Identifying and bridging the “Graduate Engineers practical skills gap” in the New Zealand Power Distribution Industry.

Author and Presenter:
Luke Mainwaring
Powerco

Identifying and bridging the "Graduate Engineers practical skills gap" in the New Zealand Power Distribution Industry

Introduction

The issue addressed in this paper via action research is identifying and understanding the "Graduate Engineers practical skills gap". How large it is, the type of skills lacking within the Power Distribution Engineering industry, and identify steps that can be taken to help decrease this skills gap.

Background, Context and Literary review

What is a skill?

Skill according to the Cambridge dictionary is "an ability to do an activity or job well, especially because you have practised it". Within the Power Industry, graduate engineers may have the ability to do an activity, but not the opportunity to practice it, making them less skilful in the role that they need to fulfil.

(McKenney & Handley, 2020) claim that this practical development of skills has somewhat been lost due to the attitudes of business. Presently, the Power Industry within New Zealand in general does not provide a place where graduates can learn practical skills with minimal risks to themselves, others and the electrical network.

Why is it important?

Not having these practical skills overall in the industry creates situations where roles are filled with people that do not have the necessary competence, and as a result work is completed inefficiently, costing companies time, money, and can have an adverse effect on those around them.

What type of problem is this?

This can be categorised as a wicked problem (Grint, 2010), where there is no fixed solution, but an on-going problem that will shift and change over time. It is the largest anticipated obstacle or difficulty that businesses may face in achieving objectives over the next few years in the UK (Institute of Engineering and Technology, 2019). For the UK engineering sector to reduce its talent shortage, the UK needs 186,000 skilled recruits each year until 2024 (Heuble, 2019). New Zealand faces a similar problem.

How long has this problem been around?

This is not a new issue. Shortages of skilled engineers is something that has been apparent in developed countries (Lynch & Aglan, 2016) (Hodes, 2017) (Institute of Engineering and Technology, 2019), (Heuble, 2019), and (McKenney & Handley, 2020).

As far back as 2003, all researched papers acknowledge that the skills gap exists. In the UK it was identified there was an imbalance of skills rather than an overall shortage (Lenton, What Skills crisis, 2003). During that time, a solution in New Zealand was to import the skills from abroad, which now seems to have been unsuccessful as the gap is

still apparent, and due to the recent COVID pandemic it has been made worse.

Why do we have a skills gap?

There are many reasons that have been identified that may cause the skills gap with workers. The modern-day skills requirements are outpacing the education system. Organizations are not training their existing workers, or are just not effective at identifying requirements, have a lack of motivation to do something, poor attitude, dependability, and have concerns over filling positions.

The skills gap has also not received much attention in the academic literature as it has been viewed as largely an organizational problem, and often "workarounds," such as additional training, adding extra personnel, and overtime hours are used to address the gap (McKenney & Handley, 2020).

One of the other potential reasons for the debate about skills' gaps is that it is also difficult for organizations to measure and quantify them. While every organization is different, each with its own unique set of issues, a prescriptive method to provide and evaluate skills gap data does not exist (McKenney & Handley, 2020).

What is the current set up of training in the Power Industry?

In New Zealand the government have given industry the role to set occupational standards and make the arrangements for people working in industries to achieve them. It is a demand-side solution where the idea is that industry wins if the skills are right, and industry loses if the skills are wrong. (Williams, 2021).

New Zealand uses Industry Training Organisations (ITO's), which are industry- owned and governed entities, formed up from enterprises, that apply to the Government for recognition as the standard-setting body for an industry or set of industries. In the modern sector, most ITOs are entities in their own right- for the most part not for profit incorporated societies - though they have also been run as arms of industry associations.

ITOs' core role is to work with industry to develop occupational standards (commonly referred to as unit standards) and develop training and assessment resources in support of their achievement (Williams, 2021). Unfortunately, this system does not appear to have worked well for the power industry as we are still experiencing a skills gap. One reason may be the ITO's are separate entities and they do not have skin in the game (Taleb, 2019).

How are we currently dealing with this problem?

