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Two Steps Forward, One Step Back: Women in Professional Engineering in Australia

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ABSTRACT
There have been many calls to increase the participation of women in the engineering workforce and recommendations that, in order to achieve this, cultural change was required within the engineering profession. This paper first examines the research published in this area over the last three decades. It then considers the progress made in this regard in the Australian context, by comparing the findings of two national surveys of all female members and a matched sample of male members of the national society for engineers that were conducted in 2000 and 2007. The comparison showed that significant progress had been made, particularly with regard to the provision of family-friendly work practices in many engineering workplaces, hence two steps forward. However, these improvements had not yet had any impact on retention statistics, gender pay gaps or experience of discrimination, findings which suggest that the underlying issues of engineering workplace culture are yet to be addressed, taking us one step back.

KEYWORDS

Women in engineering; employment

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INTRODUCTION

Across the English speaking world the profession of engineering has made little progress towards achieving gender parity in its workforce. The proportion of women amongst professional engineers currently ranges from 7% in the UK (Kirkup *et al*, 2010) to 11% in Australia and the US (Australian Bureau of Statistics, 2009; National Science Foundation, 2009). Explanations for the small proportion of women professional engineers are wide-ranging. Many focus on what might be described as the input stages to the profession. High school girls' interests, preferences and self-concepts and the extent to which these have steered them towards or away from considering a career in engineering have been explored. Further research topics have included whether girls opt in or out of the advanced mathematics and science subjects required for admission to engineering degree programs, and then whether they do in fact commence and complete engineering study.

The demonstrated tendency for young women to opt out at consecutive input stages to the profession has led to the term 'leaky pipeline' (Blickenstaff, 2005; Kirkup *et al*, 2010; for example). Leaks before actually entering the profession have been ascribed to the unattractive image of engineering to female high school students, the lack of informed careers advice and role models for girls, gender stereotyping, lack of confidence in female engineering students, and the gendered nature of engineering degree programs (McIlwee and Robinson, 1992; Faulkner, 2000; Womeng, 2006; Bagilhole *et al*, 2007; Gill *et al*, 2008; Bell, 2009). Various governmental, educational and professional initiatives and campaigns addressing these problems succeeded in increasing the proportion of female engineering undergraduates from about 3% in 1980 to about 15% in 1999 in Australia for example (DEEWR, 2009), and similarly in other countries.

By the late 1990s it was becoming apparent that the increasing numbers of women graduating in engineering was not resulting in the expected proportional increase in women in the professional engineering workforce. The question thus arose whether attrition from the profession itself was another significant leak in the pipeline. In 2000, the Australian professional engineering institution (then called the Institution of Engineers, Australia, now known as Engineers Australia), commissioned a study to investigate this question. That study, titled *The Careers Review of Engineering Women* (*CREW*), found that Australian women engineers were subject to discrimination, harassment and paternalism, and were indeed leaving the profession faster than men (Roberts and Ayre, 2002a). Similar findings emerged from studies conducted at about the same time in the US and the UK (CAWMSET, 2000; Greenfield *et al*, 2002).

Subsequently, in the 2000s, Engineers Australia and a number of Australian engineering employers put in place many of the recommendations in the Roberts and Ayre report for improving women's retention. They also took additional steps to

introduce and implement equity and diversity policies. In 2007 the *CREW* survey was repeated in order to investigate whether these changes had produced a difference in terms of workplace satisfaction and engagement of women engineers (Mills *et al,* 2008). Using the terms *CREW1* and *CREW2* in this paper for the 2000 and 2007 surveys respectively, *CREW2* found that overall, women engineers' job satisfaction and perception of workplace culture had improved markedly since *CREW1*. Yet despite these improvements, women continued to leave the profession at approximately the same rate as seven years previously.

The question remains as to why the high attrition of women engineers in Australia and other western countries persists, despite the improvement of many workplace conditions. In this paper we review the literature in this field, looking for new insights into the problem. We then report findings from *CREW2*, identifying what has and has not changed in Australia since *CREW1*. We conclude with recommendations for further research and/or action.

ENTRY AND RETENTION DATA

Entry to the profession

One model of the leaky pipeline states that "Women qualify in SET [science, engineering and technology] but are lost at key transition points" (UKRC, 2010). The first transition point after graduation is into first employment or further study. Here there are clear national differences. In the US, 77% of the female engineering students who graduated in 2006 went into a science or engineering occupation or remained in full-time education, compared with 83% of the male graduates (NSF, 2008). Thus, in the US there is a slightly greater proportional loss of women than men at this point. In the UK the gender difference is more marked: 42% of male SET graduates in 2007 entered professional SET employment, but only 21% of their female equivalents (Kirkup *et al*, 2010), although it must be noted that these statistics include science as well as engineering.

