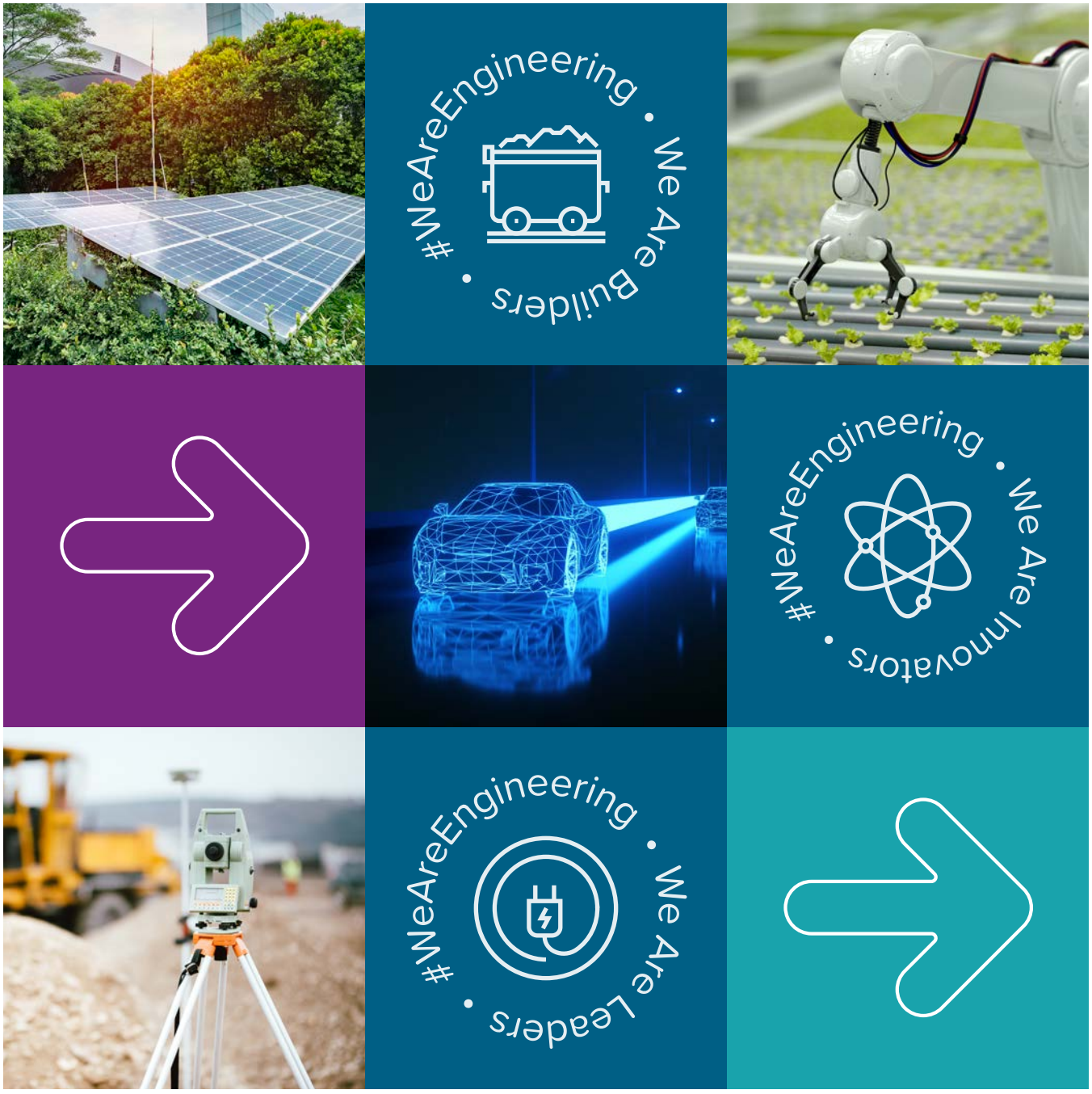
Ontario's Engineering Community in Transition

Benchmarking Report 2022



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ONTARIO SOCIETY OF PROFESSIONAL ENGINEERS

"The superpower of engineers is problem-solving."

–Sandra Odendahl, P.Eng., OSPE Member

We are keeping our families, friends, and neighbours safe at home, work, and play.

We are building a better Ontario, together.

#WeAreEngineering

The Ontario Society of Professional Engineers (OSPE) commissioned this study to define and enumerate who makes up Ontario's engineering community today, what they think of engineering as an education choice, and where they see the profession going in Ontario.

What we found is both surprising and not surprising, but it paints a picture of an engineering community in transition.

Contents

29%

of employed engineers and engineering graduates were between 50 and 64, suggesting an imminent wave of retirement.

43%

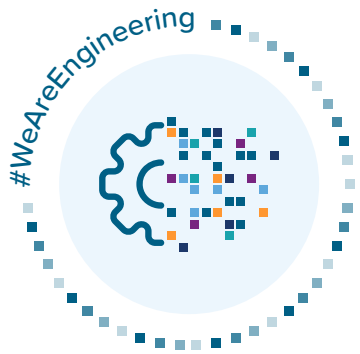
of respondents were not employed as engineers. Some worked in related fields, while others had left the profession altogether.

57%

of respondents were unsure about, or disagreed, that the field is in touch with the needs of new engineering graduates.

36%

of female respondents were currently employed in a related field, but not licensed as engineers.



ENGINEERING IN TRANSITION

A generation-defining transformation presents uncertainty—but also opportunity.

Today, a seismic shift is underway in Ontario's engineering community. Nearly one-third of Ontario's working engineering graduates are over 50 years old.

As they retire, a younger generation will fill their shoes, bringing new perspectives and priorities to the profession. OSPE commissioned this study to define the shape and scale of the coming changes.