As this is seen as a global problem, other countries have adopted the following approaches with dealing with the skills gap:

In the UK, new approaches to engineering higher education involves new approaches by universities incorporating creativity into engineering, focussing on broadening the diversity of students, a strong emphasis on project work, industry engagement in design and delivery, experience of the workplace for students, and greater interdisciplinarity (Institute of Engineering and Technology, 2019).

In Penn State Behrand University, USA, in 2016 the first semester of education was held

at the Advanced Manufacturing and Innovations centre. This multi-million-dollar complex was half occupied by students, and the other half by corporate tenants that shared the access to the labs and equipment. This centre gives the opportunity for academia and the industry to have contact and share knowledge and practical experience with each other (Lynch & Aglan, 2016).

In Japan, the Hiroshima Training Academy has a 40 engineer a year intake to carry out a 4 month "Pole Camp".

In Seoul, South Korea, the KEPCO Training academy have a practical set up using all the equipment types for vertically integrated networks.

Research into the skills gap in the Power Industry

As part of an executive Masters of Business Administration (eMBA) research project at Massey University using the action research methodology outlined in (Dikilitas & Griffiths, 2017) and transdisciplinary approach (Belcher, Rasmussen, & Zornes, 2015), the following section discusses the graduate skills gap specifically in New Zealand. A literature review, interviews with industry stakeholders, a working group with consultants from the industry, and a graduate on-line survey was carried out.

Literary review

The literary review involved searching for information and finding examples from global sources of the engineers' skills gap in industry, the findings of which have been outlined in the previous section.

Interviews with industry stakeholders

Interviews were carried out using video conferencing and recorded using dictation software. There was a total of 28 participants. These were from Powerco (two General Managers (GM's)) , the Chief Engineer, and HR Recruitment, GM's from Orion and WEL, GM's from Transpower, consultancy owners from Ergo and Edison, two recent graduates working at Powerco and Mercury Energy, and two managers from service providers Downers and NorthPower.

A pre-set of questions was asked during the interviews (Found in Appendix B) and are discussed in the following section.

Working group with industry consultants

The working group consisted of 8 Engineers from Ergo, Edison, Jacobs, Aecom, and Powerco using the same questions asked in the interviews. Interestingly, this part of the research had to be omitted from the final eMBA submission as the University had the view that there was a possible conflict of interest. However, having such a small amount of industry members, this was seen to be inevitable, and for the purposes of this paper have been included.

Online survey of graduates

Using software Survey Monkey, a questionnaire was created and circulated amongst

graduate engineers electronically from the e.e.a using targeted questions relevant to the research. These can be found in Appendix C.

Summary and Discussion of the interviews and working group:

Overall, with both the interviews and working group there seems to be slightly different views on the same themes. The following discusses these themes and elaborates further for wider discussions.

From the interviews there appear to be four interpretations on what a skills gap is:

1. The gap between the existing skills, and the required technical or practical skills for graduates to carry out their roles.

2. The lack of numbers, which is sometimes stated as the skills gap in the industry where more diversity is required to fill the void.

3. The existing and future skills gap of technological lag between people and technology.

4. The gap between the universities provision of education and what is needed by the industry.

Recruitment Processes

When recruiting, the majority of the employers are more interested in a particular mindset rather than the academic qualifications, and they look for more of a technical background with a mixture of practical experience if they can get it. However, they mainly use a formal process of CV selection first, where only the higher level of academics are chosen and progress to the following stage, then relying on interviews and phone calls to gauge suitability.

It is observed that final selection on employing a graduate is based upon personalities and whether they can "fit" into the existing team, however employees are still trying to promote diversity.

Most of the companies are relying on their reputation when attracting people to the organisation. Once they have recruited the graduates, the main method of retainment was to give them varied work that challenged them. Only one company offered structured career pathways for engineers and the graduates could map them out. There was no mention of benefits, such as extra holidays, and the younger interviewees mentioned that these benefits are quite important.

If there is a gap identified with an individual, then mentoring and on-the-job-training is the method of choice of bridging it. This may be adequate, but if there are bad habits, flaws, lack of knowledge or even personality traits the mentor has, these may get picked up by the apprentice graduate. There is also the problem of the aging population of engineers that can provide the mentoring and correct level of work for the on-the-job training to take place effectively.