In Australia, graduate destination surveys have consistently shown that almost equal proportions of female and male engineering graduates seeking full-time employment as professional engineers find it within six months of graduation. In 2008 the proportions were 83.6% female and 86.5% male respectively for engineering graduates. Virtually all the remainder were either seeking engineering work or undertaking further study (Graduate Careers Australia, 2009). Thus in Australia women appear to join the profession in equal proportions to men.

Attrition from the profession

Over the last twenty years there has been considerable evidence in Australia, US, and the UK that proportionally more female engineers leave the profession than male. US exit rates have recently been estimated as 12.9% for women and 9.8% for men (Hunt, 2010). In the UK, 56% of male SET graduates were in SET employment in 2008, but only 35% of their female equivalents (Kirkup *et al*, 2010). In Australia, the *CREW1* study found that women's attrition from the profession peaks in the age-group 30-39, the age that men are least likely to leave the profession (Roberts and Ayre, 2002b). The Association of Professional Engineers,

Scientists and Managers, Australia (APESMA), which conducts annual surveys of their members, has also noted that:

> …in 1996, 18% of all engineering graduates were female. However, by 2006, female engineers made up only 11% of all engineers with between 7 and 10 years experience. This indicates that women are leaving the engineering profession at a rate of 38.8% faster than their male counterparts. (APESMA, 2007, p.2).

The following section summarises what is known about workplace effects on the job satisfaction, progression and retention of female professional engineers.

PREVIOUS RESEARCH

Disadvantage, dissatisfaction and discrimination in the profession

Research into female attrition in engineering consistently finds that the masculine cultural environment leads to the disadvantage and dissatisfaction of many women engineers. Since the values, systems and procedures of the profession have been developed almost exclusively by men and for men, the relatively small numbers of women who have entered engineering employment have rarely as yet had sufficient influence or power to become a force for cultural change.

During the 1990s research on women's low representation in the profession focused on identifying discriminatory barriers or impediments to their career satisfaction and progression. Gender-discriminatory processes, judgements or perspectives found to occur in engineering in the 1990s included: different operational styles; exclusion from 'old boy' or 'boys' clubs' networks; double standards; paternalism; isolation; pay; restricted access to resources; training and mentoring; the difficulties of combining career with family; and, sexual harassment (McIlwee and Robinson, 1992; Evetts, 1993; National Research Council, 1994; Geppert, 1995; Khazanet, 1996; Vetter, 1996; Maskell-Pretz and Hopkins, 1997, NSF, 1998; APESMA, 1999; MIT, 1999; Glover, 2000). While these studies were predominantly set in a US context, their findings were used to provide the basis of the *CREW1* study of Australian women professional engineers, which found that all these barriers and impediments also existed in the Australian profession at that time (Roberts and Ayre, 2002a; Mills *et al*, 2006).

International research in the first decade of the 21st century found the discriminatory practices listed above still operating. Davis (2001) for example, used terms like 'aggressive' and 'ritual opposition' to describe male scientists' discourse style. She also reported that differences in male and female communication styles continue to undermine women's confidence and reduce their credibility amongst male colleagues. Others such as Griffiths *et al*, 2006; Womeng, 2006; Mills *et al*, 2006; Bagilhole *et al*, 2007; Hewlett *et al*, 2008; Riley, 2008; Faulkner, 2009 report on the importance for women to match male colleagues' communication styles and interests in order to be included in professional engineering networks. They also note the ways in which sexist humour and other forms of sexual harassment in the engineering workplace can undermine women's professional status. The same authors report the persistence of double standards (women need to work harder

than their male colleagues for recognition and promotion), and women's feelings of isolation and invisibility in the workplace. This overlooking or dismissal by the dominant men of female contributions and achievements in the professional arena is still having a detrimental effect on women's recognition and credibility in terms of pay, promotion and other rewards (Womeng, 2006; Bagilhole *et al*, 2007; Hunt, 2010).

In Australia for example, despite the increasing numbers of women joining the profession, female engineers remain clustered in the lower levels of professional responsibility. In contrast, male engineers are distributed across the responsibility levels in an approximation of the normal curve (Roberts and Ayre, 2002b; APESMA, 2007). In the US the gender pay gap for professional engineers is 14% (NSF, 2009), having improved from 19% in 1998 (NSF, 1998). In the UK the gap for professional engineers is currently 11% (Kirkup *et al*, 2010), whereas in 2000 it was 20% across all professional science and engineering occupations (Glover, 2000). Hence, although the pay gap for professional engineers has narrowed somewhat over the last decade, it is still considerable. Female engineers are however better off than women in other occupations. The gender pay gap across all occupations is about 20% in the US (Daily Mail, 2010), 12.6% in the UK (Kirkup *et al*, 2010), and 18% in Australia, but rising rather than falling as it appears to be doing for engineers (EOWA, 2010).

