
AC 2011-1243: NOT ALL WOMEN LEAVE! REFLECTIONS ON A COHORT OF "STAYERS" IN CIVIL ENGINEERING

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NOT ALL WOMEN LEAVE: REFLECTIONS ON A COHORT OF 'STAYERS' IN CIVIL ENGINEERING

Abstract

Several reports of the disappointing numbers of women who leave the engineering profession within 10 or so years after graduation in a range of western economies have been released in recent years. This paper reports on a recent study of the careers of all female graduates from civil engineering at an Australian technical university which found that a much higher proportion of them had remained in the profession than would be expected from these reports. It found that despite the cohort reporting higher rates of parental and other care responsibilities than typically found in engineering women, the group were more satisfied with their workplaces and jobs as a whole than the respondents of a comparative national survey of women engineers in Australia in 2007. The reasons for this satisfaction and retention are explored with the hope that these may provide inspiration for other women engineers and their employers.

Introduction

Studies since the 1990s have found that in western countries higher proportions of female engineers leave the profession than males¹⁻⁶. As a result, in the 2000s there has been a marked focus on the retention of women in the engineering profession⁶⁻⁸. The reasons for the high female attrition are attributed principally to the masculine culture of engineering workplaces⁹⁻¹², augmented by a lack of family-friendly workplace policies and, where they do exist, the negative reactions from colleagues and managers when they are taken up^{7,13,14}.

This paper reports a recent study of the careers of all the female graduates in a single engineering discipline from an Australian technical university (ATU), which found that a much higher proportion of them have remained in the engineering profession than the rates frequently cited in the literature. The study's findings on workplace conditions, availability and use of family-friendly practices and intentions to leave the profession are compared with the findings of a national study of Australian female engineers across all engineering disciplines undertaken in 2007 to seek potential explanations for the high retention and satisfaction rate of this cohort.

Women in the engineering profession

In all western countries, women comprise a very small proportion of professional engineers and engineering students. In Australia, only 16.6% of engineering graduates in 2008 were female, and this proportion has been steadily decreasing since a peak of 17.4% in 2003¹⁵. In North America the corresponding statistics are only slightly higher: 17.8% in USA in 2009, 17.6% in Canada, and also decreasing^{16,17}. In the UK the proportion of female engineering students is smaller than in any of the other countries mentioned: 14.9% in 2009, but it is increasing slowly¹⁸.

Women's representation in the engineering workforce is lower still: 11% in Australia and the US, 12% in Canada and 7% in the UK¹⁸⁻²¹. To some extent, these lower proportions of women in the workforce than in engineering education are to be expected, since until about the mid 1980s

less than 5% of engineering graduates were female and it will still take some years for the increased number of female graduates to ‘work through’ the profession. But these statistics are also affected by women’s attrition from the workforce, which has been shown to exceed men’s. A recent US study has found statistically significant differences in the exit rates of men and women of 9.8% and 12.9% respectively⁸. In the UK, 56% of male STEM graduates were still working in STEM in 2008, but only 35% of their female equivalents¹⁸. In Australia it is estimated that women are leaving the profession at a rate nearly 40% greater than men⁵.

