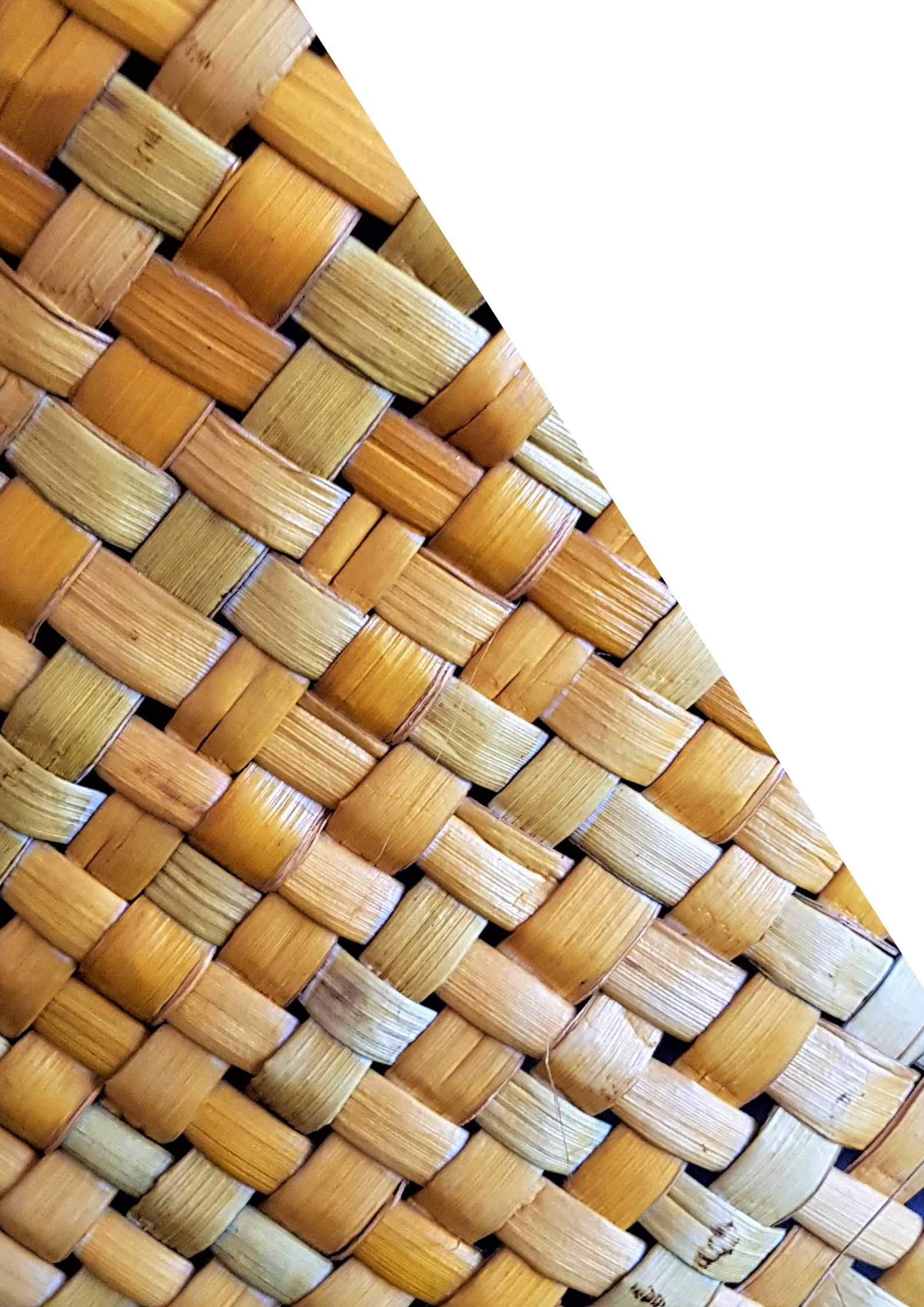




A roadmap for development

Best practice in the delivery of the NZDE and
BEngTech



Prepared for the Tertiary Education Commission
Level 10, 44 The Terrace
PO Box 27-048
Wellington, 6011
New Zealand

March 2019

Authors

Edmonds, Michael and Mischewski, Brenden

Every effort is made to provide accurate and factual content. The authors, however, cannot accept responsibility for any inadvertent errors or omissions that may occur.



