlight on the importance of being able and determined to find new ways to work and accomplish your goals. The world will always find a way to test you. Whether it's in response to a crisis or an opportunity, we demonstrate our resiliency when we show ourselves capable of swiftly adapting to changing circumstances, trends and innovations.

Emily Roebling lit a candle for female engineers. Each time we use that flame to ignite the candle of another woman in engineering, there is more light.

It is so important to remember that when we share our light, our own flame is not diminished. Instead, the room grows brighter. We need to share our light with even more women so true equality can be achieved and the room can shine its brightest.

The Brooklyn Bridge opened on May 24, 1883. Emily Roebling was the first person to cross it.

A century later, inspired by what Emily had achieved, I became one of the first female nuclear energy workers in Canada. In fact, I may have been the first Canadian woman to perform radioactive work.

To this day, I often find that I subconsciously place my hands so that I can see my Iron Ring. It reminds me of those who came before – the trailblazers and pioneers of our profession. And it brightens my spirits with thoughts of those who will follow, and what you and your contemporaries will achieve through this noble profession.

Rumina Velshi

President and CEO of the Canadian Nuclear Safety Commission.

Mary Wells

“We must let go of the life we have planned, so as to accept the one that is waiting for us” - Joseph Campbell, American Philosopher.

Dear Graduates,

Congratulations on completing a milestone in your lives. Do not underestimate the feat you have just achieved. Graduating with an engineering degree from a Canadian university requires hard work, resilience, perseverance, and optimism. Savour this moment and feel proud of what you have accomplished!

I think Joseph Campbell's quote is very relevant for this moment in time. Life does not always work out the way we want, but my advice is to stay flexible and be open to new opportunities as they present themselves. Attending university is a life altering experience which provides an opportunity to learn more about ourselves and the world around us.

The next part of your journey may not feel as certain. There are no more lectures to attend or labs and exams to write. While your engineering journey at university was challenging, it provided you with a sense of structure and accomplishment, as each term was completed you progressed towards your degree.

You are now entering an open ended and unbound part of your future. You will now establish yourself as a graduate and decide where to apply your engineering skills and mindset, considering what you hope to accomplish. This may seem both daunting and exhilarating and I encourage you to embrace the upside of

uncertainty and reflect on your hopes and dreams, ones for yourself and our world.

In reflecting on my own professional journey, I would like to offer a few words about two polar opposites: planning and serendipity. Together, they have directed the arc of my own career, one that has been both joyful and personally fulfilling. I share this with you in the hope that it might inspire you to make the same discovery as you embark on your own careers.

While today is about future expectations and excitement fulfilled, reflect back over your time at university and how many times the unexpected and the unexplained changed your life's course. Perhaps you landed a dream job, which took you by surprise. Perhaps you met your true love through an unexpected encounter. Perhaps you had a life-altering travel experience. Serendipity is the gift of making fortunate discoveries by accident. Today fifty percent of modern inventions were the result of someone stumbling on a novel solution by accident. Penicillin, the computer, microwave oven and even Velcro were all discovered by accident.

So how do we cultivate serendipity?

Take risks, be open to unexpected opportunities, pursue novelty, and put yourselves out there even if it feels a bit scary.

Next, go with your gut and trust your intuition.

When I was choosing my first job after completing my undergraduate engineering degree, I was very methodical and made lists of pros and cons for each opportunity before deciding what I would do. Although it led to a good first job, I was also bored within three years and anxious to try something new.

When I decided to pursue a PhD, I took the opposite approach. I tried a new subject that I had no experience in – I took a risk! I moved across the country to Vancouver, BC to attend UBC and encounter a new group of people and new ways of thinking.

I loved doing my PhD and it led me to a career in academia which I still love today.

So trust your gut and don't always allow logic to blind your decisions! This is sometimes difficult for engineers and I still struggle with it myself!

