interuniversitäres forschungszentrum
für technik, arbeit und kultur

IFZ – Electronic Working Papers 1-2007

Career perceptions of women in industrial technology research

Anita Thaler

Planned to be published in:
Anne-Sophie Godfroy-Genin (ed.). Women in Engineering and Technology Research, Proceedings of the PROMETEA international conference, October 26-27 2007. Zürich: Lit Verlag.

Das IFZ ist der Grazer Standort der Fakultät für Interdisziplinäre Forschung und Fortbildung (IFF) der Universität Klagenfurt
ALPEN-ADRIA UNIVERSITÄT KLAGENFURT

forschung verändert

Career perceptions of women in industrial technology research

Anita Thaler

IFZ - Inter-University Research Centre for Technology, Work and Culture
Schloegelgasse 2, 8010 Graz, Austria
E-mail: thaler@ifz.tugraz.at

Medieninhaber und Herausgeber:

IFZ – Interuniversitäres Forschungszentrum für Technik, Arbeit und Kultur
Schlögelgasse 2
8010 Graz
Tel: +43/316/813909-0; Fax: +43/316/810274
E-Mail: office@ifz.tugraz.at; http://www.ifz.tugraz.at

1 Introduction

In the so called Lisbon strategy the European Council decided in 2000 that research investment should increase, with the aim to make Europe, by 2010, the most competitive knowledge-based economy in the world[1]. One of the keys for improvement is the business sector, because the proportion of researchers working in industry is in Europe much lower (50%) than in Japan (nearly 70%) and in the US (80%)[2]. In 2003 the WIR-Report (Women in Industrial Research, EC 2003a) declared the lack of female researchers in the business sector as one of the main problems:

> "The core of European industry is industrial research. It is the heartland of innovation, development and ideas. However, the vibrancy of industrial research in Europe is hampered by the fact that it taps into less than half the talent pool. Women's ideas and women's potential tend to be under- represented (and under-valued). Our vision, therefore, is to create democratic, open and transparent companies where women as well as men can prosper, and their ideas can flourish and be developed and contribute to the innovation process." (p.29).

Industrial research is considered to be still a male dominated area. In Europe, only 18 % of researchers in industrial research are women[3]. The general challenges of European research, regarding lack of attractive research and career prospects[4], could further intensify gender related problems, like the horizontal and vertical segregation of research labour market, with all its consequences for technological developments (see, for example, Wajcman 2000, 2002). The interview data presented in this paper come from the European Commission (EC; 6th framework program) funded project Prometea, which analysed female and male engineers' careers in research in thirteen countries[5], in order to get further insight in those gender-related problems. To contextualize the results of this paper a description of the background of industrial research, its relevance and its gender distribution in the named countries is needed.

---

[1] http://ec.europa.eu/invest-in-research

[2] http://ec.europa.eu/growthandjobs

[3] EU 25 average (EC 2006)

[4] http://ec.europa.eu/invest-in-research

[5] The involved partners and countries are: CDEFI – Conference of the Heads of Engineering Schools (France), Ecole Normale Supérieure de Cachan (France), Institut National des Sciences Appliquées de Lyon (France), Bergische Universität Wuppertal (Germany), University of Klagenfurt (Austria), Technical University of Kosice (Slovakia), University of Edinburgh (United Kingdom), Helsinki Collegium for Advanced Studies (Finland), Centre d'Estudis Dona I Societat (Spain), University of the Aegean (Greece), Linköping University (Sweden), Siauliai University (Lithuania), Mihajlo Pupin Institute (Serbia), Orel State Technical University (Russia), CEM (Women's Studies Centre, Chile), Egalité des Chances dans les Etudes et la Profession d'Ingénieur en Europe (France), Consulting Engineers Hoeborn (Germany), Schlumberger Limited (France).

Table 1: Business enterprise expenditure on R&D 2004[6] (data comes from OECD 2006)

	Austria	Finland	France	Germany	Greece	Russian Federation	Slovakia	Sweden	United Kingdom
Proportion of business research expenditure in % of GERD[7]	66.8	70.1	62.9	70.4	30.1	69.1	49.2	74.1	65.7
Researchers, per 1000 total employment	5.8	17.3	7.7	6.9	3.9	7.1	5.2	11.0	5.5

The relevance of research in the business sector8 can be defined with two indicators: money and persons (see table 1). On the basis of the percentage of the gross domestic expenditure on research and development (GERD) the investment can be compared from country to country. Evaluating this indicator for the countries of my sample, Sweden, Germany, Finland and Russia are investing most, followed by Austria, UK and France. At least business research intensity in terms of money can be found in Slovakia and Greece. Taking also employed researchers into account; Finland and Sweden have the highest level of business enterprise expenditure on R&D, followed by countries with also high levels of expenditure on industrial research, France, Russia, Germany, Austria, and UK. Slovakia has relatively many researchers, considering its lower financial expenditure. And Greece has additional to its low share of gross domestic expenditure on business R&D also a low researchers rate.

The second table shows that the women's share in industrial research is predominantly higher (which means, in this case, a share about one third of all researchers) in those countries where industrial research is of minor importance regarding the above mentioned business enterprise expenditure and/or the persons involved in industrial research.

Table 2: Female and male researchers in business sector (data comes from EC 2006)

	Austria(2002)	Finland (2002)	France (2003)	Germany (2003)	Greece (2003)	Lithuania (2003)	Slovakia (2003)	Sweden (2003)
Female Researchers	2012	4993	21813	20205	1599	187	696	7715
Male Researchers	17383	22120	85588	151014	3012	325	1559	22898
Female proportion (%)	10.4	18.4	20.3	11.8	34.7	36.5	30.9	25.2

Sweden, with one quarter women industrial researchers, together with France and Finland, with about a quarter and nearly one fifth female researchers, compose a group of countries where industrial research plays a key role and the women's share indeed is not satisfying but better then the rear light of this table: Germany and Austria. And the situation in Germany is especially alarming; because it is the largest industrial research job market which creates many

[6] No data for Chile, Lithuania and Serbia included in the OECD Report.

