Engendering technology empowering women
Pascall, A.N.

Document version:
Publisher's PDF, also known as Version of record

Publication date:
2012

Link to publication

Citation for published version (APA):

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ENGENDERING TECHNOLOGY EMPOWERING WOMEN

PROEFSCHRIFT

ter verkrijging van de graad van doctor
aan Tilburg University
op gezag van de rector magnificus,
prof. dr. Ph. Eijlander,
in het openbaar te verdedigen ten overstaan van een
door het college voor promoties aangewezen commissie
in de aula van de Universiteit
op maandag 19 november 2012 om 14.15 uur

door
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geboren in Griekenland
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SIKS Dissertation Series No. 2012-28

The research reported in this thesis has been carried out under the auspices of SIKS, the Dutch Research School for Information and Knowledge Systems.

TiCC Ph.D. Series No. 23

ISBN: 978-0-9566292-2-7

Published by Portia Ltd, Prince Consort House, Albert Embankment, London, SE1 7TJ, United Kingdom

The cover of this book was conceived and designed by Areti.
"Boys play with cars, girls play with dolls!"

If I had a Euro every time I heard this I would be rich now! I was different though! I played with dolls until well in my teenage years but I also played with cars, Meccano, Little Electrician, Chemist etc. Yet, I was not so different from other girls of my age and country. Perhaps when I was a child, money was tighter and toys had to be shared and passed down from one sibling to the other.

Despite my moving out of technology and making different study choices I quickly found myself drawn into this technological universe which I thought was well behind me. The roles were different but I slowly moved into policy making and cautiously found myself in a subject which was important for me, the proper and equal integration of women in the information society. I must admit I enjoy it!

The idea of this thesis stemmed from the work I have been doing for the last 20 years. I discussed it with Myriam (Diocaretz) who brought me in contact with Jaap (van den Herik) and this was when all started. Little did I know at the time how difficult it is to convey your knowledge of an integral part of your life to others who in the best scenario are interested parties; little did I know how difficult it is to translate your experience into readable material and references; little did I know how pre-submission nerves are worse than wedding nerves. But I made it with the help of my friends!

Information and Communication technologies grew in leaps and bounds in the last twenty years. It is astonishing to see that what was considered science fiction in the eighties is now part of our everyday reality. Despite the known and accepted advantages of the new technologies, women are still
reluctant to participate and are under-represented at all levels. This means on the one hand that they do not benefit fully of what technology has to offer and on the other that the technology itself misses out on new talent, creativity and innovation.

It is said that "Technology is neutral!" This in itself might indicate that it is not so. In this thesis, I tried to show the gender facet of technology and demonstrate that this engendering will be an empowering tool for women.

I would like to take this opportunity to thank some people whose contribution was vital for the completion of this work. There were many who supported me during this period and if I forget any I do apologise in advance. First of all, my two PhD supervisors, Professor van den Herik and Professor Diocaretz. Without their invaluable help and advice I would not have been able to proceed. I was taught some very useful lessons on how to write a scientific paper, something I had not done for many years; Dr Eva Fabry for her help with the dissemination of the questionnaire; Dr Elizabeth Pollitzer whose encouragement and help was instrumental for my not giving up this project right at the end; Dr Gaelle Le Gars, a wizard of the internet and formatting. Last but not least all my friends who put up with me moaning and in particular Chrissa Mela for her continuous encouragement and support.

It is customary to dedicate a thesis so I dedicate this one to my son Christos who was telling me off when I was not working and who does not want to be an engineer although he loves maths. No one said that it is biological!

Nancy Pascall

Brussels, November 2012
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<tr>
<td>ABC</td>
<td>Audit Bureau of Circulations</td>
</tr>
<tr>
<td>AARP</td>
<td>Formerly the American Association of Retired Persons, it is a non-governmental organisation (NGO) leading to positive social change and delivering value to people age 50+ through information advocacy and service. <a href="http://www.aarp.org">www.aarp.org</a>.</td>
</tr>
<tr>
<td>ARPA</td>
<td>Advanced Research Projects Agency.</td>
</tr>
<tr>
<td>ARPANET</td>
<td>Advanced Research Projects Network.</td>
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<tr>
<td>Beijing Declaration and Platform for Action</td>
<td>Beijing Declaration and Platform for Action adopted by the Fourth World Conference on Women: Action for Equality, Development and Peace, Beijing, 15 September 1995. The declaration aims amongst other things to &quot;Ensure women's equal access to economic resources including land, credit, science and technology, vocational training, information, communication and markets, as a means to further the advancement and empowerment of women and girls, including through the enhancement of their capacities to enjoy the benefits of equal access to these resources, inter alia, by means of international cooperation&quot;.</td>
</tr>
<tr>
<td>CAS</td>
<td>Common Assessment Scale.</td>
</tr>
<tr>
<td>CCITT</td>
<td>Comité Consultatif Intéernational pour le Téléphone et le Télégraphe.</td>
</tr>
<tr>
<td>CEDEFOP</td>
<td>European Centre for the Development of Vocational Training.</td>
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<tr>
<td>CDA - Critical Discourse Analysis</td>
<td>The use of written and oral language as a form of &quot;social practice&quot; indicating the dialectical relationship of a particular event and the situation(s), institution(s) and social structure(s) framing it</td>
</tr>
<tr>
<td>CERN</td>
<td>European Organisation for Nuclear Research.</td>
</tr>
<tr>
<td>CMT</td>
<td>Chartered Market Technician</td>
</tr>
<tr>
<td>Critical Discourse</td>
<td>The use of written and oral language as a form of</td>
</tr>
<tr>
<td>Analysis - CDA</td>
<td>&quot;social practice&quot; indicating the dialectical relationship of a particular event and the situation(s), institution(s) and social structure(s) framing it</td>
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<td>---------------</td>
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<tr>
<td>CTM</td>
<td>Crime, Thrillers and Mystery (books)</td>
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<tr>
<td>Cyberpunk</td>
<td>Cyberpunk is a science fiction genre noted for its focus on &quot;high tech and low life&quot;. The name is derived from cybernetics and punk and was originally coined by Bruce Bethke as the title of his short story &quot;Cyberpunk&quot;, published in 1983, although the style was popularised well before its publication by editor Gardner Dozois. It features advanced science, such as information technology and cybernetics, coupled with a degree of breakdown or radical change in the social order. <a href="http://en.wikipedia.org/wiki/Cyberpunk">http://en.wikipedia.org/wiki/Cyberpunk</a> accessed 02/09/2008.</td>
</tr>
<tr>
<td>DARPA</td>
<td>Defence Advanced Research Project Agency.</td>
</tr>
<tr>
<td>DAW</td>
<td>Division for the Advancement of Women.</td>
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<tr>
<td>Demographic Transition</td>
<td>It is a long term development which leads from a regime of high mortality and high fertility to one with low mortality and low fertility. The Demographic transition model (DTM) is a model used to represent the transition from high birth and death rates to low birth and death rates as a country develops from a pre-industrial to an industrialised economic system. The theory is based on an interpretation of demographic history developed in 1929 by the American demographer Warren Thompson. Thompson observed changes, or transitions, in birth and death rates in industrialised societies over the previous 200 years. Most developed countries are in stage 3 or 4 of the model; the majority of developing countries have reached stage 2 or stage 3. The major (relative) exceptions are some poor countries, mainly in sub-Saharan Africa and some Middle Eastern countries, which are poor or affected by government policy or civil strife, notably Pakistan, Palestinian Territories, Yemen and Afghanistan. Although this model predicts ever decreasing fertility rates, recent data shows that beyond a certain level of development fertility rates increase again.</td>
</tr>
<tr>
<td><strong>DG</strong></td>
<td>Directorate General.</td>
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<tr>
<td><strong>DG EAC</strong></td>
<td>European Commission Directorate General Education and Culture.</td>
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<tr>
<td><strong>DG EMPL</strong></td>
<td>European Commission Directorate General Employment, Social Affairs and Inclusion.</td>
</tr>
<tr>
<td><strong>DG JUST</strong></td>
<td>European Commission Directorate General Justice.</td>
</tr>
<tr>
<td><strong>DG RTD</strong></td>
<td>European Commission Directorate General for Research and Development.</td>
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<td><strong>ECWT</strong></td>
<td>European Centre for Women and Technology.</td>
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<tr>
<td><strong>EPO</strong></td>
<td>European Patent Office.</td>
</tr>
<tr>
<td><strong>EPWS</strong></td>
<td>European Platform of Women Scientists.</td>
</tr>
<tr>
<td><strong>ESCO</strong></td>
<td>Classification of European Skills/Competences, qualifications and Occupations.</td>
</tr>
<tr>
<td><strong>EUD</strong></td>
<td>European Directory for Women in ICT.</td>
</tr>
<tr>
<td><strong>FP7</strong></td>
<td>7th Framework Programme for Research and Development.</td>
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<tr>
<td><strong>GDP</strong></td>
<td>The Gross Domestic Product per caput, or GDP, of a country is one of the ways of measuring the size of its economy. GDP is defined as the total market value of all final goods and services produced within a given country in a given period of time (usually a calendar year). It is also considered the sum of value added at every stage of production (the intermediate stages) of all final goods and services produced within a country in a given period of time, and it is given a money value.</td>
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<tr>
<td><strong>Glass Ceiling</strong></td>
<td>The term &quot;glass ceiling&quot; refers to a situation when there is a transparent not obvious obstacle blocking upward advancement. It is due to typically unwritten or unofficial policies and is distinguished from formal barriers such as education or experience.</td>
</tr>
<tr>
<td>GWT-I</td>
<td>Global Women and Technology Initiative.</td>
</tr>
<tr>
<td>ICT(s)</td>
<td>Information and Communications Technology(ies). OECD in 1998 based the definition of ICTs on the International Standard Industrial Classification of All Economic Activities (ISIC). The definition relates to activities in manufacturing and service industries, which use electronic means to facilitate processing, preparation, transmission and display of information. The classification of information technologies does not include &quot;content&quot; industries, i.e., the industries that create information. The industries included in the definition of the ICT sector have been classified in ICT Manufacturing and ICT Services.</td>
</tr>
<tr>
<td>ITF</td>
<td>The International Taskforce on Women and Information and Communication Technologies.</td>
</tr>
<tr>
<td>ISP</td>
<td>Internet Service Providers.</td>
</tr>
<tr>
<td>ITU</td>
<td>International Telecommunications Union</td>
</tr>
<tr>
<td>ITU-T</td>
<td>Telecommunications Standardisation Sector of the International Telecommunications Union (replaced CCITT).</td>
</tr>
<tr>
<td>JPO</td>
<td>Japan Patent Office.</td>
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<tr>
<td>Mainstreaming</td>
<td>Mainstreaming involves ensuring that gender perspectives and attention to the goal of gender equality are central to all activities - policy development, research, advocacy/ dialogue, legislation, resource allocation and planning, implementation and monitoring of programmes and projects. (<a href="http://www.google.lu/search?q=accessed">http://www.google.lu/search?q=accessed</a> 03/09/2008). Some critics claim that although mainstreaming brought into the policy makers' attention the issue of ensuring gender in policy making, it lacks the strength for implementation due to lack of ownership of actions.</td>
</tr>
<tr>
<td>MOO(s)</td>
<td>A MOO is a text-based online virtual reality system to which multiple users (players) are connected at the same time. The term MOO is used in two distinct, but related, senses. One is to refer to those programs descended from the original MOO server, and the other is to refer to any MUD that uses object oriented</td>
</tr>
<tr>
<td><strong>MUD</strong></td>
<td>A MUD (originally Multi-User Dungeon, with later variants Multi-User Dimension and Multi-User Domain), is a multi-user real-time virtual world. Most MUDs are represented entirely in text, but graphical MUDs are not unknown. MUDs combine elements of role-playing games, hack and slash, interactive fiction, and online chat. Players can read or view depictions of rooms, objects, other players, non-player characters, and actions performed in the virtual world. Players typically interact with each other and the world by typing commands that resemble a natural language (Bartle, 2003).</td>
</tr>
<tr>
<td><strong>NCWIT</strong></td>
<td>The National Center for Women &amp; Information Technology. It is a 501(c) (3) coalition that develops and amplifies efforts to increase diversity in IT and computing. &quot;We believe that inspiring greater diversity in IT will create a larger and more competitive workforce, and will foster the design of technology that is as broad and innovative as the population it serves. Our work focuses on the entire spectrum of K-12 through college education, from the workforce through entrepreneurial careers&quot;. From NCWIT: Who we are <a href="http://www.ncwit.org/pdf/WhatIsNCWIT_2011.pdf">http://www.ncwit.org/pdf/WhatIsNCWIT_2011.pdf</a>; accessed 5/10/2011.</td>
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<tr>
<td><strong>NSF</strong></td>
<td>National Science Foundation.</td>
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<tr>
<td><strong>NSFNET</strong></td>
<td>National Science Foundation Network.</td>
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<tr>
<td><strong>PWN</strong></td>
<td>Professional Women Network</td>
</tr>
<tr>
<td><strong>SCCC</strong></td>
<td>A Social Cognitive Model for Career Choice</td>
</tr>
<tr>
<td><strong>Social Network(s)</strong></td>
<td>A social network is a communication structure made up of individuals or organisations connected by one or more common factors such as friendship, family relationship, common interests, financial exchanges, dislikes, sexual relationships, or beliefs, knowledge.</td>
</tr>
<tr>
<td>TCP/IP</td>
<td>Transmission Control Network/Internet Protocol.</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Technophobia</td>
<td>Technophobia is the fear or dislike of advanced technology or complex devices, especially computers. The term is generally used in the sense of an irrational fear. It is the opposite of technophilia. First receiving widespread notice during the Industrial Revolution, technophobia has been observed to affect various societies and communities throughout the world. This has caused some groups to take stances against some modern technological developments in order to preserve their ideologies. In some of these cases, the new technologies conflict with established beliefs, such as personal values in simplicity and modest lifestyles.</td>
</tr>
<tr>
<td>Twitter</td>
<td>Twitter is an online micro blogging and social networking which enables users to send a read text-based post up to 140 characters (tweets).</td>
</tr>
<tr>
<td>WiL</td>
<td>Women in Leadership.</td>
</tr>
<tr>
<td>World Economic Forum</td>
<td>The World Economic Forum is an independent international organisation committed to improving the state of the world by engaging business, political, academic and other leaders of society to shape global, regional and industry agendas. It takes places annually at Davos in Switzerland.</td>
</tr>
</tbody>
</table>
1 WOMEN & ICT: STATING THE PROBLEM

In the last twenty years the evolution of Information and Communication Technologies (ICTs) has exceeded the imagination of almost everybody. Only a few visionary people, such as Moravec (1988), Kurzweil (1990), de Garis (1996, 2005), and Warwick (2004), speculated along the lines which have now unfolded, particularly in this century. The commercialisation of the Web and the use of its different applications have changed our society beyond recognition. Before the realisation of Tim Berners Lee’s ideas, which led to the World Wide Web (WWW), most, if not all communication networks such as UUCP, AUNET, EARN, and JANET were limited to allow smooth communication between the stations of the network. The communication between networks initially suffered from standardisation.

In the beginning, all operations were based on the central mainframe computer model. In 1962, at the height of the Cold War, a military project was developed to enable the military to communicate with a system which could not be destroyed in a nuclear war situation (Roberts 1973; 1974a; 1974b; 1974c; Roberts and Wessler, 1970), and which grew into today’s descendent, the World Wide Web (WWW). Nowadays WWW is used for a variety of purposes, e.g., tracking seismological phenomena, ordering pizza or sending news to family members in Australia by email.

A prevailing question is: do these new uses indicate that the world's priorities have changed? Perhaps, but what they mainly signal is that technology has many more uses than many of us can, even now, conceive. So far, however, the current technology does not appear to accommodate human behaviour. It does not appear to distinguish between male and female attributes and specific requirements. A wise computer is a computer that knows how to address gender meaning a computer or any kind of digital device which can cover the needs of all its users including women. This latter is one of the main issues of this thesis. Currently, ICT is a technology which does not take into account the needs of all of its users. In my opinion, ICT is designed taking into account only half of the population of this planet. I believe that technology needs to be engendered in order to become more innovative, easier to use, and all encompassing. This is what I would like to investigate.
Scientists in the 1960s knew that what they were building was going to be bigger than what they had envisaged (cf. Moore’s Law, 1975). At that time no one had predicted either the Internet explosion or the interest it would create in recent years. Since 1990, "Information Superhighway" has been the most used phrase within ICT. Large numbers of people sign up and try to become part of the Internet community. Today’s technology is rapidly developing in unexpected directions, but it is also riding on the waves of fashion, with the direct consequence that what was invented almost half a century ago led to a social revolution. This revolution, however, leads to a serious digital divide not only between the developed and developing countries, the haves and have-nots, but also between men and women.

In this thesis, I am going to investigate: (1) whether women participate in the cyber-community in the same way as men, and (2) whether women adequately benefit from all the advantages ICT has to offer. The emphasis of the thesis is therefore on two concepts, viz. engendering technology and empowering women. The line of reasoning I envisage is as follows: engendering technology leads to increasing the number of women in the production, design and use of technology. Production and design would lead to technology which takes into account female-specific requirements, thus covering specific needs. In return, this would make the technology more user-friendly for women, resulting in their greater involvement and participation, not only at a simple user level but also as professionals. Technology would eventually provide them with more skills which are usable for gainful employment. So we may speak about empowering women.