There is no evidence that the distribution companies look outside of the industry for resources. There is a possibility they could benefit from spreading the recruitment net wider to try and pull people from other industries and re-train them. But, due to the barriers to entry (mainly

qualifications and training required), it seems more difficult to become an engineer mid-life, because it takes time, lots of effort and money to get there.

There were mentions of creating marketing campaigns for engineers, looking at our "engineering" competitors, that personnel could be attracted from construction sectors and so on, and even further afield from other industries which would mean diversification.

The distribution companies rarely talk to each other, and communication is poor at the moment and could be improved, there are channels of communication, which in New Zealand are Engineering New Zealand, (which is mainly a Civil Engineering Institute), the e.e.a and the IET. These organisations play a role in the communication; however, it is generally felt they could do a lot more.

Several acknowledgements towards the way that the distribution companies are being run is detrimental to the long-term future of our electrical networks, the type of distribution companies that we have set up are for the shareholders, and are no longer run as asset management companies.

Summary and Discussion of the online graduate/younger members e.e.a survey

Out of a total of 158 questionnaires sent out there were 66 respondents. These were mainly Consultants and Power Distribution graduates, with the remainder being from various other parts of the industry; 60% were from New Zealand and 87% of those surveyed were between 20-30 years old.

There was a 30% Female and 70% Male distribution in the population surveyed, which is higher than the 10% and 11% of females found in the IET and e.e.a surveys dated (2019). This may demonstrate that the industry is progressing in diversification in the ratio of male to female category.

The largest groups of engineering students come from Canterbury University. Of those surveyed, 77% thought they were either prepared, or slightly prepared for entering the industry.

If the younger members (YM) could have had prior *Technical knowledge* before joining the Power industry, the YM would like to have the skills of:

1. *Reading and Creating Electrical Engineering drawings*
2. *Power System Economics*
3. *Practical Testing, Installation*
4. *Operation of equipment*
5. *Substation Equipment and their application in the field*
6. *Application of Protection and Design principles*

The areas of *technical knowledge* they felt they would need over the next two years are:

1. *Reading and creating electrical drawings*

2. *Protection System Concepts*
3. *Substation Equipment and their application in the field*
4. *Earthing Systems*
5. *Substation Protection*

When coming out of university, the majority of the students are unable to create and read engineering drawings and feel they still need to develop these skills going forward.

Recommendations

The following are recommendations for bridging the skills gaps

Create the sense of urgency to make a change

There are steps being taken by the industry towards this at the moment, with papers being produced such as Environmental scan for the electrical supply Industry for Kohi Whakaaro – the Electricity Supply Industry Workforce Development Strategy (Hayes, Rob;, 2021), and Opportunities and Challenges to the future security and resilience of the New Zealand power system (Transpower New Zealand, 2021). These reports acknowledge the need for more skilled people but not the urgency in which these skills are required. Further information gathering through more research and better data collection should take place to help strengthen the argument that something needs to be done.

Create Power Engineers marketing campaign

Currently, the perception of engineering is very poor both internally and externally of organizations. A marketing campaign for engineers and the engineering brand can be created promoting Power Engineering and the Power Industry brand. At the same time there is a prospect to attract more diverse people, including more females and Maori, to join the engineering profession. Some of the learnings, strategies and methodologies can be implemented from part 7 of (Kotler & Kelller, 2016) This could be spearheaded by the e.e.a and the I.E.T if sufficient funding and support is given from the industry stakeholders.

Establish a Practical Training Centre

Other than the drawings highlighted in the above recommendation, if the younger members could have had prior *Technical knowledge* before joining the Power industry they would like to have had the skills of Practical Testing, Installation and Operation of equipment, Substation Equipment and their application in the field, Application of Protection and Design principles.

The above skills can all be covered with a practical training centre, where they can learn a more pragmatic form of thinking. The possibility of the distribution companies and universities having a mutual interest could help the funding of an established center, and share the benefits.

Expand and strengthen the professional engineering communications across the Power industry.

