



# Changing the Construct

Funded by the Government and led by a Distinguished Fellow of IPENZ, an impressive group of organisations and individuals are working hard to broaden and increase the pool of engineering graduates.

**Writer** Aidan Rasmussen



White. Male. University-educated: this could describe any number of professions in any part of the world. But when you add civil, structural, or roads and bridges to the end of these descriptions, you get the New Zealand public's perception of engineers. This barely reflects the variety within an industry that includes such fields as software, biomechanical or environmental engineering. It also presents a significant barrier to attracting a diverse range of people - like women, Māori and Pasifika - into engineering, which means fewer students are considering it as a career option. The result? A significant shortage of engineers in this country.

On the face of it, this might seem to be a problem for only one sector of industry or society. But talk to the people involved in turning this situation around and it becomes clear the misconception surrounding engineers, the lack of numbers and homogeneity within its ranks could forever chain us to our commodity-based economy.

That's not to say efforts haven't been made to raise the profile of engineering as a profession. Techlink, a partnership with IPENZ and Technology Education New Zealand (TENZ), promotes teaching and learning in technology from early childhood through to career. Futureintech, another IPENZ outreach initiative funded by Callaghan Innovation and Ministry for Primary Industries, trains and sends "Futureintech Ambassadors" from the science, technology and engineering industries into schools to inspire future generations. Then there are the initiatives run by educators like Canterbury Institute of Technology that has a dedicated STEM (Science Technology Engineering Mathematics) co-ordinator who works closely with schools in its region. Or, the open days, and graduate and mentoring

programmes carried out by engineering employers like Beca, Fonterra or Fletcher's.

As valuable and successful as these programmes are, according to the Government we're still short 500 engineers each year. Which begs the question - what are they doing about it?

### **Giving engineering education a boost**

During the past four years, the Government has allocated over \$60 million to boost engineering education to generate the additional 500-plus engineering graduates per year from 2017. This, the Government hopes, will provide the impetus for the technology and innovation-led economy we require if we want to compete internationally.

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That figure - 500-plus new engineers per year - came from several research projects, but the blueprint can be traced back to the National Engineering Education Plan (NEEP). Undertaken by IPENZ and released in 2010, some of the NEEP Report recommendations included a specific need for more engineers at Levels 6 (diploma level) and 7 (bachelor's degree or graduate diplomas and certificates), separate career progression models for those with qualifications in engineering or trades, better advice for students from secondary through to tertiary, and

greater awareness of minority groups.

"We identified we needed all these engineers. The Minister read the NEEP report and focused the Tertiary Education Commission's attention on it. The timing is right for this sort of activity because the Government is focused on increasing New Zealanders scientific literacy, improving the economy through technology and engineering," Angela Christie, IPENZ General Manager - Outreach, says.

This led to the Tertiary Education Commission (TEC) establishing Engineering Education-to-Employment (Engineering E2E) and asking Angela to act as its project manager. Set up in 2014, Engineering E2E is a partnership between the TEC, the institutes of technology and polytechnics (ITPs),




BusinessNZ, IPENZ and various organisations that employ engineers. Its main focus is to address the shortfall of Levels 6 and 7 graduates.

### **Leading the engineering education revolution**

One of Angela's first tasks was to select a steering group. It took little arm-bending to bring together an impressive array from the engineering, education and public sectors: Beca, Fonterra, Fletcher's, BusinessNZ and chief executives from four of the country's ITPs, to name a few. The biggest coup,

