



Title: Why Do Female Engineers Discontinue their Construction Careers: A New Zealand Perspective

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**Why female engineers discontinue their construction
careers: a New Zealand perspective.**

by
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Abstract

The study sought to understand why few female construction engineers progress from graduate roles through to middle and senior management. This was studied through a literature review, industry analysis, and a questionnaire issued to early-career engineers at Downer New Zealand.

The study found that the inherently masculine culture of construction companies is hostile to women in various ways. They feel culturally adrift, harassed, separated from informal business networks, and suffer from a lack of role models and clear career paths. Factors that affect retention of all genders include unpleasant working hours and locations.

These concerns were echoed in the results of the questionnaire issued to Downer New Zealand staff. They added further concerns about pay progression, and unclear or unfair job descriptions. The perceived inflexible nature of their work means that many respondents felt that a career at Downer New Zealand was incompatible with their future plans to have children.

The recommendations include greater inclusion of women when developing initiatives aimed at retaining women – this inclusion could be achieved in a number of ways that would also gain them greater access to networks, role models, and potential career paths. Specific equity targets should be set and published, with a clear focus on reducing discrimination. These targets should include SMART goals, and senior executives should be made accountable for progress.

Keywords: human resources; construction; women in engineering; gender; staff retention

Dedication

This report is for the women in construction who have felt lonely, ignored, harrassed, unwanted, unrecognised, or tokenised. Even at your lowest moments, you are demonstrating a determination and resilience that many will not fully appreciate. I hear you, I respect you, and I support you.

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Thank you to the WILD women of Downer New Zealand who helped me realise that this research question was both urgent and important. I am grateful to my colleagues who answered the questionnaire – every one of your needs and opinions is valid and important.

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Finally, I thank my friends, family, and colleagues for lending me their ears. All of you have heard me questioning these themes for the last 20 years, which allowed me to develop the ideas for this research. To my construction colleagues of all genders who want to make things right – I am with you.

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List of Acronyms

DNZ	Downer New Zealand
L&D	Learning and Development
PEST	Political, economic, socio-demographic, technological
SIT	Southern Institute of Technology

Chapter 1. Introduction

1.1. Introduction

The construction industry has existed in some form since humans first decided to make improvements to their caves. However, women have only recently joined the construction industry as engineers.

The first New Zealand woman to graduate with a civil engineering qualification completed her degree in 1975 (The University of Auckland, n.d.). The number of women working as construction engineers in Australia remains at least an order of magnitude fewer than men (M. Stewart, 2019, fig. 8.2). There has been a recent increase in the number of women joining the construction industry as intern or graduate engineers - Engineering New Zealand notes the increase from 626 women in 2011 to 871 in 2015 (The Institution of Professional Engineers New Zealand Inc., 2015). The relative number of female graduates to male graduates has decreased during this same period due to overall industry growth.

Since 2000, the absolute numbers of women studying engineering and entering the profession have increased. Per Engineers Australia, “in 2006, there were 21,174 women qualified engineers in the Australian engineering labour force. By 2016 this number had grown by 112.4% to 44,982... this numerically large increase translated in a relatively small change in the proportion of women in the engineering labour force, from 10.6% in 2006 to 13.6% in 2016” (Kaspura, 2019, p. 12). It is relevant to note that the proportion of women gaining engineering qualifications has not increased, and in fact may have slightly decreased since 2012 (Kaspura, 2019, p. 22). These figures are not specific to construction. This implies that there have been some factors attracting more women to the industry, but the overall growth in engineering is outstripping this demographic change.

Attrition of women across all engineering industries continues at a rate higher than men – as much as a 20% difference within age cohorts (Beasley & Fischer, 2012;

Frehill, 2013; Silbey, 2016). Women leave the industry 39% faster than men (N. Galea et al., 2020).

Thus, if equitable outcomes are desired, it is critical to understand why women have or may leave the construction industry prematurely. In 2021, the supply of engineering graduates and experienced engineers in New Zealand is constrained by both migration restrictions and the lag in increasing graduations of local engineers following investments in recruitment. The New Zealand market for civil infrastructure is growing – corporations and government cannot afford to have excess attrition reducing the number of early-career female engineers.

1.2. Statement of the problem

This paper explored why Downer New Zealand (DNZ) has a gender-unbalanced engineering workforce at middle and senior career levels, despite employing an equal number of female graduate engineers in recent intakes. An industry analysis and literature review sought to understand the New Zealand data first, aided by the larger body of Australian and international research. The literature review was followed by a questionnaire, issued to a cohort of recent engineering graduates at DNZ. The results of this questionnaire were analysed to understand the correlations between DNZ and other organisations and jurisdictions. The intent was to understand trends and find relevant management applications to attract and retain a better gender balance of engineers.

There is little available data from New Zealand about the changes over time to number of female graduates, mid-career construction engineers, and senior construction engineers. A core assumption is that there are too few recruits and excess attrition leading to a continued gender imbalance, which the construction industry seeks to address.

Engineering and construction companies in Australia and New Zealand have recognised that their workforces have insufficient gender diversity (Construction Sector Accord, 2020). During the last 20 years, various efforts and initiatives have been undertaken by the broader industry or individual companies to employ more women. This could potentially deliver a more sustainable workforce and address ethical issues with

access to high-paying jobs and consideration of diverse perspectives within the management of construction and engineering.

Any business improvement project should have clear goals, with metrics of progress and effectiveness. Diversity improvement practices, which have been attempted in various ways since before the beginning of this century, are ripe for review and analysis.

The fact that relative numbers of women in construction are decreasing (Kaspura, 2019; M. Stewart, 2019) demonstrates a lost opportunity both for women and for the construction industry. Some reflection on this is necessary to ensure that investment in diversity practices is used to create lasting industry change.

Downer New Zealand is a major employer of engineers in construction. It is noted for having an attractive graduate and intern programme for aspiring engineers and business students (Downer Group, n.d.). DNZ is one of the largest employers in the nation, with approximately 52,000 employees mainly in Australia and New Zealand (*About Us*, n.d.). Operations are split across several areas, including Transport Services (civil infrastructure projects and maintenance), and Facilities (non-residential construction and facilities management). Much of this work is funded by either local or central government, including the work in the Pacific Islands. The types of employment range from corporate and commercial roles, through to engineering and management, plus skilled and less-skilled labour and operations roles.

DNZ is proud to have recruited approximately 50% female enrolment in the current graduate programme. However, as with many other New Zealand construction companies, there are few female engineers in senior roles. DNZ's civil infrastructure business has no female engineers employed as General Managers, and few in the next two levels below. While it is possible that over time this proportion will resolve itself to better reflect society, with a plausible career length of 40 years the natural increase of female construction engineering managers will be very slow indeed.

DNZ does not specifically track attrition following the graduate programme, or for female engineers. There is no clear picture of why the number of women progressing to more senior engineering roles remains very low or non-existent. This is an industry-wide problem in New Zealand, and similar concerns are noted overseas.

1.3. Significance of the study

To date, there has been little formal research around this subject as it applies in New Zealand. There are several likely reasons for this – the small population, relatively recent inclusion of women in the engineering community, the small number of research institutions, and the recency of concerns about diversity, inclusion, and minority participation in professional careers.

The retention of female engineers is a significant issue as there is pressure on construction workforce due to ageing infrastructure, ageing workforce, a housing shortage and construction boom, and now Covid and other immigration restrictions. The industry simply cannot afford to be unattractive to 50% of the population. It is crucial to address the “leaks” in the employee supply pipeline as the demand pressure continues to increase (M. Stewart, 2019).

This research questions what has happened to the numbers of women in mid career or higher-level construction jobs. A lag in supply is to be expected while graduates become experienced, but the pipeline is leaky and many of last decade’s graduates have left the industry. As reported by Engineering New Zealand (Kaspura, 2019), the percent of female engineering graduates may have peaked approximately 10 years ago – and yet few women graduating in that cohort are visible as managers in the construction industry. Continuing this trend will hamper NZs performance in both infrastructure delivery and economic performance as a significant sector of the potential construction workforce is not participating.

This paper is an opportunity to demonstrate the usefulness of research in Applied Management to a real-world problem at one of New Zealand’s largest employers, Downer New Zealand. The unique position of the researcher as a current employee

allows greater access to the research population as well as an understanding of how management theory could be applied in this large organisation.

The study seeks to provide suggestions for appropriate management applications at Downer New Zealand, to retain early-career female engineers and eventually increase their numbers at higher echelons of the organisation. These may be generalisable to other similar organisations, but they are not specifically intended to be.

1.4. Research question/aim and objectives

The research question considered in this paper queries why few women progress from graduate engineering roles to middle management and beyond in New Zealand construction companies – specifically Downer New Zealand.

The aim of asking this question is to qualitatively research and recommend applied management solutions through a greater understanding of the problem. The context for this understanding is both a review of the local and international literature, as well as a questionnaire seeking the thoughts and opinions of DNZ's cohort of recent engineering graduates.

The research objectives include:

1. Understanding, through literature review, why female engineers exit the construction industry;
2. Correlating literature with a cohort study of early-career engineers working at Downer New Zealand;
3. Understanding the concerns and attitudes of these early-career engineers as they may relate to retention at DNZ and in the wider construction industry; and
4. Generating recommendations for greater retention of early-career female engineers.

During the short history of women working in civil engineering and construction, industry dropout rates have consistently been higher for women than men. The research project is a questionnaire and literature review, seeking quantitative data about retention of women in engineering and construction. Additionally, the review and analysis will include qualitative research about why women leave the industry, and initiatives to improve retention. The literature will focus on New Zealand and Australia but will extend to international research as well due to the relative paucity of local data.

The questionnaire surveyed the graduate and intern cohort in Downer New Zealand, regarding why they chose to enter construction and what support they need to stay in the industry. This is a small group of fewer than 100 people – a convenience sample selected for both timeliness and access for the researcher. Understanding the opinions of this group is key to generating appropriate and relevant management actions, suggesting applications of theory to improve the retention of female engineers.

The survey results are analysed and compared to the literature to identify any trends. Recommendations for actions to retain female engineers at Downer New Zealand are developed based on links between the survey results and the trends discussed in the research.

1.5. Structure of thesis

This paper is structured with 6 key chapters. Chapter One introduces the problem and provides some context for developing this study. It describes the status of female engineers in Downer New Zealand and the wider industry. This section introduces the research problem (why few female engineers are employed in construction companies beyond entry-level roles), and explains how this paper will help to answer the research problem.

Chapter Two: Theory and Industry describes the applied management theories that could explain the research problem, and thus could be investigated further to describe potential solutions. It also provides context for Downer New Zealand both within the

New Zealand construction industry, and as a part of the international construction community.

Chapter Three: Literature Review seeks to find patterns in local and international literature across several topics. It looks specifically at the experiences and concerns of women in construction and engineering, as well as more broadly at the difficulties of attracting and retaining minorities within unbalanced industries.

Chapter Four: Research Methodology explains the theoretical basis behind the research design. This explains why a questionnaire was selected as the research method, how it was developed, and why the recent graduates at Downer New Zealand were selected as the research population.

Chapter Five: Findings and Analysis reviews the results of the questionnaire responses and puts context around the raw data. Correlations are discussed, with a particular focus on the gender data relating to results. The findings are linked back to the research question, both to suggest solutions and to confirm that the questionnaire collected relevant data. The analysis also considers the correlation between the DNZ questionnaire results and the literature review, seeking to confirm which literature themes and management theories apply to the DNZ situation.

Chapter Six: Recommendations and Conclusions links the industry and theory analysis, literature review, and research findings. It strives to offer a framework for applied management solutions to the research problem and provides recommendations for actions and further analysis.

The appendices contain elements related to the questionnaire and research approval.

Chapter 2. Theory and Industry Analysis

2.1. Introduction

By considering applied management theories and the environment of the New Zealand construction industry, this chapter provides contextual information about the research problem of why few female engineers progress from graduate roles to management roles in construction companies – in particular, Downer New Zealand. The research objectives are:

1. Understanding, through literature review, why female engineers exit the construction industry;
2. Correlating literature with a cohort study of early-career engineers working at Downer New Zealand;
3. Understanding the concerns and attitudes of these early-career engineers as they may relate to retention at DNZ and in the wider construction industry; and
4. Generating recommendations for greater retention of early-career female engineers.

The chapter begins with the theoretical analysis, which begins to answer research objective 2 and 4. It briefly describes applied management theories that may explain why female engineers join or exit the construction industry. Theories regarding the process of improving retention and promotion of female engineers are also discussed. This provides an exploration of applied management concepts applicable to the research question of why few women progress from graduate engineering roles to middle management and beyond in New Zealand construction companies – specifically Downer New Zealand.

To partially answer research objective 1 and 3, the second part of the chapter delivers a PEST (political, economic, socio-demographic, technological) analysis based on industry literature from and about the construction industry. This seeks knowledge of the environmental factors which may influence the current and future work situations.

This chapter provides insights from the construction industry in New Zealand and internationally, as well as discussion from other industries where gender balance is sought. The industry analysis draws on business-orientated resources such as construction and engineering periodicals and news articles, alongside publicly available white papers, research from industry bodies and corporate information.

The concepts reviewed include the retention and promotion of female engineers and other minorities in the construction industry. International literature is included here where relevant, due to the limits of New Zealand data. The context provided by the PEST analysis is compared with the experiences and concerns of young female construction engineers, which forms the final part of Chapter 2. A summary is then provided.

2.2. Theoretical analysis

Civil engineering and construction have been male-dominated industries for as long as they have existed. The first female civil engineering graduate at Melbourne University was in 1944 (Muldowney, 2019). In 1990, about 11% percent of engineering students were female.

Galea, Powell, Lingard, and Dainty provide academic theories as to why this gender imbalance persists today. These can be summarised as an overtly masculine culture (Powell et al., 2018), work conditions that are not congenial for any gender but contribute additional pressures for women (Lingard & Francis, 2005), and organisational structures that are inherently biased against women (A. R. J. Dainty & Lingard, 2006).