Family formation and maintenance

Much of the literature about women's discomfort and disadvantage in the engineering workplace relates to the difficulties associated with combining a career with family formation and maintenance, perceived by many men and women as a woman's job. As the Australian APESMA (2007) remarks: "The capacity of women to effectively balance work and family can impact upon the rate of childlessness and the retention of women with children in a profession" (p. 3). In a recent analysis of the literature in this field, Bagilhole *et al* (2007) found that "Women still experience clear discrimination surrounding the issue of maternity leave and the return to work" (p.41). After 40 years of feminist activism there is still a strong underlying assumption that of the two parents, only the mother needs to fit her career around family and childcare responsibilities (Womeng 2006, Bagilhole *et al*, 2007; Hewlett *et al*, 2008; KPMG, 2009). Thus in a strongly masculinised workplace, the needs of engineers who are mothers for flexible working hours and other 'family-friendly' employment practices continue to be viewed as exceptions rather than standard, leading to what has been described as an "anti-family culture" in the profession (Bagilhole *et al*, 2007, p.41).

The actual incidence of motherhood amongst professional engineers provides some interesting indicators of its potential impact and influence on women's careers. In Australia it has been consistently found that women engineers are the least likely of all female professionals to have children. It was recently reported that 67% of women engineers are childless, with the next highest proportion of childless female professionals being 60% in ICT. In contrast, the average across all Australian professions is about 49% (APESMA, 2007). Blackwell and Glover (2008) found similar rankings of childlessness amongst female UK professionals in longitudinal

data from 1971-1991. They found that only 40% of women in SET became mothers, compared with 80% of women in health-related occupations. Both APESMA, and Blackwell and Glover, view this relatively low incidence of motherhood among women engineers partly as an effect of the known difficulties of combining family life with an engineering career, and partly a result of attrition from the profession for this same reason.

Family-friendly employment practices are usually understood to mean the availability of flexible working hours, part-time employment, paid parental and carers' leave, leave without pay, job-sharing, and employer-provided childcare. Many of these options are available in most countries, though in some cases patchily, and are used to varying extent by women engineers with parental responsibilities (Womeng, 2006; APESMA 2007). A recurrent theme in the literature is that many women suspect or know that their use of these provisions has been detrimental to their careers (Womeng, 2006; Bagilhole *et al*, 2007, APESMA, 2007). Bastalich *et al* (2007) endorse this likelihood, suggesting that the provision of family-friendly policies "… may simply reinforce the views that women are the site of the problem and need 'special concessions' in order to succeed in science and engineering" (p.387). Mills *et al* (2006), emphasise that while it is important to have family-friendly workplace initiatives, it is also important to ensure "… that those who use them are not then penalised by being given marginalized roles, less challenging work, and limited promotion opportunities" (p.56). Thus, there are two key components to the value of family-friendly policies in engineering workplaces: firstly what is available, and secondly whether (male and female) engineers can use them without jeopardising their careers.

Newer perspectives

Along with these recent confirmations and elaborations of discrimination against female engineers that were identified in 1990s' research, there has been a conceptual shift during the 2000s locating women's disadvantage and discomfort within frameworks of gendered stereotyping and gendered identities. Examples of gender stereotyping are views that women engineers are less able and less interested than men in technical problems. Further, that since their skills are stronger in communication and interpersonal relations, women are better equipped for the 'softer' management roles in engineering than technical or 'real' engineering (Faulkner, 2006; Womeng, 2006; Sappleton *et al*, 2009). Women are also seen as less ambitious than men, and seen to put family formation and care before their careers. These, possibly unconscious, male perceptions of female inferiority in the profession underlie much of the discrimination against women (Womeng, 2006, Blackwell and Glover, 2008; Sappleton *et al*, 2009; Watts, 2009).

Gendered identity is a related concept which focuses on individuals' views and ambitions for themselves. A typical manifestation of this is a preference among male engineers to be valued for their technical expertise, and they are thus reluctant to move into coordinating roles. In contrast, women's gender identity does not pull them so strongly towards being seen as technicist, and they more easily accept project management roles, thus perpetuating the 'gendering' of the profession (Faulkner, 2006, Womeng, 2006; Bagilhole *et al*, 2007). However, other

studies have noted the opposite effect of women remaining in technical roles with men moving into management (Evetts, 1993; Sharp *et al*, 2011). These findings have occurred where management roles are seen as higher status and consequently more highly paid. The explanation for these contrasting findings is almost certainly that while the gender preferences play out differently in different organisations or study sites, whichever role is valued more highly (technical or managerial) is the one least likely to be readily available for women.

In summary, for over two decades researchers have probed ever more deeply into the impact of the masculine culture of engineering on the careers of women engineers. In the 1990s, the focus was on identifying the more manifest and discrete forms of gender discrimination and harassment. Many were identified, and all of those were found by the *CREW1* survey to exist in the Australian profession at the end of the 1990s. In the subsequent decade these disparities and inequalities have been shown to persist despite the introduction of flexible work practices by increasing numbers of employers. In addition, by exploration of the strengths and influence of concepts such as gender stereotyping and gender identity, greater understanding has been achieved as to *why* these discriminatory practices are so entrenched and resistant to change.