[7] Gross domestic expenditure on R&D (GERD)

[8] "The business enterprise sector includes: All firms, organisations and institutions whose primary activity is the market production of goods or services (other than higher education) for sale to the general public at an economically significant price." (OECD 2002, p.54)

technological developments as well as it profoundly shapes technological research culture in Europe.

Beside that, it is necessary to make a note of the differences in industrial compared to academic research. Company-related technological research and development (R&D) follows other rules and has other logics than academic research. One example is the way of representing research results. Although patents and publications are important in both technological research areas, their appearance is different and their consequences are as well. In academic context publications and patents often appear to be the result of individuals work, although this "myth of individual, independent academic achievement" (Bagilhole & Goode 2001, p.165) can easily be unmasked by looking into the daily practices of academic research groups. However, in industrial research results are often distinguished as a team or company success, with less connotation of the individual's work.

2 Methodology

This paper analyses data from 39 interviews and 16 focus groups which were carried out in 2006 in the context of the initially mentioned project Prometea. These interviews were originally conducted in the eleven different national languages; afterwards the transcripts were summarized, translated into English and entered into a shared database. This web-based database allows the various European (and Chilean) project teams to generate answers from all interviewees to special questions. For this paper a special part of the sample was analysed: technological researchers working in industry9. With 39 female researchers semi-structured interviews (I) were carried out, and 31 females and 32 males took part in overall 16 gender-homogenous focus group (FG) discussions (see table 3). The methodological design of Prometea did not include interviews with male researchers. This could be improved in future research to gain a holistic picture of gender issues in technology research.

Table 3: Numbers of Interviewees in industrial technology research in twelve countries[10]

	Austria	Chile	Finland	France	Germany	Greece	Lithuania	Russia	Serbia	Slovakia	Sweden	UK	∑
Females (I)	2	2	3	9	6	2	1	2	4	2	3	3	39
Females (FG)	5	0	5	5	3	0	0	4	3	0	3	3	31
Males (FG)	4	0	4	5	5	0	0	4	4	0	3	3	32
∑	11	2	12	19	14	2	1	10	11	2	9	9	102

[9] This sample contains rank-and-file researchers whose interview summaries have been entered in the database from persons of the following teams. Austria: Birgit Hofstätter, Anita Thaler, Christine Wächter; Chile: Dámaris Fernández Donoso, Claudia Paz, Sonia Yáñez; Finland: Liisa Husu, Paula Koskinen; France: André Béraud, Anne-Sophie Genin, Cloé Pinault, Yvonne Pourat, Emilie Saunier, Jean Soubrier, Hélène Stevens; Germany: Jennifer Dahmen, Gaby Hoeborn, Felizitas Sagebiel; Greece: Maria Lambrou, Nikitas Nikitakos; Lithuania: Ala Kovieriene, Diana Saparniene, Virginija Sidlauskiene; Russia: Elena Myasina, Vera Uvarova; Serbia: Jovan Dudukovic, Jelena Jovanovic, Sanja Vranes; Slovakia: Oto Hudec, Natasha Urbancikova; Sweden: Helen Peterson, Minna Salminen-Karlson; UK: Wendy Faulkner, Lisa Lee, James Stewart.

[10] Spanish data are not included in the database.

While the 39 interviews with the women researchers bring some detailed insights in their career orientation and revealed experiences from their work lives, the group discussions allows to follow some discourses amongst female and male researchers. To add also the male's view strengthens the validity of the gender-related findings (see, for example, Thaler 2006).

In addition to the interview the informants filled in their relevant biographical data in data sheets. That makes some additional analysis possible, for instance comparing the family status, nationality, research sector and other categories. Therefore we know that the majority of the sample of 39 female interviewees has engineering degrees (86%11), are living in a partnership/marriage (89%12) and have children (81%13). The interviewees are mainly between 30 and 45 years old (19), followed by the age group over 45 years (13) and a smaller subgroup of under 30 years old women (4). Their academic degrees are mostly masters' degrees (17) the others have doctoral (7) and bachelor degrees (5); and 7 women declared themselves as associated professors. The sample represents a broad variety of engineering fields, most prominent information and communication technologies, followed by different subcategories of chemical and bio-technology, various fields of applied technology like safety engineering, as well as the core disciplines electrical and mechanical engineering. Also relevant for this paper are additional information about the career steps of the interviewees, like their positions and personnel and financial responsibilities. But there are limits to this further comparative analysis as not all interviewees completed these data sheets in the same way and the subcategories are too small to generalize found differences (especially for country comparisons). So there are some interesting interpretational approaches possible, which should be analysed in detail in further research.

3 Findings

3.1 Job motivation

Women in industrial research seem to really love what they do; asked about what they like about their job the 39 interviewees mostly referred to the content of their work, appreciating the innovations and creativity, making discoveries and producing items that people like to use and they stressed the fascination of technology:

> "I always have been a fan of cars and the whole topic is fun for me!" (Germany, B_T_WR3_M3)

[11] There are 36 data sheets available in the database. 31 of those 36 women declared an engineering degree, the other six interviewees completed a natural science degree.

[12] 32 of 36

[13] 29 (of 36) indicated to have in sum 59 children, which is an average of 2.0 children per mother.

They highly value the possibility to contribute significant improvements and that their job is meaningful. Interviewees in management positions also mentioned management tasks, team leading and training of younger colleagues. To work with and for people was stated several times; also that travelling brings intercultural insights. But what turned up as especially important are the working conditions, that is on the one hand to have an organizational frame with human resource development and career opportunities, and on the other hand good access to equipment.