Finally, dream. Dream big. Knowing what you want from life will allow you to recognize opportunities when they present themselves serendipitously. If you combine this with a deep commitment to achieving excellence in your craft, through study and hours of practice, you will achieve a sense of satisfaction, fulfillment and happiness in both your career and your life.

Consider the sense of satisfaction earned by working hard to find the best solution to a problem, one that considers all the stakeholders and is driven by ensuring a positive and sustainable impact is made on the world. That, to me, is the joy in being an engineer.

When the opportunity to become a Dean became available, my colleagues suggested I apply as they knew I was passionate about students and their experience at university. I felt intimidated as I had never been a department chair but I decided to apply. I took a risk and pushed myself beyond my comfort zone. Three years in, I cannot describe how much meaning and joy I derive from being a Dean. The chance to guide and mentor the faculty, students and staff towards a common objective and provide an environment where they will thrive is something I find energizing.

In reflection, many of the important moments in my life were and continue to be shaped by serendipity - chance encounters with the right people and ideas.

There is no denying that this engineering journey will at times be challenging and ask much of you, but I can assure you that if you persevere you will receive much more in return.

Now more than ever our world needs passionate, engaged and compassionate people who can think beyond themselves to have the courage and the fortitude to address some of the most important problems our world faces.

Take care of our world and the people in it. Generously share your gifts - your intellect, empathy and kindness with those around you. I now pass the baton to you as you move into your own engineering careers and use your own talents and energy to make a positive difference in our world.

Mary Wells, PhD, P.Eng.

Mary Wells is Dean of the Faculty of Engineering at the University of Waterloo. She was previously Dean of the College of Engineering and Physical Sciences at the University of Guelph (2017 to 2020). Prior to her tenure at Guelph, Dr. Wells was a Professor of mechanical and mechatronics engineering at Waterloo for 10 years.

Joerg Wittenbrinck

Congratulations on a big accomplishment.

You have positioned yourself for personal success and for making an important contribution to our shared public good. The world needs your expertise and your drive to develop solutions.

There has never been a shortage of problems that require an engineer. Today, it is becoming increasingly clear that climate change will be one, if not the defining issue of our lifetime. We need engineers to supply important technical solutions. But engineers on their own won't be able to 'fix' the problem.

Think in systems. Problems are almost never 'just' technical in nature. In fact, the bigger the problem, the more complex and intertwined the issues. To address them effectively, social, economic, and political forces need to align with technical solutions. We have a decent sense of the kinds of technical options available to slow climate change (and we are counting on engineers to continue to turn rapid scientific developments into better and better technology). But the implementation of those options requires cost-effective development in a way that is acceptable, even desirable to people and communities. In addition, preparing for a changing climate and adapting to its impacts requires us to think about layers of resilience, not just technical. In some areas, designing to higher standards, to make systems fail-safe, will suffice. In others we must think more holistically about what it means to have physical infrastructure that is safe-to-fail, with resilient communities ready to respond.

Be part of a team. To make a difference in tackling the big problems, you must collaborate and communicate. You may already have discovered that your chosen discipline comes with a distinct vocabulary and way of approaching problems. It's the kind of

specialized language and mindset that all professions develop. But not everyone understands it. If you can explain your ideas to those who don't speak your 'language' and if you are able to connect your ideas to the social, economic, and political imperatives that others are concerned about, then your ideas can gather a lot of support. Listen and understand where others are coming from. Reflect on your own perspective. Then collaborate and contribute with all that in mind.

Learn and anticipate. Working interdisciplinary isn't just necessary to achieve outcomes, it is also an enriching experience. You will continue learning, but not in the way you have until now. Consider the new and ancient knowledge, familiar and not. And if you want to know what major developments are coming next and what solutions we'll need in the future, then you'll have to understand and embrace societal needs and broader dynamics. It will be an exciting journey. But don't worry, you won't need another degree for that, at least for now.

Trust in the skills you have learned and earned. Appreciate others for what they can teach you.