This work is licensed under the Creative Commons Attribution 4.0 International licence. You are free to copy, distribute, and adapt the work, as long as you attribute the work to the TEC and abide by the other licence terms.

Where are the opportunities? Engineering enrolments are growing quickly in New Zealand overall, but enrolments in the NZDE and BEngTech lag those of other engineering programmes (Mischewski & Edmonds, 2019). A key reason is that the NZDE and BEngTech are seen as a second-choice option by local students (Mischewski, 2017), (TEC, 2018) and key population groups are underrepresented among engineering learners (Mischewski & Edmonds, 2019).

The lack of demand for the NZDE and BEngTech is problematic because New Zealand needs more engineering technicians to support innovation-led economic development (IPENZ, 2010). Research into the capabilities of recent engineering graduates also suggests that they may not always have the skills and competencies to be work-ready (Scott, 2015), (Naylor, 2016).

What did we find in this project? The Making Tertiary Studies in Engineering More Relevant project found that there is a general consensus about what constitutes effective teaching and learning practice. We organised these practices into five key factors - Learners at the centre, Tutors as skilled educators, Valued industry connections, Quality Resources and Excellent Support Systems. Engineering educators provided extensive examples of how these factors were reflected in teaching and learning (Edmonds & Mischewski, 2019).

Surveying of engineering departments that offer the NZDE and BEngTech suggested that uptake of these practices is variable, and there are often large differences among departments in the patterns of participation and achievement of learners. Our analysis showed that engineering education, particularly among ITPs, is unable to generate positive economies of scale due to a highly dispersed delivery model (Mischewski & Edmonds, 2019).

Focus groups with employers and engineering educators indicated a nuanced understanding of the structural factors that underlie the problems we have identified. The engineering education system is not well coordinated across the providers of that education, employers are not always aware of the benefits of the NZDE and BEngTech, and the work of teaching staff is often duplicated across the ITP sector (Edmonds & Mischewski, 2019).

What needs to change? The ITPs involved in the delivery of the NZDE and BEngTech have several key advantages. The NZBED provides a robust and credible coordinating function including a common programme document for the NZDE. ITPs contribute willingly to common moderation and quality assurance activities, and strategic planning for the BEngTech in particular. The NZDE has proven to be very popular among international students, and co-teaching of NZDE and BEngTech courses is very effective.

Our analysis suggests that there are several priorities for engineering education which we present in this roadmap for development.

What do we recommend TEOs do?

Share resources across the ITP sector

The focus of much of the collaboration among ITPs has been at the front-end (programme design) and the back-end (moderation and quality assurance). Course design and resource development is the missing bridge. Each ITP separately develops the content for the courses they offer as part of the NZDE and BEngTech. This approach is inherently inefficient and unwarranted given the modest number of enrolments in many courses.

ITPs need to work together to better coordinate course development. In most cases, this approach will involve a single ITP developing the detailed content of a course on behalf of its peer organisations. Other ITPs will retain the flexibility to tailor aspects of courses to the specific context of their regional demographics and industries.

This approach will free up the time of teaching staff to engage more systematically with industry and tailor their teaching approaches to the needs of learners. Consistency of course design will also aid quality assurance and moderation. It will also contribute to a more optimal cost structure for engineering departments.

Other strategies that should be considered include common induction programmes for international learners, training on academic integrity principles and deeper collaboration with international partners.

Address diversity of learners

The engineering workforce needs to be more reflective of the communities that it serves, and lack of diversity in engineering learners is commonly cited (Chubin, et al., 2005), (Davis & Finelli, 2007), (Oehlberg, et al., 2010), (Duderstadt, 2010), (IPENZ, 2010). The education system has a role to play in supporting these goals for the engineering workforce, particularly those whose achievement is influenced negatively by the ‘...complex interactions of ethnicity, socioeconomic status and the education system.’ (The University of Auckland, 2019).

