SESSION 3.31

What does it take to get to the top?
Women at the top of technological research

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31.1. INTRODUCTION

Technology and engineering are the most male-dominated research fields in Europe. Women are a minority of researchers in Europe generally, but even more so in technological research and in the business-enterprise sector especially. Engineering and technology is the field with lowest proportion of women researchers in higher education in the EU-25. In the professoriate women are a clear minority in Europe and globally 1, but they are especially few among professors of technology in Europe and among leading researchers in industrial and governmental technological research. Less than 6% of full professors and equivalent in engineering and technology were women in the EU-25 in 2004 2.

Women at the top of technological research are thus exceptional indeed. Exploring the profiles of the few women who have proceeded to the top in

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different national settings can highlight women’s opportunities, obstacles and future visions in technological research careers more generally. It is illuminating not only because of the top women’s own, exceptional career experiences, but also because it can be assumed that their high position presumably gives them a broader and more informed vantage point on gender dynamics in the field. Participation in PROMETEA, an EU FP6 funded research project on empowering women in technological research provided an opportunity to explore experiences of women at the top of technological and engineering research in twelve European countries and Chile.

The research landscape and context varies in the thirteen participating countries in many ways, and this should be kept in mind when interpreting the results. There is a large variation across the PROMETEA countries in the overall research intensity. Finland and Sweden represent countries with the highest research intensity in the EU, measured by the share of the R&D of the GDP; Austria, France and Germany are also above the EU average, and UK slightly below the EU average, whereas research intensity in Greece, Lithuania, Slovakia and Spain remains clearly below the EU average. Sweden and Finland again topped the EU statistics when it comes to the share of business sector expenditure on the R&D of the total GDP, and Austria, Germany, France and UK were also above the EU-25 average, whereas Greece, Lithuania, Slovakia and Spain were clearly below the EU average in 2003. When measured by the number of researchers (FTE) per 1000 labour force, Finland and Sweden were at the top of the EU-25 in 2003, whereas Austria, France, Germany, and UK all had figures higher than the EU-25 average, but Greece, Lithuania, Slovakia and Spain had fewer researchers in the labour force than the EU-25 average.

1. “PROMETEA – Empowering Women Engineers in Industrial and Academic Research” was funded by the European Commission within the Sixth Framework Programme (HPSE-CT-2005-017660) and was carried out 2005-2007. We would like to thank our project partners in the participating countries for the great input they provided. This article is based on their results and analysis. In alphabetical order, in Austria: Birgit Hofstätter, Anita Thaler and Christine Waechter, in Chile: Damaris Fernández Donoso, Claudia Paz and Sonia Yáñez, in Finland: Liisa Hiusa and Paula Koskinen, in France: André Béraud, Anne-Sophie Gouffroy-Genia, Cloé Pinault, Yvonne Pourrat, Emilie Saunier, Jean Soubrier and Hélène Stevens, in Germany: Jennifer Dahmen, Gaby Hoeborn and Felizitas Sagebiel, in Greece: Nikitas Nikitakos and Maria Lambrou, in Lithuania: Ala Kovieriene, Diana Saparniene and Virginija Sidlauskienė, in Russia: Elena Myasina and Vera Uvarova, in Serbia: Jovan Dudukovic, Jelena Jovanovic and Sanja Vranes, in Slovakia: Oto Hadec and Natasa Urbancikova, in Spain: Carme Alemany, in Sweden: Helen Peterson and Minna Salminen-Karlson, in UK: Wendy Faulkner, Lisa Lee and James Stewart, at Schlumberger : Pierre Bismuth.

The gender context of the participating countries shows also a large variation. In a recent global gender gap comparison, compiled by the World Economic Forum, Sweden topped the world statistics as the most gender equal country of all. Finland was on the third place, Germany and UK also in the top ten, Spain and Lithuania in the top 20, whereas the rest of the PROMETEA countries were placed lower, Chile as the lowest (78), and Serbia was not included.

Top women in each PROMETEA country were interviewed, addressing their career trajectory, obstacles and support in career, and on gender dynamics and future prospects in technological research. This paper will present a profile of these top women in terms of their family background and life patterns, discuss perceived support and obstacles in their career, and views on the preconditions which are needed to proceed to top positions in technological research. It will also explore and discuss their views on gender dynamics in engineering and technological research and on promotion of women in research.

31.2 CREATING THE TOP WOMEN SAMPLE

Each of the 13 national PROMETEA teams identified and interviewed 2-4 top women in technological and engineering research in their country. The scarcity of women at the top of technological research was evidenced by the fact that many national teams reported first that they had difficulties identifying any top women of this kind for interviews in their country. Multiple approaches had to be used to find interviewees. Rank-and-file women researchers interviewed were asked whether they could mention any women who had advanced to the top in engineering and technological research. Many interviewees could not suggest any names at all. It appeared to be most difficult to identify any top women in the business enterprise sector, regardless of country. However, once the top women had been identified, access problems were reported only in a few cases.

1. The Global Gender Gap index compiled by the World Economic Forum in 2006 measured gender equality in 115 countries in the world by a broad range of indicators obtained from mainly public “hard data” indicators describing fertility, labour force participation, political empowerment and proportion of women among professional and technical workers.
2. National teams were instructed that top women interviewees in technological research could be sought among female professors, leading academics, research directors of companies or laboratories, directors in governmental research institutes, or in high profile position in Ministries and other national institutions. It was also specified that they do not need to work currently in day-to-day engineering/technological research but must have a solid background in this kind of research.
Semistructured interviews using a joint template were conducted by the national teams in the native language (11 languages). The interviews were taped, transcribed and summarized in English by the national teams and entered into the project database, question by question.