In this chapter, a brief description of the Information Society is given (Section 1.1), as well as some historical background about the ICTs (Section 1.2). In Section 1.3 we discuss the internet as a powerful tool. The chapter continues by presenting the Problem Statement: A New Approach to ICT (Section 1.4) and the corresponding research questions (Section 1.5). The research methodology is described in Section 1.6. The chapter concludes by providing the structure of the thesis in Section 1.7.

1.1 THE INFORMATION SOCIETY

The Information Society can be seen as an all-encompassing term. Currently, there is no universally accepted term which can adequately describe the concept of an "information society". Most theorists (cf. Gingrich, 2008, 2005; Negri, 2000) agree that in the mid-seventies a transformation started which has gradually led to where we are today living in a society of
knowledge with easy access to obtaining and exchanging information. This could all have been achieved with the technology development we have seen in the last twenty years. One should emphasise that the Internet is just a part of the information society.

It is useful to look briefly at how the information society concept was developed. One of the first people to coin this term was the economist Fritz Machlup (1962), who presented his ideas on the effect of patents on research. He introduced the concept of the knowledge industry, distinguishing five sectors: education, research and development, mass media, information technologies and information services (Machlup, 1962). These helped the transition into another kind of economy. From a material goods economy, we shifted to a knowledge-based one (Drucker, 1969). Even as early as 1971, Touraine spoke about the post-industrial society as follows: "The passage to post-industrial society takes place when investment results in the production of symbolic goods that modify values, needs representations far more than in the production of material goods or even of services. Industrial society had transformed the means of production: post-industrial society changes the ends of production that is culture. (…) The derisive point is that in the post-industrial society all of the economic system is the object of intervention of society upon itself" (Touraine, 1988:104).

This also leads to a programmed society having the capacity to act upon itself. Touraine gives a rather suitable description of the notion of the Information Society. A different concept is the one proposed by Bell, who focused on the capacity to process and generate information for efficient society functioning (Bell, 1976).

It is opportune to briefly mention here another representation of the Information Society, the "network society". This is a "new mode of development, informationalism, of which networking is a critical attribute" (Castells, 2010). The structural changes due to the growth, use and integration in everyday life and work of information technologies led to an informational model based on networks. These structural changes were manifested in the workforce and created a new culture that effected traditional work patterns especially in the areas of part-time and temporary employment. This new order influenced considerably women as they are the main takers of part-time and temporary employment.

In order to facilitate a better understanding of the transition of our society into an information society, a brief presentation is given of the Internet, and the possibilities it offers for
information, communication and other social activities. In particular, in Subsection 1.1.1, a description of ICTs as agents of change leading to innovation and therefore to the role of social networking will be examined, moving then to Subsection 1.1.2, which will focus on the sociology of the Internet.

1.1.1 ICT as an agent of change

The previous brief discussion about the concept of the information society formulates the question and eventual debate on whether the world is socially or technologically driven (Van den Herik, Lamers, Verbeek, 2011). Taking up this debate is not part of the present work but we may establish that ICTs are critical to Europe’s future and underpin the realisation of the Lisbon Agenda (European Council, 2000; European Commission, 2005)\(^1\). As a major driver of economic and social modernisation ICTs have a catalytic impact in three key areas.

- Productivity and Innovation.
- Modernisation of Public Services.
- Advances in Science and Technology.

In 2008, businesses in the European Union (EU) devoted 20% of their investment to ICTs. This same sector accounted for 26% of the overall research expenditure (European Commission, 2008b). Many predictions state that the new technologies and the changes in work performance and organisation will result in an important employment expansion. At both ends of the employment spectrum job creation projections will show an increase with a strong bias in favour of high-skilled jobs (European Commission, 2008a). The use of new technologies is not limited to research and employment but covers many areas of our current society, including education, communication, entertainment, safety and public administration.

Half of the productivity gains in our economies are explained by the impact of ICT on products, services, and business processes (European Commission, 2008b). With the change of our society from an industrial to a knowledge-based one, technology could be considered as

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\(^1\) The Lisbon Agenda is a European Union strategy which aims to make Europe by 2010 "the most dynamic and competent knowledge-based economy". This strategy takes into account globalisation and ageing. It was re-launched in 2005 taking into account progress and targeting growth and employment.
the leading factor in boosting innovation and creativity and in mastering a change in value chains across industry and service sectors. The demographic change in Europe indicates that ICT applications relating to the social and health care sector would be in great demand. Some examples are devices monitoring elderly people (movement sensors or panic buttons). Moreover, ICTs are a requirement in the modernisation of services in domains of public interest, such as education, cultural heritage, learning, social inclusion, cohesion, security, energy, transport and the environment. Furthermore, ICTs can be used to promote accessibility and transparency of governance and policy development processes. Finally, ICT plays an important role in R&D (Research and Development) management and communication. It is a stepping stone for progress in other fields of science and technology, as it transforms the way researchers conduct their research, co-operate and innovate (European Commission, 2009b). The development of ICTs has brought a substantive "peaceful revolution" in human society by transforming its very essence. The well-known motto of the Chicago Fair, "Science finds, Industry applies, Man conforms", has undergone a mutation to "People propose, Science studies, Technology conforms". (Here we see the socially driven world). Looking at the technological development we see that an ever-increasing amount of applications and research points to human-centred systems aiming to improve human life. In this respect, ICTs are an important agent of change. But what is an agent of change?

When we are talking about agents of change, we refer to people or systems that have some sort of authority and power to act as catalysts (Stevenson, 2008; Forrester, 2005). This kind of authority can be found in ICTs, expressed through five traits considered important. Characteristics of a true agent of change are as follows:

- She\(^2\) sees a future which no one else does.
- She has a vision.
- She will not rest until this becomes reality.
- She is also willing to take risks in unknown fields.

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\(^2\) For readability and brevity, we use "she" and "her" whenever "she or he" and "her or his" are meant.
• She galvanises people into action.

These five traits are part of ICTs and, in a broader sense, of the cyber-community to be discussed in Section 1.3. ICTs look into the future and have visions about new research and new applications which become reality by taking risks in unknown fields and galvanising people into action.

ICTs are considered to have acted as agents of change in areas such as education, employment, health, environment, government, business, and entertainment. Looking at these areas, one can identify different layers where ICTs further function as agents of change through more refined and specific applications and procedures. It is more specifically so in sub-areas such as higher education, convergence, practices and organisations, cyber-sciences, computer assisted learning, privacy and security, biomedicine, biometrics, socio-economic development, innovation, healthcare, communication environment and crisis response. The areas mentioned are not exhaustive but one may safely conclude that ICTs, and subsequently the cyber-community they create and the information society to which they belong, are agents of change for the totality of the public and private domains of a human being.

It should be emphasised that the development of ICT, and the Internet in particular, has both made possible and set up entirely new forms of social interactions, activities, and modes of organisation through widespread usability and access. The social networking websites, such as Facebook and MySpace, have created innovative forms of socialisation. At the end of the first decade of the 21st century, social networks are part of young people’s lives, but there are a number of hidden threats, such as Data Protection rights, movement of illegal substances, child pornography and human trafficking, to name but a few (see Ong, 2010).

1.1.2 Sociology of the Internet

The Internet is a relatively new phenomenon, as we are going to see in Subsection 1.2.3. It is a revolutionary change that "took place yesterday, or the day before, depending on how you measure it" (Darnton, 2008). It is a new field for sociologists to explore, leading to the development of the sociology of the internet theories. The sociology of the internet, or sociology of cyberspace as it is otherwise called, explores the social implications of the

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3 This does not exclude them from being part of other traits, such as leadership.
Internet, the new social networks developed, the online societies (virtual communities) and the social interaction on the Internet. With the development of Web 2.0 tools a new, and different, social order appears to be emerging (Cavanagh, 2007; Bargh and McKenna, 2004).

The Internet is of interest to sociologists in various ways. We mention three of them: (1) as a tool for research, for example, in using online questionnaires that can reach a wider audience, (2) as a discussion platform, and (3) as a research topic. The sociology of the Internet basically aims to analyse online communities, almost all of them being virtual, as well as organisational changes which are accelerated through the new media. The principal subject of analysis is the emerging social change due to the transformation of society from an industrial to an information society. Online communities can be studied through network analysis and, at the same time, interpreted through virtual ethnography in a quantitative and qualitative manner. Social change can be studied through demographics or through the interpretation of changing messages and symbols in online media studies (Menchik and Tian, 2008).

When the Internet phenomenon emerged, there were many predictions that it would either change everything or that it would change nothing and from these two positions it took some time for a consensus to emerge. The consensus was that the Internet tends to complement rather than displace existing media (Di Maggio et al., 2001). In the end, the Internet still offers a valuable opportunity to study changes brought about by the newly emerged - and still evolving - communication technology, and is a powerful tool.

The social impact of the Internet is important in many areas, such as in political organisation and censorship, leisure activities and the creation of socially identifiable groups in the social networks established (e.g., Facebook, MySpace). The phenomenon of a new sense of individualism akin to social isolation (Nie, 2001) stemming from the Internet was created through grouping and collectivisation of like-mindedness, and it brought fundamental social changes.

According to Di Maggio et al. (2001), research tends to focus on the Internet’s implications in five domains.

- Inequality (the issues of digital divide).
- Community and social capital (the issues of time displacement).
• Political participation (the issues of public sphere, deliberative democracy, and civil society).

• Organisations and other economic institutions.

• Cultural participation and cultural diversity.

The implications of these five domains, and in particular of the one relating to inequality and issues of the social divide referring to women, will be examined during the course of this research.

1.2 Historical Background

To understand the processes and impacts of globalising ICTs such as the Internet, we analyse three developments: (1) the historical development of that technology, (2) the process of technology transfer in general, and (3) the local cultural dynamics in unique regions. Moreover, one should always consider that:

• the availability of the Internet varies in different regions, and even among different sectors within those regions;

• diffusion and use patterns may vary among different regions in large countries (India or China), among different countries, and among different continents.

The above considerations pose several challenges for the development of a symmetrical global cyber-community fuelled by ICTs. This last statement often weaves into the "taken for granted" rhetoric as seen in the multi-lateral conferences such as the World Summit on Information Society (WSIS). It would be naïve to assume that ICTs will in themselves solve inequities in social, political, economic and even scientific terms.

It should be noted that various and rather complex factors govern the implementation and use of new technologies which, even to this date, cause and maintain inequalities.

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4Unless otherwise stated, information about the history of computers and the internet was based on information from the Wikipedia (www.wikipedia.org/en/wiki accessed on 15/4/2009)
In the history of the development of ICTs, there are three milestones to be mentioned. They are as follows:

1. The creation of networks as a technical infrastructure.
2. Miniaturisation (PCs).

After the creation of networks as a technical infrastructure (Subsection 1.2.1), we focus on women who played an important role in the setting up and maintenance of the proper functionality of the tools for this new era (Subsection 1.2.2).

### 1.2.1 The creation of networks

As early as the seventeenth century, mathematicians were already trying to create a machine that could perform basic mathematical functions such as addition, subtraction, division, and multiplication.

Blaise Pascal, a French mathematician, was the first to construct a mechanical adding device in 1640 (Pascal, 1640). The programming language Pascal was named in his honour. In 1804 the automated punched card machine was introduced to operate weaving. This is the first known use of programmed instructions which led the way to the concepts that are behind today’s computers.

Around the same time, the British scientist, Charles Babbage (Babbage and Hyman, 2007; Dubbey, 2004) designed an all-purpose problem-solving machine, called the analytical engine, which had a mechanical memory to store the results of calculations. His partner, Augusta Ada (Stein, 1985), the Countess of Lovelace, suggested the use of the binary system for data storage instead of the decimal one. She also refined the design of the analytical engine to include the automatic repetitions of a series of calculations. In the 1850s the British mathematician George Boole (Hawking, 2005) realised that complex mathematical problems could be solved by reducing them to a series of questions which could be answered either positively or negatively represented by either a 1 or a 0, and thus the binary numbering system and Boolean logic was founded.
The early twentieth century saw the next stage in computer history and the creation of the first electronic machine capable of solving simple differential equations. In 1937, George Stibitz constructed his complex number calculator from batteries, flashlight bulbs, wire and strips of metal from a tobacco can! This was the first binary adding machine and it paved the way for all digital computers. John Atanasoff and Clifford Berry (Hally, 2005) built the Atanasoff-Berry computer known as ABC in 1939. The ABC is now acknowledged to be the world’s first general purpose electronic digital computer, which at the time created little interest. In fact, when Dr. Atanasoff contacted IBM he was told that the company would never be interested in an electronic computing machine. In 1941, Konrad Zuse, as the story tells us, in his parents' house in Germany, built the first operational general purpose computer and was refused funding. Alan Turing, the eccentric English genius, designed ACE, the Automatic Computer Engine based on Zuse’s work (Barron, 1970). This was followed by Mark 1, the first automatic sequence-controlled calculator, which was completed by Howard Atkin, a US Harvard mathematician, in 1944.

As previously discussed, computers\(^5\) were conceived to do high-speed and repeated execution of basic arithmetic in order to calculate ballistic tables for artillery and accurate aerial bombing during World War II (Smith, 1996). When it became apparent that the letters of the alphabet could be encoded and "crunched" by computers, and that quantities such as temperature and pressure as well as audio and visual images could be encoded in a compatible form, it was evident that computers had limitless possibilities for acquiring, storing, manipulating and reproducing data and information.

The first large-scale computer, Electronic Numerical Integrator and Computer, ENIAC, was developed in 1946 by Mauchly and Eckert with the help of Goldstine and his wife Adele (Open University, 2009). The ENIAC was equipped with vacuum tubes instead of the electromechanical relays employed in other computers of the time\(^6\). The ENIAC had military applications and was mainly used for calculations for the design of the hydrogen bomb. It is interesting to note that this first machine weighed 30 tons and contained 100,000 electronic components, including 17,000 vacuum tubes. The machine was 80 feet long and 18 feet high.

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\(^5\) They were called computers due to their first uses which were computational.

\(^6\) The vacuum tubes were the equivalent to transistors in the "modern" microprocessors switching themselves to "on" and "off" positions.
The detailed description of the first computers is included in this introduction in order to show the contrast between these first machines and the modern devices, which are getting smaller all the time (see Table 1-1).

| First Programmable Computer | Z1 created by Konrad Zuse - 1938. |
| First Digital Computer      | ABC – Atanasoff-Berry Computer after litigation.  
| First Personal Computer     | Altair 8800. The term Personal Computer was coined by Ed Roberts in 1975. |
| First Laptop or Portable Computer | Osborne I developed by Adam Osborn weighing 12 kgs, with a 5 inch display, memory of 64KB, two 5 ¼” floppy drives and a modem. |
| First Multimedia Computer  | Tandy Radio Shack in 1992 was one of the first companies to release a computer based on the MPC standard with its introduction of the M2500SL/2 and M4020 SX computers. |

Table 1-1 gives us the chronicle of the "firsts" for computer devices.

### 1.2.2 Engendering the history of computers

In the general history of computers as it is presented in most literature, the absence of female scientists is noticeable. Although the Countess of Lovelace is frequently mentioned, other important female contributors are lacking. In an attempt to raise awareness about the engendered technology, six female scientists who have been instrumental in the development of ICTs but who are rarely mentioned, are briefly presented, together with their environment.

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7 Information found in www.computerhope.com/issues/ch000984 accessed 30/01/2009 and verified when researching the computer history.

8 19 October 1973, US Federal Judge Earl R. Larson signed his decision that the ENIAC patent by Eckert and Mauchly was invalid and named Atanasoff the inventor of the electronic digital computer.
**Countess of Lovelace**

Lady Ada Lovelace wrote an analysis of the Babbage Analytical Engine and is thought to have written the first ever computer program – a plan on how the engine could calculate Bernoulli numbers. Her work was acknowledged in 1977 when her name was given to the programming language – ADA.

**Admiral Grace Hopper**

Grace Hopper was a mathematician who believed that programming computers in English would be more accurate and faster. She developed the first [computer] compiler for the UNIVAC computer. In 1959 she took her work one step further and invented the computer language COBOL (Common Business Oriented Language), the first user-friendly language for business software programs. She worked hard to have this language standardised. Soon after she had succeeded, the Navy and others were using it. Her work has changed the face of computing. She was the first person ever to receive the Computer Sciences Man (sic) of the Year Award from the Data Processing Management Association in 1969. In 1991 she was the first individual woman to receive the National Medal of Technology.

**Adele Goldstine and the other ENIAC women**

Adele Golstine and her team of six other computer programmers worked on the programming and maintenance of the Electronic Numerical Integrator and Computer (ENIAC), and produced its operating manual.

One should not forget the six women who are the world's first programmers: Key Mauchley Antonelli, Jean Batrik, Betty Hoberton (also known for her work with COBOL), Marlyn Meltzer, Frances Spence and Ruth Teitelbaum (Smith, 2010; Brown, 1996). They were the experts who were chosen to make the ENIAC computer work, inventing the field of programming. The women were mathematicians and logicians but were labelled as clerks and classified as "sub-professionals", probably due to their gender, and as a cost-saving device.

