

Letters to a Young Engineer

2015



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2015

Second edition, 2015.

First published 2014 by the University of Ontario Institute of Technology, 2000 Simcoe Street North, Oshawa, Ontario L1H 7K4 Canada.

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This publication was designed and published by the Communications and Marketing Department of the University of Ontario Institute of Technology (UOIT), Oshawa, Ontario, Canada.

Book design by Derek Webster, UOIT Communications and Marketing.

Special thanks to Amy Neil, Manager, Projects and Event Services - Communications & Marketing; Jen Clarke, Production Strategist, Communications and Marketing; and Michelle Cholak, Administrative Assistant, Jeffrey S. Boyce Research Chair, for editorial support.

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# Hymn Of Breaking Strain

*By Rudyard Kipling, 1935*

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!*



# Forward

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 increasingly to learn, to lead, and to live with integrity and aptitude.

Some of us write to a daughter or son, some write to our students, some to our future employees or customers; but all of us write to you, the graduate. You are the future. In you we trust our profession, and as you will see in the next few years, much of the planet’s

future is now entrusted to you.

Engineers tend to shy away from hyperbole and sensationalism. We take comfort in the facts of science, of realities, and of perceived certainties, and we apply this knowledge. We design the future but only to the extent that the laws of science permit. We are bound by rules, and hopefully, by professional ideals and disciplines. But make no mistake, this is not your grandfather's world, or even your father's and mother's. The rules are changing. Like the world you now enter, your careers will be more turbulent, faster paced, and probably more impactful than ours.

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. Much is magnified; you will be called upon with greater urgency.

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; and more than two billion able adults are under- or un-employed. Here in Canada we are fortunate to have amassed institutions and wealth, and we are the envy of many. However, our privilege is certainly not guaranteed. There are cracks in the foundation.

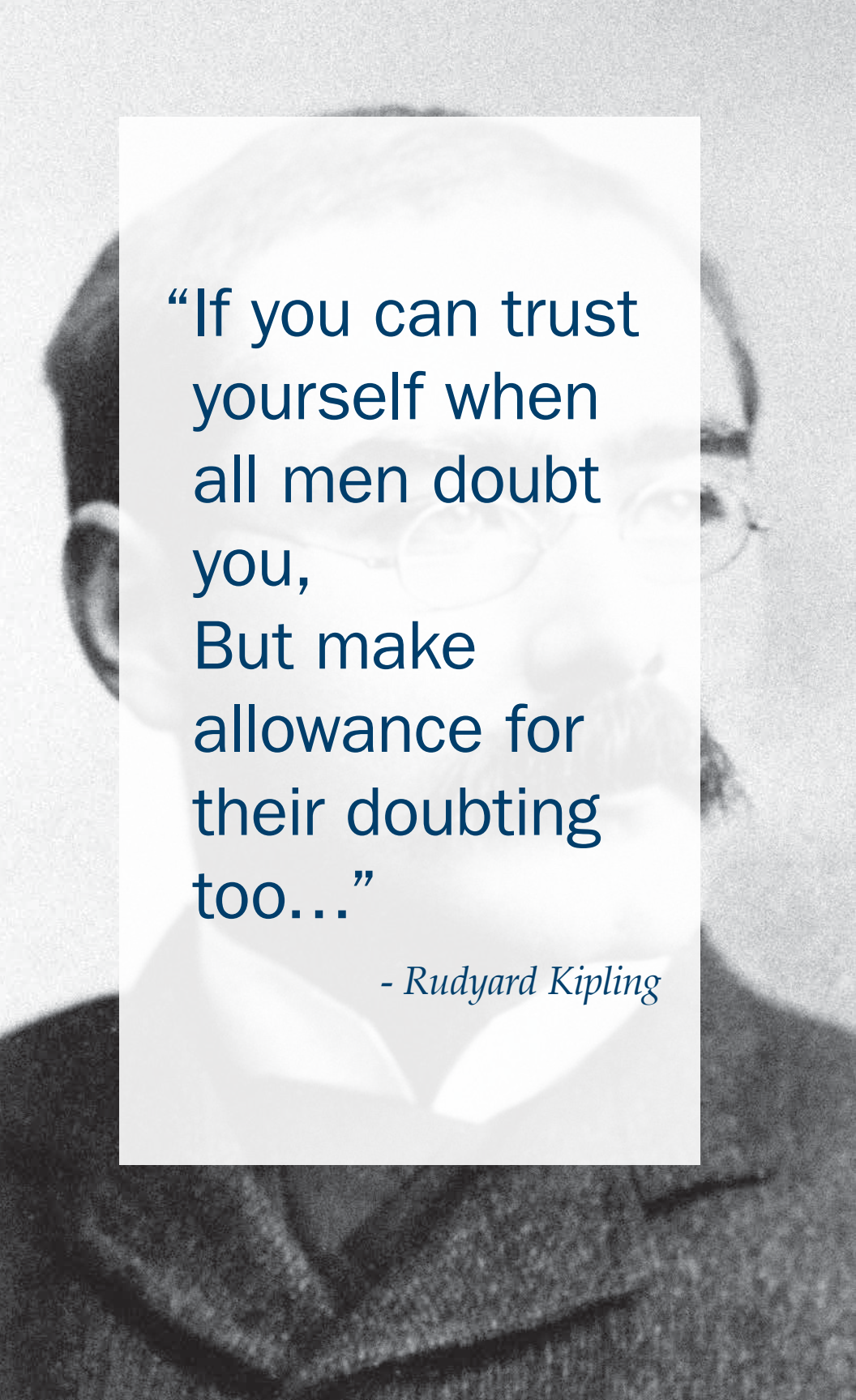
Many of us are worried, our consciences shadowed with doubts: did we try hard enough, were we brave enough in protecting the vulnerable, did we include all the known considerations in our calculations, and what remains unknown? We know we will be judged by you – as it should be. We will be found wanting.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

We are confident that 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 planetary ecosystems. A professional engineer must engender trust. This trust is earned through honest humility and openness to all. 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 around the world, 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 evidence-based policies and clearly and openly-measured progress.

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 are a few letters written with heartfelt hope and a smattering of suggestions for your upcoming careers. Please accept them in the spirit they are given; enjoy the journey.



“If you can trust  
yourself when  
all men doubt  
you,  
But make  
allowance for  
their doubting  
too...”

*- Rudyard Kipling*

# If

*By Rudyard Kipling, 1935*

If you can keep your head when all about you  
Are losing theirs and blaming it on you;  
If you can trust yourself when all men doubt you,  
But make allowance for their doubting too:  
If you can wait and not be tired by waiting,  
Or, being lied about, don't deal in lies,  
Or being hated don't give way to hating,  
And yet don't look too good, nor talk too wise;

If you can dream — and not make dreams your master;  
If you can think — and not make thoughts your aim,  
If you can meet with Triumph and Disaster  
And treat those two impostors just the same:  
If you can bear to hear the truth you've spoken  
Twisted by knaves to make a trap for fools,  
Or watch the things you gave your life to, broken,  
And stoop and build'em up with worn-out tools;

If you can make one heap of all your winnings  
And risk it on one turn of pitch-and-toss,  
And lose, and start again at your beginnings,  
And never breathe a word about your loss:  
If you can force your heart and nerve and sinew  
To serve your turn long after they are gone,  
And so hold on when there is nothing in you  
Except the Will which says to them: "Hold on!"

If you can talk with crowds and keep your virtue,  
Or walk with Kings — nor lose the common touch,  
If neither foes nor loving friends can hurt you,  
If all men count with you, but none too much:  
If you can fill the unforgiving minute  
With sixty seconds' worth of distance run,  
Yours is the Earth and everything that's in it,  
And which is more; you'll be a Man, my son!

# 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 crea-

tivity 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.*

# Daniel Hoornweg

**Congratulations.** You have done well and your mother and I are very proud; you are truly a daughter of delight.

Writing to you as an engineering colleague is difficult. You are so much more than just an engineer. You are the little girl who caught frogs and kept pet lizards. You read voraciously and loved art. You could just as easily have been a painter; you are talented and fortunate that both sides of your brain work well. Although perhaps as an artist, your student loans would be outstanding a little longer.

Painters and poets distill our lives and our surroundings while engineers re-design and re-build them. True, our engineering work is not always for the better, but we are professionally bound to try our best, and on balance we are building a better world.

Youth is such a powerful force. You now get to ask the questions as well as answer them. Your energy is your future and passion. You possess the skills to make people's lives better – what an amazing honour and responsibility.