Because there are extremely few top women in engineering and technological research in the PROMETEA countries, and because the sample is small, and the interviews included potentially sensitive personal data, particular attention had to be paid to protecting the anonymity of the interviewees in reporting on this research. This is why such issues as exact research fields linked with other information of the interviewee, names of people and institutions directly related to interviewees, and some other features related to their professional life and scientific activities, professions of partners, exact amount of children etc. are not mentioned in the analysis in detail.

31.3 PROFILE OF TOP WOMEN

All in all 28 women at the top of technological and engineering research were interviewed in the 13 countries involved, two interviews in most countries, three in Finland, four in Germany, and one in Greece. Key background data of the sample is presented in table 1 and the distribution of the interviewees by country in table 2. As could be expected, an overwhelming majority of the interviewed top women were mature professionals, aged over 45. Most were employed in the higher education sector, some in the top management of their universities or organisations, some as heads of departments or units, and some as professors and associate professors.

The career trajectories of the top women have been different: some have had internationally very mobile careers with work experience from several countries and research systems, whereas others have had their work base in their native country only. A few are currently working in a different country than their native one, and one mentions having a different ethnic background from the majority in country she is mainly working in.1 Some had moved between sectors, e.g. from industry to higher education, or had work experience from all three main research sectors. However, since the mobility and career trajectory data is not available systematically on all interviewees (due to the fact that the data sheets linked to the interviewees have been filled to a varying extent), the mobility data could not be systematically analysed.

The fields of engineering and technology of the interviewees were: Agricultural Engineering, Architecture, Atomic engineering, Bioengineering,

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1. For protecting her anonymity we cannot disclose her ethnic group.

TABLE 1. Background of the PROMETEA top women interviewee sample

<table>
<thead>
<tr>
<th>Age group</th>
<th>Children</th>
<th>Position of interviewee</th>
</tr>
</thead>
<tbody>
<tr>
<td>under 45</td>
<td>3</td>
<td>Head/vice-Head of Laboratory</td>
</tr>
<tr>
<td>over 45</td>
<td>25</td>
<td>President of a University</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>President of Organisation</td>
</tr>
<tr>
<td></td>
<td>3 or more</td>
<td>Full Professor</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Associate Professor level</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Partnership status</th>
<th>Research Sector</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>single</td>
<td>HE</td>
<td>21</td>
</tr>
<tr>
<td>in partnership</td>
<td>GOV</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>RES</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Family status</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>partner and children</td>
<td>21</td>
</tr>
<tr>
<td>children, no partner</td>
<td>3</td>
</tr>
<tr>
<td>no partner, no children</td>
<td>4</td>
</tr>
<tr>
<td>no partner, no child</td>
<td>0</td>
</tr>
</tbody>
</table>

TABLE 2. Top women interviewees by country

<table>
<thead>
<tr>
<th>Country</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>2</td>
</tr>
<tr>
<td>Chile</td>
<td>2</td>
</tr>
<tr>
<td>Finland</td>
<td>3</td>
</tr>
<tr>
<td>Finland</td>
<td>7</td>
</tr>
<tr>
<td>Germany</td>
<td>4</td>
</tr>
<tr>
<td>Serbia</td>
<td>1</td>
</tr>
<tr>
<td>Lithuania</td>
<td>2</td>
</tr>
<tr>
<td>Russia</td>
<td>2</td>
</tr>
<tr>
<td>Serbia</td>
<td>2</td>
</tr>
<tr>
<td>Slovakia</td>
<td>2</td>
</tr>
<tr>
<td>Spain</td>
<td>2</td>
</tr>
<tr>
<td>Sweden</td>
<td>2</td>
</tr>
<tr>
<td>UK</td>
<td>2</td>
</tr>
<tr>
<td>TOTAL</td>
<td>28</td>
</tr>
</tbody>
</table>
31.3.1 TOP WOMEN AND FAMILY

A recent study on women in European universities found that “significantly more female professors are living alone and do not have children, whereas the majority of male professor enjoy a traditional family life with a partner who is primarily responsible for the housework and child-rearing”.

In the light of this overall picture of European professors, one of the most surprising and unexpected results in our data concerned family status and motherhood among top women in technological research. An overwhelming majority of the top women interviewees lived with a partner and had children, who were either still living with them or were adults. Half of the top women had two or more children. Only three out of 28 did not have any children, and all women who did not have children lived with a partner. There were no top women in the sample who did not have either children or a partner. This suggests that contrary to commonly held beliefs, getting to the top in technological and engineering research does not necessarily require that a woman gives up or “sacrifices” (as many interviewees among the rank and file engineers put it) motherhood and family life or that children and motherhood would necessarily be a “handicap” in women’s careers (a view expressed, for example, in the Spanish male researchers’ focus group).

The data suggests that what seems to be significant is rather something we could call the management of having children and a family in the broad sense: the timing of children in relation to career phase, the division of labour between parents in child care and other household tasks, support networks available which could be mobilized for help in child care (parents, other relatives, friends) or the opportunity to hire help, and child care provisions offered nationally or by employer institutions. These issues were not asked directly about in the top women interviews but were frequently commented upon by the interviewees.