I urge you to read and understand Engineers Canada's national guideline Principles of Climate Change Adaptation and Mitigation for Engineers (2018), which articulates a professional expectation to review new evidence (here: climate change), to integrate it into practice and to communicate the associated risks.

Joerg Wittenbrinck

Joerg Wittenbrinck is Senior Policy Advisor, Strategic Policy and Research, at the Ontario Ministry of Energy, Northern Development and Mines. He works on climate resilience and emerging energy trends.



Image courtesy of the Major Matthews Collection, City of Vancouver Archives.

Afterword

By Daniel Hoornweg

As the quitting-time horn sounded on the afternoon of August 29, 1907, the Quebec Bridge—nearing completion after four years of construction—collapsed. Earlier that same day, local engineer Norman McLure, after writing letters outlining his concerns of key structural members, had finally travelled to New York to meet with supervising engineer Theodore Cooper. The Phoenix Bridge Company had disputed McLure’s earlier concerns, claiming the beams must have been bent before installation. McLure convinced Cooper of the seriousness of the situation, and Cooper immediately telegraphed Quebec: “Add no more load to bridge till after due consideration of facts”. But it was too late; 75 workers lost their lives.

The collapse of the Quebec Bridge was catalytic in giving rise to professional engineering in Canada. A few years after the collapse, Professor Haultain of the University of Toronto contacted Rudyard Kipling, asking him to prepare a ceremony for newly graduate engineers commensurate with the need to temper engineering influence and hubris with ethics and obligation. Kipling enthusiastically responded with *The Ritual of the Calling of an Engineer*, and the inaugural Iron Ring Ceremony was held April 25, 1925, at the University Club of Montreal. The first permanent local chapter, or camp, started a week later at the University of Toronto on May 1, 1925.

Kipling received the Nobel Prize in Literature in 1907, the same year the bridge collapsed. Kipling, born in India in 1865, is to date the youngest person ever to win the Nobel Prize in Literature. In 1907 the world's cities were home to just 250 million people (about 15 per cent of the world's population at the time) and the world's overall combined wealth was less than \$2.5 trillion. Today, more than four billion people live in cities and our total wealth, almost all of which resides in and is created through our cities, is about \$350 trillion.

Kipling often commented on India's teeming streets and 'chock a block' crowds. He was in India when the population was about 270 million people and the country's biggest city Mumbai (then Bombay) had 750,000 people. What would he say today upon learning that India will soon overtake China as the world's largest country. Mumbai, the city of his birth, is on track to be the world's largest city in 2050 with some 42 million people.

If Kipling were alive today he would be horrified. How much damage and wealth we've created and how Herculean a task we have to build our cities and societies in a way that protects the planet and provides a dignified life for all.

Engineers graduating today will see urban populations—and probably wealth—double during their careers. More than seven billion people will live in cities when you retire (about 28 times more than in 1907) and, in today's dollar, global wealth should be more than \$450 trillion (about 200 times more than in 1907).

Our city-building and accompanying wealth often comes at great cost. As global wealth doubles over your career, about 12 per cent more of the world's total biodiversity will be lost. Atmospheric carbon dioxide emissions will likely rise from today's 415 ppm to more than 500 ppm (compared with about 298 ppm in 1907). The climate will be markedly affected; sea levels will be higher, and political strife and the number of environmental refugees will increase.

Global demography is changing; populations of some countries have already started to wane. Power is shifting, like tectonic plates. Change is afoot: Never has the need for savvy, humble and effective engineers been greater.

Engineers are critical in developing the innovations and technologies that grow our economies while at the same time engineers use this new wealth to improve our quality of life, better protect our environment, and assist the poor and underprivileged. Complexities and uncertainties abound. Our economies are not sustainable, yet if we decided to, we could eliminate extreme poverty over your career. Your education has prepared you for much, but the calls on your intellect and conscience will be severe.