**Edith Clarke**

Edith Clarke was the first female engineer to be employed in the United States, the first female electrical engineering professor of the country and the first Fellow of the American Institute of Electrical Engineers. Her engineering career had as its central theme the
development and dissemination of mathematical methods that simplified and reduced the time spent in laborious calculations to solve problems in the design and operation of electrical power systems.

**Erna Hoover**

Erna Hoover created a computerised switching system for telephone call traffic, and earned one of the first software patents ever issued using a computer to (1) monitor the frequency of incoming calls at different times, and (2) to adjust the call acceptance rate accordingly. In addition to patent #3,623,007 (Nov. 23, 1971), Hoover’s system earned her a position as the first female supervisor of a technical department at Bell Labs. The principles of Hoover’s switching system are still widely used today, as various communications companies struggle with ever-increasing incoming traffic.

**Rózsa Péter**

Rózsa Péter (originally Pollitzer) is the founder of recursive function theory for which she received some recognition in her lifetime, but her name should be written together with the names of the founders of the computational theory including Gödel, Turing, Church, and Kleene. Although she intended to study Chemistry, when she enrolled at the university she found that she was fascinated by numbers and mathematical logic. She worked as a college teacher and when the college closed, she became a university professor. In 1976 she published her main work "Recursive Functions in Computer Theory". As an advocate for the beauty of Mathematics, she is known for her lectures often titled "Mathematics is beautiful". Part of her work was dedicated to increasing the opportunities in Mathematics for girls and young women.

**Military Projects**

The Military Projects list is certainly not an exhaustive list, but it indicates that a number of women were directly involved in the development of the early technologies. An interesting fact is that as the whole process of setting up networks was part of military projects, women

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were, de facto, excluded. Whilst the ideas were at a theoretical level, some women had the opportunity to have an influence in shaping the field. As military defence is a "no-women area", credit was mostly given to men.

1.2.3 Miniaturisation

Over the last twenty years, computer systems and architecture research addressed the performance of general-purpose microprocessors and desktop computers. ICTs' uses, however, are not limited to scientific applications. Their importance lies in their uses outside the scientific world and in their general multi-purpose applications. Miniaturisation, "more for less", aims to improve the competitiveness of the European industry, enabling Europe to master and shape the future development of ICT and ensuring thus that the demands of its society and economy are met. It can only be achieved by driving and stimulating product, service and process innovation and creativity. As such ICT progress is harnessed and transformed into benefits for Europe’s citizens, business, industry and governments.

Miniature systems are a driving force as they are able to contribute new application domains by being replicated in large numbers and by collaborating on solving specific problems. Such collaboration is at present a new territory that still needs to be explored. To this end, different projects are financed at European level to do just that.\textsuperscript{10}

1.2.4 Towards the World Wide Web

The USSR’s launch of Sputnik in October 1957 spurred the United States to set up the Advanced Research Projects Agency (ARPA) in February 1958, in order to regain the technological lead. ARPA created the Information Processing Technology Office (IPTO) (Nichols, 2009) in the framework of the Semi-Automatic Ground Environment programme (SAGE), which had networked country-wide radar systems. IPTO proceeded and started a project to make a network which used packet switching. On October 29, 1969 two of the four nodes which would become the ARPANET were interconnected between UCLA and SRI (later SRI International) in Menlo Park, California (Roberts and Wessler, 1970).

\textsuperscript{10} Nanotechnologies are an important part of the research financed under the 7th Framework Programme for Research and Development of the European Commission.
One of the stepping stones in the history and development of computers is the development in CCITT (now called ITU-T) of the X.25 switching standard which moved away from the switched network service. The collection of X.25 based networks grew from Europe and the US and by 1981 it was covering Canada, Hong Kong, and Australia.

X.25 was independent of the TCP/IP protocols stemming from DARPA’s work on the APRANET, Packet Radio Net, and Packet Satellite Net in that period. Cerf and Kahn developed the first description of these protocols in 1973, publishing their work in 1974 (Cerf and Kahn, 1974).

There are a number of developments relating to networks and in 1988 networks were opened to commercial use. The US Federal Networking Council approved the interconnection of the NSFNET\(^{11}\). The first commercial network was the MCI Mail systems, with the link made in the summer of 1989. It was the start of the Internet with other commercial electronic e-mail services connected, such as OnTyme, Telemail, and Compuserve. 1989 also saw the first three commercial internet service providers (ISP): UUNET, PSINet, and CERFNET. Soon other commercial and educational networks were set up and the Internet started to grow.

The Internet is a global network of interconnected computers enabling its users to share information along multiple channels. A computer which is connected to the Internet can access information from a broad range of available servers and other computers by transferring information to the computer’s local memory. At the same time, the computer can in turn send information to servers on the network.

The basic applications and guidelines making the Internet possible existed, as previously seen, since the 1970s. The network did not, however, gain a public face until the 1990s, when on 6 August 1991, CERN\(^{12}\) 13, publicised the new World Wide Web project, designed by British Scientist Sir Tim Berners-Lee in 1989. An early popular web browser was Viola WWW, replaced later on by the Mosaic web browser and in 1993 by version 1.0 of Mosaic. By 1996 the word "Internet" had become commonplace, and a synecdoche in reference to the World

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11 NSFNET is a university 56 kilobit/second network backbone using computers called “fuzzballs”. It was commissioned by the United State’s National Science Foundation (NSF) in 1985.

12 CERN stands for European Organisation for Nuclear Research.

Wide Web. The majority of accessible information on the Internet consists of inter-linked hypertext documents and other resources of the WWW\textsuperscript{14}. Computer users manage, send, and receive information through web browsers.

Apart from the complex physical connections that make up its infrastructure, today’s Internet is facilitated by bi- or multi-lateral commercial contracts and by technical specifications or protocols which describe how to exchange data over the network. One could say that the Internet is defined by its interconnections and routing policies. According to Internet World Statistics\textsuperscript{15}, by 31 December 2008, 1.574 billion people were using the Internet and by 31 December 2010 that had reached 2.050 billion people, i.e., 29.2% of the world population (Internet World Statistics, 2011).

1.3 Internet – A Powerful Tool

The evolution of the Internet brought a number of changes in today’s professional and social canvas. It has made possible entirely new forms of social interaction, activities, and organisation, thanks to its basic features such as widespread usability and access. It made changes to the way of working (teleworking, teleconferencing etc.), which had an impact on financial and energy savings. At the same time, it led to the emergence of new disciplines and research trends as well as totally new professions, not all of them related to technology.

The Internet has achieved new relevance as a political tool. Many political groups use the Internet to achieve a whole new method of organising themselves, in order to carry out Internet activism (Salisbury, 2008). The presidential campaign of Barak Obama in 2008 in the United States was the first one to use this tool, as well as twitter\textsuperscript{16}, for publicity purposes and, most importantly, for its ability to generate donations via the Internet (Cain Miller, 2008).

ICTs can also be seen as a source of leisure activities through entertaining social experiments such as MUDs and MOOs (Shah and Romine, 1995)\textsuperscript{17}. This, however, is a sector of connectivity that most certainly does not empower women. Pornography and human

\textsuperscript{14} World Wide Web.
\textsuperscript{16} Twitter is a social networking application for PCs, smart phones and mobile phones.
\textsuperscript{17} See List of Abbreviations and Definitions.
trafficking, two of the thriving areas of WWW, are in fact destructive for women, as well as the repercussions of gambling upon family economics.

Many people use the Internet to access and download music, movies and other works for their enjoyment and relaxation. The World Wide Web is also used to access news, weather, and sports reports, to plan and book holidays, and to find out more about random ideas and casual interests.

This brief overview of the uses of the Internet was made in order to emphasise the important role it plays in both work and leisure. With the changing fabric of our society it has also started to play a role in health and safety. Women need to and must be able to harvest the benefits of modern technology to better their lives. Digital literacy is but the first step. Equal participation in the production and design of technology is the goal.

1.4 **Problem Statement: A New Approach to ICT**

From the introduction above, the reflections and our emphasis on the contribution by women to the history of ICT, we arrive at the following problem statement.

**Problem Statement:**

“Would engendering technology, i.e., increasing the number of women in the production, design, and use of technology, lead to empowering women?

In order to answer the problem statement, statistical evidence relevant to the representation of women in the cyber-community is going to be investigated. Based on the results of the statistical analysis, five research questions are formulated to be further explored.

For clarification purposes, it should be noted that the term "cyber-community" is used most of the time (interchangeably with "information society"). A cyber-community is an all-encompassing term, including information and communication technologies for both application and production. It includes the Internet as it exists at present, and it goes beyond
both the networking to find jobs, either technical or "spin-offs", and also the totality of the
digital world including cyberspace (Gibson, 1984).\footnote{The term was coined by William Gibson in his 1984 novel "Neuromancer", and is a futuristic computer network that people use by plugging their minds into it! The term now refers to the Internet or to the online or digital world in general – retrieved from answers.com on 14/4/09 (http://www.answers.com/topic/cyberspace).}

One should be careful not to confuse the term "cyber-community", which is the umbrella
term, with the Internet itself or indeed with the term "cyberspace". The Internet can be
defined as a publicly accessible computer network connecting many smaller networks from
around the world (Encyclopaedia Britannica, 2008), whilst the term "cyberspace" is often used
to refer to objects or identities that exist largely within the communication network, and is
metaphorical, although unlike most computer terms it does not have a standard, objective
definition (Gibson, 1984). The development of Web 2.0 (O'Reilly, 2005; Di Nucci, 1999) is
increasing the cyberspace considerably.

It should be noted that the work carried out in this thesis is mainly limited to the Western
world and in particular to Europe and North America. The main reason is that empowerment
is considered through the engendering of technology is envisaged especially in the production
and design of technology and technology policy. The effects of engendering technology in the
West would granulate to other parts of the world where the implementation of technology
applications on the one hand is limited or rather basic e.g., in parts of Africa, and on the other,
production and design is based on the transfer of know-how (China, India). The local culture
and customs are in many cases obstacles for the proper empowerment of women (Arabic
countries, Japan).

It is important before we go any further to unfold the two main terms of the problem
statement, i.e., "engendering technology" and "empowering women".

1.4.1 Engendering Technology

An engendered technology is a technology in which there is an equal (approximately 50%)
participation/representation of women at all levels, including the design and production of
technology. An under-representation of women could be defined as a participation that is less
than 50%, especially at decision making levels where the orientations for technology
development are set. But an engendered technology is also a technology which is women-
friendly in terms of its use, and which deals with a technology developed for women, thus taking into account their needs. An under-representation has serious consequences at different levels, such as innovation, design of technology, empowerment for women and equity in general.

1.4.2 Empowering Women

The second part of the problem statement deals with "women’s empowerment". From a sociological point of view the term "empowerment" often addresses members of groups that social discrimination processes have excluded from decision making processes through - for example – discrimination based on different attributes such as sex (Wilkinson, 1998). Empowerment includes the following similar requirements (Thomas and Velthouse, 1990):

- the ability to make decisions about personal/collective circumstances;
- the ability to access information and resources for decision making;
- the ability to consider a range of options from which to choose (not just yes/no, either/or);
- the ability to exercise assertiveness in collective decision making;
- positive-thinking about the ability to make change;
- the ability to learn and access skills for improving personal/collective circumstances;
- the ability to inform others’ perceptions through exchange, education, and engagement;
- being involved in the growth process and changes that are never-ending and self-initiated;
- increasing one's positive self-image and overcoming stigma;
- increasing one's ability in discrete thinking to sort out right and wrong.

The terms "equality" or "equity" - the latter is a more recent term - are used in the sociology framework to indicate that all people have the same status in certain respects. These terms
include equal rights under the law, such as security, voting rights, freedom of speech, as well as access to education, health care, and other social securities. These terms also include equal opportunities and obligations involving the whole of the society. Equality requires the lack of enforced social class and unjustified discrimination motivated by a part of a person’s identity such as sex, gender and age, which result in unequal treatment under the law and unjustifiably reduce opportunities. Social equality refers to social rather than economic or income equality. "Equal opportunities" is interpreted as being judged by ability regardless of gender or other differences, which is compatible with a free-market economy (Blackford, 2006).

1.5 Five Research Questions

Statistical evidence showing that women are under-represented in the cyber-community is taken as the basis of our research. This statistical evidence found in Chapter 3 will be used as the sprinting board for the work of this thesis. Of course, we should examine the areas where this under-representation is observed and investigate the obstacles women face in the sector and why they face them. The answers to these questions would ideally lead to further investigation on (1) whether there has been an improvement of the position of women in the sector, both in terms of quantity and quality, and (2) what could be done to improve the situation. Based on this reasoning, we formulated five research questions which will be instrumental in answering the problem statement.

RQ1: Which are the areas in the sector where women are most under-represented?

RQ2: What are the problems women face when they are in the sector?

RQ3: Why are women under-represented in the cyber-community?

RQ4: Has there been any improvement in recent years?

RQ5: What measures can be taken to improve the representation of women in the cyber-community, both qualitatively and quantitatively?

The answers to these research questions aim (1) to build the rationale of how gender can be brought into the focus of the mainstream of technology, (2) to fulfil the requirements, as listed in Subsection 1.4.2, and (3) to empower women. This will be the main body of the work in this thesis and will lead to answering the problem statement.
1.6 **Research Methodology (M)**

The work for this thesis is organised in different chapters, which first attempt to answer the research questions and then provide an answer to the problem statement. Our research methodology (M) consists of six different parts:

M1 - literature review;

M2 - statistical analysis (based on the outcome of the literature review);

M3 - design of a research approach (desktop research and questionnaire);

M4 - performing an analysis to develop and validate a model;

M5 - performing questionnaire analysis and "in-depth" interviews in order to test the model;

M6 - evaluating the results.

Throughout the chapters of this thesis, I shall be trying to identify and connect the issues of "engendering" technology and "empowering" women. Here we see that Subsections 1.4.1 and 1.4.2 are essential to our thesis and reasoning. The concluding chapter will couple those issues and answer the question of whether an engendered technology is a tool for women’s empowerment. Although the research mainly deals with European, and secondary USA data, some references at an international level are included.

1.7 **Thesis Structure and Overview**

The thesis is structured in eight chapters, a brief overview of which is given hereafter.

Chapter 1 is an introduction to the history of ICT. It provides a presentation of the problem statement and the five research questions, and describes the methodology used. It deals with all the research questions.

Chapter 2 provides a literature review on how women’s presence in the cyber-community is seen and any possible connections with the first, second and post-feminism movements. As the subject of women in the cyberspace is relatively new, available literature is limited. It deals with Research Questions 1-5 and the methodology used is "Literature Review" - M1, RQ1 – 5.
Chapter 3 looks at statistical evidence concerning women and ICT. Statistical evidence referring to education, employment and decision making is going to be examined in order to prove that women are indeed under-represented in the cyber-community. It investigates Research Question 3 and the methodology used is "Statistical Analysis" - M2, RQ 3.

Chapter 4 looks at the reasons for which women are under-represented in the cyber-community, and the gender of technology, answering Research Question 1. In this chapter, some of the main elements deterring women from studying and working in ICT (related to RQs 2, 3 and 4), are examined and the methodology used is "Design of a research approach (desk top research and questionnaire)" - M3, RQ 1 - 4.

Chapter 5 looks at stereotypes in literature and media, and provides feedback for the preparation of the questionnaire answering Research Question 3 and using as methodology "Performing an analysis to develop and validate a model" - M4, RQ 3.

Chapter 6 presents a number of activities at national, European and international level, aiming to increase the number of women in the cyber-community by bringing down stereotypes, presenting possibilities for empowerment and demystifying the ICT area. It answers Research Question 4 using as methodology "Performing an analysis to develop and validate a model" - M4, RQ 4.

Chapter 7 presents a quantitative and qualitative analysis of a questionnaire sent to a sample of women working in the sector. The aim of this chapter is to see whether there have been changes in the sector over the years and also if some of the claims and statistical evidence are still valid. It should be mentioned that the aim of the questionnaire is exploratory. It plays an affirmative rather than an investigative role, a sort of "gathering of voices" supporting in a limited manner the issues presented in previous chapters. It answers thus Research Questions 2 and 5 using as methodology "Performing questionnaire analysis and 'in-depth' interviews" - M5, RQ 2, 5.

Chapter 8 concludes the work by answering Research Questions 1 to 5 and the Problem Statement. This chapter presents a number of recommendations for future activities.

The structure of this research and the answers to the research questions are presented in Table 1-2 as well as in Figure 1-1.
The thesis has four Appendices for additional information, an abstract, an executive summary, a list of abbreviations used and a list of relevant references.

The structure of this thesis, which aims to answer the research questions and to answer the problem statement, can be graphically represented in a model as shown in Figure 1-1, i.e., the
original model. The model will be completed in Chapter 8 where the results of the research and recommendations are presented.

The Model "Getting In - Staying In" investigates the factors which influence the choice of career in general and the more specific influences on the choice to study ICT-related subjects. The conditions of staying in the sector are also investigated, as well as those for retraining women returners (this is placed in the no career/no employment part of the model).

Looking at the initial form of the model, we can see that the career choice is influenced by four main factors. We briefly describe them below.