For example, both Chilean top women interviewees had their children relatively early, one (H_TW1-Z) when during her student time, before her PhD, the other (H_TW2-Z), when starting her university career. Children of the latter went to the university nursery. The first Chilean top woman interviewee mentioned that she had received a lot of support in childcare, from her mother during her student time and later from her husband and sister-in-law who took care of the children during her studies abroad. One of the Austrian top women (H_TW2_Y) had also her child during her student time and mentions the support of her social networks in organizing child care. She explicitly took up that having a child later in her career might have been more

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difficult. The top woman in Germany (H_TW1_M1), working in Germany, but from another European country originally, mentions how her husband gave up his job when they moved, because of her research, to a university in UK, and how he still looks after their two children. Swedish, Finnish and UK top women mentioned husbands who have taken a lot of responsibility of child care and domestic arrangements. Hired household help was considered crucial support by a Swedish top woman:

It has been important for me to have a mother who has always worked. It was a matter of course that you ought to work and have advanced working tasks. And I was also used to having help. I have had both cleaning help and nursemaids and my children were left to childcare early on. And I have never had a bad conscience about that, as many others have. I think that is because of my background. (B_TW2_W)

Motherhood could also be seen as supportive for one’s career, making it possible to obtain skills transferable to work contexts. The Finnish top woman, a professor with several children, reflected on motherhood and children not as a career obstacle but rather something that has enhanced her career:

I have several children and a family and all my experience of life, which has been an enormous resource for me. So it’s difficult for me to imagine what it would have been as a father but being a mother has been an enormous resource indeed. When the children were little it of course slowed down my career progress but it has been possible to catch up later. And having a family has given me so much that I don’t know if I would have reached this position, this professorship, without them. Having raised my own children is a huge advantage… this is a pedagogical job. (H-TW2_J)

In a similar spirit, Russian top woman interviewee, herself a mother of one child, when asked about what has been supportive said: “I suppose that children stimulate a woman to progress in her career. Ambitions are this kind of stimulus for men.” (H_TW2_V)

A Lithuanian top woman argued that family, children and career are all important and that it is possible to match everything. “But if it is difficult to match, family should be in the first place and then career.” She also described family and children as women’s “special purpose of life”. (G_TW2_2)

Another issue of interest related to family relations is disciplinary or academic endogamy: to what extent these top women had partners in the same field (engineering and technology) or in academia more generally. The Women in European Universities study found that almost half of the female professors who had a partner were married to a faculty member 1.

Unfortunately the profession of the partner was neither asked directly in the PROMETEA interviews, so the degree of endogamy among the sample is not possible to define.

### 31.4 SUPPORT IN CAREER

Support in a research career is crucial, especially for women. In the extensive US Access study by Sonnert and Holton, on careers of successful male and female researchers, female scientists acknowledged the support of family and significant others, colleagues and friends, more than male scientists did but also encountered more obstacles. Sonnert and Holton argued that women appeared to be more dependent on social support in overcoming career obstacles. Another way of interpreting their result would be that men may under-report much of social support and mentoring they receive in the scientific community because they may take it for granted.

Support in a research career can be derived from various sources, and from both private sphere and public sphere, notably from the scientific community and one’s own research setting. Additionally, women’s research careers may benefit from equal opportunities programs and specific measures to promote women. Certain personal characteristics, approaches and behaviour can be perceived as being supportive or hindering in a research career. Finally, certain circumstances out of control of the individuals involved may support or hamper one’s career: luck, chance, serendipity, or being in a right place in a right time or in the wrong place in the wrong time.

What kind of support and from who did these top women receive from the scientific community and their research and education environment? It could be expected that those few women who have reached the top in engineering and technological research would have been strongly supported by their superiors, heads of departments and laboratories, Ph.D. advisers, colleagues, and both informal and formal scientific networks. One could also expect that many would have had a mentor supporting their career development. As the proportion of women is so small in engineering and technology, most of this support would necessarily come from men.

Among the top women in the PROMETEA sample we found many women who reported of strong and various, multiple kinds of support from their research environment and from early on in their career but also some, who thought that support they had received had been rather scarce.

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Both Swedish top women, the one from the higher education sector, the other from the business enterprise sector, recalled how they had enjoyed important support, initially encouraging them to take up an academic and research career, and later to advance in career. The Swedish professor explained:

I got support from an old professor; she retired a long time ago. I think she was among the first woman professors in one of our Universities of Technology. She supported me very much. Our previous vice-chancellor supported me. And my husband of course. Very much. Those are the most important. The professor opened my eyes to an academic career. I had never thought about becoming a professor or that it was a possibility for me. However, she made it clear that it was, even when I was only a postgraduate student. I also had a very supporting supervisor who thought that I could make a career as a researcher. The vice-chancellor of the university recognized me as a future leader and he helped to promote me when posts were announced as vacant. He was also helpful in creating my professorship. In addition, I benefited career-wise from a positive action measure promoting women in the university. (H_TW1_W)

This Swedish professor is one of the few in our sample who mentioned that gender equality actions had concretely advanced her career. Her relationship to the old female professor could be seen as mentoring. The other Swedish top woman from the business sector reflected her career support before she obtained her doctorate and underlined the importance of peer support in a male-dominated environment. Her account illustrates also how one can actively build up support for oneself:

I think that my supervisor, when I was a postgraduate student was very important. It was a very male dominated environment but he was very supporting by believing that it was obvious that I should get my doctor’s degree. His support was more about his attitude than his practical support. But I also had support from a female postgraduate student colleague. Since I wanted to have a friend in my research group, I actually looked for a female colleague whom I convinced also to take up postgraduate studies. And that was a great support during all my time as a postgraduate student, that we were two friends. When I worked in a task with international issues I don’t think that I got much support. Since I’ve been back in Sweden I think that I have had several mentors in the Swedish industry, that is, top managers in the Swedish industry who have supported me in different ways. (B_TW2_W)

The Austrian top woman working currently in a high university management position attributed her success to support from others. She mentioned how she has frequently had superiors and supervisors who “gave freedom to develop and start projects”. She mentioned also the support from her Ph.D. supervisor. Her projects were supported by government officials as well as the city leadership. She also had a mentor, her superior from the time she worked
in the business sector. This mentor encouraged her to take a degree in engineering at the top of her earlier academic degree (H_TW2_Y).