For over two decades researchers have probed ever more deeply into why women do not enter or remain in the engineering profession. During the 1990s research focused on identifying the more manifest and discrete discriminatory barriers or impediments to their career satisfaction and progression. These included sex disparities in seniority, tasks and roles, pay, retention, operational styles, participation in networks, and double standards, as well as all the issues associated with family formation. All of these were found to exist in the Australian profession at the end of the 1990s⁴. 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 reasons for women’s attrition from the workforce remain a matter of considerable current research interest. The authors have conducted a series of studies of women in the Australian engineering workforce since 2002^{4,7,22}. They have found that women leave the profession for a number of reasons such as unsatisfactory pay and promotion opportunities, difficulties in combining work with responsibilities for children, and sexual harassment, discrimination and bullying. In all these areas, women’s dissatisfaction exceeded men’s, although as the decade progressed, most of these differences became less significant, with the exception of promotion opportunities. Other recent Australian and US studies have identified similar reasons for women engineers’ dissatisfaction in the profession.^{6,8,23} Hunt examined the 1993 and 2003 National Surveys of College Graduates in the US and emphasised that the reasons women leave engineering are principally dissatisfaction about pay and promotion followed by related factors such as lack of networking and mentoring, but found that “family-related constraints are not a factor.”^{8,p.3} Also, and interestingly, although she identifies discrimination as a possible influence on women’s attrition from the engineering profession, she does not mention the incidence and impact of sexual harassment or bullying, which was found to be a significant issue in the Australian studies^{4,7}. Hewlett *et al*, in their US study, do discuss in some detail the disturbing effects of the high incidence they found of sexual harassment⁶.

The ATU and CREW2 studies

In this paper we compare the findings of two studies of Australian female professional engineers that took place in close succession: in 2007 and 2009. The 2009 study is referred to in this paper as ATU (Australian Technical University). The 2007 study is referred to as CREW2 because it was the second of two consecutive studies of women in the Australian engineering profession both known as CREW (*Careers Review of Engineering Women*) conducted in 2000 and 2007^{4,7}.

The CREW2 study surveyed all female members and a matched sample of male members of *Engineers Australia* (EA), the Australian professional engineering body in 2007. It therefore included women working in all engineering disciplines and across all Australian states. The purpose of that study was to explore women's satisfaction and success in the profession in the context of the known higher female than male attrition rates. The subjects of the second study (ATU) were all the female graduates in a single engineering discipline from a single university, most of whom grew up, studied and subsequently worked in the same Australian state.

Both studies used the same online survey questionnaire, with only minor amendments when used for the ATU study in order to make it appropriate for respondents from only one engineering discipline and institution.

The ATU study

The Australian Technical University (ATU) was designated a university in 1991 on the amalgamation of an Institute of Technology and a College of Advanced Education, both of which were previously degree-awarding institutions in their own right. ATU's commitment to equity and making higher education accessible to those traditionally under-represented there is embedded in its Act of Establishment, and it has a record of successfully recruiting and graduating students who lack the usual entry requirements to undertake higher education. One of ATU's areas of priority has been women in engineering.

The first female civil engineering student at the Institute of Technology which was one of ATU's antecedent institutions, graduated in 1974. The study included all female students who had graduated with civil engineering bachelor degrees up to 2008, totalling 76 women. Current contact details were sought by utilising alumni databases, social networking sites such as Facebook and by asking members of the cohort to provide contact details for others that they knew. After this process, no contact details were able to be obtained for 11 of the graduates. Of the 65 who were sent the survey, 56 responded (86%). It cannot however be assumed that the majority of the 20 who were either non-contactable or who did not respond have left the profession. Four of the un-contactable graduates were international students, who may well be working as engineers in their own countries. Others who were un-contactable were reported by other members of the cohort to be 'on the move', either temporarily working as engineers overseas, or taking a career break to travel, intending to return to the profession in a few years' time.

The CREW2 study

The CREW2 national survey invitation was sent to all female members of EA (excluding undergraduates). Since only current members of EA were invited to take part, the invitation would not have reached most of those who had left the profession, since it is unlikely that these 'leavers' would have retained their membership of EA. Hence the retention rate emerging from the CREW2 survey is likely to be a considerable overestimate of actual retention in the Australian profession.