Many of the survey's results are encouraging and exciting, highlighting the strong sense of pride, unity, and professional purpose felt by engineering graduates of all backgrounds. But we also found potential cracks in our profession's foundation. Younger engineering graduates aren't necessarily ready to step into newly empty roles. Some, especially women and those from international backgrounds, feel their opportunities may be limited. Many are finding success outside of core engineering fields.

In this document, we seek to outline the issues identified and discuss how to address them. This provocative, revealing research will stand as a benchmark against which the wellbeing of the profession can be regularly tracked.

93%

of respondents said they were proud of their engineering degree.

66%

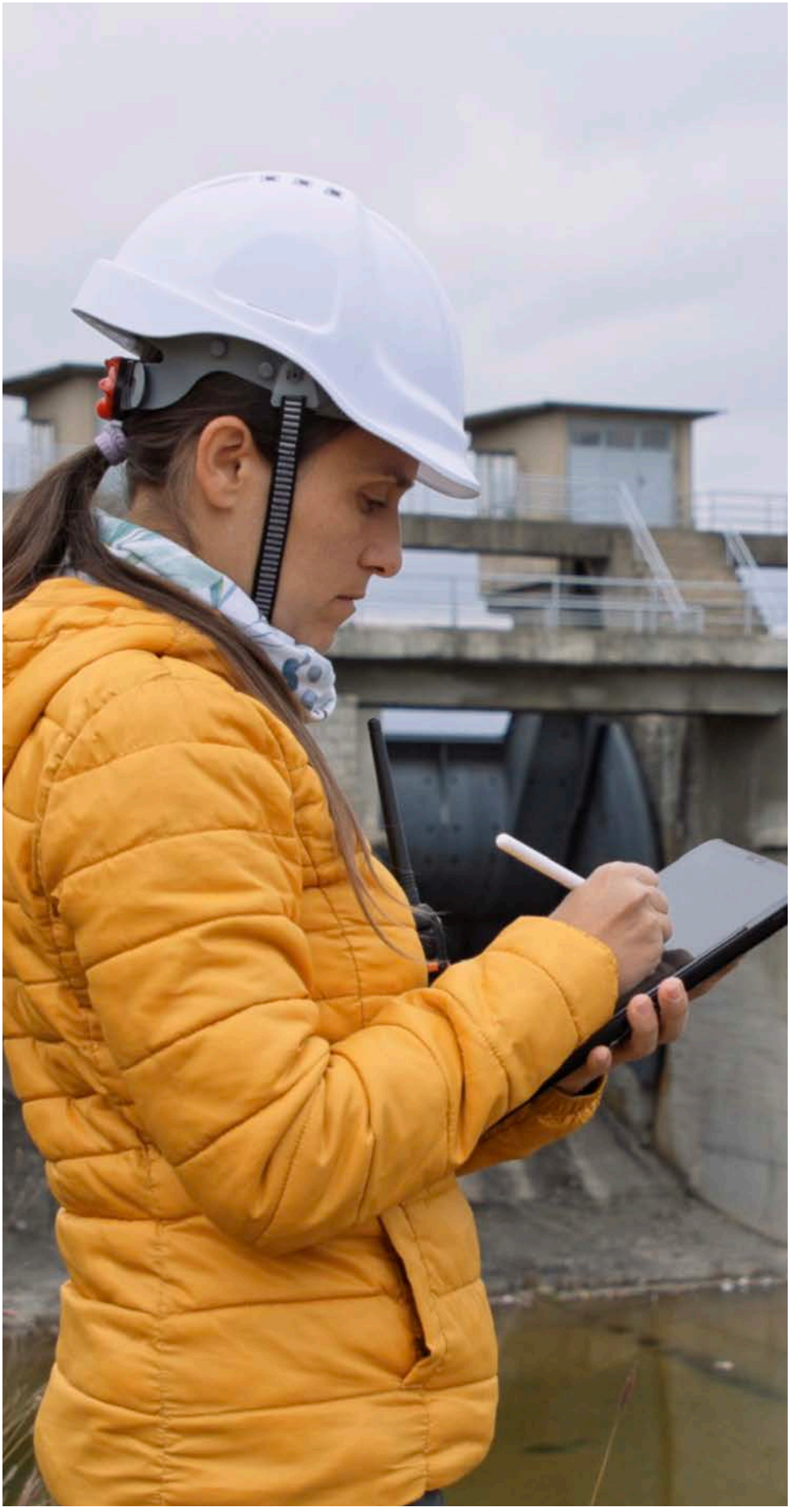
of respondents said they were proud because engineering is a vital component of a functioning society.

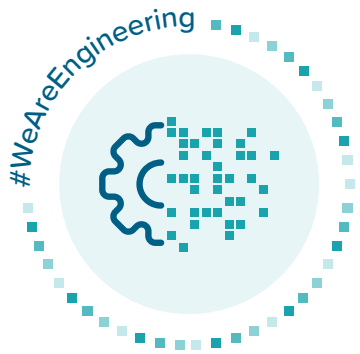
48%

of respondents believed society at large respects an engineering degree.

41%

of respondents felt their family and friends respected an engineering degree.





PRIDE IN A CHANGING PROFESSION

Despite their differences, engineering graduates of all backgrounds believe in the value of what they do.

Our survey included hundreds of engineering professionals in Ontario: men and women, engineers, engineering graduates, and International Engineering Graduates (IEGs).

Of the 821 engineers and engineering graduates surveyed for this research, roughly half were over the age of 50, and only one quarter under 35. Of these respondents, 78 percent were male, and mostly educated in Canada. The survey results indicate that 29 percent of employed engineers and engineering graduates were between 50 and 64—not too far from retirement.

From transportation to housing to cutting-edge computer systems, engineering is vital to every aspect of modern life.

Respondents to our survey were nearly universal in expressing a sense of purpose, pride, and positivity about their work and its contributions to society. Those positive feelings cut across all ages, genders, and backgrounds.