Currently the main networking and information sharing platforms are provided by the e.e.a.

IET, Engineering New Zealand, and energy academy. These need to be developed further to become more of a networked environment between the power companies, where they join together to deal with a common problem. One method would be to create an Engineering social group.

Review and implement a different selection process for recruiting

When recruiting new employees, companies need to create environments that get people to work together as a team and problem solve, demonstrating their softer skills and their analytical prowess. From the interviews, it appears no selection process assessing groups with practical exercises takes place. A more inventive selection process is needed that is tailored for the practical graduate that covers problem solving, team working, and communication to get suitable graduates for the roles required.

Further work on Retainment

Better strategies for retainment must be implemented to stop the churn of engineers. They need to be treated with the respect within the organisation, as "money doesn't cut it".

Incentives such as pay grades for professional registration, an engineering career pathway, overseas trips, professional development, extra holidays, flexible work hours, and maintaining the holding environment so that they do not get "too much interesting work" and able to have a social life.

Set up a simple drawings course for graduates

The inability to read technical drawings was raised by both those interviewed and the graduates surveyed. Reading drawings is a fundamental and essential skill that is required to be an effective engineer. To accommodate this gap, it is recommended to find a training provider and provide graduates the required training when they join a company.

Conclusion

There are several versions of the skills gap identified. These being the gap between the existing skills of students and the technical or practical skills required to carry out their roles.

It's a complex intertwined wicked problem that has various factors. It has been around for years and is not going to go away, therefore the industry must be able to adapt as the skills gaps widen and take the necessary actions to close them down.

The graduates being selected are more of the implicit nature rather than tacit. The balance of what the universities are providing are fixed, and the mixed requirements of the employee is fluid, influenced by diversity, the need for management skills, and method of recruitment. Finally, engineering not being seen as a trendy profession does not lend itself to attracting people to the industry.

The business model of the companies is a major contributing factor to the skills gap not being addressed, as they are not set up for asset management and have shareholder influence. Therefore a focus on keeping costs to a minimum and not investing the money in people development.

The consequences of the skills gap are difficult to quantify, however it is perceived that job completion is slowed, costs are increased, the lack of understanding will

mean that the best solution is not chosen, and the consequences of these decisions can vary between hundreds to millions of dollars.

There does not seem to be that much of a call to action at the moment within the industry as the impacts do not have the shock factor. It is seen as something that is developing slowly over time ,and when the industry acknowledges it as a problem it may be too little, too late.

There are things that can be done, such as the above recommendations, which will require a high level of leadership and commitment from industry with the passion and the drive to make it succeed. The industry seems to know what it requires to help with dealing with the problem, but who is going to take up the gauntlet and do something about it?

References

Institute of Engineering and Technology. (nd). *New approaches to engineering*. Retrieved from Institute of Engineering and Technoloogy: https://www.eea.co.nz/Site/publications/newsletters-reports/reports/electricity-industry-training-survey-report.aspx

Belcher, M. B., Rasmussen, R. K., & Zornes, A. D. (2015). Defining and assessing research quality in a transdisciplinary context. *Research Evaluation*.

Bouge, R., & Sekaran, R. (2019). *Research methods for business: a skill building approach.*

Connexis. (2021). Retrieved from About connexis.

Dikilitas, K., & Griffiths, C. (2017). *Developing Language teacher autonomy through action research.* Macmillan.

Electrical Engineers Association. (2019). *Industry Training Report.* Retrieved from Electrical Engineers Association: www.eea.co.nz

Electrical Networks Association. (2021). *Overview of the Electricity Industry*. Retrieved from http://www.ena.org.nz

Grint, K. (2010). The Cuckoo Clock Syndrome: addicted to command, allergic to leadership. *European Management Journal*.

Hayes, Rob;. (2021). *Environmental Scan for the Electricity Supply Industry.* Infometrics.

Heuble, B. (2019). Skills Shortage? the answer's female. *Engineering & Technology*.

Hodes, C. L. (2017). Closing th skils gap through technical excellence. *Athens journal of education*, 253-269.

