



Promoting Young Women in SET: Lessons learned. A Cross-National Analysis

of Past Research Projects



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IFAC PROJECT Information for a Choice: Empowering Young Women through Learning for Technical Professions and Science Career

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EUROPEAN CO-OPERATION BETWEEN:



EKEPIS-National Accreditation Centre for Continuing Vocational Training (Coordinator, GR)



EVREMATHIA AE, Educational Services (initial partner) (GR)



E 2000 Consulting Association (partner replacing) (GR)



SEE, Hellenic Association of University Women (GR)



WU- Wirtschaftsuniversität Wien (Vienna University of Economics and Business Administration) (AT)



ZSI - Zentrum fÜr Soziale Innovation, (Centre for Social Innovation) (AT)



IMC - Information Multimedia Communication AG (DE)



NPC - Noorderpoort College Groningen (NL)



KTH - Kungliga Tekniska Högskolan (Royal Institute of Technology) (SE)



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Part 1:

Introduction and Methodology

1. Introduction

For decades the low participation of women in the field of science, engineering and technology (SET) has been an issue for research projects in various countries throughout the European Union and even though numerous initiatives have been implemented to change the under-representation of females, the situation has not improved much since.

Data on the situation of women in SET shows an image of exclusion and segregation. Verified by raw facts and figures, it is a European reality that women and men are not equally represented in academic fields or in professions related to SET. Throughout the member states women are still less likely than men to opt for studies in science, mathematics and computing, and it is engineering, manufacturing and construction where we find the greatest differentiation of choice¹. Difficulties for women continue when they enter professions in the field by meeting intrinsic obstacles to their career enhancement, and even more so when progressing to the upper echelons of management positions. Also, a gender wage gap still exists².

A study of the European Association for Women in Science, Engineering and Technology (WITEC) points out one factor considerably influencing women's educational and professional career choices; stereotypes, already present at an early age and decisive in each decision-making process later on, thus consecutively affect the occupational choices of girls and boys differently (Tackling Stereotypes 2006: 11-32).

This interconnection is taken as a starting point for the research conducted by IFAC. This project seeks to address the issue of choice unfettered by stereotypes about male and female gender roles. Hence our strategic goal is to increase options for young females in high school by informing them on possible studies in SET, unrestricted by stereotypes on gendered occupations. Therefore the core question of IFAC has to be: What prevents young women from seeking a degree in Science, Engineering and Technology? Thus IFAC mainly focuses on two significant reasons for lower female enrolment rates in SET:

- (1) There are pre-existing societal gender stereotypes reflected within the educational system that prevent young women from studies in SET.
- (2) There is a lack of accurate information on career options provided by sources like media, school etc. on the field of SET, which negatively influences possibilities of choice.

¹The Women and Science Report of the European Commission, Directorate-General for Research Information and Communication Unit "She Figures 2006" gives in-depth insight into statistics and indicators on the current situation. Online available at: http://www.embo.org/gender/she_figures_ 2006_en.pdf

² For a general overview on the situation of Women and SET see the report conducted in 2006 by WiTEC (Tackling Stereotypes 2006).

Participation of women in SET is an issue of equality, of tackling long embedded gender stereotypes that dominate the field. Gaining a deeper understanding of reasons for the prevailing gender gap in SET will help to propose efficient tools to augment the number of young women in SET and furthermore dismantle the professional and academic environment hostile towards females to date. In pushing this political agenda, the aim of our research is to compile all the available knowledge in the partner countries Austria, Greece, the Netherlands and Sweden today. First and foremost this report intends to facilitate transfers of knowledge from outcomes of already implemented past projects and surveys to key agents in the field. Another endeavour in this effort was made by initiating a database on IFAC's website, featuring interviews with females successful in SET professions that will serve as role models for young women³.

In short IFAC seeks to:

- Identify and analyse the reasons behind low female participation in Scientific and Technological Careers
- Sensitise public and private organisations and research bodies towards female participation
- Encourage young women to participate in SET through the promotion of role models

This publication consists the final report, which provides the outcome of a compara-

tive survey undertaken within Work Package 2 of the IFAC project. All partner countries, namely Austria, Greece, the Netherlands and Sweden, have conducted it in order to examine the reasons behind low female participation in SET by utilising the outcome of past research-oriented projects, yielding valuable results. The material was gathered in two stages, first on a national level and second on the European level. The survey itself is entirely secondary and seeks to draw results and conclusions by putting together all the insights gained so far by other organisations and projects.

In contrast to other similar research conducted in the past (for example Womeng⁴ for engineering), the survey of IFAC has a wider scale. The focus is on SET and certain areas of SET that have been identified as focal points, however, not one 'profession' stands out in the survey.

Due to different 'professions', and the variety that exists from country to country not only in terms of definition but also in terms of demand, the tools developed for the research were applicable to the different participating countries. Additionally we should point out that comparisons are going to be made on the data collected by partners, which nonetheless function as support to the main body of work. In the end the survey is an amalgamation of previous works and research conducted in the past on a national and European level, made accessible in English.

³ The role model interviews are available online: http://www.set-careers.eu

⁴ Womeng - Creating Cultures of Success for Women Engineers, a research project within the 5th European Framework. See http://www.womeng.net

IFAC: Information for a Choice: Empowering Young Women through Learning for Technical Professions and Science Careers is a European project financed by the European Commission within the 6th Framework Programme under the specific programme "Science and Society, Women and Science". The Co-ordinated Action represents a cross-European partnership including organisations of various types in five different countries. These are:

- EKEPIS. National Accreditation Centre for Continuing Vocational Training (coordinator), Greece
- EVREMATHIA AE (initial partner), replaced by E-2000, Greece
- Hellenic Association of University
 Women (SEE), Greece
- Centre for Social Innovation (ZSI), Austria
- University of Economics and Business Administration Vienna (WUW), Austria
- Norderpoort College (NPC), Netherlands
- Högskolan i Halmstad (HALM), Sweden
- Kungliga Tekniska Högskolan (KTH), Sweden
- Information Multimedia Communication AG (IMC), Germany

Overview of the Contents

After giving a short introduction to theoretical concepts of the relation between

women, gender and technology, Part one of the publication introduces the main research methods as well as a common set. of definitions for the cross-national report. Moreover, methodological difficulties met during the process are not blinded out. Following that, the report presents findings on female participation rates in Sweden. Austria, Greece and the Netherlands and gives details on the national educational systems and policies on women and SET. The core question of the IFAC project is also discussed in Part two: What are young women's reasons for not choosing studies in SET? IFAC debates findings on pervasive gender stereotypes and on the lack of accurate information. Other reasons not covered by the two first parts are exemplified additionally. Eventually, Part three proposes promoting factors for reducing the gender bias in SET. The respective proposals are drawn from lessons learnt during vears of research and political action on this matter. The here selected and compiled findings from past research projects and good practices cover four European countries. For the first time they are all made accessible in English, thus helping to spread already gained knowledge. Ultimately, this report sees itself as a pro-active source of information for overcoming intrinsic impediments on gender-equal possibilities in SET.

2. A Lack of Women in Technology? – An Overview of Current Research

Given the stagnating or even declining numbers of women in Science, Engineering and Technology, it is not surprising that much of the research to date has been driven by the desire to increase access for women to these fields of study, whether in schools or in higher education (Hornung-Prähauser et al. 2004; Womeng 2005; Tackling Stereotypes 2006). However, research on this issue tends to depart from varying basic assumptions. Hence, research that promotes the access of women to technical fields should avoid working with a very limited understanding of technology, equality and gender and thereby limiting it. These would be understandings that incorporate a determinist model of technology and a deficit model of women and girls. In such accounts, technology is understood as rather unproblematic, as neutral, as solely comprising a set of skills to be acquired. Yet technology is never a neutral 'given', let alone women and girls in deficit or in need of catching up. Beyond these oversimplified accounts, a social-constructionist perspective (Henwood et al. 2000; Faulkner/Lie 2007) focuses on gender and technology as a relation and therefore favours addressing gender differences and technology headon.

So, what constitutes the relation between technology and gender then? An answer to this question is highly dependent on the theoretical standpoint of the debater. In her essay "The Technology Question in Feminism", Wendy Faulkner distinguishes between three differing approaches of feminist research towards concepts of technology: first, the ones departing from (1) "women and technology" that stand in a liberal feminist tradition and ask why there are so few women in the field. As already noted above, these efforts tend to blind out the gendered aspects of technology, as they largely assume that it is per se neutral. Concepts of (2) "women in technology" focus on specific technologies or technological areas encountered by women in the workplace or in the course of reproduction, whereas the ones discussing (3) "gender and technology" take the view of gender and technology as being socially shaped, thus being potentially reshape able (Faulkner 2001: 83f).

In support of the latter approach, a basic theoretical understanding of the IFAC project is that we need to study **gender as well as technology as dynamic and rapidly changing notions and practices** (Faulkner 2000, 2001; Wajcman 2000). In this regard, gender and technologies are co-produced, and thus both may change during the process. Alongside being concerned with getting more women into technology, it is equally important to explore reasons why they are so often excluded or why technology has come to be perceived as masculine.

Now, the IFAC project assumes that it is foremost gender stereotypes and a lack of information that prevents women from embarking in SET. But how exactly do social constructionist perspectives deal with 'information' and 'stereotypes', which are the specific focus of this report? First, it should be noted that 'information' is not a neutral term, even if there is a 'lack' of information in the sense of an absence. We refer to 'lack of information' as lacking accurate information. One of our basic assumptions is that messages on studies and occupations in SET are deeply pervaded by the ruling gender bias, meaning that messages on SET studies are communicated and received differently by both genders. Even the process of not receiving information is gender biased, as we will see in chapter 5. Second, a lack of accurate information (meaning information exempt from gender bias) and the existence of gender stereotypes are closely inter-related, as gender stereotypes are both a source and a consequence of biased information and vice versa. Through this perpetual circle, a binary view on technology and technical skills is prolonged that spreads the message that men are good with technology whereas women are technically incompetent (McNeil 1987). The gendertechnology relation is thus constructed according to biologistic assumptions and in oversimplified, oppositional terms; moreover the acquisition of respective technical knowledge is a threat to male gender identities, as the 'mastery of nature' still remains a 'powerful emblem' of science and technology, both within engineering and in the wider culture (Faulkner 2001: 84). Hence gender-technology relations are also manifest in gender symbols and identities. It is therefore advisable to explore the links between hegemonic masculinity, between structures, symbols, forms of representation and identity in the gendertechnology relation (ibid.).

Recent developments in the debate on 'gender and technology' (Faulkner/Lie 2007) draw on theories concerned with complex and interlinked societal relations. Critically, these see shortcomings in feminist social constructionists' preferential focus on the category gender by stressing that gender cuts across other dynamics in the technological divide: age, income, and vocation with other factors like education. whiteness, or single parent families intervening. With an emphasis on intersecting approaches to the process of marginalisation, it is stated that there is not one single group of women equally excluded from technology, but there are diverse groups of females, some of them being more privileged than others (because of their whiteness, educational background etc.). To ensure access to the shaping of technoloqv, various but intertwined aspects of societal marginalisation need to be consolidated. These recent accounts widen the perspective and encourage the revision of the initially posed question by rephrasing it: So, how do we diversify technology?

3. Methodology

The secondary analysis of reasons for low female participation rates in SET based on national data on the one hand and on European facts and figures on the other called for a cross-national approach. As defined by Linda Hantrais and Steen Mangen (Hantrais/Mangen 1996: 1), a crossnational approach studies particular issues across various national contexts. Within IFAC, these issues are:

- The gendered influence of pre-existing societal and individual stereotypes and
- The lack of or blased information on SET-related fields of study and career trajectories.

To discuss these two assumptions, relevant data had to be collected. This was done by: **first**, compiling information on the situation of Women in SET in Sweden, Austria, Greece and the Netherlands in order to disclose the national contexts; **second**, by gathering information on findings of past national research projects and EU projects; and **third**, by assembling recommendations given by the collected projects.

Thus, processed information on national contexts and past research projects and good practices covers Union-wide and national levels. For the data gathering, both quantitative and qualitative approaches were adopted within the limits of cross-national comparison. From a methodological point of departure, cross-national research methods allow fruitful insight as they open up a wider context in the research process. However, as the Womeng report pronouncedly puts it: 'Never forget you are comparing grapefruits with tangerines' (Womeng 2005: 18). Crossnational approaches face specific difficulties because they come across linguistic boundaries and different scientific cultures, they have to question the equivalence of concepts and terms, and they face difficulties regarding the consistency of data because there are interferences due to differing contexts of application. All these factors aggravate the actual comparability of findings.

3.1 For Data Gathering

To enable meaningful outcomes of an analysis comprising material from changing geographical and scientific contexts, a common framework for the data gathering had to be agreed upon in order to provide joint definitions of central categories. A second emphasis was put on the accessibility of the information in question. And third, the scientific standards for quality had to be met. The IFAC project therefore agreed upon mainly collecting research projects with a scientific approach, additionally ensuring that all needed information was available and the respective findings were legitimate. The following will describe the main steps in the gathering of data.

3.1.1 Gathering Data for the National Context

In general, there is no common definition on specific categories that have to be included in the field 'Science, Engineering and Technology'. The label 'SET' is often used in official statistics, but 'the precise definition of these terms varies from country to country' (EC 2004: 4). To enable a meaningful analysis within IFAC, all partners agreed to use the EUROSTAT definition of fields of SET related education. Furthermore, the IFAC definition of SET follows the recommendation of the ETAN 2000 report, which suggests to exclude the field of 'medicine' because the Life Sciences are seen as highly feminised professions that very likely bias the specific data on

women's representation in SET (EC 2000). Where national statistical data had disclosed other fields with high feminisation rates, this information was incorporated into the data gathering. The following table summarises fields of SET used by the IFAC project:

The definition of SET for the IFAC project includes the following fields of sciences:

- Physical sciences
- Mathematics and statistics
- Computing
- Engineering and engineering trades
- Manufacturing and processing
- Architecture and building

In detail, the common European database EUROSTAT lists two major fields of study: first, 'Sclence, Mathematics and Computing' with Physical Sciences, Mathematics and Statistics, and Computing, and second, 'Engineering, Manufacturing and Construction' with Engineering and Engineering Trades, Manufacturing and Processing, and Architecture and Building.

International Standard Classification of Education (ISCED 97)

As the educational systems vary from country to country, it is difficult to compare⁵ them. Hence, the International Standard Classification of Education, the ISCED 1997 (UNESCO 2006), allows the systematic crossnational framing of data according to a widely recognised international scale. In detail, ISCED 97 distinguishes between 6 levels of education, whereas IFAC concentrated on ISCED level 3 to ISCED level 6. These are: (upper) secondary education (ISCED level 3-4), the first stage of tertiary education (ISCED level 5-6) as well as the second stage of tertiary education (ISCED level 6). These stages are the most relevant to the IFAC target group.

Additionally, our findings were complemented with specific information on the national context, as the gained information on national educational systems needs to be placed into a context to illuminate specifications in possible pathways to SET. To be more specific, the IFAC project compiled the following information for a better understanding of the national contexts, specified in chapter 4 of this report:

- Female participation rates in SET for each country
- Educational pathways to become a scientist or engineer within SET, including information on obstacles for prospective students
- Prestige of occupations in SET
- Takes on the low female participation in SET by governmental policies

In addition to the above outlined process of data collection, the status and prestige of SET careers in the respective countries were estimated by depicting the public discourse⁶. Finally, IFAC collected recent national public policies on 'Women in SET' that describe the public awareness of low female participation rates. The gathered information allows for a better understanding of the contextual differences. Moreover, IFAC gained consolidated findings by opening up a broader context. Although national governmental entities might be fundamental in developing policies for more gender equality in Science, Engineering and Technology, the impact of EU-wide strategies should not be neglected.

⁵ See http://www.bildungssystem.at/article/articleview/278/1/66/?swlang=en

⁶ For example, Womeng states that the prestige of SET careers is quite low in Slovakia, at the same time the female participation rate in SET is one of the highest in Europe (Womeng 2005). So we should consider this national specific background in our analysis.

It was the Lisbon Agenda⁷ that set inclusive social policies on a Union-wide agenda by increasing the human resources in science and technology as one key objective. The EU plans to achieve this goal by expanding and using the existing pool of highly trained women by 2010. Consequently, this Unionwide agenda needs to gain momentum on national and regional levels through implementation of policies that have the advancement of women in SET as their main target. Nevertheless, not all policy concepts travel along the same route. Cross-national research has to be sensitive towards the varying underlying contextual differences that shape Union-wide policy goals respectively. Having a clearer picture of the differing educational programmes and career possibilities in SET in Austria, Sweden, Greece, and the Netherlands is of utmost importance because gaining a deeper knowledge on the status quo will be beneficial for future policy making. All in all, findings on the national contexts build the empirical foundation of this report, moreover they support the analysis of past research projects and have an impact on further recommendations.

3.1.2 Collecting Past Researchoriented Projects

For the core question of this report, findings from past research projects explaining the low female participation in SET had to be gathered. One main criterion was that past research had been conducted in the IFAC partner countries Austria, Greece, the Netherlands and Sweden and that it had discussed causes for low female participation rates in SET education and professions. Eventually, the findings from these national projects were complemented with additionally gathered results of four EU research projects. To confine the material and to maintain scientific standards of quality, IFAC chose to collect findings from recently conducted research projects that had been completed and were the subject of a scientific report. Furthermore the main aim of the conducted past research was of utmost relevance to IFAC. To be more precise, it should explicitly or implicitly seek to identify reasons for low female participation in SET. Yet, past research should deal with the influence of stereotypes on choice options and explain how the lack of accurate information on SET is to the disadvantage of girls and women. Furthermore, past research should give recommendations for curbing the prevailing gender bias in SET. Noteworthy, a special emphasis should be on IFAC's target group: women, 16-18 years old. To facilitate comparability, a template was developed for compiling the necessary information for each project. Amongst others, the following indicators were requested: information on the funding, the source of information on the project including overall aims and objectives, the design of the conducted research or study, as well as information on the addressed fields of SET and on the geographical scope.

One factor becoming a challenge for this cross-national analysis was the variation of languages. As most of the findings from national projects were only available in the respective national language, partners had

⁷ The Lisbon Agenda was developed in 2000 and is a Union-wide action and development plan. Its aim is to make the EU the most "dynamic and knowledge-based community in the world capable of sustainable economic growth with more and better jobs and greater social cohesion, and respect for the environment by 2010." One sub-ordinate target is combating social exclusion by enhancing the female share in knowledge-based sectors like SET. See the official EU-summary on the Lisbon Strategy online: http://europa.eu/scadplus/glossary/lisbon_strategy_en.htm

to translate the outcomes into English to make them available for the analysis. This procedure was conducted in two phases. First, the partners translated their national findings into English. Second, this translation was taken up for the analysis in English conducted by one partner. However, this procedure was likely to cause potential lacks of information itself, since not all information demanded was either transmitted or received. Therefore several feedback loops had to be initiated.

Eventually, the collection of projects focused on 'best practices', meaning that IFAC sought information on past research that was identified as exemplary⁸. IFAC chose a twofold approach on 'good practices': first, in focusing on how these examined gender stereotypes and the lack of accurate information in SET, and second, in focusing on the way the respective findings had been adapted, applied and disseminated. The projects should have been evaluated, but this criterion appeared to be too idealistic, since none of the collected projects was publicly evaluated.

3.2 For the Analysis

All templates filled in by the partners were used for the secondary analysis of the material. The overall objective for the cross-national analysis by IFAC is to give an overview of the status quo in each partner country and furthermore to explore simi-

larities and differences regarding the collected material. For the report this is done on three levels. First, for SET education and career prospects, regarding the national background, where we focused on female participation rates in SET, the educational pathways pupils needs to go to become a scientist or engineer, and moreover on the prestige of SET. Finally we discuss how the low female participation rates are tackled by governments. For this level the analysis is mainly based on statistical data and information on national contexts. Second, the core chapter of this report deals with identified reasons for low female participation in exploring gender stereotypes and how they explain low participation of young women in SET. Moreover, several types regarding lack of information were identified and given explanations for low participation rates classified. Yet another focus lies on other reasons detected in past research projects and good practices. Third, promoting factors to reduce the gender bias in SET were subjected to IFAC's analysis, focusing on possible ways of curbing the prevailing gender stereotypes. In what ways can the lack of information be reduced? Where are obstacles? Who are agents of change? What implementations seem to work? These were the leading questions for the analysis presented in chapter six. All in all, the here illustrated methodology

will eventually ensure a valuable basis for consolidated findings.