The Serbian Director (G_TW2_Q) working in the governmental sector mentioned that her university professors, mostly men, have been most important people supporting her career. She was supported by her supervisors during her Master’s and Doctoral studies, and her professor helped her to join the institute where she now works. She felt they appreciate her work and tells that she has kept good contacts with them also later.

The Russian top woman, director of a laboratory, also mentioned as a key support her Ph.D. supervisor who had a high standing in his discipline:

The most important person in my career is the first supervisor of the post-graduate study at the X Institute. He was a member correspondent of the Academy of Sciences, the head of the Institute, worked with the leading scientists in his field of science, was a really cultural person and an art expert, he communicated with us not only formally but informally, too, giving us a wide outlook in life. (G_TW1_V)

A Chilean Associate Professor maintained she “never had a problem at work”. When asked about support, she names several family members and a friend, but also a key colleague and mentor who, after she completed her M.Sc. abroad, helped her get started. In fact, it was he who encouraged doing most of what she has done, she said (H_TW2_Z).

The importance of colleagues as a source of support was mentioned by both Slovak and both UK top women, as well as a Serbian professor. Her family and her colleagues (her generation) have given her the most important support. After graduation she worked in a team together with several colleagues of the same generation. She explained that at that time, they had no support from professors and older colleagues (because of hierarchical reasons), so they had to help one another and struggle for projects. This was very difficult (H_TW1_Q). The Slovakian manager working in industry recalled:

At the university it was the professor who was director of my PhD. studies. At the very beginning of my career the first colleague who introduced research to me was important. Later there were several “examples” of colleagues who were successful in solving research issues guided me. (B_TW1_K)

On contrast, some top women reported having received relatively meagre support from their research environment. A Spanish professor explained:

In Spain in my field there is no support for women. This is not new. There is not any support when you want to be a scientific personality or when you want to be innovative, you will have many difficulties and obstacles. (TW1 Spain)

When asked about support in academic career it is not uncommon that the respondent starts to reflect on difficulties in her career, as this Spanish professor. The issue of scarce support or non-support especially from one’s own
academic work setting came up frequently in an earlier study of Husu on Finnish academic women across all academic ranks, and can be understood as a form of subtle or hidden discrimination\textsuperscript{1}. The Spanish professor, when asked about most important people supporting her career, again goes back to non-support and obstacles:

I have a personality that I have a lot of endurance. During my career in engineering I have had to put up with it. To create a new field in Spain is very difficult and a new field in a so macho environment as engineering is a long obstacle race. I have to have a lot of endurance. (TW1Spain)

Similarly, a Finnish professor, when asked about support, starts to reflect the lack of it:

Well, it is difficult to name one… my husband has been the most important. When it comes to science, I cannot say I would have received much support from anyone, except for my doctoral thesis opponent A. These two have been the most important. External funding organizations, not my own university. Through different projects I have been able to build my research career and my professorship, my own research unit and obtained professorship based on evidence I have gathered with my “own” money. By own money I mean project funding I personally have acquired. From the university I never would have achieved this kind of position, I had to work my way to the system from outside.

I got some understanding and support from the highest management but not really anywhere else. You could say that … there have hardly been any male patrons around. Mind you, no female patrons either. This is a solitary job; you have to be able to manage on your own. In principle, the people in University administration are willing to help, both men and women, they have supported me, but if you think about colleagues and such, the support has been very scarce. Maybe some exceptions, joint projects which have been reciprocal and left a good vibe. Sometimes it has been another way round. A few such kind of positive male colleagues, working in joint projects, fair play. (H_TW2_J)

It is to be noted that the non-support she described refers to the immediate research environment, whereas she acknowledges that the university administration and external funding sources have supported her career.

As indicated earlier, all top women in the sample lived with a family of some kind, they were either married or partnered with or without children or had children but no partner. Academic endogamy and disciplinary endogamy is a fairly common phenomenon in science and academia especially for women scientists, and also among European female professors\textsuperscript{2}. The interviews indicated that some of the top women in the sample had another researcher as partner but

\textsuperscript{1} Husu 2001, 2005.
since the profession of the partner was not explicitly asked when collecting the data, this information is not systematically available on all interviewees. Academic endogamy can both advance and hamper women’s research career: a partner who understands the dynamics of research and academic life is able to offer important support and advice, and couples collaborating in research are not uncommon either. In our sample of top women, however, no one reported this kind of collaborative relationship with their spouse.

The family or class background of the top women was neither asked systematically in the interview template or background data sheet. Only one mentioned that her parent was an engineer. Support from the family was frequently mentioned by the top women: husbands and partners, fathers, mothers, uncles, sisters, brothers and broader family had provided various kind of support the interviewees considered important. Only a few mentioned something negative about the way how the family or close relatives related to their research career. A UK professor told how her traditionally thinking mother-in-law did not understand her professional commitment.

Some of the top women described an exceptionally supportive family background, such as the Finnish professor: “I was the only daughter in my family and had a strong father who thought I was the star of our family” (H_TW1_J). She told how she also was supported by her brother who thought she could do anything she wanted, and later her husband took very much care of household tasks so she could concentrate on her research.

The Austrian professor mentioned her extended family as supportive, and the Austrian top woman in a high management position told how her parents were very open to everything, she felt there were no barriers and everybody told her “if you want to do this, do it”. She also felt she learned necessary toughness at home helping her to cope with pressures, since her parents were entrepreneurs.