To move from a poor gender balance to one that is more sustainable and equitable, it is useful to consider the 8 “accelerators” from Kotter’s change management theory (Kotter, 1995, 2012b). Kotter’s seminal books on change management and leadership theory could provide a framework to fundamentally alter the demographics of the construction industry. Without a formal pathway to manage the structural change in employment and promotion patterns, change initiatives are less likely to succeed. The content and progress of change must be agreed with the target audience and the managers

who will be tasked with ensuring that it succeeds (Beer et al., 1990; Nohria & Beer, 2000).

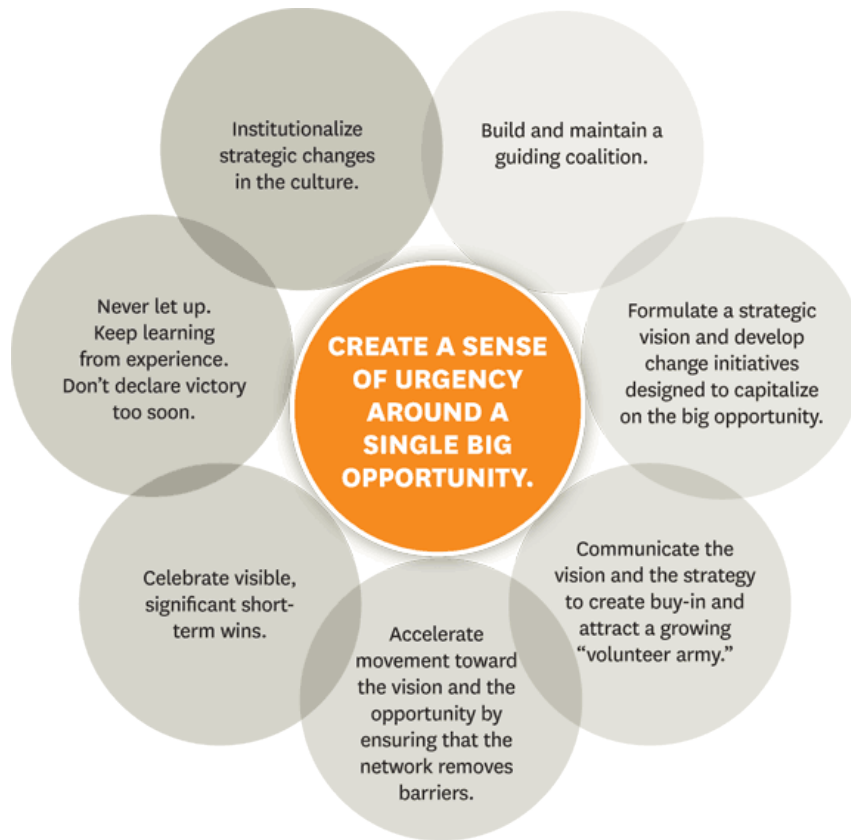


Figure 1 Kotter's "eight accelerators" of change management (Kotter, 2012b)

Additionally, implicit bias theory provides insight on the difficulties faced by minority employees seeking to climb the corporate ranks (Bagenstos, 2007). This explains how, despite policies and legal structures, stereotypes and assumptions may continue to define employment patterns. Identifying the gendered power imbalance within the current management structures is at least as important as developing a business case to examine why minority employment is business-critical (Mills, 2014, p. 114). This understanding can inform a change management model, particularly when seeking to remove barriers.

2.3. Industry analysis - why female engineers exit the construction industry

In recent decades, construction business practices have changed towards active marketing of construction careers to young women. However, despite the extensive body of research on how gender diversity will improve business outcomes (particularly in ethics and sustainability) (Boulouta, 2013; Provasi & Harasheh, 2021), the number of women entering and staying in construction jobs has not kept pace with the number of women studying engineering (Stedman, 2020). In fact, the number of women studying engineering may be on a downwards trajectory (Bolton, 2019), which increases pressure on the industry to demonstrate that construction is a safe and rewarding career for women.

To understand the factors that affect attraction and retention of female engineers in the construction industry worldwide, a PEST analysis has been undertaken. These factors are discussed under the headings below.

2.3.1. Political factors

Acts of Parliament such as the Human Rights and Equal Opportunity Commission Act 1986 (Australia) and the Human Rights Act 1993 (New Zealand) explicitly made certain forms of discrimination unacceptable. In Australia, reporting on and inclusion of women and minorities is a requirement for any organisation with over 100 employees to tender for government contracts under an Act signed in 2012 (Workplace Gender Equality Agency, 2021). Downer New Zealand (as a company that is headquartered in Australia) has a board-agreed “Diversity and Inclusion Policy and Standard” for New Zealand (*Board and Executives Policies*, n.d.), which references a specific policy for Aboriginal and Torres Straits Islanders but not Māori, women, or other minorities.

The New Zealand Government does have procurement rules which incorporate “broader outcomes” (generally focussing on social equity) (New Zealand Government Procurement and Property, 2019). These include women as a “target group”, but do not set thresholds or require reporting from corporations. There are examples of social

procurement being used by New Zealand government bodies, though women are not necessarily the targeted minority (New Zealand Government Procurement and Property, 2019). Indeed, the case study notes that Australia also made little progress in social procurement until measurable targets were set and reported on. This supports Kotter's change management theory as being critical to success, as the development and communication of targets supports sustainable change.

2.3.2. Economic factors

Downer New Zealand had decreased revenue in the most recent financial year, due to disposing of underperforming segments of the business (NZX, New Zealand's Exchange, 2021). However, profitability has increased and the expected economic recovery of New Zealand post-Covid will include significant spending on infrastructure.

The continued low numbers of women in construction is unsustainable as it limits the potential workforce while demand grows (Dy Buncio, 2019). The pressure on the New Zealand construction industry to increase its available workforce may encourage creative solutions. There is no formal mandate, but with sustained construction growth (Stats NZ, 2019) and challenges in international recruiting (Deloitte New Zealand, 2021), companies that fail to attract female engineers may face increasing difficulty in meeting revenue targets.

The Workplace Gender Equality Agency (an Australian Government statutory agency) suggested that companies should publish salary ranges and demographics (per WGEA) (Workplace Gender Equality Agency, 2020). Despite this being mandatory in Australia, they do not have demonstrably better pay equity than New Zealand. Australia does, however, pay many staff based on salary 'award' agreements (often negotiated by unions). As these are widespread and must be published, this effectively mandates more pay transparency in Australian workplaces.

It is noteworthy that the cost of living in Auckland is relatively high on a world-wide scale, when compared to graduate salary rates (Hart, 2020; Keogh, 2020). It is also substantially higher than the cost of living elsewhere in New Zealand. Organisations that

employ people in the same roles across the country may need to consider the impact of living costs on their lowest-paid professionals.

2.3.3. Social-demographic factors

In STEM education, the number of women studying engineering increased to around 20% where it has largely stalled since 2000 (Bossart & Bharti, 2017). However, the change was not all well received or implemented. “Reverse discrimination” was a fallacious term that was used to push back on diversity initiatives (Pincus, 2003). The perception that women were always free to join the industry was perpetuated by people who felt that women were circumventing the so-called “meritocracy” (Lawton, 2000; Rodriguez, 1998).

Disappointingly, the number of women facing harassment and discrimination in construction and engineering remains high. In one US survey and meta-analysis, there was an approximately even split of harassment on sites and in the office (Rubin et al., 2018). This indicates that the problems are widespread and that the perpetrators are likely to be in various roles and positions within the hierarchy.

Not all companies are taking action to support their words (Fagg & Sanders, 2014; Patten, 2019). This causes reputational damage and reduces the trust of minorities. It is also likely to put another crack in the pipeline of women who may be considering a career in engineering or construction. As noted in Chapter 2.3.1 above, Downer New Zealand has limited information about what strategies are in place to improve diversity within the organisation.

The critical mass needed for sustainable demographic change hints at retention issues. Engineers in senior management are around 95% male (Engineering New Zealand, 2018) – this is across client and consultant organisations as well as construction, which is noted for having an even poorer gender balance. Thus, a sustained effort needs to be undertaken by business to deliver a change in this demographic. There is little data on current initiatives being undertaken by New Zealand construction companies, which

may suggest that either few exist, or few have publicity-generating success (New Zealand Institute of Building, 2021).

2.3.4. Technological factors

An issue affecting the wellbeing of construction managers is the often-remote locations and unsociable working hours (Lingard & Francis, 2004). Experiences during the global Covid-19 pandemic have demonstrated that telework is possible for at least some construction roles, some of the time. While this could be seen as a positive aspect for women seeking a better work-life balance in construction, there are distinct downsides that must also be understood. Women continue to spend more time on domestic activities than men, and their already-tenuous access to informal networks is decreased by not being physically present with decision makers (Ibarra et al., 2020).

It is also noteworthy that the privileges of remote and flexible working are more commonly offered to those with increased seniority (OECD, 2020). Thus, younger women in construction are less likely to receive this benefit than those already in more senior roles.

Downer New Zealand does not have any information publicly available that demonstrates their approach to technological factors with regards to employees.

2.4. Concerns of young female engineers in the construction industry

Fewer than 15% of employees in the UK construction industry are women, and that number includes those working in more traditional female roles such as administration, finance, and human resources (Williams, 2015). New Zealand lacks analogous data but could be assumed to have a broadly similar composition. The National Association of Women in Construction (NAWIC) in Australia states that 88% of senior managers in the industry are men (Day, 2019). NAWIC posits that the construction industry culture both appears to be and is hostile to the interests of women – including a

“lack of flexibility and progression, poor parental leave practices and a tolerance of sexism”.

Many of the major employers in New Zealand’s construction industry have policies and programmes intended to attract young women to the industry (Construction Sector Accord, 2020). It is not clear if, or how, these are developed using links to research regarding the concerns of young female engineers (either in their organisation or more broadly in the engineering community). As noted in Chapter 2.3.1 above, the Downer New Zealand Diversity Policy is not specific to New Zealand. It references an Aboriginal and Torres Strait Islander policy but no other target groups. The policy also does not state progress metrics. It is possible that these are further developed in internal documents and procedures, but the information accessible to the public (and thus potential and current employees) gives the impression that diversity in the New Zealand business may not be a priority.

New Zealand research shows that public policy targeting specific groups is more effective and fair than generic policy that does not identify the needs of different groups (Durie, 2005). Similarly, organisational policies are more likely to be accepted by the workforce when they are framed as having a clear mission to address discrimination rather than as a generic means to increase diversity (Lambouths et al., 2019). Thus, the efforts to address the lack of female employees within New Zealand’s construction industry may be misdirected or not sufficiently targeted.

2.5. Summary

The key applied management theory for attracting, retaining, and promoting female construction engineers is related to change management. This is due to the large change required from the status quo towards gender equity in the industry. Supporting this are theories on implicit bias and gendered power disparities.

The PEST analysis shows that gender equity in the New Zealand construction industry is not mandated, but companies that fail to effectively address this will suffer economic side-effects due to the industry-wide skills shortage. It also demonstrates that

women still have difficulty entering and progressing in the industry due to assumptions, stereotypes, and a lack of support and role-modelling.

New Zealand construction companies may also be failing their female engineers by not publishing policies that specifically address their concerns, nor setting appropriately targeted improvement goals. This may also be contributing to the attrition of female engineers before they reach the career potential in the construction industry.

This industry analysis sets the context for the research questionnaire on early-career engineers at Downer New Zealand (Chapter 5 below) and provides themes for further consideration.

Chapter 3. Literature Review

3.1. Introduction

Chapter 3 seeks to answer research objective 1: Understanding, through literature review, why female engineers exit the construction industry.

The literature review summarises academic research to illuminate why few women progress from graduate engineering roles to middle management and beyond in New Zealand construction companies. This is separate to the exploration of applied management theories and industry analysis in Chapter 2, which drew upon different resources to explore the same questions.

It provides relevant themes to answer research objectives 2 and 3 later in Chapter 5 and 6. These objectives are to correlate literature with a cohort study of early-career engineers at Downer New Zealand, and to understand their concerns as they relate to retention.

The key terms used to research this topic are contained in the sub-headings. “Women in construction” and “minorities in construction” were the themes used to generate more specific searches. The review concentrates mainly on the retention of women in construction, and approaches that have been tested with this aim – this is with the intent of developing recommendations for practice at Downer New Zealand. Context is provided for why women join the industry and the consequences of excess attrition, because understanding these concepts may suggest how to prioritise interventions.

Themes across the Australian and international literature have not changed markedly in the last 20 years. This indicates that there is an ongoing gap between research and application of knowledge to address the gender gap in construction engineering roles.

There is a small but growing body of research on the experiences of women in construction careers internationally. New Zealand’s first female civil engineer gained her

qualification in the 1970s, and few women have found their way into construction careers since. Therefore, there is a gap in the literature specific to New Zealand as few studies have been completed to date.

It is noteworthy that the masculine status quo benefits from not closely examining the inequality in the industry (N. Galea, 2018), and that a failure to quantify or set targets is an indicator that the management structure wishes to distance themselves from responsibility for outcomes (Mills, 2014, p. 67). This paper considers how the current gender imbalance affects the real-world activities of construction companies regarding recruitment and retention of women as a minority group.

This study contributes to the understanding of how local and international research relates to the New Zealand experience of women in construction. The questionnaire issued to the cohort of new engineering professionals at Downer New Zealand was based on themes raised by this literature review.

3.2. Why women join the construction industry

The motivators for people to join the construction industry as engineers have not been widely studied. Hence, it is assumed that the same key drivers apply as in many other fields: pay, recognition, ongoing employment, and personal satisfaction. Career opportunities (Kehinde & Okoli, 2004) are an important and valid reason for anyone to join the construction industry.

Women have only joined the construction industry relatively recently. In New Zealand, there were no locally trained female engineers until the 1970s.

Key drivers of historical demographic change included:

- Higher education initiatives to increase the number of women in STEM; and
- Formal recruitment programmes with clear entrance requirements (Helman et al., 2020; A. Stewart et al., 2004), as opposed to employment stemming from informal networks.

As more formal recruitment practices were implemented, one source of bias was reduced. Previously employment in construction, like other professions, was often through networking and matching the internal assumptions about stereotypes made by recruiters (Meador, 2018). This biased recruitment against women, as they did not match the stereotypes (Cowgill et al., 2020). Thus, the implicit and mandated move towards equal hiring practices has influenced the ability and interest for women to join the construction industry.

