

Preface

INTRODUCTION

Despite improvements in workplace and employment conditions, women remain seriously under-represented in some specific disciplines of engineering, science, and technology, and furthermore, are not well-represented at the most senior levels in all disciplines. There has been academic research into the under-representation of women in these non-traditional fields and changes to government and organisation policy but the situation does not appear to be improving.

In recent years, some women in Australia have received national recognition in the disciplines of engineering, science and technology. Role models include Julie Hammer who became the first female President of Engineers Australia (EA) in 2007. In the same year, EA announced it had achieved a significant milestone: membership of females has broken the 10 percent barrier. Australia's Chief Scientist is also a woman, Professor Penny Sackett. In the field of information technology, Professor Shirley Gregor was made an Officer of the Order of Australia in the Queen's Birthday Honour's list in June 2005 for services as an educator and researcher in the field of information systems and in the development of applications for electronic commerce in the agribusiness sector.

This book provides a collection of recent high-quality empirical studies related to the education and careers of women in engineering, science and technology disciplines. As such, this book provides a valuable contribution as it highlights innovative approaches to attracting girls and women to non-traditional disciplines and well as supporting students through their university experience. The transition to the workforce and challenges faced by graduates are also examined. The profiles of successful girls and women included as 'career spotlights' provides a practical, rather than a theoretical discussion of factors which contribute to successful career progression of female students and graduates. The women profiled are inspirational role-models to other women in these non-traditional fields.

In achieving the overall objective of presenting a collection of recent empirical studies related to attracting, educating and retaining women in engineering, science and technology disciplines, it is hoped this book is relevant to educators and well as business managers as each chapter investigates and reports on a particular issue. The contributions include cases of innovative approaches to attracting and supporting women to engineering, science and technology training courses. It also includes a discussion of the effectiveness of mentoring, role models, government policy, and initiatives by professional bodies.

Although the target audience of this book is professionals and researchers working in the field of education and career development of women in engineering, science and technology, the book also provides insights and support for academics concerned with attracting and retaining women in these disciplines where women are traditionally under-represented. The book also provide valuable information to executives and members of professional bodies representing engineers, scientists and technology workers who wish to encourage women during their transition from education to the workforce, and during their career progression.

As well as the editors' home locations of Toowoomba (Australia) and Bristol (UK), the book attracted submissions from authors based in South Africa, Malaysia, Brazil, five different states in the USA, and Salford and Manchester in the UK. This interest from the international community proves the issues are of global, not local relevance.

The call for chapter proposals was widely disseminated through the use of women's networks and mail lists subscribed to by academics in engineering, science and technology. However, the Moderator of the software engineering mail list 'SEWorld' refused to distribute the call for proposals with the excuse that 'the list is about software engineering research and the message has a broader scope'. As a result, there were no proposals related to the challenges experienced by women in software engineering!

STRUCTURE OF THE BOOK

This book is divided into four main parts: government initiatives, schools, college and university, and finally, careers. In each section, profiles of outstanding women are provided in the form of career spotlights.

Section 1 sets the scene with two chapters related to government initiatives and legislation. These two chapters relate to the general situation without solely focusing on school, university or career aspects.

In the opening chapter, Alexandra Winter describes the policy and outcomes adopted by the Queensland Government to encourage women to participate in Science, Engineering and Technology (SET). The Queensland Government's Smart Women – Smart State Strategy (the Strategy) was an innovative response to address the under-representation of women in fields traditionally under-represented by women. From 2005 – 2009, the Office for Women (OFW) coordinated the delivery of the Strategy which encompassed the integration of policy analysis and development with program delivery. OFW is recognised as leading policy development and implementation to support the participation of women in SET in Australia, and have been approached by other jurisdictions seeking to develop similar policy initiatives. The Strategy used strategic leverage points with industry and Government to promote science, engineering and technology (SET) education and careers to women, profile women achieving in SET, and to influence employers in SET industries to consider strategies to attract and retain women.