Parents can provide practical support also during research career. The Chilean Head of Department had a mother who had a science degree (but never practiced her profession since marriage) and who supported her plans to go to university whereas her father opposed this. Her mother also later “helped with the logistics of raising my children and freed me from many everyday domestic obligations” (H_TW1_Z).

The Chilean Associate Professor told about broad support from the private sphere: in terms of support she mentions a long list of relatives and friends: her mother who had also studied at the university; her uncles who were engineers; a friend who invited her to work with him in the university. In addition, her husband works in the university (H_TW2_Z).

1. On pitfalls of spousal co-operation, see e.g. Scott 1990.
The Russian director of a laboratory told how her parents always strongly influenced her career, and mentioned as supportive the “cultured environment” at home (G_TW1_V), and also the Russian professor and head of department mentions her parents as supportive.

The UK professor’s father was an engineer and she commented on how in her non-Western background it is common for women to work. The other UK top woman characterized her parents as “extremely supportive”.

Most of the top women in the sample who had partners described them as supportive, with a few exceptions. Some top women only mentioned their partner as supportive without elaborating but many gave also fuller accounts on this. The Spanish top woman with several children strongly underlined the support of her family:

But I have a very good support of my family. I have a very good husband; he is not “macho”. I have several children and if I could work very hard it was because my husband helped me very much in the domestic tasks and he supports me anywhere and all the time. (TW1Spain)

The Swedish top woman in a high management position gave credit to her husband and explained how it is he who has given up things to support her:

My husband has supported me and encouraged me to apply to different positions when I have hesitated. We have several children and he has arranged domestic services and he has given up things for me in an extraordinary way. (H_TW1_W)

It is noteworthy that she described her husband, not herself, as “giving up things”. The Russian assistant professor described how she and her husband “always shared household chores between us, we had equal rights” (H_TW2_V).

A German top woman interviewee, one of the few interviewees aged under 45, explained how in their dual career family she and her partner take turns in career moves:

I really have to say that my husband was very supportive for my career. I think it’s always, it’s always a dual career type if things…, if you want to have it all, if you want to have career and good personal life, and so on, I think it’s always two people that have to work together, and my husband was supportive, or I was supportive for him, and he was supportive for me in terms of that we always said, well one job I choose where we go, the next job you choose where we go, basically, and that he always was supportive in that I am working and we are both working part-time at the moment, and just in terms of listening to all the happy and not so happy factors at work, I think he was very supportive for my career on a personal side. It’s maybe the main really, then there were of course a lot of persons within the work environment whom I worked with, who advised me, whom I advised, from
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whom I learned a lot, there are a lot of people there. But I think on personal side that was really helpful, or is really helpful. (H_TW2_M2)

A British top woman, also from the less than 45 age group, characterized her husband as very supportive. Part of this support was that he was willing to be mobile in a way that supported her career. He followed her moves during the post doc period abroad, “anywhere in the world”, and now he works in an administrative job. When talking about support more generally she said: “Most important is a partner, or not marry, or marry late” (H_TW1_O). Obviously there are too few interviewees in the under 45 group in the sample to draw any conclusions on generational changes in spousal support for mobility and mobility behaviour. This would be an interesting topic to explore in further research.

31.5 OBSTACLES IN CAREER

What kind of obstacles had the top women in our sample encountered in their career? Responses on obstacles varied remarkably, in terms of whether obstacles were mentioned, to what extent the interviewees disclosed their personal experiences on them or whether they talked in general terms only, and whether the interviewees reflected on their obstacles from a gender perspective or not.

A few top women said they had not encountered any obstacles: “Nothing! I have had a wonderful career!” declared a top woman from Austria (H_TW1_Y). A colleague from the UK replied in a similar way:

I honestly can’t really remember many obstacles. Yeah, its not, it’s never obviously plain sailing. But I honestly can’t remember big obstacles. I think my biggest problem has always been not having enough time to do everything I want to do, but that’s hardly an obstacle. (H_TW2_O)

The Swedish top woman with long work experience from several sectors reflected:

I have always chosen environments where I have got support, except [when I was working in] XX, but there no one got support. It was just as tough for everybody. (B_TW2_W)

The other Swedish professor did not see any obstacles in her career in hindsight, even if she let the interviewee know that “it has been tough”:

I don’t think that I have ever been discriminated against. I have had the advantage of being quite alone. I have been alone and have therefore not constituted a threat. And in this technical world I have legitimacy. I have done everything you should do and the fact that I’m an engineer has given me confidence. I’m a mas-
ter of engineering and I’m a licentiate and a doctor. I have been an assistant pro-
fessor and in every single position you can be. I have worked in the industry and
in the academy. I don’t know if it matters to my colleagues but it has mattered to
me. What I have felt the last couple of years is that the higher you get the tougher
the climate, no doubt about it. Because then we talk power and another kind of
threat. I actually have not experienced any obstacles. It has been really, really
tough some periods. (H_TW1_W)

A German top woman, when asked about personal experiences of career
obstacles, said she had never thought about hindering factors, and that chil-
dren (she had wanted and did have children) had not been hindering her at all,
referring to that child care used to be much easier to organise in Eastern
Germany where she used to live. However, when she was reflecting on what
it takes to get to the top, it came out that she had experienced serious difficul-
ties in access to important networks:

To reach to the top you need networks, I have learned this by terrible experi-
ences. It is very difficult as a woman in my position and with my ideas for research
to get access. This is a gender question of course. Men meet for a drink. If you
react in the same way as a woman you are talked about. (H_TW4_M)

There was also variation across the sample in whether the obstacles were
reflected in gender terms, or whether the interviewee perceived obstacles
rather linked to research structures and practices without any gender perspec-
tive. More than half of the interviewees in the sample talked about their career
obstacles in gender terms, the rest gender-neutrally. The Slovak top woman
from BES reflected:

I have an experience from various occupations. Until I have been hired for this
job I had been applying for several years. My application was refused several
times. I think one of the reasons was discrimination. The prejudice that woman
cannot fulfill duties at such work i.e. man’s work, man’s position. Finally the occa-
sion and good luck had rearranged all circumstance where I had been hired. The
prejudice of “woman’s work” is still vivid in this community especially Slovak
one. The culture (of other nation) makes a difference, where the assessment (not
gender) is what counts. (B_TW1_K)

Russian director of laboratory mentions “male solidarity” as one of the
obstacles (G_TW1_V). All three Finnish top women in the sample reported
on their career obstacles in quite outspoken gender terms. When asked about
her career obstacles, one of the Finnish top women replied: “Envious men in
the workplace”. She continued:

Yes, when I was working in industry IT I was denied a leading position simply
because I was a woman. They hired a man with less educational qualifications sim-
ply because he was a man. I did my Ph.D. mostly there and they did support that,
my closest boss saw that it was worthwhile to support me. And when I left this firm
the HR-people were really surprised, they had rated me as potential future leader in the company after I would get my PhD. When I left they were very surprised: “where are you going?” I told them that the firm didn’t offer many opportunities for people like me. (H_TW1_J)

The other Finnish top woman mentioned her earlier superiors as worst obstacles. Both of these professors had initially worked in industry but shifted to academia. The professor described in the interview how the discriminatory treatment made her finally leave industry for academia:

Interviewee (H_TW3_J): I happened to be at the wrong place at the wrong time. And I didn’t fit in the patterns of my boss. So I didn’t get where I maybe had wished to. The problem was probably also that I am this kind of very straightforward person and because of that I didn’t really fit in that corporate culture. I didn’t know how to lobby.

PK (Interviewer Paula Koskinen): When and where did this happen? How did it show?

I: When I worked for the industry. I worked there for many years. My boss didn’t trust my abilities. I was not promoted. One of them said it to my face. When the issue of promotion to a management position came up one of the higher up managers told me that “we decided that no women will be appointed”. I didn’t agree with this and said it out loud, was told off but later they admitted I was maybe right and I became the only woman who was promoted.

PK: So he actually said out loud that no women will be promoted?

I: Yes. But I give him credit for that. That he said it. Because it was so obvious. If he had done like my other boss and had come up with every possible excuse for not promoting me, that would have been much worse. It is much worse when they say things like you are not cooperative, you can’t make decisions and things like that for reasons of not promoting somebody.

PK: In this other case, why do you think it was because of your gender?

I: Well everybody knew that was the reason. People commented on it to me. Especially considering who was actually chosen (laughter). So I think it was much fairer to say it out loud. It hurt of course; I’m not saying it didn’t. In this other case the person was clearly less qualified than me, everybody knew it. Some years after the incident my boss, after a couple of gin tonics, told me that I was right all along but that he was not in the position to criticize his boss, who had made the decision. This is what happened to me. But it was enough; this is why I left [from industry]. I did not stay to wait for more than that back then.
The German top woman working in higher education also described obstacles in explicitly gendered terms:

The biggest hindering factor has been the men. I have to say this quite strongly, my male colleague hindered me. They have a quite different social background, they have a different way of communication and they have the old boys’ network. I never got any contracts of some institutions because I did not belong to the network. (H_TW3_M)

She described to the interviewer how nowadays she has got her own ‘fan club’ which is paying well. A Spanish top woman reflected:

In the university is very difficult to have a career in research and to teach at the same time. Sometimes I think it is easier to be researcher in the private sector than in the university. The university organisation is adapted for men not for women. It is a very unequal institution and in the Higher Schools of Industrial Engineering even more. But I didn’t have more obstacles than any women in this environment. (TW1 Spain)

Obstacles related to the research system and practices which were mentioned were fast pace of technology (Spain), temporary projects and having to look for funding (Austria), lack of financial resources (Serbia), superior’s fear of scientific competition (Russia), having a non-traditional approach to engineering (Germany), the German Hausberufungsverbot system forcing mobility (Germany), competence in only engineering too narrow for some relevant professorships (Germany).

Accounts by many top women from Central Eastern European countries reflected the extensive changes these countries and their research systems have experienced during the transformation from socialism to market economy. Many described their career obstacles referring to the earlier political situation in their countries. A Lithuanian top woman stated that there were no big obstacles, except for lack of knowledge of foreign languages and a lack of contacts with the scientists from Western countries. She thought now the conditions are much better (G_TW2_I). The other Lithuanian top woman described how during Soviet period there were many barriers which had to be crossed: “a complicated bureaucratic mechanism that took in fact from me a number of years” (H_TW1_I). The Slovak top woman working in industry mentioned that not being a member of the Communist party had slowed down her career earlier (B_TW2_K). The Serbian top woman from governmental sector said that although she had no actual obstacles, during one period unpleasant atmosphere and climate prevailed, caused by the political situation in the country. Because of high uncertainty, she was in a dilemma whether or not to leave the country, but could not do so for family reasons (G_TW2_Q). The other Serbian top woman explained that the largest obstacles were the lack of financial resources and “the patriarchal subordinate-superordinate
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hierarchy” (younger colleagues hardly dared to address older ones). The situation is now different, she said, because the young have a variety of opportunities she did not have (H_TW1_Q).

A few reflected also on internal, psychological obstacles or personal characteristics that they saw had been obstacles in their career. Some interviewees chose not to elaborate the obstacles in the interviews but referring to them in general terms, such as the Chilean top woman (H_TW1_Z), who only mentioned that it has “taken quite a lot of effort” to get where she is now.