3.3. Factors associated with retention of women in construction and engineering

An early paper comparing the experiences of women and men in the UK construction industry found that there was a disparity between career progression, and that women faced additional pressures from “inflexible working arrangements and overt resentment from male colleagues” (A. Dainty et al., 2000). The inequality in career progression is essentially the subject of this paper, and it is not clear whether the other issues noted have been entirely resolved. This signifies some fundamental reasons why women may not progress or continue in construction careers.

A paper researching the impact of work-life balance on retention of construction engineers (Morrison & Thurnell, 2012) found that the challenges in New Zealand are similar to those internationally. However, the benefits offered by New Zealand companies tend to be lesser in scope and impact than offered overseas – such as support for care of dependents, and genuinely flexible working hours or locations. The work-life factors were grouped into the categories of “wellness and personal development, crisis assistance/support, alternative work arrangements, and childcare support”. This study did not find a significant gendered difference between work preferences.

A “lack of networking opportunities, challenges in achieving a work–life balance and gendered discourses” (Barnard et al., 2010; N. Galea et al., 2020) are commonly raised as issues for women in construction. Further concerns include bias and discrimination in construction company policies and procedures, and the heavy and dirty nature of work which takes place in remote locations, during unsociable and/or long

hours (Lingard et al., 2008; Lingard & Francis, 2004). This can be summed up as “many employees endure these experiences in silence, adhering to unspoken masculine workplace norms of long hours, total availability, and presenteeism” (Powell et al., 2018).

Mentoring roles are often used to support young construction professionals. The same women who are expected to mentor newer female employees often suffer from a lack of mentoring and networking themselves (Crampton & Mishra, 1999; Schipani et al., 2009). This leads to questions around their ability to promote the industry in a way that is objectively accurate and consistent with their own experience, as well as the sustainability of this approach. Unpaid and personally taxing work such as mentoring adds pressure to women who have already progressed further in the hierarchy.

One study found that the likelihood of women remaining in the construction industry did not have significant association with “marital status, source of initial interest in construction, mentoring experience, financial compensation, or participation in professional groups” (Morello et al., 2018). This was a small survey of 163 women at all career stages. It reported that women with a “dominant” style of communication were likely to be employed in more senior roles, which may reflect the continuing dominance of a masculine culture (Loosemore & Galea, 2008).

The removal of “environmental clues” to a workplace unfriendly to women has a positive effect on feelings of inclusion (Cowgill et al., 2020, p. 2). This could mean the removal of outright offensive or masculine decorations but could also include less blatant examples such as traditionally male networking events like golf days.

The high average workforce age (Schwatka et al., 2012, p. 160) in construction is a factor which has not been widely explored. The current demographic of women in the construction workforce is the inverse of the overall older male preponderance – most women in construction are relatively young recruits with less experience. Thus, there may be an inherent cultural mismatch.

The cultural mismatch of an older, masculine culture with a more ethnically and gender diverse entry-level cohort compounds the experience of feeling like an outsider. Literature describes this as “deficit thinking” and the assumption of being “not good enough”, reinforced by poor progress being made in one’s career and a lack of role modelling (Howard, 2013; Sharma, 2018). There are parallels with racial bias inherent in the schooling system and these should be studied in the context of super-diversity (Meissner & Vertovec, 2015) within the construction engineering community.

A related concept for minorities at work is “silence, isolation, and racial battle fatigue” (Rangel, 2019). An intersectional approach to the retention of women in construction suggests that this concept should be further explored amongst other minority employee groups. Staff who feel isolated and tired from simply being themselves at work are at a distinct performance and progression disadvantage.

3.4. Trends in staff retention initiatives – successes and failures

Inadequate reflection on the diversity efforts to date have led to myths (Pincus, 2003), a reduction in female engineering students (Bolton, 2019), and unjustifiable attrition rates (Beasley & Fischer, 2012; A. R. J. Dainty & Lingard, 2006).

Framing the gender gap as problematic, even from an industry standpoint rather than a personal one, may inadvertently send a message to women that it is a challenging environment. On the other hand, ignoring the gender gap implies that it is of low importance (Cowgill et al., 2020, p. 3). Understanding this factor may change the effectiveness of recruitment and retention efforts. Exploratory research shows that construction companies with more female employees are more likely to have specific programmes for recruiting and retaining women (Morello et al., 2018).

The weight of numbers of women in construction engineering remains at the graduate level, with this demographic expected by organisations to lead the way to greater diversity. There is an abundance of literature demonstrating that this structural demographic change must be managed from the top, rather than assuming a natural progression (Kotter, 2012a; Nohria & Beer, 2000). To change from an unequal status quo

there must be “critical agents of change” (Rangel, 2019). This requires that specific people or groups have explicit responsibility for improving the gender balance of engineers beyond graduate programmes. Employee’s psychological wellbeing comes from leadership that engages with the team, then drives, measures, and reviews the outcomes of action plans (Robertson & Cooper, 2010). Thus, this transformational action links strongly with an employee engagement strategy.

Cost-based strategic workforce planning strongly supports aligning recruitment and retention practices with the other business goals of an organisation like Downer New Zealand (Sparrow & Makram, 2015). There is a constrained supply of new talent in many segments due to closed borders. Workforce segmentation can be used for cost-based strategic planning to ensure that investments are distributed appropriately for the value they return (Sparkman, 2018). Non-monetary reward systems such as opportunities for promotion and development (Güngör, 2011) could also be offered.

Research shows that greater transparency produces variable results on actual pay equity (Wang, 2016) – however, a positive result is often shown on culture and engagement by publicly demonstrating a commitment to equity (Estlund, 2014). Sharing of salary information allows stakeholders to informally police the social responsibility of an employer.

Setting metrics is critical to the success of measures to address inequality. When a business does not measure an issue or outcomes, they are absolving themselves of responsibility to manage it (Mills, 2014, p. 67). This is particularly true of industries where genuine change may involve perceived risk to those who benefit from the status quo (N. Galea, 2018).

3.5. Consequences of female attrition from the industry

Women are leaving the industry as fast as they are recruited into it (Hunt, 2015). This has wide-reaching causes and effects, including a lack of role modelling, poor publicity, and wasted effort on recruitment when retention is a potentially larger problem. Burnout of women in a workplace minority (Hall et al., 2015; Parker et al., 2021; Ronen

& Pines, 2008) is a threat to the sustainability of increasing diversity. This is not usually addressed by business as an issue specific to minorities, and thus the opportunity to address the needs of these women is lost.

Disillusioned women leaving construction may feel so negatively towards engineering that their career track changes entirely (Abri, 2006; Hunt, 2015). This leaky pipeline constitutes a threat to business stability and human resources.

Employees who are not engaged, or actively disengaged, do not provide good value and may damage the performance of the strongest team members (Anitha, 2014). Construction companies should consider how to open meaningful dialogue between female engineers and senior leaders. Effective use of employee engagement surveys requires engaging with employees across various groups to then develop action plans for weak areas. In relation to the research question, that would include dialogue with female engineers at all levels to understand their concerns and formulate responses and action plans. “Consultation without action” not only damages trust, but wastes the resources used to collect the opinions of employees (Robertson & Cooper, 2010).

3.6. Summary

This literature review demonstrates that the issue of attracting and retaining female engineers in construction is neither new nor limited to New Zealand. Unfortunately, it also shows that the past 20 years of effort have not brought strong results.

Work/life balance and opportunities for career progression are common reasons for women to exit the industry. Additional pressures come from the feeling of detachment from the predominant (masculine) culture, and the informal workload of experienced female engineers - mentoring without having adequate support for themselves.

Initiatives associated with successful demographic change in the construction industry include:

- Having specific programmes with metrics for recruitment and retention of female engineers;
- A leadership-driven formal change management process, with “critical agents of change” responsible for outcomes; and
- Workforce segmentation aligning pay and benefits with corporate goals.

Attrition must be addressed lest it become a self-fulfilling prophecy, demonstrated by a leaky pipeline and disengaged staff leading to overall morale problems.

The following chapter explains how the literature review provided themes to support the chosen methodology for collecting data about attraction and retention of early-career female engineers at Downer New Zealand.

Chapter 4. Methodology

4.1. Introduction

Chapter 4 introduces the development of a questionnaire to answer the research question of why there are relatively few women in mid- or senior-career engineering roles at Downer New Zealand. This chapter explains the research methodology, which is a mixed-methods case study of a group of relatively new construction engineers at Downer New Zealand. It provides detail of the selected methods, why they were selected, how they were implemented, and the limitations of the research design.

There have been few studies explicitly focussing on the experience of young women who have recently entered the construction industry. There even fewer specific to the New Zealand environment. Thus, while New Zealand's borders are generally impermeable for staff recruitment and the construction industry is working at close to capacity, it is important to understand how female engineers can be retained in critical roles. This paper links the findings from Chapters 2 and 3 to the development of a questionnaire which focuses on a small population of new construction engineers.

The research philosophy and design is supported by several key texts (Creswell & Creswell, 2018; Dawson, 2009; Saunders, et al., 2016). More nuanced research relating to the design of this study is provided by papers relating directly to this topic, such as those on small population questionnaires and research on minorities.

The chapter begins with an explanation of the research design chosen for this study, and the alternative options considered and discarded. It then describes the development and deployment of the research questionnaire. This is further expanded upon by explaining the methods of data analysis, and the bias or limitations experienced or expected by this research.

Finally, this chapter outlines the ethical considerations, and how any concerns were proactively addressed.

4.2. Research philosophy and design

To restate the research question: why are there few women progressing from graduate engineering roles to middle management and beyond in New Zealand construction companies – specifically at Downer New Zealand? To analyse this question of practical relevance to Downer New Zealand and the wider construction industry, a Mode 2 approach (Bartunek, 2011; Starkey & Madan, 2001) was used to link academic research to applied business knowledge. This required framing the business problem in a way that could be studied through applying academic knowledge, rather than using the business world to illustrate an academic concern.

This is applied research, to explore themes linking the opinions of female engineers who have recently joined the construction industry at DNZ to themes and strategies related to staff retention. It has the explicit intent of delivering insights and actionable recommendations to DNZ, which is the source of the study population. With further work, the results may be generalised to other populations either within Downer New Zealand (such as other minority groups), or to other parts of the New Zealand or wider construction industry.

The role of the researcher was both removed and involved as they work within the same organisation and followed a similar career trajectory to that being studied, but do not directly supervise any of the study population. This was an advantage (Fleming, 2018, p. 313), as the researcher was invested in understanding the underlying organisational factors that contribute to the lack of female engineers progressing through construction careers. The potential shortcomings of bias are discussed in Chapter 4.4 below.

Due to the small sample size, a reductionist approach to statistical analysis was not used. Instead, the quantitative analysis of results was interpreted through the lens of the qualitative data – a critical realism approach recognising that the validity of the responses was not limited by the bounds of p-values.

The discussion and recommendations enable informed and practical applications of theory which may support the retention of female engineers in construction.

The research philosophy and design is described as layers of the “research onion” shown in Figure 2 (Saunders, et al., 2016). This methodical approach is explained further under the headings below.

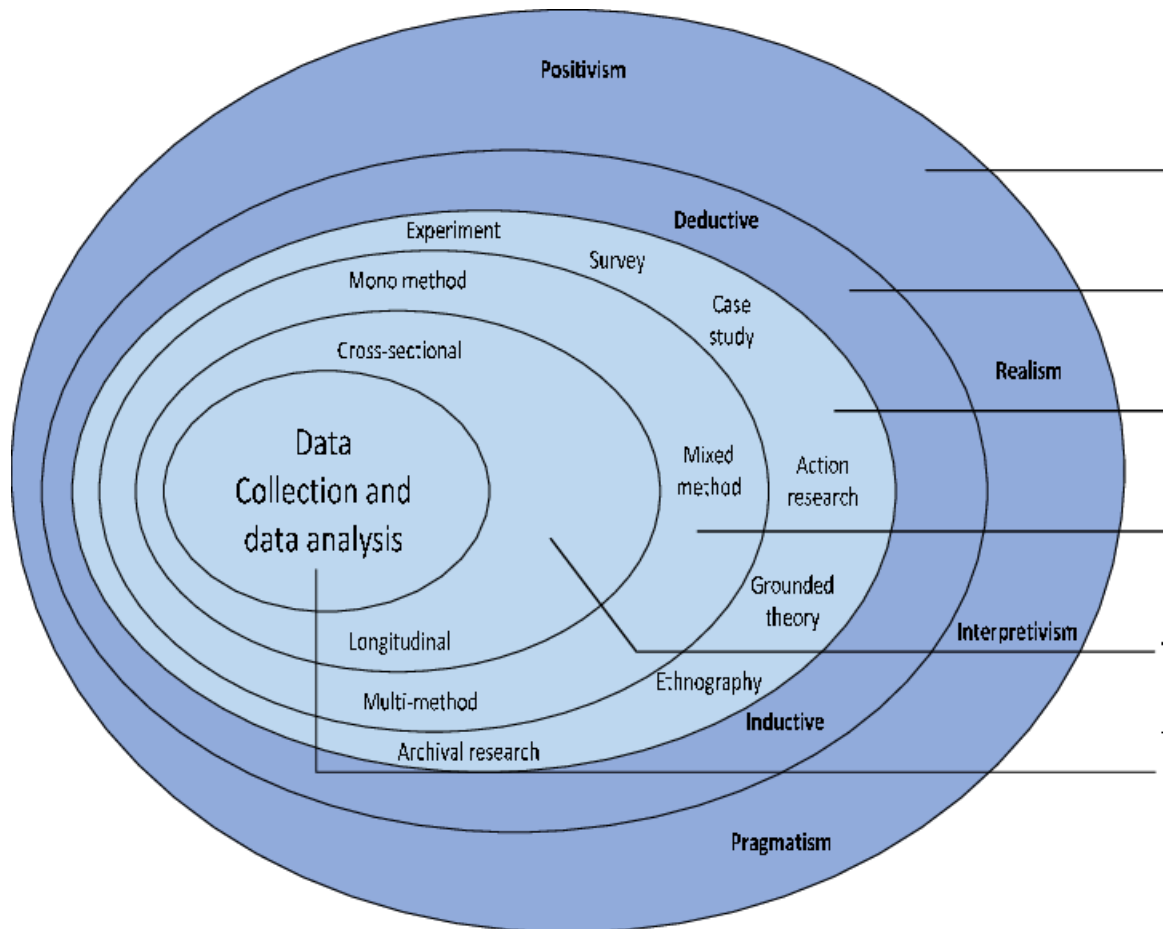


Figure 2 The 'research onion', from Saunders (Saunders, et al., 2016, fig. 4.1)

4.2.1. Philosophy

A pragmatic philosophy was applied to the research question. As the problem relates to the real-world question of employee retention in a construction business, it is critical that the research leads to potential actions.

