

MANAGING THE CHALLENGES – INTRODUCING THE FEMALE MINORITY IN TECHNICAL RESEARCH SOCIETY

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Abstract

The under-representation of women in both undergraduate and graduate students in technical universities all over the world is a well-known fact. From the beginning of the 21st century, noticeable effort has been made to encourage women into engineering and to support them in their studies in Finland. Figures in the amount of undergraduate and graduate students in science and engineering have been moderately increasing. However, women are not eager to pursue a post-doctoral career as research scientists. We examine this problem defining the female research scientists' work circumstances and working career strategies in technical academic positions. We represent that the work of a technical research scientist is suitable and can be very rewarding for women. However, there exist certain dominating factors that in large scale clearly prevent women from considering technical research as a favourable career choice.

Keywords: academic culture, gender, qualitative methods, research society, women,

1. INTRODUCTION

Women form a minority of employees in most technical and engineering professions. When choosing a field of study majority of technically and mathematically qualified women choose in favour of other studies than engineering or natural science. [1] This leads to a forceful segregation and variety of social problems in some fields of engineering. The phenomenon has strong societal, cultural and organisational roots. In Finland as well as globally this produces problems in terms of labour market segregation, potential loss of qualified employees in field of technical research and potential decelerated Gross National Product.

Our approach to examine this problem is to define the female research scientists' work circumstances and working career strategies in technical academic positions. This study is based on an extensive survey conducted in a international three-year project (2005-2007), WomEqual. WomEqual's objectives are to support women's career development especially in technology fields, promote women's innovation activities and entrepreneurship as well as to create and implement a tool for women's networking. WomEqual's activities are:

- Development of weme.fi web community. This tool aims to support women's networking in technology fields. The community provides e.g. role models and

the possibility to share experiences and knowledge and solve career and family challenges.

- Launch of peers support groups and mentoring programs to create and implement operations models to universities who are studying or working in technology fields. To pair and peer group mentoring.
- Offering Business education for postgraduate students. This programme is focused on sparring highly educated women into entrepreneurship and improving the ability to recognize results that can be applied to business development training programme "Introduction into business thinking, technology applications and enterprise leadership"

in order to create co-support

networks, which aim to support women in technology fields. The supporting actions are to be

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2. GENDER DIFFERENCES IN ENGINEERING EDUCATION IN FINLAND

In Finland, during year 2005 women constituted 57 % of matricular examination candidates. The gender-balance has been quite permanent, since there is only one percentage variation during the last ten year period. [1] Most of these women apply for a higher education of field other than technology. At year 2005, 24,7 % of accepted higher education engineering students were female. At the same time, the proportion of women in master's level graduates was 24,9%. The percentage of women of overall students has been slightly less than 20 %. The amount of both female applicants for engineering studies as well as master graduates has been moderately increasing in recent years. Figure 1 depicts the percentage of accepted female applicants and female graduates in engineering education during years 1990-2005. Line has been adjusted by method of moving average per two measuring points to visually more explicable manner. [1]

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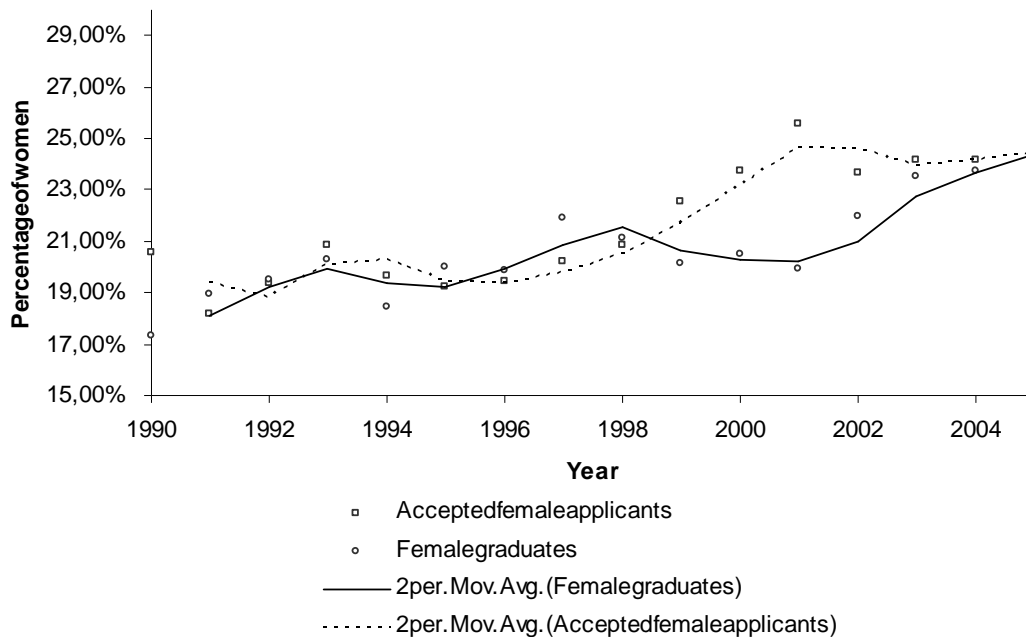


Figure 1. The percentage of accepted female applicants and graduates in engineering education during years 1990-2005 illustrated in moving average of two.

