
Engineers: Problem Solving in Society

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Abstract

Engineering is an often mysterious profession. For the author, engineering is a rewarding and challenging career where she can see that her work has a positive impact on the natural environment and on the people who use it and sometimes even make a mess of it.

*Unless someone like you cares a whole awful lot,
nothing is going to get better. It's not.*
—Dr. Seuss, *The Lorax*, 1971

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Engineers are problem solvers, creators, and innovators. We use a fundamental knowledge and understanding of science to design, build, and adapt. That said, not all engineers build things or are builders. Many of us just love using science and our creativity to make a difference.

Engineering is not what I originally thought I would do as a career. I was interested in biology and environmental sciences in high school, but also had strengths in maths, physics, and chemistry. But physics was definitely not my favourite subject – and most guidance counsellors will tell you that engineers are first and foremost physics lovers. Not me. Not then; not now.

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When I began to consider what I wanted to study at university, my parents and I sat down to read university calendars. It seemed like a logical way to learn about the myriad options that I never would have known about otherwise. I found a description for an engineering program that spoke to me. It talked about solving environmental challenges, applying science to improve water quality, and investigating biological systems. It intrigued me and, despite not knowing what an engineer is or does, I applied, was accepted, and began my engineering career in near ignorance. That said, I've never regretted the decision. I have a career that offers diverse opportunities and challenges. I get to play with science and technology every day. And most of the time I absolutely love it.

To the casual observer, my choice to become an engineer may seem somewhat haphazard and serendipitous. I walked in with my eyes barely open, not knowing that there weren't many women in engineering (about 10% in my classes in the 1990s) and not really understanding what the career options were. But I knew my strengths and my interests, and I strongly believed that I wanted a career where I could make a difference in the world.

Many young women have never considered engineering as an option or even heard about it; other young women enrol in engineering only to leave after an unfulfilling first-year experience. Maybe we do not hear about engineering as a career option from parents, teachers, and guidance counsellors; maybe we think it is not interesting; maybe we do not know what engineering is; or maybe we do not think we are capable. It can be intimidating to walk into a room with 90% male students, all of whom seem to have never-ending confidence in their abilities and their decision to study engineering. Female students do not seem to reveal these same attributes, even if we feel them strongly. Regardless, engineering can be a rewarding and challenging career for men and women. Engineering is everywhere, but most people never see it or recognize it. In the media, there are often reports of scientific breakthroughs and engineering disasters. If that is all we ever hear about engineering, is it any wonder that many young women and men are not drawn in?

I knew I had made the right choice in engineering during my second year of studies. Really, first-year engineering is rarely what students think it is going to be. The majority of the courses are "foundational" – pure sciences and maths – that provide the necessary tools for engineering applications later on. They can be interesting, but they are not engineering; they are not the reason we, as students, came to register in engineering at university. In that first year, students generally have only two or three engineering courses. Thus, it is harder to really be invested in the subjects and earn the high grades – or at least that was my experience. Second year is where the fun of becoming an engineer really begins, where students have a chance to learn about engineering and their chosen discipline (civil, mechanical, environmental, electrical, and so on). I chose a discipline focusing on environmental engineering and rural livelihoods. And in my second year, I began to learn about groundwater resources, food supplies and sustainability, and the interactions of agricultural processes, equipment, and decision-making with the environment. That is when I started to really get excited about university and about becoming an engineer.

What inspired me then and continues to inspire me now is that I can make a difference in people's lives and in the natural environment. I continued my academic career through a PhD in environmental engineering, focusing on water quality and treatment. These days, I work with mining companies, farmers, cities, and towns to look at how we use water as a society while ensuring that there is enough good-quality water to support wildlife and aquatic species. I get to learn about how industry works, what industries need, and how I can help them be more efficient with their water use and treatment. I get to be outdoors with farmers to help them make the most of the water they have for animals and crops. I get to work with staff, engineers, scientists, planners, and managers in cities and towns to look into how they collect and treat drinking water, storm water, and waste water. In this way, I get to make a difference in how we use environmental goods and services today and preserve environmental goods and services for the future. And if I had decided to leave engineering after first-year university, I never would have known what career options are out there and what I am capable of accomplishing.

Engineering breakthroughs are responsible for smartphone technologies, electric cars, space travel, and so much more. For me and the work I do in environmental engineering, the breakthroughs are much less grandiose, but just as important to those affected. I work directly with people and communities to solve environmental challenges and to offer creative solutions to their problems. Here are a few examples of engineering activities I am proud to have been involved with:

- Working with small rural communities to improve how their drinking water is treated while keeping costs affordable and the technology appropriate for a small population. My research team and I were able to come up with chemical-free and biological treatment designs that are now in use in several communities, approved by the regulators, and sold and maintained by a local water treatment business.
- Monitoring and adapting agricultural practices with farmers to improve water access and maintenance of water quality for livestock and crops in times of flood, drought, and increasing attention to nutrient management (e.g., keeping fertilizers on the crop and out of the water) and pathogen transport (e.g., keeping dangerous bacteria out of the water).
- Researching how nutrients and bacteria move in water environments and can impact water quality, treatment needs, and industrial uses and access to water resources.
- Learning from people in rural areas of Canada, Chile, Colombia, Argentina, and Brazil about how they are adapting to climate changes and extremes (floods, landslides, droughts, hurricanes) and in what ways engineering can help to reduce vulnerability of people and their livelihoods to climate impacts.
- Investigating and designing systems to harness microbial power sources – using bacteria to make batteries to power environmental monitoring equipment on the bottom of the ocean and for developing regions of the world.

My experiences in engineering have focused heavily on the interdisciplinary aspects of understanding problems and identifying potential solutions to those problems. In many projects, I work with colleagues and students in other fields of science and

engineering, as well as the social sciences and humanities. If I did not have a basic understanding of fields such as biology, geography, agricultural and soil sciences, and even sociology – and an ability to collaborate with those who practise in these fields – much of what I do would not be possible. Working across disciplines in support of solutions to regional, national, and global societal needs is both rewarding and productive. It builds social skills and teamwork. It means working together for the best solutions, not just engineering solutions. And it means continuous learning and opportunities to try new things. Our training and expertise give engineers an opportunity to innovate and solve problems and to design and operate the processes that make life comfortable, from food production to computers and smart devices and from oil production to robots and automation.

Engineers have the opportunity to make decisions and solve problems for the benefit of society. I have had many a debate with engineering and non-engineering colleagues as to the role of engineers. We discuss how engineers address societal challenges in reference to the impact of technology on society, human impacts on environment, technology as saviour or debilitator, and the balance between behaviour and technology in addressing issues related to all aspects of sustainability. Of course, engineers don't have all the answers, but working with colleagues in diverse fields of study and focusing on societal benefit are motivational to continue working on solutions to all problems.

Engineering is everywhere, but rarely is it well understood. Further, most people wouldn't automatically think of engineers and environmentalism in the same sentence. And maybe there's more truth in that than I'd like to admit. As an environmental engineer, I am not an environmentalist per se; I am most interested and appropriately employed in mitigating and remediating environmental problems. In essence, I trained to be a problem solver, using technology, science, and creativity for the benefit of society.

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