What We Found

Established engineers and engineering graduates—typically older and more often male—expressed greater positivity toward the profession. Female, younger, and internationally trained engineering graduates were also positive, but expressed noticeably more hesitation and uncertainty on key questions about engineering's reputation in society, as well as their own career opportunities. One-third of all engineers and engineering graduates, predominantly from those latter groups, reported that the profession may be falling out of step with modern society.

We also found reduced engagement with core engineering disciplines. Engineering graduates under 35, and those with fewer than 11 years of work experience, were more likely to be working outside of engineering. And while 20 percent of all respondents surveyed had studied civil engineering, that number fell to 12 percent among recent graduates, possibly a reflection of reduced

interest in what has traditionally been a strong core specialization.

Finally, fewer than half of engineers and engineering graduates surveyed believed that schooling is affordable, that gender representation and other metrics of equity, diversity and inclusion in the profession are sufficient, and that wage standards are equitably applied. Younger engineers and engineering graduates from more diverse backgrounds were more likely to feel this way.

There was concern that universities are failing to impart soft skills. If true, this may impede graduates' potential in the workforce.

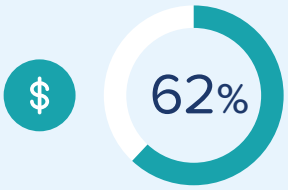
The Future of Engineering Education

Encouragingly, 93 percent of respondents indicated pride in their degree. These are two of the reasons:

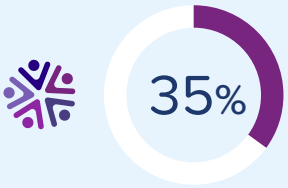
- Engineering is a vital component of a functioning society (66 percent of respondents).
- Engineering contributes to ground-breaking developments in how we live our lives (53 percent).

A majority of respondents felt that universities are keeping engineers up to date on technical abilities and new technologies. There was, however, concern that universities are failing to impart soft skills—interpersonal communication, diplomacy, and similar abilities—to students. Only about half of respondents agreed that schools are currently doing enough in this regard. If true, this may impede graduates' potential in the workforce.

How do today's engineers and engineering graduates feel about our profession?



Strongly or somewhat agree that an engineering education is too expensive.



Strongly or somewhat agree there is a lack of multicultural representation and diversity in the field.

Strongly or somewhat agree that the engineering field is out of touch with the needs of new graduates.

Q&A with Sandro Perruzza

CEO, OSPE

Looking over the themes and major takeaways, does anything from this research surprise you?

Not especially—the themes uncovered here are very close to what I'm hearing from employers and from engineering students. Employers in core engineering fields are saying, "My people are retiring, and I don't have the next wave. I have senior employees leaving, and there's no way to fill the gap." This has been the case for several years, really, but there wasn't a lot of urgency about it.

We're seeing that younger engineers and engineering graduates, and those from diverse backgrounds, may be less interested in the field. Why?

A major issue that we have to address together as a profession is hostile or otherwise challenging work environments, and the persistence of old attitudes.

Let's take just one example: women are less than a quarter of students in engineering undergraduate programs. They're even less represented among those getting newly licensed. Why?

Imagine there are two co-op jobs; one goes to a woman and one to a man. He goes out and does the field work, she stays in and does the administrative work. It's no wonder that after enough experiences like that someone might say, "Forget this; banks are hiring engineers and paying better."

Do we see young engineers and engineering graduates moving into other fields?

Yes, and the longer they stay away from traditional engineering, the less connection they have to it. This also raises another point, which is that we have relatively few engineers from low-income communities.

How is OSPE helping address these barriers?

We have a diversity and inclusion committee, which we're calling the IDEA Committee—inclusion, diversity, equity, and accessibility. It provides advice to us about workplace challenges, what we need to be doing, and it's our own advisory committee so we can keep up to date on challenges and solutions. We run a website called DiversifyStem.ca, which contains micro-lessons on what employers and practitioners can do on diversity issues.

From an equity, diversity and inclusion perspective, OSPE has many programs and areas of research. These approaches target employees and employers, as well as newcomers, international students, and others. And they're all in place to help more people, from more backgrounds, find success in the engineering profession. If we choose not to make these efforts, the identified issues will only become more difficult to deal with, and more urgent.

74%

of female respondents were under 50 years old, compared with 46 percent of men; this reveals an opportunity to reduce the gender gap.