[®] The term 'best practice' is widely used and according to the BEEP projects' glossary defined as: 'the best examples of practices, e.g. which methods, tools, organisation, systems, technology, etc., were used to achieve the excellent performance seen. Such examples should also imply ease of transfer to other situations where users have similar objectives and should facilitate learning by them. Since 'best' is highly subjective and context dependent, as well as implying that no further improvements are possible, the preferred term now is good practice.' In line of this argumentation the selection of projects should be preferably oriented along the definition of 'good practice': 'Good practices – the use of a method, tool, technology etc. which is generally regarded as 'practices which are good for learning', i.e. practices which either achieve their own objectives and/or have a beneficial impact on their environment, or (and more important) provide useful learning experiences which are likely to stimulate creativity, ingenuity and self reflexivity on the part of the user. [...] Beep now prefers this term to best practices, since best practice implies that there is no scope for improvement and may limit ambition' (Beep Glossary 2005).



Part 2:

National Context and Key Findings

4. Young Women Participating in SET -The National Backgrounds in Comparison

n what follows, we primarily intend to provide an insight into national frameworks of Greece, Sweden, Austria and the Netherlands regarding education, occupational patterns and policy-making, all with respect to developments in Science, Engineering and Technology. Thus selected social dynamics in the respective countries are the focus. The following passages will stress the features and patterns that are specific to each country and point out common denominators. As the synthesis will revert to figures presented by EUROSTAT or schematic classification systems on education as ISCED, internal diversity is voluntarily factored out for the sake of an overall picture. Additionally, this synthesis involves screening the domain of our research through a specific lens: For analysing the situation of women in SET in the respective countries today, it is not enough to dissect raw facts and figures: the context has to be taken into account as well.

As noted before, IFAC took the international ISCED 97 classification as a common framework of reference, supplemented with EUROSTAT data on participation rates in SET. However, during the process it became clear that figures for the agreed period were inchoate in some cases. Therefore, selected facts and figures were contrasted with data from the national statistic agencies like Statistik Austria⁹ or Statistiska Centralbyran¹⁰ (Sweden), which clarify that data sets obviously differ due to varying summarisations and categorisations. Although renewed efforts were made by revising the ISCED classification (ISCED 1997), still, there are limits to the reflection of national variations and differences: e.g. in some countries the Master's degree is the first degree in higher education, and in others, the first stage of higher education is more oriented towards vocationallybased courses. The same may occur regarding content and length of single study programmes in SET fields of study, as a common European framework within higher education (Bologna Process) was only implemented recently. Therefore limits to the comparative consistency of the given information still apply. With this in mind, the information provided by the secondary data analysis is only seen as one tool for visualising evidence on European trends. Additionally, an exploration must be undertaken with the divergent national contexts in this field firmly on the agenda. Context, if not all, is essential for a better understanding of the specifications.

The overall objective for the cross-national synthesis is to explore similarities and differences between the partner countries. In this effort, all IFAC partners contributed with information that was specified through the leading questions outlined in chapter three. The following is structured around the main crosscutting themes: differing educational pathways to SET professions indicating that choosing SET is rather a matter of school performance than a matter of choice, auspicious takes on gender inclusive and/or gender exclusive SET strategies implemented by governmental policies, and to begin with, by clearly demonstrating that numbers actually do matter.

4.1 Female Participation Rates¹¹

4.1.1 Upper Secondary Education

The comparison between participation rates for women in SET fields of education is a common trend. There is a relevant under-representation of women in Science, Mathematics and Computing (EF4) throughout the Netherlands, Austria, Sweden and Greece. Secondary graduation of females even decreased dramatically over the research period in Holland (from 33.92% in 1998 to 7.42% in 2004). In Greece as well as in Austria the trend also goes downwards as recent figures prove. The data for Sweden in this field is inchoate; however, it can be observed that the female share declined over the years from 39.66% in 1999 to 26.67% in 2004.

The gender gap becomes even bigger in Engineering, Manufacturing and Construction (EF5). A major under-representation can be stated for Greece with only 7% females in ISCED level 3 in 2004. In the Netherlands the female share levels between 5.96% in 1998 and 4.93% in 2004. Female participation rates slightly increased in Sweden over the years from 5.38% in 1998 to 7.91% in 2004. However, the overall proportion is highly unequal. A similar trend applies to Austria, where the gender imbalance is considerable (7.30% in 1998).

Already during Upper Secondary School a differentiation in choice becomes obvious (Athanassouli 1998). Once different options

arise there are male and female fields of study. As pupils make first decisions on their future career trajectories already at this stage, gender segregation starts already here. Thus the gender imbalance at ISCED level 3-4 mirrors the gender segregation in the labour market. Developments in Austria, Greece, the Netherlands and Sweden demonstrate that school systems to date are not likely to change prevailing trends in the labour markets.

4.1.2 First Stage of Tertiary Education

The increasing presence of female students in the tertiary sector reflects the educational reform endeavours in the 1970s of the last century. Looking at graduation numbers for tertiary students in Sweden, Austria and Greece, the picture presented is quite similar. In Sweden 60% of all university graduates are females. The academic year 2003/04 saw a female proportion of 51.6% of all graduates on Austrian universities. The situation in Greece is similar. According to EUROSTAT data, women represent a high proportion of university degrees (52.6%), of which around 34.5% were awarded in all fields of Science and Technology.

Still EUROSTAT data on the proportion of male and female students of the tertiary sector indicates unequal participation rates between men and women in SET throughout the four countries. With 4.96% to 5.45% female shares between 1998 and 2004, the gender gap is the widest in the Netherlands in Engineering and Engineering and Trades. An approximate gender balance (nearly 50%) can be found only in the Life Sciences. In general, the number of women enrolled in SET studies remained quite stable in the last years, whereas the number of males slightly increased.

¹¹ The following findings are the result of analytical considerations on IFAC partners' data collection, based on EUROSTAT facts and figures. For some cases these are additionally contrasted with data sets collected by national statistic agencies.

The percentage of female students in technical fields of study in Austria is a little less than 20% (Statistics Austria 2007). Proportions under 20% can be found in Computing. Again Engineering and Engineering Trades brings up the rear with a female proportion of only 2.7% (1998) to 11.5% (2004). The only field within the defined SET categories with an identifiable high feminisation rate is the Life Sciences with a female share of 62% (1999) to 65% (2004).

In Sweden female participation in SET programmes has decreased from almost 30% in 1998 to 20% in 2000. The recent years have shown a rise to a little more than 20%. The study line Architecture and Building with a female share of 42.46% is the most gender balanced. As the figures already indicate, it is still a majority of male students that enrol in SET studies. According to the Swedish National Agency for Higher Education, 50% of all male students choose some kind of technical career (Skolverket 2007).

In Greece the lowest female proportions within SET fields of study are found in Computing (26%), Engineering and Engineering and Trades (27%) and in Manufacturing and Processing with only 18%. These figures remained rather steady between 2002 and 2005. In the last years the share of female students in the fields of Life Sciences and Architecture and Building, however, were close to male proportions (49% and 51% respectively for each field). Physical Finally in Sciences and Mathematics and Statistics, the female share reached 37% and 39% respectively.

In general it can be noted that the gender gap in Engineering and Engineering Trades as well as in Manufacturing and Processing is still remarkable throughout the Netherlands, Austria, Sweden and Greece.

4.1.3 Second Stage of Tertiary Education

A comparison between ISCED level 6 and ISCED level 5-6 shows similarities in the relation between male and female students in some SET fields of study, however a major female trend is not to expand the educational curriculum to a higher level (ISCED level 6). This trend is traceable especially in Greece as well as in Austria and Sweden, albeit with different peculiarities.

Another common factor is a decreasing female share in ISCED level 5-6 in Austria, Sweden and to some degree in the Netherlands, indicating a negative long-term effect on future female participation rates in ISCED level 6. Due to inchoate EUROSTAT data for the Netherlands, data-based general conclusions for ISCED level 6 cannot be made.

Although the number of Swedish female postgraduate students in Technology Sciences has increased from 20% to 30% over the last three years, males are still significantly dominant on this level of SET studies. In 2007 there were 74.34% male PhD students and 72.12% male PhD graduates in Computing. Last decade's encouraging rise of female PhD candidates might not persist however. The number of female postgraduates is likely to decrease again due to falling female participation rates in ISCED level 3-4 and ISCED level 5-6.

EUROSTAT data is inchoate for the majority of the programme lines in ISCED level 6 for the Netherlands. Existing numbers on the programme line Engineering and Engineering Trades, however, indicate a moderate increase of the female share between 1998 (11.21%) and 2004 (23.40%). Still the proportion of male and female PhD students and graduates is far from being balanced. Noticeably, the participation rate of female postgraduates outnumbers the female share in ISCED level 5-6 (8.74%) three times. Thus the Netherlands are very likely to see a decreasing female participation rate in Engineering and Engineering Trades in the coming years for ISCED level 6.

Numbers on Greek ISCED level 6 students and graduates in SET illustrate the lower share of female postgraduates compared to participation rates in ISCED level 5-6. This cleavage is even getting bigger in fields like Computing and Engineering and Engineering Trades. In 2004 ISCED level 5-6 counted 15% females, ISCED level 6 only 7% for Computing and 26% to 19% respectively for Engineering and Engineering Trades. These numbers point out the existence of a leaky pipeline for females between ISCED level 5-6 and ISCED level 6.

In Austria the proportion of female students and graduates has increased generally while the total number has declined. A leaky pipeline can be found for females on ISCED level 6, even if not to the same extend as on ISCED level 5-6. Again, the most noticeable gender gap is traceable in the programme line Computing, where the female share raised from 5.56% (1999) to 8.45% in 2004. Additionally, the proportion of female graduates is lower than the share of female students in this field. Females in Engineering and Engineering Trades are outnumbered by far at this level, but their proportion here is higher than on ISCED level 5-6.

4.1.4 Human Resources in Science and Technology (HRST)

Regarding data on human resources in Science and Technology (HRST)¹² provided by EUROSTAT, the proportion of women with tertiary education in SET is comparatively low in Austria, Sweden and the Netherlands. There is no reliable EUROSTAT data on HRST available for Greek figures, neither for the field of Science, Mathematics and Computing nor for Engineering, Manufacturing and Construction, but data was added from the Statistics in focus issue 'Women employed in science and technology⁴⁵ (Meri 2008). The most recent S&T statistics¹⁴ (S&T Statistics 2006) draw a similar picture for Greece.

Sweden leads the field regarding female participation rates, even though on the whole there are still less women with tertiary education in SET professions than men. A considerable discrepancy in employment figures within SET occupations is detectable between female participation rates in the Services sector¹⁵ (55.4%) and in the Manufacturing sector (30.1%). In the first women clearly predominate, whereas the lack of females is clearly marked for the second with one of the few negative annual average growth rates (-0.4%) in Europe (Meri 2008). In detail,

¹⁵ According to the international NACE code (statistical classification of economic activities): Manufacturing services are represented by professions from 15 to 37, the Services sector ranges from 50 to 99. The NACE code is available online at http://www.cebus.net/sic/

¹² Human Resources in Science and Technology (HRST) can be divided into different sub-populations, generally based on educational achievement and occupation. HRST are individuals who fulfil at least one of the following conditions: They have successfully completed tertiary-level education (ISCED level 5-6) and/or work in an S&T occupation as professionals or technicians (Meri 2008).

¹⁵ Available online at http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-SF-08-010/EN/KS-SF-08-010-EN.PDF

¹⁴ S&T statistics is provided by the UNESCO Institute for Statistics. It is the result of the UIS survey and of data collections undertaken by the Organisation for Economic Co-operation and Development (OECD), EUROSTAT and the Network on Science and Technology Indicators-Ibero-American and Inter-American (RICYT), online at http://stats.uis.unesco.org/unesco/TableViewer/document.aspx? ReportI d =143&IF Language=eng

the year 2006 saw a proportion of 37.78% women in Science, Mathematics and Computing. This figure slightly decreased as there were 40.24% females in 2004. Nonetheless, the numbers for Engineering, Manufacturing and Construction are even worse; additionally there was practically no change over the years. Between 2004 and 2006 the female share was 22.28% to 22.23% and thus stagnating on a relatively low level. Furthermore, Sweden was the EU member state with the relatively oldest female population employed in S&T in 2006. More than 46% of its female human resources in occupations are between 45 and 64 years old (Meri 2008).

Slightly increasing but still lower than in Sweden is the status quo of women in SET professions in Austria. Here even more women are employed in the Services sector within SET (52.8%). However, between 2001 and 2006 the female share in the Manufacturing sector rose considerably up to 26.8%. Thus Austria has the highest Union-wide average annual growth rate with 19.8% in the Manufacturing sector (Meri 2008). This may be partly due to an increased national policy effort to attract more women to SET professions since 2002. In the field of Science, Mathematics and Computing, the female share increased from 26% in 2004 to 31% in 2005. In the field Engineering, Manufacturing and Construction however, the rate is still considerably male-dominated. Here the female proportion was only 10.6% in 2005. Females below 45 years of age are predominant (68%) among Austrian professionals in SET (Meri 2008).

When it comes to female participation rates within human resources, the situation in the Netherlands varies only partly from the Austrian status quo. Again more women employed in SET professions work in the Services sector (53.1%), the

Manufacturing sector has a female share of only 26.3%. In 2006 the annual average growth rate was rather moderate for both sectors with 2.4% for the Manufacturing and 2.9% for the Services (ibid.). The share of women is the lowest in the Netherlands according to available EUROSTAT data for the fields of Science, Mathematics and Computing and Engineering, Manufacturing and Construction, Additionally, participation rates are even decreasing in both fields. The female share dropped from 25.32% in 2003 to 23.38% in 2006 in the first and from 8.86% to 7.26% in the second. Females below 45 years of age (63%) are less predominant than in Austria but still form a majority among Dutch human resources in SET.

Finally, Greece is the EU member state with the smallest share of female human resources in occupations in the 45-64 age group (27%). Like other countries in Southern Europe, Greece is experiencing a change in the traditional employment pattern as young females increase their presence in SET occupations. Additionally, the female share in the Manufacturing sector is the highest of all four countries with 35.4%. accompanied by a rather strong presence in the Services Sector (50.1%). In 2006 the annual average growth rate was 10.4% for the first and 6.7% for the second (Meri 2008). As noted before, there is no relevant EUROSTAT data on HRST available for the fields of Science, Mathematics and Computing and Engineering, Manufacturing and Construction. However, in 2006 the highest unemployment rate for female HRST was found in Greece with 8.5%, followed by Sweden with 3.1%, the Netherlands with 1.7%, and finally Austria with 1.5%. The greatest gender disparities in terms of absolute numbers of unemployed HRST were also found in Greece, where the figure was twice the figure for men (ibid.).

4.2 SET Education and Career Prospects

The underlying educational systems¹⁶ need to be taken into account, as they provide valuable insight into differing female participation rates in SET education and professions within the Netherlands, Sweden, Austria and Greece. As an aid to understanding the differences between the various national contexts, the following chapter is going to provide details on national education programmes, differing admission requirements within Science and Technology pertaining possibilities of choice and their effects on the genders. Additionally, these findings will be related to the prestige of SET occupations and possible career prospects in the four countries.

4.2.1 Upper Secondary Education in Comparison (ISCED level 3-4)

Sweden

The Swedish school system is open to all children aged between 7 and 16. School attendance is mandatory for 9 years. After finishing compulsory school attendance, pupils may continue with upper secondary programmes. Single programme lines offer specialisation in SET already at this stage. Thus the first educational choice for a career trajectory in SET may be made at the age of 16. Respective programmes offer three different pathways: they prepare for further study, they are vocationally oriented or offer apprenticeship trainings (Skolverket 2007). Pupils may choose the programme line according to their interest as there are no ratios or entrance examinations, however, as chapter 4.1 clearly demonstrated, once different options arise there are female and male fields of study. SET programmes are notably male dominated

already at this stage. At the end of upper secondary school students receive a final grade (leaving certificate), which partly determines the choice options for future fields of study. To be eligible for higher education a pupil leaving upper secondary school must have passed courses covering at least 90% of the 2,500 credit points required for a complete programme (EC 2006d).

Austria

Starting with primary school, the common compulsory school attendance starts at the age of 6 and lasts 9 years (EC 2006a). After finishing primary school, pupils may continue education in lower secondary school (Hauptschule) or on the lower level of an academic secondary school (Allgemeinbildende Höhere Schule or AHS). Starting from grade 8 or 9 respectively, a broad range of general, technical or vocational schooling is provided for, opening a broad range of possibilities of choice as pupils may decide between 300 technical and vocational training programmes (VET colleges) apart from training at academic secondary school (AHS). In contrast to the latter, the secondary technical and vocational colleges have the task of imparting a higher level of general and specialist knowledge. Additionally they qualify students for direct entry into higher-level occupations within technical professions. At the same time secondary technical and vocational colleges also qualify for university studies. Thus pupils interested in SET professions and studies may already start early with specific programmes at the age of 14. Once again, this first possibility of choice for SET is highly gendered, since male students outnumber their female colleagues by far as seen in chapter 4.1.

¹⁶ As an aid to understanding the differences between the various countries, up to date information about the different educational systems in the European Union is available from EURYDICE. See their website at http://www.eurydice.org

Finally, by completing AHS or technical vocational colleges, graduates receive the Certificate of Secondary Education called *'Reifeprüfungszeugnis'* or *'Matura'*, which entitles them to enter tertiary education (ibid.). Having attended a VET college is a beneficial prerequisite for further studies in SET. Thus gendered participation rates in upper secondary education continue to have an effect on unfavourable female participation rates in higher education.

Greece

Education in Greece is compulsory for all children from 6 to 15. After Demotico Scholeio pupils move on to secondary education. including Gymnasio (lower Secondary School), Eniaio Lykeio (unified upper Secondary School) and Technica-Epaggelmatika Ekpaideftiria or TEE Vocational (Technical Educational Schools)¹⁷. TEEs definitely provide the best basis for future occupations in SET and can be chosen at the age of 15. Apart from reinforcing general knowledge, the objective of the Technical Vocational Educational Schools is to teach modern and specialised techniques and vocational practice. Thus trained graduates of TEEs may enter the labour market directly. Additionally, there are several places reserved for TEE graduates on technical programmes in higher education. The earlier a pupil chooses SET programmes, the more likely he (she) is studying further in programmes of higher education and the higher the chances to secure a place¹⁸. Again an enormous gender divide can be noted at this educational stage already (see chapter 4.1.1) with the female share even declining. Thus Greek upper secondary education is characterised by gender segregation that

forms the basis of low female participation rates in higher education.

The Netherlands

Compulsory school starts at the age of 5 and ends at 18. After finishing primary education (age 12), a student has three options: VHBO, HAVO or VWO (ISCED level 3). Each of these school types covers science, though in a different way and on a different level. Nation-wide sixty percent of all students are enrolled in VHBO, thus combining vocational training with theoretical education in languages, mathematics, history, arts and sciences. The choice of SET education starts quite early in VHBOs: within two years students have to choose out of four sectors: technology, health care, economy and agriculture. This choice determines follow-up studies at higher (bachelor) levels.

HAVO (senior general secondary education) has five grades and is attended between 12 and 17, allowing access to the bachelor cycle (ISCED level 5) of tertiary education. Like the VHBO, the system demands early specialisation. In the third year pupils are obliged to choose out of four programme lines to specialise in a specific set of different subjects. This choice directly affects possibilities for future fields of study, as some HBO (higher professional education) and WO (university education ISCED level 5) studies require the profile 'Nature and Technology'. Both programme lines demand an early choice for SET studies at the age of 14-15. Once again this choice option is highly gendered as female participation rates in SET programmes have been declining (Science, Mathematics and Computing) or are stagnating on a very low

¹⁷ Attendance of Eniaio Lykeio lasts for three years; in TEE attendance is two (1st level) or three years (2nd level). Apart from day Secondary Schools one has the opportunity to choose evening classes (Esperino, Gymnasio, Lykeio and TEE).

¹⁸ For a multi-levelled and differentiated insight into the structure of the Greek Education system please check the annual report in the Eurydice data base at http://www.eurydice.org.

level (Engineering, Manufacturing and Construction). Furthermore an early choice for SET studies is quite definite, since studies in SET may only be singled out after having completed a full programme in SET during upper secondary education. Overall Dutch students have to make very early and definitive choices at this educational stage and up to now these are highly gendered.