Opposite: Driving the Engineering E2E project, from left to right, and top to bottom: Angela Christie, Programme Manager; Grady Cameron, Chief Executive - Delta Utilities; Kevin Palfreyman, External Relationships Liaison Manager, Research, Science, Technology and Development - Fonterra; Lindsay Crossen, Chairman - Board of Engineering Diplomas; Mark Flowers, Chief Executive - Wintec; Michael Pervan, General Manager - Altitude Aerospace; Sir Neville Jordan, Steering Group Chair; Mica Moore, Programme Co-ordinator; Richard Muggleston, Senior Bid Manager - Fletcher Construction; Dr Rick Ede, Chief Executive - Unitec; Tony Gray, Chief Executive - NMIT; Carrie Murdoch, Manager, Education Skills and Trade - Business NZ; Kay Giles, Chief Executive - CPIT; Craig Price, Regional Manager - Beca Christchurch; Murray Johnson, Chief Advisor, Strategy - Tertiary Education Commission; Johnny Tramoundanas, Investment Manager - ITP Investment.



*"We know how many students we need at high school level doing physics, chemistry and calculus. Working backwards we know how many senior primary school students we need to feed that pipeline."*

perhaps, was securing the services of Sir Neville Jordan KNZM as the steering group's Chairman.

"Sir Neville was invited to chair the steering group because he is a Distinguished Fellow of IPENZ, and also because he comes from a field of engineering [electronics] that isn't traditional," Angela says.

Furthermore, he is also Victoria University's Chancellor, the founder of MAS Technology, a former AgResearch director and a past president of the Royal Society of New Zealand. Sir Neville has also won the Governor-General's Supreme Award for Exporting, has been inducted into both the New Zealand Hi-Tech and Business Halls of Fame, and funnels some of his wealth into his international private equity and advisory company, Endeavour Capital.

"I got a call from TEC one day and they said this Engineering E2E panel was getting formed and would I consider chairing it. I had been involved in a number of previous panels, both in Australia and here and it seemed

like a good use of my time to be able to assist the profession of engineering," Sir Neville says.

Kay Giles, CPIT Chief Executive and one of the steering committee's two Metro ITP representatives, says Sir Neville has been instrumental in linking together, then leveraging, the many diverse groups and stakeholders. "He's been the perfect person to drive the project as there are a lot of diverse interests involved and the industry is quite diverse as well. He's definitely recognised we've got an issue to deal with and problems to solve, and has just been very determined and calm in pursuing that," she says.

It also helps to know what you're working towards and which seeds need to be planted to reach that target. "For the first time the demand for engineers has been rendered down to a number and that number has been verified through a variety of separate sources. We know how many students we need at high school level doing physics, chemistry and calculus. Working backwards we know how many senior

primary school students we need to feed that pipeline," Sir Neville says.

That's 3,800 more students enrolling in maths and physics at NCEA Level 2 and 625 going on to study engineering at tertiary level, preferably at Level 6 or 7, where the main shortfall lies.

"They're studying engineering at BE Honours level, although it's not a particularly diverse group of people; very few women, very few Māori and Pasifika students. They're not interested in a BEngTech [Bachelor of Engineering Technology] - they don't even know about a BEngTech," Angela says.

### **Taking the initiative**

Engineering E2E is working to raise people's consciousness of what's available in the engineering and technology space. After almost a year of listening to and learning from their stakeholders, the steering group has developed a greater awareness of what is required to meet the Government's goals. That is, a collaborative cross-sector approach, better understanding of engineering as a career, improved links between educators and employers, and more flexible pathways to and through work. Armed with this knowledge they've created an action plan for the next two years that includes three categories of initiatives: Employer Engagement, Educational Delivery and Promotion. Some of these build on or leverage existing resources and programmes like Futureintech and Techlink, and what employers are currently doing.



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**The power of people**

Below: Electrical engineer and Futureintech Ambassador Ivan Nyo works with Year 7 and 8 students at Wainuiomata School to create their own electronic Christmas trees. Photo: Susan Weekes.



Right: East Coast students out in the field with electricity distribution company Eastland Network. Photo: Careers New Zealand.



“All these programmes have been started. This is a pretty well-structured work plan. It’s been well supported by TEC and IPENZ. The engagement from employers has been very encouraging. This is going to work,” Sir Neville says.