I do not know the best alchemy to mix your passion for life with your new profession. How best do you continue to catch those frogs, as well as now protect them and maybe one day teach your own children about the magic and joy of those same frogs? How are you the same girl who kept lizards, and now you research how we might mimic their capacity to regenerate limbs for humans?

Although we admonish you to not be afraid, truth be told, I am fearful. I am an optimist and I know humans can respond with staggering compassion and power when called upon. However, I think the storm clouds amassing over the horizon could overwhelm our capacities. During your career, the world's cities will double in size,



along with the need for energy and water, food and meaningful work, and the strains in health care; our ability to ensure sufficient quality of life could be surpassed. And you will be called on as a first responder.

I also worry about you as my daughter. My more selfish thinking is of you as an individual with family, maybe our grandchildren. What sort of world is left to you? You are Canadian, well educated, well gifted; you are more fortunate than most. We may have helped to provide some of that, but in the last few years you did it on your own.

As a woman in full, what does your profession hold for you? Although there are soothing words and growing numbers, women are still not treated with the respect they deserve, by society in general, and by the engineering and business profession in particular. You will need to help change that.

I worry about many things:

- That professional engineering associations can care more about preserving privilege than protecting the planet and our profession;
- That industry has the most money and fights desperately to maintain the status quo;
- That our political system often encourages bland, mostly short-term compromises;
- That financial systems are driven more by greed than by service;
- About growing inequality, about more Occupy movements, and about growing discontent and not enough jobs;
- That we are not sufficiently vigilant and mindful of the evil that led to the Montreal massacre;
- That sexism, and many other ‘-isms’ still linger too strongly; and
- About climate change and biodiversity loss. Your frogs are threatened.

I offer only one suggestion to counter your own worries that may grow within you. Find solace where you may, nurture solace, and

share solace. There is great peace in this world. And joy and beauty, love, and hope can always win over the ill intent and vagaries of spoil and frailty.

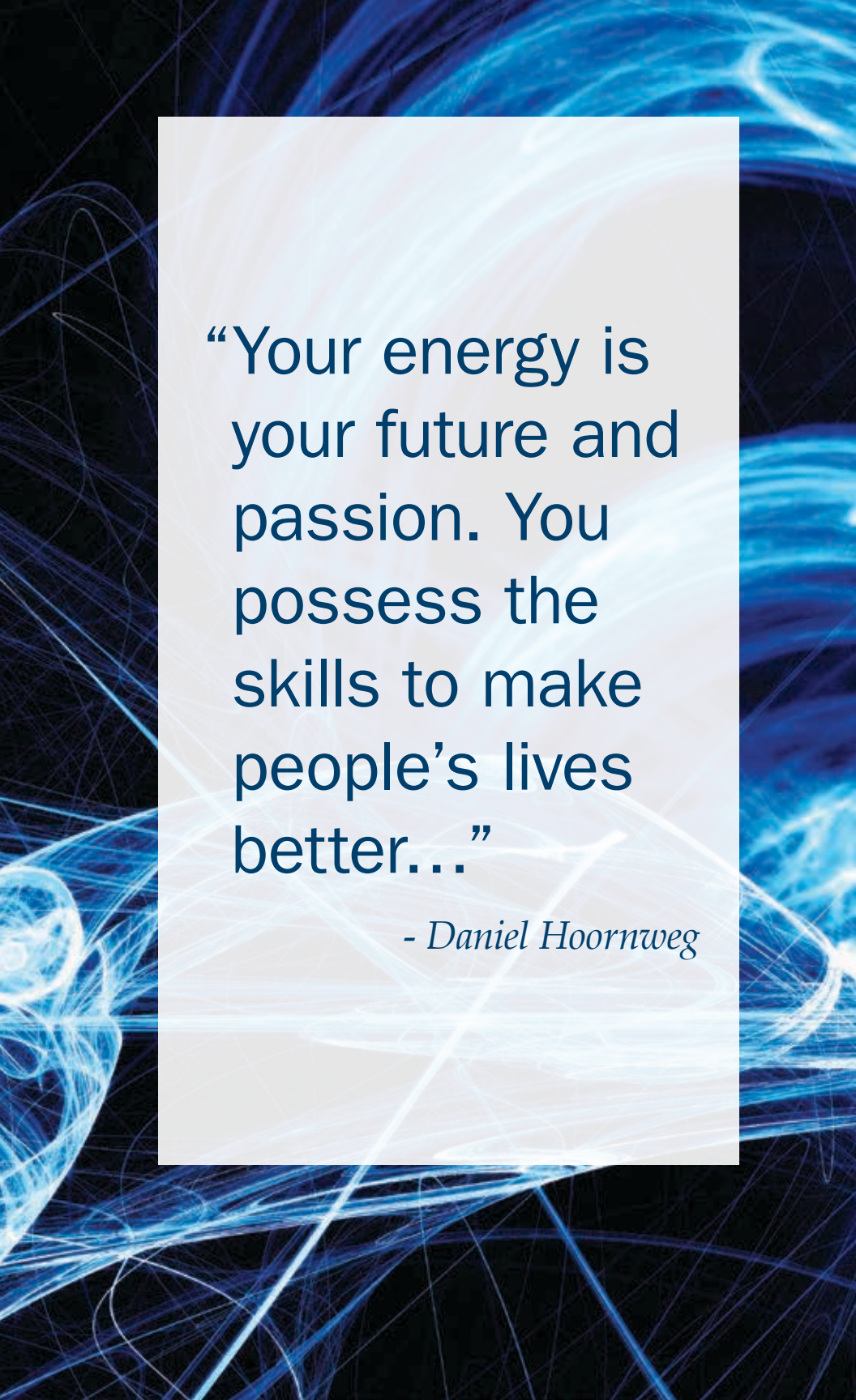
For me there is comfort knowing that wilderness still exists, places where nature reigns. The Canadian Shield, that land of permanence with its weathered rock outcrops, windblown trees and remnant lakes, gives me solace. For others it may be the mountains or savannahs, wind swept beaches, or perhaps the rainforests. For some it may be better knowing their God, or having a strong yet gentle partner, friendships, art and music, sharing bedtime stories with a child, long walks and ambling conversations, grand fiestas, sporting matches, or maybe pushing themselves when biking, hiking, scuba diving, bungee jumping, or parachuting. Your mother gives me great solace as do you and your sister. Solace is an antidote to fear.

Two roads wait for you in the yellow wood – they diverge but you will choose what seems best for you and be well on your way. Do not worry too much about the choice; unlike large-scale infrastructure, your life is not locked in. Throughout your journey, every day, every hour, almost every decision gives you the chance to choose again and again tiny changes in direction – continuous course correction. A life well lived, a career well delivered, is the compilation of a multitude of thoughts and acts.

Travel well and fear not, the woods and all your paths hold great promise.

### **Daniel Hoornweg, PhD, P.Eng.**

*Daniel Hoornweg graduated from the University of Waterloo (Geotech, '85) and travelled extensively during his career in sustainable development. He is Associate Professor and Jeffrey Boyce Research Chair at UOIT. His daughter is a biomedical engineering student.*

The background of the image is a dark, almost black, space filled with intricate, glowing patterns of light. These patterns consist of numerous thin, overlapping lines and curves in various shades of blue and white, creating a sense of dynamic energy and movement. The lines appear to be light trails or perhaps a complex network of connections, similar to a neural network or a data visualization. The overall effect is one of a vibrant, futuristic, and somewhat ethereal atmosphere.

“Your energy is  
your future and  
passion. You  
possess the  
skills to make  
people’s lives  
better...”

*- Daniel Hoornweg*

# Kathy Milsom

**Congratulations!** You worked hard, hopefully enjoyed yourself, and you are now an engineer. Savour your accomplishment for a moment. 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 is an exciting prospect but also a great responsibility. It is 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. 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 make sure you never make the same mistake twice. Know that regardless of how smart you may 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, understand that your most valuable resource is your team, and you will be successful if you are able to create a work environment that is conducive to high morale and performance. 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 work day 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 and 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 a member of the Board of Directors of the Greater Toronto Airports Authority, the Chair of the Standards Council of Canada, Chair of the Advisory Board for Direct Construction Company Limited, and a senior fellow of the Canada School of Public Service for their Crown corporation director orientation program. She graduated from Civil Engineering from the University of Toronto, and was awarded the 2004 Engineering Medal for Management from the Professional Engineers Ontario, and is the recipient of the University of Toronto's 2008 Meritorious Service Medal Award for Mid-Career Achievement.*

# Bob Breeze

**Congratulations on your graduation!** You have certainly earned the degree and I have every confidence you will soon earn the P. Eng. designation.