THE TWO STUDIES: CREW1 AND CREW2

The Careers Review of Engineering Women study *(CREW1)* was commissioned specifically to investigate whether female engineers in Australia were leaving the profession in proportionally greater numbers than male engineers, and if so, why this was happening. In 2000, all 1819 female members of Engineers Australia (EA) (excluding students) were contacted and invited to participate by completing a questionnaire. A sample of 450 men was also invited to participate. The men were matched proportionally with the women in terms of membership grade, engineering discipline, and geographical distribution by State. However, it was not possible at that time to match by age since age was not then a category of EA's membership databases. As a result the male respondents in *CREW1* tended to be older than the females. Responses were received from 767 women and 122 men, giving respective response rates of 42.2% and 27.1% (Roberts and Ayre, 2002b). The initial survey was followed up in 2002-3 with a qualitative study involving interviews with 41 women and 10 men (Mills *et al*, 2006).

In 2007, the survey was repeated (*CREW2*). Again, all female members of EA (excluding students) were invited to participate, now 3214 members. The increase in membership was primarily due to changes within EA and successful membership drives that increased overall membership of that particular organisation, rather than any significant increase in total female engineer numbers in the workforce. Five thousand male members of EA were also invited to take part, and because EA by then held age data, it was possible to match the male and female samples proportionally in terms of age as well as geographical location and engineering discipline. Responses were received from 1,187 of the women, and 605 men: 36.9% and 12.1% respectively (Mills *et al*, 2008). The questionnaire used in *CREW2* was almost identical to that used for *CREW1*, with minor amendments to

improve clarity of responses. A new question explored the incidence of workplace bullying: a practice that had become increasingly studied in the 2000 decade.

The profiles of respondents for *CREW1* and *CREW2* were well matched in terms of gender, year of graduation, first destination after graduation, engineering discipline, and geographical location. Ages of female respondents were also well matched between the surveys, but as explained above, since the time *CREW1* was undertaken it had become possible to improve the male/female age match of those invited to participate in the survey. This was done for *CREW2*, thus making comparison of male data by age invalid between the two surveys, but improving the validity of male/female comparisons within *CREW2*. Figure 1 illustrates the successful matching of ages and years of qualification of male and female respondents to *CREW2*.

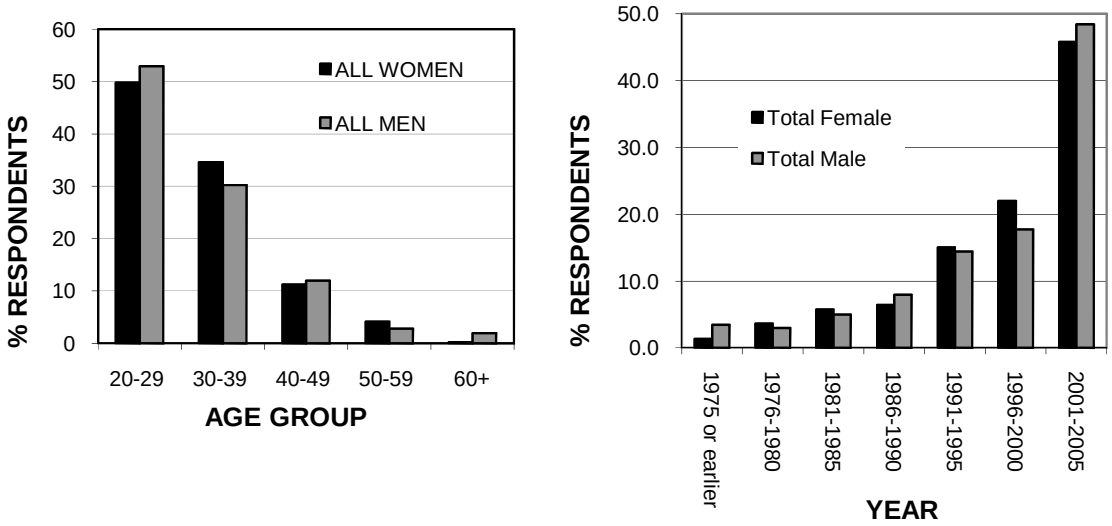

Figure 1: Age profiles and years of graduation by gender for CREW2 respondents

In the following discussion, where differences appeared between *CREW1* and *CREW2* results, or between sexes in either survey, simple chi-squared tests were used to test the level of significance. The results of these tests are expressed throughout this paper by providing the *p* value, where $p<0.05$ indicates at least 95% confidence in the results.

Employment status

Reflecting other national statistics cited earlier, the *CREW* surveys showed that female and male engineers joined the engineering workforce in similar proportions after graduation. In *CREW2* 86.1% of women and 87.3% of men joined the profession immediately, slightly closer figures than in *CREW1* (84.7% for women compared with 88.7% for men). There were no statistically significant differences between genders in these responses.