In June 2015, 25 chief executives and senior managers from across the engineering sector and representatives of engineering education providers attended the “Engineering E2E Talking with Employers” workshop facilitated by Geoff Scott, Emeritus Professor of Higher Education and Sustainability at the University of Western Sydney. Participants tested a Professional and Graduate Capability Framework built on studies of successful early-career employees in nine professions.

The Framework identifies the key personal, interpersonal and cognitive capabilities which, along with generic and role-specific competencies, make “work-ready plus” graduates. The participants discussed the capabilities their industries and the engineering sector value, and endorsed the Framework and the idea of replicating the study in the New Zealand context. They also considered the current and future engineering needs that could potentially feed into and help shape engineering qualifications.

One of the workshop’s key outcomes

*“The plan is underway and all the players are keen to change the face of engineering so our economy can be well and truly technology and innovation-led.”*

was the emergence of an engineering graduate archetype. Employers want “work-ready plus” individuals who have a strong grounding in engineering, and have interpersonal skills and emotional intelligence.

Craig Price, an Engineering E2E employer representative from Beca, says employers want “people who are strong communicators with all round skillsets, who are practical and pragmatic in their application of their technical and professional skills and think outside the box: people who are willing to engage in innovation and commitment to the profession and to themselves.”

Like many of the companies represented on the Steering Committee (and others that aren’t) Beca has been trying to promote engineering as a profession. Supplying Futureintech Ambassadors, for example, is one way they do this.

“It’s a natural extension to get involved in something like Engineering E2E. We’re a commercial business ... but we believe in the importance of having a strong profession and a strong industry. I think it’s really important for us to contribute so we can see an outcome. A key of our business is employing technicians, technologists and professional engineers that have come through the training system,” Craig says.

Five recommendations came out of the workshop and the Engineering E2E Steering Committee aims to “implement them all,” Angela says. One is for the curriculum to be changed to incorporate the Engineering E2E framework to provide students with opportunities to experience engineering across disciplines and get a better understanding of what it takes to be an entrepreneur. Another

*“Employers actually need to be involved in the business of education and tertiary providers need to be involved in the business of engineering much more intimately.”*

is to improve the way students and employees are guided into and then through their training so they come in at a level that fits their skill sets, while being given an opportunity to grow. Professor Scott has been asked to investigate the possibility of replicating a graduate engineering study he conducted in Australia. A report into the benefits of “staircasing” (developing common entry and exit points for qualifications so students can move smoothly between tertiary engineering programmes, from trades through to PhD level) is underway.

### **Educational delivery**

If engineering organisations want to be supplied with “work-ready plus” graduates then much closer collaboration between educators and employers will be required, Kay Giles says.

“Training really needs to be work-integrated. The training models need to be much more seamless between the institutions and the employers in industry. Employers actually need to be involved in the business of education and we [tertiary providers] need to be involved in the business of engineering

Below: Employees at Orion Health, who offer one of the largest intern programmes in New Zealand. Internships not only provide university students with experience in the industry, but also provide a valuable point of reference when applying for employment after graduating. Photo: Orion Health.

Opposite: Site Engineer Amy O’Donnell (left) left school after 6th form and chose a BEngTech (Civil) at Unitec as it “seemed like a more practical hands-on program with smaller class sizes”. From there Amy went on to work at Fulton Hogan where she is currently based.

much more intimately, so our students have those work-ready skills when they graduate.”

This could mean, in some instances, taking an apprenticeship-type approach to training, which is what *Stepping into One Another’s World: Apprenticeships - Transforming Engineering Technologist Education in New Zealand* recommends. Commissioned by Engineering E2E, the report’s authors, Massey University’s Professor Jane Goodyer and Dr Greg Frater discovered there had been a global resurgence of apprenticeships as a means for delivering higher education. Renaming apprenticeships “sponsored degrees,” this approach could provide employers with more well-rounded graduates. Because this learning method mixes the academic with the practical - leading to the acquisition of skills the students may not have been exposed to otherwise - it could attract a more diverse range of students. Earning as you’re learning might also be more appealing for less advantaged groups in the community.