You have good reason to be proud of your accomplishments: four years of intensive study of some of the most difficult material that higher learning has to offer. While students in other faculties seemed to have time on their hands, you knew you could call a classmate at 1:00 a.m. to ask a question about an assignment... and you knew they would be up and thinking through the same material.

Now take time to reflect on your accomplishments, the courses you have taken, your professors, and the friends you have made. Take time to think about your personal and professional goals. Reflect as well on what it means to be an engineer in this ever-changing world and, more importantly, what it means to be a fully contributing member of society. How will you take your place in your community, this country and the world? Take this time to reflect. There are tough personal and career decisions ahead that will challenge the very idea of who you are.

Engineering teaches that you can think your way through any problem when it is broken down into manageable parts. But today's broader societal problems can't be broken down in the same manner. Our problems are intractable. They are multi-dimensional. Sound decisions require us to consider the ethical, social, cultural, environmental and economic sides of any issue. They didn't teach us that in engineering school.

I can't help you make the tough decisions ahead. Frankly, I'm not

sure what tomorrow or these decisions will look like. But here are some things that you can do to prepare yourself for the future.

## Read Broadly

Engineering students don't receive a broad education. The curriculum focuses on the narrow confines of our profession. Many argue that it must focus given the amount of material engineering students have to master. I won't argue either point, but you need to catch up and develop a broader understanding of the world around you.

Read literature, history, economics, philosophy, biographies and poetry. Build an appreciation of the arts. Go to the symphony as well as the jazz festival. Listen to TED lectures and download podcasts for those long flights or commutes to work and back.

There are many points of view. And many solutions to any problem. The key to taking a broader role in your community is to understand these points of view, develop sound judgement and use it to guide you in the future.

## Follow Current Affairs

We aren't just tax payers. We are citizens first. To be good citizens, we must follow what is happening around us and seek to understand root causes. Take an interest in what's happening in your community, Canada and world affairs.

What is the "Arab Spring" all about?? How will it affect us? What should we do about it? Can we do anything about it?

And at home, what caused the Lac Mégantic disaster and the Walkerton drinking water tragedy? Were these caused by lazy or drunk workers? Or by greedy companies? Or by the current focus of our society on profits? It's up to you to decide and to use this understanding to guide your professional and personal decision making.

## Get Involved Politically

Politics isn't a dirty word! Politics is how societies consider issues

and make decisions. Being a politician is a noble profession. Yes, too many politicians have been found lining their own pockets at our expense. And political parties have become far too introspective. They cater to the needs of the party base and not the good of the province and country. You can help change that! Politics must focus on the broader public good and not just the good of the few.

It doesn't matter what political party you choose to support. Just make sure that the vision and, more importantly, the actions of your chosen political party align with your personal views.

## Volunteer

Mahatma Gandhi said, "The best way to find yourself is to lose yourself in the service of others." Remember the two years your mother and I spent in the African bush teaching science and languages. It was a tough assignment, but in the end we gained far more than our students. It taught us self-reliance and judgement, and it gave us an appreciation how difficult life is in many developing countries. It was a personal growth experience and... we found ourselves!

Your mother and I have done well personally, financially and in our careers. You could argue that it was because of hard work and good judgement. Yes, but there was a lot of luck involved too. We were born and grew up at the right time and place. Reach out to those who are less fortunate and in need of help. Volunteer in your community. Give back!

## Be Ready for Opportunities

You need to have career and personal goals and sound plans to achieve them. After your time of reflection, you need to decide what you want to do with your life and your career. But you still need to maintain a good measure of flexibility and be ready to seize opportunities that present themselves.

This will often mean a move out of your comfort zone. But that's a good thing. The psychological high after you've accepted a challenge



and achieved what you set out to do is amazing!

Just don't be complacent. Keep moving forward. Challenge yourself.

## Learn to Communicate Effectively

Engineers are poor communicators! We think once we have worked through the calculations, the solution should be obvious to everyone. But it is not obvious to everyone.

The best ideas are often lost because they weren't well communicated or the timing was wrong. Senior decision makers have limited time and are being pressed from all sides. Make it easy for them to see the benefits from their perspective.

Join Toastmasters, or take a course in public speaking and making presentations. And before the big day, practice, practice and practice!

## Speak Truth to Power

Let's stop building subways to city wards when there is no business case. Spending hundreds of millions of dollars to extend a subway to solidify votes for the next election is dishonest! Let's push for evidence-based decision making.

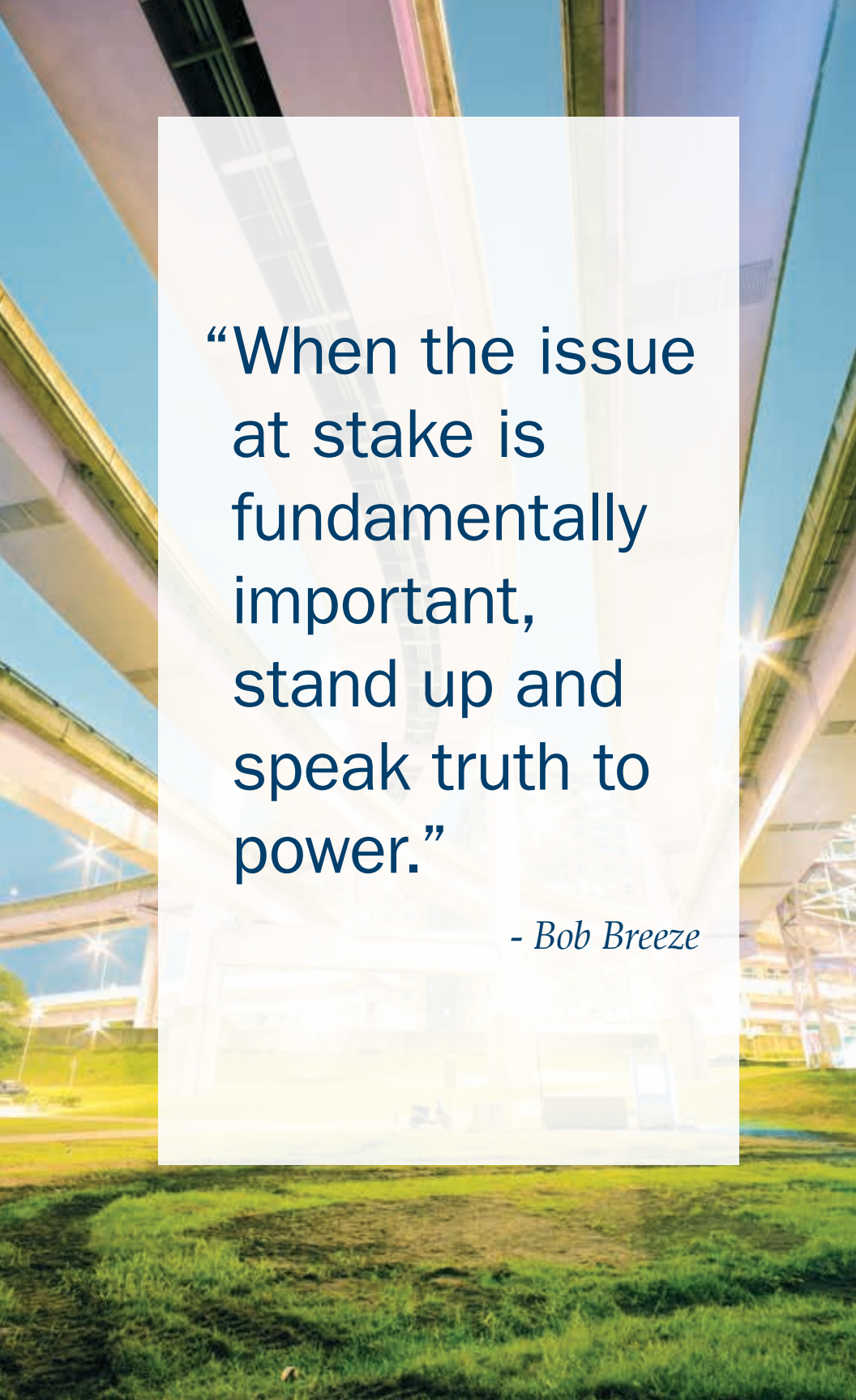
It's easy to follow the path of least resistance, and we all need to do that at times. You can't keep hitting your head against the wall. But when the issue at stake is fundamentally important, stand up and speak truth to power. Engineers need to let their voices be heard on issues of public importance.