4.2.2 Tertiary Education: Choice versus Performance (ISCED level 5-6 and ISCED level 6)

Sweden

Swedish institutions for higher education usually do not charge any fees, except for some independent institutions. In general they follow a two-track policy. On the one hand prospective students have to fulfil basic requirements and there are specific qualifications prescribed by the university to be admitted to a study programme. On the other hand each institute for higher education sets a limit to available study places. Thus institutions of higher education directly steer enrolment numbers. However, it is the government that indirectly determines the number of study places by setting a ceiling on the total allocation of state funds by basing it on the number of students. If single programme lines exceed their ceiling, they will not receive state funding for all of their students. The government also determines the goals for the numbers of degrees in single fields of study. For the period 2005-2008 these ratios were operative in Engineering, Nursing and for some degrees in Teaching (EC 2006d). However, no gender ratios apply here.

Higher education and research in SET takes

place at state universities (*universitet*) and university colleges (högskolor) (ISCED level 5-6). Additionally, there are independent programme providers with the right to award degrees. What differentiates the two types of institutions notably is that universities offer a broader range of courses and that they provide postgraduate programmes (ibid). Albeit the number of female students at Swedish universities increased, the trend goes downwards within SET study programmes. Especially due to gendered choices in upper secondary education, females pursuing higher education in SET are rather the exemption than the rule. One reason might be that the special requirements prescribed by the study programme are not met. Thus the lacking specialisation in SET plus the status as an outsider may be the reasons for many females not to choose respective study programmes. Another trend of females within SET studies is not to expand their studies to the PhD level.

Austria

Since 2001, Austrian, EU or EEA member state students of national universities have to pay € 363.36 tuition fee per term. For students from other countries tuition fees are even higher (€ 736.72). In contrast to universities of applied sciences, there are no special requirements for students and entry is not regulated by most university programmes within SET¹⁹. The providers of technical/vocational higher education (Fachhochschule or university of applied sciences) are entitled, but not obliged to charge tuition fees (EC 2006a). Universities of applied sciences within SET offer university level study courses which intend to offer a scientifically based vocational education.

¹⁹ Exception for SET fields of study not addressed by IFAC: In 2005 there was a change in access requirements for study programmes affected by eight numerous clauses-study programmes in Germany and apply mainly to study programmes in the Life Sciences.

The main aim is to ensure a vocationally oriented training at university level. A student interested in SET fields of study may either apply for courses at the more application-oriented Fachhochschulen or enrol at more scientifically oriented technical universities. Raw facts and figures prove that females are not likely to choose SET studies, even if the female proportion slightly increased in the recent vears. Although there are no official prerequisites prescribed besides the upper secondary level leaving certificate, study programmes within SET act on the assumption that their students have already gained respective knowledge in VET colleges. Due to the gender segregation in upper secondary education, many females (and males) who have not attended VET College do not meet this hidden agenda and are very likely to drop out. Only universities are entitled to offer postgraduate education in SET (ibid.). Once again females have to face a leaky pipeline at this level.

Greece

Higher education within SET in Greece is structured around university education and the Technological Educational Institutes (TEIs). These also include ASPAITE, the Higher School of Pedagogical and Technical Education. The role of Higher Technological Education is to contribute to the country's development and progress in the fields of science and applied research. All in all there are 15 *Technological Educational Institutes* located all over the country. There is a tendency to locate new departments in cities other than the headquarters of the institution as a measure for local economic development (EC 2006b).

In accordance with the Greek Constitution, tertiary education institutes are entirely provided and largely financed publicly and there are no tuition fees. However, admission to SET studies is mainly a matter of performance and less a matter of personal choice. According to the existing admission system, the basic requirement for admission is the possession of the Eniaio Lykeio (unified upper Secondary School) graduation certificate. Hence, the Ministry of Education appoints the number of students allocated to each TEI institute annually, whereas selection is based on the students' performance during the second and third class in nine general and orientation lessons and on basis of nation-wide examinations, including oral and written grading (ibid.). Some study places within SET programmes are reserved for TEE graduates. As these are in their majority male, it comes by no surprise that males predominate in SET studies. Once again the gender divide in upper secondary education proves to have long-term effects. More females gain a study place at ISCED level 5-6, whereas fewer women choose to continue postgraduate studies provided by state universities.

The Netherlands

In contrast to many European systems of higher education, the Dutch system is binary, meaning that there are different institutions for bachelor (HBO) and master degrees (university). With an MBO, HAVO or VWO diploma pupils are entitled to attend courses at **HBO** (higher vocational education) (EC 2006 c).

Master and PhD degree courses within SET are provided at three universities focusing predominantly on Science, Engineering and Technology: the universities of technology in *Delft, Eindhoven and Twente* (EC 2006c). For higher education at universities students have to pay tuition fees; in the academic year 2007/2008 the amount was € 1.538 for students under 30 years. 30+ students have to pay directly to their institution of choice. This amount can be much

higher²⁰. Admission requirements for HBO institutions and universities are administered centrally. Several study programmes are subject to a ratio system ('numerus fixus'); within SET right now ratios apply to the Life Sciences. There is a weighted draw followed by selections by the institutions for admission to these studies.

Where no restrictions on study places apply, students are free to enrol at those HBO institutes where the students' combination of subjects studied in secondary school allows entry (EC 2006c). Candidates who do not meet the requirements may still be admitted due to the strength in certain optional subjects (EC 2006c). As in all the other analysed countries, gendered study choices during upper secondary school prove to have long-term effects, since SET studies on the graduate and postgraduate level are clearly predominated by males.

Prestige and Career Prospects

Status and prestige of SET careers seem high within the public discourse in Austria. Greece. the Netherlands and Sweden. According to a recent Swedish survey, engineers just made it into the top ten by coming 9th, whereas computer consultant ranks 14th (Ulfsdotter-Eriksson 2007). A study conducted among students at the Johannes Kepler University, Linz²¹, revealed the ascription of a high status to technical fields of study. Furthermore this high value is assumed to be attached to SET occupations throughout a professional career (Horwath et al. 2007). Studies in SET are reasonably popular in the Netherlands as well, since they are rated third place out of seven regarding enrolment numbers. Overall, studies in SET promise good career prospects as this sector is a key contributor to EU growth and a shortage of skilled workers

within this field is expected by 2010. However, SET is still a predominantly male field throughout the four countries. Women who enter SET careers often drop out or move to different sectors. Fewer women also make it to the upper management level (EC 2007). Additionally, a gender pay gap still prevails and it becomes even more persisting in high tech sectors in all four observed countries (ibid.).

4.3 Governmental Policy Statements

In what follows, we provide an insight into the state of public awareness towards gender inequality within SET fields of study and professions. In drawing our attention towards top-down policy statements, we will analyse different takes on strategies in combating prevailing gender stereotypes and in counteracting the lack of accurate information in SET. As we will see, these strategies are either exclusive or inclusive towards the gender category. Some of them even exceed this category by applying a cross-sectional approach that considers other factors like class, age, education, race etc. alongside the gender category. Now, this information should only accomplish the already outlined benchmark data on the national contexts. Work package 5 of the IFAC project delivers a more profound analysis on national policies in this field and its results will be published separately.

4.3.1 Sweden: Inclusive Policies for Gender Equality

Swedish governmental policy statements for over a decade pinpoint that women and men should have the same rights in society (SOU 1998:6.). This is generally expressed in laws, statutes and agreements, addressing issues spanning reproduction, work-life balance,

²¹ This was a qualitative survey with more than 50 students and former students who studied mechatronics or informatics. The aim of the project was to explore the conditions of studies within the faculty of engineering and science and to develop measures to support students.

the labour market and social welfare. In approaching these topics, Swedish authorities prefer to apply **gender inclusive strategles**, meaning that every public policy should be shaped in such a way that it addresses men and women equally. Hence, Swedish governments of the recent years did not address equality issues within SET directly, but they pursued respective goals within an overlapping field: ICT. In what follows, the focus will be on Sweden's move from *ICT policies for the society to policies for an ICT society* as there are no policies on SET.

Women and ICT (2000-2006)

In 2000, the Swedish government called attention to the situation of women and/in Information and Communications Technology (ICT), claiming that ICT was still a male domain, despite a vast majority of women applying its tools. Hence the real gender gap lies in the gender stereotypical division of labour. It is still males that develop new IT devices, while females are mainly end users. Furthermore, this analysis was backed up by enrolment numbers of IT programmes in upper secondary school and universities, where men were and still are clearly predominant. Therefore the Swedish government set itself a new policy goal: Women and men should steer developments within ICT together.

To proceed with this issue from an integrative perspective, the government established a council to follow most recent developments in Science and Internet Technology. The council's main activity was to analyse different equality questions within ICT and to propose possible measures to increase equal opportunities (SOU 2000:58. and SOU 2001:44.). Notably, the

government proposal was titled: From ICT policies for the society to policies for an ICT society (Fran IT-politik för samhället till politik för IT-samhället²²). This signifies a fundamental shift in the problem analysis. As the title already indicates, ICT now discursively pervades all segments of society and is thus analysed as a far-reaching, intersecting societal factor. Consequently, the proposition named broad target groups. Additionally, several state and local authorities were to be involved in building a nation-wide network for implementation of the various policy programmes (Svensk Regeringskansliet 2006). However, no gender specific sub-targets were expressed. This can be seen as a result of the Swedish gender equality policy with its very specific basic approach: each governmental policy is seen as a strategic tool for fostering gender equality on all possible levels. In detail, this means that each and every policy should be shaped in such a way that inclusive effects for all genders are to be ensured. This approach would be contradictory to policies that have the exclusive enhancement of one gender as a goal, since all governmental policies should address the genders equally.

Since 2006, no specific governmental policies for SET or ICT were voiced. The emphasis of the current Swedish government (2006*) within gender equality issues lies on gender-sensitive taxation and on programmes reducing physical and psychological violence against women.

4.3.2 Austria: Exclusive and Inclusive Policy Strategies²³

Noticeably, gender equality issues within SET are rather reflected in more recent governmental policies, since the national policy

²² The paper is online available on the site of the Swedish government under: http://www.regeringen .se/sb/d/108/a/47411.

from 1997 to 2000 is not taking unequal gender relations into account. Not until the drafting of the national policy from 2000 are gender equality issues taken into account. Main areas of political action are the gender wage gap, work-life balance, the glass ceiling and social protection for older women. SET is identified as an area with high male participation rates; therefore several enhancement programmes for females are initiated, among them mentoring networks for women working at universities or universities of applied sciences or the implementation of a national action plan for the advancement of women.

As described above, governmental policies mainly favour exclusive enhancement strategies to attract more women to SET. Only recent policy programmes (fFORTE School) attempt to strengthen the possibilities of choice for all genders and therefore introduce gender inclusive policy approaches.

The fFORTE Programme

In 2002 the government started 'fFORTE -Women in Research and Technology', an extensive policy programme for the advancement of women in SET (state of the art 2007). It is a co-operation between initially three, by now four Federal Ministries. These are the Ministry for Transport, Innovation and Technology, the Ministry for Science and Research, Economics and Labour (since 2004) as well as the Ministry for Education, the Arts and Culture (since 2007). These ministries cooperate with the Austrian Council for Research and Technology Development (state of the art 2007).

The policy programme fFORTE itself consists of four programme lines (state of the art 2008), aiming at different target groups: 'fFORTE-academic', addressing women in academia, 'w-fFORTE' for women in the business sector, 'FEMtech' enhancing women studying and working in technical fields and, finally, 'fFORTE School' strengthening the presence of science and technology in school education. Major goals of fFORTE are to facilitate the access of women to training in SET, to improve the opportunities of women to embark on and successfully pursue careers, to facilitate access to research funding and infrastructure, and to sensitise key agents in education, economy and public administration to gender issues as well as to provide accompanying research and cross-disciplinary research on women and science (state of the art 2007). Policy strategies framed in the operational programme FFORTE pursue gender exclusive goals by the majority, only a few programme lines emphasize gender inclusive strategies like in the newly introduced programme line 'fFORTE School'. This could be due to the fact that the Austrian government intends above all to raise the female share in SET. Hence, this goal should be reached through implementation of enhancement programmes that exclusively foster the far under-represented gender in this field. The national policy from 2003 to 2006 announces the continuation of the "action plan 2003: Girls into technology" (Mädchen in die Technologie)²⁴. Thus the financing of several projects and initiatives established before 2003 were prolonged. In 2007, the continuation of the fFORTE programme line was also announced. Finally, the majority of policy strategies still favour gender exclusive approaches.

Older governmental policy statements can be found at the Austrian parliament's website at http:// www.parlament.gv.at/PG/PR/STICHW/STICHW_3009/2000.shtml.

²⁵ The official government policy statements can be downloaded from the Austrian government's website at http://www.austria.gv.at/site/3431/default.aspx.

²⁴ http://archiv.bmbwk.gv.at/schulen/unterricht/ba/gb/aktionsplan2003 11-05-2007

4.3.3 Greece: Exclusive Enhancement for More Women in SET

Greek governmental policies on increasing the female share in Science and Technology are a rather new phenomenon. The recent years saw a rising number of EU directives on Gender Mainstreaming measures that were adjusted to national contexts. Thus it can be stated that mainly EU directives on gender equality strategies influence Greek governmental policy statements (Pantelidou Maloutas/Kakepaki 2007). On a national level, respective policies are largely channelled through the General Secretariat for Gender Equality of the Ministry of Interior (GSGE), Public Administration and Decentralisation as well as the KETHI, the Research Centre for Gender Equality. These policies take up employment issues, explicitly combat gender stereotypes or campaign against the gendered division of labour. Additionally, they offer guidelines for the combat of violence against women and provide advice for improving the worklife balance. Gender equality policies within SET mostly use strategies that enhance women as we will see in the following.

Raising Awareness in Education for Gender Equality (2004-2008)

Not a policy initiative in SET per se, but the 4 year action plan under the operational programme "Education" named "EPEAEK II" is of importance for tackling gender stereotypes. It was installed in 2004 and implements broad consciousness-raising activities. The action programme has 4 main axes; one of them is exclusively dedicated to the combat of gender stereotypes. Under this guideline education programmes for more **gender inclusion** are implemented that address public school teachers nation-wide. Furthermore, GSGE is distributing material for gender-sensitive education in technology, made available to libraries in public schools. Aiming at tackling gender segregation and stereotypes, the CSCE also organised information conferences on gender issues, reaching educators and students from Gymnasio, Eniaio Lykeio and Technica-Epaggelmatika Ekpaideftiria/ TEE.

Encouraging Participation in Research and Technology (*2000)

Within SET, the General Secretariat for Research and Technology (GSRT) is the key agent in promoting women in research and technology. Its main goal is to encourage women to take part in research areas with low female participation. The main activities for the enhancement of women in science and participation in R&D fall under the policy priority "Human Capital" (Axe 8), more specifically they are referring to Human Research & Technological Capital" (Measure 8.3. Actions 8.3.1 and 8.3.4.). Activities include mostly policy strategies addressing exclusively women like the setting up of an information and communication network among women scientists. In 2000 the PERIKTIONI Network was launched, named after Plato's mother, who was a keen mathematician as well as a philosopher. Its main goal is the promotion of equal opportunities for women within R&D throughout Greece. Additionally it should foster ties with other networks in the Balkans and the Mediterranean. Another action is the creation of a data base for female researchers²⁵. Yet another goal is the establishment of a National Observatory to survey the trends in R&D and analyse the needs and occupational gualifications needed for professions in scientific domains. Furthermore, in 2001 GRST has launched a specific action programme called "Reinforcement Programme of Human

Research Potential" (PENED) to increase the number of female PhD students.

Future Policies: Improving Women's Access to the Labour Market

Greek authorities stress the challenge of technological change and new models of work as they demand refined skills and competencies. Most recent governmental policy goals will therefore focus on the development of Human Resources and the internationalisation of research and innovation by attracting high-potential scientists from abroad. Regarding the promotion of young women in SET, the Ministry announced 1319 scholarships for young women in technological state schools. All in all, it can be stated that Greek authorities will most likely continue to mainly pursue exclusive policy strategies for the enhancement of women in SET.

4.3.4 The Netherlands: Inclusive Policy Strategies for Emancipation

Inclusive Policies for Emancipation

Like in Greece, European-wide debates for the advancement of equal opportunities had a high impact on national policy making. In the case of the Netherlands it was the Fourth United Nations World Conference on Women in Beijing in 1995 that may be considered as a benchmark, since it caused a major shift in Dutch debates. In line with the final statement of the Beijing Conference, the Dutch government explicitly called for policy action. A special thematic emphasis now lies on paid work, unpaid care and income, the re-distribution of power and decision making, on work-life balance, women's rights, women's health, and on the implementation of equal opportunities in countries receiving development aid from the Netherlands. The consistent strategic policy approach emphasizes the shift in policy making, for it applies **inclusion** strategies for diverse groups of males and females, all to strengthen emancipation processes. Noteworthy, there is also a change in the terminology. Dutch authorities do not label their efforts as striving for 'gender equality' as in every other country considered here; they rather call for the emancipation of the Dutch society as a whole. SET was not directly addressed in Dutch governmental policies of the recent years. Nevertheless, for the enhancement of women in ICT genderinclusive and exclusive policy strategies are applied, as we will see below.

Two-tracked Policies

Since the Beijing Conference, the Dutch government follows a two-tracked policy approach on emancipation issues:

- 1. The first line of approach is to renew government emancipation policy.
- The second line of approach is to mainstream or integrate emancipation aspects and insights into regular policies.

On the one hand, specific emancipation policies are designed to promote change, to place new issues on the agenda, to propose new instruments for the enhancement of gender equality and to stimulate strategic alliances with social partners and non-governmental organisations. On the other hand policies are set up that integrate a gender perspective into all regular policy areas. These two tracks of policy making are closely interrelated; the expertise gained in one track represents a key condition for strategies applied in the other (Multi Year Emancipation Policy Plan 2006).

Multi Year Emancipation Policy Plan (2006-2010)

Efforts for more emancipation are also visible in the Dutch Multi Year Emancipation Plan (2006-2010). In highlighting intersecting processes of marginalisation, Dutch authorities take a different stance in the problem analysis. The striving for e.g. more women in SET is not solely a question of emancipation but also one of diversity in general. Notably, gender cuts across other dynamics in the technological divide: income, occupation and age with other factors like education, ethnic minorities, or single parent families intervening. Thus various but intertwined aspects of societal marginalisation have to be consolidated in the concept of **social participation** (Multi Year Emancipation Policy Plan 2006: 6).

According to the guidelines above, the Dutch government did support ICT initiatives that either improved or accelerated access to possibilities of social emancipation on a national and international level in recent years. These included ICT programmes for low-skilled girls and boys like the 'Rechtinbeeld.nl' that informed young migrants about their rights in cases like child abuse, domestic violence etc. according to Dutch legislation. Another policy programme strengthened the position of women and men in ICT, named 'Balance of Men and Women in ICT'. The latter addressed gender imbalance in intermediate and in higher vocational education (MBO and HBO) and developed several routes with special regards to needs of girls and women. One school focusing on women and SET occupations is the 'Vrouwenvakschool' in Utrecht, with two Dutch pop stars as figureheads.

Enhancing possibilities for full social participation is the utmost policy goal of the Dutch government. Reaching equal opportunities for both genders is only one crosssectional matter that is best reached with policy strategies not only inclusive of all genders but inclusive of several processes of marginalisation.

4.4 Summary and Conclusions

Numbers matter

In most of the European countries, the proportion of women entering studies in SET is static or in decline, even in cases of sustained inclusion efforts. Hence the trend is slightly different within the four countries. Sweden saw a decent increase in graduation numbers, whereas the number of female postgraduates ranges at conspicuously low levels in all four countries. Declining or stagnating participation rates for females might be interwoven with contemporary developments like the conversion of the educational system (Bologna) or the burst of the IT bubble at the turn of the millennium. Notwithstanding, the high female dropout rates at ISCED level 5-6 and the leaky pipeline for females at ISCED level 6 calls for action. Thus, the overall picture is an ambiguous one: optimistic with respect to women and SET (that is, women actively using SET services and devices) and pessimistic with respect to women in SET (that is, women in SET professions, developing devices)²⁶. Some sort of critical mass in SET still needs to be reached to turn SET studies into a female-friendly environment.

Numbers do matter if SET is to become a gender-authentic option for study choices. When it comes to SET occupations, another major gender divide can be noted. There are far more women employed in the SET services sector than in the manufacturing sector throughout the four observed countries. Additionally, the unemployment rate is noticeably higher for women in SET, being up to twice the figure for men in absolute numbers in Greece. On labour markets, a stereotypical gender division is at work that still waits for de-stabilisation.

