

WHAT MAKES AN ENGINEER TODAY?

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ABSTRACT: *This paper explores a sample of statistics of gender imbalance in the Engineering sector which are accompanied by the story of a young female engineer in-the-making and how she came to be an Engineering Cadet at Parkes Shire Council. A study by members from the University of Ballarat in 2003 identified four main barriers for year 10 female students in choosing a career in engineering. Those include a lack of interest in the perceived image, a lack of knowledge, a traditionally male dominated industry, and limited recognisable role models. Other studies have shown that students make assumptions about careers opportunities from the early stages of formal schooling. These studies show that effective intervention should begin much earlier in a school career than what is currently being achieved. In many cases, by the time education around career options is being delivered, a student's perception of what engineering is, how it relates to them, and their belief of the opportunities in tertiary education, has already been formed. The views and opinions expressed in this 2003 study have changed very little in 15 years despite huge industry and government investment. The four barriers identified are commonly expressed across the general community, as well as students looking to study STEM fields. The challenge for professionals in STEM is to accept that societal change will only come through a grass roots approach. The responsibility is on us to share knowledge and our achievements on a broader stage, with the aim of gaining more recognition for the role that engineering plays in our society. By sharing her story, Cate wishes to encourage a dialogue for removing barriers to careers in STEM, and find ways to encourage others to enter the engineering field in Public Works.*

KEYWORDS: STEM, women in engineering, studying, engineering, barriers, students.

1 Introduction

A study by members from the University of Ballarat in 2003 (Darby et al, 2003) [1] identified four main barriers to year 10 females in choosing a career in engineering as: lack of interest in the perceived image, a lack of knowledge, a traditionally male dominated industry, and limited recognisable role models. Engineering is not held with the same social esteem as positions such as doctors and lawyers, and it could be argued that the interest and limits to attracting women and indeed any future students to the field is this lack of societal esteem within the broader community. However in recent years the industry is not only suffering from a stagnation of female students. Overall the enrolment and graduation rates for engineering degrees has decreased in Australia (OCS, 2016) [2]. For the purpose of this paper, the four barriers will be broadly addressed under two categories: a lack of interest due to misconceptions of the industry, and lack of recognisable role models.

In Australia, entering and maintaining a career in engineering related fields has attracted a stigma of difficulty and a misconception of what

personality traits are required to succeed in those fields. Statistics show that breaking into an Engineering field is becoming increasingly difficult for all students. Decisions around what career a student wants to pursue can be influenced from the earliest years of formal education (Holland et al, 2016) [3]. In most cases, by the time a student reaches year 9 they have already decided what careers are personally achievable. More likely than not it will not be STEM-related. This argument is reflected in the number of students selecting STEM subjects to pursue in their Higher School Certificate (HSC), such as advanced maths, chemistry and physics. Statistics show that in 2012 11.5% of male students and 6.2% of female students chose to complete advanced maths for their final year studies (EA, 2017) [4]. Alarmingly, this figure reflects a steady decline.

2 The Barriers

In a focus group survey conducted by members from the University of Ballarat into the barriers faced by year 10 female students when choosing engineering as a career, the four main areas identified were; lack of interest in the perceived image, a lack of knowledge, a traditionally male dominated industry, and

limited recognisable role models. Some students were quoted as saying, "(if) I knew more about an engineer and what they did I'd relate more to what I like to do. But because I haven't heard anything on TV or seen anything in newspapers, it just doesn't appeal to me because I just don't know anything about it" (Darcy et al, 2003) [1]. This survey also identified the interconnectedness of the four barriers, as shown in Figure 1 below.

Diagram 1. Relationships between barriers to girls choosing engineering as a career as identified by participating year 10 female students

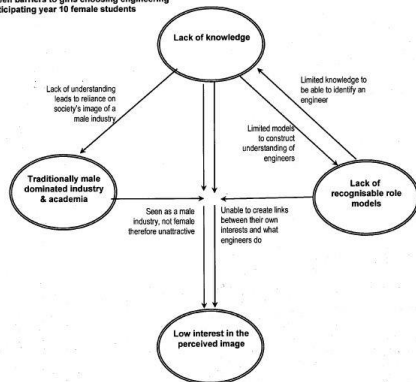


Figure 1: Relationships between barriers to girls choosing engineering as a career as identified by participating year 10 female students.