- **School:** the way the different subjects are taught and the attitude of teachers influence pupils. Depending on how lessons are taught, pupils form likes and dislikes, and consider some subjects more difficult or less interesting than others. Teachers' different ways of behaving towards boys and girls, in relation to the subject taught, create classes which work at "two speeds".

- **Family:** specific roles within the family provide children with role models for their future life. Avoiding "male things" could lead to girls steered away from science and technology.

- **Peers:** the boys and girls division starts quite early in life and children tend to stick initially with those of the same sex. The segregation of male and female careers is reinforced by peers.

- **Media environment:** the proliferation of stereotypes presented in the media and of the "fashions" of choosing a career which is typical to one's gender strengthens ideas and attitudes formed at school and at home.

Regardless of whether a student chooses to follow a technical/ICT career, the way she is treated at university or during vocational training has an important effect on how she is going to progress in her chosen path. A number of women trained at university give up their careers or move on to different areas to have "better careers". This makes them "get out" of the sector even when they have initially chosen it. They can get back through training and retraining.
This model will be revisited in the final chapter in order to see where interventions could be made, not only to encourage girls and women to get into the sector, but also to stay in it.

Figure 1-1 Getting In, Staying In the Model
Chapter 2 LITERATURE REVIEW

This chapter contains a literature review of four important topics:

1. Feminist theories.
2. Empowerment through ICTs.
3. Engendering ICTs.

We explore the segment of feminist literature which embraces technology as an empowering tool for women, describes how technology is not neutral, and offers a feminist theorist’s perspective on the issue of women and technology. We focus particularly on the work of Donna Haraway. In her *Cyborg Manifesto* (1985), she tried to create an ironic political myth, faithful to feminism, socialism, and materialism. She accurately and acutely addressed the persistent dualisms of the Western traditions based on the domination of women (2.1). This is followed by a section which goes beyond feminist theory to look at significant publications which address the issue of the empowerment of women through the use of ICTs (2.2). More importantly we are going to look at the gendering of the relevant technologies, some of it by examining the work by Sophia Huyer\(^\text{19}\) and Nancy Hafkin\(^\text{20}\) who presented us with the heroine of the twenty-first century, Cyberella (2.3). Finally, we are going to review literature investigating how the gender divide poses a threat to the ability of women to take fully part in and benefit from the cyber-community (2.4). In Section 2.5 some basic concepts will be

\(^{19}\) S. Huyer is the executive director of WIGSAT (Women in Global Science and Technology) and senior research adviser with the Gender Advisory Board of the United Nations Commission for Science and Technology for Development. Her recent publications include: *Women in the Information Society* (in *From the Digital Opportunities: Measuring Infostates for Development*), *Overcoming the Digital Divide: Understanding ICTs and Their Potential for the Empowerment of Women* and the UNESCO/GAP Toolkit on Gender Indicators in Engineering, Science and Technology.

examined about the problems women face when in employment. The chapter is completed by presenting tentative conclusions (2.6) based on the findings of the four areas examined.

This chapter's literature review aims to provide the theoretical background which will act as the starting block for the analysis and discussions of the five research questions.

2.1 Feminist Theories

In this section we discuss classical feminist theories (2.1.1) and distinguish amongst the three waves of feminism. In Subsection 2.1.2 we briefly consider feminist approaches to technology. This is followed by a brief review of the Cyborg Manifesto (2.1.3). In Subsection 2.1.4 we continue by considering ICT and new gender theories. Of course, this is not the end, and therefore we speculate on future trends in Subsection 2.1.5.

2.1.1 Classical Feminist Theories

Any analysis about the relation between the sexes would be incomplete without looking at the work of major feminist philosophers. We singled out three of them, Simone de Beauvoir, Julia Kristeva, and Luce Irigaray. They presented different ideas regarding the marginalisation of women in society. Although they do not deal directly with the position of women in the cyber-community, their work is relevant as it helps us investigate the pillars on which social constructs were built, despite their end differences. Looking at their opera in a chronological order, the work by Simone de Beauvoir is to be examined first, then Julia Kristeva and finally Luce Irigaray.

2.1.1.1 Simone de Beauvoir

Simone de Beauvoir belongs to the first and second wave of feminism (Schneir, 1994). Her essay, The Second Sex (de Beauvoir, 1972), was a revolutionary and controversial piece of feminist literature which showed her thoughts about the position of women in the world and placed previously unseen emphasis on women defining themselves first as individuals and then according to their sex. She continues to emphasise that women are being oppressed due to their designation as "the other" within a male dominated society. De Beauvoir's argument is that although men see themselves as "self" and women as "the other", women are not able to see themselves as "self" but retain the role of "the other" to the man's "self". Men imposed this constraint. In addition, the male justification for doing so has always been self-serving.
Anti-feminists, according to de Beauvoir, cite the fact that women became the inferiors in the conflict between absolute self and absolute other as evidence for female inferiority within the frameworks of, for example, religion, philosophy, biology, and psychology. She puts forward the argument that in order to progress we need to discard the notions of superiority, inferiority or equality and start afresh. I believe that information and communication technologies present us now with a unique opportunity to do so. Furthermore, de Beauvoir claims that the traditional mother-role which is what is keeping women in their position of oppression, and also that employment is a right they have as free and autonomous beings. She considers that it is essential for women to reap the benefits of financial and social independence from men, be it fathers or husbands. What de Beauvoir clearly identifies are structural "defects" in the very fibre of society which are catalytic in keeping women in their subordinate role. These are the same structural defects identified in socialist-feminist theory i.e., sexism and the gendered division of labour are determined by the economic system of the time (Kennedy Lapovsky, 2008; Wharton, 1991). Those could be articulated through capitalist and patriarchal relations. Socialist feminists reject the Marxist notion of class and class struggle as the main elements of economic development which in turn would help eliminate gender oppression.

2.1.1.2 Julia Kristeva

Julia Kristeva belongs to the third wave of feminism. She believes that motherhood contributes to the marginalisation of women but her way of thinking differs to that of de Beauvoir. In her essay, *Powers of Horror*, (1982) Kristeva presents the idea of abjection in relation to maternity. She claims that when a child is separated from its mother it does so in order to form its own identity and its dependence on the mother is now seen as a threat to the departing child (Oliver, 1998). Kristeva argues that this separation of the mother from the child is to be blamed for the marginalisation of women in contrast to de Beauvoir's "oppression of women due to motherhood". Kristeva also analyses the use of language which she considers important and divides it into two different entities: the symbolic and semiotic. She associates the symbolic with men and the semiotic with women. She also claims that both entities need to be coupled in order to make any sense.

Kristeva’s (1995) identification of the three waves of feminism is an important framework for theoretical work in this area. Her classification is as follows:
The **First Wave of feminism**, prior to 1968, is the one focusing on *equality*: "equal pay for equal work, and the right to the same opportunities as men have, as well as the rejection of feminine or maternal traits considered incompatible with participation in such a history". This is where she places de Beauvoir. The problem with the First Wave, according to Kristeva, is that through the ideas expressed, women reinforce the belief that men are their superiors which is the reason that they themselves are disparaging what identifies them as women. She further claims that equality can only be achieved by overcoming the attitude of inferiority women have because of their sex (Kristeva, 1995).

The **Second Wave** is chronologically placed after May 1968 and this is where feminists brought their aesthetic and psychoanalytic experiences with them. She considers that a great deal of the discourse in this wave focuses around men (or the phallus), and this needs to be changed in order to encourage a more matriarchal participation in society. She also rejects this wave on account of "culture and language being the domain of speaking beings and women are primarily speaking beings" (Kristeva, 1995, 1986).

The **Third Wave**, where Kristeva places herself, seeks to overcome the rivalry between men and women without discounting the differences between the two. Kristeva claims that the idea of the role of a woman as a mother should not be rejected but rethought and that both sexes (male and female) are dependent on each other (the same as semiotic and symbolic) and if men and women are more empathetic and accommodating with each other, equality can be achieved.

It should be noted that this is the timeframe in which Kristeva orders the three waves of feminism: First Wave, 1945 – 1968; Second Wave, 1968 – 1980 and Third Wave, 1980 - present. Other scholars use different starting points for the First and Second Waves of Feminism (Friedan, 1974). Conventionally, the First Wave refers to a period of feminist activity during the late 19th and early 20th centuries with the term coined retrospectively in the 1970s (Schneir, 1994). The Second Wave came after the Second World War (Friedan, 1974) and lasted until the late 1980s. Third Wave Feminism or Post-Feminism starts around this period and continues to the present (Freedman, 2002). The issues dealt with in these three waves are different depending on the specific issues of the period. The Third Wave, for example, deals with issues such as race, social class and sexuality, looking at the same time at concerns in the workplace such as the glass ceiling, sexual harassment, maternity leave policies, childcare and support for single mothers (Munden, 2003).
Luce Irigaray’s work is outside this framework of waves of feminism, as she bases her claims on the socially constructed rather than the physically. Irigaray advocates that the differences between the sexes are not intrinsic but socially imposed. She discusses linguistics at length and believes that overcoming the competitive relationship between men and women would result into equality. Her ideas overlap with many ideas in all three waves of feminism. She attributes to women "the responsibility to maintain the social order through motherhood" (Irigaray, 1985). She considers, firstly, that women are defined according to their status in relation to motherhood, whereas men are defined in relation to culture and subjectivity and, secondly that women act as supporters to the only true "subjects" in the Western world (i.e., men). She does not however offer a concrete plan of action of how to create a more empathetic relationship between men and women or on how the relationship between men and women could stop being discriminatory; she expects that all this will happen naturally.

The three theorists presented are only a sample of feminist writers. It would be opportune to mention here that writers such as Sappho, Emily Brontë, Jayne Austin, Maya Angelou, and Toni Morrison are also considered to be writers with feminist ideology. There is a distinction to be made between feminist and feminism writing. The latter mainly deals with theoretical, philosophical and/or academic work. In this category Alicia Walker and Hélène Cixous should be mentioned.

2.1.2 Feminist Approaches in Technology

In this Subsection we focus on cyber-feminism and the progress of women in technology. I consider the work by Rosi Braidotti as the most influential in this period. She is the main ambassador of feminist approaches to technology. In her work, Braidotti manages to combine post-modern theories with the politics of parody, the power of irony, and feminist visions of science fiction.

Rosi Braidotti

Braidotti is considered to be a pioneer in European feminist philosophy and to have a serious influence on the Third Wave of feminism. She has managed to bring post-modern feminism into the Information space, introducing the issue of cyberspace. In her article Cyberfeminism with a difference (Lykke and Braidotti, 1996), she places post-modernity in the "specific historical
situation" of the post-industrial societies, and as a successor of the declining modernism. According to Braidotti, modern society, with its ever-increasing economic problems and new social structures, further defines post-modernity which alters between technology and culture. She considers (Braidotti, 2006; Lykke and Braidotti, 1996) that technology moved on from the panoptical device analysed in terms of surveillance and control by Foucault (1975) to the more complex mechanisms described by Donna Haraway as "the informatics of domination" (Haraway, 1985)\(^{21}\). Braidotti claims that technology should be considered as "a material and symbolic apparatus", i.e., "a semiotic and social agent among others", rather than "antithetical to the human organism and set of values". Braidotti clarifies this claim in an interview (O'Grady, 1995), saying that universal technology is the mediating factor in our continuous interaction both with culture and nature. She goes further by emphasising the political question of the new technologies in order to reassert the difference that women can make.

Braidotti (Lykke and Braidotti, 1996) believes that there is an important shift of perspective which would lead to the move from the present technophobia to a more technophilic approach redefining thus the relationship between technology and art. More specifically, in the field of information technology, computer design will tie creativity to technical work. I believe that this is a perspective which would hopefully attract more women to the ICT sector.

Looking at Braidotti’s work with parodies and paradoxes, she appears to promote the idea that post-modern theories were unable to create, or even show, any changes to the chronic status quo of women as long-standing subjects to oppression and exclusion. All these necessary changes are bound to create a crisis of conventional accepted values. From my understanding of her work, inequalities relevant to gender, race, colour, and sexuality remain, despite her assertion that parodies move feminism away from traditional femininity, thus empowering new forms of subjectivity. This leads to the paradoxes of cyber-imagination, and Braidotti (Lykke and Braidotti, 1996) makes a special point about "the cultural reality production surrounding virtual reality". She claims that "all this imaginary of virtual reality and promises, leads to the creation of new utopias about the relationship between the sexes and produces divergent political strategies looking for alternatives".

\(^{21}\) More analysis of the work by Donna Haraway further down this chapter.
Braidotti often refers to the work by Donna Haraway, which we are going to see in more detail in the section that follows, and in particular her *Cyborg Manifesto*.

2.1.3 Donna Haraway

Haraway, although she is not a feminist as such, made an important contribution to the cyber-feminist discourse. She is currently a professor and chair of the History of Consciousness Programme at the University of California, Santa Cruz, USA.

Below we describe the development of ideas that preceded Haraway's *Cyborg Manifesto* (1985), starting with a definition.

2.1.3.1 Cyborg

The term "cyborg" was first used in 1960 by Manfred Clynes and Nathan Kline, in an article about self-regulating human-machine systems in outer space, and can be defined as "an organism combining both natural and artificial systems (cybernetic organism)".

Later on, Clynes, in the introduction of Halacy's *Cyborg: Evolution of the Superman* (1965), expanded his definition and wrote of a "new frontier" that was "not merely space, but more profoundly the relationship between 'inner space' to 'outer space' - a bridge ... between mind and matter". Although the cyborg was stereotyped as an organism with enhanced abilities as a result of its built-in technology, strictly speaking a proper definition of a cyborg is a person assisted by a person-made device, such as glasses or a bicycle.

Fiction portrayed cyborgs as creatures made from organic and synthetic parts. However, they frequently lacked human traits such as morality, empathy, and free will. Through these fictional portrayals, one could feel the increasing discomfort of our society with everything technological. In my opinion, the fictional cyborgs project the individual's personal fear of technology dependence and eventual control (the "Big Brother" syndrome), as well as, to some extent, a hidden technophobia. The correct representation of cyborgs refers to people using cybernetic technology to repair, overcome or improve physical or mental constraints of their bodies.

From the initial definition of the cyborg to the one actually using electronic devices indicates a much more rapid progress than that which was originally anticipated. The evolution of ICT's played an important role in this mutation.
Theoretically speaking, there are two types of cyborgs: the restorative and the enhanced. The restorative cyborg is the one which is helped due to necessity by an external device. The enhanced cyborg "follows a principle, and it is the principle of optimal performance", intending thus to exceed normal processes or even gain new functions not originally there.

Cyborgs are to be found in medicine, art, history, sports, military, fiction and electronic games. For the purposes of this work, we shall look at “cyborg feminism” and in particular the work by Haraway and the *Cyborg Manifesto*.

2.1.3.2 *Cyborg Manifesto* - Donna Haraway

Haraway is described as a "feminist, rather loosely a neo-Marxist and a post-modernist" (Young, 1982). She is known for using metaphors to reveal new areas of thought and possibilities. In 1985, Haraway published the essay *A Cyborg Manifesto: Science, Technology and Socialist Feminism in the Late Twentieth Century*, in "Simians, Cyborgs and Women". One should note that although up to that time, all her works emphasised the masculine bias existing in the scientific culture, she moved on to start a feminist narrative aiming to challenge third wave and post-modern feminists to go beyond the naturalisms and essentialisms which they were advocating until then.

Haraway, in her *Cyborg Manifesto* (Haraway, 1985), uses the analogy of the cyborg in two different ways:

1. To compel feminists to go beyond the politics of naturalism and essentialism as previously mentioned.

2. To present a political strategy for what appeared to be the different interests of socialism and feminism.

Haraway goes further than that, deconstructing the existing binaries between control and lack of control over (1) the body, (2) the object and (3) the subject, nature and culture. As a post-modern feminist, she argues against essentialism, which she defines as "any theory that claims to identify a universal, trans-historical, necessary cause or constitution of gender identity or

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22 A manifesto is a call to action, a verbal slap in the face, an effort to use language to make things happen (definition from a lecture on Donna Haraway found in www.transcriptions,english,ucsb.edu/archive/courses/warner/english122tg/Haraway, accessed 30/06/2008).
patriarchy" (Anderson, 2011). Such theories, she argues, either exclude women who do not conform to the theory and segregate them from "real women" or represent them as inferior.

The analogy of the cyborg is used to show that women are often discussed and treated in such a way as to be reduced to just bodies, ignoring their other qualities. The cyborg identity however is constructed (1) by the natural elements such as the human body and (2) by what we think about it, i.e., the attributes we bestow on it.

The 1990s was the start of the cyborg era and Haraway continued contributing to the cyber-feminism she created. Although she endorsed technology by using the specific metaphor she was also just as critical of the changes technology could bring about. On the positive side, technology could contribute to female liberation, i.e., the transition of women from the position of objects to that of subjects. This transition leads to empowerment, and this is something that feminists and women, above all, should consider seriously. Haraway further points out that the concept and image of the cyborg is empowering to women as the modification of circumstances can provide increased strength and control over social constructs, in the same way that modifications in cyborgs lead to increased strength and control over nature23.