Institute of Engineering and Technology. (2019). *IET.org skills*. Retrieved from IET Website: http://www.thiet.org

Institute of Engineering and technology. (nd). Retrieved from New approaches to engineering higher education: Case studies of six UK universities leading the way for change in the sector: http://www.theiet.org

Kotler, P., & Kelller, K. L. (2016). *Marketing Management.* Essex: Pearson global.

Lenton, D. (2003). What Skills crisis. *IEE Review*. Retrieved from http://www.iee.org/review

Lenton, D. (2010). Looming Skills gap threatens economy. *Engineering & Technology*.

Lynch, P., & Aglan, F. (2016). Filling the skills gap in U.S manufacturing: Promoting internships and co-op experiences and integrating industrial engineering courses to improve student design and manufacturing knowledge. *IEEE Frontiers in Education Conference*, (pp. 1-8). Erie.

McKenney, M. J., & Handley, H. A. (2020). Using DSRM to develop a skills gaps analysis model. *IEEE Engineering Management Review*.

Panth, B. (2020). Conclusions and recommendations: Implications and Way Forward. In B. Panth, & R. Maclean, *Anticipating and Preparing for Emerging Skills and Jobs* (pp. 32-337). Springer.

Taleb, N. N. (2019). *Skin in the game: Hidden asymemetries in daily life.* Penguin Books.

Texiera, B. (2021). *Decrease in Tech Skills Gap Leads to Increased* . Retrieved from http://ww.td.org

Transpower New Zealand. (2021). *Opportunities and chalenges and resilience of the New Zealand power system.* Transpower New Zealand.

Williams, J. (2021). Industry-Led Training and Apprenticeships: The New Zealand Model. In B. Panth, & R. Maclean, *Anticipating and Preparing for Emerging Skills and Jobs.* Springer.

Worldometer. (2021). *Population by Country*. Retrieved from Worldometer: https://www.worldometers.info

Appendix A: Geographical locations of the Power Distribution Companies in New Zealand

Appendix B: Interviews and working group questions.

1 *What are the skills requirements of the engineering industry in New Zealand?*

- 1.1 When recruiting what do you look for when recruiting graduates in your Industry?
- 1.2 When recruiting, do you rely on a formal process or do you go for informal "gut feel" approach?
- 1.3 Which do you prefer? Technical or practical ability when recruiting graduate engineers?
- 1.4 When recruiting are you more concerned with efficiency or quality?

2 *What are the factors affecting the skills gap in the engineering industry in New Zealand?*

- 2.1 What training do you provide if you identify a "skills gap"?
- 2.2 Do you look to solve the skills internally? or do you rely on external resources?
- 2.3 Does your company actively promote engineering?
- 2.4 How do you attract graduates to come and join your company?
- 2.5 What do you do to keep employees engaged and not look for work elsewhere?

3 *How are the curriculum of the Universities aligned with the skills needed in the engineering industry in New Zealand?*

- 3.1 Do you know if your company has interaction with any of the universities in New Zealand?
- 3.2 Do you think universities focus on the correct skills when doing engineering degrees?
- 3.3 If there was an unlimited budget what would you change about the graduate schemes at Universities?

4 *How can the skills gap be bridged between the role players of the engineering industry in New Zealand?*

- 4.1 Do you have close collaboration with other Power distribution companies and knowledge share?
- 4.2 Do you have Collaboration with any Universities in New Zealand?
- 4.3 Do you collaborate with Connexis regarding training for graduates?
- 4.4 Do you provide a basic training package for new starting engineers?

5 *What do you think the road blocks (if there are any) are to bridging the skills gap?*

Appendix C: e.e.a. Survey Questions.

1. How long have you been with your company?
2. What is your Gender?
3. What is your ethnicity?
4. What best describes your role?
5. On a scale of 1- 10 would you say that you were prepared for the transition from University to working in the Power industry? 1 being unprepared, and 10 being fully prepared (Please tick one).
6. Which University did you graduate?
7. If you were asked on areas in which you could have had more development on prior to entering the Power industry to help with your role, what would they be?
8. What specific skill areas are most important to your development in over the next 2 years would be?
9. What areas of development have you had in the last 12 months?