

Engineers Australia ACT branch

Butters Oration: Realising success in the emerging industries: The role of leadership

Dr Cathy Foley

Tuesday 8 November 2022, National Press Club

Thank you, Belinda, for that kind introduction.

I'd like to first acknowledge the Ngunnawal people, the traditional owners of the lands on which we meet. I acknowledge the elders who are caring for those lands. I pay my respects to the old ones who have come before and the young ones who will follow. Our First Nations people are also the first engineers – the Brewarrina fish traps in northern NSW are examples of knowledge and endurance that we can only learn from and respect.

Thank you for inviting me. I always feel at home among engineers.

I've been enjoying reading about the work of Sir John Butters in preparation for today.

I discovered he was given just two years to complete the construction of old Parliament House when he took on the job in 1925. Then he was told that the entire central office of the public service must also be accommodated in Canberra. At the same time, he was responsible for construction of the Lodge. And the historic Barton hotels, West Block, Albert Hall, the National Film and Sound Archive building which was then the Institute of Anatomy, and the Australian Forestry School in Yarralumla. As well as 500 cottages!

1926 was a formidably busy year for construction in Canberra.

Kudos to Sir John Butters. I admire anyone who achieves so much in such a short time, especially when they're navigating federation politics, bureaucracies, and momentous questions of state. Clearly, engineers know how to get things done.

But his achievement was not simply to get things built. His achievement, and the achievement of the Commonwealth architect and the team around him – was to get beautiful things built.

Each of these buildings has elegance, solidity and longevity. And 100 years later, we want to protect them not simply because they represent history, but because they are the most beautiful buildings in the city. Even today.

I was reminded, when I was reflecting on this, of my mother's work as an architect with NSW Railways. She designed the terrazzo map of Australia which is laid into the floor at Sydney Central Station. It's still there, and every time I walk through the station, I think of her, and of the value of history.

Canberra is such a fascinating city. The preponderance of government gives the city an influence beyond its size. Decisions are made here that set the direction of the nation; that define the ambition and the nature of the nation. But the flipside of that is, things can take time. There's an inertia in consequential decisions and big weighty systems.

The scrupulous planning of Canberra gives the city great underlying beauty through symmetry and green spaces. But that tension between the tightly planned vision of 100 years ago and the way people live now. There are two layers of planning in Canberra, which adds complexity.

It was a city built for the car, and now the big challenge for the engineering profession is how to get the tramline across the lake!

**

I've been reflecting on these things as I prepared to speak with you. And it seems to me that as we come up against moments of big change, as we launch ambitious national agendas and seek to unlock new industries and capabilities, we often face a similar set of questions:

- How do we preserve what is good about the past without becoming constricted or defined by it?
- How to preserve good ways of operating, at the same time as we reinvent our businesses and organisations for the future?
- How to safeguard our businesses and institutional reputations as we embed flexibility and discovery, experimentation and risk?

Australia has an ambition to play a new role in the semiconductor supply chain, to expand the extraction of critical minerals and value-add through midstream processing. We aim to be a key supplier in the global shift to renewable energy, to develop new submarine capabilities, and new capabilities in space and defence. We have ambition in biotechnology, agritech and quantum technologies.

The scale is really significant. There's a remarkable confluence of technology with agreement on goals – within Australia, but also among our international counterparts. There's goodwill and eagerness to invest. And there's a deadline, which creates momentum and a sense of urgency.

All of this comes together to create an opportunity for Australia to lift the complexity of our economy, and embed ourselves in the global supply chains for high-tech manufacturing and renewable energy.

Your profession is in the box seat. These are tasks for engineers!

So, how to make it work?

First, we must tackle the skills challenge from all angles.

I'm sure you're well aware of the numbers – a near 200,000 shortfall in IT and tech, 8000 jobs on the horizon in hydrogen, 16,000 in quantum. There's a bit of overlap in these figures, but they give a sense of the scale of the job opportunities and of the ground we have to make up.

I know you've done a lot of your own thinking and analysis in the engineering profession. I note Jane MacMaster's comment that Australia is experiencing perhaps its greatest ever engineering skills shortage, with at least 50,000 engineers needed across nearly all sectors of the economy this decade.

There's a structural issue when we graduate more overseas students than home-grown students, and when more than half of our engineering workforce was born overseas. It's a concern that engineer-trained migrants are not always working in the profession. I heard at our most recent STEM Champions of Change meeting that female engineers born overseas have almost three times the unemployment rate of those born in Australia. Skilled migration is part of the solution. But I know you agree with me that it's far from the only solution.