The Titanic; the Quebec Bridge; the Ocean Ranger; the Bhopal Disaster; Hurricane Katrina and New Orleans; the Deep Water Horizon Oil Spill; the Fukushima Nuclear Plant; the manipulation of personal data: Bad things happen. And probably—in light of increased climate variability and greater demands on infrastructure systems—more bad things are likely to happen. You will be called on to “meet with triumph and disaster and treat those two imposters just the same”.

Much has changed in the more than 110 years since the Quebec Bridge collapse, yet much stubbornly persists. Obfuscation and denial, saving face and personal insecurities, the understandable need to focus on timetables and costs, poor communication, these all led to the bridge's collapse and are very much still evident today.

Technology, and the innovation that drives engineering, progresses exponentially. Yet our social norms, the hardwiring of our brains and our behaviour, change only linearly. Engineers, along with other professionals, urgently need to develop better ways of working together and integrate solutions across societies.

We need a robust emphasis on professionalism. George Washington, Thomas Jefferson and Abraham Lincoln, all great leaders, were professional land surveyors before entering politics. They often held to their professional roots when buffeted and battered by circumstance. We need more professionals and professionalism in politics, and we need better accommodation of political imperatives in our professional practices. We need to urge that partisanship and partial truths of politics be tempered with leadership and an appreciation that complex problems warrant robust, respectful ongoing discussions. We do not have all the answers—but we know that no one does.

We need to acknowledge risk—even more, we need to embrace risk. Risk means we are trying to make things better. But we need to do a much better job of communicating risks or more specifically, the choices and their comparative risks. What makes us uniquely human is our ability to discern, through trends and data, the probability of future events. Almost always, with good information, people make the best choices for themselves and their families. We need to have faith in the public and err on the side of giving them more information, rather than less.

We need to be honest about much of the technology we represent. GMOs, energy systems, nuclear energy and medicine, data-mining, complex chemical reactions, geo-engineering, nanotechnology, artificial intelligence; there will always be much we do not know. But frontier technologies will not be stopped, so we need to apply new risk assessments. How we address, communicate and mitigate risk needs to evolve at a pace commensurate with our technological advancements.

We need to improve our communication capabilities. As engineers we bristle when we are told how to design a bridge by a dentist, or a wastewater treatment plant by a highschool teacher, yet we often have no qualms thinking our own skills are completely transferable to other sectors. Today's challenges are complex—we must address them through respectful dialogue with our colleagues on teams with a diversity of backgrounds and capabilities.

The relative silence of engineers in the climate change debate, as well as in loss of biodiversity, soil degradation, and poverty discussions, is lamentable. No one is in a better position to argue the facts, and yet we sit by as half-truths, biases, and political considerations dominate.

Stereotypes are powerful. If a bright highschool student asks “how can I best help the world?” we need to help make sure the answer is more obvious. There is no better job than applying science, policies, and even dreams to make a better world.

Today's civilization is being defined by our cities. The strength of our cities comes from their ability to bring together people and ideas. Sustainable development will be won or lost in our cities, and it will be engineers who most determine the outcome.

We have a professional and moral obligation to provide, as best we can, a factor of safety on what we see and what we are called to build. Unlike doctors, engineers are not able to apply the "do no harm" credo. We knowingly cause great harm—but we do so within a safety margin, confident that the benefit we provide outweighs the harm. We need to be vigilant to consider the benefits and harm to all, before we move forward—not just to our clients and fellow citizens, and arguably not just to our own species. An engineer's most important task is protection of public well-being.

Over the life of their careers, many engineers do not solely practice what is typically thought of as engineering work. Many go on to business, corporate leadership and management, and a few go on to politics, teaching, full-time parenting, and a host of other callings.

In all these endeavours there is still a need to balance hubris and influence with ethics and obligation. You are being called to an important honour and responsibility. We look forward to working with you.