Comparison of full-time employment status with part-time, contract and casual status revealed a significant gender difference. Ninety-four per cent of men, but only 88% of women were in full-time permanent employment (p = 0.001). By contrast, 7% of women, but only 1% of men, were employed on a permanent part-time basis, again statistically significant (p = 0.001). Unfortunately part-time employment status was not included in the *CREW1* survey so comparisons are not possible.

The industry sectors in which the respondents were employed reflected the strengths of the Australian economy at the time, with 32.4% of the women, and 41.3% of the men in *CREW2* employed in construction, resources and mining, (compared with 30% and 39% respectively in *CREW1*). Fewer than 10% of both sexes were employed in any single other industry sector. Of these 'minor' industry sectors, a greater proportion of women than men were employed in gas/water supply, transport, communications, and medical engineering, and proportionally more men than women in electrical/energy, manufacturing, mechanical, agriculture, and forestry/fishing.

Because only current members of Engineering Australia were surveyed, and those who had left the profession would be unlikely to retain their membership, it was not possible to learn much about attrition from responses to the survey. Only very small proportions of respondents (7.3% of women, and 4.1% of men, but with p = 0.03, significantly different) were not currently working as engineers. Nearly half of these, 45.2% of women, and 44.7% of men, were either taking a career break or seeking another engineering position and intending to return to the profession eventually. The majority of the remainder were working outside engineering (or intending to do so), with only two of the women, and six men having left the workforce altogether.

Figure 2 shows the age profile of *CREW2* respondents who responded that they were not currently working as engineers. As in *CREW1*, the age profile of women in this group peaked in the 30-39 age bracket, and as might be expected, the main reasons nominated by these women related to family responsibilities. Rather unexpectedly, the peak age range for men not currently working as Engineers was 20-29 years, and this was principally to travel (a reason shared by women in this age group – and perhaps a particularly Australian phenomenon). Thus, not only were a significantly larger proportion of women than men not currently working as engineers, they did so in greater numbers in the 30-39 age group than at any other age, because of parental responsibilities. In contrast, the (lower) male rate peaked in the 20-29 age group, and was seemingly unaffected by the onset of parental responsibilities ten years later.

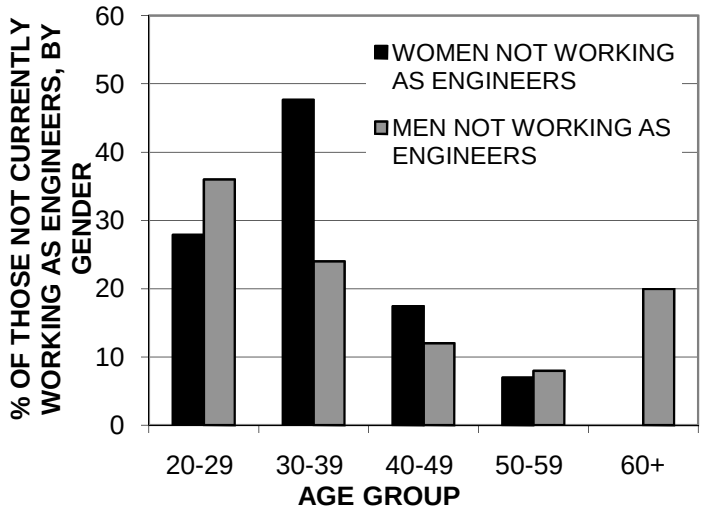

Figure 2: Age and gender of CREW2 respondents not currently working as engineers

Formal workplace and employment conditions

Comparison between the two surveys of satisfaction with formal workplace and employment conditions found a general improvement in satisfaction since *CREW1.* Then, 60% of women were satisfied or very satisfied with overall workplace conditions, compared with 70% of men; and 19% of women were dissatisfied or very dissatisfied, compared with 10% of men, with both results being statistically significant. In *CREW2*, seven years later, these statistics had improved to 74% of women being satisfied or very satisfied, with those dissatisfied or very dissatisfied down to 12%. The men's data had likewise improved: to 78% and 8% respectively, and their satisfaction levels were not statistically significantly different from those of the women. These data certainly represent some steps forward in terms of narrowing the satisfaction gap between men and women, although the overall improvement in satisfaction may have related to the stronger national economy in 2007 compared with 2000.

The workplace conditions surveyed were: rates of pay; hours of work; opportunities for staff development and training with pay; physical work conditions; and, job security. Of these indicators, the most unsatisfactory for both men and women were rates of pay and paid opportunities for professional development. The following text comments were fairly typical from respondents who were dissatisfied with rates of pay and would not choose engineering as a profession again:

> *Not a well rewarded and respected profession. Do not receive the same recognition as other countries.*
> (Male, 20-29 age group)

> *The public do not appreciate or reward engineers commensurate to the level of skill and dedication required.*
> (Female, 20-29 age group).

