System thinking: How universities can boost the retention of a higher proportion of women engineers in the engineering workforce

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Abstract: Ascertaining ways in which higher education institutions could assist in the retention of a higher proportion of women engineers in the workforce, was the focus of one strand of a recently completed project, supported by the Australian Council of Engineering Deans. The project was addressing shortages in the engineering workforce by investigating curriculum design and support systems that could attract and retrain people from under-represented and non-traditional backgrounds. Consultation with key informants from industry, academia and members and ex-chairs of the Engineers Australia National Committee for Women in Engineering emphasised that the major barrier to women engineers continuing in the workforce lay with workplace culture, lack of access to flexible work conditions and lack of career path. Although it appeared that educational strategies were initially considered of minor importance, a second cycle of discussion widening the circle of informants, elicited seven recommendations focusing on: the wider provision of flexible short courses, employer and higher education funding for part- time study, opportunities for women to work part-time in engineering faculties as well as the importance of culture change within many engineering workplaces including academia.

Introduction

Identifying how higher education institutions could assist in the retention of a higher proportion of women engineers in the workforce, was the focus of one strand of a recently completed project, supported by the Australian Council of Engineering Deans (Godfrey & King, 2011). The project addressed recommendations proposed by King(2008) to alleviate shortages in the engineering workforce by investigating curriculum design and support systems that could attract and retrain people from under-represented and non-traditional backgrounds. In particular, one aspect of the project sought to scope how tertiary institutions could assist the retention of a higher proportion of women engineers in the workforce.

The under representation of women in engineering study has continued in Australia despite twenty years of initiatives and even the small gains in the proportion of female graduates, have not been reflected in corresponding increases in the engineering workforce.

Until recently the low rate of women in the engineering workforce in Australia was linked to low rates of female enrolments into engineering and the dominant metaphor has been one of 'pipeline'. Optimists relied on the 'fullness of time'. Despite a gradual climb in enrolments, and a corresponding gradual climb in the proportion of women graduating from engineering and securing graduate positions, recent investigations have reported significant attrition by women engineers as they reached their late twenties (Mills *et al*, 2008; Roberts & Ayre, 2002).

This paper will consider the context in which the scoping study was undertaken, and the consultation process involved. The findings from consultation, and the resulting recommendations are then discussed. The paper closes with consideration of appropriate strategies and conditions for systemic change in this area.

Context

The national priority given to the skills shortage in engineering has drawn attention to the reasons female engineers repeatedly give for considering leaving engineering.

Both the Careers Review of Engineering Women (CREW) and the APESMA survey of 2007 confirmed the top three barriers to women engineers continuing in the workforce were:

- lack of access to flexible work conditions, including part-time;
- lack of a career path; and
- workplace culture

The CREW studies, 1999 and 2007, (Roberts & Ayre, 2002; Mills et al., 2008) show that many women in engineering experience a difficult workplace. Workplace culture and conditions remained a source of dissatisfaction for women in 2007, and sexual harassment, discrimination on the basis of gender and bullying (of both men and women) remain major concerns. The APESMA survey of 1100 women members in 2010 confirmed this experience and added dissatisfaction with pay inequity. (APESMA, 2010)

In Australia, the increasing awareness by some engineering companies of diversity issues, and the uptake of family-friendly policies such as paid parental leave, may have contributed to the indications from the 2007 CREW study that there have been some improvement in the percentage of women continuing to work as engineers.

A significant body of international literature over the last twenty years has considered the issues associated with retaining women engineers in the workforce (European Commission, 2009; Lewis, Harris & Cox, 2007; Male, Bush & Murray, 2009; Sagebiel & Dahmen, 2006). The effects of workplace culture feature strongly. Part I of Faulkner (2009a) presented fieldwork observations about everyday interactions in engineering workplace cultures, which tend to make it easier for men to build working relationships and to 'belong' in engineering. Part 2 of Faulkner's paper (2009b) extends the analysis, by examining the 'in/visibility paradox' whereby women engineers are *simultaneously highly visible as women yet invisible as engineers*. This paradox is a key to understanding how women engineers experience engineering workplace cultures, and a major factor underlying the poor retention and progression of women in engineering. These in/visibility dynamics have a significant cumulative effect, not least because they are subtle and taken for granted.

It was therefore viewed as highly likely that, for a significant group of women, it has been a considered decision to not return to the engineering workforce.

Consultation process

With the benefit of the evidence from the this literature and reports named above, the project team saw its first step as the identification of barriers to retention of women engineers in the Australian engineering workforce, and best practice examples of retention strategies. Initial consultation with key informants from industry, the Engineers Australia National Committee for Women in Engineering, and within academia (Godfrey and King, 2011, p. 186) focused on three questions:

- What do women engineers see as barriers to returning to the workforce?
- What (if any) areas of (re-)training would assist return to the workforce?
- What strategies or examples of best practice, should be promoted as effective in retaining female engineering graduates in the engineering workforce?

Responses from these key informants were collated, summarised and recirculated for further comment.