71%

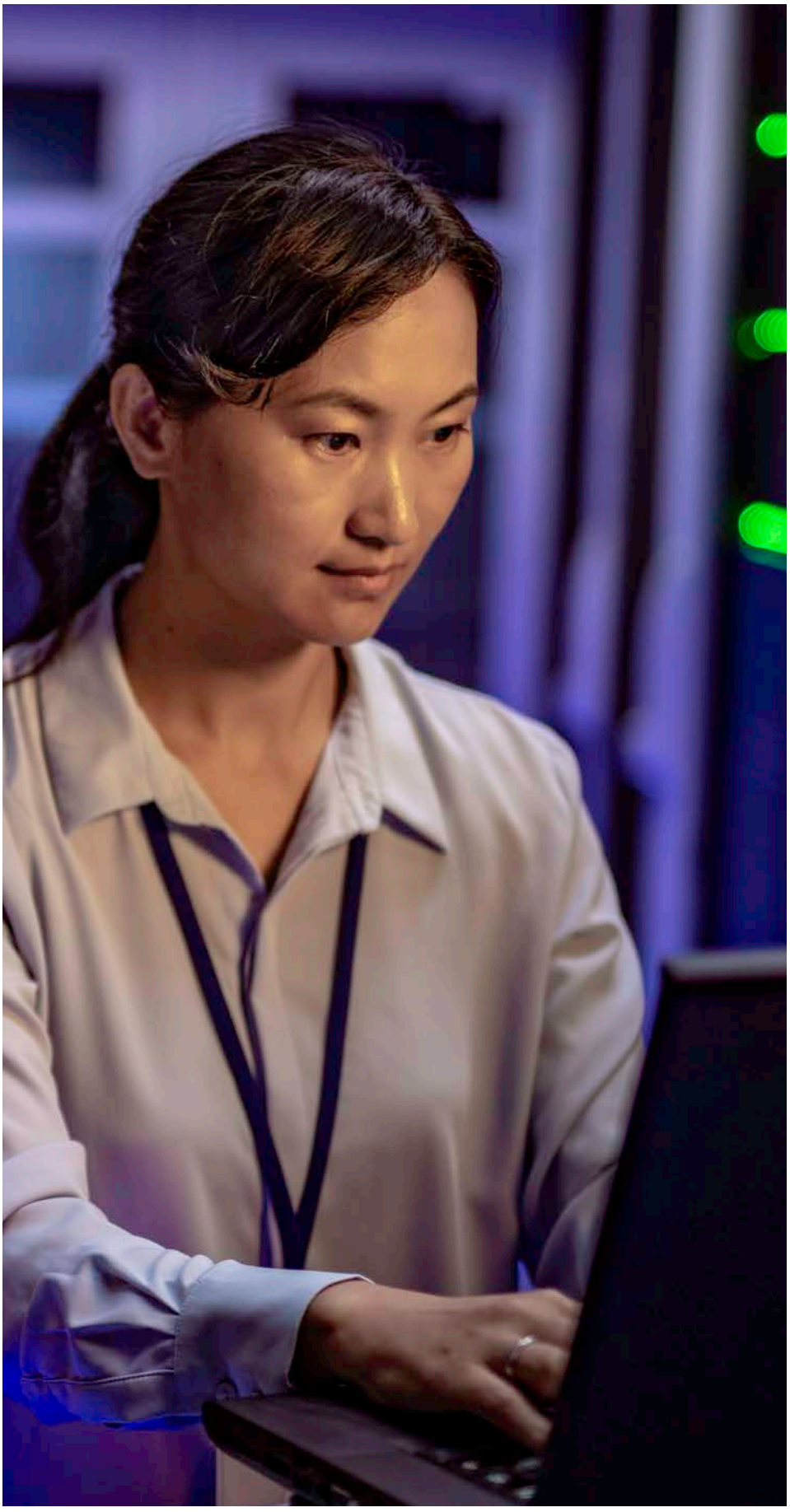
of female respondents said there is a lack of gender representation in engineering.

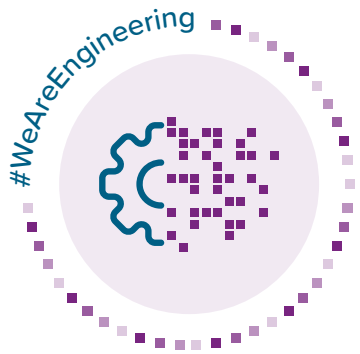
58%

of female respondents viewed the profession as struggling to keep up with the needs of modern society. They see the profession as less inclusive and merit-based than their male colleagues do.

57%

of female respondents felt a sense of accomplishment, compared with 69 percent of men.





WOMEN IN ENGINEERING

The number of women in engineering is growing fast, but what kind of welcome are they finding?

One of the most striking disparities in the data was the difference between how men and women experience their engineering education and careers. While female respondents were clearly proud of their work, they were more guarded in their enthusiasm.

Female respondents were less likely to believe that the profession is broadly respected or that it contributes ground-breaking innovations. They were much more likely to note a lack of gender diversity (as well as overall diversity) in their workplaces and in the profession as a whole.

At the same time, women were more likely to believe that the engineering profession is resistant to change (40 percent, compared with 32 percent for men), and were less likely to believe that the profession is "up to date with the needs of modern society" (58 percent, compared with 68 percent for men).

Finding Success Outside of Engineering

Differences were especially noticeable among younger women. Those in the industry less than 10 years frequently flagged limited job and co-op opportunities as barriers to advancement, further limiting their engagement with the field.

Unsurprisingly, given those findings, only 48 percent of women indicated they were currently working as professional engineers, compared with 59 percent of men. Of the women respondents, 36 percent indicated they were employed in a related field, but not licensed as an engineer. Only 27 percent of men indicated the same.

Most striking, however, was one undeniable fact: only about one-fifth of respondents were women, indicating a significant gender imbalance in the profession.

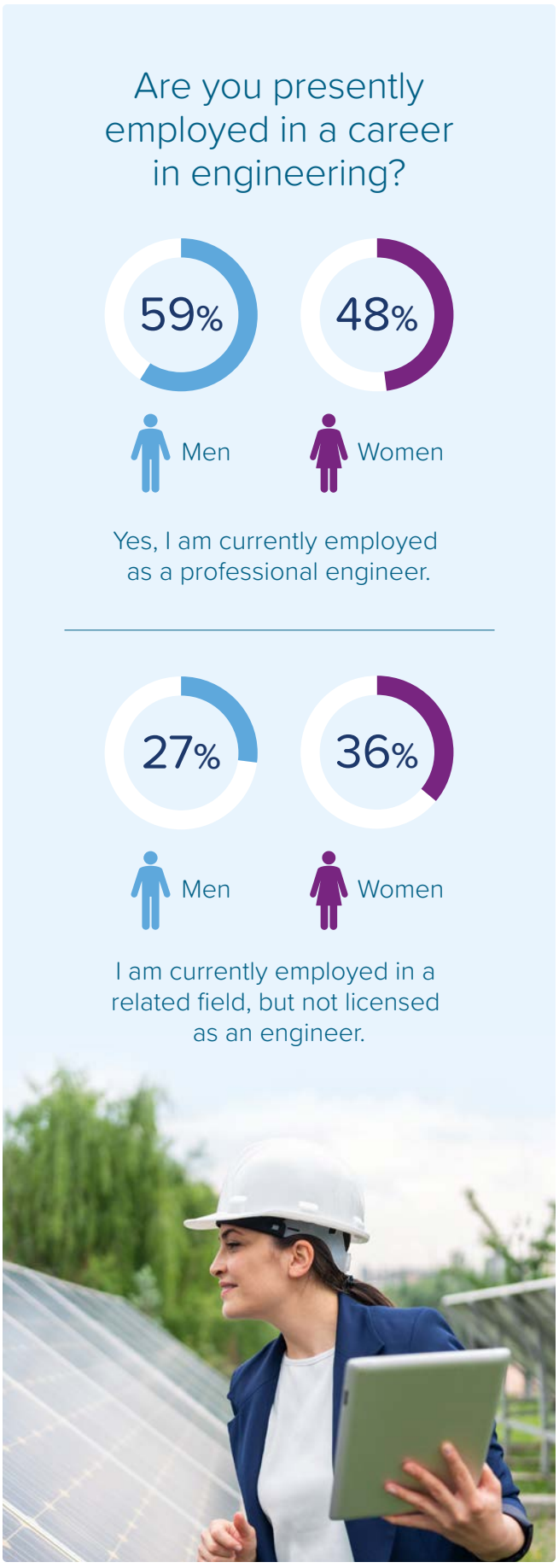
However, that figure changes among younger engineers and engineering graduates, where women were much better represented among recent graduates. Of all women surveyed, 75 percent were under 50 years old, compared to about half of male respondents.