In the 20th century, Canada's engineers built much of Canada. We knit the country together with roads, rails and seaways, telephones and satellites. We worked in the north, in space, and in the oceans and lakes. We built great buildings, designed polymers, electricity systems, trains, planes, cars, snowmobiles, highways, water treatment plants, landfills, and a long list of attributes that underpin our current quality of life. Canada's engineers are now being called to a new task: continue to build and manage Canada's infrastructure; but also, take more of these skills to a world desperately in need.

Measure success by taking what came before, strengthening it, building it, and then passing on the gift to those who come after you. Best wishes.


A Promise to Future Generations

Back in the 1970's, the mariner and pioneering marine conservationist, Jacque-Yves Cousteau was deeply troubled by the degradation of marine life that he had observed in his lifetime. This led to the rhetorical question, "Why should we preserve a livable planet if not for our children and grandchildren?" Today, the question resonates even more deeply and more urgently as we awaken to the realities of climate change. Cousteau knew that we needed to change our ways. To protect the rights of people in the future, he proposed a Bill of Rights for Future Generations. Through the auspices of the Cousteau Society, he sought a United Nations declaration of these rights back in 1992. Unfortunately, the work of his society was not accepted.

Since the time of Cousteau, the effects of climate change are accelerating. Our use of inexpensive carbon-based energy threatens our biosphere and ultimately, our industrialized economies. Climate change and our energy use not only threaten our ability, but the ability of future generations to meet their needs. Solving these global challenges means that we need to work together to make more sustainable decisions.

In an attempt to foster more responsible decision-making among graduating engineers, a group of students and staff in the Faculty of Applied Science and Engineering at the University of Toronto adapted Cousteau's "Bill of Rights" and created "A Promise to Future Generations". A copy of this document is presented here. Committing to the "Promise" is purely voluntary—a choice made by anyone who believes in declaring and respecting the rights of people in the future. Can you imagine a world where all people were honour-bound to respect the rights of future generations?

K.D. Pressnail



“Why should we
preserve a livable
planet if not for
our children and
grandchildren?”

- Jacques-Yves Cousteau

A Promise to Future Generations

Inspired by and Adapted from:

“THE COUSTEAU SOCIETY / EQUIPE COUSTEAU”

I, _____, believe that all generations should have the opportunity to enjoy the bountiful world that I have come to know.

I believe that all life is precious and inseparable from the environment, and that the well-being of humanity is dependent on the condition of this Earth.

I believe in the worth and dignity of all people, present now and in the future.

I believe that the consequences of humanity’s decisions can threaten the ability of future generations to meet their needs, to fulfill their dreams, and to determine their destinies.

As an engineer and as a citizen of the world, I know there are better paths.

My journey, a product of my choices, shall not be bound by the practices of the past. Guided by the best foresight that our wisdom can provide, together we shall find responsible solutions that will make future generations proud.

If I can do something to change this world, let me begin now.

Today, I declare this promise. Tomorrow, we shall face these challenges together.

To this end, and in addition to complying with the ethical standards established by my profession, I promise to uphold to the best of my abilities the principles outlined in the five Articles herein.

Article I

Each generation has the right to inherit a healthy Earth where they can develop their culture and social bonds as a member of one intergenerational family, and each generation has a corresponding responsibility to accord a similar right to future generations.

Article II

All generations, sharing in the estate and heritage of the Earth, have a duty as trustees for future generations to use resources responsibly and with forethought, to honour life on Earth, and to foster human freedom.

Article III

In fulfilling the duty owed to future generations, it is the paramount responsibility of each generation to be prudent and constantly vigilant to ensure that biodiversity and the balance of nature are respected.

Article IV

All appropriate measures shall be taken to ensure that the rights of future generations are protected and not sacrificed for the expedience and convenience of the present generation.

Article V

The rights of future generations have a claim on the conscience of all peoples. To develop a culture that promotes respect for individuals, society, and the environment, every person is challenged to imaginatively implement these principles as if in the very presence of those future generations whose rights we seek to perpetuate.

This promise was signed and sealed this ___ day of _____, _____, in the presence of _____;