One special aspect of job motivating factors was mentioned in many of those 39 interviews with women but also in the 16 group discussions with females and males on the occasion of other questions: freedom. The interviewees talk about general autonomy, the freedom to come and go as you please and the freedom of deciding when to work and which project to do:

> "I like doing research and we have a lot of freedom here to do what we want really as long as we get the – as long as we're aiming towards a goal we can kind of meander around a little bit, it's nice. And if there's something interesting, you can just go off and do that on the side." (UK, B_WR1_02)

In the group discussions, but also sometimes during the interviews, the interviewees broached the issue of differences between academia and industries, emphasizing the freedom which industrial research brings on various levels. One point is the implicit critique towards the system at universities, where research groups are hierarchically led, that means only the group leader decides what research is done and often only he or she gains also the reputation for the work (see also Bagilhole and Goode 2001). In the following quotes two women talk about these different attitudes in companies compared to universities:

> "That I feel that if I want to work with something I can express my wishes without appearing pushing, which is different from the university. If you say that you want to be a professor people think that you are incredibly arrogant. Here it's completely different. My manager says: 'It's important to know what you want. How else could I keep you content in order to make you remain here?' I think it's a much freer attitude. The company encourages you to take your own initiatives, in order to keep the employees in the company." (Sweden, WCC2_W)

> "I have been able to decide for myself what I wanted to do, what kind of methodology I wanted to use and I have used different kinds of methods and cooperated with universities and I have been able to do basic research. But that has been possible because I have organized the funding for this myself, from sources outside the company, especially for the cooperation with the universities. In fact my current job is not very different from what I used to do in the university. In here I have more responsibility but also more freedom in what I do. In the university I had to follow the professor's orders." (Finland, B_WCC2_J2)

A male researcher sums up his perception of differences between academia and industry, and interestingly he has a different opinion about the freedom in industrial research; in the second quote he attributes research at universities as "happy engineering":

> "In industrial research one has fewer problems to get certain equipment if one can justify its necessity economically, whereas at university one has to beg for the equipment. On the other hand at university one can work much more independently than in industry. As mentioned before, there is not such a high time pressure at university. In industry everything has to make sense, has to be economically successful. You have to convince a

> number of people, you have to compete with other projects. One has to meet the needs of customers and to be successful in solving their problems."
>
> "Then there is the challenge of deadlines because we don't do happy engineering here and we cannot take our time like at university." (Austria, B_FGGP_FGM_Y2)

This opposite perception of having more freedom in academic research than in industrial is also emphasized through statements from female academics, here is one example:

> "This is an awfully interesting job. For starters, being a researcher gives you a degree of freedom you don't normally have in other lines of work, including freedom of expression and the freedom to chose your area of interest, what you want to do. I at least see quite a different story in people in the private sector, with lots of frustration over being restricted to doing whatever the boss says." (Chile, H_WR2_Z1)

The ambiguity of the reported degrees of freedom in the different research fields indicates a different perception or definition of freedom. The freedom discourse can be interpreted as an expression of agency, in the sense of having a certain self-influence. The interviewed researchers who talk about the special freedom in their fields, respond less to the actual context but more to their personal agency, meaning "beliefs about their capabilities to exercise control over events that effect their lives" (Bandura 1989, p.1175). Another discussed difference between academia and industry, beside the ambiguously perceived freedom, is the better financial situation in industrial research, which many women refer to, here is one example:

> "The excitement of making discoveries and having actually relatively good funding and good access to equipment, in fact that's luxurious compared to the university. Timescales are tight eh, but what I like most about the job is you can do high quality research and that's very, very nice. It's very easy to get very good equipment and that's of course – I think we are equipment junkies a bit so like that's something that's very nice and I still like that a lot. It's very, one can be proud of … and in terms of the quality of the research that's very nice." (UK, B_WR3_02)

And the following quote from another woman underlines the better financial situation from a different point of view, the better career prospects at companies, meaning more stable and not short-term-contracted employments:

> "It is not worth it somehow, to invest in an academic career. I wanted children and an established position, that kind of security. It is more important. I think that it is very common and that is why there are so few women who pursue an academic career. If I had been offered a permanent job at the university or at least felt that it was a possibility, I think that I would have considered it." (Sweden, B_FGW_W1)

3.2 Career orientation

The 39 interviews with women researchers working in industry represent a variety of research careers and also different sorts of career definitions. But beside all the differences, there are some common tendencies how career is defined and reproduced in the interviews. First, a distinction is drawn between a management career and an expert career. This is a speciality of companies with large R&D departments, they often have explicit career policies calling them figuratively the management career ladder and the technical career (or expert career) ladder. The interviewed

women are aware of those career opportunities and tell quite clearly about career strategies one has to map out and pursue. But secondly, many interviewees also refer to a personal and holistic career approach, emphasizing personal development, satisfaction, work-life-balance and fun.

The management career definition comprises answers about (growing) staff and financial responsibilities, constant hierarchical progress, adequate position and salary, taking part in decisions, reaching the upper management level in an organisation, enhancement and promotion. A French woman states pragmatically: "when your name appears on the company's organization chart". Another woman researcher explains the different career possibilities in technological research, naming also the specialist career:

> "There are options; you can have a career as a home-maker (laughter) or you can be a researcher or become a teacher or do both. You can become an expert or a guru on some small topic or gather a group around you and look beyond that one topic or start to think whether your idea has any business possibilities, there are many options. In this organization you can choose to be a researcher or get to the business unit. Career progression often means bigger budgets and more people working for you but it can also mean becoming a specialist in some area. " (Finland, B_WCC2_J2)

The so called technical career ladder or the expert career is a possibility for researchers to stay in their research work but with growing expert status, which is usually connected to a growing salary as well. A male researcher from a focus group discussion describes it ingenuously:

> "[…] the technical ladder was also established to offer the possibility to promote people who don't want to take responsibility for personnel, to avoid that people who are frustrated with their career take responsibility for personnel, who are maybe not good at that and could be of more use to the company in another way." (Austria, B_FGGP_FGM_Y2)

The female interviewees define this career by getting recognition from colleagues and superiors, to be heard as a specialist by the community, to be taken seriously, to gather concrete achievements, earn respect at work and in the society and move forward – in the sense of knowledge.