There are clearly systemic barriers limiting women's participation in the field and driving some talented engineers toward other lines of work.

Positive Signs

Together, these findings suggest a profession that is moving, albeit belatedly, toward more equality and equal representation for women and men. But there are clearly systemic barriers limiting women's participation and slowing the transition, driving some talented engineering professionals away from the field and toward adjacent lines of work.

As older engineers and engineering graduates reach retirement, it will be critical—both for social equity and for the health of the profession—to tear down those barriers and ensure women are welcomed, respected, and valued.



Q&A with Dr. Marilyn Powers, P.Eng.

President and Chair at OSPE & Director, Academic Technology Integration & Innovation at Mohawk College

This research shows that many women feel less welcome in our profession. They also feel less certain that success is based on merit. What do you make of those results?

Let's break down merit: we've had merit defined in a certain way for a long time, or worse yet, not well-defined, but something that goes by gut feeling. Time and time again in my career, I've heard, "Oh, that guy, he's competent. He's done this and that and this," even though he might have failed at this and that and this other thing. Whereas women will often find their failures held against them. For whatever reason, very often in the profession, we do see men getting judged on their successes and women on their failures.

It's not surprising, then, that women may find more roadblocks or take longer to break into the field.

No. You end up with an over-rotation on those who are determined to have merit. That also may mean a certain kind of technical expertise, but not soft skills that are increasingly needed in the world today.

And then, this is a broader issue around diversity, but you miss out on designing for everyone. When you engineer for the people at the table, you end up with something that works brilliantly for those people, but may miss obvious design flaws. This has been shown over and over in research. A classic example of this is seatbelt design—decades ago, cars were designed with an average male in mind, and that included the fit of seatbelts. The result was that women were much more likely to be injured or killed in accidents.

We do see more women enrolling in engineering degrees or programs. Do you think the shortage of women in the field will self-correct, to some degree?

Probably in part, but we can't rely on that doing the job for us altogether. It won't self-correct if we're laissez-faire about it. If new people and graduates enter the field, they're still entering a system that works a certain way, and if it serves them well, there may not be enough reason to work to change it.

What is OSPE doing to address these issues?

This is a great opportunity for OSPE. We have the Ontario Engineering Academy (OEA), which has courses and is building out more on topics related to equity, inclusion, and accessibility. And we're looking now at how we can support companies to bring that to their internal cultures—tools and resources they can use easily—and help them incorporate them.

I'm optimistic because I know the interest is out there, I know the profession is more and more aware of the need to create that change. But we need that guidance and knowledge to help make the change real.

20%

of International Engineering Graduates were not working as engineers, or even in a field requiring engineering training.

42%

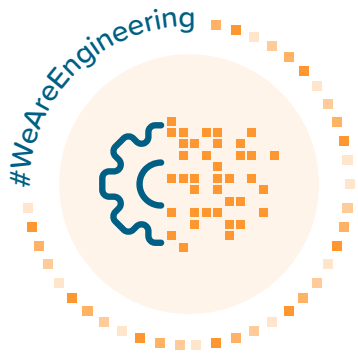
of International Engineering Graduates reported concerns about lack of cultural diversity.

50%

of International Engineering Graduates found the licensing process too costly.

71%

of International Engineering Graduates found schooling too expensive.



INTERNATIONAL OUTLOOK

What does a more diverse, more global workforce mean for the future of engineering in our province?

Where can we find Ontario's engineering future? In large part, all over the globe. Though International Engineering Graduates (IEGs) represented only one-quarter of our respondents, they are a fast-growing and especially enthusiastic part of the province's engineering workforce.

IEGs are more likely to have decided early in life to pursue engineering, in part owing to an inherent respect for its social importance. Globally educated and experienced engineers and engineering graduates in our survey exhibited even greater pride in the profession than domestically trained engineers and engineering graduates, as well as more enthusiasm for new innovations and greater interest in pursuing novel technologies and sub-fields.

And, of course, they bring with them greater cultural, ethnic, and linguistic diversity, as well as greater diversity in training, skills, and specializations.

That's why it's critically important that IEGs, who can choose from any number of jurisdictions around the world, feel at home in our province.

Warning Signs

But it's not all good news. Unsurprisingly, IEGs were also more likely to express concern over issues of equity and were less likely than domestic engineers and engineering graduates to feel welcomed in Ontario's engineering community after graduation. They noted more limited job opportunities, a lack of cultural diversity in the profession, and excessively costly licensing.

