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## Women, Engineering and Research: Providing Choice and Balance

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## **2006-2560: WOMEN, ENGINEERING AND RESEARCH - PROVIDING CHOICE AND BALANCE?**

### **Cecilia Chan, Dublin Institute of Technology**

Cecilia Chan has published a number of conference papers on Engineering Education in areas of retention, recruiting, motivation and support for non-traditional students such as international students, and female engineers to disseminate successful educational strategies. She is also committed to encourage more women into Engineering. She is also an active researcher in the areas of digital signal processing, machine vision, bio-metrics and medical imaging engineering.

### **Michael Murphy, Dublin Institute of Technology**

# **Women, Engineering and Research – providing choice and balance?**

## **Abstract**

“Research cannot reach its full potential when half the population is excluded from its activities”<sup>1</sup>. Women researchers in engineering remain a minority in both Higher Education and industry in Ireland. Recent statistics of women graduating in science and engineering indicated an increase (a slow increase) but the numbers moving through to completion of PhD and careers in academia or industry remain quite low. Statistics on women in professorial and senior positions within the engineering sector also remains low.

The educated workforce produced in Ireland by its education system is acknowledged as a key factor in attracting international investment to the country and in the growth of the modern technological industries which has helped make Ireland one of the fastest growing economies globally. However, as a country Ireland would put this success at risk if it does not continue to develop its research and development capabilities.

There has been much debate at national and European level ‘to boost gender equality in research through stimulating the participation of women in science and technological development; and fostering the integration of the gender dimension throughout European research.’ As a result, national and European research funding has been directed at this area. Two such project proposals have been submitted by the Dublin Institute of Technology, one through Science Foundation Ireland and the other at European level, through the Sixth European Framework, this was submitted in conjunction with other European Partners.

In this paper, we will discuss a number of primary obstacles that our research has found most of our female encountered in our survey and interviews – how to balance the choice you choose. Some initiatives on the proposal based on the statistics survey to support women in engineering will also present and share among the academic community; it is hoped that the measures proposed will be of practical use for other academic communities who are affected by the under-representation of women. The overarching aim is that potential research insights from women will be encouraged and not neglected so “no great research” is overlooked.

This paper may be of value to an American audience by (i) informing them of the situation regarding representation of women in engineering and science roles in Ireland; (ii) outlining a self-assessment exercise conducted at Dublin Institute of Technology into research participation by women in science and engineering and (iii) highlighting a comprehensive range of proposed measures to redress gender imbalance in science, engineering and technologically related disciplines in DIT.

## **1.1 Introduction**

Time is slowly changing, the equality of women in the Western World is no longer the headline news, in fact, women in power is common these days and is accepted by the

general public. In the last turn of the century, feminists argued that traditional gender roles were oppressive for women and were perpetuating patriarchy. Two of the most notable feminist movements being the second-wave feminism<sup>2</sup> and radical feminism in the 1960s<sup>3</sup>, these movements have resulted in considerable amount of changes to the traditionally accepted feminine gender role. However, these women's rights movements were about giving women choices and respecting the many choices that women make; they have however not gone far enough to change the views of how women behave and view themselves with regard to non-traditional gender roles. Support mechanisms if women are to take up these traditional male dominated roles were also limited.

Despite significant increases in the number of females entering law, medicine, and business fields previously dominated by males, there is still a shortage of women in the discipline of engineering. It is questioning why electricians, plumbers, builders, engineers, architects, pilots and many other professionals (particularly professions linked with machinery or gadgets) always seem to associate with males? There exist a mindset; these professions are entirely men's job. At least not until a trendy film or a popular television series of these professions lead by women exist on air; this mindset will stay with us. Many females are uncomfortable to choose a career that is male dominated because they cannot regard themselves as part of them and many even find themselves being isolated. As a result, there is only a fraction of women who are willing to take up this challenge. It is undeniable females and males are naturally different, their thoughts, their ideas and their views; it would not be balanced without the opinion of one or the other.

Recent statistics for women graduating in science and engineering has increased overall but the numbers are comparatively low, and moving through to completion of PhD and careers in academia or industry are even lower. According to Science Foundation Ireland (SFI), "based on CAO statistics only 16.4% of students who accepted places on four-year engineering degree courses in 2002-2004 were female. Therefore there is a clear need to increase the participation of women in engineering in Ireland and the most direct way to build the talent pool in Ireland is through an enhanced focus on undergraduate engineers"<sup>4</sup>. In a 2005 report published by the Irish Central Statistics Office it was found that around 95% of Irish High School students taking higher level engineering, construction studies and technical drawing examinations were male. The pattern continued at third level with men accounting for around 80% of graduates in engineering, manufacturing and construction<sup>5</sup>. This trend is then carried forward into engineering careers. In Ireland we can find no statistics for women in engineering careers but an indicator of the imbalance relative to men may be seen in the percentage of female members of the professional Irish Engineering Institution (Engineers Ireland) which is only 6% of the total.