Of the 3217 female EA members who were invited to take part in CREW2, 1,187 responded (36.9%). A sample of 5000 male members was also invited to participate, matched proportionally with the female members by age, geographical location and engineering

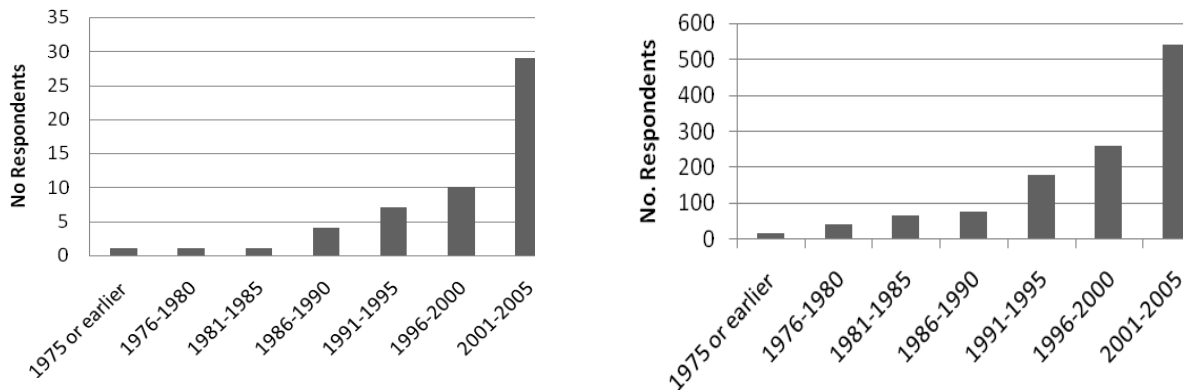
discipline. The male response rate was 12.1%. Little further mention of the male sample is made in this paper since the focus here is on the comparison of the women in the CREW2 survey with those in the ATU survey. A full report of the CREW2 survey, which includes comparison between the female and male responses, has been made elsewhere⁷.

Comparisons of ATU and CREW2 respondent personal and employment profiles

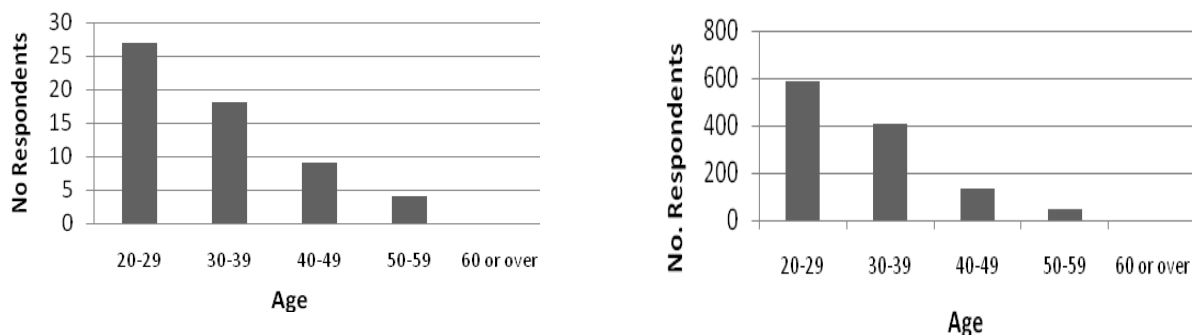
Year of graduation, age and further study

Although the sample numbers obviously differed (56 for ATU compared with 1187 for CREW2) the distribution of graduation dates and ages was very similar, as illustrated in Figures 1 and 2. The age distribution of the ATU respondents showed that 71% were under 40 years of age and the corresponding figure for female CREW2 respondents was 84.4%.

A higher engineering-related qualification was held by 8.9% of ATU respondents, compared with 20.0% of female CREW2 respondents, and 19.6% had acquired or were acquiring another qualification such as an MBA or Graduate Certificate, compared with 16.6% of CREW2 female respondents.