In order to explore the perception that female attrition from the engineering workforce was due to a career break or parental leave four engineers from the Sydney branch of the Engineers Australia Women in Engineering committee who had undertaken a career break were interviewed. In addition, a focus group of eight women engineers from a major consulting company which had been the recipient of Equity Awards were a rich source of "stories" and useful suggestions.

The findings were again summarised, recommendations drafted and re-circulated to key informants for final feedback.

Findings

The consultation process revealed that postgraduate or higher degree qualifications in engineering were not a major priority for women, so any contribution by tertiary institutions needed to be more than incentives to take up graduate study. Much of the information gathered confirmed the findings of the CREW and APESMA reports and where this concerned workplace culture it was beyond the scope of this project. This information will be disseminated via other means to Engineers Australia and industry.

(Re) training as an issue for engineers returning to the workforce.

A strong reaction was received from two of the key informants about suggestions for further education for women wishing to re-enter the workforce.

"Education is the last thing that these women need. They need to have a paid job and if necessary learn on the job, just like other engineers. Education sets them back financially, further delays their re-entry to the workforce, consumes their time, and returns them to the low status of "student" hence further reducing their confidence…… Engineers are always learning and women returning to work can learn on the job just as all engineers do when they change roles or solve new problems."

"it is not about re-educating the women - fundamentally - why did they leave in the first place ?– the workplace didn't give them the opportunity to be part time, or flexible. They do not deserve to be taken back as second class citizens. The CREW study didn't pick up many people who went back. Unless they see those reasons changed, they won't see the point in going back – they tend to retrain as teachers or set up as their own consultants"

Other informants recognised that some of their peers may lack confidence, about their return to work, particularly after a significant period of leave. It was noted that in some industries such as software engineering, a "*year can be a lifetime*".

It appears from these and other discussions that women engineers do <u>not</u> believe that women (relative to men) need re-training by courses tailored for women engineers .They assert rather that women engineers have issues common to other professional women and men returning to work after a career break.

For those women (or men) who have sought to use their career break / parental leave for further study, barriers include the cost of tuition and study resources, including childcare. The APESMA scholarship, for example, which aimed to support professionals whose family responsibilities impacted upon their career, was quoted as a best practice exemplar during the period it was offered. Similar scholarships that could be used to fund child care and support services were recently cited as having made the difference for women scientists considering leaving their career (WISE, 2011).

Interviews with women from a leading civil engineering consultancy revealed a lack of policies for funding employee study or professional development whilst the employee is either part-time or on an approved career break. Such employees were reluctant to seek funding for conference attendance or professional development. This type of policy need not be exclusively for women. Informants suggested that although flexible and part-time work arrangements were perceived as provisions for women, uptake by men was increasing, particularly by men nearing retirement..

An example was given of a best practice strategy for professional development that comprised a partnership between a company and a university which successfully offered certifiable courses in project management to employees, on-site during working hours.

Professional development and upskilling could be viewed as options to be negotiated between the returning engineer and the employer. These are less likely to be available when the engineer returning to work is applying for a position with a new employer rather than returning to the same employer after a break.

Workplace cultures

Several of the women engineers interviewed emphasised the diverse workplace cultures they had encountered in their engineering careers. In particular, working in the public sector was considered as a supportive environment to sustain career growth whilst managing family commitments or further study. By contrast, despite increasing efforts to value workforce diversity, the very nature of the practice and business models in engineering consultancies presented challenges. The necessity of networking for performance in the consulting industry was seen as a barrier to "time-poor" female engineers likely to have a greater share of family responsibilities.

As public sector institutions, Australian universities, have demonstrated leadership in equity and diversity in student recruitment and employment practices but the current environment is subject to competing agendas on which funding is contingent. Strategies to increase the proportion of female engineering academics will have to contend with the priority that is being given to Excellence in Research for Australia (ERA) performance criteria to increase research performance and to the Higher Education Participation targets for increasing the number of Australians with a Bachelor degree to 40% of 25-34 year olds by 2025 and increasing to 20% by 2020 the enrolment of students of a low socio-economic background. These seemingly competing goals of increased research specialisation and strictly defined and measured outputs, and increased student enrolments, teaching loads and provision of tailored teaching and learning support, already project an increasingly gendered allocation of workload (AHRI, 2011, p12).

Recommendations

The recommendations arising from the project focus on actions within the domain and control of higher education institutions. They are underpinned by the continuing need for systemic culture change, as expressed in the guiding principle

> *Systemic 'culture change' in engineering education, in the engineering profession and in the engineering workplace towards valuing and including women still needs to be the guiding metaphor for an effective strategy to redress the low participation of young women in engineering education and to retain women in the profession beyond their late twenties.*   *Godfrey & King, 2011, p.189*

A full list of the recommendations is available in Godfrey and King (2011) with three themes relevant to the contribution higher education institutions could make to support this cultural change.

The first theme, is represented by recommendation W15 which suggests that all engineering students are educated about the social and political dimensions of engineering workplaces. This is an opportunity to educate engineering students and academic leaders about the gendered profile of the engineering workforce and the reform agenda needed to transform it for the next generation of graduates. This can be done by incorporating workplace diversity and best practice case studies into preparation for internship and for the professional induction required in the undergraduate curriculum.