The underlying assumption is that the inability to retain women in the industry is limiting to both construction companies and female engineers. An alternative philosophy could accept that women do not wish to have long careers in construction, and instead consider how the industry can source additional male staff. This alternative did not match the axiology of the researcher – it was a strongly held value that the research was important to improve equity and access for traditionally excluded populations. Sourcing additional male staff may serve a business purpose but less so a social need, and thus the second philosophy was rejected.

Critical realism accepts that there are objective data that can be measured, but they must be interpreted to understand their meaning. An in-depth postmodern review of the power relationships between construction companies and minority employees is outside the scope of this dissertation. However, the author does recognise that their own position as a minority employee may lead to biases, and this is addressed in a later section of the chapter.

The chosen philosophy requires that the research should strive to quantify and categorise the problem and solutions. However, the nature of researching minority opinions is that rich understanding is achieved by listening to individual voices rather than strictly statistical analysis. Thus, both the problem and suggested solutions can be quantified by their outcomes rather than their adherence to any single theory or dogma. This supports the Mode 2 (Starkey & Madan, 2001) consideration that the needs of the organisation may be understood through academic research, but qualitative analysis may demonstrate nuance related to the particular environment at Downer New Zealand.

4.2.2. Approach to theory development

It was necessary to take a subjective approach towards this research question due to its relationship with preferences and attitudes (Veenhoven, 2002). It appears that the presumed goal of DNZ as the employer (being an employer of choice for women) does not match the goals of women who work there and find it unsatisfactory. Thus, the research sought to find common ground to allow the two entities to co-exist successfully.

4.2.3. Methodological choice

The research was a case study of early-career engineers working in construction at Downer New Zealand. A questionnaire was used to link the cohort to trends shown in research, and in turn using the literature to suggest potential solutions. Data was collected from construction engineers regardless of gender, to test whether responses and attitudes are gendered.

Due to the time constraints of this paper, and the limits of the readily available study population at Downer New Zealand, the research used mixed methods. A meta-analysis (Onwuegbuzie & Leech, 2010) of this technique demonstrates that it may have limitations with small sample sizes, such as sample bias leading to inaccurate generalisations. This potential issue is addressed in more detail in the questionnaire analysis and conclusions.

Qualitative analysis used the free text questions, and the context of the respondents and their attitudes and approaches to the questionnaire. It considered the basic statistical analysis of the quantitative results in the context of the demographics to which they correspond – with the limitations of a small sample size and thus an inability to conclusively reach statistical significance.

4.2.4. Strategies

The research strategy chosen could be described as a cross-case method (Gerring, 2006, p. 1), seeking the opinions of many to represent the group as a whole. This method has an affinity to qualitative evaluation, but the results also include basic quantitative analysis.

A case study allowed consideration of the data from Downer New Zealand employees in its own context. This inductive approach did not presuppose any solutions and may not be generalisable. However, the themes arising from the analysis may be applicable to other situations and this is discussed in the final chapter.

4.2.5. Time horizon

The delimitation of this cross-sectional study (Saunders, et al., 2016) was a time limit of one semester, including questionnaire preparation, ethical approval, data collection, and literature review. Earlier in 2021, a preliminary discussion with Downer New Zealand senior management agreed the use of an internal mailing list to generate a convenience sample for the study. Thus, this short-term horizon necessitated a research method to capture opinions at a point in time, rather than a longitudinal study. This also informed the questionnaire methodology of using the online tool SurveyMonkey to collect data and store it in the cloud.

4.2.6. Techniques

A quantitative survey was selected as the key strategy to respond to the research question (Saunders, et al., 2016). The quantitative analysis is limited by the small population and sample size. The ease of use and potential for repeatability were factors in selecting a survey strategy. Additionally, the anonymity and ability for respondents to complete it in their own time supported the use of an online survey in the population of busy new professionals.

An open-ended question was asked of recipients regarding any other factors they believe are relevant to the retention and promotion of female construction engineers. This was deliberately included at the end of the questionnaire, to use the preceding questions as a prompt but also to provide a ‘final word’ to those who felt they had relevant contributions.

4.3. Method: Questionnaire

4.3.1. Purpose of the questionnaire

This paper questions why few women progress from graduate engineering roles to middle management and beyond in New Zealand construction companies – specifically Downer New Zealand. The aim of asking this question is to deliver potential applied

management solutions through a greater understanding of the problem. A questionnaire supports the research objectives of:

- Correlating academic and industry literature with a cohort study of young engineers working at Downer New Zealand; and
- Understanding the concerns and attitudes of these young engineers as they may related to retention at DNZ and in the wider construction industry.

The questionnaire method was chosen for several reasons. As discussed previously, the time delimitation of the study ruled out longitudinal studies or in-depth analysis of DNZ employment trends and data (due to the extensive approval process this would require). Interviews would take more time from both the respondents and the researcher than was justified for this preliminary research.

Consideration was given to the use of data from previous employee engagement surveys, which are conducted approximately annually at DNZ. This option was discarded, as the surveys do not provide adequate data for the purpose of understanding graduate retention and progression.

4.3.2. Questionnaire design

The information sheet (Appendix B) makes it clear that the researcher is a part of the same organisation and that the study is supported by management. This encouraged trust in the process (Rowley, 2014) to attract a sufficient response rate.

The information sheet thanked the population for either considering or completing any part of the survey and explains how their input will be valued. The intention is both explicit (offering thanks) and subliminal (providing motivation to complete a response) (Codó, 2008, p. 175).

Online survey software allowed the researcher to quickly collect and process responses. SurveyMonkey was used for the convenience and familiarity of respondents but also to maintain separation between the research and the employer – i.e., Downer

does not own the responses and thus the information remains confidential between the respondents and the researcher, as well as being anonymised. This software contains in-built functions to ensure that no identifying data is collected, which supports ethical research techniques.

Most of the target population are familiar with the online SurveyMonkey format as it is occasionally used to collect other data at DNZ. All employees in the study population are provided with internet, computer, and phone access so there were no limits on access to complete the questionnaire.

The questionnaire followed a common format of demographic questions, followed by closed questions. Core questions sought to understand why the employee joined Downer New Zealand, what their current likes and dislikes are regarding their work, and what concerns they may hold for the sustainability of their employment at DNZ. The questions either required a single answer, or a selection of up to three from a list. These multiple-choice type questions include an option of “Other: please specify” where the respondent can write their preference in a free-text box.

The questions were generated along themes shown in industry and academic literature about job satisfaction and retention in construction, particularly for women (A. Dainty et al., 2007; Lingard & Francis, 2004).

Consideration was given to the type of bias common in questionnaires (Choi & Pak, 2005). ‘Administration’ type bias was largely avoided by participation being both optional and anonymous. ‘Design’ bias was reduced by using a simple online format and piloting it with an appropriate group, to ensure the questionnaire was neither too long nor difficult to read or use. There was potential for the ‘question design’ to retain some bias. Some of this was reduced by providing the option of “Other: specify”, allowing respondents to skip questions, and using a final free-text question.

All questions were optional. This was to provide a level of comfort, as employees may feel apprehensive about sharing their honest opinions on any subject. As strict statistical analysis is not the only method used for analysis here, a reduced number of

responses did not derail the research. In fact, inferences could be made regarding which questions were answered.

The inclusion of a final text-based open question allowed respondents to provide any feedback they wish – the stated question was “Please provide any other comments that could help the researcher understand why graduate engineers leave construction before becoming managers”. This was intentionally at the end of the questionnaire to provide context with the earlier questions, but also to prompt a spontaneous response based on themes from the survey (Schuman & Presser, 1979, p. 692). Text responses tend to be inversely correlated with job satisfaction (Borg & Zuell, 2012), which was highly relevant to the information sought by this research.

4.3.3. Pilot testing

A small number of engineers outside of the target population were identified among the researcher’s peer group. They were sent a link to the online survey, with the same supporting information sheet as the formal questionnaire release. They were requested to provide feedback on any questions that were unclear, any concerns that arose, or difficulties they had in navigating the online survey. No issues were reported, and the pilot group were positive about the usability of the online tool as well as the potential benefits of the study. Data from the pilot study is excluded from the analysis.

4.3.4. Procedure

Following discussions between the DNZ Human Resources Executive General Manager, and the Learning and Development team, the researcher was permitted to survey the population. The L&D team were provided with a template email containing a link to the online survey (via the SurveyMonkey website) and a PDF copy of the approved information sheet.

The L&D team issued this email and attachments to their mailing list of current and recent (fewer than 10 years) engineering graduates and cadets. This was a population of 95 employees. The email was sent on Monday 16 August 2021. It advised recipients

that they had until the end of the following week (27 August) to complete the survey. The researcher made a choice to accept surveys submitted before Friday 10 September. This was due to the disruption caused by the Covid-19 lockdown commencing on Tuesday 17 August.

Data was immediately available to the researcher via the online platform. The analysis was not commenced until two weeks after the survey link was issued.

4.3.5. Participants and sampling

The study population was 95 people who have been or are currently in the Downer New Zealand graduate and cadet programmes within the previous 10 years. The participant list was generated and retained by Downer's Learning and Development team. This was a theory-based convenience population (Onwuegbuzie & Collins, 2007) – the theory being that this population can provide insight as to why few women progress from the graduate and cadet cohort to middle and senior management roles.

The recipients of the questionnaire were permitted to self-select whether to participate. No incentives or disincentives were offered. The researcher made no exclusions from this group based on gender or any other demographics. This was for two reasons – to maintain anonymity for respondents, and because the population was already small.

Self-selection will lead to sample bias, whereby the people who feel they will benefit the most are more likely to respond. This unrepresentative sample limits the usefulness of generalisations based, particularly, on quantitative analysis (Bethlehem, 2010; Greenacre, 2016). It is already recognised that this will be problematic due to the inability of the sample to reach statistical significance. However, the qualitative analysis may consider any correlations between the demographics of those who choose to participate, and the relevance of this to the generation of conclusions.

4.3.6. Data analysis

The data was analysed using the three Cs method of coding, categorising and concepts (Lichtman, 2013). This is a process of analysing qualitative data where concrete answers are abstracted to themes and concepts.

Basic mathematic tools were used, such as quantifying, comparing, and grouping the frequencies of multiple-choice answers. The focus is correlating the responses with stated gender, as the purpose of this research is specifically to understand the factors affecting women continuing construction careers.

Quantitative analysis was only used alongside the qualitative results. Due to the statistically insignificant population, and the respondent bias inherent in the sampling method, it is recognised that strict statistical analysis is likely to be inaccurate. Qualitative analysis is used to understand the attitudes, aspirations, and concerns of the overall group.

The open question was analysed in several ways. Each response was considered as a complete piece of information, illustrating the themes already surveyed or adding to them. This could suggest future study or focus areas. Another analysis was a thematic assessment of what is being said – a word cloud was used for this purpose (DePaolo & Wilkinson, 2014, p. 42). A third consideration was to quantify the demographics of those who answered and correlate it to their opinions and attitudes to earlier questions.

The data analysis did not seek to generalise the results, due to the small population. It was intended to develop a profile of the needs and preferences of recently graduated engineers at Downer New Zealand. This cross-sectional survey, thus, sought to understand the concerns of this cohort and compare them to other larger surveys or bodies of research. The similarities or differences were then analysed to understand patterns or suggest actions.

4.4. Limitations, reliability, and bias

Understanding the subjective nature of surveys requires consideration of how the authors may influence the responses. The researcher's background was informed by a career including joining the construction industry as a graduate engineer in 2006 – the only female graduate in her cohort at a large Australian employer.

Some bias may be present due to the participants knowing or recognising the researcher, both as a colleague and as one of few experienced female construction engineers at DNZ. This was unavoidable, as the industry is small and insular at the level of experienced engineers. It was mitigated by the anonymity of individual responses as well as the questionnaire method not allowing the researcher to see which people have responded. This reduced the chance that any potential respondent felt pressured to complete the survey.

A positive aspect to this potential bias is that it may lead to a greater response rate, and the personal capital of a known researcher may increase the feeling of trust by the respondents. It is also noteworthy that contacting this population would have been significantly more difficult without the researcher being a trusted insider within the Downer New Zealand community. The research population being a sample from the researcher's employer is a practical delimitation given the single-semester duration of this study.

Sampling errors were characteristic of this questionnaire. The survey recipients were in a ratio of approximately 2 males to 1 female. As the study explicitly seeks to improve the experience of female engineers, it is to be expected that they will respond in greater numbers. While this may bias the quantitative results, gender comparisons will be made across the responses and their implications will be discussed in later sections of this paper.

Due to the size limitation of the population and sample, robust statistical analysis is not possible. The author acknowledges the limitations to the reliability of the

quantitative data. Due to the subjective nature and small sample, quantitative analysis should be considered lightly and only in conjunction with the qualitative results.

The request for the survey was issued less than 48 hours before the whole of New Zealand unexpectedly moved to Covid-19 Alert Level 4. Forty surveys were already returned by then. Thus, the duration of the study is not considered to be a significant limitation.

There was potential for an overall negative outlook due to the difficulty of working during heightened pandemic alert levels. While this cannot be addressed during the period of this project, a baseline should be considered for future research. It is inevitable that environmental factors will influence employee questionnaires, and this may inform the analysis but does not invalidate the study.

The reliability of this study is checked against trends in literature to confirm the generalisability of the results. This qualitative analysis is discussed in the results of the questionnaire. The research question focuses particularly on the career paths of female engineers at Downer New Zealand, but also considers the relevance of this research to other organisations that employ construction engineers.

4.5. Ethical considerations

This questionnaire received ethical approval from the Southern Institute of Technology Ethics Committee. Refer to Appendix A for a copy of the approval letter. Appendix B includes the Information Sheet that was provided to the sample population so that they were aware of the purpose of the survey as well as the anonymity of results.