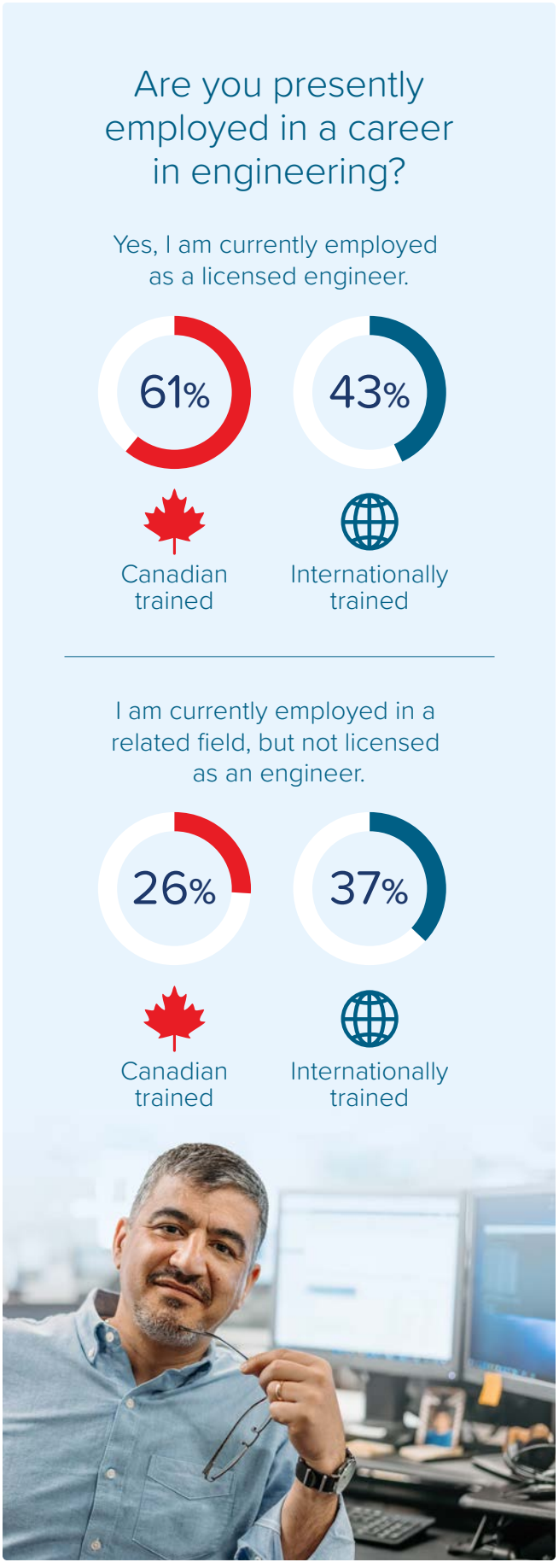
They are also less likely to believe a P.Eng. is necessary for their careers and less likely to pursue one. Only 43 percent are currently employed as professional engineers, compared with 61 percent of domestically trained engineers. Of those who responded,

20 percent were employed in neither engineering nor even a related field.

International Engineering Graduates are passionate and enthusiastic, but barriers to employment may limit their ability to contribute to the profession.

What Can We Take From This?

IEGs are some of the most passionate and enthusiastic members of our profession, with an eagerness to try new ideas and to apply classical engineering skills and aptitudes to today's world. But the barriers they face finding employment may limit their ability to contribute in the future, ultimately undermining the health of the profession overall.



Q&A with Anna Gkalimani, P.Eng.

Former Board Director at OSPE,
Project Manager/Structural Engineer
at Westinghouse Electric Company

What has been your experience in Ontario as an International Engineering Graduate and professional engineer?

I moved to Canada in 2013 from Greece, where I worked as a civil and structural engineer. I joined OSPE shortly after and joined several committees, and I've met a lot of international colleagues that way. And the ideas identified in this research, and barriers to success, definitely reflect the experiences many of us have had.

What kinds of barriers?

One of the most significant is simply the lack of connections—co-workers, students, professors—the network you build in school and those first years in the field. This is an enormous obstacle that domestic engineers don't have to deal with. And then on top of that, we're in a different culture, where social norms are different, specific behaviours and customs. This is all about those soft skills, and someone who has very good soft skills from their home country may not be as well-adjusted to life in Canada. So that's a difficulty.

But the bigger issue is of course the one of diversity. What strikes you about coming to Canada as a newcomer is how diverse it is, especially in Ontario and our large cities. But our profession often doesn't reflect that there are plenty of engineering jobs. These jobs need to be filled, but we lose the talent that could fill them because licensing is costly, and because people who come here may be a few years out of school, they are mid-career, they have busy lives, maybe families, and the process of studying for the exam can be more difficult. But not having your P.Eng. can make it more difficult, and in the meantime, there are other jobs, other fields, that may be ready to use your skills.

What can be done to improve outcomes for IEGs?

One issue is a culture that has developed, where if you don't have Canadian experience, you're not qualified, regardless of what you've done in your career. It needs to become easier to turn international experience into domestic opportunities.

And part of that is who you know, and developing contacts and new networking opportunities, and OSPE is a great place to network. They have many workshops, events, and valuable opportunities like that, which helped me a lot. It's a great place to start as you're building your networks and contacts.

71%

of respondents agreed that a P.Eng. should be required to work as an engineer.

55%

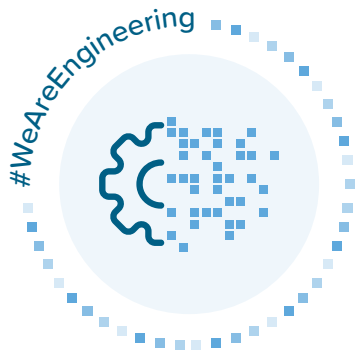
of respondents believed a P.Eng. is necessary to ensure quality standards are met.

32%

of respondents who pursued non-engineering education opted for an MBA.