The second group of recommendations W16, W17 and W18, consider the provision of short courses or on-site collaborations and flexible delivery options. A career break can be an opportunity for further study in an area of professional interest, but the study is likely to be part-time and/or involving distance learning at a time of reduced earning capacity.

A preference was expressed for short courses rather than the sustained commitment needed for post graduate award programs although there was some demand for post-graduate courses in specialized technical engineering fields, and other management related fields, if they could be offered in flexible study modes. Institutions should reinvigorate consultation and collaboration with industry through their advisory networks, direct communication with companies, and via Engineers Australia, to extend provision of appropriate short courses with flexibility of delivery including on-site rather than on-campus delivery. Timing and location should be appropriate for engineers with family commitments.

A major advantage of short courses or on-site courses was seen as the increased opportunity for professional networking by comparison with university-based postgraduate courses.

The dearth of scholarships for part-time postgraduate study or re-training was a potential barrier even for the motivated. Higher education scholarships for post graduate study are predominantly for full - time study. There is an opportunity and need to examine the possibility of revising scholarship criteria to be more flexible. Companies seeking to be pro-active in stimulating employee career development, could well provide funding for engineers on negotiated leave to pursue further study or take up professional development opportunities.

The third group of recommendations, W13, W19 and W20 are aimed at systemic culture change in the higher education workplace. The most important step towards this end, is the need to adopt recruitment strategies to attract more women applicants for all positions. A source of short term, part-time tutors or lecturers and supervisors within engineering institutions could well be female (or male) engineers on a career break. The current work experience of these engineers would benefit students, and relieve pressure on academic departments seeking to bring engineering relevance into academic curricula. With appropriate mentoring, this could be a win-win strategy for institutions with low numbers of female academics, providing role modelling to all students, plus possible transition of the engineer to further postgraduate study.

A note of caution needs to be sounded here. Earlier in the paper comment was made about the current environment in Australian universities. An emergent 'fix' being discussed for a declining labour supply is a menu of 'academic career paths' into which the workforce can be sorted, and a new strategy to diversify academic faculties in non-traditional fields by gender looks like a vulnerable priority. It would not be satisfactory if an intervention to recruit more women into engineering faculties served only to populate the ranks of a new class of 'teaching-only academics' and exempt cohorts of researchers from teaching load and engagement with student engineers. As in industry, women academic staff in engineering faculties are generally few in number, and are spread across departments. They are also likely to be as diverse as any other group of staff, and where there are only two or three women in a department, they may are not readily form personally supportive relationships and networks. Women academic staff all speak of extremely busy working and personal lives, but would value occasional opportunities to meet other women.

It was suggested that engineering faculties could ensure that opportunities are funded, and resourced for women academics to meet informally to enable friendships or mentoring relationships to evolve. As an example, an informal lunch in the staff dining room in vacation periods, funded by the Faculty Equity Committee at one university had very positive spinoffs, in terms of the uptake of leadership training opportunities, with resultant confidence building and promotion success, for the women academics.

Responding strategically

Major research and educational institutions participating in a national WISE (Women in Science and Engineering) Summit in Canberra in early 2011 made commitments to redressing the participation, retention and success of women in their organisations. These commitments are in the context of relevant federal reforms relating to paid parental leave, the right to request flexible working conditions for employees with defined carer responsibilities and the overhaul of the Equal Opportunity in the Workplace Act (EOWA) with an increased emphasis on outcomes, for accreditation.

As with all major organisational reforms - successful intervention in universities depends on endorsement at the top. A system approach which is endorsed, adequately supported and resourced could yield returns at all levels. It needs champions - and ownership by faculty leaders who recognise that gender diversity is a necessity, and the lack of diversity is a drag on innovation, inclusion and 'organisational modelling' for prospective students and staff and industry partners.

To win institutional support in the current climate, a gender diversity strategy for engineering will need to address recruitment, so as to attract motivated professionals who can bring their breadth and depth of experience to teaching and learning, and contribute new and relevant questions to research and scholarship in the academy. To retain them, and improve engagement generally there will also

need to be a concerted effort to address the 'structures, process, work practices and mental models' which condition the climate in engineering faculties (Khare, Tam and Siebert, 2011) .

Conclusions

The women engineers interviewed for the ALTC Report were rightly sceptical about the need for re-education of women who had taken leave from the workforce and its 'deficit' implication. Women engineering graduates have a higher rate of academic achievement by virtue of being a small self-selecting minority (Godfrey & King 2011) and this confirms the likely aptitude for lifelong learning of this cohort.

The recommendations provided in the ALTC Report "Curriculum specification and support for engineering education (Godfrey and King 2011) demonstrate that there is a role for higher education institutions in boosting the retention of a higher proportion of women engineers in the engineering workforce. This role includes the provision of inclusive curricula and flexible delivery options in undergraduate, postgraduate and professional development courses. .

The most effective strategy for engineering faculties to assist in the diversification of the engineering workforce by gender will be to start by addressing their own workplace culture- including values, assumptions and practices which may be gender biased - and in so doing, leverage the expectations and empowerment of the next generation of graduates to look forward to 'making a difference' in their workplaces.

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