There is no identified risk to the participants. All questions and overall participation are voluntary, and thus participants can opt out of any part of the questionnaire which they are uncomfortable with.

The information sheet explicitly states that participation in the online questionnaire gives consent for the data to be used. The implied consent process is also used with this questionnaire (O'Neill, 2004), as answering a specific question implies

consent for the result to be included in the data. Any question can be skipped if the respondent feels that it will be personally revealing in a way that they are uncomfortable with.

Quotes and data from the questionnaire were anonymised. The questionnaire is collected so that it is not possible for the researcher or anyone else to link a response with a particular individual even with access to the raw data (i.e., “anonymous responses” was selected when setting up SurveyMonkey).

The student researcher is employed by the organisation which will be researched. No specific outcomes have been requested or will be provided to DNZ. The researcher is undertaking the study outside of their paid work and it is privately funded. Thus, there is no undue pressure on either the researcher or the participants to deliver any particular outcome.

4.6. Summary

The mixed methods research was undertaken with a questionnaire, the results of which are described in Chapter 5. Due to the small sample size, the quantitative analysis is unreliable on its own, but when read in the context of the qualitative information it suggests links between the body of literature and the sample population of engineers at Downer New Zealand. This assists in answering the research question of why few female engineers at Downer New Zealand progress in the corporate hierarchy.

Chapter 5. Findings and Analysis

5.1. Introduction

The research question seeks to understand why few women progress from graduate engineering roles to middle management and beyond in New Zealand construction companies. A questionnaire was used to support this objective by asking relatively new engineers in Downer New Zealand (one of New Zealand's largest construction companies) why they chose this industry, and why they may stay or leave. The questionnaire is provided in Appendix B, and the research method was described in Chapter 4 above.

Chapter 5 seeks to answer research objective 3, understanding the concerns and attitudes of these young engineers as they may relate to retention at DNZ and in the wider construction industry. It does this by gathering data related to the opinions of early-career engineers currently employed at Downer New Zealand.

The group surveyed are current or recent (fewer than 10 years) graduates or cadets within Downer New Zealand. The master email list was provided by the Learning and Development team, who maintain records of those engaged with the company through this scheme. The population who received the request to join the survey comprised 95 people: approximately 62 males and 33 females. Of this sample, 46 responses were received – 25 from female engineers and one from a gender diverse respondent.

This chapter describes the results of the questionnaire in detail and provides a quantitative and qualitative analysis of the data. As stated in Chapter 4, there are limitations on the reliability of quantitative data due to the small population and sample size. Hence, the qualitative analysis not only reviews the subjective data, but is also used to frame the quantitative data that was collected.

Each sub-heading relates to a section of the questionnaire, which in turn relates to the research objectives. The quantitative results present objective trends to be examined,

including linking demographics to perspectives. The qualitative results analyse how the quantitative data supports or questions the validity of the questions, and vice versa. Quotes are presented in italics, and it will be noted when they come from a male respondent. The quotes will not be attributed to specific people who were invited to complete the questionnaire, and no inference about the personal identity of the respondents shall be made.

The discussion then reviews the results of the questionnaire against the research question. This enables evaluation of whether the questionnaire is useful in its current form, and how the results link to the industry analysis, literature review, and applied management theories.

From this discussion, the recommendations based on the research are then summarised in Chapter 6.

5.2. Questionnaire Results

A key objective of this research was to correlate the questionnaire results with themes from literature. This confirmed that the work environment within Downer New Zealand is sufficiently like other studied environments, and thus that broader research findings can be applied to this business.

From a population of 95 with a 95% confidence and 5% error level, Yamane's formula demonstrated that the survey needed 77 responses for statistical significance (Adam, 2020). The number of completed responses (46) was insufficient for robust statistical analysis, suggesting that a quantitative analysis may be useful but should not be relied upon.

Yamane's formula should be used with caution (Tejada & Punzalan, 2012) even for larger populations and is used here only to illustrate the difficulty of robust quantitative analysis of small populations. In particular, the usefulness of studying a key minority group should not be discounted by placing undue weight on formal statistical analysis. To do this would risk implying that a minority, by definition, is not worthy of

study due to the small numbers. The overall analysis of the survey should thus place weight upon qualitative and environmental factors.

Some questions have responses that do not sum to the number of surveys received. This is because respondents were allowed to skip questions, and some questions allowed more than one response.

5.2.1. Demographics

Of the 46 respondents to the survey, 25 self-identified as female and one as gender diverse. This is an over-representation of women compared to both the population invited to complete the questionnaire, and the proportion of women in the industry. This was an expected sampling error, as discussed in Chapter 4. It does, however, allow for an approximate numerical comparison of answers between male and female respondents. For the remainder of this paper, female and gender diverse responses will be grouped together to focus on the experience of those who do not identify as male.

The majority of people returning the questionnaire had a Bachelor's degree in Engineering. The respondents joined DNZ between November 2014 and February 2021. The most common year of commencement was 2018, as stated by 16 respondents.

5.2.2. Reasons for joining the industry

Following the demographics, the next question asked “Why did you join the construction industry? Choose up to three” from the list which is provided below. This list was developed by the researcher based on a broad reading of graduate engineer advertising in the New Zealand construction industry.

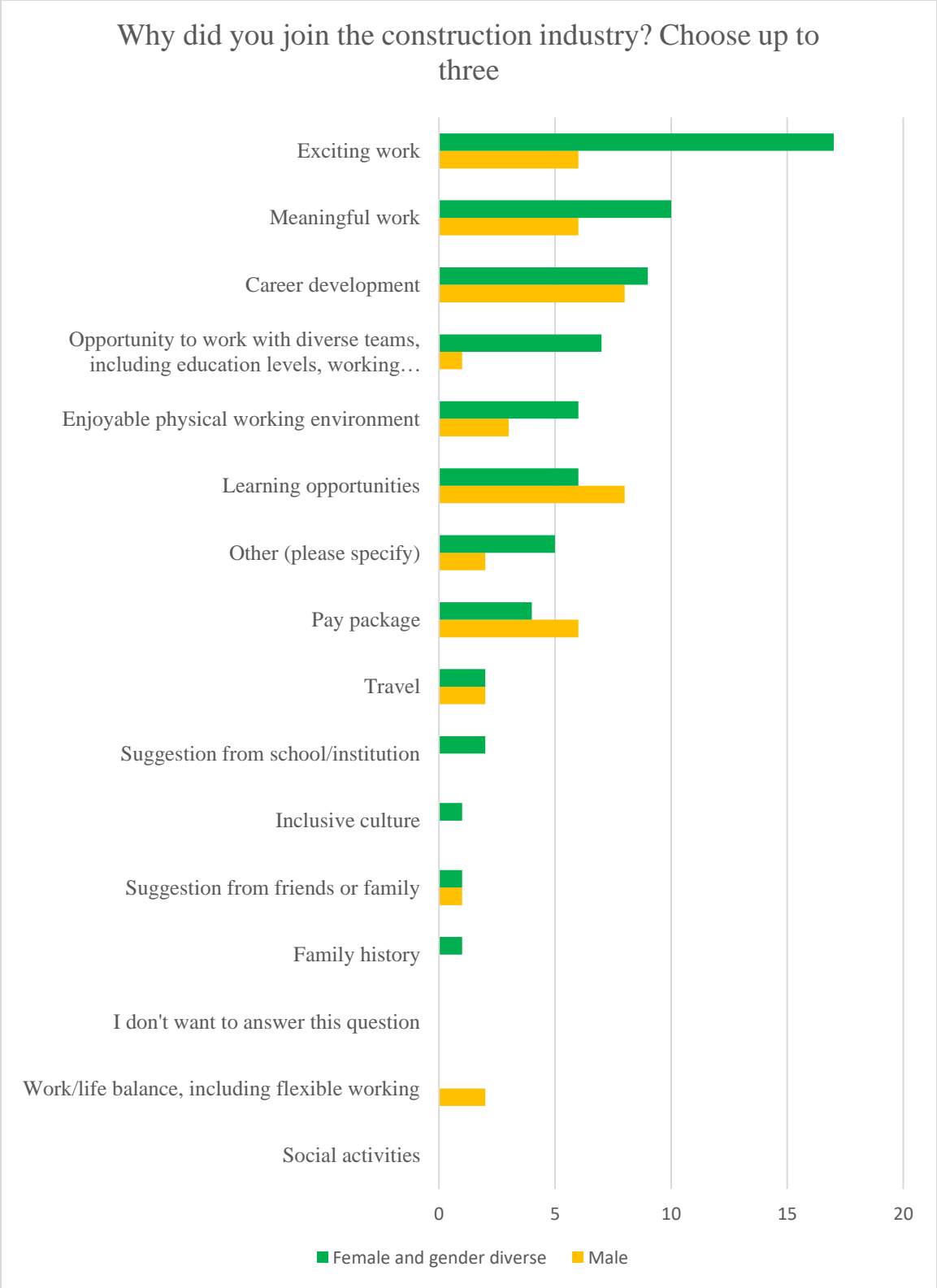


Figure 3 Graph depicting reasons for joining the construction industry, split by gender

“Exciting work” was a primary driver for recruitment in this cohort. The other top four responses were career development, meaningful work, learning opportunities, and pay package.

There was a gender disparity between the reasons selected (see Figure 3 above). The top two reasons for female and gender diverse people to join the construction industry are exciting and meaningful work. The two responses most often provided by male engineers are career development and learning opportunities.

A notable difference is in the “opportunity to work with diverse teams, including education levels, working backgrounds, ethnicities, abilities, etc”. Only one male respondent selected this, compared to 7 women/gender diverse engineers.

5.2.3. Reasons for joining Downer New Zealand

This question asked respondents to choose from the same set of reasons as the previous question, this time considering specifically why they joined Downer New Zealand. Asking this may provide insight to the extent to which DNZ may be representative of the overall New Zealand construction industry, and the strengths of DNZ as a recruiter of early-career engineers.

The most common response from the options available was “career development”, selected by 10 female/gender diverse engineers and 12 male engineers. “Learning opportunities” was selected by 7 and 8 engineers, respectively. “Meaningful work” was the third most common response, selected by 5 and 5. Thus, there is little gender disparity between the reasons provided for joining Downer New Zealand.

Of the 6 people who provided a written response to this question, four mentioned a scholarship or job stability as factors in choosing employment at DNZ.

5.2.4. Enjoyable aspects of current role

This was another question where respondents were asked to choose up to three aspects from a list or provide a text answer to “other” if desired.

There were notable differences between the responses provided by female or gender diverse and male engineers.

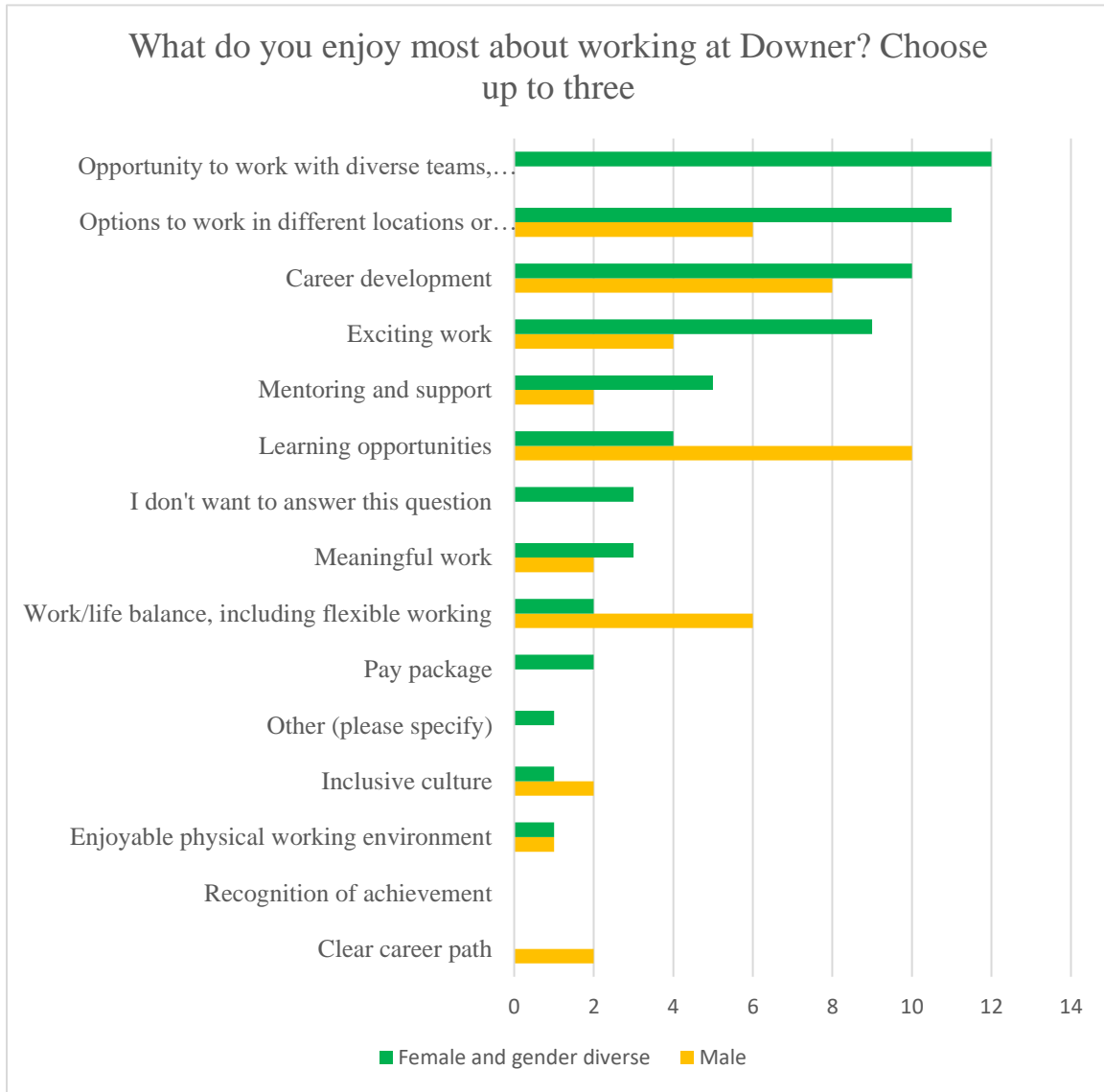


Figure 4 Graph depicting most enjoyable aspects of working at DNZ, split by gender

The most common response selected by female/gender diverse engineers was the opportunity to work within diverse teams, with 12 respondents choosing this as a key enjoyable aspect of working at DNZ. No male respondents selected this option.