22%

of respondents without a P.Eng. don't see it as relevant to their career.



THE FUTURE OF THE P.Eng.

Is the P.Eng. licence losing relevance as the very definition of “engineering” shifts underfoot?

The P.Eng. licence has long been a point of pride for engineers, signalling competence, high standards, and a strong sense of professional ethics. Yet while the research shows that engineers are proud of the P.Eng. designation, more and more see it as less relevant to their own career needs—an effect likely exacerbated by the trend away from core engineering disciplines, for reasons discussed elsewhere in this report.

This trend is particularly pronounced among IEGs. Of the IEG respondents to our survey, 45 percent had a P.Eng. designation, while 61 percent believed that the designation is necessary to identify as an engineer. This signals that 39 percent of IEG survey respondents value their engineering training and way of thinking over the designation itself.

Compare that with domestically trained engineering graduates, of whom 68 percent had P.Eng. designations and 74 percent believed the designation is necessary to identify as an engineer.

Does the Industry Value Other Credentials?

“I’ve never needed my professional engineering licence to work, and I’ve never been asked for it,” says Dr. Marilyn Powers, P.Eng., President and Chair of OSPE’s Board of Directors. “I have gotten jobs because people have said, ‘Oh, you’re a P.Eng.,’ but I’ve also left it off resumes so that I could get a job. Certainly, getting into the technology world is where people begin leaving out the P.Eng., because there can be stereotypes associated with it—that you would be too expensive, or be overly technical.”

Indeed, many of today’s fastest-growing and highest-valued start-ups were founded by engineers, or feature engineers on their executive teams. They bring their analytical expertise and engineering skillsets to their work—even if they don’t identify themselves first and foremost as engineers.

“An MBA is more respected by industry than a P.Eng.,” says OSPE CEO Sandro Perruzza. “Every year I go to the Ontario Economic

Forum, where they showcase up-and-coming start-ups advancing new technology that they believe is ground-breaking. Most of those companies are founded or operated by engineering graduates, and many are professional engineers. But do they put P.Eng. in their bio? No, they say, 'So-and-so graduated from the University of Waterloo's engineering program.' But then it will talk about their MBA, and that will be the designation they use, because they find it more professionally valuable."

"People begin leaving out the P.Eng. [from their CV], because there can be stereotypes associated with it."

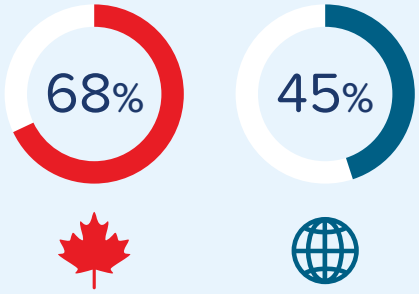
–Marilyn Powers, P.Eng.

What It Means

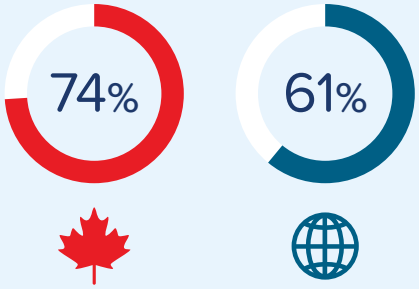
The waning relevance of the P.Eng. for some engineering graduates, especially international and younger engineering graduates, is driven in part by this move away from core engineering fields and into other professional sectors. Some of this shift may be a result of the difficulty and expense of licensure. And still more of the change may be driven by the possibility that the licensing process itself hasn't caught up with the explosion of new engineering disciplines and fields, an idea we'll explore here.

Do you intend to pursue P.Eng. licensure in engineering?

Responded Yes.



Strongly or somewhat agree that the P.Eng. is required to identify as an engineer.



Q&A with Nicholas Burgwin, P.Eng.

Treasurer, OSPE,
Co-founder, FIBOS

What did you make of this research?

I wasn't surprised. I work at the University of Toronto in a contract teaching role, and that's why I have my P.Eng. Their strong preference is that all staff have it for accreditation purposes, but if not for that, I probably wouldn't have it. I'm the co-founder of a company that's developed an optical-sensing platform for industrial uses, and for what I do day-to-day in the industry, it's not necessary.

Is this something you see more among colleagues?

Absolutely. I think in some ways this reflects the movement of people out of core engineering fields, but I also don't think we can look at that as a bad thing, necessarily. We have new and emerging industries, and engineers who are bringing their knowledge and skills to those fields.

> Our regulators need to do a better job keeping up with emerging fields that maybe should require regulation, or maybe do need that stamp. Traditionally that's infrastructure, energy systems, mechanical systems, civil systems. But the need for the stamp is driven by the demands of the customer, and regulators need to encourage new industries to have oversight if it's necessary.

What are some possible examples?

You can think of medical engineering, or the engineering attached to medical devices, or emerging fields like bioengineering, where lives are on the line in a very immediate way. Certainly, consider cybersecurity, which has never been more important. Think about the future, about autonomous vehicles.

Is it fair to say that this kind of technology is a sort of infrastructure itself?

Yes—it's a new type of infrastructure from the IT space and from technology. And oversight may become more and more necessary.

Is the popularity of other designations, such as the MBA, a positive trend for the profession?

I think that's a mixed story, but positive in some ways. Diversity in terms of education or opinions in the engineering field is valuable; it certainly helps to have a broader set of opinions at the table.

A lot of things that a P.Eng. signs off on are also going to be influenced by what an MBA is doing, from a pricing perspective, sales perspective, and you need to deliver something safe that also makes sense from a business perspective. It's important to connect these different ideas and opinions and areas of knowledge.

WHAT'S NEXT?

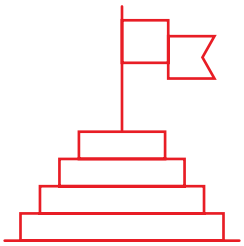
How OSPE is preparing today for tomorrow's challenges.