31.6 WHAT DOES IT TAKE TO GET TO THE TOP

“Hard work” was among the most often mentioned issue when top women were asked what it takes to get to the top in technological and engineering research. It was striking that such inborn characteristics, often linked to excellence, as exceptional talent, brilliance or intelligence as prerequisites were hardly mentioned by the top women, whereas many of them underlined various acquired professional qualities such as thorough professional competence and training, knowing and mastering one’s field, and equivalent. Good managerial and organisational skills were also stressed by many. In fact, it was only a few rank-and-file women researcher interviewees who explicitly stressed talent and intelligence, such as “Francoise” from France: “You have to be brilliant, head and shoulders above the others”. A Finnish top woman, working in a university but with a lot of projects funded by industry argued that in her field one does not need exceptional mathematical, technological or physics skills but rather ability to “translate” between the two worlds of science/research and industry.

In my case it has meant the ability to build research projects that are particularly interesting for the companies and also challenging in the research aspect. It requires the skill to “translate” these business problems into the language of science and research. That way you can get the companies involved in the project, which is a prerequisite for funding. I don’t think you need any exceptional technical, mathematical or physics skills. When you have the basic skills and a degree in whatever field of technology, what is crucial after that is the ability to perceive problems and to shape them to research projects and getting the funding organizations interested. You have to act as an interpreter between practice and theory. That kind of special skill is what is needed. At least in our field. (H_TW2_J)

Ambition, motivation, curiosity, initiative, thirst for knowledge, were considered important. Self-confidence and self-esteem, energy and strength, stamina, perseverance and stubbornness, not giving up were also mentioned frequently. A Swedish top woman reflected that to get to the top, it takes
...strength, that is to say, health. You need to be healthy and strong, and stubborn of course. That has helped me, at least. And that you have a driving force and that you are energetic and ambitious. (H_TW1_W)

A Chilean top woman argued that getting to the top takes perseverance. In her case, her own determination, strong character and refusal to take no for an answer have all helped. She told she always finds a way to do what she wants (H_TW1_Z).

Male gender is more important than intellect to get one to the top, argued the Russian top woman working in the governmental sector (G_TW1_V):

To move to the key positions in engineering research one needs to be a man. The intellect isn’t necessary. Cunning, obsequiousness and helping people who are higher in post are important and necessary.

For a Spanish professor, hard work included also resisting or coping with discriminatory or mobbing behaviour in the research environment:

You have to work constantly and without weakening despite blows below the belt. You need a lot of will-power. Those that succeed do so despite a long list of “a pesar de…” [against the odds]. This part is invisible but it is more important than the visible part. For example is usual that women suffer bullying especially from their male colleagues in the Higher Education of Engineering Schools but nobody talks about it. It’s a great problem. (TW1 Spain)

For a Swedish top woman in the higher education sector women’s minority position in engineering was a challenge when she started her career. She wanted to have the same opportunities than the men, and explained that she likes to compete with men and show off, how she took up a fight against them, as she said (“I know just as much as you do”). She described how she “perhaps became one of them actually and was anxious to get the same opportunities as they. That made me function as them. It was a major competition” (H_TW1_W).

Networks and right connections, role models and mentors were taken up as important as well by many. Participation in national committees had been significant for a few in terms of career advancement. Both Russian top women stressed the role of connections:

There are quite a few women in our field of science who have achieved any positions. The highest post is the head of a big department. To progress in career a woman needs prestige, respect in scientific field, along with the ability to make her own way, energy and influential connections. There should be some support. Basically all careers are built on this. (G_TW1_V)

Men more often make careers with the help of connections; it is difficult for a woman to do so. (H_TW2_V)
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The Austrian top woman explained:

For women, it’s like how much you feel yourself as outsider or how much you feel yourself integrated completely within that group. So if you feel yourself as outsider because you have only male colleagues it is very difficult to go to the top because a top figure should come from the middle and not from the border. If you’re already polarised within the team, you will polarise even more if you go to the top. [...] and of course, you have to do top work. (H_TW1_Y)

The role of luck and serendipity, being in the right place in the right time or not being in the wrong place in the wrong time was also taken up. “Generally, you have to be lucky!” (B_TW2_N). It is also important to recognize and seize opportunities when they come up. A Business sector top woman from Slovakia argued:

When there is someone professional, a specialist in the field and as well as manager and communicative, than the occasion will come. Perhaps you cannot always judge, if this is the right occasion to take advantage of. Anyway I would say that you need 85% of being a good specialist and the rest what you need to proceed to the top are occasions. (B_TW1_K).

When many rank-and-file interviewees thought that to get to the top one needs necessarily to make a lot of sacrifices, the top women did not use this frame, except the Spanish.

31.7. GENDER DYNAMICS IN TECHNOLOGICAL RESEARCH

Half of the top women thought, many without much hesitation, that their career would have been different, had they been men. Less than a third did not think there would have been a difference, and some could not say. Gender was seen as mattering either positively or negatively. However, among those who thought gender had mattered, majority thought that being female had slowed down their career and created more obstacles. Benefits, mentioned by a few, were higher visibility because of strong male domination in the field, daring to take more risks as a woman, less pressures than men to take status tasks, instead of those one really is interested in, or being promoted because of positive action measures.

Both when it came to views on male colleagues’ perceptions and gender talk at work there was a wide variation in the top women’s accounts, on a continuum of gender conflict – gender harmony – gender neutrality. Some of the top women explained that they were seen as a threat by their male colleagues, mentioned envious male colleagues or collegial exclusion, whereas others painted a harmonious picture of collegiality and integration, or argued that if problems occurred they were not gender based or that being a woman does
not affect male colleagues’ opinion on them. A few took up generational shifts, referring to that they had more equal relations with younger male colleagues than to the men of older generations.