The next two most common female responses were the options to work in different locations or departments, and career development.

Male engineers were more likely to select learning opportunities, career development, and the option of working in different departments and locations as criteria for enjoyment of their work at DNZ.

Male engineers were more than twice as likely to choose learning opportunities and work/life balance as enjoyable aspects of their jobs. Female engineers were more than twice as likely to select exciting work and mentoring and support as reasons to enjoy their jobs.

5.2.5. Least favourite aspects of role

There was a wide spread of answers chosen for the question of “what are your least favourite things about your work at Downer right now? Choose up to three.” Each answer was selected by at least one respondent, implying that many options were relevant and indicating a substantial degree of individual variation amongst work preferences and experiences. The options suggested by the researcher were generated based on the reasons offered in the previous questions and themes in the industry and academic literature.

There were, again, differences in the response patterns of female/gender diverse engineers and male engineers. Twelve women do not feel they have adequate work/life balance or access to flexible work, compared to 3 men.

Women are much more likely to have responded that they dislike having an unclear career path (7 versus 2).

The most common response for men, and second most common for women, was that the pay package is one of their least favourite aspects of working at DNZ.



Figure 5 Graph depicting the least favourite aspects of working at DNZ amongst the research population

5.2.6. Likelihood of retention at Downer and in construction

The following question asked if any of the concerns noted previously would lead employees to consider leaving Downer. The responses to this are shown in Figure 6 below. Approximately 80% (20 out of 26) of female and gender diverse respondents expressed concerns that may lead them to leave Downer New Zealand, and nearly 50% (9 out of 20) of male respondents said the same.

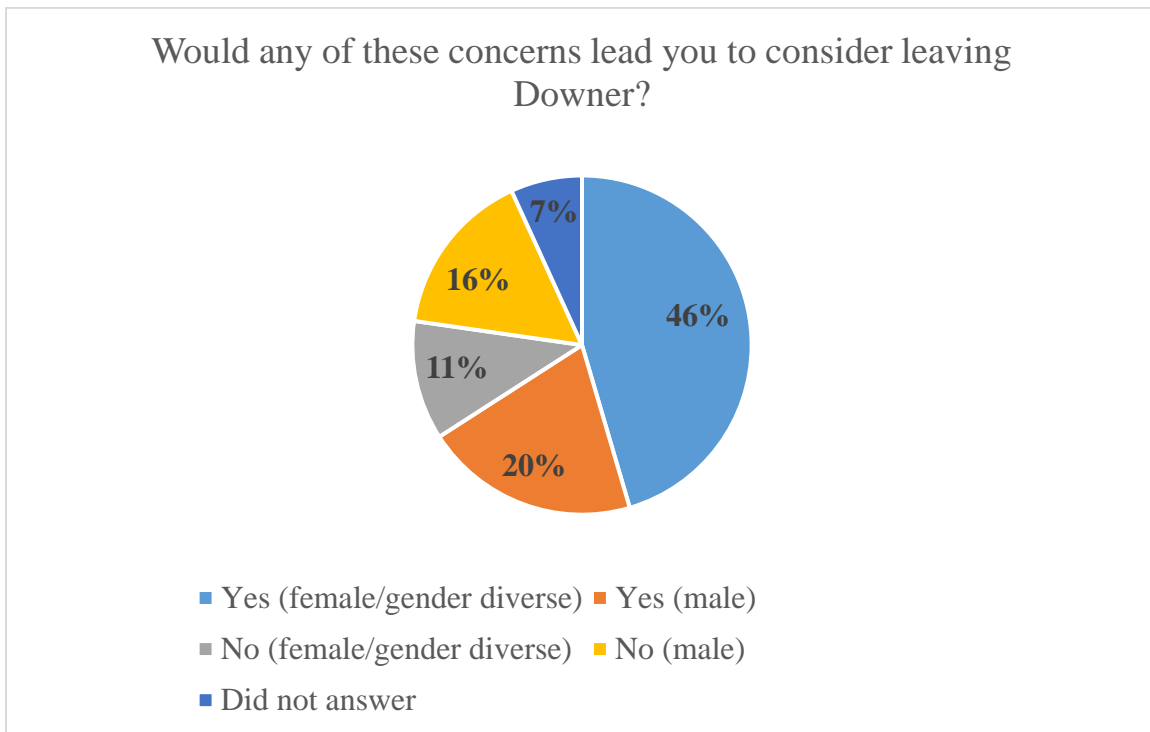


Figure 6 Percentage of respondents who have concerns that may lead them to leave DNZ

The related question in this series was “if you left Downer, what would be your likely next step (even if you think you may return)?” This question could be responded to or skipped, regardless of the answer to the previous question. Nonetheless, the same respondents provided answers to this from the selection provided by the researcher.

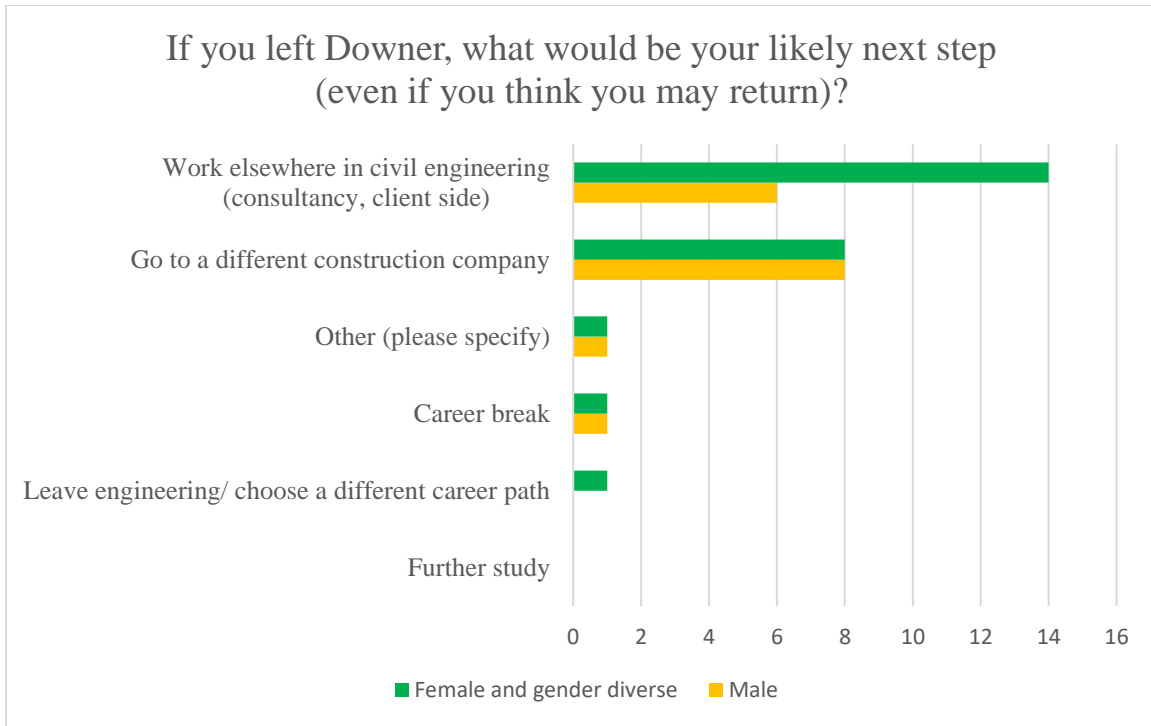


Figure 7 Potential next steps for those who leave Downer

The responses to this question imply that career choices related to leaving Downer New Zealand are not necessarily correlated with gender. Sixteen of the 29 responses suggested that the construction industry itself would not be the catalyst for leaving, as they would attempt to find work at another construction company. However, women were more likely to say they would leave Downer New Zealand to work in another non-construction employer within the civil engineering industry.

5.2.7. Career supports and concerns

Women provided more responses to this question – 74 out of the total of 116 (noting that up to three responses could be provided by each survey respondent). This could mean that women had more concerns that their needs were not understood or would not be met. It is possible that they simply chose to fully exploit this opportunity to provide feedback. Therefore, a comparison of the number of male versus female responses in each category may not be numerically meaningful, but patterns can be detected.

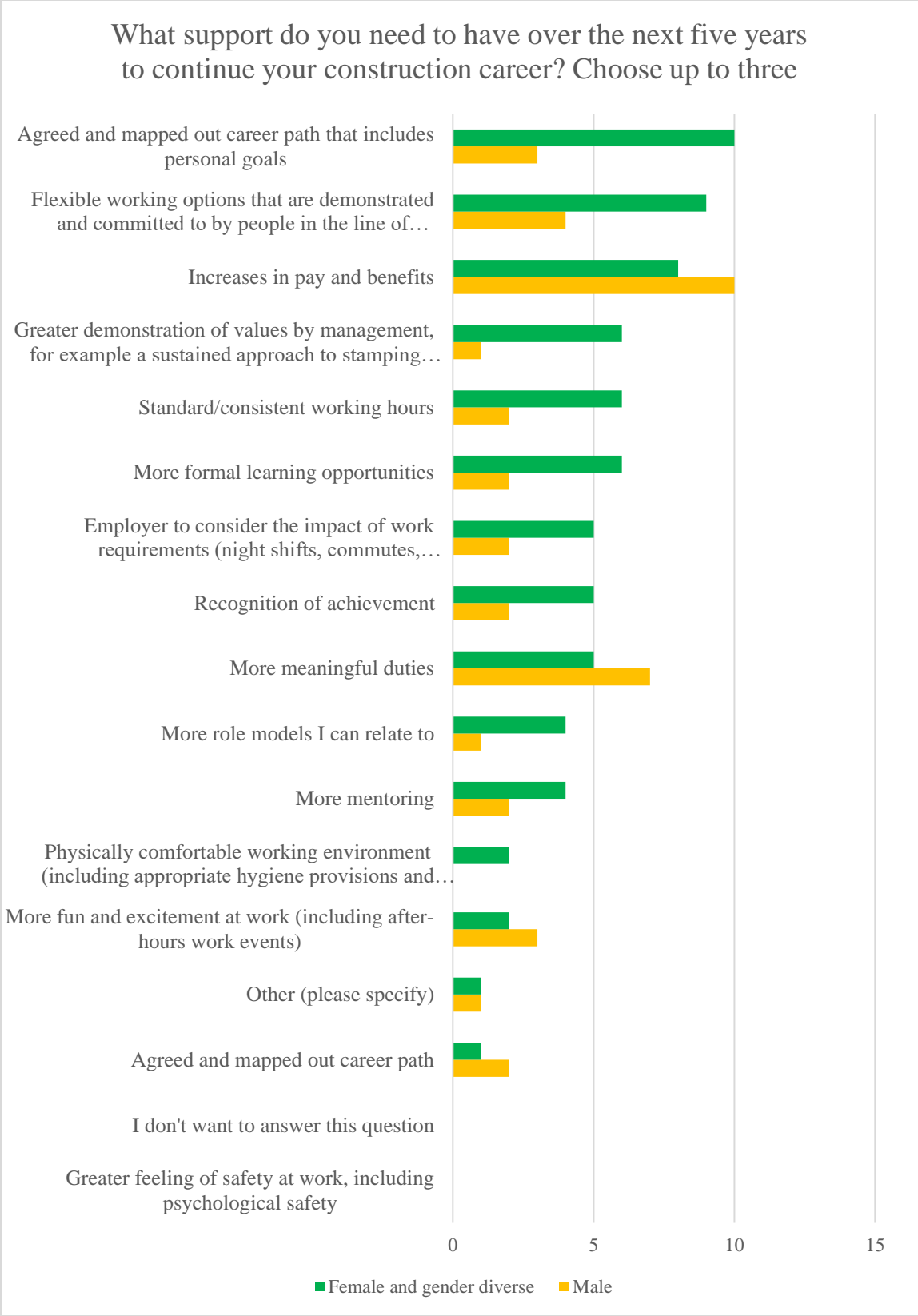


Figure 8 Career supports for the next five years

The top three employment supports desired by female and gender diverse engineers were having an “agreed and mapped out career path that includes personal goals”, “flexible working options that are demonstrated and committed to by people in the line of management”, and “increases in pay and benefits”. The top two options were worded to capture the special concerns of female engineers as described in literature.

The use of “personal goals” within the career path may relate to maternity leave, family responsibilities, and caregiving, or less gendered concerns such as travel, further study, or pursuit of interests outside of work. Flexible working demonstrated “in the line of management” reflects the concerns raised by Lingard, Galea, and others - flexible work tends to only be available to those outside of operational construction roles (human resources, business support services such as accounting, etc). Many construction companies - Downer New Zealand included - offer and publicise a commitment to flexible working. However, it is rare to see how often this is utilised for roles in the construction management line.

The top three concerns for male engineers are increases in pay and benefits, more meaningful duties, and flexible working options.

While the numbers are not statistically significant, it should be noted that women also ranked the following areas more highly than the men ranked flexible working options:

- Greater demonstration of values by management, for example a sustained approach to stamping out harassment;
- Standard/consistent working hours;
- More formal learning opportunities;
- Recognition of achievement; and
- More meaningful duties.

This reflects the higher number of women who completed the survey question. However, it also demonstrates the importance of ranking the concerns amongst the target demographic rather than only considering raw numbers.

To assist with ranking, it is useful to visualise this data across engineers of all genders. This shows where the organisation could focus their efforts for staff retention – though care must be taken to focus on the specific concerns of female engineers to reduce the attrition that is indicated in the previous question.