It's striking that Australia has one of the lowest rates of engineering graduates in the OCED. Just under 9 percent of our university graduates are in engineering. The equivalent figure in Japan is 18 per cent. And in Germany, almost one-quarter of tertiary graduates are in engineering.

So Houston, we have a problem!

As with most problems, each of us has a role to play. I know the Government is very focussed on boosting skills, and announced more university engineering places in the budget. There's work to be done in microcredentialing and upskilling – and I know your organisation is switched on to this, which is great to see.

I'm working with the National Science and Technology Council on a STEM career pathways project that I hope will have a real disruptive impact on this difficult issue.

One of the most important tasks is to ensure children are getting the right grounding in maths and science right from kindy up – and then sticking with those subjects through Year 12. This is a task for the curriculum and for specialist teaching, and it's also about visibility of the science careers so young people can see a clear pathway.

I often wonder why people have such a single-dimensional picture of an engineer, based on big infrastructure, high-rises and bridges, when the reality is often so different. I'm an engineer, of a kind. My predecessor Alan Finkel was an engineer. Neither of us built actual bridges.

Engineering is increasingly a qualification that will lead you into an electronics career, semi-conductors or quantum computing, or into a career in space or defence, into robotics, biotech, or into the renewables sector, developing solar and wind technology.

This is the world we are in – and the task of us as leaders in science and engineering is to embed that reality into the public consciousness. And inspire our kids with it.

Once we've done the hard work of inspiring people to follow an engineering career and they've got the qualification and hopefully entered the profession, we need to keep them there. It's striking how many qualified engineers are lost to the sector. Once they're in the workforce, our qualified, trained engineers should be feeling the love. They should be seeing this as a career which can be about discovery with a real sense of purpose.

In my field, electrical and electronic engineering, 9 out of 10 graduates are men. It's no wonder I spent much of my early career as the only female in the lab.

It's not easy to shift the dial when the disparity is as large as it is in your profession but I know you're well aware of these issues and working hard to address them.

I hope that hard work is also being done in every individual workplace. My suggestions are to think deeply and honestly about your workforce. Consider the proportion of women. Consider whether you have women of all ages, and whether women are equally represented at different levels of the organisation. Take a hard look at rates of pay. And then ask yourself why the disparities exist and how you can close the gap. Understand that this means meeting women on their own terms, especially while they are caring for children.

This isn't charity. It's not only a question of equity. This is absolutely about the success of your organisation into the future.

You might have seen the stories about "Ada" – the ultra-realistic robot artist which appeared before the UK House of Lords last month. Ada is referred to as a female. I have to say I'm pretty uncomfortable with the female attribution of artificial intelligence. But this was deliberate on the part of the engineers and designers who built this robot.

Ada was given a female persona to provoke the debate about the male domination of the robotics, AI and tech communities. Ada was also made an artist to spark debate about creativity in a world of artificial intelligence.

These are fascinating questions. They're also important questions as we develop the algorithms that dictate how AI behaves. And it's one of the central reasons that we keep talking about diversity in the tech fields, including engineering. A human-machine interface, a new piece of tech – any piece of engineered infrastructure – will limit its relevance and usefulness in the real world if it is designed by just one subset of the community.

Maybe this is why it took five thousand years before someone thought to attach a wheel to a suitcase!

So as you work on getting more people into engineering and ensuring your profession is set up for the capabilities of the coming decade, I encourage you to take the diversity message

to heart. And to take an active role in making sure we're training the right people by reaching into and collaborating with the education system right from school to VET and university.

The second thing I want to raise with you today is the role of basic research in the emerging sectors.

I said earlier that Australia has an opportunity to embed our economy in the high-tech supply chains and the global demand for clean energy and low-emissions technology.

But the truth is that the precise path is unclear. It's like heading on a family holiday. You might have the destination booked and the route planned, but you also know that any number of challenges will plague the execution!

Yes, we have research expertise, natural advantages, an excellent regulatory system and other things on our side. But we're entering a new world and we need new capabilities. The reality is that some of the technology to get to net-zero hasn't been invented yet. We're still working out how to produce green steel, and how to make green hydrogen more efficiently. We need new battery technologies. New technologies for recycling.

The same can be said across any number of the sectors where we have an ambition. Australia's involvement in minerals processing, semiconductors, in the space industry, in nuclear submarines – is nascent.