Choice versus Performance

A look at Greek. Swedish or Dutch educational systems discloses that embarking on SET studies is not only a matter of choice. In fact, it is rather a matter of performance during upper-secondary education, as grades (Sweden, Greece) or chosen subjects (the Netherlands) provide the basis for studies in SET. Especially for the Netherlands, embarking on SET studies has to be a very early individual choice (ISCED level 3). While operating on specific admission requirements for prospective students on the one hand, on the other hand ministries appoint the number of study places annually (Greece, Sweden) or apply a ratio system ('numerus fixus'/the Netherlands). Thus the government sets a ceiling to the allocation of funds and roughly regulates the number of graduates. The Austrian educational system is particular as there are no specific admission requirements adopted within SET; students are entitled to enrol in almost²⁷ any university programme for an unlimited time period.

However there is still an end to possibilities of choice: Austria has generally introduced tuition fees in 2001. In the academic year 2007/08 these summed up to $737 \in$ for EU and EAA citizens and $1473 \in$ for most non-EU/EAA citizens. Whereas higher education is free in Sweden and in Greece, there are tuition fees in the Netherlands as well, amounting to $1538 \in$ per annum. These can be even more for the age group 30+. In general, tuition fees may constrain socially marginalised students from choosing SET studies.

Moreover, there are two possible pathways to SET occupations in all observed systems of higher education: first, the more vocationally oriented University Colleges (Sweden), Universities of applied sciences (Austria) and the Technological Educational Institutes (TEIs). The Dutch system is entirely binary with all students attending Higher Vocational Education (HBO) before being entitled to move on to the Master's degree. Second, there are scientifically oriented universities that provide education on all levels. After all, it is more likely that scientifically trained university graduates choose to run the gamut from ISCED level 5 to ISCED level 6. All in all, there are various limitations to possibilities of choice that need to be considered in the process of policy making.

All in all, the highly gendered study choices in upper secondary education prove to have negative long-term effects for female participation rates in higher education. These continue to be effective during the first and second cycle of higher education in draining out females from SET studies. This proves the existence of a 'leaky pipeline' for females.

Governmental Policies: Inclusive and Exclusive Strategies in Need

There are several important differences in terms of how strategies were framed by governmental policies. Basically, all strategies mentioned so far have gender inclu**sion** as a particular objective, though some aim exclusively at women whereas others target 'everybody', including women. As in the case of the Netherlands, inclusive policy strategies even exceed the category of gender by trying to be inclusive towards intersecting processes leading to marginalisation (social background, education, age etc. and gender, being only one of them). This difference in the approach is also reflected in the terminology. Whereas policies focusing on gender inclusion strive for gender equality, the Dutch concept of emancipation seeks inclusion in the form of social participation for its society as whole.

²⁷ Mainly studies in Life Sciences are excluded.

Another differentiation has to be made regarding different kinds of inclusion processes. A common strategy is that of increasing skills and overcoming a SET renitence (or ICT renitence as in the case of Sweden and the Netherlands) by different types of training courses like the use of ICT in primary education in Sweden. Another strategy is to create women-friendly spaces for learning as in initiatives like FIT (women into technology, Austria). A third one is to create networks of research and collaboration aiming at improving the relative numbers of women within SET. like the PERIKTIONI network in Greece. And finally, there are strategies that aim to redefine symbolic images of SET that associate them to men and masculinities in providing different information on SET studies and occupations (see IFAC role model data base). Additionally, strategies for equality by the European Union were channelled into national policy making as seen with the integration of Gender Mainstreaming policies. Yet another example is the drawing up of national budgets and the spending of public money on initiatives in SET, all under the premise of the Union-wide Lisbon strategy. As IFAC mainly deals with gender stereotypes, another approach that matters is how strategies try to tackle gender stereotypes. Some strategies take up gender binary assumptions and merely twist them. Thus, they promote till then negatively assessed 'female' skills and competencies as assets. Notwithstanding the good intention, in the long run this strategy is in danger of again assigning women to gender stereotypical areas in SET.

Other approaches try to move beyond gender stereotypes by destabilising them.

This is done by e.g. not assuming that to reach women means that one has to advertise SET as 'soft' or 'non-techy'. Ideally, strategies that, at a first glance, aim at reaching 'everybody' might fall in this category. The Swedish gender equality strategy promises to depart from such terms by addressing both genders and so does the Dutch concept of social participation as a basis of all policy making by considering intersecting aspects of marginalisation. The question remains, however, in which ways this necessarily pervasive policy strategy is interpreted in the process of policy making. On the other hand, strategies dedicated exclusively to women may serve to validate so far disregarded interests. In fact, females-only initiatives might create a space where otherwise excluded groups of women obtain essential information on SET hands-on, as in the example of the Austrian initiative MIT (Mädchen in die Technik, girls into technology). A look at the here mentioned highlights of national policies in SET shows that three of the four observed countries (Sweden is excluded) use both gender-inclusive and gender-exclusive policy strategies to curb the gender divide in SET. Table 1 and 2 at the end of the report summarise key issues of the four national educational systems and the policy strategies applied in the respective countries.

After all, context does matter. This means that effective tailoring is in need if gender inclusion and inclusion efforts beyond the category gender are to succeed. So, there can never be a single 'cure all' strategy to increase the participation rates in SET. Instead we should be aware of the applied strategy and of what kind of effects it is likely to trigger in the end.
5. Reasons for Not Choosing SET-Findings from Past Projects

On the following pages, the results from the analysis of the collected past research-oriented projects are presented. At first a short overview of the material is given, including basic context information on the diverse projects. Afterwards the material at hand, collected by the partner countries, is analysed as to how the projects explain low female participation in SET and the issue of females not choosing studies in the field of SET.

Most projects assume a complex set of explanations which interact with each other and cause low female participation. Different factors need to be considered which, taken separately, would not suffice as an explanation but together produce cumulative effects. Firstly, there are inequalities in education and training, which do not explicitly exclude girls but systematically support boys. For example, the organisation of school courses in the field of SET mostly reproduces the male image of those studies. And in school orientation and curricula advising, SET professions are not presented in a way that could raise the interest of girls, instead often the male image is reinforced. Secondly, working conditions in the field of SET still discriminate women. and common perceptions of professional careers mainly support men. And thirdly, there are also cultural factors that reinforce the male image of SET, e.g. in the media.

As mentioned before, according to IFAC's hypothesis, the reasons for young women not choosing science and technological subjects are on the one hand a strong influence of gender stereotypes and on the other hand a lack of information on SET subjects and career prospects. So this analysis of the past project focuses especially on findings concerning these two reasons, but we have also compiled further explanations for low participation given by the collected projects. As already outlined in chapter two of this report, gender stereotypes and the lack of information are of course also interrelated: gender stereotypes are often caused by a lack of information; and a lack of information often is a lack of accurate information caused by the persistent circulation of stereotypes concerning SET as well as gender stereotypes. But for the analysis it is useful to present the individual findings separately.

5.1 An Overview of the Collected Projects

Altogether there are twelve past researchoriented projects to be analysed: eight national projects from four partner countries and four transnational projects on several EU countries. From Austria there is information on three past projects, from Greece and Sweden there is information on two projects per country. The Dutch partners were not able to find any fitting research projects conducted in the Netherlands. So for the sake of completeness, instead of a research-oriented project, information on a national programme has been collected, within which several projects were launched concerning the issue of women and SET, but unfortunately up to the time of data collection none had been finished yet.

Some projects also had a broader target

group than IFAC. In those cases we concentrated on the findings relevant for IFAC. To get a short overview of all the collected projects, please take a look at the two tables at the end of the report, tab. 3 for the collected projects on national level, tab. 4 for the projects on EU level.

5.1.1 Projects Collected on a National Level

As can be seen in tab. 3, the collected national projects are very diverse. Some projects conducted mainly basic research with a strong focus on gaining new findings. Other projects were rather application-oriented in the sense of implementing actions to improve the actual situation of women and SET. Almost all projects were funded by public institutions²⁸, some were financed by local organisations, others by national agencies.

Most projects were conducted in the beginning of this decade; one Austrian and one Swedish project were conducted in the late nineties, for one Austrian project and one Greek project only the publication date was available. Most projects were rather short-term projects carried out over a period of about two years, only one Swedish project had a term of four years.

Also the research type and the type and size of the data collection vary tremendously. While most projects conducted interviews mainly with pupils or university students, some also did secondary analyses of national statistics, and one Greek project is basically a literature review. The sample groups are mostly broader than IFAC's target group of 16-18 year old women in high school. Some projects focus on females only, some look at both genders. The age groups are roughly 13-25 year-olds. Five of the projects have a regional scope consisting mainly of specific case studies, the Dutch programme has a nation-wide focus, and one Austrian project has a national scope since analysing national statistics. The Greek literature review took into account not only national but also international literature.

Many different fields of SET were covered. Three projects focused on only one field of SET: a Greek project centres on mathematics, one Swedish project looks at the electricity sector, the other Swedish project focuses on ICT. Three projects do not focus exclusively on the field of SET: two projects investigate a broader area of male-dominated fields, and the Greek literature review focuses on equal access of girls and boys to all fields of education.

Up to now, all the information on the collected national projects was provided in the respective national language. As a result from this process of data collection, the information on these projects is now available in English as well and therefore accessible for a larger public. Below you will find a short summary of each analysed national project.

5.1.1.1 The Austrian Projects

Technology-Education and Gender

The local government in Villach, an Austrian city, established the "Micro Electronic Cluster Villach" and a university of applied sciences and tried to integrate a gender and labour market perspective in the whole process. Women should be able to take advantage of these new developments. The research project (Wächter 2003) was conducted within this framework and aimed at raising the proportion of women in high-qualified technical professions. It encompassed two steps: a "manual" was developed which entailed a list of measures to raise the proportion of women in tech-

²⁸ The only exception is the Greek research "Gender and Mathematics", which is a MSc thesis, and where no actual funding information was available.

nical fields, and a study was conducted which focused on investigating the national conditions and existing approaches and activities concerning women in high-qualified technical occupations.

53 interviews were conducted in total with teachers and pupils from a technically-focused VET college; with professors and female students from the university of applied sciences; and with employees and managers of companies of the "Micro Electronic Cluster Villach".

Tequality – Technology. Gender. Equality. Technology Studies as seen by Women and Men

The project (Horwath et al. 2007) aimed at describing the situation of students at Johannes Kepler University in Linz/ Austria and in particular at developing appropriate measures to increase the proportion of women in the two investigated fields of study, i.e. informatics and mechatronics, because women are highly under-represented in these fields of studies. The survey is in particular directed to the initial stage of university education and also refers to secondary education in many ways. It focused on influencing factors regarding dropout or success, on how students, dropouts and alumni perceive their situation, how they refer to the tension between gender and technology, and on which selection mechanisms are incorporated into formal requirements that affect women.

A qualitative and a quantitative analysis was made in informatics and mechatronics: 46 interviews were conducted with alumni, students, study beginners and dropouts, and the quantitative analysis was based on questionnaires for persons who had attended the subjects mechatronics or informatics from 1993 to 2006.

Career Orientation and Career Entry of Cirls into a Segregated Labour Market. Empirical Research on Career Choices of Cirls The study (Bergmann et al. 2002a,b) was conducted to give insights into the situation of girls aged 13 to 17 regarding their job decisions and into the services which should support girls at this age, in particular employment agencies and career counselling centres. Thus the study could also be seen as a kind of evaluation of these institutions and their services.

The aim of the study was to identify possible reasons for the gender-segregated labour market on the basis of qualitative and quantitative research and an analysis of other relevant studies. The focus lies on the influencing factors with regard to the occupational and educational choice of young women and their actual situation in unconventional occupational fields. Measures to increase the equality between men and women were to be developed.

The study is based on qualitative and quantitative data. 71 qualitative interviews with career counsellors, labour agents and girls (age 15-17), focus groups and one workshop were carried out. In a quantitative approach questionnaires from pupils (age 13-15) and national statistics were analysed.

5.1.1.2 The Greek Projects

Gender and Mathematics

The overall purpose of the research (Kotarinou 2004) was to discuss, analyse and identify reasons behind low participation of young women in mathematic courses and careers. The main research questions were if there are any inherent gender characteristics that guide young women in their study and career selection or if social roles are responsible for that; and if the two genders have different intellectual faculties or if it is a scientific excuse in order to justify the subordinate position of women in the labour market. Additionally the research presents "pilot initiatives" tested in schools during math class to assess

impact and responses of students and attitude changes towards mathematics.

The research drew conclusions and results from the existing literature, previous research done by organisations and sources, and finally from two primary research projects conducted on two separate groups, one with high school students (age 15-16) and another one with final year undergraduates of the department of mathematics at Athens University.

Education and Gender

The general aim of this literature review (Vitsilaki-Soroniati et al. 2001) was to investigate if in Greece studies have been realised that examine the degree of equal access of boys and girls in education; woman's participation in the educational system; the effective role of school books and teaching procedures in forming beliefs and attitudes (socialisation); and finally the effect of gender on "gaining" skills related to ICT.

Developments that took place in several sectors of education and literature on a national and international level (especially from English-speaking countries) were analysed and then the main goal was to record the lack of studies in Greece, which could explain the gender inequalities that can be observed in school records.

5.1.1.3 The Swedish Projects

More Girls into Professions with Voltage

While carrying out this project (Gillebert 2005), only five girls were studying in the Gävleborg municipality's six electricity programmes. In general, there are only few girls applying to electricity programmes in upper secondary school, and many of the girls starting this education drop out early. The aim of this project was to recruit more women for the electricity sector and retain the existing women within the sector. Information was directly given to female pupils in penultimate class in intermediate schools in the municipality.

The survey is based on interviews with several study advisors and vocational guidance officers. There was also an experimental element with wide information for pupils at 39 of 43 intermediate schools in Gävleborg municipality. Every information occasion was combined with a "testing" feature. Pupils could test different tools and get some practice. In a second step, the project created a network for girls in electricity professions.

Women and Information Technology

This project (Jerndal 2000) investigates the female view of ICT and ICT usage in Sweden in the late 1990sat the end of 1990. The aim of the report was to emphasize the perspective of women on this technology. Are there gender-specific factors which restrain women from computer usage? Are women not interested in the possibilities of information technology? Are there aspects of this technique which can be regarded as limited for women? The survey is based on interviews with young women from five municipalities in the region of Västra Götaland to understand how women approach ICT.

Also five women in top positions in the ICT sector were interviewed to find out how women who work with ICT conceive ICT. In a next step a small case study of an ICT company in Gothenburg was carried out.

5.1.1.4 A Dutch Programme

The Glass Wall

The national programme "De glazen muur"²⁹ (cf. Desczka et al. 2006) seeks to overcome segregation in the labour market, since in a thriving economy high-qualified personnel is needed in all sectors. The Dutch economy

²⁹ For further information see also the website www.glazenmuur.nl.

could no longer ignore highly educated women, as the number of educated men is declining and the demographic change, like in other European countries, also demands its tribute. In that sense, the programme wants to encourage organisations to employ more qualified women and to encourage women to make use of their talents. The project can be considered as a framework of seven pilots. In the field of SET there is the pilot called "Oriëntatie-brug N- profielmeisjes" (a VHTO project). This pilot is linked to the Dutch educational system with its specialisations within secondary education (cf. also chapter 4), where students must choose between four profiles: "nature and technology", "nature and health", "economy and society" and "culture and society".

As can be seen easily, a broad variety of national projects has been collected which cannot be compared in a simple way. In addition to the existing problems of crossnational research as outlined in chapter 3, further difficulties are encountered. Most challenging are not just the diverging research contexts and aims, but especially the strong disparities in availability and accessibility of the project information. There are sources of very different qualities: some projects published academic books or scientific reports, but for some projects information was mainly gathered by referring to websites.

So the comparative analysis has to be done with high caution, not just regarding the different national backgrounds (cf. chapter 4), but also concerning the different sources of information and the different research contexts of the projects themselves.

5.1.2 Projects Collected on EU Level

Each of the collected EU projects was carried out in five to nine EU countries. Consequently they are quite diverse as can

be seen in tab. 4. Each project had a scope of very different European countries involved, regarding their geographical position within Europe, their historical backaround or their economic power. Two of the projects are very application-oriented actions and two projects carried out basic research. All projects were funded by the European Commission, but by different programmes, and they were conducted around the same time, i.e. between 2002 and 2006. The period of all projects was rather shortterm: some had only a little more than one year of duration, others up to three years. Two projects focused exclusively on one field of SET, on ICT, while one project concentrated on the broader field of engineering, and another one covered the whole range of SET fields and did not specify.

Like the collected national projects, also these EU projects investigated a broader sample group than the target group of IFAC. Three projects conducted interviews, two of these projects also collected quantitative and qualitative data. One project referred exclusively to already existing literature and research.

But fortunately, for all projects there are final research reports available, so for the European projects we have access to an equal level of project information. Now a short summary on each analysed EU project, concerning its main research aims and the applied methodology, is presented.

PRO:: ICT. Promoting ICT to Female Students

The aim of this project (Hornung-Prähauser et al. 2004) was to develop gender-sensitive training material to train change agents to help young women through difficult career choices in ICT. The intention of PRO::ICT is to be a blueprint for further practical interventions. Therefore the project's aim is to produce study results as a guide for action: the material should include material for gendersensitivity, workshop designs, information material on the ICT market, manual and guidelines for organisational interventions, and case studies of successful women.

After a literature survey, interviews with girls and students as well as with change agents such as teachers, educationalists, human resource managers and career counsellors were conducted. The project partners also collected best practice examples of innovative approaches to improve the situation of females in ICT.

Tackling Stereotypes. Maximising the Potential of Women in SET

The project (Tackling Stereotypes 2006) intended to increase the representation and participation of women in SET, in professional academic and business spheres in the private as well as in the public sector. The project aimed to explore the reasons for the under-representation of women in some SET sectors through the research of stereotypes regarding women in SET.

Partners collected and analysed existing literature (reports, articles, books, studies) and statistical data on the situation of women in SET in each country. They benchmarked their results and experiences concerning existing stereotypes and consequences in recruitment, retention and promotion, and they collected good practices in business or academic grounds.

Womeng. Creating Cultures of Success for Women Engineers

The project (Womeng 2005) seeks to understand why women are not attracted by engineering and technology and it proposes efficient tools to change that. The research is divided into three parts: "Reasons for Choices" aimed at understanding the internal and external influences on women's choices towards engineering careers. The second part "Success and Non-Persistence" identified factors that may influence success or non-success in completing the degree and developing an engineerina career. The third part "Organisational Culture and Social Change" analysed gendered institutional cultures and structures in higher education and in the professional sphere to understand their influence on women's studies and careers. Interviews with students, female engineers and other experts were conducted. Furthermore other qualitative tools like participatory observation and webpage analysis were carried out. In the quantitative part, questionnaires were given to students, and there was also an analysis of statistical material collected from EUROSTAT.

WWW-ICT. Widening Women's Work in Information and Communication Technology

The project (d'Ouville/ Collet 2004; Valenduc et al. 2004; Vendramin et al. 2002) aims to provide a comprehensive and focused investigation of the gender gap in ICT professions and to give recommendations on how to improve equal opportunities and the quality of life in ICT professions and how to increase female participation in the field of ICT. It focuses on achieving four objectives:

- Developing a comprehensive understanding of the various aspects of gender disparities in ICT professions;
- Conducting an empirical investigation of these disparities through qualitative case studies and interviews;
- Identifying policy implications for equal opportunities in ICT professions;
- Disseminating results, recommendations and good practices to 'agents of change'.

This is done by reviewing the existing literature and studies concerning the gender gap in ICT, biographical interviews were carried out with women working in ICT, case studies of enterprises in the ICT sector with focus on gender issues were conducted, and good practices aiming at improving women's place in ICT professions were evaluated. Summarising this overview of the collected past projects, it must be stated that these projects present a broad range in research aims, methodological approaches, sample groups, type and amount of gathered data, geographical scopes and covered fields of SET. Since all these projects are very unique, it is not reasonable to do a comparative analysis by country or region, but to analyse and compare the results of the different projects with each other.

Now the core findings of the projects are presented as of interest to the before mentioned hypotheses IFAC has developed. First, we will go into the aspects of stereotypes and second we will address the issues concerning the lack of information.

5.2 Findings on Stereotypes

All collected projects identified gendered stereotypes as an important reason for many girls and women not to choose science and technology subjects. According to all analysed projects, stereotypes have a major impact on women in SET, since they hinder women from participating and developing a professional career in the field of SET.