The next chapter by Ruta Sevo and Daryl Chubin focuses on Bias Literacy by reviewing the concepts in research on gender discrimination and the U.S. context. It offers a quick digest of the evidence for discrimination, especially with reference to women in science and engineering in the U.S., explains common terminology and lists relevant legislation and national policy initiatives. The chapter summarizes the difference between tradition and bias, conscious and unconscious discrimination, overt and covert discrimination, and personal versus institution bias. Drawing on research in psychology and social science, it summarizes core concepts including: gender schema, accumulative advantage, stereotype threat, implicit bias, glass ceiling, mommy track, occupational segregation, statistical profiling, climate study, and the value of diversity in learning. A short section lists some U.S. national and international approaches to measuring whether discrimination is occurring and how improvements are benchmarked. There is a list of major organizations working for diversity in the U.S., with links.

Section 2 is focused on encouraging girls at school to consider engineering, science and technology careers.

Natasha Veltri and her colleagues report on GETSMART, an Academic-Industry partnership encouraging female participation in Math, Science and Technology careers. The GETSMART (Getting Everyone To Study Math and Related Technologies) program is a model mechanism for influencing socio-cultural factors affecting female IT career choice (role models and mentors). They describe the development a formal social mechanism for communication among female IT role models (industry

executives and recent college graduates), higher education IT academicians, and female middle school and high school students, and report the attitudes of GETSMART program participants towards a career in STEM. This feedback from girls indicates the importance of teachers, parents, role models and early STEM experiences in formation of interest in STEM, and serves as a feedback loop to the program executive and academic leaders.

Increasing the number of women in science is the goal of the next author, Gwen White. Although recently women have had more opportunities to enter these fields, previously stereotypes, misinformation and ignorance shut women out of these important career choices. This chapter explains that although there are a number of programs available that encourage females to enter the fields of engineering and technology; they just need to move up on the priority lists of corporations, guidance counselors and parents.

Section 3 is focused on College and University students.

Elizabeth Yost and her colleagues from Birmingham Alabama examine the impact of mentoring on self-efficacy for female graduate students and post doctoral fellows in STEM fields. Using data from a national study of selected U.S. academic institutions, recommendations are made in order to enhance mentoring practices that will reduce the barriers women face within STEM fields. Quality mentoring programs represent a viable way to enhance institutional change that may result in increased numbers of women in STEM fields.

The next chapter presents a case study by Jacquie McDonald and her colleagues about a current project to support students and academics in an Australian University. The Go WEST - Supporting Women in Engineering, Science and Technology project has built a mentoring and support network among female Science, Engineering and Technology students, staff and industry professionals. As well as the context and history of the project, the chapter describes the activities undertaken and the challenges faced in making the project sustainable. Factors critical to the success of the project are identified and include securing funds and commitment from senior management, having a multi-disciplinary team with strong leadership and effective support, and using information technology to enhance personal networks and to promote activities.

Section 4 presents eight chapters and is focused on women who work in engineering, science and technology disciplines, either as academics or in the wider work force.

The first chapter in Section 4 examines a new and exciting industry: computer games development. Julie Prescott and Jan Bogg focus on the current position and experiences of women working within the computer games industry, the Information and Communication Technology (ICT) sector and the wider context of the Science, Engineering and Technology industry (SET). They review global data collected as part of a larger quantitative study on women who are currently working in the male dominated computer games industry, in relation to the 'long hours' culture associated with the sector. In addition, the lack of females, especially females with families in the gaming industry, skills shortages, work life balance and flexible working is discussed in the games industry context. The discussion is related to the question of attracting and retaining women in the games development workforce of the future.

Jessica Guth and Fran Wright explore women's perceptions and experiences of promotion of academic women. The chapter focuses on the promotions process and criteria as one important issue emerging from that research. At the UK university studied by the authors, the Human Resources department has sought to make the promotion process more transparent and, officially at least, it no longer depends purely upon research achievements. However, these changes will not necessarily result in easier progression for women academics. The authors' study confirms that there is still a mismatch between what women think the criteria for promotion are, what the formal criteria are and how those criteria actually operate.

The next chapter is from South Africa. David and Marinda Maree discuss the structural and individual barriers responsible for the under representation of women in SET (Science, Engineering and

Technology). Self-efficacy as a requirement for success in SET is discussed. The results are illustrated with a report on a study done with a sample of 29 women in successful SET careers. Strong self-efficacy beliefs which can be associated with resilience and cognitive hardiness came to the fore. These women believe that they can achieve their goals and they do to a large extent.