Both surveys found proportionally more women than men in the lower paid salary groups and more men than women in the higher salary groups. Whereas in *CREW1* this may have been explained by the different age profiles of respondents, with more senior men than women in the survey, this could not be used as an explanation in the *CREW2* data, where age profiles were well matched (Figure 1). Thirty percent of the female respondents to *CREW2* earned less than $60,000, a statistically significant difference from the 24% of men in this salary range (p = 0.02). In the highest salary range, only 10% of women, compared with 15% of men earned more than $121,000, which is statistically highly significant (p = 0.001).

The statistics quoted above include data from respondents working part-time, of whom as reported above, the majority were female. However, even when all data relating to part-time employment were excluded, the strong statistical significance between genders remains across the whole salary range (p = 0.001), as illustrated by Figure 3.

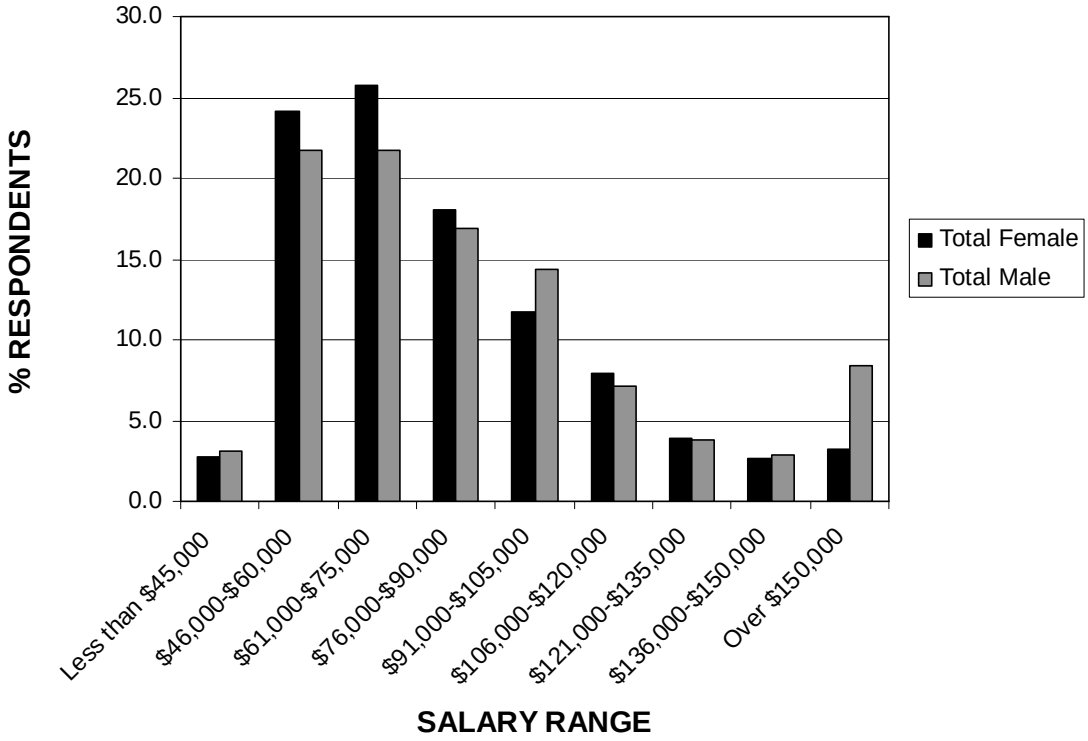

Figure 3: Salary range by gender for CREW2 excluding respondents working less than 35 hours per week

Informal workplace conditions and practices

There were no statistically significant differences between men's and women's responses to questions about workplace management and communication. Many areas of potential 'double standards' were investigated in the sense that women's performance and other contributions to their employing organisation, as well as their recognition and rewards, are judged by stricter standards than men's. While

no statistically significant gender differences were found in opportunities to use abilities (which had been significantly worse for women in *CREW1*), recognition of good work, amount of responsibility given, and variety in job, written comments included:

> *Despite 25+ years of working in the profession, I still face discrimination and scepticism of whether I can do the job.*
> (Female, 50-59 age group).

> *The industry that I am working in is very male dominated. There are many views that females do not belong in the industry. Some state that females are too emotional and there's no room for it in engineering.*
> (Female, 20-29 age group).

Women did however, report less frequent participation in the decision making process than men. Only 25% of the women reported that they participated in the decision-making process most of the time, or always, compared with 35% of the men ($p = 0.001$). Significant gender differences ($p < 0.05$) were also found in respondents' estimation of their chances of promotion, but this had slightly improved from *CREW1* ($p < 0.01$).

Given these findings, it is not surprising that 42.3% of the female respondents to *CREW2* reported having experienced discrimination while working as an engineer, and that most of this discrimination was gender related. What is more notable is that this proportion had risen markedly since *CREW1*, when 36% of the women reported that they had experienced discrimination. This difference could reflect an increased awareness of the forms of gender discrimination as well as increased incidence.