2.1.3.3 Further discussion on Cyborgs

Many scholars believe that Haraway wrote a brilliant and well-argued essay in her Manifesto which addressed modern feminism in an intelligent and creative way. Many other scholars, however, have criticised and commented negatively on her work. We mention three of them.

2.1.3.4 Krista Scott

In her interpretation of the Cyborg Manifesto, Scott (1997b) says:

"Haraway feels that the cyborg myth has the potential for radical political action as it frees feminists from a desperate search for similarity with one another, since physical/epistemological boundary breaks can be extrapolated to political boundary".

23 Interpretation of Haraway's message by the author of this work.
Why should feminists be concerned with Haraway’s vision of the cyborg? According to Scott (1997a) there are two reasons: (1) in a more literal interpretation, the cyborg represents the world of techno-science which feminists must fearlessly enter and engage with, and (2) more metaphorically, the cyborg represents a paradigm for collective political action.

2.1.3.5 Karen Kayfetz

Kayfetz (2005) claims that Haraway’s attempts to connect the cyborg identity to cyborg feminism lack proper justification. Kayfetz believes that although Haraway provides definitions for cyborgs and women’s movements in terms of social realities and relations, she fails to provide any reasons for this connection. Kayfetz further advocates that Haraway’s statements leave the reader of the *Manifesto* puzzled due to lack of continuity in her claims. She further emphasises the fact that from the start of her essay, Haraway unsuccessfully tries to construct a relationship between cyborgs and the feminist movement.

2.1.3.6 Younus Dhamee

Dhamee (2005) points out that the female cyborg features intensely in cyberpunk literature, which is usually the product and fantasies of a male writer. Cyborgs in cyberpunk imply a dangerous sexuality, which creates a female identity simultaneously familiar, frightening and titillating to male viewers. However, in my opinion, Haraway aims to take the female cyborg image away from the male authors and she sees it as a tool with which to combat the male/female binary. Dhamee concludes that rather than "creating a dangerous woman, as defined by the male, one could create new forms which challenge traditional notions of both femininity and gender". He continues, stating that, "at the same time, women are given the opportunity to come to grips with the innovative technology they are traditionally kept from exploiting. The machine is us, our processes and aspect of our embodiment. Rather than being dominated by computers, the cyborg woman controls the machine". I believe that Dhamee's view is interesting as on the one hand he rejects the idea of the cyborg due to its use in a

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24 **Cyberpunk** is a science fiction genre noted for its focus on "high tech and low life". The name is derived from *cybernetics* and *punk* and was originally coined by Bruce Bethke as the title of his short story "Cyberpunk", published in 1983, although the style was popularised well before its publication by editor Gardner Dozois. It features advanced science, such as information technology and cybernetics, coupled with a degree of breakdown or radical change in the social order. http://en.wikipedia.org/wiki/Cyberpunk accessed 02/09/2008.
particular kind of literature and on the other, he approves of the use of the metaphor as it provides a window of opportunity for women.

2.1.4 ICT and new Gender Theories

This section aims to show briefly the evolution of feminist theories in relation to ICTs and presenting some new questions about the relationship between women and technology. In this context the work by a number of theorists, such as McLuhan, Zimmerman, Hubbard, Agger, Kramarae, Butler, Wajcman, Lawley, Van Der Leuen and Turkle is presented in a chronological order.

Critical theorists are not the only ones who approach the issues of dehumanisation and the deterministic role of technology. It is interesting to see the following quotation from McLuhan's (1964) classic *The Medium is the Message*:

"The medium, or process, of our-time - electric technology - is reshaping and restructuring patterns of social interdependence and every aspect of our personal life. It is forcing us to reconsider and re-evaluate practically every thought, every action, and every institution formerly taken for granted. Your education, your government, your family, your neighbourhood, your job, your relation to "the others". And they're changing dramatically."  

(McLuhan, 1964)

Worryingly this quote defines the end-user of technology as a passive/reflective object rather than the active subject. It is not all gloom and doom though. Many theorists started to reject this idea of deterministic view of technology and find a larger and more important role for its users. On the one hand, some consider this view as in principle true: that technology involves the creation of a mediated or virtual environment. On the other hand, the non-deterministic perspective is specifically attractive to feminist authors dealing with the issues of technology's social impact. If we see technology users as subjects and not useless objects, women can act as agents of change in this digital revolution.

This same view is also shared by Zimmerman (1982) who claims that if women do not gain financial and political control over the new values, they "will find themselves replaying a

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25 As cited in the premiere issue of *Wire* magazine.
familiar scenario in which new technologies serve to reinforce old values. As the number of women currently involved in the design and production of technology is rather low, I believe that it is necessary to include and promote more women in the political and economic control of technological change" (p.355).

Hubbard (1983) believes that technological systems and their consequences are a form of ideology which is shaped by the creators, designers, and managers of technology. She assumes that women can only "gain control" through the design and production of technology. This is particularly relevant for a better participation of women in the ICT sector, where the necessity to participate and integrate women's needs in the production and design of technology is clear.

Theorists in the field of critical theory and post-structuralism addressed the present as well as potential effects on science and technology over a number of years. Technology is often viewed as a tool of scientific rationalism, creating concerns relating to its determinist aspects and a possible dehumanisation of both the individual and society as a whole. Agger (1985), for example, deals with the issues of control exerted by computer experts and system managers. His point of view draws on Habermas' (1968) neo-Marxist views on science and technology as the basic ideology and gives a perturbing image for women as they are unlikely to be in great numbers amongst the elite of system managers. This image is supported by Agger's description of Habermas' work:

"The laissez-faire legitimation of earlier market capitalism has been largely replaced by the scientific-technocratic legitimation that cedes all system-steering authority to an elite of system managers".

(Agger, 1985)

Kramarae (1988) following the same line of thought says that:

"Technological processes have been studied from the (usually implicit) vantage point of men's experiences. When one puts women at the centre of analysis, male bases and masculist ideologies become clearer, and one discovers new questions as well as fresh approaches to old questions".

(Kramarae, 1988)
She challenges at the same time women to strive to understand social relations and ideologies of technological processes. Looking at communication technologies, female scholars should provide a "woman vantage point" for women in communication technologies and look at the shift of definitions of "woman" and "man" within this new framework of communication. She advocates the need for new theoretical perspectives to examine the shifting boundaries of gender definitions and rework the existing deterministic view about the effect of new technologies on society in general and women in particular.

In her book *Gender Trouble*, Butler (1990) defines gender as fluid and never fixed. This definition changes the categories of gender as they have been historically defined by feminists, and leads to a re-definition which takes into account the influence of communication technologies. This shows how computer-mediated communication is reforming social conceptions of gender and identity.

Looking at the evolution of feminist theories in relation to ICTs and looking at the theoretical analysis, we can see that there are other changes which are paramount in further shaping the complex relationship of women with science and technology. I believe that Wajcman (1991) gives a clear indication that a new relationship between women and technology is emerging and this needs to be shaped by all relevant parties:

"Feminist debates about political strategy concerning technology posit forms of action that break with conventional politics. They are about making interventions in every sphere of life".

(Wajcman, 1991)

Lawley (1993), in *Computers and the Communication of Gender*, identifies that many feminist scholars, including Haraway, exclude various aspects of information technologies and focus on technologies providing physical recreation for the body. Lawley, with other theorists, considers that Zimmerman's (1982) way is not the only one for women to become agents of technology. She claims that the reshaping of current conceptions of gender and sex roles through the manipulation of the virtual communication world(s) would lead towards the agency of the end-user. The institution of gender needs to be re-evaluated and reconsidered in the electronic virtual world. This would be a difficult task as stereotypes prevail and writers fall into a pattern describing women as users rather than agents of technology. These descriptions
tend to turn essentialism to determinism and instead of fighting marginalisation of women in technology they reinforce it.

Van Der Leuen (1993)\textsuperscript{26} refers to the stereotypical characteristics of gender found in the computer world. According to Van Der Leuen the biological boundaries between sex as a biological category and sex as sexual interaction are blurred and he assumes that genders remain unchanged in the virtual world, i.e., biological females remain women and biological men remain men. But he continues by describing women online having "sexy, naughty" personae and generally act upon male fantasies. A small reminder here is that many people who participated in this kind of virtual sexual interactions were at the end surprised when they discovered the biological sex of their partner!

Last but not least in this sector we are going to look at the work by Sherry Turkle, who has been looking at the societal of ICTs for three decades. Turkle (1984) takes some steps in her study of the cultural and psychological world of Computer Science to redefine what makes a "woman". In her interviews with a number of girls and women she identifies different attitudes towards computers which are mainly part of gendered construction. She also notes that there is a male "generalisation" of science. In her newest book, though, (Turkle, 2011), she reconsiders the advantages of technology in general, and I would say, more specifically for women, as the "personal costs" of relying on communication with relative strangers can damage intimacy and commitment to people we know from face to face interaction. Technology "guarantees" that we can do anything we want from any place. The other side of the coin is that this same technology overwhelms us as it propagates actual loneliness and unsettles emotional relationships. Women are more vulnerable not only due to their having additional everyday commitments but through the structure of society. Still, the development of technology brings a ray of hope as young people start to question what is happening. This, the "robotic moment" as Turkle calls it, asks us not to forget that we still have human purposes and need to rediscover what they are.

\textsuperscript{26} Article entitled "This is a Naked Lady" found in the premiere issue of Wired.
In this subsection we looked at ten theories relating to the social influence of ICTs and their restructuring of society as well their influence on women within the technological framework. I consider that the impact of technology on women, which is integral to the work in this thesis, should be investigated looking at the positive aspects. Technology can offer many advantages to women but it has also a number of hidden dangers, making them more vulnerable.

It should be noted that in this thesis theorists dealing with the social and feminist side of ICTs are presented as from the end of the 1980s, instead of general feminist theorists.

2.1.5 Future Trends

In order to determine future trends, it is necessary to provide a brief description of the current state of development. Western culture has a number of specific persistent dualisms which are systemic to logic and practices. Many of these are directly linked to domination practices of all types including the domination of women. Five of these dualisms are right/wrong, reality/appearance, agent/resource, mind/body and active/passive\textsuperscript{27}. Technology is labelled as the wrong place for women as: (1) they are mainly evaluated on appearance, (2) are considered to be resources rather than agents and (3) are usually considered to be passive. Gender consciousness is achieved through different social realities based on those and other dualisms. However, new technologies are shifting these dualisms and creating a new order of things. These are the basis for the future trends we are going to look at below.

Haraway's ironic cyborg focuses on networks and the freedom to construct one's self and one's identity, taking into account the dualisms previously mentioned. In a lecture given by William Warner (2008) at the University of Santa Barbara, in the framework of the project Transcriptions, he presented an interesting chart of transitions from "the comfortable old

\textsuperscript{27} Only the dualisms considered more pertinent to this work are mentioned.
hierarchical dominations to the scary new networks". He calls this Informatics of Domination$^{28}$ (see Table 2 - 1).

Table 2-1  The shift from Modern to Post-modern systems

<table>
<thead>
<tr>
<th>Traditional system (Modern)</th>
<th>Informatics of Domination (Post-modern)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Representation</td>
<td>Simulation</td>
</tr>
<tr>
<td>Bourgeois novel, realism</td>
<td>Science fiction, post-modernism</td>
</tr>
<tr>
<td>Organism</td>
<td>Biotic component</td>
</tr>
<tr>
<td>Depth, integrity</td>
<td>Surface, boundary</td>
</tr>
<tr>
<td>Heat</td>
<td>Noise</td>
</tr>
<tr>
<td>Biology as clinical practice</td>
<td>Biology as inscription</td>
</tr>
<tr>
<td>Physiology</td>
<td>Communications, engineering</td>
</tr>
<tr>
<td>Small Group</td>
<td>Subsystem</td>
</tr>
<tr>
<td>Perfection</td>
<td>Optimisation</td>
</tr>
<tr>
<td>Eugenics</td>
<td>Population control</td>
</tr>
</tbody>
</table>

Warner's is remarkable for a number of reasons as he himself explains. We provide three reasons below.

1. Although all the right-hand side labels cannot be coded as "natural", even the left-hand side ones challenge the notion of naturalistic coding. There are two options: either to go back both materially and ideologically, or to revive both the materials and ideology in a world which is loaded with policies on microelectronics and biotechnologies.

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$^{28}$ http://transcriptions.english.ucsb.edu/archive/courses/warner/english122tg/Haraway. Retrieved 20/06/2008. Further literature review showed that this chart of the Informatics of Domination is a subset of Donna Haraway's chart in her Cyborg Manifesto essay.
2. There is a transformation led by the centrality of communications which symbolise and implement new social relations for women.

3. Warner looks at the new world geography which is the geography of cyberspace. He says that "the old places no longer define, but become a networking matrix for women. … there is no place for women in these networks, only geometries of difference and contradiction crucial to women's cyborg identities" (Warner, 2008).

This transitional theory from modern to post-modern defines that the time is now ripe to interpret the new "webs" (structures) of power and social life, in order to set up new coalitions aiming to empower women. There is a need for a new common language in order to break the wall of separation between men and women in the technology sector. I personally believe that women should invest themselves in this transformation in order to use the available instruments, including communication sciences, to construct a complementary identity.

We have briefly looked at the doubts raised by Turkle (2011) in her latest work about what is happening in our society and the new threshold we are about to cross, which would lead to the "robotic moment".

Following the same trend of thought, Van den Herik, Lamers, and Verbeek (2011), in their introduction in "Understanding the Artificial", put in the forefront the question of the conflict between technology and society (the 3Is, Interaction, Intelligence, and Imagination, contrasted against the 3 Ss, Safety, Security, and Supervision). This is still an on-going debate which is expected to characterise the period 2010 - 2015 in the medium-term, and 2015 – 2035 in the long-term. The new generation of robots, given characteristics such as connectedness, identity and reciprocity, will have assigned identities and communicative skills. This will bring an important inversion in how women are positioned in the Information Society.

### 2.2 Empowerment Through ICTs

Most literature available on the issue of Women and ICT, as well as relevant activities, focuses on three areas.

1. Women's access to ICTs.

2. The use of ICT as a tool for networking and advocacy.
3. Women working in the sector.

However, women's empowerment covers a broader range of aspects that are not frequently addressed. We mention as important examples educational facilities, access to health information, well-being and advice on the setting up of one’s own business.

Whilst empowerment for women through ICTs appears to be at the top of the agenda for modern and post-modern feminist theorists, it is still not clear how this is going to be managed. In this section we are going to investigate the transition that women may experience due to the impact of ICTs (i.e., from object to subject), and by which they may be empowered (2.2.1), the knowledge to be developed and learned with the use of ICTs in the classroom (2.2.2), and the role of the new technologies in obtaining this technology (2.2.3).

2.2.1 Cinderella or Cyberella?

Cinderella is known to all of us from the Grimm fairy story of unjust oppression and jubilant reward. The character of Cinderella has come by analogy to portray "one who unexpectedly achieves recognition or success after a period of obscurity and neglect".

Nancy Hafkin and Sophia Huyer (2006), in their book Cinderella or Cyberella? Empowering Women in the Knowledge Society, look at the future for women in the knowledge society. They present two opposing figures - Cinderella and Cyberella.

According to Hafkin and Huyer, Cinderella works in the equivalent "basement" of the knowledge society, if she is employed at all, and has little or no opportunity to benefit from what the new era in technology can offer her. She is waiting for her prince to decide her future, and is the traditional object. Cyberella is using Information and Communication Technologies competently and in different ways to improve her life. The book has a number of different examples of the use of technologies helping women's empowerment, such as the female mobile phone operators in Bangladesh who help other women obtain information about registering their land, opening a business or obtaining tax certificates, or the use of

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29 Statistical information relevant to the three areas is provided in Chapter 3.
31 This is another dualism on the Haraway theoretical model.
technologies (on-line fora, radio) in Latin American regions to push for social change and the advancement of women's rights.

The book answers the question: "can information technology contribute to women's empowerment?" The positive answer is backed up by a number of different examples from across the world and, in particular, the developing world. Furthermore, the book focuses not only on the importance of the internet and computers as such but also their supporting technologies and applications.

In addition, the barriers and limitations in the equation of gender equality and ICTs are investigated and the production and design in technology is examined. The development of software programmes exclusively aimed at men should change and particular attention should be given to relevant content.

The conclusion is that in the 21st century we are, or we should be, aiming for Cyberella if we wish to benefit from the knowledge society32.

One should note that ICTs are not the magic wand of Cinderella's fairy godmother; they are not going to wave away centuries of submission, oppression and inequality. Rather, they provide the necessary tools to build upon for a better and equal society. Cyberella, the role model for young women, does not need a magic wand but will enter into the world of ICTs and will be an active member of the knowledge society. Cyberella, though, will only become a reality through the proper use of ICTs in the classroom, and by fighting technophobia.

2.2.2 ICT in the classroom

Assuming that Cyberella is the woman of the future we are aiming for, it is important to understand the obstacles preventing girls and young women from entering the knowledge society and remaining in it. What are the necessary tools to enable this transformation?

Hafkin and Huyer (2006)33 underline the fact that the gender divide poses a serious threat to the ability of girls and women to take part in the knowledge society. Even further away is the

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32 Knowledge Society is used by the authors as "the use of ICTs for development through empowering the poor and increasing scientific and technical capacity of nations in a way that is consistent with development goals, to support democratic decision making, more effective governance, and lifelong learning". This is from Mansell and Wehn (1998).