ATU CREW2
Figure 1: Year of graduation with Bachelor of Engineering



ATU CREW2
Figure 2: Age distribution of respondents

Initial and current employment characteristics

A range of characteristics of the initial and current employment status and the nature of the engineering duties of ATU and CREW2 female respondents is provided in Table 1. If a survey respondent had left the profession they were asked to reply to employment related questions in relation to the last engineering position that they had held. The similarities and differences in the employment characteristics of the respondents to the two surveys are also shown in Table 1. Chi-squared significance tests have been applied to assess the level of confidence in differences between the two samples: the symbol * indicates 95% confidence ($p < 0.05$), referred to in the text as ‘significant’; and ** indicates 99% confidence ($p < 0.01$), or ‘highly significant’ differences.

Table 1: Profiles and employment characteristics of the ATU and CREW2 respondents

Employment Characteristics	ATU (% of respondents)	CREW2 (% of women respondents)
In engineering employment or further engineering study in 1 st six months after obtaining first engineering qualification	89.3	86.4
Still working as an engineer at time of survey	94.6	92.6
Currently working in a full-time permanent engineering position**	81.5	87.7
Has obtained a higher engineering qualification	8.9	20.0
Working in public sector*	43.6	27.5
Working in private sector*	56.4	72.0
Work described as mainly engineering-technical*	29.6	44.4
Work described as mainly engineering-management*	22.2	11.9
Work described as both technical and managerial	40.7	40.3

The sizes of the samples were very different, as would be expected when one was a national survey and the other comprised the female graduates of only one department in one university. Nevertheless, some characteristics of the samples were very similar: the distribution of years of graduation, age distribution, retention in engineering immediately after graduation, and proportions who described their work as both technical and managerial.

Significant differences between the groups occurred in: acquisition of a postgraduate engineering qualification, whether working in the public or private sector, and whether the work was described as mainly technical or mainly management. A highly significant difference occurred with respect to working in a permanent full-time position, with CREW2 respondents much more likely to be doing so, apparently due to ATU respondents having more part-time or casual work opportunities than CREW2 respondents. In the case of the public/private sector divide, while a minority of both groups work in the public sector the ATU respondents were significantly more

likely than their CREW2 counterparts to work in the public sector. This may be important in the later analysis, since family-friendly policies are known to be more accessible in the public sector and their use more acceptable. Since the ATU respondents were all civil engineers and almost all working in their home state, the public sector in this case primarily consisted of the state transport department, the state water and electricity utilities (although both are partially privatised) and local government authorities (termed councils in Australia, or counties in the US).

Although the retention rates for the two groups appear similar (94.6% for ATU, 92.7% for CREW2), it is important to note that these statistics are not directly comparable, due to the sample selections. The ATU sample included *all* the female graduates from that university department who could be contacted, whether they were still working as engineers or not. The CREW2 sample included only current female members of EA, and thus excluded all those no longer working in engineering who had discontinued their membership. While the CREW2 retention statistic is therefore almost certainly a considerable over-estimate of the national retention rate of women engineers as a whole, the very high retention rate of the ATU sample is particularly pleasing and the investigation of why these women are “stayers” may provide an important contribution to the study of what factors can assist in retaining women in engineering.

Employment satisfaction

The remainder of the questionnaire used for both surveys consisted of 70 questions about workplace satisfaction and employment conditions. Responses to a selection of these topics are reported in this paper, chosen either because they showed significant gender differences in the national (CREW2) survey or because they are identified in the literature as being important to women engineers.

Workplace conditions

Questions about workplace conditions ranged over recognition at work, rates of pay, opportunities for professional development and promotion, and satisfaction with the job as a whole. Respondents answered on a Likert scale ranging from ‘very dissatisfied’ to ‘very satisfied’. Percentage responses of those who were satisfied or very satisfied with the selected topics are listed in Table 1 below. As in Table 1, * shows where chi-squared tests indicate 95% confidence that the differences shown are not due to chance.