The extent of sexual harassment[1] was one of the most disturbing features of the *CREW1* survey, with 27% of the women respondents having experienced this, as well as 4% of the men. By *CREW2* it appears there has been some improvement, with the comparable figures now 22% and 3% respectively, although 22% is still unacceptably high. The new question on bullying[2] in *CREW2* elicited the information that 28% of the women had experienced bullying, compared with 18% of the men. What is not clear is the extent to which bullying overlaps with sexual harassment. Taken together however, these figures show that women are much more likely to encounter negative 'power games' in their workplaces than are men.

The data given above relate to discrimination and harassment experienced by women engineers, whether or not they have children. We now consider discrimination experienced by women with children or planning to have them. There was virtually no difference between the two surveys in the proportion of women respondents responsible for the care of children: 21.8% in *CREW1*, and 21.9% in *CREW2*, both even lower than the previously cited national statistics. There was however a difference in the male response to this question: with an increase from 8.5% in *CREW1* to 18.1% in *CREW2* of male respondents having responsibility for

care of children. This difference is probably accounted for partly by the older male age profile in *CREW1* explained earlier, and partly because it is now more acceptable for men to be carers.

Both surveys explored the existence and use of family-friendly policies such as availability of flexible work hours, job sharing, part-time work, leave without pay, carers' leave, paid maternity and paid paternity leave. When *CREW1* was undertaken only flexible work hours and leave without pay were available in more than 50% of workplaces. In the subsequent seven years until *CREW2*, the availability of all of the family-friendly features listed above increased markedly. All except one are now available in two-thirds or more of Australian engineering workplaces. The single exception is job sharing, which although now available in 30% of workplaces compared with 17% at the time of *CREW1*, is thus still relatively unusual. The areas of greatest change in availability of family-friendly practices between 1999 and 2007, as reported by women, have been: carer's leave (up 31 percentage points from 48% to 79%); paid maternity leave (up 28 percentage points); part-time work (up 19 percentage points); flexible work hours (up 13 percentage points); and, job sharing (up 11 percentage points). These findings are very encouraging and indicate that many employers have taken on board the messages about family-friendly workplace practices being critically important to attract and retain women and have put appropriate policies into place.

Utilisation of these family-friendly practices has not only also increased overall since *CREW1*, but also in almost equal proportions by both women and men, as detailed in Table 1.

Table 1: Availability and use of family-friendly employment practices by gender, CREW2

Family-friendly employment practices	**% reporting the availability of these practices**		**% reporting having used these practices**	
	% Women	**% Men**	**% Women**	**% Men**
Flexible work hours available	79.0	78.3	75.5	79.4
Job sharing **	29.6	30.4	18.0	28.7
Part-time work **	67.7	55.5	21.2	10.1
Leave without pay **	91.4	89.1	35.8	26.3
Carer's leave	79.1	77.3	18.1	19.1
Paid maternity leave	72.4	70.0	11.7	NA
Paid paternity leave	67.7	68.6	NA	9.9

*** Indicates a significant difference in "having used these practices" using the Pearson Chi-squared test with a p-value of <0.05 signifying a 95% confidence in the results*

Significantly more women than men have utilised part-time work and leave without pay. Interestingly, proportionally more men than women have job-shared and two-thirds of these were in the 20-29 year age group, but the reasons for this were not explored in this study. However, a number of text responses from women indicated

that their career prospects were adversely affected by taking advantage of family-friendly policies; for example:

> *I do feel that even though employers are prepared to employ me part time since I have children they are not really prepared to promote me. I actually have significant and rare experience that is increasingly sought after but feel that since I am a parent I am denied opportunities for promotion.*
> (Female, 30-39 age group)

These data indicate that family-friendly and flexible work practices are attractive to both males and females. However, the increase in take up has not kept pace with the increase in availability and there is also work to do to ensure that people are not penalised for utilising them.

Intentions to leave

Respondents were asked about their intention to leave their current employment and why they left their last employer. There was very little difference between women's and men's responses to whether they were likely or very likely to leave their present employment within the next year (25.4% and 23.4% respectively). However, in comparison with *CREW1*, the proportion of men who were likely or very likely to change jobs in the next year had risen steeply from 11.7% whereas the situation for women had hardly changed from 25.1%. For men this may be a reflection of the more buoyant jobs market in 2007, rather than an expression of dissatisfaction with the profession.

The differences in reasons given by women and men for thinking of changing employers are enlightening. Significantly different reasons for leaving included to gain experience (22.7% of women, 31% of men), more pay (9.7% of women and 17.1% of men), and 'Other' (42.3% of women and 22.8% of men). 'Other' reasons varied by age. Both women and men in the twenties age group were intending to leave in order to travel, but the big gender divergence in reasons for leaving appeared in the thirties age group. Here, the predominant reasons for women leaving were related to maternity leave and family responsibilities, while men were considering leaving for further study and travel, or for a more interesting or better-paid job. Thus the most significant gendered reasons for leaving were issues related to work/family life balance. This mirrors the findings of the interview phase of *CREW1* when "… all [women] thought it would be difficult to combine having children with their work, and some were clearly agonizing over when to have children and how they would manage their careers after that …" (Mills *et al,* 2006, p.55).