Statistics on women in professorial and senior positions within the engineering sector also remains low. Recent statistics published by the EU indicate that the percentage of female senior academics in engineering in the EU-25 is only 5.1%<sup>6</sup>. Over the last decade significant local, national and international initiatives – (such as Sixth European Framework, National Development Initiatives, Helsinki project) to increase participation

rates of women at the higher level in industrial and academic engineering careers have been quite common. However, there is a concomitant lack of awareness among women engineers of the opportunities generated by such initiatives.

The Dublin Institute of Technology in Ireland (DIT, 2005; funded by Science Foundation Ireland) undertook a self-assessment study to assess the participation rates of men and women in research and research management within the faculties of Science and Engineering. The study investigated enablers and barriers to conducting research as well as career aspirations. The results indicated that the DIT was comparable to European data relating to the numbers of women in Science, Engineering and Technology and their concomitant career levels. It was found that relatively few women were employed at the higher career levels in DIT and that women in the Faculty of Engineering were found to be significantly under-represented. The outcomes of the survey have highlighted a comprehensive range of proposed measures to redress gender imbalance in science, engineering and technologically related disciplines in DIT.

## **1.2 DIT Self Assessment Study**

The DIT self assessment study into research participation for men and women in science, engineering and related disciplines was undertaken over three months from July to September 2005. The data for this survey were gathered using six methods:

1. Analysis of existing archival data from DIT's Human Resources department. (A comparison was made with employment statistics for women academics in Europe)
2. Information drawn from a Women in Science and Engineering Research (WiSER DIT) workshop and network where national and international experts were brought in to present.
3. Review of best practice from other initiatives and institutions for women in SET.
4. Development and deployment of two separate online surveys to staff and postgraduate students.
5. Semi-structured interviews with staff and postgraduate students at all levels of employment
6. Analysis of existing initiatives in DIT

The primary function of the semi-structured interviews was to inform the development of the online questionnaires. Several barriers were identified as inhibiting research activity in DIT and these areas informed the development of the survey. The barriers are outlined below:

- Negative attitude and ethos in DIT towards research
- Not enough time to conduct research
- Childcare
- Funding and seed resources
- Lack of Role models
- No Career Progression Structure for researchers
- Lack of recognition, motivation and support
- Recruitment at undergraduate level

The outcomes of the survey have highlighted a comprehensive range of proposed measures to redress gender imbalance in science, engineering and technologically related disciplines in DIT.

### **1.3 Proposed Initiatives to Redress the Under-representation of Women in Engineering**

There are three primary stages in which inspiration, motivation and rewards must endeavor to increase female participation in engineering, namely, the pre-college stage, the college stage, and the post-college stage. The purpose of these stages is to engage three levels of engineers into an engineering network, incorporating undergraduate students, postgraduate students and academic staff levels. There is also a stage for “women-returnees” who have taken career breaks and are now seeking to return to research.

#### **2.1.1 STAGE 0: Pre-College ~ Secondary level (High School) Student Cohort**

Many recruitment techniques have been used to generate interest among young women for engineering, science and related technological careers. It is known that to attract this cohort; they must be exposed to and excited by engineering from a sufficiently young age. Many high school students have no idea what an engineer is or does. Some characterize them as laborers or craft works such as electricians or plumbers. It is amusing yet naïve of us to expect them to actually know what an engineer does. In fact, from a recruitment survey, most engineering students who choose to study engineering do so because they have some family members or friends who are engineers. But for those students who do not have any engineering relatives, they would have little or no idea what an engineer does. To effectively understand whether secondary-level students know what the engineering profession constitutes, a psychology lecturer<sup>7</sup> in DIT has developed a small *game* which demonstrates such information. A number of DIT undergraduate students were invited back to their own schools to present on “life as an engineering college student”. Prior to the presentation, the high school students were given a piece of paper to draw their understanding of what an engineer is. Many (both young men and women) have associated engineer as a man with a hard hat and tools. At the end of each presentation, these same students were re-issued another piece of paper to see if they now had a clearer idea of what an engineer does. The results are not surprising: the before and after picture had vividly changed. The simple but powerful conclusion is that if high school women don’t honestly know what engineers do, why should they pick engineering as a career?

DIT has many initiatives aimed at encouraging secondary school students to study science and engineering such as STEPs to Engineering week presentations by Engineers Ireland, Young Scientist exhibition, Open days and Shadow day workshop. As a guideline, it is important to ensure the audio-visual material presented is gender balanced, depicting women in the role of engineer and portrays positive female role models. Other initiatives such as inviting school students to “Become a Scientist or Engineer for a day”

was also put forwarded. These 'days' will be coordinated by female and male undergraduate science and engineering students, where the female undergraduates will act as role models.