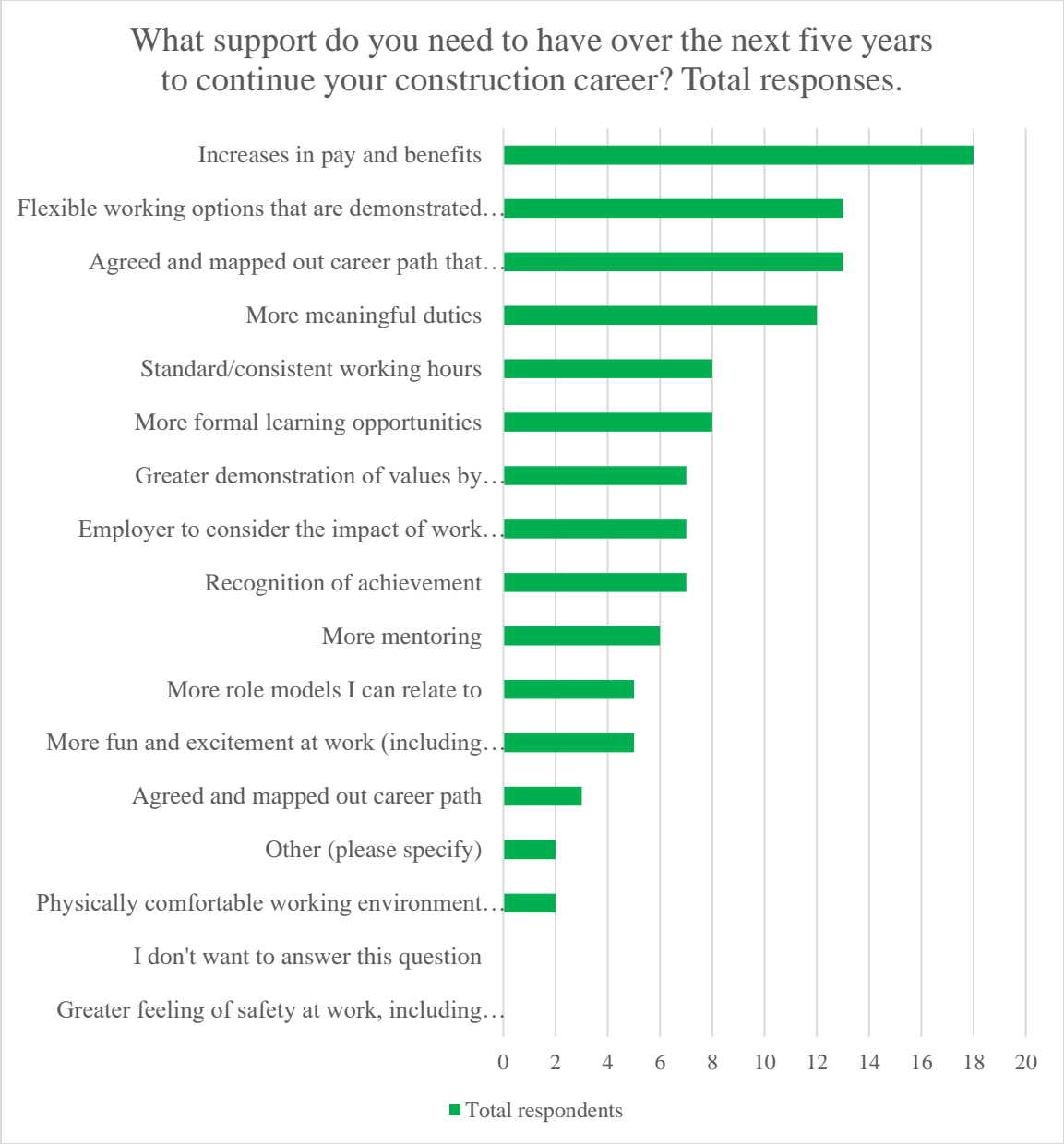


Figure 9 Career supports tally across all genders

When asked to respond to the statement “I expect that I will have the support that I need to stay in Downer for five years and beyond”, 28 out of 40 responses said that they did not expect to, or were unsure that they would, have the support that they needed. Nineteen who responded “no” or “unsure” were female or gender diverse.

5.2.8. Other insights to retention and attrition

The responses to the final question “Please provide any other comments that could help the researcher understand why graduate engineers leave construction before becoming managers” have been coded and categorised with the related concepts (Lichtman, 2013). Individual answers have been included here as quotes, both for their illustrative quality and because the relatively small pool of responses increases the significance of any results.

A word cloud was generated from the key words and phrases used by respondents in the final question (Figure 10). This is provided here as a visual prompt demonstrating the relative weight of concerns or opinions, without the influence of gender or other demographics on the answers.



Figure 10: Word cloud from the final question in the survey

Of the 31 responses to this question, 20 are from female or gender diverse respondents. Twenty-three of those 31 respondents responded with No or Unsure to Question 12, “I expect that I will have the support that I need to stay in Downer for five years and beyond”.

The text responses gave nuanced reasons why women may leave the construction industry – understanding this was one of the research objectives. Quotes are not edited for grammar and may only include a part of the response. Where the response comes

from a male study participant, this is noted. Representative quotes have been chosen for each category.

There were several on the theme of not being able to raise a family and work in construction:

“You might feel that you will fall behind in your career progression if you take maternity leave.”

“Working hours and stress does not align with prospects to settle and start a family.”

“I don't have children now but working in this industry is not sustainable when working 55-60 hours weeks is considered normal.”

“It is not possible to be a part-time site / project engineer, therefore having children while working at Downer is not possible.”

Flexibility and work/life balance were a significant concern:

“Due to the site-based nature of work, flexibility can only easily be awarded to higher management or office based roles.”

“Long work hours, stressful work-environment, poor work-life balance due to long hours” [male respondent]

“We are contracted for 40 hours but will NEVER only work 40 hours. It's accepted as an industry norm but it shouldn't be.”

The nature of the work and the career paths provided to early career engineers was also raised by both men and women:

“work not relevant to degree” [male respondent]

“lack of visibility into the career paths that grads can go into”

“One girl wanted to become a site engineer but the region did not give her a contract because there apparently were no projects for her to go on. Meanwhile, majority of the boys in the same intake were already working as site engineers.”

“We are expected to perform the same if not more duties than males. We often get roped into admin work rather than construction work.”

“very low initial wages and long hours. which aren't sustainable in the current economic times.” [male respondent]

Poor behaviours and role-modelling were discussed:

“Construction companies are still very heavily male dominant at the senior level and there is still an element unconscious bias towards women engineers”

“I've seen some female colleagues targeted by workplace harrasment. They're harrassed by ther peers, undervalued by their managers, and undermined by their subordinates. It seems like women have to work much harder to recieve the same recognition and respect.” [male respondent]

“Lack of role models to look up to. Desire to have connections with other women at work. It's tiring just working with men day in and day out.”

“We target 50% women but don't yet have the support systems or networks to maintain that in some regions or teams- lack of visible leadership. On site those woman can feel isolated as they are not aware of the wider Downer and Corporate network.”

“I can't think of anyone who resonates with me in a higher/management position in civil Construction field in downer - minimal young women of color who have successfully stayed to become a manager”

While these are individual responses and their results cannot be meaningfully quantified, categorising them suggests themes to investigate regarding attrition. These are individual opinions and may not represent objective elements of working at Downer New

Zealand – however, perceptions provide important insight to the concerns of the study population.

5.3. Discussion

This discussion of the questionnaire results seeks to answer parts 2 and 3 of the research question:

2. Correlating literature with a cohort study of young engineers working at Downer New Zealand; and
3. Understanding the concerns and attitudes of these young engineers as they may relate to retention at DNZ and in the wider construction industry.

5.3.1. Correlation between literature and questionnaire results

Correlations between themes in the industry and academic literature and the results of this questionnaire provide several insights. Firstly, it confirms the hypothesis that Downer New Zealand is a representative subset of the construction engineering employers worldwide and within Australasia. As such, the body of literature contains relevant lessons for DNZ. The work of Galea and Lingard are both centred on the Australian construction industry, and both demonstrate the gendered and non-gendered concerns reflected in the questionnaire responses (A. R. J. Dainty & Lingard, 2006; N. Galea et al., 2020; Lingard et al., 2008; Lingard & Francis, 2004; Powell et al., 2018).

Secondly, the literature confirms the validity of the questionnaire. The themes from literature were used to inform the development of the questions and suggested responses. These resonated sufficiently to generate a meaningful response from the surveyed cohort, thus it can be broadly assumed that the questions are relevant and valid.

The tally of results given in Figure 9 demonstrates that some of the concerns are those which may naturally be expected of early-career professionals in many fields – pay, progression, and meaningful work. These concerns could be addressed through regular

performance and salary reviews, which are common in many construction companies. Downer New Zealand completes these with all staff annually as a minimum.

The top three concerns for male engineers are increases in pay and benefits, more meaningful duties, and flexible working options. It is interesting that the third concern overlaps with a major concern of female engineers. Flexible working is often correlated with “working mothers”, but the body of research by Lingard et al has repeatedly demonstrated that men also dislike the extreme demands placed on them by long working hours and remote locations.

The responses suggest that some generalisations can be made between the results of the questionnaire and the overall body of literature. Thus, many of the recommendations provided to Downer New Zealand could be adapted for use in other similar organisations. The results must, however, consider that the small and self-selected sample could lead to generalisation errors (Onwuegbuzie & Leech, 2010). This is addressed here in two ways – one being that a recommendation that Downer New Zealand should seek to understand the potential concerns tabled in greater detail, by interviews, focus groups, or employee representatives on committees. Another way of improving the validity of the results is to increase the sample size, potentially by distributing the survey to other employee groups or even outside the organisation.

5.3.2. Concerns and attitudes of young engineers at Downer New Zealand

The reasons for joining construction provide useful insights. The low number of responses for work/life balance and inclusive culture may either be because the employees surveyed do not value these things, or because they do not believe that a job in the construction industry will deliver them.

Only one male respondent nominated a desire to work with diverse teams, compared to 7 women/gender diverse engineers. This expectation of difference is important to understand further, as it may have an impact on the perceived attractiveness of the industry to women (feeling like outsiders), and reinforces the masculine image of construction engineering (Loosemore & Galea, 2008).

While this survey was intended to capture a snapshot of the current attitudes of young engineers, it is possible that they are projecting their future wishes and requirements into the answers. For example, the women saying they have inadequate access to flexible work may be considering a future situation of raising families while working in construction. This is supported by the text responses in the final question.

The pay package was a common concern across men and women who responded to the survey. While this supports a conclusion that pay and its concerns are equal across genders, there may be a benefit in further discussion of this issue with the cohort. Benchmarking can be done across the industry to reduce the chance of this concern leading to engineer attrition. It is possible that there is simply a lack of information about career and salary progression, which if provided it may allay some concerns. New Zealand has a widening gap between cost-of-living increases and pay increases (Hart, 2020).

Women were more concerned about not having a clear career path. This may reflect that they feel inadequately informed about their options, compared to men who feel they have sufficient information and certainty for their needs. A more likely reason, given the text responses, is that they lack informal networking and obvious role models – more experienced women who have followed a career path to which the graduate cohort aspires. DNZ should seek to understand this discrepancy, as it has a direct impact on the likelihood of a female employee seeking to continue a career in the organisation. The text responses confirm that some women feel their career duration is limited. DNZ could consider how they can show female role models in aspirational career paths. This need for role models should be addressed in a way that is meaningful to early-career female engineers, lest it become a self-fulfilling prophecy.

Industry-wide benchmarking would be valuable. For example, 50-80% of the respondents (gender-dependent) had employment-related concerns that may lead them to consider leaving Downer New Zealand. It would be useful to understand how this compares to the potential attrition rates at other construction companies, and more

broadly across employers of civil engineering graduates. This would help to identify if the factors are specific to the organisation, the work type, or the broader industry.

Of the employees who said they may consider leaving Downer New Zealand due to their employment concerns, more than half said they would seek employment in another construction company. DNZ should investigate which opportunities are sought elsewhere and find a way to provide those while retaining staff.

Nearly half of the women who said they would consider leaving DNZ expressed a wish to move to a non-construction employer in the civil engineering sector. This could correlate with the answers given about the less enjoyable aspects of their current jobs. If, for example, a clearer career path or better work/life balance was demonstrated outside of the construction sector, this could be a factor in the decision. The responses to this question imply that their needs are simply not met by the construction sector (not just their current employer).

5.4. Summary

This questionnaire provided useful insights toward answering the research question of why female engineers do not progress to management levels in construction companies, and specifically at Downer New Zealand.

The first research objective of understanding why female engineers exit the construction industry is explained by the mismatch between the career supports provided by DNZ, and those desired by female engineers. Inadequate work/life balance and an unclear career path coupled with inadequate pay and mentoring are discouraging this cohort.

This matches the themes described in literature, particularly the long working hours and feeling of not being a cultural fit. Thus, the questionnaire achieves the second objective of correlating survey results with academic and industry research.

The third research objective of understanding the concerns and attitudes of these young engineers as they relate to retention at DNZ and in the wider construction industry

is also achieved. Stated simply, many do not believe that they will receive the support they need to continue working at DNZ, particularly as they plan to start families. Further, they believe the construction industry is a difficult and unsustainable working environment. This was demonstrated by their concerns about working hours and locations, inadequate pay for the tasks performed, and unclear work tasks and career paths which seemed to be allocated in an ad-hoc manner.

The fourth research objective, generating recommendations for greater retention of early-career female engineers, is concluded in Chapter 6.

Chapter 6. Recommendations and Conclusion

6.1. Purpose of the research

The research question queried why few women progress from graduate engineering roles to middle management and beyond in New Zealand construction companies – specifically Downer New Zealand. This final chapter summarises the findings from earlier chapters to answer the fourth research objective: generating recommendations for greater retention of young female engineers.

The aim of asking this question is to suggest applied management solutions through a greater understanding of the problem. The context for this understanding is a review of the local and international literature, as well as a questionnaire seeking the thoughts and opinions of DNZ's cohort of recent engineering graduates.

The research objectives were:

1. Understanding, through literature review, why female engineers exit the construction industry;
2. Correlating literature with a cohort study of young engineers working at Downer New Zealand;
3. Understanding the concerns and attitudes of these young engineers as they may relate to retention at DNZ and in the wider construction industry; and
4. Generating recommendations for greater retention of young female engineers.

The literature demonstrates that there are established issues with retention, particularly for women, across construction engineering organisations. The key issues include:

- Acknowledging that women are a key demographic for a sustainable construction engineering workforce;

- Implementing appropriate formal change management to address the demographic change needed in the construction industry;
- A lack of momentum in addressing the difficult conditions faced by women in construction. These span a broad range of concerns such as sexism, harassment, a lack of targeted organisational commitments, poor work/life balance and flexibility, and a lack of supportive community and role models.