Quantum technologies will unlock fundamentally new capabilities in encryption, sensing, communications and computing. They will be disruptive, and to realise the full potential, we will have to find ways to integrate quantum capability across our economy. Building understanding and capability at the same time we focus on research. I've said before that the language of quantum needs to be part of our kids' backpacks. It also needs to be understood across our broader research, innovation, government and business communities.

What all of this means is that for each of the emerging sectors, a significant research effort is needed. This effort has to be alongside the efforts to commercialise and scale-up the new industries. We don't have the luxury of time to move in a linear way from research to experimentation, to innovation, commercialisation and scale. We have to do all of these things at the same time, and work on all of these things together, collaboratively.

I said earlier that I've never built an actual bridge. But I'm going to stretch the metaphor and say that, as Australia's Chief Scientist, I'm in the business of building metaphorical ones – to try to bring those different parts of the system together, which is the only way we're going to achieve the task of discovery, innovation, commercial application and scale-up all at once.

One of the things I'm urging business to do is take a much greater role in research and development – and to understand that the pay-offs are not instant and not always even obvious.

Australia's task is not simply to get better or more efficient at things we're already doing, to refine existing competencies and technologies. The task is to change the way we're doing things. So that we become competitive in those frontier sectors. This means being adventurous in our choices, in the way we run our organisations, and where we choose to invest.

There are obvious risks in investing in exploration, in new ideas and approaches. But this is where the gold lies.

I'll come now to some specific comments about leadership, which is related to these questions that I've been raising – how to reinvent our organisations for the future; and embrace discovery.

It's interesting to me how often I'm asked to speak about this topic. I'm sure most of you in this room would have valuable insights as useful as my own. After all, most of what we know about leadership comes from experience.

One of the paradoxes is that we've often had 20 years, or more, in our careers before we become workplace leaders. This means the environment in which we're leading is very different to the environment in which we developed our careers.

Of course, the fundamentals are the same. Trust, integrity, inspiration, agency. But the culture of the workforce is quite different. The shape of the workforce, and the expectations, are quite different. Engineering is not the same profession it was when you and I were at university. And whatever we think it is today, this year and next, it will look very different again 20 years from now.

As leaders, we're shaping our workplaces for the future.

And so my observation is that the best leaders are perhaps not those who run an organisation according to what has worked in the past, the tried and true.

But those who are able to recognise what's of value in their own experience and apply it to a very different set of operating conditions.

None of us can predict the future. Who would have predicted Elon Musk would be the owner of Twitter? It sounds like not even Elon Musk himself quite predicted that outcome!

But in that simple act of recognising and accepting unpredictability, you orient yourself in the right direction.

Let me finish by telling you about one of my most challenging leadership experiences. And yes, it has a Canberra angle!

At one point I was Chief of Materials Science and Engineering at the CSIRO. It was a big job, 800 staff at the peak, and a \$120 million budget. But we faced the budget chop. In one bracing Budget night, CSIRO lost 20 per cent of its funding – and a lot of the impact fell to

my division. Many staff lost their jobs. I kept my job but lost my role. It was a really tough time, and for a while there, I felt hard done by and wallowed in my misery. As I said, Canberra has its unique challenges!

But what I soon found was that the change freed me up. When I was holding the levers, as chief of the division, it sometimes felt like I spent my time dealing with bike-rack problems. Who gets the parking space? But when I no longer held the levers, I had the freedom to develop future plans, to do some deep thinking about new directions and strategies.

That led to the CSIRO's Future Science platforms which are all about design-led research and planning. We worked on areas such as developing new materials and new ways of doing sensing. We combined this with AI, and it led to major new capabilities that has positioned CSIRO well and ahead of the game. I would never have been able to do that if I had stayed in the line-management role.

This isn't just a story about picking myself up and carrying on. Although we all know that's important. The take-home message from me is that you don't have to be in control to lead. In fact, maybe you can be more successful if you're not! Having to do the hard work of coming up with new ideas, having time for design-led thinking and planning – that was all really valuable. And then learning to use influence to bring those ideas through when I didn't have my hands directly on the leadership levers.

So this is the thought that I want to leave you with.

We're engineering a new economy. We're dealing with disruptive, unpredictable technologies, we're looking for new solutions, and the scale of the task is often daunting.

I've talked about the need to come together if we're going to achieve these goals – to build those metaphorical bridges. But the reality is that each of the sectors of our economy, and each of us as individual leaders, has to take responsibility for this transformation.

We will be most successful as a nation if we all, in our own organisations find ways to free ourselves from the bike-rack problems; avoid the trap of the tried and true; actively pursue diverse and fresh solutions. And then make like Sir John Butters – and help create something that stands the test of time.

Thank you.

##