As can be seen from the figure 1, in year 1997, the amount of female applicants begins to increase somewhat noticeable. The timing is analogous to the organizational movements in Finland due to which the intake of engineering students was remarkably increased. At the same time the labour markets in the sector of information technology (IT) were growing rapidly. Simultaneously the Gross National Product of Finland was accelerating. At year 2001 a negative turn of the image of engineering profession took place. This phenomenon was due to several widespread lay-offs from large-scale IT-employers. At the same time the intake was decreased. Mentionable however is that the percentage of women, both as applicants and graduates, seems to continue their growth despite overall societal pressure to other direction. It seems that the reasons that encourage women to engineering studies are somewhat separate from the ones of their male peers.

The continuing growth has presumably two major dominators: From the beginning of the 21st century, noticeable effort has been made to encourage women into engineering and to support them in their studies in Finland. Large-scale supporting projects have been originated both from two technical universities, Helsinki and Oulu as well as The Association of Finnish Technology Industries. First pilot projects in terms of this kind of activity were started already in the eighties, but the operation hasn't been this systematic or large scale before. Simultaneous, a few novel and interdisciplinary programmes (for example Bioinformatics Technology at Helsinki University or Technology) were relaunched.

According to earlier research, increased interdisciplinary has an impact on both bringing women into technical fields and supporting them through their studies. [3]-[5] It is commonly noted that enhancing engineering curricula with for example arts, improves among other benefits networking channels and communication methods. This in turn creates more balanced and supportive climate for learning. [6]-[8] A positive climate and feeling of comfort affects women more than their male peers: a study of women in Computer Science (CS) suggests that women with low comfort level perform significantly worse than average. On the other hand women with high comfort level are most probably to exceed their normal ratings. [9] This example reveals the importance of supporting acts in bringing women into technical profession.

The proportion of women in doctoral studies has moderately grown already in the eighties. However, the strong growth of female postgraduate students started in the early nineties and has continued straightforward. This growth is straight connected to the overall amount of postgraduate students in Finland: The volume of doctoral students has doubled from 1990 to 2005. In addition the amount of both licentiate and doctoral degrees has grown, yet not as steadily as the number of students. This can be due to two factors: the growth of the amount of the students and an organisational pressure to produce especially either licentiate or doctorates. The amount of female postgraduate students is noticeable compared to master's level students. Figure 2 illustrates the growth of doctoral students, licentiate and doctorates during years 1990-2005. [1]

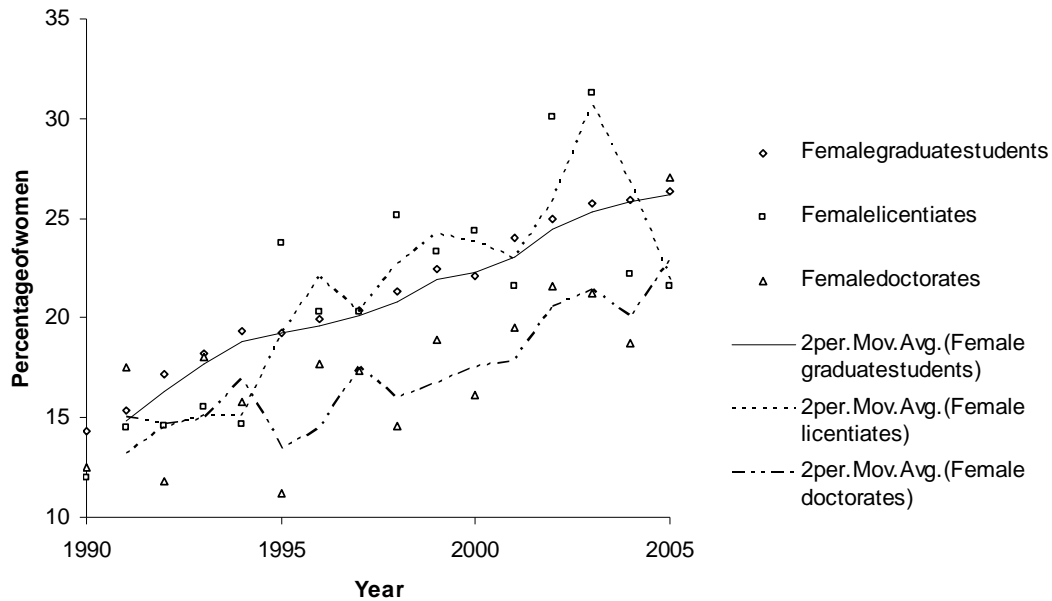


Figure 2. The percentage of female graduate students, licentiates and doctorates during years 1990-2005 illustrated in moving average of two years.