The overall enrolment and graduation rates for engineering degrees has decreased steadily over the past 15 years in developed nations.

In 2016 a similar study was conducted of year 8 and 9 students with the aim of identifying the influencers on STEM. This study broadly concurred with the main barriers identified in the University of Ballarat's findings that the main barriers were a lack of interest in the perceived image of engineering and a lack of recognisable role models (Holland, 2016) [3].

2.1 Changing the Perceived Image

It is critically important that we promote the industry, and further educate and inform young people about how fulfilling a career in engineering can be.

Engineers are not typically known for publicising their achievements, instead they quietly ensure the systems of the world run smoothly. It is time that engineering successes are brought into the spotlight - to celebrate those achievements, but more importantly to show young people exactly what they can achieve in the industry.

When Hollands study concluded, the participating students unanimously indicated that they would consider studying STEM

subjects in the high school, as well as consider pursuing a career in science and engineering.

With limited access to outreach programs and limited subject choice at regional schools, the ability of students to access engaging information about engineering careers is limited. Research has shown that if the industry is to attract students to the field, they need to deliver informative, yet engaging content in schools prior to year 9 (Holland et al, 2016) [3].

2.1.2 The Millennial Opportunity

If the industry was to look at sending a clear marketing message to young people, one clear advantage over competing career options would be that: *with engineering, you can save lives and change the world.*

Millennials have shown different career expectations to previous generations entering the job market. New research has shown that millennials initially search for careers and employers that provide social justice and global opportunities. However, a recent survey has shown that once students are secure in a position they more greatly value remuneration and conditions at work (Kuron et al, 2015) [5]. The Public Works Industry in Australia also holds this advantage over many of its competitors boasting some of the best working conditions in the current job market as well as competitive salaries at all levels of employment. Additionally, Local Government engineering provides a grass roots, hands-on approach with a strong connection to the community in which they live and work.

2.2 Creating Recognisable Role Models

The decline of visible engineers in media in the industry has flow-on effects of recruiting in the next generation. If a student has never met an engineer, how could they look up to one as a role model? Industry bodies need to lead the campaign for stronger diversity in their workforce and for better strategies to attract students to the field.

Institute of Public Works Engineers Australasia (IPWEA) NSW has followed suit of their Queensland counterparts in developing an Ambassadors program, with the aim of putting a face to the young engineers of the State, and providing them with a public platform to promote the industry. The committee of the Young Institute of Public Works Engineers New South Wales (YIPWEA NSW) also created a fictional engineering role model, called Pocket Sally, with the aim of spreading a positive message across social media and the wider industry. But there is no room for her to grow. The space in

which Pocket Sally can operate is relatively unseen.

Additional to engineering holding onto its secrets, the public works profession operates in a further subset of this shadow. If the industry is serious about changing the demographics of engineering in Australia, we collectively need to infiltrate workshops, study days, career profiles, and all other initiatives that help shape a student's idea of what careers they may like to pursue. We need to challenge the perceptions of what an engineer looks like and what an engineer does. In other words, the grass roots approach and personal ownership to this cause is critical to the future success and prosperity of this profession and the country's growth.

3 This Engineers Experience

As a young woman growing up in regional NSW, I had a 'textbook' experience of these statistics. Despite a strong interest in science and engineering in school, it was never promoted as a career avenue. With my parents support, I attend a number of university-run science programs, however it was never really made apparent that these areas of interest were available for me to further pursue at a tertiary level or as a career.

By the time I was leaving school I had convinced myself that I was bad at both maths and science, and that pursuing these fields was not an option. When I later looked at apprenticeships, the discrimination was so prevalent that a recruiter advised me to not list my name on the application, and to only put my initial. A lack of role models in technical fields meant that I also struggled to find someone to talk to for guidance about these careers and how to get there.