Within Downer New Zealand, the results from the questionnaire correlate with the issues noted above. The lack of community and role models is compounded by a seeming lack of line managers demonstrating how a commitment to both family and work are achieved. The feeling of exclusion from workplace culture is a key difference between female and male respondents. The top three concerns which relate to retention and progression of female engineers at DNZ are:

- The provision of clear career paths and role modelling, with adequate commitment and support from management to ensure that career goals are achieved while young engineers move between different locations and managers;
- The demonstrated availability and use of flexible work by people on the same career path; and
- Pay levels that allow employees to lead an independent life and adequately reflect the work completed.

6.2. Relationship to previous research

This research is uniquely significant, in that it adds to the small body of literature specific to women in the New Zealand construction industry. Additionally, it uses cross-sectional data from early-career engineers currently working at Downer New Zealand to validate theories and research developed internationally regarding the retention and promotion of female engineers in the construction sector.

Galea, Lingard, and Dainty have generated a body of research, particularly focused on Australia. They demonstrate that the needs of male and female engineers in construction are more similar than different – reasonable working hours and demands and fairness of work allocations. A strongly gendered masculine organisational culture institutionalises counterproductive work practices that damage wellbeing and career longevity for engineers of all genders. This study tested these findings against a cohort of early-career engineers in one of New Zealand’s largest construction employers.

The results of this paper confirm a correlation with international research on the retention and career paths of female construction engineers, and thus the international body of research can be distilled to provide recommendations to Downer New Zealand.

6.3. Limitations of the present study

An assumption was made that both female engineers and employers of construction engineers are limited when there is a failure to attract and retain women. Thus, this research is significant only when this assumption is true.

The time and practical delimitations of this study were set by the researcher, which led to the questionnaire being issued to a convenience population of new-entrant engineers within their own organisation, Downer New Zealand. The sample population is numerically insufficient for robust statistical analysis. Thus, this paper seeks to qualitatively understand the opinions and needs of the population with limited quantification. Future research with a larger sample population may seek to take the findings of this study and test the theories to generalise further.

The current limitations may reduce the generalisability of this study outside of Downer New Zealand.

6.4. Recommendations for future research and practice

This study provides the following key recommendations for greater retention of early-career female construction engineers:

- Directly engage the target demographic in developing programmes and support systems to address their retention and promotion;
- Develop appropriate baselines and metrics to measure the effectiveness of programmes to reduce sexism, increase numbers of women in strategic roles and career levels, and demonstrate career progression; and
- Publicise metrics and successes, with senior executives nominated to retain responsibilities for improving outcomes.

6.4.1. Further research

Future research could focus on the following ideas, which are indicated by this study but not covered by detail:

- Learn more about this cohort to develop specific plans for retention. Downer New Zealand managers and senior leaders should seek to understand individual and collective employment concerns and provide a plan or pathway specific to each employee they seek to retain. Group recruitment is effective for graduate engineers but once they are established within the organisation, each individual needs to understand their role and potential future directions. This could be undertaken by one-on-one interviews, focus groups, or through other appropriate mechanisms.
- Seek to generalise this research to other employers in New Zealand. This could be done by collecting baseline and cross-sectional data for a wider group of young professional engineers, through industry groups or across several organisations.
- Study the phenomena of recruitment and retention across other cohorts in the construction industry, to encourage employment growth in other minority groups. Suggested demographics for study include people with disabilities, immigrants and ethnic minorities, LGBTQIA+ employees, and other under-represented groups. Research methods for intersectional analysis may differ due to small populations and privacy concerns.

Careful consideration of the issues regarding recruitment and retention of minority employees in construction will bring benefits to the New Zealand industry and community at large. There is an ongoing deficit of skilled people at all levels in the construction industry, a pipeline of new and ageing infrastructure contracts, and severe restrictions on immigration. Thus, retaining and developing female construction engineers provides economic and social benefits to the wider community and the women employed in the industry.

6.4.2. Recommended practices

Recommendations for Downer New Zealand and the wider New Zealand construction industry are provided in the numbered paragraphs below. They are based on the literature review and case study provided in this research. The first recommendations relate to DNZ specifically, with those provided later in those section more likely to be successfully generalised. While the intent of this research was not necessarily to be generalised across the industry or internationally, consideration could be given to modifying these recommendations for other entities.

1. Include representatives from the target population to determine best practices for retention of female construction engineers at Downer New Zealand. Assumptions and generalisations can reduce buy-in to diversity efforts and may not target outcomes that are the most important to the stakeholders.
2. Metrics should be developed for female engineers at Downer New Zealand. A baseline should be set via a 'stocktake' of current employees and their job titles, locations, seniority levels, and other applicable data. These metrics can then be monitored on a regular basis and following changes to employment practices or other external factors. This enables evidence-driven decisions to either resource or discontinue practices based on their measured outcomes.
3. Consider re-issuing the questionnaire to understand the concerns of female engineers at other career levels within Downer New Zealand. This could give

insight to whether the younger cohort has similar concerns to more experienced minority engineers.

4. Amend the questionnaire to include other minority groups. This would again allow comparison between the attitudes and concerns of the majority population (assumed to be white male engineers) and other target demographics.
5. Downer New Zealand should ensure that each person in the graduate cohort has a career plan for the short, medium, and long-term to which both the organisation and the employee are committed. This could include guidance on expected pay increases, duties at each level, and an agreement about working hours and locations. It is expected that this is currently done in a more general manner, but the findings of the questionnaire show a mismatch between the expectations of the employer and the employee.
6. Consider how to integrate the voices of female construction engineers into wider corporate policies and outcomes. Early- or mid-career female engineers could become employee representatives at Board meetings or senior executive conferences. This could be further capitalised as a way of recognising high-potential staff in early or mid career, demonstrating women as role models, and the concept could be extended to other groups who are not adequately represented in the organisation.
7. Set SMART goals, aligned with business values, to establish targets and measure the impacts of any schemes or progress towards greater retention of female construction engineers. Metrics and targets should be explicitly stated so that appropriate change management processes can occur. These metrics can also be used to measure the impacts on other populations. For example, many of the concerns shown in the research affect all genders, and this could have an impact on overall staff retention.
8. Apply change management theory to the overall desire to change the demographic make-up of a construction organisation. It is a substantial undertaking to move

- from approximately 5% to approximately 50% female engineers across a large organisation, and the efforts to do so should be closely managed to ensure both orderly delivery and appropriate review.
9. Recognise that the needs and concerns of young women and gender diverse engineers are sometimes different from those of young male engineers. While there are many similarities, actions to improve the retention and promotion of women need to be specific. To treat everyone equally does not give equitable results, because female engineers are not starting from a position of cultural comfort and status quo bias.
 10. Diversity actions (such as employing more female graduates) need to be linked to outcomes (more women in management, for example) so that success is defined in a meaningful way. This also illuminates the need for diversity policies to be specific and clear about reducing an inequity in the system.
 11. Celebrate authentic changes towards inclusion and equity that lead towards larger triple-bottom-line goals. Seek ways to celebrate the successes of women so that they do not feel tokenised.
 12. Consider how any of the actions above can be modified to support greater inclusion of other marginalised groups (rainbow community, people with disabilities, different cultures and ethnicities, and so forth). An intersectional approach should be further explored.

6.5. Conclusion

The research question asked why few women progress from graduate engineering roles to middle management and beyond in New Zealand construction companies – specifically Downer New Zealand.

Fundamentally, construction engineering remains a masculine culture with many work practices and environments perceived as hostile by early-career women. Retention

and promotion of women in the industry has generally not been addressed in specific policies or with publicly displayed targets and progress.

Early-career female engineers at Downer New Zealand expressed concerns regarding unclear career paths and possible bias against them in role descriptions. They were also concerned about access to flexible working, reasonable work hours, and pay progression. Regardless of whether these are already in the process of being addressed, the perception is that they may limit the duration of women's careers.

The population studied also raised other concerns that correlated with published literature, such as feeling culturally excluded, harassed, and unable to see relatable role models.

Successes in increasing retention will eventually be self-sustaining. This is crucial in the current recruiting environment in New Zealand. A more equitable distribution of women in higher-level positions will encourage more female recruitment by demonstrating a clear career path and inclusive environment.

A change in corporate culture must be driven and supported by the senior executives. A company vision with explicit goals will support this. Actions must match the words and there is an increasing expectation that organisations will demonstrate their own goals at the highest level. Change management theory supports this concept – buy-in is needed across the entire organisation but leaders must steer the ship. Organisations should consider implementing targets for female recruitment and retention at all levels of the business.

Each transformative action selected should have SMART (Specific, Measurable, Achievable, Relevant, Timely) targets, and regular reporting both to senior management and employees about progress.

Successful initiatives to improve retention of female engineers will also attract and retain staff from other demographics. Well-considered investments in this area will bring economic and social returns to the organisation.

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Appendix B. Questionnaire



Questionnaire: understanding why women leave the construction industry

Information Sheet for Participants

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate, I thank you. If you decide not to take part there will be no disadvantage to you of any kind and I thank you for considering my request.

Kia ora, my name is Kat Jackson and I am studying for a Master of Applied Management at Southern Institute of Technology in Invercargill. I'm also a civil engineer, working as a Project Manager at Downer New Zealand.

Downer invests significantly in recruiting and supporting intern, graduate, and cadet engineers. In 2021, about 50% of this cohort is female. However, statistics and experience show that most women will leave construction before progressing to management – around 29% leave engineering in the first five years, compared to around 18% of men. This study seeks to understand the needs of early-career engineers in order to develop strategies for staff retention (for all genders).

This survey should take no more than 15-20 minutes of your time. Participation is voluntary, and you can choose not to answer any or all of the questions. Your answers will be kept confidential and anonymous.

If you do participate, I thank you. Your participation gives consent for the data to be included in my research project. The data will be stored on a password-protected computer for 3 years and then will be destroyed.

The results of this questionnaire will be formalised in a dissertation and assessed as a part of my course of study. You will be offered a copy of the final report after it is assessed.

This project is being carried out under ethical approval from the Human Research Ethics Committee. If you have any questions, please contact my supervisor, Dr Jacob Wood,

████████████████████.

Understanding why women leave the construction industry

Demographic Questions

1. What is your gender?

- Female
- Male
- Gender diverse
- Prefer not to say

2. What is your highest qualification?

- Bachelor's degree
- Master's degree
- Other (please specify)

3. Is your qualification in engineering?

- Yes
- No

4. When did you first start working for Downer (month & year)?

[text field]

Core Questions

1. Why did you join the construction industry? *Choose up to three*

- Exciting work
- Meaningful work
- Pay package
- Family history
- Suggestion from friends or family
- Suggestion from school/institution
- Learning opportunities
- Career development
- Social activities
- Travel
- Work/life balance, including flexible working
- Enjoyable physical working environment
- Opportunity to work with diverse teams, including education levels, working backgrounds, ethnicities, abilities, etc
- Inclusive culture
- I don't want to answer this question
- Other (please specify)

2. Why did you choose Downer specifically? *Choose up to three*

- Exciting work
- Meaningful work
- Pay package
- Family history
- Suggestion from friends or family
- Suggestion from school/institution
- Learning opportunities
- Career development
- Social activities
- Travel
- Work/life balance, including flexible working
- Enjoyable physical working environment
- Opportunity to work with diverse teams, including education levels, working backgrounds, ethnicities, abilities, etc
- Inclusive culture
- I didn't or it was not my first choice
- I don't want to answer this question
- Other (please specify)

3. What do you enjoy most about working at Downer? *Choose up to three*

- Exciting work
- Meaningful work
- Pay package
- Learning opportunities
- Career development
- Clear career path
- Options to work in different locations or departments
- Work/life balance, including flexible working
- Enjoyable physical working environment
- Opportunity to work with diverse teams, including education levels, working backgrounds, ethnicities, abilities, etc
- Inclusive culture
- Mentoring and support
- Recognition of achievement
- I don't want to answer this question
- Other (please specify)

4. What are your least favourite things about your work at Downer right now?

Choose up to three

- Work is not exciting
- Work is not meaningful
- Not enough/ too many social activities
- Pay package
- Learning opportunities – not enough or not aligned with interests
- Career development doesn't meet your needs
- Unclear career path
- Not offered options to work in different locations or departments
- Working in a location that does not suit you
- Inadequate work/life balance, including access to flexible working
- Physical work environment doesn't meet your needs
- Feel excluded by the workplace culture
- Unrealistic deadlines/ lack of support to complete work
- Mentoring and support doesn't meet your needs
- Feel unsafe (physically or mentally, on site or in the office)
- Have been subjected to or witnessed unsafe acts (including Zero Harm, harassment, bullying)
- Not enough recognition of achievement
- I have no complaints
- I don't want to answer this question
- Other (please specify)

5. Would any of these concerns lead you to consider leaving Downer?

- Yes
- No

6. If you left Downer, what would be your likely next step (even if you think you may return)? Please choose one answer

- Go to a different construction company
- Work elsewhere in civil engineering (consultancy, client side)
- Leave engineering/ choose a different career path
- Career break
- Further study
- Other (please specify)

7. What support do you need to have over the next five years to continue your construction career? *Choose up to three*

- More meaningful duties=
- More fun and excitement at work (including after-hours work events)
- Increases in pay and benefits
- Agreed and mapped out career path
- Agreed and mapped out career path that includes personal goals
- More formal learning opportunities
- Recognition of achievement
- Flexible working options that are demonstrated and committed to by people in the line of management
- Standard/consistent working hours
- Employer to consider the impact of work requirements (night shifts, commutes, relocation) when discussing potential work assignments
- Physically comfortable working environment (including appropriate hygiene provisions and support for disabilities)
- Greater feeling of safety at work, including psychological safety
- Greater demonstration of values by management, for example a sustained approach to stamping out harassment
- More mentoring
- More role models I can relate to
- I don't want to answer this question
- Other (please specify)

8. I expect that I will have the support that I need to stay in Downer for five years or longer

- Yes
- No
- Unsure

9. Please provide any other comments that could help the researcher understand why graduate engineers leave construction before becoming managers.

[open text field]