In conclusion, engineers can continue to be small, bit players in community, provincial and national decision making by providing technical solutions to narrowly defined problems. Or they can get involved in helping define the problem, thinking through the broader social, cultural, environmental and ethical implications, considering the broader options, and communicating to the broader society. They can make sure that engineering thinking is part of problem definition, analysis and solution.

I have a tee off time this afternoon. Here's the torch! Let me know how it goes.

### **Robert (Bob) Breeze, P.Eng.**

*Bob Breeze graduated in 1975 with a degree in Chemical Engineering (Honours) from Lakehead University, Thunder Bay, Ontario. Over his career, he has worked in the petrochemical industry, with government, with NGOs and, most recently, with multilateral and bilateral aid agencies. He is currently working as a consultant to the World Bank with a focus on hazardous and solid waste management in Southeast Asia and East Africa. Bob wrote the letter for his son, Glen, who graduated as a mechanical engineer in 2004 from Queen's University, Kingston, Ontario.*



“When the issue  
at stake is  
fundamentally  
important,  
stand up and  
speak truth to  
power.”

- *Bob Breeze*

# 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 network you have forged while at university, and look for solutions beyond your disciplines. You have much to teach and much to learn. Collaborate for success.


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 – for yourself and others.

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. Of course, 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 Dean of the Faculty of Applied Science & Engineering, University of Toronto.*



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

- *Cristina Amon*

# Alec Hay

## Tomorrow I will watch you take your place among your peers at the Iron Ring Ceremony.

Ahead of you stretches a career of innumerable possibilities – in many ways, far more possibilities than I could have ever imagined when I was starting out. After an engineering career that has taken me around world variously as client, consultant and contractor, it has consistently struck me what a wonderful force for good engineering can be. After just twenty-five years' practice, I am still very much learning, and so I hesitate to give advice to you who, in this changing world, will learn more than I will ever know. Instead, I would like to offer five observations that I have found to be consistent in all those engineers I respect most.

In my experience, nothing has been so powerful an indicator of success as attitude. Your attitude and conduct as an engineer is an extension of who you are and defines your relationship with your fellow human beings, both as a servant and leader in your community.

The imagination, when used intelligently, is a powerful tool for an engineer. If we slavishly follow process and what has been done before, we very quickly become staid and ineffective. That is not to say that we should disregard the established ways of doing things. Rather, that in understanding the reasons and assumptions behind established practices, we are able to intelligently apply our imagination to solving the next generation of problems and recognize when those established practises are inadequate. A sound grasp of the first principles will never let you down. Realize your imagination.

It is an unfortunate human trait that we rarely learn from our mistakes, let alone anyone else's. Yet this is quite possibly the most powerful learning vehicle available. Taking the time to understand why something failed is to learn how to avoid repeating the same mistake. It takes humility to recognize and analyze your own mistakes



and both tact and an open mind to learn from another professional.

Technology and practice continue to evolve, and keeping abreast of not just the changes in your own discipline but the wider profession and the community are vital to your professional development.

Over the last few years there have been studies into what is required of engineers in 10 and 20 years time. The consistent finding, irrespective of discipline, was the increased emphasis on soft skills and a sound general technical competency with niche specialization. Both the general competency and the specialization require currency. The tendency to commoditize some engineering services detracts greatly from a genuine understanding of the discipline and its context.

Teaching a subject is a great way to refresh your own knowledge and understanding of the theory and practice, as well as to impart the benefits of your experiences to the next generation. Research and study are excellent ways to understand what is emerging and how it might affect your own practice. Both teaching and learning are valuable supplements to effective practice, each contributing to and benefiting from the others in equal measure. It is important to find a synergy between the three, which will change and shift as you progress through your career.

My last observation is that once we know who we wish to be in the future, we will have a better idea of ourselves and what is important to us. The demands and issues of today can be managed much more simply if we have a clear vision of the future. As the expression goes, “don’t sweat the small stuff.”

Engineering is one of the finest callings and we should feel good about what we do and the effect we have in the world. It defines who we are. If we don’t feel good about it, we will never be truly successful.

## **Alec Hay**

*Alec Hay is the Risk, Resilience and Security Planning Principal at Southern Harbour.*

# Chris Kennedy

## So you've just finished your undergraduate degree in engineering – congratulations!

That was hard work, wasn't it? But over the past four years, hopefully you have learnt some important skills – problem solving, quantitative analysis, communication, decision making, etc. – that will set you up for a fulfilling career, whether in engineering or some other profession. Another thing you should have begun to realize is the huge responsibility that engineers have toward society. I'm sure you fully understand why there are all those safety factors in the design calculations you've done. Engineers have a lot of experience in assessing, designing and constructing structures, machines, products, and systems, and the processes that make them useful and safe for humans. 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, chemical pollution, interference with the nitrogen cycle, etc., you might be asking, “are engineers responsible for addressing such large overwhelming challenges?” These are problems that engage many professionals – 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 the following:

“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.”

The finite assimilative capacity of the planet is well described by a paper in *Nature* (September 24, 2009) by Johan Rockström and colleagues. The authors present best-available scientific knowledge on nine non-negotiable planetary boundaries that humanity needs to respect in order to avoid potentially catastrophic environmental change at continental or planetary scales. They called this the Safe Operating Space for Humanity. Three of the planetary boundaries pertain to systemic processes at the planetary scale: climate change; ozone depletion; and ocean acidification. The other six boundaries relate to processes that occur on local or regional scales, but which provide resilience to the Earth as a system, and in aggregate manifest themselves as global measures of concern. The six processes are: changes to global nitrogen and phosphorus cycles; atmospheric aerosol loadings; freshwater use; land-use change; biodiversity loss; and chemical pollution. For seven of the nine, Rockström and his colleagues were able to quantify, albeit with some uncertainty, long-term boundary values within which humanity is safe. In three cases – climate change, biodiversity loss, and interference in the nitrogen cycle – the safe long-term thresholds are currently being exceeded!

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 CO<sub>2</sub> concentration of 350 ppm, and a radiative forcing of 1 Watt per square meter above pre-industrial levels are the boundary values required to have a good chance of

keeping temperature rise to within 2°C. As of 2007, the Intergovernmental Panel on Climate Change reported that CO<sub>2</sub> concentrations were already at 387 ppm and the change in radiative forcing was around 1.6 Watts per square meter. Thus the climate change scientists argue that CO<sub>2</sub> and other atmospheric greenhouse gas emissions have to be reduced. The planetary boundary that is being most overstretched according to Rockström and colleagues is the 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 ten to one hundred 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.

I encourage you to read the Rockström paper, but perhaps more importantly, try to stay up-to-date with the latest findings and debates about global environmental stresses. There are, as Rockström et al recognize, some uncertainties in the planetary boundaries. Scientific understanding of the processes involved has increased a lot in recent decades, and should continue to do so going forward. With current knowledge Rockström and his colleagues conclude that “Anthropogenic pressures on the Earth System have reached a scale where abrupt global environmental change can no longer be excluded.” This should be of concern to you.

Engineers design many of the things that give rise to the global environmental stresses. Power supply systems, 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 toxics 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. 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 second of those 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, understanding how to redesign these systems is at the forefront of industrial ecology 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 of Civil Engineering at the University of Toronto.*

# Ekaterina Tzekova

# Marianne Touchie

Most of the letters in this collection contain advice stemming from many years of engineering experience and life-long careers.

This letter is different. We have graduated only a short few years ago, and we write to you as your peers. Just like you, we are trying to find our places within the world and grappling with the challenges that affect our engineering profession now more than ever.

We have certainly graduated at an interesting time where we face many challenges! Populations and city centers 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?

Between the two of us, 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 we are all young engineers, we must also have the courage to speak up for what we 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. Your peers 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 we have passion, desire and youth on our side. Now let's go out there and make a difference together.

**Ekaterina Tzekova, PhD**

**Marianne Touchie, PhD**

*Ekaterina Tzekova and Marianne Touchie work for the Toronto Atmospheric Fund. They are co-organizers of the Promise to Future Generations<sup>©</sup> initiative, “an oath that is taken by graduating students and industry representatives to protect the rights of future generations.”*

*For more information, please visit [www.ptfg.org](http://www.ptfg.org).*

# 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 CEO of Ontario Power Generation.*

# Patrick Lane

*Convocation address, University of British Columbia, 2013.*

Back in early December of 1958 I was nineteen 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 is an award-winning Canadian poet.*

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

*- Patrick Lane*

# Richard J. Marceau

## Career Success: The Richard Hamming Formula

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 fifty 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.