> "It's when you become the go-to person." (Chile, WCC1_Z)

Against the background of management and expert career definitions, one can understand the emerged interpretation of career as a compromise, between the position you want to reach and the sacrifices you are ready to make therefore, as a French interviewee points it. Another Finnish woman refers to the picture of sticking in one field, collecting merits and gain power in that field, which also brings out the negative connotation of the word career. And a German woman sees the term career with its implicit goal of reaching the top as purely negative:

> "Career that meant suck up to people, go through the beds, to buckle, to cheat, career had been linked to a negative impression. I doubted to be still myself when reaching the top." (G_GP_NT_WR2_Y3)

But as an alternative draft, many women describe a holistic approach of career; where they emphasize the personal development, the learning effect through different project experiences, developing and doing exciting and new things, new challenges to master and having a satisfying

professional life. Some stressed the importance of one's own feeling of professional development, a contrary approach to the myth of objectivity in the scientific and technological research field. Others add there the importance of doing what corresponds to one's personality, reaching what one wants to reach, gaining self-fulfilment and reaching personal aims. Many statements imply fun and pleasure like "enjoying what I'm doing", "liking one's own work" and "wanting to have fun at work". Several interviewees also include a balance between private and professional life to their personal career definitions. In the following three statements the holistic approach appears very clearly:

> "I want to have fun at work. Career is less related to salary or status and more to my own feeling of professional development." (Sweden, WCC2_W)

> "Working on something that I like, that has an impact and that I can live from decently." (Finland, B_WCC1_J2)

> "Career means living. Career means considering what you want to do with yourself, and not for tomorrow but for many, many years that you will probably live." (Austria, B_FGGP_FGW_Y2)

Some women combine their personal definition with the management career definition, which shows that they are aware of the game and its rules (as Aisenberg and Harrington pointed it out 1988) but prefer another version of the game for themselves:

> "[…] for me personally career is if you can do a job you are interested in. If you get new challenges to master, and if that is somehow connected to managing a team or to having subordinates, yes okay." (Austria, B_GP_WR1_Y2)

This combined career definition, switching between their personal ideal of a satisfying work life and official career criteria seem to represent the everyday process of fitting in the given pathway while pursuing one's own pace. Goffman (1961) discussed this two-sidedness of career:

> "The value of the concept of career is its two-sidedness. One side is linked to internal matters held dearly and closely, such as image of self and felt identity; the other side concerns official positions, jural relations, and style of life, and is part of a publicly accessible institutional complex. The concept of the career, then, allows one to move back and forth between self and its significant society." (p.127)

3.3 Career obstacles

According to the overall fields of engineering/technology and academia career obstacles are also expected to be implied in the special field of industrial technology research, especially because of the few female researchers in the field. As a matter of fact, the interviewed women named several hindering factors in industrial technology research which are also well known from studies about women engineers (Faulkner 2007; Thaler 2005, 2006; Wächter 2007) and/or women academics (Aisenberg and Harrington 1988; Bagilhole and Goode 2001; Husu 2001). They are organisational and structural obstacles like non-transparent promotion criteria, missing or inflexible and too expensive childcare facilities (more about organisational change: Thaler and Wächter 2007). Then they talk about dual career problems, like the necessity of declaring a

leading career which is often the husband's career, hurdles on a social level as bullying superiors and competitive colleagues and subtle exclusions from men's networks. Some women also mention in the interviews individual limits like lack of self-confidence, refusing opportunities and prioritizing their private lives. These "limits" are mostly decisions against management careers or other forms of job paths which seem to be too time consuming and/or combined with the need to expatriate. One French interviewee explains that it was her own choice not going to the top and that she is happy with her decision.

Many women report miscellaneous gender troubles based on different/higher expectations towards women, and also the influence of hegemonic masculinity (Connell 1995):

> "It's really interesting because in the past I was sort of 'Why couldn't I be CEO of [the company]?', and now knowing what I know now, so after 11 years, I know I will never be CEO of [the company]. As a woman, it is completely not possible to have a woman CEO. It will never be a non-European tall male, that's the description." (UK, B_FGW_0)

This statement illustrates the process of disillusioning of women, after some years of observing the mechanisms of careers in organisations; they come to the conclusion that top positions are limited to "hegemonic males". Another woman describes that gender stereotypes and the cognitive concept of "hegemonic masculinity" are also spread by females:

> "But also the women who work here consider men, not women, as future managers." (Sweden, WCC2_W)

This quote underlines the core of stereotypes as "commonly held beliefs" (Six and Eckes 1991, p.58) which means that neither women nor men are excluded from the process of gender stereotyping. Therefore gender stereotyping could be found in the interviews and group discussions with female interviewees as well as in the male focus groups, for instance the following dialogue of Russian men perpetuating traditional gender roles, which illustrates the tension which women working in that organisation probably feel:

> Informant a: "Men do not have family responsibilities and women take sick leaves because of children's illnesses and overall, women can not totally dedicate themselves to career."
>
> Informant b: "It is impossible to work well at two places. It is needed to make a priority: either a family or work." (Russia, B_NT_FGM_V2a)

Then one other Russian focus group participant adds that he gives assignments to his employees on the basis of different abilities of women and men. For example, he thinks it is better to send a man to the plant to interact with men-workers and he believes that a woman would be much better in administrative tasks, especially if it needs attention to details, persistency and more psychological steadiness. And then another male from that discussion group completes with an overall statement, which was obviously intended to be forgiving, but it can be read as benevolent sexist:

> "Overall, it is nice to work with women. Women help releasing tension in the team and also they make us feel and be gentlemen." (Russia, B_NT_FGM_V2a)

Fiske et al. (2002, p.880) elaborate on this kind of benevolent connoted stereotyping:

> "When people rate women in general, traditional homemakers serve as the paternalistic default […]; this generates the 'women are wonderful' effect: positive ratings of generic women […], but primarily on communal (i.e., warm), not agentic (i.e., competent), qualities."