Now that I am studying Engineering, there seems to be no shortage of family members and friends who discuss their engineering backgrounds and experience with me - but where were these people when I was looking at career options? Perhaps if I, and the students in early high school had a greater perception of "What an Engineer looks like" then I may have had the confidence to make different choices earlier on. I would hope that in the future we could open a new dialogue about attracting school leavers to pursue engineering and can promote it as a diverse and exciting industry which the community holds respect for.

Unfortunately the research suggests that this experience is not new or unique. It has been shown that the later in their development that a student commences mathematical studies the

less likely they are to study STEM fields at university - limiting their ability to follow a STEM related career (OCS, 2016) [2].

4 Importance of growing the industry

GDP and industry statistics can often paint a false picture that we are keeping up with the demand to place students into the growing STEM field, however this is not the case (OCS, 2013) [6]. Australia is being left behind in STEM studies and industries. Global indicators on mathematics and science are continuing on a downward trend, and with it, our ability to compete as a global leader in engineering and scientific pursuits. The clear loser in this situation is the public works industry. If the industry loses the ability to train and mentor the next generation of engineers, where does that leave a society with an estimated 354 billion dollar public infrastructure system? Is the public works industry content to rely on a pipeline of migrant workers to care for the projects we work on today? Is the industry content to hand the reins of our current portfolio of 25 billion dollars in capital works to undertrained and underqualified professionals?

The Office of Chief Scientist of Australia recommends that the change needed to correct the current trajectory of STEM output is a fundamental societal shift. A change in the way we view the status of primary teachers, arguing that an increase in their societal esteem will attract applicants who have passion and qualifications in STEM, and that these applicants would intern become primary school teachers (OSC, 2016) [2]. We can't wait that long.

Before this step is successful, students first need to be attracted to STEM studies - an initiative that needs to be led by current practitioners in the field.

Conclusion

Pocket Sally is an inspirational idea, and she has the *potential* to represent what we are striving for in this industry as well as be a role model for girls and young people in general. But there is now room for her presence to grow in a society where engineers aren't having a media presence. The opportunity to promote, share and open up a dialogue about the achievements of engineers and the broader industry, is ours if we take it. IPWEA has the power to drastically change the demographic of the engineers of tomorrow and address an impending major skills shortage in our industry. We, as professionals, could say that it is up to industry bodies to interact with future students and

challenging the perceptions of what an engineer looks like, what an engineer does, our achievements, and the importance of engineers in a societal context.

Therefore, I encourage you to take up this challenge. Step into the spotlight and share the wins and achievements of our industry and your colleagues. Have a conversation with a young person about how exciting and innovative our industry is. Show the next generation of young professionals 'What makes an Engineer today'.

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References

1. L. Darby, S. Hall, K. Dowling, B. Kentish, (2003). Perceptions of engineering from female secondary college students in regional Victoria. 2003 Australasian Association for Engineering Education. *In 41st Annual AAEE Conference*. Melbourne, Australia, 29 Sept - 1 Oct, 2003. Melbourne, Australia: AAEE. 507 - 516.
2. Office of the Chief Scientist, Australia, 2016, Transforming STEM Teaching in Australian primary schools: everybody's business, Position Paper
3. B. Holland, M. Ronca, C. Raffaele, M. Marcus, (2016). Collabor8 and disrupt: Identifying influencers on STEM subject choices. In AAEE2016 CONFERENCE. Coffs Harbour, Australia, 2016. Coffs Harbour, Australia: AAEE. 349 - 356.
4. Engineers Australia, 2017, *The Engineering Profession - A Statistical Overview*, Thirteenth Edition, February 2017
5. Lisa K. J. Kuron, Sean T. Lyons, Linda Schweitzer, Eddy S.W. Ng, (2015) "Millennials' work values: differences across the school to work transition", *Personnel Review*, Vol. 44 Issue: 6, pp.991-1009, <https://doi.org/10.1108/PR-01-2014-0024>
6. Office of the Chief Scientist Australia, 2013, National Press Club Address July 31, 2013, Professor Ian Chubb.