A large variation was observed on whether top women talked about gender issues at work. Some top women were not talking about gender issues at work, “not at all”; some felt that university is not a place for discussing gender issues whereas many others did discuss gender topics a lot at work. For a few, promoting gender equality was also a part of their work tasks. Some top women told they were not interested in talking about gender issues at work, whereas some others said they “could not do without”. The contents of gender talk varied also: when some talked about various gender equality issues, others understood gender talk as traditional “women’s talk”, or said that they did not talk about gender issues but family topics, and a quite a few mentioned that they did talk about gender, but mostly by joking.

There are so few women at the top of technological research because the female recruitment base has been and still is so narrow, argued many. The scientific community was not considered to be very welcoming to those women who have entered a research career. A few top women, from Slovak Republic, Russia, Lithuania and Chile, appeared to accept the traditional and current male domination in technology as a natural taken for granted phenomenon. These women also emphasized strongly women’s family responsibilities as more important priorities than a career. This discourse is interesting to contrast with the low birth rates in these countries (except in Chile).

31.8 VIEWS ON WIDER SITUATION OF WOMEN IN TECHNOLOGICAL RESEARCH

Most top women recognized a positive change in the situation of women in technological research: that numbers of women in the field are increasing: more female students, researchers, women higher in the hierarchy, studying and working in engineering and technology have become more acceptable for women. Those perceiving that not much change has occurred were more often from Central Eastern Europe.

Internationally, the situation of women in technological research was considered quite similar everywhere: men dominate the field and women are a minority. Still, some countries were mentioned where women were thought to do better or worse. India, China, US, Nordic countries, Eastern European countries, Southern European countries, France, Italy, Russia and Serbia were mentioned as countries with a better situation than elsewhere. Paradoxically, Nordic countries were mentioned to be more gender equal in technological research by many non-Nordic top women, whereas many Nordic top women
themselves had much more critical views on this. Chilean top woman with a lot of international experiences saw the situation in her own country worse than elsewhere.

Fields of technological research where women stand best chances to make a career were considered to be fields which are less male-dominated, where there are already more women studying and doing research, such as chemistry and bio-engineering. Medical engineering, industrial engineering and management, fields of engineering with an “art fit”, were also mentioned, as well as new, emerging fields more generally. Hardest for women to make a research career were considered to be fields with traditionally heavy male domination, and traditional engineering fields, such as mechanical engineering and electrical engineering, and traditional industrial research. However, some top women completely rejected the idea of comparing engineering fields in this way and did not see one field as harder than the other for women to advance.

At least in this sample, top women were willing to facilitate the careers of women who come after them. Over half of the top women in the sample were or had been personally involved in gender equality promotion or measure in some way or another. However, a few had not been involved in any kind of actions and also considered such actions as unnecessary. They saw career advancement in more individualistic terms. These top women were from Lithuania, Slovak Republic, Russia and Chile.

The top women mentioned a wide spectrum of measures they thought could promote women, starting from various actions targeting schools to make engineering and technology more attractive and accessible, and once women have chosen to study technology and engineering, various measures to encourage and support them. Gender sensitive policies and practices which have to do with recruitment, support in career, work environment and family friendly policies were described. Creating technology programs with a clear societal relevance was thought to attract more female students and researchers.

31.9 FINAL REMARKS

What is common for the top women interviewed in the thirteen PROMETEA countries? They are all exceptional, because they represent a very small minority, having advanced to top positions of different kind as women in an extremely male-dominated disciplinary area. They are in fact in an interesting triple minority position: as women in research in general, as women in the very male-dominated technological field, and as women in top positions in research. These kind of women could, in theory, be fully immersed in their
research work. However, a joint feature was that an overwhelming majority of the top women in our sample was living with a partner, and an overwhel-
ming majority had children, half of the sample having two or even more chil-
dren. Most also reported strong support from their family and partner.

As has been shown, otherwise these top women are far from a uniform
group, when it comes to the field of technology they work in, mobility pat-
terns, reported support in career and career obstacles, and how they
approached and understood gender issues in their career and the scientific
community. Half of the top women saw, without much hesitation, that their
career would have been different, had they been men. Most of them thought
being a woman had slowed down their career, but some also saw they had
benefited from their gender through higher visibility or less career pressures.

Most saw that a positive, even if slow change in the position of women in
technological research is taking place. Those who did not see much change
were more often from Central Eastern Europe. High amount of top women
who were involved in various actions promoting women and gender equality
in technological research was a promising finding. There were also a few who
appeared to accept the traditional male domination as a natural phenomenon,
taken for granted, and approached problems women encounter in research
careers from individualistic perspectives.

Further, more detailed research with larger samples, and including also top
men in technological research, would be needed to explore more thoroughly
the issues discussed here. Such questions as international and intersectoral
mobility, academic and disciplinary endogamy, age and career, and gender
discourses used would be of special interest.

BIBLIOGRAPHY

European Research Area. Science, Technology and Innovation. Luxembourg:
Office for Official Publications of the European Communities.

Statistics and Indicators. Luxembourg: Office for Official Publications of the
European Communities.

Husu, Liisa (2001) Sexism, support and survival in academia. Academic
women and hidden discrimination in Finland. University of Helsinki, Social
psychological studies 6.

Husu, Liisa (2005): Women’s work-related and family-related discrimina-
tion and support. Pp. 161-199 in Marcia Texler Segal and Vasiliki Demos
(eds.): Gender Realities: Local and Global. Advances of Gender Research,