### Lesson number 1: 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?

## Lesson number 2: 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!

## Lesson number 3: 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!

## Lesson number 4: 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!

### Lesson number 5: 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!



## Lesson number 6: 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!

## Lesson number 7: 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 his or her 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,

## Lesson number 8: 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.

Let's now summarize these points:

*Plan your future.*

*Do what you love.*

*Give yourself clear goals.*

*Knowledge and know-how are like compound interest.*

*Invest your time wisely.*

*Learn to trust yourself.*

*Practice your creativity.*

*Work on great problems.*

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.

This led me to do a PhD between the ages of 37 and 40, and to work in four different university institutions since then, gradually taking on several senior executive roles. This would not have happened had I not followed his advice!

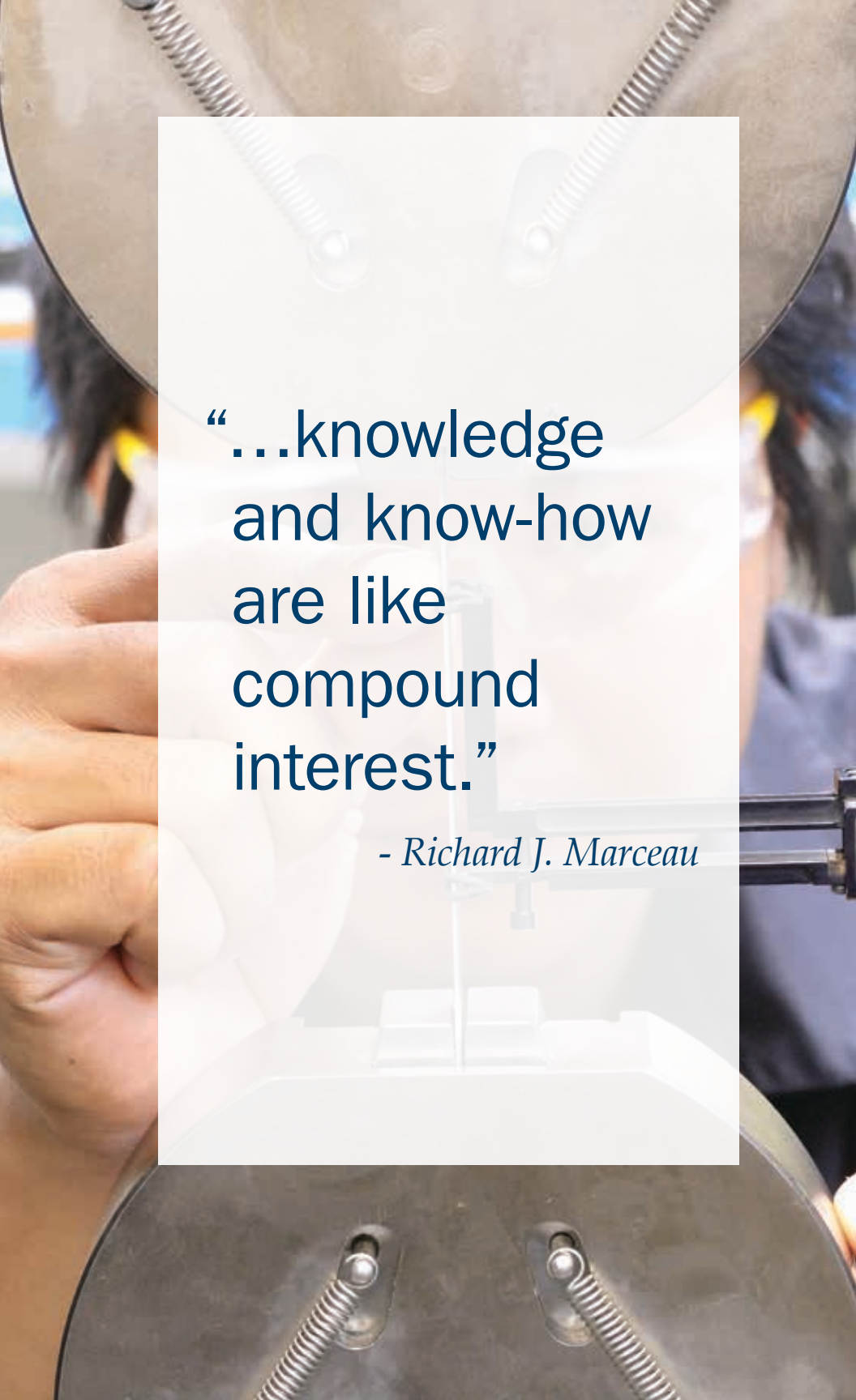
I sincerely believe that these eight lessons transform ordinary, everyday efforts into extraordinary outcomes! I do hope that you'll find them as useful as I have!

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

Warm regards,

**Richard J. Marceau, P.Eng., FCAE**

*Richard J. Marceau is the former President of the Canadian Academy of Engineering and Vice-President (Research) at Memorial University of Newfoundland.*



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

*- Richard J. Marceau*

# Kim Pressnail

## Along the Trail

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 Associate Professor of Civil Engineering, University of Toronto*

# JoAnne C. Butler

**Congratulations!** 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 thirty 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, and get your hands dirty by understanding the operations at a nuts and bolt level, before you

aspire to the lofty role of supervision and management. 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.

Engineering 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 it, 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 graduated from Queen's University (Civil '78). She has worked in the energy sector, both in oil and gas and in power, for thirty seven years in both the public and private sectors. She has had two international assignments. She is currently Vice President, Market and Resource Development at the Independent Electricity System Operator (IESO). Her twin daughters will be starting in Queen's Engineering in the fall of 2015.*





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

*- JoAnne C. Butler*

# Lisa A. Prime

I am pleased to offer you some thoughts and advice as you begin your career. I am also honoured, as someone without engineering credentials, to have been invited to do this 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 Masters from York University. My entire career has been consumed with engineering. My experience over twenty years has taken me from dealing with land-based environmental impacts of engineering projects, to building specification and improving the environmental performance of engineering in buildings and infrastructure. 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 Integrated Design Process (IDP). As an engineer, you are part of a much bigger project, no matter what key part you deliver. We have learned over the past 20 years, that we still have much work to do to truly maximize the benefits of working together in an integrated format with other disciplines. A true approach to IDP requires a multi-disciplinary 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 is still finding its way in the building-design world. There are some teams that do it well. These are the projects we can hold up a signature in moving the market to achieve a triple bottom line benefit: economic, social and environmental.

Working with IDP should not be limited to building design. There are many lessons that can be applied in any engineering project or impact-assessment approach. I challenge you to learn more about IDP as you head out in your career 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. I look forward to crossing paths with you and the projects that are your successes.

Regards

**Lisa A. Prime, MCIP RPP LEED AP**

*Lisa Prime is Director, Environment and Innovation at Waterfront Toronto.*

# Roy Neehall

**Congratulations!** As engineers you're now well equipped with critical thinking and problem-solving skills to meet 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.