33 Chapter 4 – Cyberella in the Classroom
possibility of profiting actively from it. Here we recognise the knowledge society as a successor of the ICT society. Obviously, as our society becomes more and more global and based on the exchange of information through technology products, services and processes. Women who do not have access run the risk of becoming isolated and marginalised. It is important to use ICT in order to help women to be educated. With education they may become active contributors and ensure access and use of information which will improve their standing. They continue by proposing research in certain areas which will help us understand the evolution of present trends in this domain. More specifically she identifies the following five issues:

- Gender-differentiated effects and benefits stemming from the use of ICTs for education.
- Impact of the implementation of strategies for using ICTs in education.
- Costs, efficacy and added value of distant learning including use of PCs and internet.
- Segregated statistics for women and ICT-related education.
- Strategies to encourage the girls to choose technological subjects at school and the workplace.

Research in the above domains would help evaluate both the risks and the opportunities presented by an ICT-based society. And one should bear in mind that education starts in the classroom and therefore greater attention needs to be paid to the teaching of scientific subjects as early as possible.

2.2.3 Technophobia \(^{34}\) - an obstacle to empowerment?

Technophobia is an important issue to discuss here as in many cases it is a significant deterrent to acquiring eSkills for different use. Although "digital natives" are competent users of the technologies, it should be noted that in many cases they do not have "job ensuring" skills. Technophobia is defined as: ‘the fear of the effects of technological developments on society or the environment and the fear of using technological devices such as computers’

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\(^{34}\) See list of abbreviations and definitions.
Technophobia acts as a deterrent for many women and in some cases men, from making profitable use of the new technologies. The issue can be presented more concretely by using Greece as a case study.

Kamperidou (2008) looks at issues of digital literacy in Greece, i.e., the lack of competence to use a PC as a simple user. She states that this form of lack of digital skills was detected not only amongst university students (half of which are women), but also amongst primary and secondary school teachers. It should be noted that in Greece, as in other European countries, more than 50% of primary and secondary education teachers are women. This, of course, leads to the propagation of digital illiteracy from teachers to students. Even worse, the teachers are digitally illiterate mainly due to technophobia rather than a lack of interest. Gender-constrained attitudes towards science and technology are formulated at an early age and encouraged or discouraged (as the case may be) by the family and school. Digital illiteracy and technophobia lead to exclusion from full participation in the cyber-community and therefore inability to take full advantage of its benefits.

Kamperidou, Patsantaras and Pantouli (2007) argue that the Greek public school system’s inadequate technological infrastructures, deficiencies in both the vocational orientation of students and also the continuous techno-education of teachers, including the lack of collaboration of the education system with the employment sector and the ICT industry, have made it impossible for the gender subject to keep up with the accelerated speed of technological developments.

As mentioned above, digital illiteracy has been detected amongst primary and secondary school teachers in Greece, who explicitly expressed a technophobic unwillingness to use computers in their classrooms, despite the fact that they fully agree on their educational value and usefulness (Pantouli, 2006a). For example, qualitative research conducted with specific focus groups in areas representative of Greece - urban, industrial and agricultural populations, confirmed the gender impact factor on digital illiteracy (Kamperidou et al., 2007). Discourse analysis, group interviews and questionnaires distributed to specific focus groups— (1) female and male freshmen students of the Aristotle University of Thessaloniki, (2) female students of the Aristotle University of Thessaloniki and (3) primary and secondary male and female school

(Collins English Dictionary, 2009) 35. Technophobia acts as a deterrent for many women and in some cases men, from making profitable use of the new technologies. The issue can be presented more concretely by using Greece as a case study.

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teachers throughout Greece— showed that the gender variable seems to play a decisive role in the development of attitudes about computers and ICT. The results of the study conducted at the University of Thessaloniki revealed that not only the female students enrolled in the theoretical and social sciences or departments of theoretical studies, but those in the science department as well, who in high school had followed a science orientation, claimed they felt "insecure" or/and "uncomfortable" using computers, and repeatedly maintained they had ‘low’ levels of computer skills, competency and knowledge (Kamperidou et al., 2007). A factor that seemed to play a decisive role was the gender subject’s access to a computer at home. Specifically, the impact factors that determine the degree of digital literacy, according to the findings, are firstly the male or female student’s familiarisation with a computer prior to high school or access to a computer at home, and secondly, the educational level of the student’s father. Students with fathers who had high educational levels or backgrounds displayed positive attitudes towards ICT as well as greater computer skills, in comparison to those with fathers of a medium or lower educational background.

The second study examined teachers’ attitudes, specifically primary and secondary school teachers, who were undertaking training courses on computers in regions that are considered representative of Greece since they include urban, industrial and agricultural populations^{36} (Pantouli, 2005). The Computer Attitude Scale^{37} (CAS) was given to 135 teachers, 54.1% female and 45.9% male. The majority (54.8%) were between the ages of 35-45: 76 secondary school teachers (high school) of science fields, theoretical studies, foreign languages and physical education, as well as 58 primary school teachers. According to the findings the majority (60%) displayed technophobia, in other words they claimed they felt "insecure" and/or "uncomfortable" using computers. Nevertheless, an overwhelming majority (85%) expressed a desire to receive further techno-training.

As was the case with the undergraduate students cited earlier, the findings reveal five issues. Firstly, the teachers’ computer attitudes (levels of anxiety/confidence/liking/usefulness) do not seem to be influenced by their specific field of study or specialisation - in other words, if they come from a scientific background instead of a theoretical one is not observable.

^{36} Specifically, at the 1st and 2nd Regional Training Centres (15.6% and 39.4% respectively), in Thessaloniki, at the Support Training Centre in Katerini (43%) and at the Support Training Centre in Aliveri (9.6%).

^{37} The CAS scale, designed and developed by Gressard & Loyel (1986), was formulated through views of teachers who received continued training in ICT.
Secondly, a teacher’s geographical or demographic district of residence and employment was not a factor that differentiated or influenced attitudes about computers and technology.

Thirdly, positive attitudes were shown only by the teachers who had previous experience, familiarisation or contact with computers. Additionally, the "anxiety" rate for teachers who had previous experience with computers was lower, regardless of gender. Fourthly, female teachers, in particular, expressed ‘insecurity’, namely technophobia, when they had to work with computers (60 per cent of the sample responded that they had not had previous experience). Fifthly, the majority of teachers -male and female- acknowledged computer usefulness and expressed a desire for further computer training and techno-education. They also acknowledged the fact that today techno-education is a requirement and an absolute necessity in order to avoid marginalisation and social exclusion (Pantouli, 2005).

Many international studies further confirm that familiarity. A change in attitudes can be achieved through regular use rather than formal training, although other factors such as gender have a considerable impact (Warrington and Younger, 2000). It is interesting to note here that gender could be an element leading to technophobia. The consistent display of technophobia identified when female teachers and students need to use computers is an international phenomenon (Kamperidou, 2008). If we are to close the gender gap in science and education, we need to educate girls using new teaching methods. We should eliminate first the technophobia of the teachers and then that of the girls themselves. The latter would be much easier as newer generations are digitally literate, but in a practical way rather than in a structured way. They are mainly users of social networking.

International data indicates that teachers who strive to ensure equal opportunities in their classrooms can be effective in reducing the technological gender gap (Jenson and Brushwood, 2003; Schlager and Fusco, 2003). Therefore it is crucial to set up a top-down approach in teacher technological training which would then filter to the students.

### 2.3 Engendering ICTs

Engendering ICTs entails the presence of women as part of the dynamic communities shaped by the rapid development of technology. Dynamic communities play a decisive role as producers, consumers, entrepreneurs and users. The new world is characterised by the formation of these communities which lead to an ever-increasing demand of ICT services.
Here, applications help to (1) increase profits, (2) facilitate work and private life, (3) optimise communication, (4) obtain information, and (5) create conditions for entrepreneurship. The list of applications is long, however the multiple roles that women can play in the development and evolution of the cyber-community are not often recognised and when it does occur, recognition is often limited. This recognition is vital in areas considered as critical such as ICT policy making (see 2.3.1) and regulation (see 2.3.2) (Bulchand and Rodriguez, 2005).

2.3.1 Engendering Policy Making

A tentative beginning to engendering policymaking is Gender Mainstreaming. Gender Mainstreaming is a globally accepted strategy for promoting gender equality without being an all-encompassing umbrella. Mainstreaming by its very nature creates obstacles to its own goal, i.e., gender equality and inclusion. Furthermore, it is sometimes taken as an end in itself which limits its effectiveness. Additionally, mainstreaming implementation processes are performed in such a way that it is difficult to attribute specific responsibility to actions and policies. All in all, it is a useful tool to be considered when an action is proposed for implementation.

There are different approaches to the development and analysis of a policy. Taking gender into account is necessary to ensure an all-inclusive policy. Policy making, especially in the area of ICTs, where there is a distinct lack of women, should include and strive towards universal access to communications and provide a vision for the cyber-community which is equitable.

2.3.2 Engendering Regulation

In reviewing existing literature on engendering regulation, an interesting concept was found in the Status of Women (1998), a Canadian publication by a governmental organisation. The concept is that of Gender-based Analysis. Gender-based analysis is the process which assesses the "differential impact of proposed and/or existing policies, programmes and legislation on women and men". The analysis aims to take into account during the preparation of a policy

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38 Mainstreaming involves ensuring that gender perspectives and attention to the goal of gender equality are central to all activities - policy development, research, advocacy/dialogue, legislation, resource allocation and planning, implementation and monitoring of programmes and projects. http://www.google.lu/search?hl. Retrieved 03/09/2008. There is more about mainstreaming in the List of abbreviations and definitions.

39 Definition found in the Guide.
gender differences and the nature of relationships between men and women as well as their different social realities. Further, it facilitates understanding and assessing the impact of various policies. Gender-based analysis challenges the assumption that policies are gender-neutral and therefore affect men and women in the same way. In the domain of ICT this is vital as it challenges the design and production of technology on the one hand and on the other it indirectly challenges the assumption that technology is neutral.

2.4 **Cultural Stereotypes in ICT**

Investigation of the knowledge society heavily relies on how people use ICT tools and applications. Observation of these uses by a variety of people guided us to the classification of cultural stereotypes in ICT. Due to the continuous developments and diversification we perceive that it is difficult to form a definite picture.

Below we distinguish two classifications, viz. (1) a classification into five Cultural Stereotypes (in 2.4.2 we arrive at a sixth one) and (2) a classification of Stereotypes formed by IT issues.

The seven Subsections that follow will look into (1) *Culture and Stereotypes* (2.4.1), (2) *Stereotypes framing IT issues* (2.4.2), which examines women’s perceptions of working in IT and the prevailing stereotypes, as well as the beliefs of the IT world about women (2.4.3), *Working climates and micro-cosmos*, which examines the specificities of IT working environments and their impact on the full integration of women in the sector (2.4.4). Moreover, we discuss the community in *The Virtual Harem* (2.4.5) and *A Gender-neutral Social Space* (2.4.6) and close by the question: *Is it innate?* (2.4.7).

2.4.1 **Culture and Stereotypes**

The picture found in literature relating to the question of cultural stereotypes for gender skills, abilities, proclivities and proficiencies is consistent and deeply rooted in both academic and corporate structures.40 These stereotypes are illustrated in the statistics available, showing the participation of women at all levels of ICT including professional participation. Men as well as women occur in these stereotypes, sharing a class sometimes subtly, sometimes more

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40 Analytical referencing is given when referring to specific studies and in the chapter of this thesis relating specifically to stereotypes, i.e., Chapter 5.
offensively. Eventually we expect a further reinforcement. In all cases, this reinforcement is to the disadvantage of women.

Nielsen et al. (2003) argue that women's work experiences are represented in dualisms such as home versus work, IT work versus emotion, and intuition versus analysis. These dualisms characterise in a way "female attributes" such as being home-loving, emotional, and intuitive. Haraway (1985), as we previously mentioned, tried to break these dualisms in her *Cyborg Manifesto* and to break existing stereotypes. Jost and Kay (2003) support this idea of dualisms leading to stereotypes, possibly detrimental to women, and further explain that even the sexist stereotypes, considered "benevolent" and stemming from a set dualisms, greatly contribute to justifying and maintaining the status quo of inequality and eventual exclusion of women from the different levels of ICT work.

*The first Cultural Stereotype*

Considering what was mentioned above, this leads to a well-known assumption or the first “cultural stereotype”, i.e., the stereotype of women being better in human skills such as "nurturing, emotional expressiveness and communications activities" and of men being better at "instrumental and task-oriented assignments" (Jost and Kay, 2003). What is really true in my opinion is that women can or must undertake both types of tasks whilst men are not expected to do so.

*The second Cultural Stereotype*

The second cultural stereotype is part of the accepted dualism. It creates additional obstacles to the professional development of women. The fact is that the obstacles do not allow women to participate fully in work. For example, women cannot work at irregular hours or travel without a long prior notification. Men having families do not appear to have this problem. It is important to underline here that in the 21st century both men and women have become increasingly sensitive to work-life balance or as it is now called in the UK, integration of professional and family life (Janning, 2009). This therefore ceased to be a gender issue and is now a generational one. Still, women continue to suffer from this cultural stereotype independently of their place of work. In a majority of cases they are denied advancement and line management duties. They are left out of assignments that require travel or dedication to deadlines (Catalyst, 2004; Kleiner, 2004).
It is undoubtedly true that women have more family responsibilities than men and for many women before accepting or rejecting a job the issue of professional and family life balance is an important consideration (Janning, 2009).

The third Cultural Stereotype

The third cultural stereotype for people working in the ICT sector is that it requires 24 hours a day, 7 days week availability. It should be noted here that 79% of all IT jobs are outside the sector itself and that the 24/7 requirement is usually the exception and not the rule. In addition, although some women know from the start of their career that they should meticulously plan their family life and create conditions allowing them to care for their families and also to meet professional challenges at the same time, some women, left with no choice, reinforce existing stereotypes, by claiming that they would not give up their personal life in the drive for professional success. This is a culturally constructed notion further reinforced by the role models and representation of women in literature and media (see Chapter 5).

I personally believe that although long hours at work are sometimes necessary and cannot be avoided under special circumstances, they are more often a status symbol, a sign of machismo. This is considered much more important than the "soft work" such as keeping a team together, a management skill at which women are supposed to excel. In many companies the reward structure rewards people for delaying or omitting to do things, then having to work rather long hours in order to meet their responsibilities41.

The fourth Cultural Stereotype

Tapia and Kvasny (2004) say the following on the fourth cultural stereotype, to be defined as building a power structure by working 24/7.

"The IT culture is described as largely white, male-dominated, anti-social, individualistic, competitive, all-encompassing and non-physical. This ascetic culture has strong in-group and out-group dualisms in which the needs of the disembodied intellect subsume emotional, physical and sensual needs. This dualism translates into expert and non-expert and to male and female behaviours, attitudes and values".

(Tapia and Kvasny, 2004)

Tapia and Kvasny further argue that cultural stereotypes contribute to an environment in IT where women are consistently undervalued, building organisational cultures and power structures which are male-dominated and based on masculine perspectives. These persistent stereotypes have consequences which, coupled with the endemic stress found in this highly competitive and rapidly changing field, produce a work climate unfriendly to women and which although it could be changed is not changed. This inevitably leads to the exclusion of women from the sector and their not benefiting from all of its advantages.

The fifth Cultural Stereotype

Trauth, Quesenberry and Morgan (2004) propose an alternative theory to the one mentioned above and that leads us to the fifth stereotype, which is that of the social shaping of ICT-related work. They suggest that the under-representation of women in IT is not due to any possible inaptness of women for technological work but to "essentialism" or social construction, i.e., women face different social expectations. According to their theory, this under-representation is due to individual differences.

"Women as individuals experience a range of different socio-cultural influences which shape their inclinations to participate in the IT profession in a variety of individual ways. Further, women respond in a range of individual ways to the social shaping of gender and IT work. Thus the individual differences perspective inhabits the middle ground between the essentialist and the social constructivist explanations of the under-representation of women in the IT profession"

(Trauth, Quesenberry and Morgan, 2004)

Their work brings us back to the specific experiences in the classroom, stereotypes, upbringing and life expectations. All these issues and more are presented more analytically in Chapters 4 and 5 of the thesis.
Findings supporting the work by Trauth et al. are reported by Gallivan (2004). Gallivan's work claims that individuals differ in the way they adapt to technological change and that uniform re-training will not be suitable for everybody (for the adaptation of IT professionals to technological change).

At present this kind of theoretical work is still under evolution and there is no proof yet on how sound it is or what its contribution would be to the problem of under-representation of women in IT professions. Further analysis supported by experimental evidence is needed.