Maslin Masrom and Zuraini Ismail provide a Malaysian perspective on the access of women to computers and the internet. Since Malaysia gained independence in 1957, Malaysian women have participated and contributed towards the social and economic development of the country. This was made possible by the policy standpoint of the Malaysian government which considers women are an important pool of resource that can be mobilized towards achieving the national development agenda. In Malaysia, where the use of computers is widespread, women have been found to have benefited from modern technologies. They have greater access to computers and Internet. This chapter emphasizes accessibility, delivering access to the computers and internet info-structure to women in Malaysia. A framework for analyzing Malaysian women accessing computers and the Internet is presented and discussed.

The next chapter, by Sue Durbin presents a case study of senior female scientists in the UK. It focuses upon the careers of thirteen senior female scientists in a UK public sector organisation engaged in scientific research and development. This chapter explores how female scientists have achieved senior status in a field where men dominate and where the sector is culturally and structurally gendered. Although these women's experiences of gender relations were variable and a limited career path has reduced their strategic leadership options, they have sustained a positive orientation, built around dedication to their work and a strong desire to reputation build, working within a generally supportive work environment.

The next chapter by Anne Manual addresses the career challenge of the gendered academic research culture and asks if Internet technologies make a difference. The use of Internet technologies (ITs) by academics in their research might be enabling women to meet this particular challenge and whether women in a scientific academic setting have a different experience in this respect from colleagues in social sciences and humanities. Findings are presented from 25 in-depth interviews and content analysis of 750 academic web profiles. Results suggest that although there are areas where the gendered research culture is being circumvented by the use of ITs for women in all disciplines, there are areas where women are not taking full advantage of the potential of the web to increase their visibility and research profile. Moreover, the opportunities presented by IT are not necessarily tied to discipline and women in SET disciplines appear to be no more or less likely to take advantage of them.

Focusing on women engineers in the UK, Haifa Takruri-Rizk, Natalie Sappleton and Sunrita Dhar-Bhattacharjee explain that retention of female engineers is falling, and there has been minimal progress on breaking down vertical segregation in the engineering workplace. In this chapter they explore the situation of women engineers in the UK. They examine, using qualitative and quantitative data collection methods, whether women in engineering do indeed suffer from the application of descriptive and prescriptive stereotypes in the workplace, and how they are able to circumvent them. In particular, we instigate the factors, such as self-promotion and confidence, which may aid or hinder the progression of women's careers. Our findings indicate that confidence and self-promotion should be high on the agenda of women engineers to survive and progress in the engineering industry.

In the final chapter, Mirella Moro, Taisy Weber and Carla Freitas provide an overview of women in the Brazilian Computer Society research community. The authors believe that the first step in order to solve the problem of girls not choosing technology and science related areas is to understand the current situation. They present the first study to identify which areas of Computer Science have more and less feminine participation. In order to do so, the chapter considers the gender balance in program committees of the Brazilian conferences in those areas. The study evaluates the 2008 and previous instances of such conferences. Some Brazilian initiatives to bring more girls to Computer Science are also discussed.

Interspersed between the chapters throughout the book are career spotlights of successful women. These profiles include women who are students, and women working in academia as well as the public and private sectors. The achievements of these women have been recognised with awards in the Queensland Government's Smart Women - Smart State program. These women are role models and it is hoped their personal stories will inspire other women to achieve success in the fields of engineering, science and technology.

BOOK DEVELOPMENT PROCESS

A double-blind review process was used for all chapters submitted to the editors. Authors of selected chapters were invited to act on the reviewers' comments and resubmit their chapters to the editors. Chapters were checked and final revisions applied. The Career Spotlights were sourced from recent winners of the Queensland Government Smart State Smart Women awards. The winners were given the opportunity to provide a brief biography and revise their award submission document to suit the style of this book.

We have enjoyed the process of compiling this book and in particular working with the contributors who provided such wide-ranging research on the topic of women in engineering, science and technology. It is up to you, the readers to decide if the perspectives offered here are relevant to your research or to the practical application of the concepts in your organisations. We would be delighted to hear your feedback on the usefulness of this collection.

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