The transition in our profession from one generation to the next isn't just on its way, it has already begun.

We must make sure to clear away the stumbling blocks in the way of that transition—those obstacles that may slow progress or drive away talented people.

Future Goals

- We expect that the data outlined in this report will only become more pronounced, which is why we intend to repeat the research at regular intervals.
- We must promote the work that OSPE is doing to address these barriers: the Ontario Engineering Academy, dedicated OSPE representatives to work with engineering students, and DiversifySTEM (OSPE's diversity and inclusion platform).
- We want to engage everyone in the engineering community in a conversation about solutions.
- We will speak up and out to stakeholders, consulting firms, regulators, and business leaders to ensure everyone understands the issues.
- We want OSPE to be the home for the full engineering community of Ontario, where everyone with a B.Eng. is invited to use their skills to solve these challenges together.



This report was compiled from the results of an online survey conducted in May 2022 among 821 engineers and engineering graduates in Ontario, 20+ years of age.

Data have been tested for statistical significance at the 95% confidence level.

#WeAreEngineering

Meet our members and learn what they do and why it matters at ospe.on.ca/weareengineering.

Sandra Odendahl, P.Eng.
OSPE Member

"The superpower of engineers is problem-solving."

Gary Tamber, P.Eng.
OSPE Member

"In 2022, $2 trillion was spent on digital transformations. By 2025, that number is expected to go up to $3 trillion."

Nick Mocan, P.Eng.
OSPE Member

"Engineers have the ability to change the future for the better. Not many professions can say that."

Montana Wilson, P.Eng.
OSPE Member

"I see OSPE benefitting Ontario engineers just by connecting us. We're stronger together than we are apart."

Kam Leong, P.Eng.
OSPE Member

"If you think like an engineer, you'll be able to do things you never thought you could."

Manraj Pannu, P.Eng.
OSPE Member

"When I look at engineering as a whole, we permeate so many aspects of life."

ONTARIO SOCIETY OF PROFESSIONAL ENGINEERS

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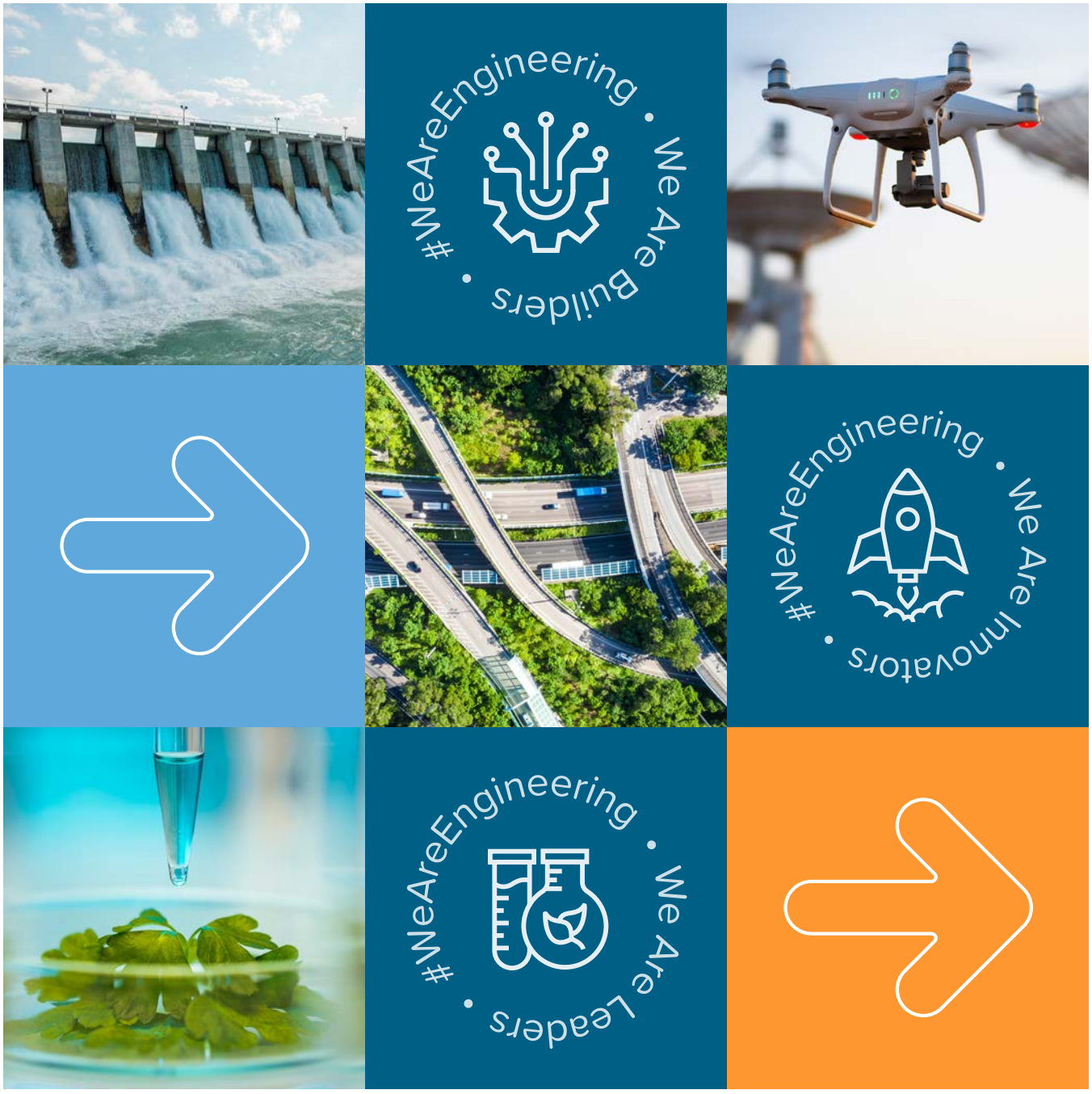

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