2.4.2 Stereotypes framing IT issues

The literature reviews carried out for this thesis indicate that across academia and industry people desire to be surrounded by "people like me". In the case of IT, this can be translated into the two categories, "male engineers and computer scientists", thus rejecting everybody who does not fall into these categories, e.g., women and minorities. After the first classification of the five cultural stereotypes which we looked at previously, we can now see the classification of stereotypes framed by IT issues. Obviously, the classification leads to the exclusion of women from the formal and, most importantly, from the informal networks that enhance skills. At the same time it deprives them from the informal insights into the politics and power strategies inside the organisation where they work. It should be noted here that even in social science most of the research which deals with women in IT is about professional women at the top of the research and industry. Only a few studies look more closely into the situation of the 79% of regular IT workers in other areas. One exception is the study by Kvasny (2003) on African-American women studying for computer certification.

The classifications mentioned above define the framework within which women's performances are measured. Women have lower performance ratings in what are considered male skills, i.e., instrumental and task-oriented assignments, which eventually leads to fewer promotions and lower pay. At the same time, the skills which are considered feminine, "soft" skills are undervalued as they are considered to be natural for women and they are not considered as achievements. It should be noted here that men who have soft skills are considered exceptional and obtain better performance ratings, faster promotions, and consequently better pay.
Psychological research suggests that cultural stereotypes provoke behaviours which in turn reinforce these stereotypes. It is often true that women need to work twice as much and be twice as good as men in order to be considered equal and progress (Steele and Aronson, 1995). Being able to meet the standard demands made, such as additional time and attention to an assignment, is considered a greater success for men and leads to better promotion opportunities offered to them by their male team members as well opportunities for self-promotion and recognition. Either way (1) this results in giving men a leading edge and (2) creates the pattern of an uneven playing field (Anonymous, 2008).

The sixth Cultural Stereotype

In contrast, the first cultural stereotype for men (i.e., the sixth cultural stereotype) is that they are not expected to have communication and "people skills". This creates professional cultures which are highly or even excessively competitive, insensitive, juvenile and offensive to women. Asocial behaviours where shouting and rudeness are the norm are accepted as the price for intellectual achievements. It is generally accepted that the engineering culture is not a welcoming one for women (Powell et al., 2004). Despite increased corporate efforts in the last years, the "not invented here" idea still dominates and the continuous push to be the most innovative creates a culture in which women do not want to work, and which often makes them move to other parts of the company or even other fields where their engineering skills will be valued.

2.4.3 Stereotypes about Women and ICT

Talking about stereotypes, it is interesting to see (A) what women think about ICT and (B) what the ICT environment thinks about women. In Ljubljana in the WS Debate (2008), I presented a concise version of the two issues (A) and (B). The different perspectives are: (1) stereotypical perceptions that women have of ICT, and (2) stereotypical perceptions that the ICT sector has about women. These are presented below.

A: The stereotypical perceptions that women have of the ICT Sector are:

1. Poor quality working conditions.
2. No holidays, no spare time.
3. Very male dominated.
4. Being a mother and having maternal responsibilities is considered not to be compatible with a (demanding) career in ICT: Being a mother and having a career in ICT are not compatible.

B: The stereotypical perceptions that the ICT sector has about women are:

1. Technical incompetence.

2. Lack of commitment and motivation to take up a challenging career.

3. No managerial capacities in top positions.

4. Being a mother is not compatible with having a career. Being a mother and having maternal responsibilities is considered not to be compatible with a (demanding) career in ICT.

(Pascall, 2008b)

The two stereotypical perceptions stem from the results of research over the years (European Commission, 2009c, 2001). Looking at the two perceptions, it can be seen that in both cases there is a belief that one cannot combine motherhood with a career in ICT. There is a main misconception though; as seen, 79% of ICT jobs are not in the sector! This point will be discussed in greater detail later on.

2.4.4 Working Climates and Micro-cosmos

All working environments, whether in purely IT companies or others, are not the same. In every environment there are different climates which create a micro-cosmos with its own specific characteristics. Before looking at the different elements which combine such climates, it is interesting to see a model presented by Maca Jogan in the WS Debate Conference in Ljubljana (May 2008).

In the second part of the twentieth century there has been a comparatively massive entry of women into the academic and scientific fields. This happened in social and cultural circumstances in which androcentric patterns are supposed to disappear and eventually lead to equity. Jogan is affiliated at the University of Ljubljana. In Creative Women in Science and Public Life, Jogan (2008) argues that this is what is happening. In her paper, she focuses on how are
women situated within scientific activities and in particular on the question of the barriers for creativity and their promotion as well as the politics of equal opportunities. Jogan claims that there is a cultural legacy of misogyny in science. The essential feature of this male-based science and of scientists is an inherent element of a traditional sexism. The androcentric cultural heritage structures the social order and includes gender division of labour and personal identities. The structure is based on the dualism "reason/emotion split". This dualism is as old as society itself, and is supported both by complex spiritual sources and harmonised institutional activities. It has been reproduced and used to maintain the social order as we see it today. Jogan illustrated her theory in the model of Figure 2.1.

Figure 2-1 The reproduction of the androcentric social order


(Design by Maca Jogan)
Jogan (2001) explains the model as follows:

"The rational sphere has been assigned to male part and the emotional one to the female part of human kind. These two spheres have been complementary connected in the hierarchical way and unchangeable regarding the gender position; the sphere of woman's activity has been subordinate. Androcentricity is rooted within the hierarchical gender division of labour in all life spheres of labour in all life spheres and it includes devaluation of nature, woman (as second class human being with 'natural' role), private, emotional, etc. As B. Marshal points out (1994, p. 38), 'it is clear that gender divisions are integral to the social division of labour in general'; they are not 'feudal relics' but they continuously re/create both public and private. Male produced definitions of 'world' and 'social order' have been functioning according to the constant needs of justification and reproduction of integral gender hierarchy".42

(Jogan, 2001)

Using Jogan's analysis of her illustration and references the following can be deduced:

• Despite the fact that women's activities are considered highly useful for the existence of the whole of society, this recognition is limited in the private sphere of home and child raising whilst they are also considered as less valuable, every day and mundane in the public sphere. This categorisation formed the basis for the justification of the subordination of women and their exclusion from socially relevant and even rewarding public activities (Jogan, 2001). Women's space was primarily limited to their "natural" role at home.

• In contrast, male activities are mainly seen in the public sphere and are designated as important and obviously "socially" recognised. They are considered to be without any doubt more valuable than activities in the private domain. This is a contradiction as women's work in the private sphere is necessary for the very existence of the human race.

So, we can establish that the division of labour which is the core of the social order is propagated. Although women now contribute and participate in the public sphere, their

43 The references used might be rather dated but are the ones the author used in her paper.
participation is still limited as they are excluded from a number of important fields. This exclusion creates thus an unequal distribution of advantages and maintains the androcentric model as well as the idea of the "other". Women's efforts to fight discrimination and engender in some way some sciences, still lead to partial inclusion and limited progress. It is important therefore to look for policies which target the idea of the cultural heritage of the androcentric order in science and technology and go beyond accepting the inclusion of women only as a result of their own endeavours.

If we take academia as an example, women have the position of the "academic proletariat" and mostly play the role of "handmaids of knowledge class" (Stolte-Heiskanen, 1991). According to the same researcher, they lack support systems and encouragement in their working environment, as well as having a distinct lack of self-confidence. Her research also showed that women are more socially isolated than men, especially as they are not admitted into the informal networks ("old boys") which are important elements to promote career success.

In addition, in academia as in most other professional structures, the hierarchical distribution follows a pyramidal model, which means that the share of women's participation decreases going up the steps of the hierarchy, as the importance, power and prestige of the position increases (Jogan, 1992; Stolte-Heiskanen, 1991; Hicks, 1991).

The discrimination of women in science and technology is a world-wide problem and is, in addition, a result of the hierarchical structures previously analysed, due to the micro-cosmos that they have to face. Sandra Harding refers to the "chilly climate" (Harding and McGregor, 1996) in which women work where in many cases they have to face special types of reaction by their male colleagues (Jogan, 2008) who consider themselves as the traditional and accepted holders of "first class" academic positions. As women reach a certain level of responsibility, a reorganisation might occur reducing the position of women and discriminating between long-standing membership and second-class (recently-arrived women) new members (Noordenbos, 1995).

Although the comments above were written at least 15 years ago, I believe that they are still valid today, especially as far as the information and cyber-community is concerned. The androcentric social order is maintained and propagated as noted from the available statistical data.
2.4.5 The Virtual Harem

I include the idea of the virtual harem as I believe that it is a valid parallelism for the situation today. The comparison with a harem provides a vivid image which goes some way towards explaining the actual structure as it is being formed of the information space/cyberspace and the social order of the ICT sector.

Kamperidou and Patsantaras (2004), in a paper in a European Commission workshop in Brussels, presented an analogy of the Information Society or cyber-community to the harem-slavery institutions in the 17th, 18th and 19th centuries.

The fundamental elements of the harem culture were amongst others: exclusion, exploitation, despotism, racism, oppression, alienation, conspiracy networks, terrorism and specific "sexual politics" (Kamperidou, 2002). Similar characteristics can be observed in today's information society. We see the exclusion of specific groups from the technological developments and benefits (this is the case for women), electronic conspiracy networks, electronic terrorism, the violation of personality, domination of the imaginary (fantasy), slave trafficking of women and children and others.

The cyber-community has been built with a bottom-up seemingly egalitarian approach where everybody is free to contribute and participate, at least in the case of Internet, provided, of course, that the means to do so are available. It appears, however, that a new elite is emerging, a new pyramidal hierarchy of power. The goals of this elite are to control technological research, technology design and development and finally its use and application. This control would result in the exclusion of many social groups and, in particular, women.

Kamperidou and Patsantaras (2004) claim in their paper that as a non-discriminatory equitable technology distribution is not available, non-mainstream groups, including a large number of women, will be excluded and this part of the population will be marginalised in a space within the framework of the information society. This can be defined as a "virtual harem", as it will include the "virtual elite" of the population, with the marginalised "servants" belonging to a lower hierarchy.
2.4.6 A Gender-neutral Social Space?

Today's unpredictable and speedy technological developments create a number of different problems of equity and ethos. We briefly mention six specific ones. First, the new, rising social order needs to be systematically examined. Second, the new order should move beyond the choices and decisions made by the mainstream groups. Third, the cyber-community is a potential space to establish gender equality as it is supposed to be both gender-neutral and emancipating. Fourth, Change Agents should resolve gender dichotomy or gender demarcation. Fifth, neutralisation of gender may be achieved through the established virtual time and space requirements, for example in the employment sector. Sixth, the cyber-community creates anonymous users, "body-less" users who slide into new electronic personalities, and further produces new prototypes, new role models which often are without genetic personification and constitute significant mechanisms to fight exclusion, thus neutralising the social meaning of gender. It is essential that these prototypes are specifically examined to take into account the specific needs of women.

2.4.7 Is it Innate?

In January 2005, at a Conference on Diversifying the Science & Engineering Workforce in the University of Harvard, Dr L. H. Summers sparked controversy with his discussion of the reasons that women may have been under-represented "in tenured positions in science and engineering at top universities and research institutions".

He actually presented three hypotheses to justify the higher proportion of men in high-end science and engineering positions. The hypotheses are as follows:

1. The high-powered job hypothesis.

2. Different availability of aptitude at the high end.

3. Different socialisation and patterns of discrimination in a search.

(Summers, 2005)

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44 A combination of ideas found in different works by Hodgson (2001), Kimmel (2004) and Tooley (2003). Proper references are in the bibliography.
In his first hypothesis, he in fact advocated the idea that the lack of women in science and technology is merely due to innate differences between the sexes ("issues of intrinsic aptitude", Summers, 2005). He continued by mentioning that women were not the only ones under-represented in some professions. He also claimed that married women's commitment to work was less than that of married men. The second hypothesis he presented, which advocated different availability of aptitude at the high end, caused the most controversy. In his discussion of this hypothesis, Summers justified it by saying that "even small differences in the standard deviation [between genders] will translate into rather large differences in the available pool substantially out [from the mean]". Summers referenced research that implied differences between the standard deviations of males and females in the top 5% of twelfth graders under various tests. He then went on to argue that, if this research were to be accepted, then "whatever the set of attributes... that are precisely defined to correlate with being an aeronautical engineer at MIT or being a chemist at Berkeley... are probably different in their standard deviations as well" (Anonymous, 2005). In his third hypothesis he cited examples from his own parenting and claimed that "there is reasonably strong evidence of taste differences between little girls and little boys that are not easy to attribute to socialization" (Summers, 2005). He was sceptical about discrimination and applied economic theory to emphasise his point claiming that "If it was really the case that everybody was discriminating, there would be substantial opportunities for a limited number of people who were not prepared to discriminate to assemble remarkable departments of high quality people at relatively limited cost simply by the act of their not discriminating, because of what it would mean for the pool that was available. And there are certainly examples of institutions that have focused on increasing their diversity to their substantial benefit, but if there was really a pervasive pattern of discrimination that was leaving an extraordinary number of high-quality potential candidates behind, one suspects that in the highly competitive academic marketplace, there would be more examples of institutions that succeeded substantially by working to fill the gap".

When some of the conference attendees retorted that his assertions were contradicted by material presented in the very same meeting, he replied: "I didn't think for a moment that I had proven anything, but only that these things need to be studied" (Dillons, 2005). The Summers' discourse shows the general social attitude of society to female participation in science and technology and brings us back to the Jogan illustration of the androcentric social order.
It must have escaped Dr Summers that these "things" have been studied for more than thirty years, and the conclusions show that difference in scientific performance between boys and girls are socially constructed, rather than innate. Hyde and her colleagues (Hyde, Fennema and Lamon, 1990) found that "females outperformed males in Mathematics by only a negligible amount … [but] differences favouring men emerged in high school and college", although in the general population gender differences were smallest and favoured females. Furthermore, the gender differences declined over the years. Similar studies came to the same conclusions (Cai, 2002; Hamilton and Snow, 1998). Moreover, a few days after the contested speech, in an article in the New York Times, Natalie Angier and Kenneth Chang produced neuroscience and social science findings (Angier and Chang, 2005). Although there are neurological differences between male and female brains in how they approach mathematical problem solving, these do not translate into significant differences in cognition or output. In the article there is further evidence of the enormous amount of research that has gone into this question, and it concludes that social and cultural issues are far more important to performance than innate differences.

2.5 CONCEPTS ABOUT WOMEN IN EMPLOYMENT

In this section we are going to see the problems women face when in employment, i.e., what is known as the "glass ceiling", as well as the glass door, glass wall and glass elevator (subsection 2.5.1). The section continues by looking at the concepts of gender fatigue (2.5.2) and tokenism (2.5.3) and finishes by presenting the theoretical issue of Womenomics (2.5.4).

2.5.1 The Glass Ceiling and other related terms

The term "glass ceiling" in economic terms indicates "the unseen, yet unbreakable barrier that keeps minorities and women from rising to the upper rungs of the corporate ladder, regardless of their qualifications or achievements" (Federal Glass Ceiling Commission, 1995). The term is thought to have been first used in an edition of the Wall Street Journal (March 24) in 1986 but it appears that it was been used prior to this in 1979 by Katherine Lawrence and Marianne Schreiber, two female employees at Hewlett-Packard. Lawrence and Schreiber described that although on the surface there seems to be a clear path for promotion for women, in reality, they seem to progress no further than a certain point (Taneja, Golden Pryor and Humphreys, 2009; Traister, 2006). It is interesting to mention here anecdotal evidence. Carly Fiorina, when she became CEO and chairwoman of the board of Hewlett-Packard, proclaimed that there
was no glass ceiling. After her term though, she said that her earlier statement was "a dumb thing to say!" (Traister, 2006).

Cotter and his colleagues (Cotter et al., 2001) attributed to the glass ceiling phenomenon four distinctive characteristics:

1. A gender or racial difference that is not explained by other job-relevant characteristics of the employee.

2. A gender or racial difference that is greater at higher levels of an outcome than at lower levels of an outcome.

3. A gender or racial inequality in the chances of advancement into higher levels, not merely the proportions of each gender or race currently at those higher levels.

4. A gender or racial inequality that increases over the course of a career. (Cotter et al., 2001).

They (Cotter et al., 2001) also found that the glass ceiling is a distinctively gender-based phenomenon, and ethnicity plays a secondary role. They mention that both white and African-American women face a glass ceiling in their career progress whilst for African-American men there was no such evidence.

One should note that although there are no explicit obstacles as such to create a glass ceiling, this continues to exist and keep many women from acquiring high level positions. I am referring to reasons which lie beneath the surface, the commonest one being giving the preferred candidate an edge by over-emphasising specific criteria (Hesse-Biber and Carter, 2005).

Two different barriers that cause and reinforce the glass ceiling have been identified (Federal Glass Ceiling Commission, 1995). Those are: the "supply barrier", which is related to opportunity and achievement, and the “difference barrier”, which manifests itself through conscious and unconscious stereotypes including gender-related bias.

It is appropriate to mention here some variations on the glass ceiling, and related terms.
Glass wall. This refers to the phenomenon of a high rate of women advancing to executive positions only in certain industries (Catalyst, 1996). In a broader sense it also indicates moving from one high-level job to another, i.e., from a lower or less important management position to a more important one. A second term which can be used here is glass door, as in some industries such as ICT it is difficult to enter.