But there are some differences between the projects concerning the amount of emphasis put on this issue. Most of the collected projects identified stereotypes as an important barrier and quote literature and research studies to support this insight. The Greek project "Gender and Mathematics" and the Austrian project "Technology-Education and Gender" elaborate this topic in depth. But one project, the EU project "Tackling Stereotypes", even had its main focus explicitly on stereotypes. Within this project, an analytical distinction between two interrelated categories of stereotypes is proposed: on the one hand stereotypes about women and men, i.e. gender stereotypes, and on the other hand stereotypes about SET (Tackling Stereotypes 2006: 35). Gender stereotypes refer to what is considered male or female in a society and mostly reflect traditional female and male role models and the gendered division of work, where women are responsible for housework and care-work in the family and men are considered to earn the money and participate in public life. Stereotypes regarding SET rely on the perception of SET professions and the perceived working conditions in this field. These stereotypes are closely linked to the segregated labour market, where certain jobs are seen as "male" or "female" (ibid. 36). Social prejudices and perceptions which regard engineering and technical profession as typically masculine regard these professions as contradictory to female gender roles and femininity³⁰.

Of course both categories of stereotypes are closely linked. As many sociologists have already shown before, the social constructions of gender and technology are interrelated (e.g. Faulkner 2000, 2001; Wajcman 1991): technology is socially constructed as a fundamental part of masculine identities. As such, masculinity refers to technological affinity, and technology is mainly for men to work and play with. These social constructions have to be challenged.

The distinction between stereotypes on gender and on SET is useful for the analysis of the findings on stereotypes of the collected projects. So, in the following we will explore the collected past projects on gender stereotypes and stereotypes regarding the field of SET.

³⁰ And even within SET professions there is a gendered occupational segregation as most women are employed in the SET services sector, whereas men are predominant in the manufacturing sector (see findings on HRST in chapter 4).

In a second step, we will elaborate how and in which way these stereotypes influence or hinder female participation in SET and the issue of female choice. We will focus especially on the identified key actors who spread these stereotypes, since they are also possible agents of change.

5.2.1 Stereotypes on Gender and Stereotypes on SET

The underlying widespread stereotypes in all explored projects, no matter from which country, are that women would not possess skills like objectivity, logical thinking, independence, assertiveness or negotiation skills, which are instead attributed to men. Stereotypical female attributes and skills would be warmth, passivity, practical thinking, as well as communication skills, social skills and empathy, while male stereotypes are described with the words activity, strength and assertiveness.

Tackling Stereotypes (2006) has compiled fundamental gender stereotypes:

- Women are responsible for looking after the household and children.
- Women cannot combine work and private life. If they do combine the two, their productivity is affected by the fact that they must dedicate time to their family.
- Women do not have the ability to think in an abstract, rational and objective way and are therefore not qualified for a SET profession.
- Women are not capable of managing a technical group composed mostly of men.
- Women cannot perform any heavyduty work, are afraid of technology and cannot use machines (computers, technological devices, etc.).
- Men are responsible for looking after the family financially.
- Men are better leaders and managers.
- Women often like to work in professions that involve nature, emotions,

instinct and feelings.

Men are rational, dominant, independent, cold and objective. Women are passive, dependent, tender and emotional. (ibid. pp. 35-36)

All these stereotypes can be found in all collected projects. Women and girls would be described as not having the abilities and competences to understand and work with technology or mathematics. The "PRO::ICT" projects states that girls themselves believe that they do not have the ability to work in ICT or study computer science (Hornung-Prähauser et al. 2004), while the Womeng project report (Womeng 2005) says that especially male engineers assume that women would be less competent engineers. These doubts and denials in female scientific and technological abilities can be found in every collected project as important stereotypes which hinder female participation in SET. The Greek study "Gender and Mathematics" (Kotarinou 2004) is the only project which refers to researchers who would openly classify these stereotypes as biological stereotypes, that the mathematical inferiority of women to men would be a result of biological differences and therefore natural. But Kotarinou herself rejects and contradicts these kinds of "scientific" approaches. All other projects rather refer to social gender roles and expectations. For example the Swedish project "More Girls into Professions with Voltage" (Gillebert 2005) states that women are not expected to be able to handle tools because they were not socialised and educated that way.

What characteristics are ascribed to SET studies and professions? The Tackling Stereotypes report (2006) has summarised stereotypes on SET professions as follows:

Careers in SET are masculine, aggressive, competitive and cold and therefore not suitable for women.

- The SET profession is boring and dirty.
- Working in SET is for "nerds".
- Working in SET is based more around individuals than teamwork.
- A scientist is a white middle-aged greying bald man in a lab coat wearing glasses holding a test tube. (ibid. p.36)

Interestingly, these stereotypes of SET as a male, nerdy, boring and hard profession can be found in all collected projects again. For example, the PRO::ICT report (Hornung-Prähauser et al. 2004) refers to perceptions of SET as too mathematical, and that an IT career would be highly technical or would mean work done in isolation. These images seem not to be interesting to most girls. Girls would regard IT professionals as male, nerdy, work obsessed and boring. The Womeng report (2005) additionally shows that these stereotypes are reproduced and reinforced by the representations of SET studies themselves e.g. on homepages of engineering departments at universities. Most websites found were highly text-oriented with very masculine images and pictures of men. This supports the image of engineering in society as a masculine one, very machine-oriented, with less communication and rational: neither creative nor positive, but combined with earning a lot of money. As a result, the report states a conflict between the image of engineering and femininity, since women would want to be feminine, so it is seen as a reason why not many women study engineering (ibid. p. 79). Engineering was perceived as a masculine, macho culture where the engineers, usually male, are more interested in machines than people and where 'warrior' style management is often used. The Swedish project "More Girls into Professions with Voltage" (Gillebert 2005) also refers to SET, in this case the electricity sector, as a macho domain.

Most analysed projects found that female

roles and ascriptions are contradictory to the masculine image of SET, and this would keep many females from starting a career in SET. The Austrian project "Career Orientation of Girls" (Bergmann et al. 2002a) links this issue especially to the age of girls when they are supposed to decide on their future careers. The report quotes career counsellors who observe that many boys and girls have to decide on their future occupation at a very early age (15 to 16) and at this age they would go through fundamental cognitive, social and biological changes and most girls would emphasize feminine behaviour and distance themselves from everything they would perceive as male. This leads to a strong focus on typical female occupations and they would reject typical male professions like SET since these were perceived as contradicting a female identity.

The Swedish project on electricity professions (Gillebert 2005) even speaks of a "male stamp" which has been produced since this sector has been dominated by men for so long. And this "male stamp" would create a polarisation which leads to a perception that if the electrician profession is a male profession it cannot be a female one. So the project explains that there is a relation between technology and gender in a way that technology is seen as an essential part of male identities, which would lead to the perception that women are seen as misplaced and must be changed to fit in.

5.2.2 Stereotyping and Socialisation: The Role of Parents

Already early during the process of socialisation, stereotypes regarding gender and SET are imposed on girls. The Austrian study "Technology Education and Gender" indicates that the social environment (in particular the attitude of parents towards technology in connection with the social role which is ascribed to females) plays a crucial 46

role for the decision-finding process (Wächter 2003). Not only general support is needed. but also the parents' ability to distance themselves from typical and conventional female role models. The decision to attend a technical school is in most cases taken together with the parents. At least the interviewed pupils refer to the attitudes and the behaviour of their parents when talking about the decision process (ibid. p. 101). The parental background is stated to be very relevant for the orientation of female pupils towards technology. The female social role models (the perception of how a woman has to behave, has to present herself, which qualities she should have, etc.) which a child experiences and becomes acquainted with in everyday interaction with the parents would also shape the perception of gender and technology. The interviewed female engineers perceived societal ascriptions to the sexes which dissociate technology from female abilities as still highly influential when they grew up. These societal ascriptions seem to be responsible for the segregation, i.e. the division into male and female dominated fields of education and employment (ibid.: 102-103). When the female pupils talked about their experiences at home it appeared that the most influential role models were their parents. For example the female students reported that it was important for them not to experience a typical division of labour between the sexes in their families. Alternative experiences, e.g. a grandfather who washes the dishes and does the cleaning as a matter of course, are seen as very important.

In this context the interviewees also brought up a topic which should not be underestimated at all: toys. When female technical students or engineers talked about their childhood experiences they frequently mentioned the use of atypical toys: like toy cars instead of dolls, or tools instead of kitchenware. Usually, the evolving interest in technical artefacts is often not fostered by the parents.

Thus the free choice and availability of technical toys (e.g. LEGO, experimentation and construction kits) which stimulate technical interest and abilities is an important issue. It is characteristic for female pupils of technical schools that they had the opportunity to use alternative toys which are usually rather given to boys. Especially fathers or other male relatives play an important role in this process. They would give their daughters a chance to make their first experiences in a usually male dominated field. The interviewees referred very positively to male role models and pointed out their importance for their further personal development. They had the chance to observe what their fathers were doing and to assist them with technical tasks. Some of the fathers had a pertinent educational background, e.g. they were engineers themselves or simply had a strong personal interest in technology.

Also the Austrian project Tequality (Horwath et al. 2007) points at childhood socialisation and the important role parents hold. The decision for a technical education and later on occupation depends strongly on the occupational background of the students' parents, in particular their fathers. 49% of male students and 42% of female students had a father who had been working in a technical field. 6% of the male students and 10% of the female students had a mother who had been working in a technical field (ibid. 98). But the project also found out that female students seem to have been supported to a lower degree than men through technical toys and practice. The ranking of most important influencing factors which stimulated technical interest was as follows: male students stated, in descending order, technical curiosity, technical toys, technical practice (repairing, tinkering) and the media as the most supporting factors. Female students instead stated technical curiosity, media, fathers and technical practice like repairing and tinkering as the most supporting factors.

The interviews showed that male and female students had different experiences during their childhood. Technical interest and abilities of female students had not been fostered by their parents and female role models regarding technology were rare. While boys were involved in technical practices, airls had to discover the field of technology on their own. When doing so they were often confronted with ambivalent gendered ascriptions which pointed to their "unusual" interest. E.g. they were called "the boy of the family". They had to find out that their technical interest contradicted their gender role and the expectations connected to it. In this context, the Greek study "Gender and Mathematics" (Kotarinou 2004) emphasizes the role of mass media in shaping and reproducing these stereotypes and influencing parents' beliefs. Women are either not referenced as scientists, engineers or technicians at all, or, if they are, they are presented as socially inept and physically unattractive.

5.2.3 Stereotyping and Discrimination: The Role of the Educational System

Within the analysed past projects, the act of stereotyping is often linked to discrimination, especially within the educational system. Here especially teachers are mentioned as key actors of reproducing stereotypes and discrimination due to stereotypes.

The European WWW-ICT project describes gender discrimination in the classroom as follows: male and female **teachers** live in a societal context in which some disciplines are considered as male and other as female and where a general agreement tends toward a higher praise for boys. Stereotypical ascriptions of how the two genders are supposed to behave lead to the opinion that girls are not interested or competent in technical areas such as computing and they are treated as less capable. So, even teachers expect girls to perform less well than their male peers.

Teachers would treat girls guite differently from boys, who are praised for their ability when they do well and criticised for not working harder when they do not, while girls are complimented on their hard work and neat performance when they succeed in math, and told they are not bright when they fail (Vendramin et al. 2002: 102). The scientific abilities of girls are doubted, and when they succeed teachers attribute their success to hard work only (Vendramin et al., 2002: 103). These stereotypical ascriptions have effects on the girls' self-perception: They are naturally less confident in their future math performance; and at equal ability, they are less optimistic than boys (Vendramin et al., 2002: 103). The report refers to studies which have shown that technology, math, physics or computer teachers, unconsciously, interact a lot more with male pupils than with female. Other examples of discrimination are: girls are interrupted more than boys; faculty members have eve contact with male pupils more often than with female pupils, are more likely to know and use the names of their male pupils than of female pupils. Girls are often asked fewer or easier questions than males and their contributions are often either attributed to men or ignored altogether (Vendramin et al., 2002: 103). This behaviour is subtle and often not intended to be discriminatory.

Very similar findings are given in the "Technology-Education Austrian and Gender" research report (Wächter 2003), which states that there is clear evidence of discriminating behaviour towards female pupils in technical schools especially by male teachers. Some of the male teachers were reported by female pupils to perceive technical VET colleges as schools for boys only. They would have very low expectations of the technical abilities from female pupils and doubt their interest in technology. Although this is just a minority among teachers, the reported incidents are alarming: e.g. one interviewee reports that her teacher said in class that female pupils were the reason for the overall low performance. Another case is reported where a male teacher told the new female pupils that just one half of the female pupils would be likely to finish the school. This would put female pupils under pressure to prove their abilities, and to invalidate the prejudices they are confronted with from the very beginning. And this would be even harder because they are much more visible than their male colleagues. This increased visibility gets them more attention from teachers, sometimes in a rather negative way.

The issue of a higher visibility is also mentioned in the Swedish project "More Cirls into Professions with Voltage" (Gillebert 2005), where it was observed that girls had difficulties to melt into the class due to the fact of being the only girl in class. In the project another issue arose: the project result showed that some teachers would give female pupils a "mother role", which means that a girl should look after the male pupils.

The Greek research "Gender and Mathematics" (Kotarinou 2004) emphasizes the role of teachers for the reproduction of stereotypical behaviour. It observes that although it is the general impression that teachers and professors do not distinguish between boys and girls in the classes, in reality the opposite happens. Educators encourage boys more than girls towards math and SET in general. For example, they would choose boys rather than girls to answer questions during class. They would give boys more time to speak; they would feed them with additional clues for answers and in general would pay more attention and encourage them more than girls. Usually they would reward boys for their cleverness and girls for their attentiveness. In light of this, the study states, girls tend to abandon more easily their efforts to understand math because they would believe that their failure depends on non-changeable factors like e.g. lack of competencies.

The Greek literature review "Education and Gender" (Vitsilaki-Soroniati et al. 2001) is even expanding this argumentation on the whole organisation of the educational system in Greece, which would be reproducing gender stereotypes. It is seen as reflecting the socially dominant, conservative gender ideology, starting from the gender-specific composition of the teaching staff, in which female educators are commonly in charge of teaching the lower age classes. The maternal role of women is promoted instead of establishing the role of working women.

It is also reported that teachers have different gender-biased expectations from their pupils due to their personal beliefs. It is said to be proved that teachers' perceptions are very significant factors for the development of gender differentiations, especially during childhood and adolescence. Also, according to the literature review, it is also noted that most of the teachers do not understand their sexist behaviour. But the review goes even further and states that the teaching methods used seem to contribute to gender inequalities, since boys and girls have different learning styles. And the review also argues that school textbooks, especially schoolbooks of history and mathematics, promote strong gender stereotypes.

The **teaching material** is also mentioned as an important factor in reproducing stereotypes throughout almost all analysed projects. For example, the Kotarinou (2004) points out that in general schoolbooks depict women in stereotypical roles and in marginal positions in the field of sciences. The absence of references to female scientists would be even more common.

Another key issue in reinforcing stereotypes are the schoolmates, especially the male ones. As Kotarinou (2004) explains, it has been shown that boys prefer activities and hobbies related to knowledge and competencies of a specific issue, while girls prefer games that provide them with the opportunities to handle interrelations competently. Maths is considered a male domain by both sexes. Additionally mathematical abilities are considered a fundamental prerequisite for the career development of the boys. Therefore there are certain perceptions amongst school children which the members of the group cannot overcome without facing disapproval from their peers.

For Austria, Wächter describes that the male/female relationship is most problematic at the initial stage of higher technical education (age 16). At the age of 16 male pupils would tend to perceive technical VET colleges as their territory and distance themselves from the female pupils. The male behaviour is described as rude and disturbing. Girls would not always be perceived as competent colleagues. But Wächter also states that after this initial first year of education male attitudes towards female pupils seem to change. They learn to accept their colleagues and even seem to appreciate the diversity which girls bring into the classroom. This change of attitude is reported by the female pupils themselves. But another problem is mentioned: there seems to be a widespread opinion among male pupils that girls are not discriminated but favoured by the teaching staff. This is not only because of their minority status but because of certain "female strategies" they are assumed to apply. This refers to the way they dress respectively the way they accentuate their looks. Male pupils often assume that their female colleagues do this to get better marks. The appearance of female pupils seems to be under continuous observation. This opinion is obviously influenced by stereotypes and puts female pupils under pressure regarding their self-presentation. The appearance of female pupils seems to be a permanent topic in the classroom. It is observed and might lead to offences if it is not adapted "properly".

According to Gillebert (2005), within the Swedish project some boys even tend to disparage towards the girls, and some of the female pupils are regarded as sex objects. There were also other negative attitudes reported, e.g. that boys do not talk with a female pupil and that they think that females should not be part of an electrician profession.

But Kotarinou (2004) points out that pressure is not only exercised amongst those of similar age but also from the predominant culture, values and stereotypes of various social groups, as expressed through the media and youth magazines. Social pressure is exercised on girls to comply with female stereotypes and rewards them with social acceptance from their parents, schoolmates, and teachers.

Wächter (2005) points to yet another issue: the predominant and male dominated language style in class. The language seems to be rather rude. "Harmless" joking and discrimination lie close to each other. Female pupils are reported to develop certain strategies to cope with male offences, but none of them seems to work effectively, and all of them consume a great amount of time and energy which could otherwise be spent on school courses. But language is mentioned in two different discriminating contexts, too. The first aspect refers to a gender-sensitive use of the German language³¹: Many of the teachers are still not used to explicitly talk to both sexes. They often use only the male form. The second aspect refers to the use of a special terms and lingo. The use of technical terms some-

³¹ Unlike the English, the German language usually has a male and a female form of the word for "pupil" or when referring to job titles.

times serves as to keep "outsiders" at a distance. If someone is not familiar with it, he or she cannot be a member of the group. It seems that boys make more use of such vocabulary than girls.

Wächter also describes an ambivalent position of girls in technical high schools due to the existing but contradicting stereotypes concerning gender and SET. She states that there seems to be a widespread opinion also among women and girls that females who are attractive face certain problems in a male dominated field because they are judged by their looks, and good looks means no competency. In other words: In order to be accepted in a male dominated field like technical education. females would not be allowed to be too attractive or to care too much about their looks. But at the same time, and here the ambivalence comes in, a woman or a girl might be discriminated if she would not adapt to the image of femininity. "She's only a technician because she is unattractive" is what female students sometimes get to hear while they are trying to understate a feminine look as much as possible to fit in with their male peers. So the conclusion might be that females are confronted with a contradictory set of stereotypical ascriptions also by their peers, which might hinder them to freely follow their interests and to be a technician and a female at the same time. They are hindered to express themselves in a different way and thus to bring in a difference into the field of technical education and work.

The EU project WWW-ICT focuses on another key actor: stereotypes also influence **guidance counsellors** when they advise girls on their career, even if they do it unconsciously, they are also affected by the societal image of the role of a woman, these stereotypes shape their advices and their ideas on what would fit a girl (Vendramin et al. 2002: 106). The study also claims that there is very little encouragement for girls to study computing at a higher level. High school teachers are more likely to advise male pupils than otherwise identical female pupils to take courses that would prepare them for post-secondary institutions. Often advisors do not take females seriously as graduates. Two main trends can summarise advisors' attitude: there is either an attempt at equal treatment based upon the faulty assumption that women had been socialised and educated the same as men, or, and this is the main trend, female graduate pupils are stereotyped as less capable and uncompetitive and are viewed as non-scientists, or certainly less good than boys and, as a result, are not advised to follow a technical career. But without this help from advisors or teachers, girls, who doubt their scientific abilities often do not dare venture in this insecure choice (Vendramin et al. 2002: 107).

For Austria, Bergmann et al. (2002a, b) observe, also referring to interviews with career counsellors, for girls only that school seems to be a place where stereotypical images of boys and girls are rather reproduced than questioned. It is reported that there are too few initiatives which try to raise the awareness of problems regarding stereotypes or gender segregation³². The disadvantages connected to typical female occupations would hardly ever be an issue. But also companies often signal that they favour males over females. This is something most of the interviewed girls experienced for themselves when looking for a job which is seen as "typical male".

As Kotarinou (2004) states, performance in mathematics plays a crucial role in pursuing or not pursuing the subject. So when teachers, schoolmates, career counsellors and the girls themselves underestimate their abilities in SET due to stereotypical believes and

³² Looking at the number of female graduates in upper secondary education, it can be said that to date school systems are not fit to change gendered educational choices (see chapter 4).

images concerning female and male as well as concerning SET professions and studies, it is not surprising that only few girls choose to study in the field of SET.