Meeting the needs of learners needs to encompass teaching and learning that takes account of the background, identity and individual circumstances of those learners. Our analysis of participation data indicated that there are opportunities for the providers of the NZDE and BEngTech to be more responsive to New Zealand’s changing population (Mischewski & Edmonds, 2019). Feedback from our focus groups indicated that engineering educators recognise the need to adjust the scheduling and structure of teaching programmes to allow learners who live distantly from regional campuses or are in employment (Edmonds & Mischewski, 2019).

Engineering educators have identified the need to ensure that teaching and learning environments are welcoming. Some steps include incorporating tikanga Māori into provider-based education including use of karakia and pepeha, regular use of Te Reo Māori and integrating mātauranga Māori into engineering education through projects relevant to iwi and hapū.

Engineering educators recognise the need to create welcoming spaces in other ways. Proactive action to retain and develop staff members from groups underrepresented in the engineering workforce, call out unacceptable behaviours and promote role models are commonly recommended.

Raise profile with a wider range of employers

Our focus group discussions indicated that some employers lack access to fulsome information about the content and practical orientation of the NZDE and BEngTech (Edmonds & Mischewski, 2019). Similar perceptions appear to be a factor in decision-making by employers exacerbated by a lack of experience with graduates of the NZDE and BEngTech (Mischewski, 2017). The need for greater leadership role for employers in building partnerships with education specialists was highlighted as a driver for the reform of vocational education (MoE, 2019).

Engineering departments in ITPs have a particular opportunity to work with engineering employers, particularly their human resources staff who

may be unfamiliar with this important facet of the New Zealand engineering education system. Communicating the role, function and content of the NZDE and BEngTech to employers is an important way that TEOs can contribute to efforts to improve perceptions of these programmes.

The results of the self-assessment survey and the NZBED's regular survey of learners also suggests that more needs to be done to connect learners with employers and employment opportunities. These actions would have the dual benefit of both lifting the uptake of effective teaching and learning practice and strengthening the connection of employers to the engineering education system.

Targeted engagement with schools

Many learners, teachers and parents consider vocational education and training to be a less prestigious option than university education (TEC, 2018). These perceptions are borne out in our analysis of the 'market share' of the NZDE and BEngTech among secondary school leavers – in 2017 just 12.7% of secondary school leavers pursuing tertiary-level engineering study were enrolled in these programmes.

Addressing these perceptions of the system as a whole is the subject of a variety of Government initiatives, including the proposed reform of vocational education (TEC, 2018). Engineering educators are involved in many efforts to promote engineering education to secondary school students including the secondary-tertiary pathways projects (Engineering e2e, 2018).

We need to continue our collective action to engage deeply with schools so that learners and their key influencers are exposed to the high-quality engineering education options that we offer.

Use of employers' equipment, facilities and staff

There are several indicators that suggest that the engineering education system is not taking full advantage of the potential contribution of employers. These indicators include the relatively low rating of institutional resources by students (NZBED, 2019), the low usage of site visits, equipment from industry and course tutors from industry (Mischewski & Edmonds, 2019) and the general state of teaching facilities (Mischewski, 2018).

Our focus groups attendees suggested that there are multiple barriers to the use of employers' resources including the demands of workplaces on staff and equipment, health and safety considerations and a reluctance of learners to undertake unassessed activities (Edmonds & Mischewski, 2019).

There are however many options to engage industry more effectively including video recording working engineers to help learners understand how they go about particular tasks, working directly with employers to develop courses, dedicated training for industry tutors and changing the nature of assessment tasks, so learners have stronger incentives to participate.



What are we doing next?

Sharing the results with engineering departments

We are in the process of sharing advice on the implications of the project with each engineering department that offers the NZDE (and the BEngTech where appropriate).

Each engineering department will receive a summary of the key findings from the self-assessment survey, information and analysis about how they compare to their peer departments and recommendations about how they should respond. This information will provide a guide to the comparative strengths and opportunities for development of each department.

The results may also help to inform planning and adaption to new unified vocational education and training system.