Table 2: Percentage of respondents who were satisfied or very satisfied with workplace conditions

Workplace condition	% ATU satisfied or very satisfied	% CREW2 women satisfied or very satisfied
Your chances of promotion	53.7	47.0
The attention paid to suggestions you make/made	74.1	65.1
Participation in decision making all or most of the time	34.5	24.9
Industrial relations between management and employees	76.4	57.6
Your rate of pay	63.6	56.6
Opportunities (with pay) for staff development/training	74.1	63.4
Opportunities to use your abilities	76.4	66.4
Amount of responsibility you were given	85.5	76.0
Overall job as a whole*	92.7	74.3

It can be noted that for all these indicators of workplace satisfaction, a greater percentage of the ATU women were satisfied or more satisfied than the women who participated in CREW2, although only one of these differences was significant at the 95% level and, most importantly, this was the ATU group's greater satisfaction with their jobs as a whole.

Family-friendly employment practices

In response to questions about caring responsibilities, it was found that the ATU women were not only nearly twice as likely to be responsible for children as their CREW2 counterparts (40.0% compared with 21.9%), but that this ratio also applied to caring responsibilities for others, such as elderly parent(s) (10.9% compared with 5.1%). This is a very interesting finding given the often made assertion that family responsibilities are the reason that women leave engineering (although researchers do not all agree with this, for example^{8,22}). Respondents were asked about the availability of family-friendly policies at their workplaces, and whether they had made use of them. The percentage results and their significance are given in Table 3.

Table 3: Workplace availability of family-friendly policies and use made of these

Family-friendly workplace practices	% ATU		% CREW2 women	
	Available at my workplace (% of respondents)	I have used this facility (% of those who have availability)	Available at my workplace (% of respondents)	I have used this facility (% of those who have availability)
Flexible work hours	90.9**	94.0*	79.0	79.2
Job sharing	50.0**	29.6	29.6	26.1
Part-time work	79.2*	31.0	67.7	22.8
Leave without pay	90.9	54.0**	91.4	36.2
Carers' leave	90.7*	34.7*	79.1	19.0
Paid maternity leave	76.4	26.2**	72.4	12.5

The results in Table 3 show that significantly greater proportions of the ATU group than the CREW2 women claimed workplace availability for all the types of family-friendly practices at their workplace except for leave without pay and paid maternity leave which was almost equally available to both groups. Likewise, the ATU group were more likely to have used all these facilities: highly significantly in the case of leave without pay and paid maternity leave, and significantly in the cases of flexible work hours and carers' leave (all of which of course relate to their reported higher rates of caring responsibilities for children and others).

Despite the medium-to-high availability of these facilities to both groups, Table 3 also shows how comparatively little both groups utilise most of these provisions. Women engineers' experience of the detrimental effects on their careers of utilising these family-friendly provisions (or fear of these effects) is well documented in the literature^{5,10,13,22,24}. Bagilhole et al for example remark that "Women still experience clear discrimination surrounding the issue of maternity leave and the return to work; requests for part-time contracts are often agreed alongside some kind of demotion of position within the company ..." ^{13, p.40}. Although reasons for the low take-up of family-friendly provisions were not explicitly explored in the ATU survey, a comment by one of the respondents echoed these earlier findings:

On return from maternity leave my position was demoted below that of a manager who worked at the same level as me. This manager had only recently joined the company and had less experience in the industry. When I stated that I was not happy about this as it de-valued my position, skills and experience I was told that I shouldn't see it that way and that I had the support and respect of senior management! (One can only wonder what would have happened if I didn't have their support!!)

It is possible that the use of family friendly work provisions will increase as the age profile of women engineers increases (given that the vast majority of both survey groups were currently under 40), but this issue requires careful monitoring into the future.

Sexual harassment, discrimination and bullying

ATU participants were asked about their experience of sexual harassment, gender discrimination and gender-based bullying, and the proportional results are given in Table 4 alongside comparable data from the CREW2 study, this time including the CREW2 men's results to emphasise their relative freedom from these experiences. Chi-squared comparisons of the two women's samples finds that while the experience of sexual harassment in both groups is roughly equivalent, the CREW2 women were significantly more likely to have experienced gender discrimination than the ATU women ($p < 0.05$).