Best wishes,

**Roy Neehall, P.Eng.**

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

# Heinz Unger

## Engineering and Other Principles

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

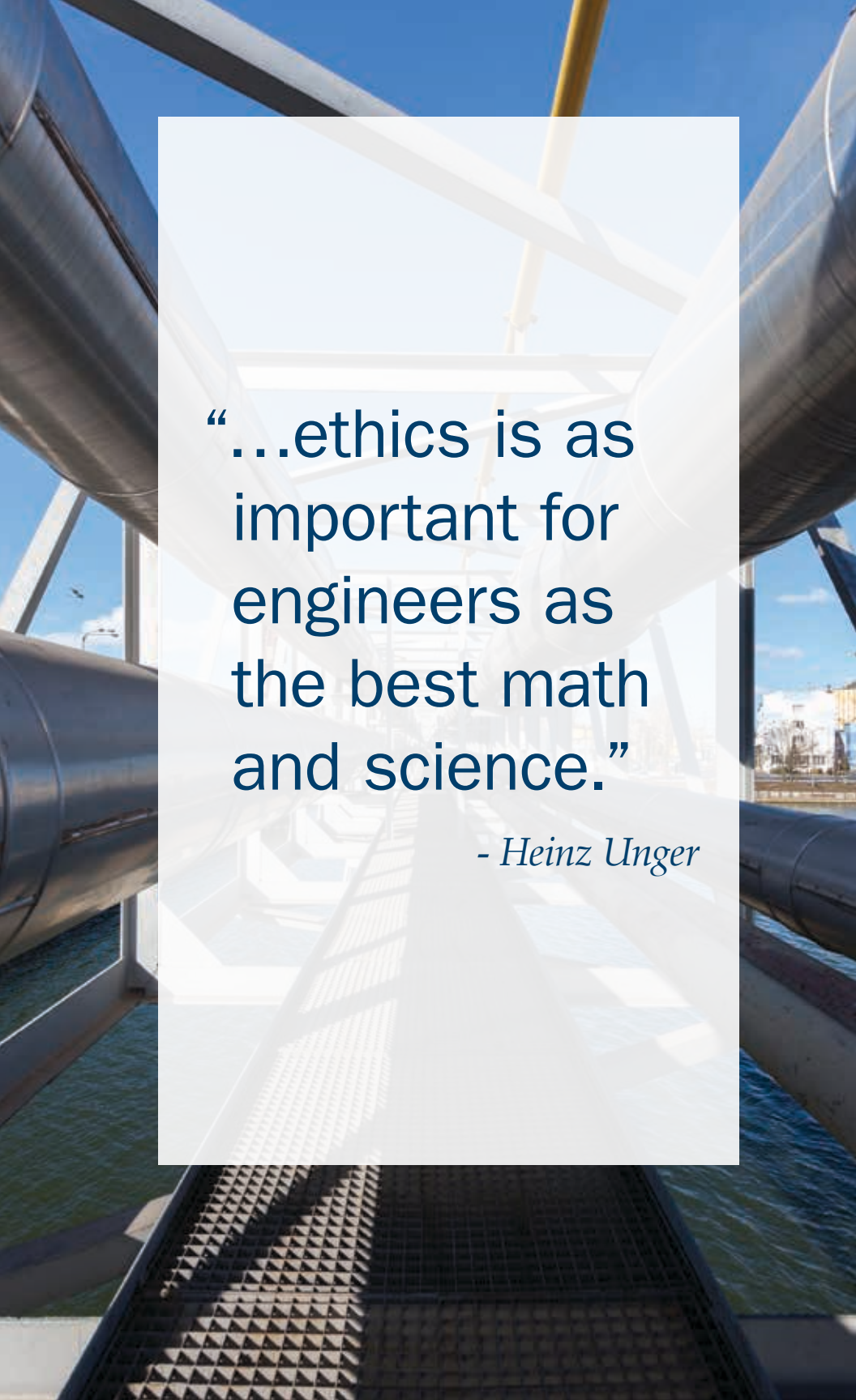
simple tenets of ethical behaviour. This may be because somebody who would never think of stealing from a friend or neighbour, might think that taking something, like intellectual assets from a faceless company, is not really unethical because no person is directly affected. Engineers potentially face 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 at 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.*



A photograph of a modern industrial facility, possibly a water treatment plant, featuring large metal pipes and a walkway. The image is overlaid with a white text box containing a quote. The background shows a clear blue sky and a body of water.

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

*- Heinz Unger*

# Ry Smith

## Congratulations on making it through!

You are about to begin a new phase of your life with a degree in what is without a doubt one of the most life enriching fields imaginable. Although I have had my good days and bad days, I can honestly say that all in all I have thoroughly enjoyed my career and my life as an Engineer.

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, Oakville, Ontario.*

# Kevin Pope

## Recognize where you are, leaving the comforts of being a senior 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 center 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.

Sincerely,

## **Kevin Pope**

*Kevin Pope is an Assistant Professor (thermo-fluids and energy) at Memorial University of Newfoundland and member of the Thermophysics Technical Committee at the American Institute of Aeronautics and Astronautics.*

# Carl Bodimeade

As you graduate, many of you will 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.

Some of you may not have any idea what comes next. That's fine too; everybody finds his or her 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 those 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.
- In your professional dealings, 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. Ask yourself: Do I want to be one of them?
- 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 Mott MacDonald. He obtained his BSc (Hons) in Engineering Geology from the University of Newcastle-upon-Tyne in the UK, and then his MSc, DIC in Soil Mechanics from Imperial College, University of London.*

# 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 Interim Dean of the Faculty of Engineering and Architectural Science, Ryerson University, Toronto, Ontario, and a Canada Research Chair in Biomedical Signal Analysis.*

# 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*

# Daniel Bartsch

## Congratulations on successfully completing your program and graduation!

You obviously have learned that hard work and perseverance has its rewards. You have 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. 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).*

# 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, cooperation 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*

# Wit Siemieniuk

## Arrogance is a Terminal Disease

I have always told anyone who has ever asked me what do you do, “I have the best career in the world!” How else can one reply about a profession that has, over time, stimulated all the senses, and provided extensive travel and the opportunity to make a difference at the policy level for the collective and the local level for the individual.

However, 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:

“**Government**” provides low pay, job security and an opportunity to work for the public good;

“**Private sector**” provides high salaries, minimal challenges and job insecurity; and

“**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 ten, 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 ten, 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 Vice-President International with AMEC in Calgary, Alberta.*

# Elizabeth Cannon

As you receive your hard-earned degrees, hold your heads up high as you walk across the stage. I take a particular pleasure in congratulating you, the next generation of Canada's engineers. Your commitment to excellence, and to rigorous scholarship, shines through your achievements.

The engineering program you have just completed has prepared you well – you are graduating with an excellent education that is recognized around the world for its quality. The iron ring you now wear is a tangible symbol of your hard work and impending profession.

You represent the future of engineering in our country, and you are role models for our profession to the world. You will help solve complex and dynamic challenges, innovate groundbreaking solutions, and bring about change that will positively impact our society. Your friends, your family and your alma mater have high expectations of the contributions you will make to engineering and to Canada.

We need engineering graduates who not only have a rigorous technical background, but who are also leaders: leaders who are creative and innovative, and who can tackle some of the key challenges in our world. Your leadership is in the skills and qualities you possess, which were honed through teamwork, a variety of extracurricular activities, and a rigorous academic experience. Leadership carries with it the responsibility to be accountable and adhere to the ethical standards of our profession.

Canada is a wonderful country that provides us with an enviable quality of life. However, sustaining our quality of life is a very real



challenge facing our country today. In fact, Canada's productivity has been slipping, relative to other nations, and it is through a skilled workforce that our productivity will be enhanced by higher innovation and economic growth output.

I would like to challenge each of you to become role models in your communities. As engineers, you have much to give beyond your own careers. You have a responsibility to your profession and your community, as well as to your country. It may be in your former high school or in your neighbourhood, within your families or among your friends. You may work to encourage future engineers or work to find other ways that you can help to build healthy and happy communities. I encourage each of you to put back into your communities as much as, or more than, your community has invested in you. We need your ideas, your entrepreneurship and your thirst for innovation to propel Canada to a richly diverse economy and society.

We know you are ready for this responsibility. You have already demonstrated your commitment to the field through the dedication you have shown in your studies. Challenge the status quo and make a conscious effort to continue to grow, capitalize on your strengths and seize opportunities to invest in your world. Strive to reach the heights of your potential, and do not hesitate to seek guidance from those who have helped you along your way.

You have chosen a challenging and extremely rewarding career. Be bold and dream big. I wish you the greatest success as you join the ranks of engineering professionals, making valuable contributions both here in Canada and beyond.

Once again, congratulations, and best wishes for continued success.

Sincerely,

**Dr. Elizabeth Cannon**

*President and Vice-Chancellor, University of Calgary.*

# Azin Behdadi

## I would like to warmly congratulate you.

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% 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.

Sincerely,

**Azin Behdadi**

*Azin Behdadi received her PhD in Nuclear Engineering from McMaster University, Ontario, and is a Research Assistant at the University of Ontario Institute of Technology.*

# Tim McTiernan

As I should, I would like to start by congratulating you on choosing to study engineering and to take up engineering as a profession. In saying this I have to declare a bias. I married the daughter of an engineer. One of my two brothers is also an engineer. I have spent a great deal of my life around engineers as a result. It has had an effect.

I can joke about recognizing an engineer by how he or she thinks 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 forty-six-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 and the risk of flooding in the neighbourhood behind the dyke. 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.

Best wishes,

## **Tim McTiernan, PhD**

*Tim McTiernan is President and Vice-Chancellor of the University of Ontario Institute of Technology. From Kilkenny, Ireland, he earned his Bachelor of Arts (Mod) in Psychology and Philosophy from Trinity College in Dublin, and his MA and PhD in Psychology from the University of British Columbia.*

# Brent Lewis

**Congratulations on your graduation.** Your hard work, perseverance and dedication have paid off. Your family is so very proud of you. This 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 the Dean of the Faculty of Energy Systems and Nuclear Science at the University of Ontario Institute of Technology. He graduated with a BSc in Physics and several advanced degrees in engineering with a MEng in Fusion Engineering and PhD in Nuclear Engineering all from the University of Toronto.*

# Murray Metcalfe

*Adapted from a Convocation speech to engineering graduates,  
University of Toronto, 2009.*

## 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!

Early in 2008, I joined a task force to explore 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? What if the source of electricity needs to be self-contained – as in the hand crank provided with the innovative \$100 laptop?