Despite the high figures in postgraduate students, relevant post-doctoral career as research scientist formed only 6% minority of professorship in the field. At the same time the proportion of female assistant professors and lecturers were around 30%. Among the managing assistants the amount of women was as 16%. [1] It seems that some kind of shrinking pipeline exists in the faculty: women are capable of accomplishing their postgraduate studies, but they do not get promoted as postdoctoral scientists or they choose not to aim for higher academic positions.

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All figures represented above are merely average figures from all technical fields in all technical universities. The proportion of female students seems to vary based on the field of technology. Statistics from the largest Finnish technical university, Helsinki University of Technology, point out that the most attractive master level programmes for women are Chemical Technology, Information and Real Estate Economics. The proportion of female students in these programmes is approximately 40%. The least attractive programmes for women are Electronics and Electrical Engineering, Computer Science and Engineering, Mechanical Engineering and Engineering Physics, the percentage of female students being circa 10%. The gender distribution with post-graduate students can be considered approximately parallel with minor differences in most and least popular departments. Mentionable is that women as postgraduate students form a majority in two most popular departments: Chemical Technology and Architecture. [10] The factors mentioned above indicate that there is a strict differentiation in gender balance between different fields of technology. Some study programmes can be considered as non-problematic whereas others are in a great need for supporting actions.

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In our research, the majority of interviewees are female. Our approach is to identify common nominators in their working circumstances, both positive and negative impacts to in their working life as well as reasons for choosing their profession.

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3. RESEARCH METHODOLOGY

In this study, results of eighteen theme interviews as a group conversation of eight persons were analysed. Additionally, the diary method was used with the interviewees. The interviewees were mainly working at the Helsinki University of Technology. Four participants worked at the University of Oulu and four at the Lappeenranta University of Technology.

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The researched women were asked to keep a diary of one week. In their diaries, they described their duties, transactions, impressions and feelings during the day. At the beginning of the theme interview, they traversed their records with the interviewer in more detail. Additionally, the interviewer asked several questions to elaborate their working life as well as their family and leisure time. The main themes of the interview is shortly categorized below :

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Working life

- Basic duties, responsibilities
- Best and worst parts of one's work
- Skills needed in one's work
- Tools used
- Working community
- Support, need of support
- Networking

Family and leisure

- Life and family situation
- Everyday life, family-work arrangements
- Support, need of support
- Balance between family and work
- Leisure time
- Networking
- Future hopes
- Does one consider being on the right field

In the group interview eight female research scientists gathered to talk about their work, challenges, practices and strategies. The conversation was guided, but not restricted. At the end, participants wrote down independently their own related ideas and thoughts. Interviews and the conversation were taped and transcribed. The data was analysed qualitatively. The content of the text was restructured and classified. The

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aim was to interpret and form an understanding of the material was analysed, the researched individuals were divided into two categories depending on the length of their careers. The first category consisted of the beginners (graduate students, or otherwise early in their research career) and the second one of more experienced research scientists (licentiates, doctors, professors). Key elements were arranged into a matrix from which similarities and characterizations were classified further.

4. RESULTS

The female research scientists experienced their work as interesting, versatile and multifunctional. They felt creative and independent and had excellent possibilities to affect their work, schedules and the completion of their duties. Additionally, the constant learning and self development processes were seen as great advantages. A detail worth mentioning is that female research scientists with children considered their balance between work and family life to be satisfactory and good. For some mothers, the flexibility of their work was a decisive factor in choosing an academic career.

The most significant problems experienced by these examined female research scientists were related to lack of support and contacts, loneliness, isolation from the society and fixed-term employments. These problems were most substantial among the beginners and they were related to situations, where the woman was only or rare, implicating the gender-balance strictly male dominant. It seemed that the feelings of loneliness and isolation correlated with the gender-balance of working team: those being only or very rare women felt more left out from the community or excluded from the group than those working in more even gender-balanced communities. However, despite the above mentioned problems, many of women working in a very uneven gender-balanced society in favour of men considered working in a male-dominated field as a positive aspect in their working circumstances.