“For companies that develop rapidly-changing technology, your Orion Healths, your Fisher & Paykel Healthcares, your Navicos - and those are the companies I’m talking with - they need people who are up to speed now. They’ve all said, ‘this is a really interesting idea, how might we progress it?’” Angela says.

Kay is more circumspect: “It’s complex stuff. You’re talking about evolving labour markets, changing economic circumstances, the impact of technology - a whole range of things. There’s no magic bullet, but that’s definitely one of the options we should be pursuing.”

One of Engineering E2E’s chief aims is to get more students studying engineering at Levels 6 and 7 at ITPs. To address this, they ran a secondary-tertiary pilot programme for nine months from April 2015. The pilot was based on the Techlink Pathways Project, which involved the Metro Group of ITPs (comprising New Zealand’s largest six institutes of technology and polytechnics.) That project identified three main issues ITPs must overcome: misalignment between secondary school programmes



and tertiary entry requirements; lack of awareness of qualifications offered at ITPs; and the belief studying at a polytechnic is inferior to university.

“I think one of the things we need to do is demystify it a little bit. You don’t have to be a super genius to do it [NZDE and BEngTech]; you do need to be able to do maths. There are a lot of careers in engineering that are accessible to a whole lot of people. There’s also this thing about engineering that makes people think it’s all about sitting in a room designing spaceships. Actually, there are a lot of jobs in engineering that have a lot of people contact and you can make a big community contribution,” Kay says.

The Engineering E2E pilot involved Weltec, Wintec and Otago Polytechnic working with schools in their regions to build more mutually beneficial relationships and provide programmes that introduced students to engineering and study. Results have been turned into case studies that can be found on the Engineering E2E website.

At the time of writing, a \$2 million national public awareness campaign was still in the planning stages and scheduled to launch at the time of print. Angela says “It will address the barriers as we see them. It’ll be telling stories essentially - what engineering’s all about; using real people. It will leverage the ITPs current marketing campaigns and what employers are doing.”

### Measuring success

After less than a year, how is the Engineering E2E project shaping up? If enthusiasm, engagement and action were a yardstick, Engineering E2E’s been a roaring success. Sir Neville’s leadership and Angela’s management have been invaluable co-ordinating and driving the project forward.



Case studies for the secondary-tertiary pilot programme are starting to roll in. Several companies are keen on the sponsored degree idea. To improve the quality of teaching and learning, regional workshops are being held with heads of school, human resource and professional development staff within ITPs. Employers are on board and stronger relationships are being built between them and the institutions that supply graduates.

Programmes to address the lack of diversity within the profession, which is one of the overarching aims of the Engineering E2E project, have yet to be developed. In this respect, a research project has been proposed with input from the Ministry of Education, New Zealand Qualifications Authority, Te Puni Kōkiri, the Ministry of Business, Innovation and Employment, Māori, Pacific Island Affairs and industry.

Overall, success depends on gaining an extra 500 engineering graduates per year from 2017. It’s too early to say if this goal will be met, but the plan is underway and all the players are keen

to change the face of engineering so our economy can be well and truly technology and innovation-led. As Angela says, “Look at the big problems facing us as a society - they need engineering solutions. We need some high tech answers to some of the more complicated problems we’re facing.”

Not only that, a more diverse, work-ready plus, broader-skilled pool of engineers can lead the way in freeing us from our reliance on primary industry and in turn improve the lives of all New Zealanders.

“We need engineers to be able to add value to the benefit of the whole economy,” Sir Neville says. “It’s that simple. If we don’t, we’re just going to be destined to ship milk powder or logs or unprocessed fish or meat - that’s not the way to prosperity.”

### Find out more

Get all the latest news and updates on the project at [www.engineeringe2e.org.nz](http://www.engineeringe2e.org.nz)





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