Table 4: Experience of sexual harassment, discrimination and bullying

Experienced:	ATU (%)	CREW2 women (%)	CREW2 men (% of respondents)
Sexual harassment	19.6	21.8	2.8
Gender discrimination	10.7	24.2*	2.1
Gender-based bullying	1.8	8.4	0.0

Intentions to leave the profession

Approximately one quarter of both the ATU respondents and the CREW2 women indicated that they were likely or very likely to leave their current job in the next 12 months. Of these 13 respondents in the ATU group: five (35.7%) responded that they would seek another engineering position, three (21.4%) planned to leave the profession, and the remainder were undecided. In contrast 58.2% of the CREW2 women contemplating leaving their current job planned to seek another engineering position, 7.6% would leave the profession and 34.2% were not sure. Although this appears to indicate that more of the ATU women are planning to leave the profession in the future than the CREW2 women, any analysis of these data must be tempered by the issue of sample characteristic mentioned earlier, namely that the CREW2 respondents are all current members of the EA professional association, whereas the ATU sample was unrestricted in this regard.

Participants were asked to select their main reason for intending to leave from a list of possible reasons. The largest group of the CREW2 female respondents (42.3%) selected 'Other', and the 'other' reasons given correlated with age. Those aged 20-29 planned to travel or undertake further study, while for those in the 30-39 age group the prevalent reasons were related to family responsibilities. The next largest group (22.7%) gave 'to gain experience' as their main reason for leaving, and the third largest group (9.7%) nominated 'more pay'. Only eight of the 13 ATU respondents who were likely or very likely to leave gave their reasons, which were: four wanted more variety in their job, two wanted wider experience, one felt that her abilities were not being sufficiently used, and one disliked the management style at her current employment.

Discussion and Conclusions

This study was undertaken to explore the similarities and differences in work satisfaction between two groups of Australian women engineers. The larger group (CREW2 women) was nationwide and encompassed all engineering disciplines while the smaller group (ATU) comprised only the female graduates from a single engineering discipline at a single university. Although it was not the original intention of the ATU study, we were immediately struck by the high proportion of the respondents who had remained in the engineering profession in comparison to published retention data, even more striking because this cohort had a much higher proportion of respondents with children when compared with the national survey group (CREW2). By comparing the responses of the ATU group with the CREW2 group in relation to a range of employment, workplace satisfaction and personal characteristics; it was hoped to gain more understanding of why the ATU women were "stayers", and whether these findings could therefore be more widely applied to support other women to stay in engineering.

The two survey groups were well matched in terms of the age distribution of the participants, and the years in which they obtained their first engineering qualification. However, the retention statistic for the ATU group (94.6%) was remarkably high. Although the corresponding statistic for the CREW2 women appears comparable (92.7%), it cannot be regarded as an indication of retention across the national female engineering professional workforce since the CREW2 respondents included only those who were currently members of the professional body.

The study showed that on almost every indicator, the ATU group was more content and satisfied with their engineering employment than the CREW2 women, although the only statistically significant difference in employment satisfaction was the overall measure, where ATU respondents were significantly more satisfied. These data, combined with the further significant differences in availability and utilisation of family friendly conditions at their workplace may indicate that quality of life both within and outside of an organisation can affect perceptions of the workplace “as a whole”. Identifying where the differences in satisfaction occurred may be helpful in suggesting which aspects of employment need to be addressed by managers in order to improve the retention of women engineers.