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?

In a speech delivered at the World Economic Forum in 2008, Bill Gates called for “creative capitalism” to address the problems of the world's neediest. He called on corporations (and that could be extended to universities and other institutions) to devote a percentage of the time of their top performers to addressing issues of the world's poorest citizens and to do so in a way that integrates those efforts and what is learned from them into the core of the organization. If today's graduates devoted just 5 or 10 per cent of their time to these problems, think of the amount of cumulative brainpower applied to this area that would be!

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 and China and other rapidly emerging economies. 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. It is a highly collaborative tool, with innovative features that allow multiple users to examine a specific project in the language of their choice – at present 35 different languages. The RETScreen operation is run by a skeletal staff of 12, of which 11 are engineers, augmented by a global set of collaborators – ranging from individual academics to NASA. The RETScreen software has been downloaded for free by close to 400,000 users to date and is very popular in Asia and in developing countries. And what is the organization behind this innovation? The Canmet Energy lab, a very small, very innovative, very 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. Good luck and all the very best to each of you!

**Professor Murray Metcalfe**

*Centre for Global Engineering, University of Toronto*

# 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 alternate 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.*

# 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 then 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 was hit by lightning as a child and the relationship has been a little strained ever since.) 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 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 (hey, admit it, you probably never liked French much) 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 coordinator 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. That's also where I witnessed some disdain for the "lower" (!?) sciences (biology and especially the ecology course). I swear it wasn't revenge when I had some fun coming up with assignments that showed off the "systems thinking" skills of those ecology students. Today, I'm pleased to see that "systems engineering" is a new interdisciplinary branch of your profession.

I was also pleased, while developing that sustainability curriculum, 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. Be a systems thinker.

And finally, think like an ancestor. Really, that's what sustainable

development is all about. It's an intergenerational golden rule. Let your life, your career, be a gift to future generations. Oh, and enjoy! Cuz if it ain't fun, it ain'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](http://greenhearted.org)).*

*As a promoter of school gardens, living roofs, rainwater catchment systems and cob garden sheds, she is orbiting back, once again, into the realm of engineers and engineering.*



The background is a light blue technical drawing or blueprint. It features various geometric shapes, lines, and circular patterns, typical of an engineering or architectural plan. A white rectangular box is centered on the page, containing the main text. To the right, a portion of a white ruler and a blue pen are visible, suggesting a workspace or drafting table.

“Find ways  
to help the  
rest of us  
understand –  
and appreciate  
– what your  
profession  
does.”

*- Julie Johnston*

# Peter Halsall

Congratulations! Your education has given you the foundation from which to do many things, and in all likelihood that is what you will do over your career. You have also 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, PEng, MASc, FCAE**

*Peter Halsall began his career in structural engineering before completing a Master’s degree and working in biomedical engineering. He then took an opportunity to build a team to repair buildings. In just 15 years, his team grew to 350 people and the company expanded to include green building services, a project management company and a management consulting firm for sustainability strategies. He is now Executive Director of the Canadian Urban Institute and Chairman of Synergy Partners, a building engineering firm.*

# Jacquie Hoornweg

## It takes a village

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.

In fact, no matter what engineering discipline you enter, chances are you chose it because you believe in its power to make a difference and think you have a meaningful contribution to make. You have learned to understand the problem, apply your expertise and solve it – maybe even advancing the solutions that came before.

Chances are you will do this as part of a team of equally dedicated and smart co-workers who also strongly believe in the value of your collective solution.

But whether yours is a better way to manage your community's garbage, build a better bridge or power a country, there is one critical ingredient you need to move forward – a social licence. That is, you need the buy-in and the trust of the communities most affected by your project.

When your team gets challenged on the projects you have developed, you may be tempted to think that if people just understood your project better – if they knew what you know -- they would come to the same conclusion about its value. A social licence seems just a well-written white paper and an effective website away.

Yet, experience shows this is not the whole story. If it were, there would be no anti-nuclear groups, no opponents to incinerators or

landfills, no objections to sewer pipes, gas lines or wind turbines. The people who fight infrastructure projects hardest, in courts, regulatory hearings, city hall and in the media, tend to know the facts surrounding them very well, yet often they still do not agree.

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. Earning a social licence means acknowledging people's fears and their need to build trust through input and through a chance to validate the information against measures they value. It's also recognizing the potential environmental, social and financial impacts your project might impose on its users, nearby residents, suppliers and on the physical world within which it exists. And, it's working together with those stakeholders to mitigate them.

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

Social licence can become part of a code of conduct that guides your work no matter where your career takes you. The principles are simple:

1. Listen to and incorporate the feedback of communities with an interest in your project during development, not just after it's done;
2. Respect and collaborate with the other professionals on your team. This includes the communicators who work directly with those communities on your behalf. Just as you have spent your life understanding the math and science and dedicate yourself to strengthening technical expertise, they have studied the pathways to interaction with people in a way that addresses the emotional and intellectual interests of your constituents and brings your perspectives forward most clearly;


3. Commit to citizenship. Work with other professionals on your team to:

- Share information in open, two-way exchanges;
- Make safety and environmental stewardship the cornerstones for your work; and
- Seek collaborative solutions that meet the interests of those who have a stake in your projects.

As engineers, perhaps more than any other single group, the power is in your hands to change the world. When you allow others to share in this responsibility with you, what you can achieve together can be limitless.

## Jacquie Hoornweg

*Jacquie Hoornweg is a professional communicator, professor and a former electricity sector executive.*

A group of four people, likely engineers or construction professionals, are gathered around a large set of blueprints spread out on a surface. They are wearing hard hats and safety vests. One person is pointing at the blueprints with a green pen. The background shows a construction site with a crane and a cloudy sky.

“As engineers...  
the power is  
in your hands  
to change the  
world.”

*- Jacquie Hoornzeg*

# 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 6 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 Director, Sustainability and International Alliances with the American Society of Civil Engineers.*

# Paul Cadario

*Adapted from a Convocation speech to engineering graduates,  
University of Toronto, 2013*

**I am deeply honoured and humbled to have the opportunity to talk about the future with the next generation of engineers.** To talk about the future, however, I'm going to talk about the past.

When I arrived at university to study civil engineering, it was an era of big ideas, great leaders and great oratory. It was barely six weeks after two astronauts landed on the moon and returned safely to earth. When US President John Kennedy set that goal in 1961, he launched an era of huge advances in science and engineering.

Beyond this remarkable engineering achievement, the civil rights protests of Paris and Chicago in 1968 had unleashed great social and political change. In Canada, Pierre Trudeau enlisted young Canadians as part of “the new commitment” after we celebrated our country’s first 100 years as a nation. We were reading books like Rachel Carson’s “Silent Spring,” about the perils of chemicals on nature, just as you watched Al Gore’s film, “An Inconvenient Truth”, about climate change.

By the time I graduated from engineering in 1973, the women’s movement was in full stride as societies started to realize the importance of unleashing the intelligence, energy and creativity of half the world who, even in Canada, did not enjoy their full rights. It was the same year World Bank President Robert McNamara

made the Nairobi Speech where he spoke about absolute poverty, “a condition of life so degrading as to insult human dignity – and yet a condition of life so common as to be the lot of some 40 per cent of the peoples of the developing countries,” and the same year the cellphone was invented.

On each of these bold ideas, an easy way out would have been to say “we can’t do it, it’s impossible.” But engineers are not like that. These bold ideas of 1973 – gender equality, ending world poverty and mobile communication – inspired a generation of scholars, practitioners and activists in many fields, including myself.

Economic and political rights, health, education and the protection of them and their children have improved for many women, in many countries worldwide. Social movements, though, generally take about 80 years. For example, it was only in 2000 that the political leaders of the world agreed at the United Nations to cut extreme poverty in the world by half by 2015. That we have done, but there are still over 1 billion left in extreme poverty and the world’s new goal, to fully eradicate it, is only 17 years hence.

In short, we Baby Boomers are counting on you, the next generation of graduates, to finish all of this important work. Fortunately, mobile communication was joined by the Internet, which engineers invented but let everyone use, in the early 90s. The Internet amplified the forces and voices of globalization as well as the great progress in improving the human condition that globalization has made possible. We can all access unimaginable quantities of digitized information, with which we can shape our world, influence millions of people, and monitor and measure the impact of our actions.