Due to lack of support many of the young female researchers had a low self-esteem concerning their technical and research skills and they had doubts of their suitability in research society. This problem was deepened by some male peers' understatements toward certain female researchers and their ideas and/or achievements. Some of the interviewees found it problematic that they were totally responsible of their work, development and progress at the same time they did not receive relevant guidance or support. With lacking guidance many of the women considered keeping oneself in track and advancing their research efficient enough as a difficult and problematic task.

One noted coping method among beginners was to concentrate on teaching tasks, which were described as straight forward and well-defined. Drawback of this method was that the teaching activities took time and resources from research work. However, teaching student guiding activities were seen very interesting and motivational. Majority of interviewees, both young and experienced saw teaching or student guidance a very positive part of their work.

More experienced researchers had created solutions (for example unofficial networks and peer groups) making them less vulnerable towards the problems represented above. Noteworthy was, that two researcher in the middle of their career commonly had networked geographically distributed and seemed to consider that solution easier

than approach colleagues in the same unit. Most of the women researched emphasized the importance of communication and interaction skills. These skills were actively used when constructing research networks to survive on field.

Common denominator for many young researchers was that they didn't actively plan a career as an academic specialist in their field. In fact considering one's working fact considering one's working meaningless and fears of current position not promoting one's career, some of the interviewees had serious doubts, whether they should leave. In fact, they considered themselves lacking in career opportunities in the academic society. Some women openly stated family-situation as a reason for current academic position. Simultaneously they planned on career outside academic technical research. Many of them assumed that in the future they would aim at a position outside the academic arena where they could utilize their full potential and receive appreciation of their efforts. As much as 40% of the female research scientists stated that current work was only contemplated as an intermediate phase in their working career.

5. CONCLUSIONS

This study reveals that in Finland the work of a technical research scientist is suitable and can be very rewarding for women. Additionally, an academic research position offers favourable possibilities for combining work and family. Certain level of autonomy and even loneliness can be considered as a part of the culture - partly gender-related. We propose further extensive research to discover whether women's experiences of isolation are at some level shared with other minority groups (linguistic, racial, etc.) or their male peers in the technical research society. Focus on getting rid of isolation experiences and bringing in social supports is especially important, since it has been shown in earlier research that feel of comfort has a major effect on women's study and work success. [9] Additionally feelings of loneliness and isolation can be explaining factor to the phenomenon that women see academic work only as a phase

This research clearly depicts that women are in a need of special supporting acts to manage in male-dominant, academic technical research societies. These supporting acts have emerged, but they need to be strengthened in order to gain better results to keep these skilled female researchers in the academic research field. Additionally study and research guidance must be deepened to achieve equality and excellence. One major problematic issue is that the work is heavily based on unofficial networks and contacts, which are difficult to attain for minority researchers. Our technical academic research society is in a need for more effective networking tools.

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Curriculum Vitae (CV)

Aura Paloheimo

Aura Paloheimo received her M.Sc. (Tech.) from the Helsinki University of Technology, Department of Electrical and Communications Engineering in 2003. Additionally she accomplished her master's level pedagogical studies from the University of Helsinki in 2006. Aura Paloheimo works at the Helsinki University of Technology, Department of Computer Science and Engineering as a researcher teaching basics of Computer Science. Her recent research areas have covered aspects of communication and comfort level in computer science teaching as well as adding liberal arts in former literature into conventional engineering curricula.

Johanna Leppävirta

Johanna Leppävirta received the M.Sc. (Education) degree in adult education from the University of Helsinki, Finland, in 2005. She is currently working towards the Ph.D. degree in engineering education at the Helsinki University of Technology. Her research topic is to study how students' mathematical proficiency in learning electromagnetics could be evaluated and enhanced by developing collaborative learning activities. The aim is also to consider the gender sensitive aspects while learning electromagnetics.

Maria Hyttiäinen

Maria Hyytiäinen is working on her master's thesis in user-centered design of communications services at Helsinki University of Technology. At the same time she is working in EQUAL project called WomEqual as a research assistant. The aim's of WomEqual project is to support women's career development especially in technology sectors, to promote women's innovation activities and to create and implement a tool for women's networking, the online community weme.fi.

Pirjo Putila

Pirjo Putila received her licentiate (tech) from Tampere University of Technology. In the beginning of her career, Pirjo worked in her home university as an assistant and a teacher. Additionally she has worked in Tampere Polytechnic as a planning officer of study affairs, in National Board of Education as a chief engineer (96-99) as well as in Helsinki University of Technology, Department of Electrical and Communications Engineering as a head of training division (99-01). In recent years she has influenced as a project manager in several equality projects like TiNA 1 – promoting female-friendly culture into higher level electrical engineering education (01-03), TiNA 2 – Women in ICT (03-06), Tinataan (06-07) and WomEqual (05-07).