That means that the cognitive role model of a woman is strongly connected to traditional gender roles and as a consequence a misfit according to demands of technological research. The opposition to these paternalistic, envious stereotypes, ascribe competency to non-traditional women but in the same breath deny their warmth and capability of being nice (Fiske et al. 2002). These two sides of stereotyping are related to the two aspects of ambivalent sexism (Glick and Fiske 1997), while paternalistic stereotypes go together with benevolent sexism, envious stereotypes and hostile sexism accompany each other. Both pairs are aiming the same goal, reinforcing traditional and averting non-traditional gender roles.

Having a family is discussed in various and also ambiguous ways. While some female interviewees say that having children (some mentioned also partners) reduces their mobility, meaning as well short time travelling and longer stays abroad, others emphasized that this is a stereotype they had to fight against:

> "After the birth of my child I was no longer regarded as 'full-reliable, full-empowered', I felt like having suddenly some kind of handicap. … On the contrary, I wanted to be mobile, but people thought that she is now a mother. Such a nonsense. My daughter made her first flight when 7 weeks old (to Helsinki in February) and we went hiking in California when she was 8 months old." (Finland, B_WCC1_J2)

This stereotype could also serve as a trigger for a self-fulfilling prophecy like this statement from a German woman shows:

> "Until now not, as long as I have no family I'm flexible." (Germany, B_T_WR3_M3)

This quote is representing a discourse especially among young women who are somehow already expecting problems although not having family yet, for example a lack of flexibility, which is seen as a key factor for success in industrial research. This anticipation of problems connected to children creates a myth, where the cognitive equation "having a family" equals "having career problems" needs no validation and all opposite examples are seen as the exception from this rule. And beside that, it claims implicitly, like in the dialogue from the Russian male focus group discussed before, that women have the main (or only) responsibility in their families; perpetuating again the paternalistic stereotype of women as caring mothers. Under that perspective children would appear as a consistent risk for women's careers, if there were not different examples of women pointing out the positive side of having partners and/or children, telling from the support at home and from personal growth:

> "Sure it took a big amount of time to raise a child, but on the hand he gave a lot to me personally and I myself grew up with him." (Germany, G_GP_NT_WR2_Y3)

And also the fact that the majority of these interviewed women from technological industrial research has children can be seen as a fact opposing the myth. Nevertheless it is no myth that mostly women struggle with balancing family and work lives in nowadays societies, but that is

mostly due to the fact that the structural support and company policies for families are not well developed in all countries. Consequently the issue of combing work and family lives are discussed very differently depending on the geographical region and its societal conditions, often accompanied by a discourse about national or cultural differences regarding family issues:

> "But abroad women have taken another path. They have not given up their family, from for example a French perspective, although they are considered to have done so from a Swedish perspective. I don't think that the women in top positions whom I meet abroad have left their children at day-care centres in the morning and have picked them up after work, or done grocery shopping. I don't think so. It seems to me that this is the big difference. It opens up other possibilities to reach a balance. As a Swede you have a certain attitude towards your children and family that could be quite hindering. That is, of course, a choice but I think that it could be hindering." (Sweden, WCC2_W)

Mobility and intercultural exchange bring researchers, as a side-effect, also insights in cultural differences of gender issues. Comparisons with other countries, naming, for instance, better child care facilities, higher proportion of fathers taking parental leave, and a different image of working mothers, are included in many statements about family issues. The following quote, where a German woman explains her former situation in Germany and her decision to move to Finland, illustrates these discourses about cultural differences:

> "I think the most dangerous point in a women's career is when she has a child. If she has a fixed-term contract chances are good she will get no follow up, especially in the universities. Also the interesting and high profile work is then often delegated to colleagues. Applying with more than one child in a CV may also be a killer while applying (the child could get ill and somehow people assume it is only the women who could take care then of this, at least in Germany). During job interviews I was more or less discreetly asked about family plans (yes, it is forbidden) and about career plans of my husband, i.e. if he takes another job and I will follow like a duck. In my personal career I solved that critical point by leaving my employer. The main reason was something different, but the treatment after the birth gave me the final 'push' to move to Finland and sign the contract with my current employer." (Finland, B_WCC1_J2)

In fact there are some differences regarding gender roles and family issues related to geographical regions. In Southern Europe, Chile and to a certain extent also in Central Europe (predominantly Austria and Germany) a traditional picture of family life predominates, which leads to lacking childcare facilities and restrictions in career possibilities of mothers (and not fathers). In Eastern Europe mothers used to work during communism to a high extent, which led to a well developed public network of childcare facilities (EC 2003b). Although this sounds auspicious, Eastern European women had, like they still have it nowadays, the main responsibility for taking care of their family accompanied by a slow-down-effect on women researchers' careers, as some interviewees stated. And in Northern Europe the higher amount of childcare facilities and the growing implementation of parental leaves (sharing responsibilities of mother and fathers) are going hand in hand with higher fertility rates[14]. But in the Northern countries predominates

[14] The fertility rates in Sweden, UK, Finland and France lie between 1.75 and 1.91 (number of children born to women aged 14 to 49); the average in all OECD countries is 1.61 (OECD 2007). The fertility rates in Spain, the Slovak Republic, Russia, Greece, Lithuania, Germany and Austria are between 1.15 and 1.42 children born per woman (CIA 2007). Only the fertility rate in Serbia, with 1.70 (Montenegro 1.96), is above those low Eastern, Southern and Central European rates. Chile has a fertility rate of 2.20 (CIA 2007), but

also a high level of gender awareness, and so the statements seem sometimes similar critical about gender issues like those of other countries:

> "That is what could be hindering, that I am not that flexible as a male employee with a wife who works part time." (Sweden, WCC2_W)

This quote illustrates the fact that, despite all the positive steps which were undertaken (for instance regarding parental leave), also in the Northern countries, gender equality is still not reached at all levels. On the other hand, especially the discussions of the male researchers in focus groups show the difference as they were also talking about parental leave and the tricky issue of combining family and work life. This father's perspective of reconciliation problems has a particular notion in the field of engineering and technology research. Dodson and Borders (2006) found out that among male engineers traditional masculine ideology prevails together with strong anti-femininity beliefs which leads to disadvantages regarding their male gender role expectations, for instance conflicts in balancing their work with their family (or private) lives.

In the female discussion groups women researchers also discussed their problems in industrial technology research and they reported cultural differences (e.g. more hierarchy in company locations abroad), missing career prospects, lack of information, and the well known phenomena that their competencies are questioned and they are mistaken as the secretary (Thaler 2006, Wächter 2007):

> "If there comes somebody from outside he comes to me first because to him 'I'm the team assistant anyway' and therefore responsible for everything or also, with a colleague, it happened that I answered his phone call and asked if I could help and he said no, he needs a technical answer, he's got a technical question. 'Ok, let's try it anyway.'" (Austria, B_FGGP_FGW_Y2)

Some informants tell about problems with male networks, a special case is the Finnish example of sauna culture:

> "Well it's not nice to be the only woman in the group or in the team, when there's some evening gathering with sauna activity. So you need the own time for sauna and be there alone and the guys are going afterwards. You don't know what they discuss there." (Finland, B_FGW_J2)

One experience of sexual harassment described by a Serbian woman, who after refusing advances from her superior, got problems (as she states it) and as a consequence left the company, illustrates that women, in fact, face other problems than their male colleagues (beside the common challenges of technological industrial research, which they experience both). And women's problems are by far not only related to family issues, although this is a general recognised and accepted discourse.

> "Much of gender discrimination remains hidden and unspoken of because many women who experience it do not expose it publicly for fear of being labelled as difficult or

---

this is not interpreted any further, because there must be considered that this South American country has totally different economic, political and societal conditions, in comparison to the other mentioned European countries.

> troublemakers or because they are afraid of jeopardising their chances of career advancement." (Husu 2001, p.176)

However, the minority status of women in male dominated areas is an often discussed aspect, both in literature and in interviews, because in technological fields and on managerial levels companies are "nearly a single-sex-organization" as Rosabeth Moss Kanter puts it (1977, p.206). Kanter (ibid.) presents three perceptual tendencies which are connected to the "proportional rarity of tokens" (p.210), and each tendency could be revealed in our interviews and focus groups: attention, contrast, assimilation.

The minority status of women in industrial research implicates firstly special attention, which is perceived as ambiguous, because it brings not only positive visibility, but also a negative way of pronouncing mistakes and outside-the-majority-norm-behaviour, this exerts pressure on the women in the company. Secondly the tendency of contrasting the group of majority against the token women serves as strategy to strengthen the dominant group of male researchers and isolates the female researchers. And thirdly the assimilation tendency acts as a stereotyping strategy by overemphasizing similarities of the minority, in this case women researchers in industry. The following quote shows this ambiguity of the minority status very clearly:

> "I think you can almost play it to your advantage, the fact that – well I haven't got – as I said to you before I'm a tomboy anyway and I like sport. I like football and cars, I fit in well with the males. But like I don't know people listening to you because you're the girl in the room and they have to listen to you. People are kind to you because you're female and you can either be offended by that – someone's been bringing me bananas every day since knowing I'm pregnant because I need to be 'healthy'. And I can either be offended by that because why is he doing that …" (UK, B_FGW_0)

And this woman reports about a certain strategy to handle the minority situation by special integration into the dominating group:

> "… all the men are standing with their beers, talking up there somewhere because they're all tall. And like the three girls are there and we all know we need to get in there and need to speak to them, but I felt like a little girl, you know, because I'm small in comparison. You have to think like 'go on, let's do it and go in' and the three of us said to each other 'come on, we need to do this now' and we split up and go in there and it was an effort but you make yourself do it. Otherwise the three of us could have sat there and talked about knitting or whatever but. No, I don't know, it's not natural. Well, I don't know, it's a bit more daunting." (UK, B_FGW_0)

3.4 Excursus: Jokes and humour

Jokes and humour are not very deeply discussed in literature about technological research working environments. One interpretation about the role of humour in engineering is that jokes and funny stories serve as a group-internal communication strategy of engineers, which create a feeling of "we-ness" as Mellström puts it (1985, p.89). Friedman and Friedman (2003) refer to that as bonding humour, describing the "I get it"-effect when group-members share a humour that needs insider's knowledge to get the punch line. Jokes in that sense are mainly used in engineering to laugh about people without technological knowledge that illustrates a shared

experience of pleasure in engineering, which excludes non-engineers (Faulkner 2000). Another frame is to see humour as a coping strategy of women (for instance in academia, see therefore Husu 2001; or in automotive industry, see therefore Thaler 2006) facing and/or reframing discriminative experiences.