One of the most obvious differences to emerge was public sector employment. Forty three percent of the ATU group and 27.5% of the CREW2 women were employed in the public sector. Although some may argue that the ATU cohort was comprised only of civil engineers and there are more likely to be civil engineering positions in the public sector, this is not the case. The vast majority of formerly public utility companies in Australia in sectors such as water and power have been privatised for over 20 years, with the only exception being transport departments that still exist in most states. An Engineers Australia analysis of 2001 Australian census data indicated that 83% of all engineers worked in the private sector, with the 17% public sector component made up of 3% in Local Government, 8% in state government and 6% in federal government employment²⁵. The analysis also indicated that 38% of all those identifying as engineers were civil engineers. Hence the proportional representation of civil engineers in public sector employment should be approximately 6.5% of all engineers. Even if all public sector employees were assumed to be civil engineers (which is clearly not the case), the resultant percentage of 17% is still way below the 43% public sector employment rates reported by ATU women. And although CREW2 data covers all engineering disciplines, women still report much higher rates of public sector employment at 27.5% than the national census result of 17%. Hence it appears that higher employment rates in the public sector are important in retaining women engineers, which begs the question “What are the characteristics of public sector employment that make it more attractive to and satisfying for women engineers?”

Nearly twice as many of the ATU respondents were responsible for children than the CREW2 women (40% and 21.9% respectively) and yet nearly 95% of the ATU women were still working as engineers. These factors considered in relation to the greater availability and use of family-friendly provisions claimed by the ATU group than the CREW2 women, indicate one of the possible answers to the previous question posed about public sector employment. Provisions such as part-time work, flexible hours and leave without pay are typically much more available and their use more acceptable in public sector employment than in private. The value of these provisions in attracting and retaining women engineers and particularly those with children appears to be clearly borne out by the CREW2 data, but even more by the ATU data.

Accounting for the ATU group’s greater satisfaction with working conditions unrelated to family responsibilities is more difficult, since there is no reason to suppose that factors such as better chances of promotion, attention paid to the suggestions employees make, rate of pay, and amount of responsibility given, are more favourable in the public sector than the private (and in fact salary data consistently show that public sector rates of pay are lower than private sector in Australia²⁶). There is a need for other questions to be asked, perhaps by exploring differences in

the sample characteristics: the main ones being the single engineering discipline represented in the ATU sample, and the common experience of this group of the same engineering program on the same campus. Those working in civil engineering may, for example, be enjoying favourable workplace conditions because there is a shortage of civil engineers in the geographic region where ATU is located. Or some aspects of civil engineering work may make it more attractive for women to persist with compared with other disciplines. Some of the questions of this nature are currently being investigated by the authors through further survey data analysis as well as interviews with some of the ATU respondents.

Questions of a similar nature arise over the reasons that ATU group were less likely than the CREW2 women to experience gender discrimination and gender-based bullying; while both groups had similar experience of sexual harassment. Do the differences arise because of different tolerance levels in the public and private sectors, or in different engineering disciplines, or might individuals be less aware or sensitive to these experiences as a result of their education? Some of these questions too are currently being explored in the qualitative follow-up study.

The ATU survey of the workplace satisfaction of a group of Australian female professional engineers who graduated from the same institution in the same engineering discipline and who have stayed in the profession has improved understanding of the factors which are important to women engineers and thus likely to affect their retention in the profession. Utilising the same survey instrument, it was found that ATU respondents had higher retention rates, were generally more satisfied with workplace conditions, had greater availability and utilisation of family friendly provisions, and experienced less gender discrimination than women engineers in the national CREW2 survey, which included all engineering disciplines. This was in spite of the fact that a greater proportion of them had caring responsibilities for children or others. One significant finding was the high proportion of public sector employment of the ATU group, with associated high availability and acceptance of family-friendly workplace practices. It would appear that the ATU group not only worked in organisations that were more “women friendly” but that these family friendly features connected with the way in which work conditions are organised may hold some potential for explaining why this particular group of women have stayed in the profession in contrast to many of their peers. Other reasons for these differences are the subject of ongoing investigation by the authors. Just how long these women will stay in the profession will be closely monitored in the years to come.

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