5.2.4 Consequences of Stereotyping: Low Self-Esteem

But all these reported discriminations, even though many discriminations were said to occur rather subtle and unintended, have a major effect on the girls' self-perception and self-esteem and therefore influence the future choice of study tremendously. And the lack of self-esteem is also a top issue which is discussed throughout all analysed projects, especially as a result of stereotypical ascriptions.

The Greek "Gender and Mathematics" study (Kotarinou 2004) shows that girls underestimate their abilities in terms of understanding math and they would feel insufficient for intellectual activities and problem-solving tasks. According to the research, girls tend to avoid math for a variety of reasons relating to their beliefs and attitudes. Many girls believe that mathematics is difficult, which is seen as a result of teaching methods, and also school books. Math is seen as a male domain, and often math's usefulness and usability is unclear to the girls. Usually in primary school there is no differentiation made between boys and girls on the usefulness of math. However, a dramatic change in their perception of the usability of math takes place as they grow up. Finishing high school, more boys than girls want to find a job in maths or related to the mathematics sector while the largest number of girls does not associate mathematical knowledge with better job placement. The reason for this is seen in the notion that girls would want to succeed in 'traditionally' female sectors like education, social work and office services, where math is not a prerequisite. According to the research, there are

men who dislike math as much as women, but they consider maths to be more useful and so they continue to pursue the subject despite their negative attitude towards it. But the study also points out that boys tend to attribute their failure to lack of effort or to bad luck, while girls attribute their failure to limited abilities.

Similarly, the Austrian project "Technology-Education and Gender" describes how stereotypical expectations towards girls and boys have consequences on their respective selfperception. Because usually boys are expected to be more able in the technical field, these different expectations can become a part of a girl's self-perception and work as a kind of selffulfilling prophecy. The low expectations make it hard for girls to discover their technical interests and abilities in a self-confident way. But the report also observes that teachers declare that female pupils are likely to underestimate their technical abilities although they often have better marks than male pupils. In general their selfconfidence regarding their technical abilities is said to be weaker. Even if they are successful, their interpretation tends to derogate their success (Wächter 2003: 124). It is seen as a matter of luck, easiness of the task or effort in the sense of working hard, but not as a consequence of their special talent. In contrast male pupils often take their success as an affirmation of their talent and they also emphasize their superiority. It is also seen as important how the pupils cope with failures (e.g. bad marks), in particular during the first years of education. It is reported by teachers that in Austria during the initial stage of higher technical education (upper secondary level) pupils usually get worse marks than they were used to getting in lower secondary education, because the overall level is raised. This hurdle must be cleared without developing feelings of inferiority and personal failure. However, girls seem to have more problems to cope with failure than boys. In this case girls stress intrinsic reasons – their own abilities - and not extrinsic reasons.

Also the Greek literature review "Education and Gender" (Vitsilaki-Soroniati et al. 2001) states that, even though there is no significant differentiation concerning the grades of boys and girls in mathematics, boys feel more comfortable and confident with mathematics.

Summarising the results and conclusions presented, it can be stated that in general young girls are not encouraged towards SET due to stereotypes which are transferred from the early stages of their childhood from various sources. Additionally the girls themselves have limited belief in their ability to succeed in mathematics because they view it as a traditionally male science.

5.3 Findings on Lack of Information

When analysing the collected projects, striking similarities regarding the described lacks of information on careers in SET were found throughout all projects. In all projects it was seen as a major issue for low female participation rates, and all projects mentioned similar crucial points which can be clustered into three distinguishable groups. First of all there seems to be the problem that girls do not get enough information on possible careers in the field of SET. Linked to this is also the lack of female role models, or better said, the limited visibilities of those women who manage a successful career in the field of SET. And a further case for lack of information is the everywhere mentioned inaccurate information on SET studies and careers. The image and perception of SET studies and working life are shaped by stereotypes as discussed in the previous chapter, but SET also seems to have a negative image for most of the females in the investigated countries which needs to be improved. Furthermore, these findings draw a counter image of the previously described overall positive estimation of prestige and career prospects in SET (see chapter 4). Obviously, the usual information on SET professions serves gender stereotypes.

Of course not all projects focused the issue of lack of information with the same emphasis. Three of the EU projects discussed the reported lack of information rather marginally, and for the "Tackling Stereotypes" project it was not a focus at all. In the national projects there are more findings on the problem of limited information on SET for girls, and the Austrian projects discussed this topic thoroughly. Especially the project on "Career Orientation of Girls" had a strong focus on the problem.

So the following discussion on the collected findings concerning the problem of information is structured along the two different clusters insufficient information and inaccurate information, and a special focus is again, like in the chapter on stereotypes, the key actors, who could be agents of change.

5.3.1 Insufficient Information on SET Studies and Career Prospects

The EU project Womeng (2005) describes the situation for most European countries in a way that pupils, when deciding on which university to go, do not have enough information about engineering professions and the actual activities of engineers. Even in countries where the prestige of such studies is high, students only know very little about engineering jobs. The report suggests that better and more complete information about engineering courses, available to all high schools, would make choices for students easier, and they would know what to expect from a university course in content, extent, form and requirements. And it is added that in countries like Austria and Germany, where different university types exist, the specialities of those institutions would have to be taken into consideration in advising individuals. Better specific counselling of pupils who want to enter university could help to reduce or avoid or diminish drop-out rates. In this context, the Austrian

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project Tequality (Horwath et al. 2007) states also that information regarding time management is insufficient: the amount of time needed for learning cannot be estimated on the basis of the course information or the curricular. The amount of work is usually much higher than presumed by the students on the basis of this information (ibid.: 60).

Bergmann et al. (2002a, b) give a detailed picture of the Austrian situation regarding information policies. First of all, they point at the important role of the parents in providing information and advice for choosing a future career. Parents tend to filter the information they give on to their children in a stereotypical way. The report explains that the strong focus of girls aged 15 to 16 on typical female occupations is also created by gender-specific information practices of schools and especially the parents. Vocational or educational information is filtered in a gender-specific way before it is given to young females. This is a serious problem because parents are probably the most important source of information for teenagers. According to the results from the questionnaire 64% of the males and 67% of the females had had information provided by their parents. Furthermore, within the scope of occupational information classes at school, it would still be common to take boys to technical VET colleges and girls to nontechnical schools. According to the research report, parents are the most important source of job information, but their advice often leads to a choice for a typical education or occupation. In particular for girls, parents and relatives are most important when it comes to information on future jobs and education. Parents are the most important role models for girls. This is seen as problematic because their occupation is usually a typical one regarding their sex. Because of the fast changing labour market conditions parents often advise their children to choose a

rather traditional and established occupation, which often means one that is typical female or male. Additionally, the disadvantages of typical female occupations are not known very well, and these would not be communicated to the children (ibid.: 16). The parents would hardly ever encourage their children to choose an unconventional education or occupation. Girls have stated their mothers as the most important source for job-related information and boys their fathers. Brochures, folders, advisory centres and the Austrian labour market agency are not perceived as that relevant. One third of boys and girls would not use any of these services. These results suggest that it would be important to include parents in the process of job orientation.

Furthermore, according to the report, the findings from the conducted research showed that parents introduced 45 different occupations to boys, but only 25 different occupations to girls (ibid.: 44-45). This would mean that the occupational spectrum for women is defined and constrained by the parents' advice. Only three girls out of 160 had been encouraged to choose an unconventional occupation, and these three girls actually did choose one. The career aspirations of young girls still seem to correspond to a high degree to their parents' aspirations. To be supported by their parents is very important for young girls. Unfortunately, in some cases the parents seem to put pressure on them to make a fast decision and to choose an "adequate" occupation, which means one that would be typical female. Some parents do not trust their children's occupational choice if it is seen as untypical. Also Jerndal (2000) reports for Sweden that since a lot of girls have "traditional" parents with "traditional" gender professions, they would keep their daughters from participating in ICT programmes, even if the girl wanted to participate, because it is seen as too male-oriented. Also the Womeng report (2005) states that parents and the family have an important influence on engineering students' choices, particularly for young women. Young people and their parents would need to know more about the reality of being an engineer so they could make informed choices about the courses and their subsequent careers they would want to follow.

Concerning the choice of technically oriented VET colleges in Austria, Wächter (2003) also points to an additional issue. The information regarding the actual proportion of girls in technical education seems to be insufficient. Entering a technical VET college seems to be a difficult choice for female pupils due to a fear of being the only girl in class. A lack of information regarding the actual gender ratio in technical schools is reported. Many of the girls were surprised when finding out that there were several other girls in class. The research showed that the thought of being the only female student could be very discouraging and could lead to serious doubts about the decision for a technical school. And indeed. Wächter mentions a teacher who states that the situation for girls who are alone in class is very difficult and that most of them drop out of school.

Concerning the role of schools in informing their pupils on possible future careers, Bergmann et al. (2002a, b) observe many deficiencies, too. Job orientation is often not institutionalised in school, in particular not in academic secondary schools, where it is up to the teachers if they integrate job orientation in their classes or not. Pupils of this academic type of school are reported to be less informed when they visit advisory centres than pupils of other school types which focus more on vocational training. The authors also state that teachers usually do not have a lot of occupational experience outside the education system and that they should attend special courses on job orientation. The situation regarding gender-specific information is

reported to be even worse. There is information material but teachers hardly ever make use of it. During class, questions on genderspecific occupational choice are not raised and the disadvantages connected to typical female occupations are not discussed. There is also evidence in the report that a stereotypical occupational choice is even promoted at schools (ibid.: 55-56). Even if there is a special school subject on occupational information. the pupils are sometimes allocated in a gendered way to different groups within the class. Girls would join groups for example on "creativity" or "services" and boys would join groups on "handicrafts" or "technology". According to the research report, teachers could play a more important role regarding occupational choice if they were more active. But often, according to Bergmann et al., vocational information is also provided rather late. At the age of 15 most of the students would have to decide on their future occupation or education. Only 33% stated that they discussed problems regarding typical female occupations in class. When girls were asked in interviews to assess the information provided by schools. they stated that the provided information had not been sufficient at all and a real insight into occupations had not been given. They further claimed that the spectrum which had been presented to them was rather narrow and oriented around typical female occupations. But positive experiences of girls often refer to company visits, which were discussed in class afterwards, and to teachers who were able to understand and encourage them.

Wächter (2003: 113-114) also emphasizes the importance of the personality of certain teachers who were able to inspire their pupils in their courses. Especially teachers in physical sciences, IT or mathematics who are dedicated to their jobs and are competent had a major impact on future decisions of the female (and male) pupils to enter a technical school.

Also for Greece similar deficiencies in career counselling at school are reported. Kotarinou

(2004) states that the way career counselling at schools is conducted it does not provide all the necessary information regarding education and professions that require specialisation, which could in turn offer better possibilities for professional advancement.

Apart from schools, one of the main key actors in providing career information are career counselling agencies. Bergmann et al. (2002 a, b) observe for Austria that the responsible institutions like AMS (Austrian labour market service) and BIZ (vocation counselling centre for youths) would not take into consideration the fact that women are often disadvantaged on the labour market. However, a difference between management and implementation level can be observed. On the management level these institutions seem to be aware of the existing problems. But on the level of implementation, where the actual information and advice is provided, there is a lack of understanding and awareness regarding gender inequality on the labour market. Even though AMS and BIZ are perceived as important sources for information by pupils, they are not assessed positively when it comes to actual decisions for a certain career or further education path. These institutions seem to provide plenty of information but they would not help young people proactively with their decision. 69% of boys and 77% of girls visited AMS at least once and around 75% of boys and girls visited BIZ. But 43% of girls and 53% of boys state that AMS is rather unimportant regarding their occupational choice. In contrast only 14% of girls perceive their mothers as rather unimportant for the decision-making process (ibid.: 57). The career counsellors at BIZ themselves state that parents, relatives and friends are much more important for the decision-making process than their own advice. Because many pupils visit BIZ together with their school classes there is

no time to concentrate on a single pupil. The BIZ counsellors actually are not meant to give direct advice to pupils, but to help them find relevant information. Even if the information material is reported to be quite good also in terms of gender sensitivity, the pupils are often left alone with too much information. In contrast, there are special counselling services for girls, which would try to give better and more individualised insight into different occupational fields. Also the chance that counsellors at AMS (AMS is responsible for job-seeking adults,

(AMS is responsible for job-seeking adults, too, and regulates the acquisition of social and unemployment benefit) proactively suggest an atypical occupation to females is very low. Therefore a better cooperation between AMS and other career counselling institutions which have a clear focus on young people is suggested. Nevertheless, parents perceive AMS advisors in turn as persons of authority and accept their decision regarding their children's occupation.

Regarding the Swedish situation, Gillebert (2005) states for example that female pupils do not get any information about electrician education programmes. When they have a career counselling about their future professional choices, the electrician professions are not mentioned by the counsellors. She states that there is no accessible information on the sector at all.

Horwath et al. (2007) also mention universities as a key actor for the lack of information. The authors point at a different issue: according to them, information on fields of studies is sometimes inaccessible due to the abstract and technical language of the course descriptions. In particular the abstract, technical language can be a barrier for better information and understanding (ibid.: 58).

Linked to the fact that there is not sufficient information on SET studies and career options, all analysed past projects mentioned the lack of role models. All projects claimed the visibility of successful women working in SET as a major influence for girls in a career deciding process. When girls are trying to choose a career, most of the time a career in the field of SET does not come to their mind as an option. Like already shown above, neither parents nor teachers nor career counsellors usually try to arouse interest in pursuing a SET career or even mention it as a possibility for girls. So if there were women publicly visible who actually are successful in SET and in balancing work and life, this would open the perspectives for girls to find out about a career in the field of SET, also as an option to follow one.

5.3.2 Inaccurate Information on SET Studies and Working Conditions

The issue of the inaccuracy of information on SET university courses and assumed working conditions is closely linked to the SET stereotypes already discussed in the chapter on stereotypes. Most analysed projects pointed to the fact that even if girls do have information on SET courses and SET career. this information is often shaped by stereotypes linking SET to masculinity. Often the image of SET courses is simply not attractive to girls. The EU project PRO::ICT observes for ICT studies that there is a need for communicating positive messages on IT and accurate information on the reality of working in IT (Hornung-Prähauser et al. 2004). They give an example on a widely accepted, but false perception of ICT, that courses and careers in computing require a strong mathematics background. But actually it would be a question of what is emphasized, what requirements and competencies are spotlighted, and which ones are to take the back seat. The Womeng report states, for example regarding engineering, that the caring and socially responsive aspects of engineering would need to be emphasized (Womeng 2005) to

attract more females to SET. But also Vendramin et al. (2004) speak about inadequate information on ICT professions. They refer to two studies showing that school girls where generally well informed of the ability of women to programme as well as men, but they were generally unsure if IT professionals worked alone and whether they mostly wrote programmes. Another study asked to indicate the skills and personality characteristics to be successful in a computer-related career, the lowest scores went to communication, analytical skills, creativity, and team player and outgoing (Vendramin et al. 2002: 109). This lack of information was proved by the WWW-ICT project's own research. An outcome of the empirical research of the project is that there is no sufficient and shared information on the actual content of ICT professions (Valenduc et al., 2004: 32). The Dutch programme "The Glass Wall" highlights another issue closely linked to the topic of inaccurate and gendered information on SET studies (cf. also chapter 2): educators have to make descriptions of "required competencies" for professions. These descriptions appear to be gender-sensitive. In technical fields and SET both specialists' cognitive competencies are stated, whereas in "female related professions" there are significantly less specialised cognitive competencies mentioned (De Ruijter 2005: 74). To encourage more young women to choose a technical profession, the presented information from the perspective of educators and schools needs to be adjusted. Looking at the descriptions of competencies needed in certain professions, it is striking that educators do describe these competencies in different ways for SET and non-SET fields. Whereas SET educators use advanced and detailed formats to describe cognitive skills and competencies. in non-SET fields they use no or just very vague descriptions. This gives the misleading impression of non-SET professions being easier to study. Due to these descriptions of pro-

fessions, young women (and men) cannot choose on objective information (ibid.: 75).

The Austrian project Tequality observed that the public image of technical education as very demanding and not "adequate" for women (Horwath et al. 2007). Technical education at university level is expected to be very demanding and to take very long. A pertinent educational background is seen as a crucial advantage. There is also the notion that studying and working in the field of technology is not "adequate" for women. Some subjects like mechatronics have a particularly negative image. In this context, the other Austrian project "Technology-Education and Gender" points to the high dropout rates because of false expectations. The information about the concrete focus of the education is in many cases not clarified before the female students start with technical education. They often find themselves confronted with a kind of work they would not want to do, and then they would drop out.

Gillebert (2005) gives an example of how a different and more realistic image of SET could attract girls to SET studies: those girls who were allowed to give technology a try within their families and schools have a less male-stereotyped perception of technology. The study observed that e.g. the fathers, friends or teachers introduced them to a technological professions would be like. So the world of technology, the so-called male area, has been disenchanted and gotten a shape. Supportive parents could lead to increased credit and faith for the girls, so that they would be able to manage in the field of SET.

5.4 Further Reasons for Low Participation

Since the low female participation in SET is a complex phenomenon, and it appears to be rather resistant to change and improvement it can be expected, that the reasons

for this situation are also complex, multifaceted and interrelated. So even though stereotypes and lack of information play an important role in the career-choosing process, there are various further reasons for the low female participation in SET. In this chapter we have compiled the most frequently mentioned further reasons in the analysed project reports.

Many projects mention **educational policies** which contribute in some ways to low female participation. For example, Womeng (2005) observes for many EU countries that pupils have to pick an educational track (academic, vocational, technical etc.) at the age of 15-18 already (see also tab. 1). And of course at that age family plays a crucial role in encouraging a pupil's interest or disinterest on a subject. The family is said to push subconsciously or consciously for a career with secure job prospects rather than a gender-unconventional profession.

For Greece, Kotarinou (2004) points to another reason concerning the choice of SET studies. She mentions the bureaucratic way in which the Greek educational system registers the preferences of the students in terms of university courses for entrance examinations. The structure of the system in Greece allows the students to complete off a list of universities the courses they would like to pursue without setting a limit on the number of places one student can apply for. As a result there is no parity in numbers.

In the Netherlands a recent policy is being implemented that students need to have a "startkwalificatie", a vocational qualification to guarantee entry to the labour market. In vocational training, however, gender segregation is much stronger than in secondary schools. The compulsory "start qualification" therefore has a negative effect on a more equal spread of males and females in SET. And here the pupils have to choose even at a younger age (see tab. 1) and probably have a less clear image of themselves and of professions at all.

The Austrian project Tequality points at another problem connected to national educational systems and policies: the implicit norm of an "ideal student" which favours men over women (Horwath et al. 2007: 110-111). According to the authors, the expectations regarding the technical knowledge of first-vear students seem to take students who graduated from technical VET colleges as standard. Thus the "ideal student" would be someone who attended a technical VET college and entered university soon after. 41% of students meet these criteria (compared to 32% of dropouts and 55% of alumni, which shows that the educational background influences study success to a certain degree). But only 6% of female students meet the criteria of the "ideal student" compared to 47% of male students. The authors conclude that the overall surroundings at the investigated university would not support all groups of students (regarding their former education and sex) in the same way. There is an implicit norm of how the ideal student should be like and the curriculum and the performance requirements are linked to that norm. It is assumed that students have previous technical experience (terminology, technical practice, experiences with technology during childhood), that they have previous technical knowledge (which only technical VET college students really have), that they start studying immediately after finishing secondary school. All these assumptions favour male students because of their gender specific cultural and social experience and their former school education. These assumptions are also connected with the ascription of certain personal qualities to the "ideal student". This implicit norm favours certain groups. The difference between men and women, which evolves during the earlier stages of socialisation regarding their technical interest and ability, is

maintained and even widened through this implicit norm, which obviously favours male students (ibid.: 144).

For Austria, Wächter (2005: 149) also mentions the low quality of IT courses in secondary education as an important reason for low participation in SET. The teachers of these courses are reported not to be qualified enough to give their students a comprehensive and interesting insight into the subject. The courses hardly prepare the students for upper secondary technical schools and they also tend to be male dominated. This disproportional percentage of males also appears to reproduce itself. For example, Bergmann et al. (2002b) point to the fear of being the only girl in a male-dominated environment as a central reason which keeps girls from choosing technical studies. This problem is also stated in the Swedish project "More Girls into Professions with Voltage" (Gillebert 2005). The author describes the situation of being a single girl in a boy group as very difficult. The school situation could be experienced as hard and lonely and this happens especially in the first year. During this period most airls drop out.