Working collaboratively to deliver the NZDE in Fire Engineering

Engineering educators and employers are forging new alliances to cater to unserved or underserved cohorts of learners such as clinical engineering (TEC, 2014) and fire engineering (TEC, 2018b). These initiatives involved close integration of perspective between employers and educators and often occur outside of more traditional models of employer engagement such as employer advisory groups. At the same time, there appears to be persistent disparities of performance in the uptake of good practice and at a course level across the engineering education system (Mischewski & Edmonds, 2019).

TEOs need to take steps to address these disparities in close collaboration with employers. This engagement needs to be purposeful and relevant to their workforce development needs. The involvement of employers needs to be action-orientated and time-bound, and the adoption of new practices should build off existing and emerging innovations.

The new NZDE in Fire Engineering is modelled on the mechanical engineering stream with the substitution of five courses specific to the needs of the industry. A coalition of five ITPs is working together to design and deliver these courses.

Each ITP will take responsibility for the detailed course design of one or two of the new courses and lead its delivery. The courses will be offered by a mix of block, distance and blended delivery including micro-credential options. This approach will allow other ITPs to offer the NZDE in Fire Engineering without incurring the overhead costs of developing new courses and enable better economies of scale.

Maximising the opportunity for learners to pursue the NZDE in Fire Engineering will open up new markets to each engineering department and broaden the profile of engineering education with employers and learners.



- Chubin, D., May, G. & Babco, E., 2005. Diversifying the Engineering Workforce. *Journal of Engineering Education*, 94(1).
- Davis, C.-S. & Finelli, C., 2007. Diversity and Retention in Engineering. *New Directions for Teaching and Learning*, Fall.
- Duderstadt, J., 2010. Engineering for a Changing World- A Roadmap to the Future of American Engineering Practice, Research, and Education. In: D. Grasso & M. Burkins, eds. *Holistic Engineering Education - Beyond Technology*. s.l.:Springer.
- Edmonds, M. & Mischewski, B., 2019. *Good Practice Guide*, Christchurch: Ara Institute of Canterbury.
- Engineering e2e, 2018. *Secondary-Tertiary pathways project*. [Online]
Available at: <http://engineeringe2e.org.nz/education/secondary-tertiary-pathways-project/>
[Accessed 21 February 2019].
- IPENZ, 2010. *National Engineering Education Plan*, Wellington: IPENZ.
- Mischewski, B., 2017. *Micro-credentials - A model for engineering education?*, Wellington: TertiaryEducationCommission.
- Mischewski, B., 2018. *ITP Roadmap 2020 - Effective utilisation of capital assets by ITPs - A Primer*, Wellington: Tertiary Education Commission.
- Mischewski, B. & Edmonds, M., 2019. *Making tertiary studies in engineering more relevant - Engineering education practice report*, Wellington: Tertiary Education Commission.
- MoE, 2019. *Reform of Vocational Education consultation discussion document*, Wellington: Ministry of Education.
- Naylor, S., 2016. *Making Tertiary Studies in Engineering More Relevant*, Dunedin: Otago Polytechnic.
- NZBED, 2019. *NZBED Student Survey 2018*, Wellington: NZBED.
- Oehlberg, L., Shelby, R. & Agogino, A., 2010. Sustainable Product Design: Designing for Diversity in Engineering Education. *International Journal of Engineering Education*, 26(2), pp. 489-498.
- Scott, G., 2015. *Engineering e2e Talking with Employers - Workshop report*, Wellington: Tertiary Education Commission.
- TEC, 2014. *Industry-provider collaboration: New Zealand Diploma of Engineering in Clinical Engineering*. [Online]
Available at: <http://engineeringe2e.org.nz/casestudy/employers/show/8>
[Accessed 11 November 2018].
- TEC, 2018b. *Developing a qualification by industry for industry*. [Online]
Available at: <http://engineeringe2e.org.nz/casestudy/employers/show/88>
[Accessed 29 January 2019].
- TEC, 2018. *Tertiary Education Report: Perceptions of vocational education and careers in New Zealand*, Wellington: Tertiary Education Commission.
- The University of Auckland, 2019. *Disparities in educational outcomes for New Zealand students: the problem with the dominant focus on ethnicity*, Auckland: The University of Auckland.