DISCUSSION

The comparison of findings between *CREW1* and *CREW2* found improvements in some areas of women engineers' workplace conditions and satisfaction. Most questions about workplace conditions found less significant differences between male and female responses than formerly, although men's satisfaction still slightly

exceeded women's. There has also been improvement in family-friendly workplace provision. Our research has also shown areas of continuing and new concern, and that the improvements reported have not led to the expected improvement in female retention in the profession.

One area of marked dissatisfaction to our female respondents was in their perception of limited chances of promotion and consequent pay rises. Women were also significantly more dissatisfied than men about their paid opportunities for professional development. Women's perceptions of their less favourable financial and other rewards have featured strongly in the international literature of the last decade cited earlier. Most notably, Hunt's (2010) recent research ascribes about 60% of the differential between female and male attrition from engineering to women's dissatisfaction about pay and promotion prospects.

Much of this research on the gender pay gap cited earlier relates the lack of recognition of women for promotion to differences in male and female communication styles, in the sense that women's style has been shown to be less aggressive, and therefore perceived as less positive and effectual than men's (Davis, 2001; Riley, 2008; Faulkner, 2009). Although in this study we did not find significant gender differences in satisfaction with 'communication' in the workplace, we do not necessarily interpret this result as deviant from previous evidence about the impact of gender differences in communication styles. It is possible that the way our question was phrased was understood by respondents as relating to formal communications, whereas the research we have cited is largely based on informal interactions in the workplace.

Although there has been some decrease in the incidence of women's sexual harassment, at 22% it is still high. Previous research has also found that sexual harassment reduces women's confidence and professional credibility. Thus, our finding of this significant incidence of sexual harassment may to some extent explain women's disadvantage in promotion opportunities.

We found that Australian women engineers' experience of discrimination has risen from 36% to 42% between the two surveys. Research into gender stereotyping may cast some light on the underlying causes of discrimination against women engineers, in showing that, to many male engineers (still the majority in senior management) women are seen as less able or less interested in promotion than men (Faulkner, 2006; Sappleton *et al*, 2009).

There has been a noticeable improvement in the availability of family-friendly workplace provisions, but it was disappointing that utilisation has not increased to the same extent. These findings have also confirmed our own and others' earlier findings that many women are reluctant to use their employer's family-friendly provisions because of possible detrimental effects on their careers. There are strong indications that this reluctance and fear leads in many cases to women leaving the profession when they start a family, or shortly thereafter (Mills *et al,* 2006; Bagilhole *et al*, 2007). The anxiety and uncertainty reported by women in their thirties about the difficulties of combining a family with work, while their male

colleagues of the same age are plotting their next career move is underlined by comparing the reasons men and women in that age group gave for considering leaving their present employment within the next year. For women of that age the predominant reason was connected with family responsibilities while for men it was career advancement.

CONCLUSION

The *CREW* studies were undertaken to explore the reasons for female Australian professional engineers leaving the profession at rates faster than their male counterparts. Despite significant improvements in the availability of family-friendly practices between the two studies, both the *CREW2* data and concurrent Australian data from other studies showed no improvement over the period between the two surveys in the retention of female professional engineers compared with males: hence our title "Two Steps Forward: One Step Back". It appears therefore that the improvements in availability of family-friendly practices are not sufficient on their own to have any impact on the retention statistics, a finding which suggests that the underlying issues of engineering workplace culture are yet to be addressed. Our findings that significant sexual harassment persists, and that a greater proportion of women have experienced discrimination than formerly, support this hypothesis, as does the higher incidence of bullying against women than men.

A twofold approach is suggested for genuine and lasting improvement, focussing on the areas of discrimination and major concern identified by *CREW2* and the reasons for women's reluctance to use family-friendly workplace provisions. Although formal company procedures are almost certainly in place to counteract these obstacles to women's satisfaction and retention in engineering, there are clearly some underlying inhibitors to their effectiveness. It seems likely that these arise from the culture of the engineering profession, and further research into the influence of gender stereotyping and gender identity may uncover the cause of these problems. Once identified, ways must be found to raise awareness amongst both male and female engineers of these concealed influences, and how to counteract them. Thus further research into the culture of the engineering workplace is needed, and also dissemination of these findings to engineering employers and employees in a way that motivates and inspires them to take effective corrective action.

ENDNOTES

[1] Sexual harassment was defined in the survey as "*any unwanted sexual advances or unwelcome conduct of a sexual nature"*

[2] Bullying was defined in the survey as "*the repeated unreasonable ill treatment of a person by another consisting of offensive, abusive, belittling or threatening behaviour directed at an individual or a group."*

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