In the group discussions with 31 female industrial researchers I found three different specific gender-related purposes of jokes, ironic comments and humour. First, it seems that political correctness and gender mainstreaming processes have left many males with uncertainty what they are allowed to say about gender in general and women in special, so they help themselves with making jokes about gender roles and perpetuating gender stereotypes with an ironic respectively humorous tone. Sometimes also sexist and discriminatory statements are hidden behind those jokes. If women or other men do not laugh about those ironic comments and jokes, they are labelled as having no sense of humour:

> "Actually, taken as a fun-factor, it [gender] is a permanent topic in our office. […] I have no problem with that. My boss once said, 'We did the project even though there was a woman involved.' He meant it as a joke; it eases up the atmosphere a lot. I can laugh about it. And it also is some sort of being nice to each other." (Austria, B_FGGP_FGW_Y2)

This intention of humour can be seen in the tradition of Freud's theory of jokes as an access to the unconscious (Freud 1989), where humour is utilized in order to discuss un-discussable topics, like the perceived "bad match of women and engineering" in the quoted example above.

Second, women serve as triggers for sexist ("dirty") jokes, especially in male dominated areas like technological industries. Kanter (1977) pointed out that males more often discuss sexual connoted stories and jokes when token women are present, whereas men amongst themselves rather talk about company or private issues. Contrary to that in the discourse about "dirty jokes and stories" women are often seen as "civilizing factors" for the male dominated area of engineering (see, for example, Wächter 2007).The next quote from a female interviewee can be seen against the background of this argument:

> "It's a bit embarrassing also to notice that because I'm having my lunch with men, there are usually never any women there in the same group. And I sometimes have kind of a feeling that they were talking about, maybe some dirty jokes but they had changed the subject before I came in. I would not want that, because I tell dirty jokes myself. I would have no problem with that. But maybe they feel that I'm somehow different even though I don't feel so different myself."(Finland, B_FGW_J2)

This woman feels excluded from a bonding humorous talk, although she does not know whether the males really shared some jokes during her absence. But maybe she just overheard a part of a joke or recognized the laughter or the abrupt stopping of laughter of the males when she joined the group, all that would have the same excluding effect, underlining the separation of the hegemonic group from the token woman, and assigning her the role of the "audience for dominant cultural expressions" (Kanter 1977, p.224).

Third and very important jokes and laughter act as coping strategies for women. For instance this humorous way of reframing a difficult situation, where token women are treated as invisible and their achievements are ignored or not valued:

> "Though it has happened a couple of times that I have pointed out something and no-one comments it but just a little later someone else says the exactly same thing and doesn't even realize that I have said it earlier. But I don't really mind, in that way you also get your ideas noticed, just hint to certain direction and someone says it out loud as his/her own idea (laughter)." (Finland, B_WR1_J2)

But not only do women laugh about difficult situations and jokes at their expense in order to prove their sense of humour. Women are also making gender-related jokes themselves, sometimes anticipating jokes from others (about women), sometimes about men or reacting to other jokes. This sometimes leads to ping-pong-situations, where alternating ironic comments and jokes are made and the common laughing can create a group-feeling beside all gender borders. For instance this example for an answer to jokes with a sexist undertone:

> "Five € for the male chauvinist cash box." (Germany, B_FGW2_M2)

Through actively participating in the joking, women get agency and power, they can influence the situation by themselves and do not have to only re-act but also act and play along. But it is crucial to emphasize that a culture including jokes, which intend to subordinate women, has to be rejected by the management of organisations, especially if they are so called male dominated. As innocent the term "dirty jokes" sounds, as offensive their content can be, there is only a thin line between those jokes and sexual harassment (Collinson 2002).

4 Conclusion and perspectives

To summarize, women in industrial research are highly motivated by their work content, mostly appreciating its innovations and creativity, and that their technological contributions produce significant and meaningful improvements for people's lives. The stated high degree of freedom in industrial research was on the one hand discussed as a boundary towards academia and can be seen on the other hand, because of its ambiguity, as an indicator for personal agency of the interviewees.

The discourse about the women researchers' career definitions reflects the existing paths of management and expert careers in industrial research but also creates a picture of a holistic career, in which pleasure with the work content, personal growth and a satisfying private life can go along together. The various personal career definitions emphasizing something beyond management and expertise also showed that the two-ladder model in industrial research is probably not sufficient to motivate and hold people in the company in the long term. Also many of those women who are already on a higher level on the management or expert career ladder confirmed the importance of a different connoted career in the interviews. However, human resources managers in industries have to deal with the fact that not every technological researcher either can or wants to become a top manager, nor reach the goal of an expert career. A satisfying balance of work and private lives is just one of the other main interests of many R&D employees, which should be considered in additional career models (see, for example, Igbaria et al. 1999).

The question about career obstacles resulted in various answers and discussions, reaching from more overtly articulated organisational and structural problems in industrial research, via dual career issues, to more hidden problems, based on gender stereotypes and (ambivalent) sexism. One prominent example of an overt discourse is the reconciliation of family life and research work, which can be analysed from micro-, meso- and macro-level. First on a macro-level, the historical development of parenthood and gender roles, legal framework, for instance regarding parental leave, and the societal discourse about gender equality in the concerning countries varies a lot. The different legal situation of homosexual partnerships can be mentioned as an example, or the acceptance of various types of families beside the traditional picture of a married heterosexual couple with their two children. Secondly, on a meso-level, organisational rules and practices, additionally depending on the field, are influencing the reconciliation (or non-compatibility) of family (in all its different shapes) and research careers. For example a culture of long working hours, evening meetings and weekend travels could impede a well-balanced family- and working life. Third on a micro-level, inter- and intrapersonal factors do also have various effects, like the anticipated myth of children as women's career killers, which act in two ways. It negatively connotes the desire of women to have children, misleadingly putting the core of the problem to the children. And it also distracts young women from various obstacles which hinder women's careers in technological research whether they have children or not.

Finally, the emerged ambiguity of humour in technology represents the various ambivalent messages women receive in industrial technology research. On the one hand, a red carpet is rolled out to get more women into technology and industrial research, but on the other hand nobody has removed the pitfalls and stumbling blocks hidden under that carpet so far.

Bibliography

Aisenberg, Nadya and Harrington, Mona, *Women of Academe. Outsiders in the Sacred Grove*, 1988 (The University of Massachusetts Press).