There is a huge opportunity for leadership awaiting every new graduate. As engineers, however, we calculate risks before we take them. We are professionals, after all. And in that respect, I want to share with you a little advice from Pablo Picasso who said: “Learn the rules like a pro so you can break them like an artist.” That strikes me as a great motto for engineers who want to make a difference.

And it is a way that you can invent a future unlike the past.

This future will not be without controversy. As engineers reshape the world with technology, there will be many ethical and social implications.

I hope therefore that you will not be satisfied simply saying, “Yes, we can do that,” but will follow that boast by asking, “Yes, but should we?” I also hope you find employment, whether in the public or private or nonprofit sector, in Canada or abroad, or in a start-up of your own imagination and effort, that will let you say every day, “I’m in a place where I can do my very best.”

In this context, I want to share a story about the world of work. A friend, who used to head organization development at a large global pharmaceutical company, was visiting one of their sites. After seeing the labs and factory, she happened upon the mailroom. As she entered, the mailroom man rose from the orderly pile of boxes on his desk and welcomed by her saying, “Good afternoon, I cure blindness.”

Seeing that she looked a bit puzzled, he went on to explain: “At our factory, we make ivermectin. It’s a drug that cures blindness caused by onchocerciasis, which people in Africa get from being infected by a guinea worm that’s transmitted by a fly. In the 1970s, World Bank President Robert McNamara visited Africa and he was shocked that some of its most productive land couldn’t be farmed because there were no people, and those few who were there were blind. Retired Vietnam War helicopter pilots were hired to spray the rivers where the flies lived and when ivermectin was invented, it was given away for free. We make it here at this plant and my job is to check all the shipments and make sure that the labels are correct and well attached. Because if those pills don’t get to Africa, people will be blind.”

As you join organizations and get exposed to office politics, which can be discouraging and sometimes even toxic, please remember

that everywhere you'll want to work has a noble purpose. For this man in the mailroom, it was curing blindness. It will be something like that for you. And as you work with people who aren't engineers, whether they are in the mailroom or the big corner office dealing with office politics, help them keep their faith in the big purpose, to which they are every bit as much a contributor as you are.

I wanted to talk about the future today because universities are about the future. They are about learning and about shifting the boundaries of knowledge, of discourse and of possibility.

What type of future can engineers help us achieve? One built on common sense and good judgment. A future with smart and connected machines; with safe technologies; with the necessary systems approaches to energy, to renewing infrastructure and our cities, to climate change and the environment, and to public policy and global affairs; and a future that is inclusive, prosperous, secure and sustainable.

## **Paul Cadario**

*Paul Cadario is the Distinguished Senior Fellow in Global Innovation at the University of Toronto.*

# Amir Shalaby

**Congratulations.** You have worked hard to get to where you are and you should be proud that you're ready to take your place in a venerable and noble profession.

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.

Best wishes,

## Amir Shalaby

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

# John P. S. Froats

## Thoughts on the Privilege of Life as an Engineer

Congratulations on your graduation. You should feel a sense of pride and accomplishment. Getting to this point is not easy. 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
- You'll become good at it
- Opportunities will find you

So success in the Engineering profession is a combination of "head" (the intelligence and logic) and "heart" (the drive, the 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.

So in closing, I am impressed by the talent in the graduating class of engineers. You are smart enough. You have shown signs that you are willing to work hard enough. 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.**

*Associate Professor and Nuclear Engineer in Residence, University of Ontario Institute of Technology and Chair of the Canadian Standards Association (CSA) Nuclear Strategic Steering Committee.*

A complex industrial scene featuring a dense network of large, metallic pipes and machinery. The pipes are arranged in various directions, some running horizontally and others vertically, creating a sense of depth and complexity. The lighting is bright, highlighting the metallic surfaces and the intricate details of the industrial equipment. The overall atmosphere is one of a busy, high-tech manufacturing or processing environment.

“To be a  
Professional  
Engineer... you  
must have a  
strong moral  
compass and  
the courage to  
stand for what  
is right”

*- John P. S. Froats*

# George Rocoski

## Congratulations on completing your well earned degree.

You are now hopefully on your way to a rich and rewarding career as an engineer. But, as you have probably heard several times by now, 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 multi-million 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 5 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. Its 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.

Do you remember what the 2010 Canadian Olympic Men's Hockey team (gold medal winners) motto was? If not, here it is:

Leave No Doubt.

- Do good
- Do amazing
- Do impossible
- Do big

- Do small
- Do unexpected
- Do helpful
- Do inspirational
- Do meaningful
- Do different
- Do better
- Commit

Whether you remembered it or not, think about living it.

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.*

# George Roter

## Problems that matter

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 9-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.*

# Daniel A. Nolasco

**Thank you for taking the time to read this**

**letter.** And 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.

I am sure you will not regret all the effort put as a student and now as an Engineer, as I haven't over 30 years of profession.

You will likely find along your career path multiple opportunities to move onto other fields. Engineers are well trained professionals who can adapt to a long list of fields. In business, management, finance, and even in medicine, Engineers stand out as fast learners, deep thinkers, team-players, and hard-working professionals. When offered to choose among other 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.

Yours truly,

**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.*

# Tarlochan Sidhu

**Congratulations on your degree.** After a long period of hard work you may feel exhausted, and are wondering if it was all worth it. Simply put, it was.

But remember that 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 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 Masters 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.**

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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; seventy-five workers lost their lives.

The collapse of the Quebec Bridge was catalytic in giving rise to professional engineering in Canada and elsewhere. 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.

Rudyard 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% of the world's population at the time) and the world's overall combined wealth was less than \$2.5 trillion. Today about 3.5 billion people live in cities and our total wealth, almost all of which resides in and is created through our cities, is about \$225 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 (each will have about 1.45 billion people in 2028). 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 must undertake to build our cities and societies in a way that protects the planet's carrying capacity and provides a dignified and honourable life for all.

Engineers graduating today will see urban populations – and probably wealth – double during their careers. About 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). For the next 35 years engineers will build a city the size of Calgary every day. You are the critical 'urban generation'. We build our cities; our cities generate our wealth, create our societies and shape us as individuals. Our cities, or more accurately the affluent that live in them, also have the single largest impact on the local and global environment.

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 400 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 probably worsen.

Global demography is changing; populations of some countries have already started to wane. Power is shifting, like tectonic plates, yet fortunately, hopefully, much of what we possess in our country should serve us well for at least the remainder of this century. 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 we could eliminate extreme poverty over the length of 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 I-35 bridge collapse in Minneapolis; the Deep Water Horizon Oil Spill; the Fukushima Nuclear Plant: Bad things happen and there's no indication that they won't continue to happen. And probably – in light of increased climate variability, greater demands on infrastructure systems and a doubling of urban populations – more bad things are likely to happen. More and more, 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 100 years since the Quebec Bridge collapse, yet much has stubbornly persisted. 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 progress exponentially. Yet our social norms, the hardwiring of our brains and our behaviour, change only linearly. Engineers, along with all other professionals, urgently need to develop better ways of working together.

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 work within society and contribute to a discourse that promotes fact-based policies. We all see the impact of public opposition against much of the infrastructure and management practices we know are needed. We understand the true costs of deferred maintenance. But this opposition, often seemingly grounded in local fears, unwillingness to pay today, or reactions to inequities, can yet be well founded. Dismissing it too quickly is also often short-sighted.

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 too much information, rather than too little.

We need to be honest about much of the technology we represent. GMOs, energy systems, nuclear energy and medicine, 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 urge the application of new forms of 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 high-school teacher, yet we often have no qualms with 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. Amazingly the business community, for example through the World Business Council for Sustainable Development, is far more engaged in a fact-based debate on sustainable development than is the engineering profession.

Stereotypes are powerful. If a bright high-school student asks “how can I best help the world?” we need to help make sure the answer is much more obvious. The coolest kids in school may not end up as engineers. Rather, the kids who wanted to do the coolest things gravitated to engineering. There is no cooler 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. The world's cities in developing countries are about to double in size over the next thirty to forty years. Sustainable development will be won or lost in our cities, and it will be engineers who most determine the outcome.

In the 20th century, Canada's engineers built much of Canada. We knit the cities together with roads and rails, 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, 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.

Engineers design the deliverables of society, ascribing through knowledge, experience and professional responsibility a factor of safety commensurate with the cost of failure and benefit of success. Through design and construction, engineers assign value to human life. Much of what engineers authorize for construction is long-lived, taking us to the close of this century. As we stand on the threshold of the largest generation of city construction ever, we need to apply a factor of safety on our global inter-connected society.

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.





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