Apart from exposing young students directly, a scheme was proposed to target the female secondary school science and technical teachers to re-invigorate their interest in engineering research. Eligible female secondary school teachers were invited to join the institute. These women will be encouraged and mentored to apply for national initiatives (where available). For example, in Ireland, Science Foundation Ireland runs the Secondary Teacher Assistant Researchers programme, in which 'teachers can receive support to conduct research within SFI funded research teams during school holiday periods for up to eight weeks. Teachers receive the equivalent of up to two months' salary for their participation in the programme'. This specific support action will disseminate new skills, knowledge about engineering careers and research to teachers that can then be circulated to their students. In addition, teachers may be encouraged to return to research on a part-time basis to pursue further research objectives.

### **2.1.2 STAGE 1: College ~ Undergraduates Cohort**

Many educational institutions have feared that girls would not fit "naturally" into technical Programs, with the weight of masculine traditions in the predominantly male engineering Profession. And at the same time, they feared the all male atmosphere was an anachronism, an unhealthy social and intellectual environment. As part of the DIT initiatives to actively promote female's participation and retention in engineering within colleges and secondary schools in Ireland, a student/staff society called WAVES – Women A Voice in Engineering Society was launched in late 2005.

With the intention of allowing student members to take on the lead roles and responsibilities of the society, it was decided WAVES would be run by female engineering students with guide supported from Faculty female staff members. The primary aims would be to provide a peer support network for all female student members in particular the female in their junior years, a network which encourages socializing, sharing common interests and assist them in becoming secondary level students' role models. It is believed that by being someone's role model will benefit both sides of the line; on one hand, the honor of guiding and leading others and being appreciate with admirable respect, and on the other hand, learning first hand experiences from someone with similar background.

The female engineering student cohort in DIT is quite small, since the launch there have only been a small number actively interested and involved. In addition, the DIT engineering faculty is separated into two campuses, this has not been easy and has created hindrances when trying to organize activities. It is undeniable that the female students enjoy having friends of the same gender to share common interests, away from the topic of "football", and the idea of being in an exclusive group. However, one noticeable trace is that when it comes to "girls-only" activities, they enjoy the idea, but the participation rate does not reflect their stated interest. In this aspect, it is true women

want to feel special, but yet there exists a need to balance. It is hoped to include the male gender for some of the future activities to create the balance. A competitive spirit would also be an asset between female and male, a healthy trait for the “well adjusted youngster” in engineering.

### **2.1.3 STAGE 3: Post-College ~ Postgraduates, research and academic staff Cohort**

As China and India are becoming increasingly globalise and economically strong due to its massive population and cheap labour. External forces from government and industrialists have been putting severe pressure to higher-level educational institutes. The educated workforce produced in Ireland by the education system has been a key factor in attracting international investment to the country and in the growth of the modern technological industries which has helped make Ireland one of the fastest growing economies globally. However, as a country Ireland would put this success at risk if it does not continue to develop its research and development capabilities. Ireland and indeed much of Europe would be in great disadvantages if we do not step up in our research and development technologies where we are still at the forefront. Potential research insights from women must be encouraged, as great research is more difficult to attain when one-half of the population is excluded from its activities.

During the DIT self-assessment survey, several barriers to research activity were identified and one of the most common ones was a lack of time for conducting and focusing on research. It also revealed that mentoring of junior staff by senior staff members significantly assisted the levels of engagement in research activities. With these suggestions, DIT has set up a networking group called WiSER DIT (Women in Science and Engineering Research). The purpose of this group is to promote women and other under-represented groups in science, engineering and technologically related fields. It is proposed that a mentoring scheme will be set up in conjunction with WiSER DIT and staff members. Experienced staff with a track record in research and attracting research funding will be trained as mentors for less experienced staff. This programme will establish groups at three levels; final year undergraduate, postgraduate research and faculty staff levels. The more senior staff will be active in a coaching and mentoring role for less experienced younger female staff and postgraduate students who in turn will mentor the undergraduates. In this way a tiered mentoring support system will ensure that relevant information and support is always available to the women researchers to help them plan their careers. The presence of such groups within an institution should act as a vehicle to encourage more women to enter and remain in research and thus address the principle objective of this call. This is an inclusive initiative involving men and women as mentors which will help boost success rates in securing research funding. This mentoring programme will build on the ‘advisory supervisor’ initiative already in place, where experienced supervisors assist those who are not experienced in the supervision of PhD students.

The focus is to identify and bring women in engineering research together to raise their awareness of the research areas and opportunities that exist within regional, national and international networks to sustain and build their own careers whilst enabling



undergraduate and newly graduated women to appreciate the scope and benefits of a professional research career. Evaluation of the newsletter will feed into the ongoing operation of the groups.

## **Conclusions**

There has been a perception in western culture<sup>8</sup>, in recent times, that the female gender role is dichotomized into either being a "stay at home-mother" or a "career woman". In reality, women usually face a double burden: The need to balance job and childcare deprives women of spare time. There are obviously some roles in which women must take the lead naturally, but can women balance these roles between career and family? Is this the question we should ask? Can the question be re-adjusted to what can we do to balances these roles for women who are trying to juggle family and career so we do not lose much talent that is required for continued success?

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