But Cillebert also mentions the **hostile environment** in the report. The research showed that some girls were harassed by teachers and male class mates. Girls had to prove that they were as good as the boys or even better. Often the girls would not be trusted to be able to do their work properly. Hornung-Prähauser et al. (2004) mention, referring to the ICT area, that negative classroom experiences, masculine culture and hostile working environment keep females from learning, studying and working in ICT.

Kotarinou (2004) even argues for the Greek situation that in many cases the biggest problem turns out to be the boys themselves, who consciously or subconsciously prevent girls from getting involved in professions that are characterised as typically male. Also male parents, teachers, partners or job supervisors tend to keep women away from SET careers. This is seen as a result of deeply embedded prejudices and beliefs which are evident even amongst peers at university. So, for example, even though both men and women are participating in the mathematics department of universities, neither may feel that the job of a math teacher is appropriate for women.

Psychological factors are mentioned as a further reason for low female participation in SET by the EU project WWW-ICT. Most girls have a low self esteem and low confidence in their technical abilities. This does not come by surprise, taking into account the discrimination and non-encouragement already discussed above. From early childhood on, boys and girls are encouraged and stimulated towards technology absolutely unequally. And as the PRO::ICT project (Hornung-Prähauser et al. 2004) adds: females simply have less access to computers than males. So the pre-conditions are very disparate from the beginning, which of course forms self esteem and confidence in handling technology fundamentally.

And this factor causes far-reaching consequences like e.g. an issue mentioned by Bergmann et al. (2002a, b): the authors found out that in Austria the occupational spectrum of girls is getting narrower the closer they get to their job decision (ibid.: 32). While during their earlier childhood girls were interested in many different occupations regardless of their gender connotation, when they are asked about the occupation they aim for at present, the percentage of girls who choose an unconventional occupation went down to 7%. Boys hardly ever choose a typical female occupation. According to the results of the questionnaire, girls seem to spend less time thinking about their future occupation or education than boys when they are in lower secondary school. The authors suggest that this is due to the common notion that girls do not have to

be prepared as well as boys for their future occupation, which influences the girls themselves as well as their families.

And as a matter of fact, the PRO::ICT project and the Austrian project "Career Orientation of Cirls" refer to the actual **low chances** for females to get into a "male" profession (Hornung-Prähauser et al. 2004, Bergmann et al. 2002b). Often, females can only expect low career prospects in ICT companies, and they have to cope with unequal remuneration. And also quite frequently demanded social competencies are not valued adequately.

But one of the biggest obstacles in starting and pursuing a career in SET is mentioned by almost all projects at least marginally. It can be summed up as the **gender-specific division of work.** Since women are expected to handle most or all of the reproduction work, like taking care of food, clothing, cleaning, the upbringing of children, and taking care of the elderly relatives, they rely a lot more than men on possibilities to balance gainful employment and reproduction work.

Like Hornung-Prähauser et al. (2004) put it, the ICT sector is often characterised by long irregular and non-predictable working hours. The authors also state "blurring boundaries" between the professional sphere and the private sphere, and between professional working time and recreation time. This leads to difficulties for women balancing work and family, since working conditions were mostly oriented to men, which results in a lack of work-life balance.

Also in the Netherlands, the lack of work-life balance is seen as a major reason for the low female participation in SET. Vlasblom and Schippers (2004) refer in their research on female participation in the labour market to the "expected career": a person makes calculations with respect to making investments to oneself. If somebody is expected to provide many caring tasks like raising children, it would not pay off to invest into a SET career, since this would need continuing professional development. Thus, the majority of Dutch women still choose professions which would be easy to combine with family tasks instead of looking for a professional career in SET.

Secondary working conditions are seen as very important for women in the Netherlands. Men usually have different demands (e.g. a lease car, bonuses), whereas women's priorities would be short distances between work and home, no danger or high risks, part-time work, or flexible working hours (Desczka et al. 2006: 139). When it comes to the labour market it turns out that advertisements often lack attractiveness for women. Companies would have to design new patterns of secondary working conditions like flexible working hours, combination of paid work and family work, and they would have to promote these measures to men as well as to women.

5.5 Summary

On the whole, all analysed projects seem to draw a similar picture concerning the role of stereotyping and regarding the lack of information.

In all projects similar gender stereotypes, what is considered typical male or female, are reported. And also the stereotypes stated concerning SET studies and professions seemed to be very similar throughout all projects. Girls and women were seen as not possessing the abilities needed for being a capable scientist, an engineer or a technician. And SET was regarded as a fundamentally male and masculine domain. These stereotypes were reported to have a strong impact on girls and boys starting at a young age, imposed to these ascriptions mainly by their parents, and throughout their educational path, discriminated by teachers, peers and career counsellors. And these stereotypical ascriptions affect also the self-perception of the girls and their confidence in their technical abilities, and so it becomes a self-fulfilling prophecy.

Regarding the lack of information, the proiects' results refer to two different issues concerning this problem. On the one hand, there is not enough information on SET studies and careers for girls, and on the other hand there appears to be a false perception of SET studies and working conditions, a male image is reproduced which is not attractive to most girls. So the girls do not get sufficient information on SET courses and careers by their parents, teachers, career counsellors or the public media. And also a lack of publicly visible female role models is reported. Additionally, the information available is characterised by reproducing the male image of SET, e.g. in the way departments at university present their courses. Usually, for SET studies and job positions, requirements and competencies are emphasized which are connected to typical male socialisation and education. This keeps girls and women from striving for a career in this field.

But of course stereotypes and limited information are not the only reasons why girls do not choose a career in the field of SET, or could even explain low female participation. All proiects assume that there is a set of different reasons and aspects which are interwoven and interact with each other. There are structural reasons, like the gender-specific division of work or educational policies, which indirectly favour one gender. There is an unequal accessibility to technology and of course women have still lower career prospects in SET professions and they are often paid less than men. To change these conditions, also governments and national and EU policy makers are called on to take action against these situations.

All the collected reasons why most girls do not choose SET careers are important when considering recommendations, which is the subject of the next chapter.

Part 3:

Lessons Learnt

6. Promoting Factors -Reducing the Gender Bias in SET

his chapter focuses on the recommendations given by the collected past projects. What has been recommended to combat stereotyping which prevents girls and young women from choosing a career in science, technology or engineering? What recommendations were given to diminish the stated lack of information?

Most projects have given a wide range of recommendations. Due to the respective main aims of each project, the focus and range of the offered suggestions for improving the situation of low female participation in SET varies. The EU project PRO::ICT had an explicit focus on developing measures for improving the situation in ICT. Therefore the proposed actions are quite specific. Other projects like the Greek literature review on Education and Gender do not give many recommendations, since their focus was directed on different matters. The Austrian project Tequality is focused on new students in university, so that its recommendations are only partly interesting to IFAC's target group.

Unfortunately no evaluations were given on actual implemented measures.

6.1 Strengthening Girls' Technological Self-Esteem

As already mentioned in the chapter on stereotyping, one of the crucial consequences of stereotyping is the low selfconfidence of girls as their technical or mathematical abilities. So, three of the analysed projects recommend very strongly, measures to increase the girls' selfesteem when approaching science, technology or engineering.

PRO::ICT (Hornung-Prähauser et al. 2004) suggests improving self-confidence by self-assessment tools for pupils to test their personality and computing skills. This would also help pupils to discover their skills and reflect on their possibilities with reference to computer skills. Students should learn how a computer system works and experience that they can "tell the machine how to work" (ibid.: 111). The project report calls on teachers and career counsellors to increase the self-confidence of female pupils to choose an ICT career path. It also sees a need for mentoring and quidance of female pupils and students who follow this path.

Also Tackling Stereotypes (2006) calls for training in self-esteem during different educational stages. Lack of self-confidence is described as the biggest obstacle for women taking part in decision-making processes, just as it is a barrier for women to choose science as a profession or making career in academia.

For Austria, especially Wächter (2003) demands measures to increase the selfesteem of girls. Rhetoric courses for female pupils should be established. In these courses they would learn how to present themselves in a self-confident way. In addition there should be separate courses for girls and boys to be trained in conflict management and to reflect on gender aspects. The aim should be to improve communication as a prerequisite for positive learning efforts and non-violent interaction.

6.2 Gender-Sensitive Education Environment

The recommendations concerning introducing a gender-sensitive education environment seem to be of greatest importance for all analysed projects. There is no project which does not perceive education and its key actors, especially the teachers, as a crucial point for intervention.

In the PRO::ICT project report (Hornung-Prähauser et al. 2004), which of course focuses exclusively on the ICT sector, it was stated that around the age of 13 to 19, young girls think about their future in terms of what career path they might choose. Right at that point, the first choices for specialisation in educational programmes are due, like passing from lower secondary to higher secondary education and then tertiary education. Or the pupils have to decide if one should take special higher advanced courses or change to a different type of school. In this orientation phase the training objective with students, their parents and peers is to develop the idea that a professional career in the ICT world would be a real option for their future. Female students should become aware that they would actually be able to gain a leadership position in the ICT world by planning carefully. They should be informed that they would not have to fight alone and that assistance would be provided throughout this process by change agents, especially the secondary level teachers and career counsellors. Womeng (2005) recommends introducing mentoring schemes for schoolgirls.

Change agents should be trained in sensitising girls, parents and peers in dissolving misconceptions of ICT careers and the job profiles and opting for an unconventional career. In this regard, a gender-sensitive education environment and an innovation

of curricula would be needed. This is recommended strongly by all analysed proiect. For Sweden, Jerndal (2000) asks for educating the teaching staff in gender issues and for developing methods and new gender-sensitive ideas. For Greece, the Education and Gender project (Vitsilaki-Soroniati et al. 2001) states that educators could promote gender equality and the participation of women in "male" fields through training and gender sensitisation. Boys and girls should be encouraged, by their school as well as by their families, to have more educational and professional choices, especially choices that are considered as "out of their gender role". Measures should be taken by the state, such as programmes, actions and studies, so that all the persons involved in the education system would be informed and sensitised towards reducing gender stereotypes. In general it is considered important to examine the factors that would cause different school performances of boys and girls.

For Austria, Wächter (2003) calls for educational programmes, in which teachers should be sensitised in gender-specific differences, and they should learn how to avoid gender-hierarchic behaviour. But to enable a gender-sensitive education environment, she also suggests introducing gender-specific youth work with boys. This would be necessary to lower the boys' aggression potential, to make them aware of discriminating practices and to help them establish their own gender role. Bergmann et al. (2002a, b) add concerning the Austrian context that there should be obligatory further education for the teaching staff regarding gender-specific issues: teacher education should be reformed regarding gender issues. And teachers would have to be informed on changes in the labour market and resistant segregation patterns, so that they would be conscious of the disadvantages which particularly girls face. The schools should also cooperate more closely with career advisory institutions, which are targeted at girls only. But it should also be fostered that social work with parents is introduced, especially regarding gender-specific occupational choices.

For Greece, Kotarinou (2004) also asks for specialised career counselling programmes addressed to parents, school teachers and career counsellors for the usefulness of math and aiming to assist young girls who understand that mathematics is equally important for their career development as it is for men. Boys should also be informed on the importance of math for women's career development in order to avoid reproducing surpassed stereotypes regarding female abilities. And finally she suggests that teachers would need to improve the overall approach of math during class, and they should promote girls to become involved in math and the broader field of SET.

Concerning the ICT field, the PRO::ICT project observed that girls often have less hands-on experience with computers. They need support in computing to gain knowledge about how computers actually work. So it was suggested that there should be sufficient equipment available to ensure access to computers for everyone in school, so that female students would also get the opportunities for computing and tinkering at school at an early age. An environment should be provided that would give girls a guaranteed access to the necessary equipment, like hardware and software, as well as form a gendersensitive learning culture in the classroom. To achieve this, collaboration and cooperative learning groups should be promoted.

The Tackling Stereotypes (2006) project also calls for introducing new and more gender-inclusive didactics. It sees a need for changing the attitudes of society by developing new methods of school education for the younger generations. Wächter (2003) suggests in this context for example more teamwork to support the learning habits of female students. But it should be ensured that a female student is not the only female in a workgroup. She also suggests that the curriculum of technical schools needs to be changed to include humanities. Kotarinou (2004) adds for the Greek national context that for example initiatives which combined mathematics with culture and history played an important role in changing the stereotypical belief systems of the pupils.

Wächter also explicitly recommends to foster activities which include only girls at technical schools (technical VET colleges) where the female participation rate is rather low. For example she suggests to introduce a girls room, which would be a room designed by female pupils themselves where they could get together and share their experiences in a self-organised way. Female students should be given the chance to share their experiences with other students of their own sex at least in higher classes. This could function as a kind of mentoring. There should be meetings at regular intervals. Wächter also proposes that female pupils who are the only females in class should get special support from older pupils. In case it is a male pupil, he should be aware of his special responsibility. But she also calls for female teachers of technical subjects as role models, female guidance counsellors for the girls and female school doctors, who could also be responsible for psychological support, and also there should be contact to female professionals. She even proposes introducing quality management regarding gender equality at technical schools, so that the condition of female and male students would be observed.

But not only the people and the methods of the education systems need to be gender-sensitised; also the educational material has to be revised to reduce the reproduction of stereotypes. Tackling Stereotypes (2006) calls for new or revised textbooks that no longer transmit the "old" gender stereotypes. And Kotarinou (2004) suggests incorporating illustrations which also girls could relate to. Jerndal proposes to use teaching material which includes both male and female images. And if this was not possible, teaching material with gender-neutral pictures and gender-inclusive language should be used. Wächter (2003) even approaches the infrastructure and architecture of school buildings of technical schools, which needs to be improved: there should be more plants, colourful design, benches, and classrooms should be refashioned by the students themselves. But she also sees the simple need for more sanitation facilities for girls in technical schools.

6.3 Filling the Lack of Information

6.3.1 Providing Accurate Information on SET Careers

As mentioned before, the limited information on SET careers is seen as a major problem by all analysed projects, therefore most projects have elaborated in-depth on recommen1dations how to improve the present situation.

Focussing on the ICT sector, Valenduc et al. (2004) propose to encourage the circulation of information on diverse career opportunities and diverse skills and job contents of ICT professions. Career counsellors and human resources managers, but also parents, teachers and students are considered the main agents of change. Women should be informed on the variety of ICT professions, not only through awareness campaigns and programmes addressing girls, but also through real experiences such as summer school and company visits.

PRO::ICT asks secondary level teachers and career counsellors to give information about the ICT labour market, occupations and skills to their pupils, who should learn e.g. about ICT companies in their neighbourhood. And they should become aware of their images of people working in ICT companies to change the inaccurate perception of computer careers (Hornung-Prähauser et al. 2004). And especially to career counsellors, the authors give advice to match the interests of women and the skills needed for jobs available in an IT context. Also in consulting processes, attention should be given to taking account of gender-mainstreaming issues. If gendersensitive issues are taken into consideration in tests and assessments, this would improve opportunities for women to get a job that meets their skills and interests. But the project also points at providing extended information on ICT courses to parents, since parents influence the attitudes of their children.

The Womeng project focuses on universities in their role as agents of change: technical universities or engineering departments should cooperate more closely with high schools in informing the pupils on what additional knowledge could be useful for their university education. Universities should also provide easily accessible information about the degree courses and facilities such as study groups, counselling services, networks, internships, studying abroad, etc. for high school pupils. This would make choice easier for the pupils, and they would know better what to expect from university studies (Womeng 2005). But the report also calls for universities and companies to put on "Open Days" and linking with primary and secondary schools. Engineers and engineering students should support science and engineering activities in primary and secondary schools. And engineers could tell pupils about their work.

For Austria, Wächter (2003) as well as Bergmann et al. (2002a, b) recommend that female pupils should get better information as to creating realistic expectations of technical education and working life. For this purpose, "Open doors day", summer courses and workshops should be held to give insight into the technical work, and there should also be information events for parents. Contacts between secondary schools and university students should be established.

On the Greek side, Kotarinou (2004) addresses rather the career counsellors, who should clarify and stress to girls the importance of maths for employment in high-profile jobs. Better information for careers in mathematics should point to the usefulness of math for the girls' own benefit.

For Sweden, Gillebert (2005) recommends career advisors to continuing further education to stay updated on the current situation on the labour market, so that they would be able to give correct information to the pupils. She also suggests introducing more information events incorporating "hands-on" activities.

Bergmann et al. (2002 a, b) provide detailed recommendations for public career counselling centres in Austria. Just like Gillebert for Sweden, they also ask for further education for career counsellors regarding gender issues. They should be able to reflect on their own behaviour in a gender-sensitive way and also should be familiar with gender issues concerning occupational choices and the labour market. Gender-sensitive guidelines for career counselling should be developed which should raise awareness of gender-specific patterns and how they could be dissolved. Within the counselling process, special media and methods should be used which could foster girls' interest in atypical occupations. There should also be services provided for gender-homogenous groups, so that girls could have the chance to meet women who work in unconventional occupations. And the promotion material for certain occupations should not reproduce common stereotypes. The authors also call for more personnel resources which are especially needed to provide efficient services for girls. There should be a knowledge transfer between all relevant institutions regarding gender-specific information. The assessment of these services should not only focus on measurable factors but also on qualitative factors, like what has been really done for the girls. But the authors also see a need for better coordination between the different types of career counselling services in Austria, and they suggest creating a steering committee which would coordinate action of all relevant institutions.

But most important, Bergmann et al. propose to introduce or support (if already existing) career counselling services for girls only (ibid.: 66-67). These centres could help girls to discover their abilities without social restrictions. Advising groups of girls and boys together would often have many disadvantages. For example, girls rather miss out within traditional structures because those are usually directed more to boys than to girls. Furthermore, it was observed that, within mixed groups, it would be harder for girls to distance themselves from stereotypical ascriptions. Career counselling services targeted at girls could provide more time and space for girls, and these centres would foster a practical approach, since girls are allowed to experience new/atypical fields of occupation hands-on. Workshops, company visits, courses, or meeting role models are activities carried out at those centres. The counsellors would also state that text-based information is often inappropriate for inspiring young people to do new and different things or to go for unconventional occupation or education. But there is an urgent need for these organisations, which provide services for girls for long-term financial support.

Kotarinou (2004) addresses an additional issue for the Greek national context: institutes and organisations (similar to the Institute for Women in Science and Engineering in the USA) which have the exclusive purpose to support women interested in higher scientific education. Such organisations, which could inform public opinion on local and national level on the difficulties encountered by female scientists and how to overcome them, should be established.

WWW-ICT even points to a higher level, where the lack of information could be sustainably reduced. National educational institutions in charge of the Process of Bologna⁵⁵ should have precise information on the job contents in ICT professions in order to better design school and university curricula. School and university should make clear, grounded and cross-disciplined curricula on account of the great diversity of entry routes into computing and including also the foreseen skills (Valenduc et al. 2004).

6.3.2 Improving the Image of SET

Five of the analysed projects provide recommendations targeted at improving the negative and sexist image of SET studies and working conditions. The PRO::ICT project proposes to discourage the view that ICT is a male-dominated area. Females should rather regard the role of ICT as improving quality of life. Offering interdisciplinary education and professions in ICT attract more female and male students (Hornung-Prähauser et al. 2004). Tackling Stereotypes (2006) also calls for improving the image of SET professions at university to attract more women.

Womeng (2005) observes a need for country-specific programmes to be developed to improve the image of engineering. Companies and professional societies should show that there are caring aspects to engineering that it is responsive to the needs of society. "Softer" images should be presented on their web pages, like pictures of people. Links with local communities, schools and universities should be built. And, like the PRO::ICT project, also Womeng asks universities to introduce more interdisciplinary subjects, which would encourage more women and men to apply.

Next to these three EU projects, also two Austrian projects propose action for

³⁵ It aims at developing a system of easily readable and comparable degrees based on undergraduate and postgraduate studies.

improving the image of SET. Concerning technical schools, Wächter (2003) also suggests designing gender-inclusive web pages containing pictures of girls working with technical artefacts. And for annual reports of the schools, attention should be paid to gender-inclusiveness of group pictures and articles.

The Tequality project addresses especially universities in making young women feel welcome. Universities should seek their attention by highlighting that there are different groups of students and that all of them are welcome. There should be signals for aiming at a higher representation of women at university. Special courses which support students at the initial stage should not be designed as a special support for women only, but for all groups who need it. An improved homepage design is also mentioned.