Bagilhole, Barbara and Goode, Jackie, "The contradiction of the Myth of Individual Merit, and the Reality of a Patriarchal Support System in Academic Careers: A Feminist Investigation", in *European Journal of Women's Studies*, Vol. 8 (2), 2001, 161–180.

Bandura, Albert, "Human Agency in Social Cognitive Theory", in *American Psychologist*, Vol. 44 (9), Sept. 1989, 1175–1184.

CIA, *The World Factbook 2007*, 2007, available at https://www.cia.gov/library/publications/the-world-factbook/ [28. 9. 2007].

Collinson, David L, "Managing humour", in *Journal of Management Studies*, Vol. 39 (3), May 2002, 269–288.

Connell, Robert W., *Masculinities*, 1995 (Polity Press: Cambridge).

Dodson, A. Thomas and Borders, L. DiAnne, "Men in Traditional and Nontraditional Careers: Gender Role Attitudes, Gender Role Conflict, and Job Satisfaction" in *The Career Development Quarterly*, Vol. 54, June 2006, 283–296.

European Commission (EC), *She figures 2006, Women and Science, Statistics and Indicators*, 2006, available at http://ec.europa.eu/research/science-society/pdf/she_figures_2006_en.pdf [18. 9. 2007].

European Commission (EC), *Women in industrial research: a wake up call*, 2003a, available at http://ec.europa.eu/research/science-society/women/wir/pdf/wir_final.pdf [18. 9. 2007].

European Commission (EC), *Waste of talents: turning private struggles into a public issue. Women and Science in the Enwise countries,* 2003b, available at http://ec.europa.eu/research/science-society/women/enwise/pdf/enwise-report_3.pdf [18. 9. 2007].

Faulkner, Wendy, "The Power and the Pleasure? A Research Agenda for 'Making Gender Stick' to Engineers", in *Science, Technology & Human Values*, Vol. 25 (1), 2000, 87–119.

Faulkner, Wendy, "Nuts and Bolts and People. Gender-Troubled Engineering Identities", in *Social Studies of Science*, 37/3, June 2007, 331–356.

Fiske, Susan T., Cuddy, Amy J.C., Glick, Peter and Xu, Jun, "A Model of (often mixed) Stereotype Content: Competence and Warmth Respectively Follow From Perceived Status and Competition", in *Journal of Personality and Social Psychology*, Vol. 82 (6), 2002, 878–902.

Freud, Sigmund, *Der Witz und seine Beziehung zum Unbewussten / Der Humor*, 1989 (first edition 1905; Fischer: Frankfurt/Main).

Friedman, Linda Weiser and Friedman, Hershey H., "A framework for the study of computer-oriented humor", 2003, in CIS working paper series, available at http://cisnet.baruch.cuny.edu/papers/cis200301.pdf [18. 9. 2007]

Glick, Peter and Fiske, Susan T. "Hostile and benevolent sexism: Measuring ambivalent sexist attitudes toward women", in *Psychology of Women Quarterly, Special Issue: Measuring attitudes toward appropriate roles for men and women*, Vol. 21, 1997, 119–135.

Goffman, Erving, *Asylums*, 1961 (Doubleday & Company Inc.: New York).

Husu, Liisa, Sexism, *Support and Survival in Academia. Academic Women and Hidden Discrimination in Finland*, 2001 (Department of Social Psychology: University of Helsinki).

Igbaria, Magid, Kassicieh, Suleiman and Silver, Milton, "Career orientations and career success among research, and development and engineering professionals", in *Journal of Engineering and Technology Management*, Vol. 16, 1999, 29–54.

Kanter, Rosabeth Moss, *Men and Women of the Corporation*, 1977 (Basic Books: New York).

Mellström, Ulf, *Engineering Lives. Technology, Time and Space in a Male-Centred World*, 1995 (Linköping University: Linköping).

OECD, *OECD Factbook 2007 – Economic, Environmental and Social Statistics*, 2007, available at http://masetto.sourceoecd.org/ [18. 9. 2007].

OECD, *OECD in Figures*, 2006, available at http://www.sourceoecd.org [18. 9. 2007].

OECD, *Frascati Manual*, 2002, available at http://www.oecd.org/document/6/0,3343,en_2649_34451_33828550_1_1_1_1,00.html [18. 9. 2007].

Six, Bernd and Eckes, Thomas, "A Closer Look at the Complex Structure of Gender Stereotypes", in *Sex Roles*, Vol. 24 (1/2), 1991, 57–71.

Thaler, Anita, "To succeed or not succeed, that is the woman engineer's question.", 2005, in Anita Thaler and Christine Wächter (eds.), *Conference Proceedings of the International Conference "Creating Cultures of Success for Women Engineers"*, 6. – 8. 10. 2005, Leibnitz/Graz, 93–115, (IFZ Eigenverlag: Graz, ISBN 3-9500472-4-7).

Thaler, Anita, *Berufsziel Technikerin?* 2006 (Profil: Munich, Vienna).

Thaler, Anita and Wächter, Christine, *Engineer your Future – Toolbox,* 2007, available at http://www.ifz.tugraz.at/index.php/article/articleview/1090/1/83/ [28. 9. 2007].

Wächter, Christine, "Blocks and Hurdles, Chutes and Slides: Women Engineers in the Automotive Industry.", 2007, Paper submitted to *The Fifth European Conference on Gender Equality in Higher Education*, 28. – 31. 8. 2007, Berlin.

Wajcman, Judy, "Reflections on Gender and Technology Studies: In What State is the Art?", in *Social Studies of Science*, Vol. 30 (3), June 2000, 447–464.

Wajcman, Judy, "Adressing Technological Change: The challenge to Social Theory", in *Social Current Sociology*, Vol. 50 (3), May 2002, 347–363.