6.3.3 Making Female Role Models Known

Recommendations concerning a better visibility of role models to increase the female participation in SET were also made by many projects. "PRO::ICT" (Hornung-Prähauser et al. 2004) mentioned that learning about role models and their success stories in school could support the students in modifying their role and career choice. They would learn about career paths of women who could be role models and learn how to manage family and job affairs as they listen to "female success stories". This would help overcome the negative notion that women are unable to compete with men in the field of ICT. Therefore, "true stories" of women who have gained success and respect as ICT professionals should be compiled and presented. "Tackling stereotypes" (2006) also acknowledges that female role models are

extremely important to allow young girls to recognise themselves in someone else and to be able to see the possibility for women in the field of SET. Womeng (2005) proposes that female and male engineers who are good in public relations should meet with the public or school children to promote engineering. Female role models should also be prominently visible on television or radio. And professional female engineers should act as mentors and role models for young women at school and university. For Greece, also Kotarinou (2004) calls on the media to promote more female role models with mathematical abilities in high-profile jobs.

For Austria, Bergmann et al. (2002a, b) mention that it is a common notion that role models influence the occupational choice to a high degree. But surprisingly the authors come up with the result from the questionnaire, which shows that 60% of women and 47% of men state that they do not have vocational role models (ibid.: 38). However, the interviews showed that girls are most likely to choose an unconventional occupation when they know female family members or relatives who did the same.

6.4 Further Recommendations

Beside the role models, "Tackling Stereotypes" presented two further ideas for creating and disseminating successful models: "Family models" demonstrate successful examples of combining family and career. This should promote both spouses to make their career, as long as they help each other and share the burdens of domestic work. And "Business models" would present working environments which help creating successful family models, e.g. companies, which implemented part-time, flexible time, parental leave, maternal leave, or kindergarten for the children of employers. Also PRO::ICT calls for improving the working conditions for women and men by introducing, for example, gender mainstreaming in IT companies. But it is also pointed out that change agents need empowerment for doing so. Gillebert (2005) also explains for the Swedish context that it is required to change the current view of female and male roles in society, but also on the labour market. This would mean combining different actions to promote female participation in the labour market with actions which guarantee equal opportunities on the job and work-life balance measures.

"Tackling Stereotypes" still points at another issue which could help maximise female participation in SET. If there were some kind of critical mass of women in SET, and especially in the technical disciplines, it would become much easier to recruit more women, since, if there were a lot of female scientist, engineers and technicians, people and the whole society would accustom to women in these professions and to the idea that women are capable of becoming outstanding scientists.

The Greek project "Education and Gender" (Vitsilaki-Soroniati et al. 2001) addresses a further issue needed to successfully change the situation. At least in Greece more research is needed that would explain gender differences concerning school performances and gender differences concerning the participation in several scientific and professional fields. Social attitudes, ideologies and gender stereotypes which are reproduced by means of education have to be analysed.

7. Conclusion -Information for a Choice

The here presented collection and analysis of past research projects and their national contexts provides a deeper insight into decisive factors for not choosing SET careers.

Context matters

Taking into account the specific national backgrounds as analysed in chapter 4, an ambiguous picture has been found when analysing female participation rates in SET. It is an optimistic one with respect to "women and SET" (cf. chapter 2), i.e. women active-Iv using SET services and devices, but it is also a pessimistic one regarding "women in SET", i.e. women in SET professions, developing devices. Some sort of critical mass in SET studies still needs to be reached to turn SET studies into a female-friendly environment. Once choice options for SET arise in upper secondary education, there are male and female fields of study. Unfortunately, the gender segregation at ISCED level 3-4 mirrors the gender segregation in tertiary education and in the labour market up till now. However, numbers do matter if SET is to become a gender-authentic option for study choices. Concerning the Greek, Swedish and Dutch educational systems it became clear that embarking on SET studies is not only a matter of choice. In fact, it appears to be rather a matter of performance during upper secondary education, as grades (Sweden, Greece) or chosen subjects (the Netherlands) provide the basis for studies in SET. But also specific national requirements for admission or tuition fees can influence the embarking on SET studies.

All in all, various limitations to possibilities of choice need to be considered in the process of policy making.

Several important differences, in terms of how strategies were framed by governmental policies, were identified (cf. chapter 4). Basically, all strategies mentioned inclusion as a particular objective, though some aim exclusively at women, whereas others target "everybody", including women. But there are different kinds of inclusion processes. One common strategy is to introduce different types of training courses to increase skills and overcome a SET renitence. Another is to create women-friendly spaces for learning as in initiatives like "FIT" (women into technology, Austria). A third one is to improve the relative numbers of women within SET, like the PERIK-TIONI network³⁴ in Greece. But there are also strategies which aim at redefining symbolic male images of SET by providing different information on SET studies and occupations which would be more interesting for females. Additionally, national policy making is integrating EU Gender Mainstreaming policies.

Approaches which try to tackle gender stereotypes also employ different strategies. Some take up gender-binary assumptions and twist them. Others try to move beyond gender stereotypes by destabilising them. A look at the highlights of national policies in SET shows that three of the four observed countries (Sweden is excluded) use both gender-inclusive and -exclusive policy strategies to curb the gender divide in SET (cf. tab. 1 and 2).

Dutch policy approaches even exceed the

³⁴ This has a broader focus on female scientific cooperation.

category of gender by taking into account different categories that cut across processes of marginalisation. Hence, Dutch policy strategies try to be inclusive towards intersecting factors such as social background, education, age, sexual orientation, race, with gender being only one of them. Instead of striving for gender equality, Dutch authorities consequently try to foster social participation of its society as whole.

After analysing the different national backgrounds, it has to be stated that context does matter. This means that effective tailoring is in need, if inclusion efforts are to succeed. So, there can never be a single 'cure all' strategy to increase participation rates in SET, only we should be aware of the applied strategy and what kind of effects it is likely to trigger in the end.

Explaining Factors

When it comes to explaining factors (cf. chapter 5), in detail most of the examined research projects seem to draw a similar picture of female marginalisation due to stereotyping and lacking accurate information. Moreover, similar gender stereotypes were detected and even the examined stereotypes on SET professions strikingly resemble each other.

All in all, past research stresses a prevailing gender stereotype, namely that girls and women do not possess the abilities needed for being a capable scientist, an engineer or a technician; in contrast, SET is regarded as a fundamentally male and masculine domain. These dichotomised ascriptions on gender and technology were reported to have a major negative impact on girls and boys from the very start, as gender stereotypes are already passed on to both genders by their parents. Refined discriminatory practices are also met along their educational pathway through deeply gendered interactions with teachers, peers and career counsellors, safeguarding a conventional female and male education and vocational choice in most cases. Stereotypical ascriptions also have a negative impact on the self-perception of females, as the confidence in their technical abilities is lowered from the start. Thus technical inability of women appears to become a self-fulfilling prophecy.

Regarding the lack of accurate information. the results yielded by the analysis discuss two different issues. On the one hand, there is not enough information as girls are strikingly uninformed on SET studies and professions. On the other hand there appears to be an overall 'false' perception of SET studies and working conditions. The message that comes across is that it is a male domain and therefore not attractive to most girls. Consequently, the girls would not get sufficient information on SET courses and careers by their parents, teachers, career counsellors or the public media. Additionally, the lacking visibility of female role models in SET aggravates this vicious circle. The available information is characterised by a reproduction of the male image of SET, e.g. in the way departments at university present their courses. For SET studies and job positions, requirements and competencies are often emphasized which are connected to typical male socialisation and education. This keeps girls and women from embarking on SET.

But there are even more reasons which need to be taken into account. Considering the findings from the collected past projects, complex and multifaceted explanations for the process of marginalisation of females in SET are needed. Stereotypes are not the only reason for not pursuing a career in SET, let alone limited information. All projects take a set of different reasons and aspects into consideration that are closely interrelated: social environments which are explicitly hostile towards females because of a prevailing hegemonic masculinity; structural reasons like the genderspecific division of work or gendering effects of the prevailing education system. All of these factors directly and indirectly favour the male gender leading to still unequal possibilities for accessing and applying technology.

Promoting Factors

Summarising the given recommendations (cf. chapter 6), a wide variety of different approaches could be identified which try to influence the choice of young women regarding SET. Some measures are introduced to change the identified lack of selfesteem caused by stereotyping processes already explained in chapter 5. Especially during school days, the self-confidence of girls concerning their technical abilities needs continuing stimulation and support by teachers, youth workers, career counsellors, peers and parents. Beyond this, a special emphasis is put on developing and constantly improving a gender-sensitive education environment. This calls for a change of didactics, further continuing education of teachers, revised teaching material, and better and sufficient equipment. The identified lack of accurate information has to be filled, e.g. by urging universities to make their websites gender-inclusive and introduce "Open Days" and the like, or by "gender-sensitising" teachers and career counsellors. But it is also widely recommended to increase the visibility of successful women working in SET as role models for girls. But the collected recommendations still point to another issue: there is also a need for improving existing working conditions, e.g. by implementing work-life balance measures in SET companies. Although some promoting factors were discussed in chapter six, there is no blueprint solution for initiatives to successfully curb the gender divide in SET. After all, context does matter and initiatives should match target groups, policy goals and contextual specifications.

Considerations and Future Prospects

We can conclude that our main findings stress the complexity and the multifaceted factors innate to gender and technology relations. As these are dynamic and rapidly changing notions and practices (Faulkner 2001), they highly depend on the enclosed settings. Therefore, varying national contexts were taken into consideration and national policy efforts within 'women and SET' were highlighted. Additionally, IFAC elaborated on basic preconditions for embarking on SET studies and professions that obviously vary across the four examined nations. The research of the IFAC project focused on factors that push the female gender away from so-called technical spheres.

This report stresses above all the pervasive interdependency of stereotypes and lack of accurate information. As gender stereotypes are both a source and a consequence of biased information and vice versa, one cannot be tackled without the other. As long as the gender segregation prevails in technology, choosing SET will never be merely a question of 'choosing differently' for females. Access initiatives for increasing female participation in SET need to be attentive to complex underlying causes that influence possibilities of 'choice'. Measures that mainly target 'individual deficiencies' will not be sufficient, while structures, symbols, forms of representation and identities in SET still favour a male gender norm.
Another approach that matters is how examined strategies try to tackle gender stereotypes. Some strategies remain within gender-binary assumptions and only campaign for the reassessment of so far underrated 'female competencies'.

Notwithstanding the good intention, this strategy is clearly in danger of again assigning women to gender-stereotypical areas in SET. Therefore other strategies are in need, if the gender divide in Science, Engineering and Technology is to be curbed. Wendy Faulkner and Merete Lie (Faulkner/Lie 2007) point out that more attention should be paid to the strategic approach of respective initiatives, because stopping exclusion is not the same as achieving inclusion. Access activities within SET should not just target at diminishing exclusion mechanisms, they rather need to implement explicitly positive measures. These could raise skills and knowledge, confidence and relevance of SET to girls and women as well as open up new perspectives and resources.

Ideally, any appeal to gender stereotypes should therefore be combined with efforts to move beyond stereotypes by furnishing messages on SET with accurate information exempt from gender bias. Moreover, to get to the core of the problem, the mutual social construction of gender and technology needs to be considered, as we still need to prise open the static notions of male and female gender norms in technology. Therefore, a broader change in society and its gender relations and gender roles is in need.

As gender cuts across other processes of marginalisation, it will not be enough to only concentrate on the gender dimensions of this problem. Policy strategies that are inclusive towards the multifaceted factors of marginalisation are more than advisable. Once again, measures which are mainly targeted at an individual level will not be sufficient, but societal structures are to be fundamentally changed. This means also that we finally should stop talking about measures to change the role of women in society. After all, it is now high time to talk about the role of men. The future challenge is to overcome the stereotypes in SET and of paid and unpaid work in general and to achieve a model of a work-life balance that is challenging and satisfying for both women and men in society.

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List of Acronyms

AMS: Austrian Labour Market Service **BES:** Business Enterprise Sector BIZ: Austrian vocational centre for youth EC: European Commission **ECTS:** European Credit Transfer System in Higher Education **EEA:** European Economic Area EPEAEK II: Greek Operational Programme Education and Initial Vocational Training **EURYDICE:** European Database on Educational Systems fFORTE: Austrian governmental policy programme: Women in Research and Technology **GOV:** Government Sector HAVO: Dutch Senior general education **HBO:** Dutch Higher Vocational Education **HES:** Educational sector **HRST:** Human Resources in Science and Technology ICT: Information and Communication Technologies IFAC: EU project: Information For A Choice: Empowering Young Women through Learning for Technical Professions and Science Career ISCED 97: International Standard Classification for Education, updated 1997 **IT:** Information Technologies **NACE-Code:** International Statistical Classification of Economic Activities **OECD:** Organisation for Economic Co-operation and Development **PENED:** Greek Reinforcement Programme of Human Research Potential PhD: Philosophiae Doctor (Latin) or Doctor of Philosophy **PNP:** Private Non-Profit Sector **PRO::ICT:** EU project: Promoting ICT to female Students **SET:** Science, Engineering and Technology TEE: Greek Technical Vocational and Educational Schools (Upper-Secondary Education) **VHBO:** Dutch pre-higher vocational education VET College: Austrian vocational colleges within upper secondary education **VWO:** Dutch Scientific upper secondary education WITEC: The European Association for Women in Science, Engineering and Technology (SET) Womeng: EU project: Creating Cultures of Success for Women Engineers

	Comparison
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	Issue
	Key
	
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Countries	Austria	Greece	The Netherlands	Sweden
Compulsory school attendance	Age 6-15	Age 6-15	Age 5-18	Age 7-16
First possible specialisation In SET (Age)	14	15	14	16
Admission requirements to SET studies in Higher Education	No specific requirements for SET studies	 Admission due to stu- dent's performance Ministry of Education appoints number of study places 	 Numerus Fixus Specific subjects chosen at ISCED 3-4 allow entrance to SET studies 	 The higher the leaving grade, the more choice options Departments set limits to study places
Tultion fees	726 EUR for EU citizens or 1453 EUR per academic year	None	1538 EUR per annum Age group 30+ pays more	None
Bologna system?	Yes	Processing	Yes	Yes
Cycle 1 and Cycle 2	At university or univ. of applied sciences (Fachhochschule)	At university or TEIs (Technological Educational Institutes)	Bachelor at HBO (Higher Vocational Education) Master at university	At university or university colleges (Högskolor) At university only
Cycle 3 (PhD)	At university only	At university only	At university only	Mostly state funded
Funding & Legal Status	Mostly state funded Public law entities	Mostly state funded Fully self-governed	Mostly state funded Public laws apply	Federal institutes

tab. 2: Overview of Selected Governmental Policy Strategies

	Austria FEOPTE procreamme	Greece EDEAEK II DENED	The Netherlands	Sweden Erom ICT nolicies for
Ministry for Trans Innovation & Techn Science & Resea Economics & Lab Education, Arts & C	port, iology, rch, our, ulture	Ministry of Education and Religious Affairs General Secretariat for Research & Technology	Emancipation Plan Ministry for Education, Culture & Science	society to policies for an ICT society Ministry of Economic Affairs
Girls and women o career stages in S Key agents in the	n all ET, field	Pupils, teachers, parents female human resources as female researchers in SET	Low-skilled girls and boys, girls and women in SET education and occupations	Pupils in schools, pre- schools and adult education and distant learning courses
Exclusive, as the maj provides measures women and girls. FF school aims at addre all genders	ority for JRTE ssing	Inclusive in combating stereotypes in school, exclusive in support of advancement programmes (scholarships) for female stu- dents & researchers in SET	Inclusive when addressing intersecting aspects of societal marginalisation Exclusive in advancement programmes for females	Aims at being inclusive towards all genders in learning for ICT To tackle a gender stereo- twnical clivision of labor in
Combat stereotype diminishing education choices and possibilitie work places: e.g. supp female PhDs, advand female professors	s s on bort ce	Combat stereotypes in education: Raising Awareness among teach- ers and designing inter- vention programmes for more gender equality	No specific programmes	ICT professions was put on the agenda, no gender- specific programme imple- mented (see above)
Sensitise key agents education, economy public administration Aim at diversifying pur scope of action, e.g Information & sampli days for girls	ng	Setting up an information and communication net- work among women sci- entists (PERIKTIONI) Creation of a database of female researchers	e.g. ICT programmes for low-skilled girls and boys the existence of the 'Vrouwenvakschool' in Utrecht is advertised through Dutch pop stars as the school's figureheads	ICT is introduced as a pedagogical tool for learn- ing across subjects. The use of computers was included into curricula and strategies to raise the knowledge on SET

tab. 3: Overview of Collected National Projects

Countries		Greece		
Name of the project	Technology- Education and Gender	Tequality – Technology. Gender. Equality	Career Orientation of Girls	Gender and Mathematics
Basic / applied research	Basic research	Basic research	Basic research	Basic and applied research
Funding	Local government Villach	Bureau for women issues Upper Austria	National labour agency	MSc Thesis at the University of Athens
Source	Report	Report	Report	MSc Thesis
Duration	1998-1999	2004-2006	2002 (date of publication)	2003-2005
Research type and data	Primary research; Qualitative data	Primary research; Quantitative and qualitative data	Primary and sec- ondary research; Quantitative and qualitative data	Primary and sec- ondary research; Quantitative and qualitative data
Sample group	Females in upper secondary and tertiary education	Students at the University Linz	Pupils, age 13-17	Pupils, age 15-16, undergraduates from math department
Geographical scope	Regional	Regional	National	Regional
Fields of SET	Technology, engineering	Computing and Engineering	Not only SET, but male-dominated fields	Mathematics
Overall aims of research	Find measures to increase female participation	Find measures to increase female participation	Identify reasons for gendered segrega- tion of labour market	Analyse and identify reasons for low female participation

tab. 3

Greece	NL	Swe	eden	
Education and Gender	The Glass Wall	More Girls into Professions with Voltage	Women and Information Technology	
Basic research	No research	Applied research	Basic research	
ESF & Public Investment Programme	Ministry of social affairs and employment	ESF, 2 Swedish Electricians Unions	Governmental Agency for Inno-vation Systems	
Report	Website and Essays	Website	Website	
2001 (completed)	2005-2007	2003-2005	1996-2000	
Literature review on studies published in Greece and other countries	None	Primary research and application; Qualitative data	Primary research; Qualitative data	
No sample group	Target group: Females, age 13-25, females in reintegration	Females, age 15-20 at compulsory school or in electricity sector	Females, age 15-25	
National and international	National	Regional	Regional	
All fields of education	Not only SET, but male-dominated fields	Electricity	ICT	
Assess status quo of research on equality in education in Greece	National programme to overcome segregation on the labour market	Recruit and keep more women in the electrici- ty sector	Analyse differences between men and women in access and usage of ICT	

Projects
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Womeng	PSE-CT-2002-00109 IST-2001-34520	stria, Finland, France, Austria, Belgium, France, any, Greece, Scotland, Italy, UK Slovakia	Basic research Basic and applied research	EC, 5th FP, Specific EC, 5th FP, European ramme "Improving the programme Information n Research Potential and he Society Technologies Knowledge Base"	Report	2002-2005 2002-2004	ry research; Quantitative Primary and secondary and qualitative data research, literature review;	 nts and faculty members her education; company Women working in ICT, age tudies, female engineers, ian resource managers, inon representatives 	eering, excluding agrono- business and architecture	Derivation Provide a comprehensive en are not attracted by and focused investigation ineering and propose of the gender gap in ICT
Tackling Stereotypes	VS/2004/0546 H	Austria, Estonia, Germany, Au Greece, Hungary, Gern Netherlands, Spain, Sweden, UK	Applied research	EC, Strategic Action Programme for Equal Opportunities among Men and Women t	Report	2004-2006	Secondary research and Prima literature review	Women that work in the Stude private and public sector in hig in the areas of SET case s hurr	SET Engin	Research, exchange and Un reflect on stereotypes relat- wom ed to women in SET, and eng
PRO::ICT	A/03/B/F/PP-158.033	Austria, Bulgaria, Denmark, Germany, Netherlands, Switzerland, Wales	Applied research	EC, Leonardo da Vinci, pilot project	Report	2003-2005	Literature review and interviews	Female pupils and students, age 13-21; teachers and human resource managers	ICT	Produce study result as guide for action to change the under-representation of females in ICT professions.
Name of the project	Identification nr.	Countries involved	Basic / applied Research	Funding	Source	Period of project	Research type and data	Sample group	Fields of SET	Overall aims of research



INFORMATION FOR A CHOICE: Empowering young women through learning for technical professions and science career.







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www.SET-career.eu

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