Glass elevator or glass escalator: This refers to the concept of rapidly promoting men over women, especially into management positions in female-dominated fields such as teaching or nursing (Kamperidou, 2011; Hultin, 2003; Williams, 1992). Hultin (2003) argues that "the glass escalator takes under-represented men on an upwardly mobile internal career path at a speed that their female colleagues can hardly enjoy". Although men are over-represented in the upper hierarchies in general, they are still promoted up the ladder and to managerial roles more frequently and much faster (Kamperidou, 2011).

Glass cliff. This term describes the situation where women are given leadership positions in circumstances of general financial downturn and downturn in company performance (Ryan and Haslam, 2005). In this way they are considered to be placed on top of a glass cliff, thus making their leadership appointment precarious and more likely to fail. These appointments are also subject to more scrutiny and criticism than those of men, as well as to less positive evaluations, even when they perform as well as their male counterparts (Eagly et al., 1992). In addition to the glass ceiling that women face, and being prevented from accessing the glass elevator, they are also likely to be placed on a glass cliff. In those specific tasks which are more precarious, they are more likely to fail and be singled out for blame and humiliation, whilst the difficult conditions of their appointments are ignored (Judge, 2003).

Sticky floor. The sticky floor refers to women who work for lower salaries, have low mobility in their jobs and cannot progress any further than where they are. This term may also refer to the barriers women face in relation to their advancement due to family obligations, attitudes, stereotyping, and most importantly organisational structures. The same term is sometimes used for women who, although promoted to higher grades, do not receive the corresponding salary (wage) increase. It may also apply to other groups of employees and not only women (Shambaugh, 2007).

Sticky ladder. This term is used to describe the efforts of women to reach the top of the hierarchical ladder and their being "stuck" in the middle (Brooks, 2005).
2.5.2 Gender Fatigue

If one talks to people working in the ICT sector today, they present their place of employment as gender-neutral (Kelan, 2010). They consider that the issue has already been solved and gender no longer matters. Kelan called this phenomenon 'gender fatigue', and defined it as the "individual's feelings of weariness or of being drained out to discuss gender discrimination and social bias" (Kamperidou, 2011). Kelan (2010) published a book with the results of a qualitative study she conducted in the ICT sector. The sector was chosen as she considers it as an egalitarian and meritocratic one. The study showed that most of the participants (mainly in their late thirties) were reluctant to talk about gender in the workplace. According to Kelan this is due to the fact that the gender bias they face is much subtler than previously, and as the young women do not connect to women's networks at the place of work they have more difficulty in recognising it. Their attitudes show clear signs of gender fatigue.

An important message from Kelan's work (Kamperidou, 2011) is that prior to launching new initiatives to confront the issues of gender discrimination and neutrality in organisations, one needs to address the phenomenon of gender fatigue, as well as to understand properly current mind-sets, attributions and attitudes of men and women at all levels.

2.5.3 Tokenism

Tokens are usually women, ethnic minorities, the aged or individuals with special needs who are often treated as symbols or representatives of a marginal or social group (Kamperidou, 2011). The inclusion of the "tokens" in different activities or groups, aims to ensure behaviours which are politically correct, or in line with equal opportunities legislation. In politics, for example, women or racial minorities are included as party representatives in places or positions where they have no possibility to be elected (Ottawa Citizen, 2011).

45 Performing Gender at Work.
2.5.4 Womenomics

Womenomics is a new trend which can be defined as consisting of three elements:

1. Power.

2. A movement that will bring you the work-life you really want.

3. The powerful collision of two simple realities: a majority of women are demanding new rules of engagement at the very moment we have become the hot commodity in today's workplace.

(Shipman and Kay, 2009)

The concept of womenomics aims to alter the way women confront their daily employment in combination with their other commitments. In principle, womenomics aims to help women empower themselves through making use of their strengths, the need of corporations to use the female talent pool, especially the experienced one, and finally the need to cut off labour costs through part-time or flexible employment regimes.

In my view, the concept of womenomics is another tool providing women with arguments to better their working conditions and reconcile their professional and private life. At the same time, it might also provide the system with arguments for confining women in jobs with less responsibility and lower salaries.

2.6 Chapter Conclusions

The chapter started by looking at feminist theories (2.1), especially work relating the feminist approach to technology. It continued with a theoretical analysis of empowerment (2.2), engendering ICTs (2.3) and cultural stereotypes (2.4). Finally, it presented a number of specific concepts such as the glass ceiling (2.5.1), gender fatigue (2.5.2), tokenism (2.5.3) and womenomics (2.5.4).

The literature reviewed investigated some of the reasons why women are under-represented in the cyber-community and provided some clues to the first research question (Why are women under-represented in the cyber-community?). All issues briefly touched upon in this chapter will be further analysed in following chapters.
It should be noted that despite the importance of stereotyping and the amount of studies in the social sciences domain, rather little was written in comparison on gender and the information society/cyber-community.

From the literature reviewed we may draw the following four conclusions:

1. Technophobia is largely responsible for the reluctance of women actively to take part in the information/cyber space.

2. Schools can play a significant role in order to promote ICTs to young women.

3. There are a number of role models and social stereotypes that are formulated in a way that reinforces the idea that science is gender-neutral.

4. The new social order is based on pre-existing androcentric social hierarchies which mainly exclude women from policy making.
3 WOMEN IN THE ICT SECTOR: FADING IN AND OUT OF THE STATISTICAL LANDSCAPE

This chapter focuses on the active participation of women in ICT as an economic activity (and by extension, related education fields), excluding more "passive" forms of participation as users and consumers. The working assumption is that women’s individual and collective empowerment in relation to ICT comes, first, through their participation in the professions and sectors directly shaping the ICT share of the economy.

Here, I aim to address, primarily, **RQ1**: *which are the areas in the sector where women are most under-represented?* As a starting point, I rely on a flexible definition of "areas" of under-representation to include any of a number of dimensions which could arise from the data such as, fields of specialisation, clusters of professions, job functions, industry sectors or stages of a career path.

As a secondary purpose, this chapter examines statistical trends and causality links identified by other studies, which may contribute to answer **RQ2**: *What are the problems women face when they are in the sector?* **RQ3**: *Why are women under-represented in the cyber-community?* and **RQ4**: *Has there been any improvement in recent years?*

Main sources used include EUROSTAT\(^46\) for the European Union, the OECD\(^47\) for its non-EU member countries and the BLS\(^48\) for the United States. Among non-EU countries, I focus most extensively on the United States since many aspects pertaining to ICT sectors, market conditions, policy environments and historical development of both the US and the EU are either similar enough to be comparable or shared as a single experience. The much greater depth and breadth of data available for US also helps where the EU data is incomplete or unavailable.


\(^47\) OECD: Organisation for Economic Co-operation and Development.

The bulk of the quantitative evidence comes from government statistics and exists primarily for purposes of government policies. The two-way relationship, where data inform policy and policy shapes the data, deserves to be examined starting with the ‘meta-issue’ of definitions. The OECD has produced a definition of the "ICT Sector" (OECD, 2009c) as an aggregate built from the UN International Standard Industrial Classification (UN Statistics Division, 2008) standard and thus directly applicable on data sets from both EU and OECD members. In the other three dimensions relevant to measuring women’s participation in ICT, namely "Occupation", "Education" and "Invention", the "meta-issues" of what is being measured and for what purpose are as relevant as the findings drawn from the data available.

This statistical examination of women in the ICT sector includes four parts as follows:

- Women in ICT education (3.1) focuses on the statistical evidence related to women’s participation in fields of tertiary education.
- Women and inventions (3.2) focuses on insights drawn from patents statistics into women’s participation in the "making" of the sector and the challenges presented by reliance on such statistics with implications on the soundness of policies aiming to increase women’s participation.
- Women and ICT employment (3.3) focuses on the statistical evidence related to women’s employment in the ICT sector and their share of ICT professions, highlighting trends in both the EU and the US.
- Women and leadership (3.4) examines available data and analyses on the extent to which women are represented in the functions and roles that have influence on the ICT sector beyond the structure to which they belong.

The performance of 15-year old girls and boys is examined through the OECD PISA reports in Section 3.5 (OECD PISA, 2009a; 2006; 2003). Tentative conclusions based on the data examined are presented in Section 3.6.

### 3.1 Women in ICT Education

This section draws from statistics on the enrolment of women at tertiary education level, in Computer Science and other, broader but related fields: Mathematics, Science, and Engineering.
It is important, at this point, to emphasise that there is no globally applicable classification as to what constitutes ICT education, even when narrowed down to tertiary level. Statistical "Indicators", measuring ICT education enrolment, are typically composites of fields from the same level. They could include those directly centred on ICT knowledge (as in Computer Science) or ICT foundational knowledge (as in Mathematics) and broader aggregates of other fields (Science, Engineering, Technologies) to encompass all other curricula potentially relevant to ICT (US LBS Occupational Outlook Handbook, 2010).

Tertiary education is the focus of this section because it is broadly regarded as the gateway to ICT specialists' occupations as increasingly verified through employer surveys (US LBS Occupational Outlook Handbook, 2010) and part of the activity taking place in tertiary education is already undistinguishable from ICT as an economic activity. This could be said in particular of Research Scientists (albeit primary education) completing doctoral degrees in the field of Computer Science. The section is going to look at statistics relevant to women's participation in the sector (3.1.1), female enrolment in the computing field (3.1.2), and female enrolment in related science and engineering fields (3.1.3).

3.1.1 Statistics on Women's Participation

The disproportionally\(^{49}\) lower participation of women in higher ICT education in Europe and the United States has been confirmed by a growing range of statistical measures\(^{50}\) throughout the first decade of the 21st century. This is also the first decade for which gender-segregated data sets have been systematically collected for the EU27\(^{51}\) countries. Efforts to harmonise gender data in scientific and technological fields among the OECD countries in the 1990s (OECD, 1995) allow for more accurate comparisons in particular between the USA and EU 27, showing very similar trends on key measures in both.

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\(^{49}\) Relative to women's participation in tertiary education across all fields.

\(^{50}\) See in particular the regularly published statistics from a) the US National Science Foundation; Science & Engineering Indicators and b) OECD, Education at a Glance.

The most useful of these statistical measures is that measuring the enrolment of female students in tertiary education corresponding to the last two most advanced levels (ISCED 5-6) of UNESCO’s International Standard Classification of Education (ISCED). ISCED 5 includes undergraduate university diplomas (bachelor degrees), as well as country-specific variations of engineering/technical diplomas. ISCED 6 includes advanced (postgraduate) diplomas independently of whether they are research driven (UNESCO, 2012).

3.1.2 Female Enrolment in the Computing Field

In absolute numbers, women’s enrolment in tertiary education in the computing field for EU 27 countries grew considerably more slowly than that of men in the first two years of the decade, (Fig. 3-1). It reached a peak in 2002.

Since 2004, both in absolute number and as a share of enrolment, women’s numbers have been continually decreasing. By contrast, men’s enrolment, in the EU, grew sharply all the way until 2008 and appears to have recovered immediately after the sudden drop of that year. EUROSTAT provides also comparable US data for the period covering 2005 to 2009. In the US, while the female participation is slightly higher, both male and female enrolment drops noticeably more sharply in 2008.

Given that both the US and the EU attract enrolment from students from third countries, part of that recovery may be attributable to third countries students choosing to enrol in the EU institutions rather than US institutions (NSF, 2012).

However, the decreasing female enrolment in both of these regions clearly points to a shrinking pool of female talents to draw from for employment in ICT knowledge professions in the future. This shrinking female participation at that crucial stage will likely have repercussions in the sector, at a global level and for decades to come.

52 A comprehensive mapping per country of the ISCED classification is available in the UNESCO website: http://www.uis.unesco.org/Education/ISCEDMappings/Pages/default.aspx.

53 NSF Science & Engineering Indicators 2012, shows twice as many women non-residents than residents were enrolled in graduate Computer Science programmes while male US residents were still the largest group overall.
Comparing trends in enrolment in computing with female enrolment in tertiary education across all fields (Fig. 3-2) for the same period shows opposite results, since over the decade, women start with the majority share of enrolment across all fields. That share continues to increase year on year from 52.4% in 1998 to 55.7% in 2009.

In 2009 the share of women enrolled in computing (Fig. 3-3), at 16.1%, is less than a third of that of all the fields combined. It is also significantly below its level in 1998, when women made up 19.6% of enrolment in that field.
3.1.3 Female Enrolment in related Science and Engineering Fields

Widening the indicator data to enrolment in tertiary education in Mathematics, Science, and Computing, may also be of relevance here, as the sector draws on a variety of research in connected domains. These connected fields of education may also lead to ICT sector employment, if not necessarily in ICT professions or occupations.

The same gender-disaggregated data is available for all EU27 countries for the past decade. EUROSTAT uses a wider indicator combining Mathematics, Science and Computing enrolment as part of its regular structural indicators on the knowledge sectors.

Figure 3-4 displays enrolment trends in four dimensions for EU27 countries:

1. All Fields: female enrolment in all sectors of tertiary education.


4. Engineering and Engineering trades: female enrolment in Engineering and Engineering trades, which, although wider, includes fields directly related to ICT infrastructures and equipment subsectors.
Here again, while the overall participation of women in tertiary education is greater than that of men already in 1998, it continues to grow throughout the period reaching 55.3% in 2009.

Female enrolment in all three ICT-related fields combined, already close to ten points lower in 1998 than across all fields, is on a downward trend overall and seemingly stabilises at 37.5% in 2009.

In the Computing field, however, the downward trend starting in 2003 is continuous and, by 2009, the share of women enrolling in Computing is two points lower than it was in 1998.

In 2009, the share of women in Engineering and Engineering trades a notoriously male-dominated field is actually higher than that of Computing.

The contrast between those two fields is even starker when looking at absolute numbers. As shown in Figure 3-5, by 2009, there are 2.5 times more women enrolling in tertiary education in Engineering and Engineering trades than in computing in the EU27 countries.


3.2 WOMEN AND INVENTIONS

This section addresses the participation of women in inventing ICT and more specifically the extent to which women’s contribution is visible and acknowledged. Among the few statistically relevant indicators of gender participation available are records of applications for patents and, as a secondary indicator, named authors of papers published in peer reviewed journals. While the question of where and to what extent women participate in inventing ICT is relevant, the information available will not provide us an adequate answer. This section explores the challenges presented by patents as indicators (3.2.1) and the findings of two studies - US and EU studies - which have addressed the gender dimension of patents (3.2.2). The purpose of this section is to point to a major hole in the statistical landscape which has direct implications for RQ1: which are the areas in the sector where women are most under-represented.

3.2.1 The Challenges presented by Patents as Indicators

The main data sets available for a statistical analysis of trends contributions by gender in ICT inventions are patents applications and patent granted data.

At first glance, the analysis would seem straightforward. For a gender analysis of patent applications, as with bolometric data, which involves analysing the gender information of
authors from peer-reviewed journals, the data set involves the gender of individuals named on the application. The key difficulty, as with bolometric data, is that gender is not included in the demographic information collected through the application process for the main patent bodies. The need to establish gender \textit{a posteriori} renders such analysis very costly and time-consuming, as detailed in the first EU-level feasibility study on patents and bolometric gender indicators (Naldi and Vannini Parenti, 2002), since it involves matching first names of individuals mentioned on the applications with databases of first names by gender in relevant countries and languages. The result is typically never free from error and may involve a portion of unresolved cases which have to be excluded from the analyses.

The three main data sets originate from the three bodies receiving the largest share of applications. These are USPTO\textsuperscript{54} for the United States, JPO\textsuperscript{55} for Japan and EPO\textsuperscript{56} for Europe. Applications to one of these may originate from anywhere, including each other’s territory, and indeed, EU-based applicants make up the third largest group of applicants to USPTO after the US and Japan. An analysis seeking to generate an indicator for EU countries will have to cover the data from the countries patent offices, EPO data and EU originated applications to USPTO which, for ICT in particular, may represent a large share of the total. In addition, working addresses of individuals on the forms are the only location information since their nationality is not part of the information collected. The data on applications is not made accessible for analysis at the same stage of the process for all bodies. This means that there may be a delay of several years between the year the information applies to and the year in which a sufficiently large portion of the data sets becomes available to support an analysis. Overall, timeliness and relevance in geographical coverage remain a challenge for such indicators.

Finally, patent statistics are an inherently biased indicator since, for example, applications mostly originate from private sector organisations which by size and type are already among those parts of the ICT sector where women researchers are less represented. The contributions to ICT R&D by women, therefore, may not be truly reflected in patent statistics.


3.2.2 The Findings of two Studies

Despite the challenges, and with the limitations mentioned above as caveats, findings are available for studies which provide partial results for the EU and the US. Two such studies are mentioned here.

1. The "EU" study: a study on "Gender specific pattern in patenting and publishing" (Frietsch et al., 2008), for the EU, which is on-going.

2. The "US" study: a report from the National Center for Women and Technology on "Who invents it" (Ashcraft and Breitzman, 2007).

The latter focuses on USPTO data and compares gender of submissions over time by applications, including US-based individuals and Japan-based individuals, which represent the two largest groups of individual applicants in the database. This allows for comparisons between the share of women among named applicants in both regions. The former focuses on EU data from EPO and beyond, but compares the industry's sectors or fields of applications.

The main findings of both of these are included below.

3.2.2.1 The "EU" Study

The EU study is first and most of all an illustration of the substantial practical barriers to gender research when the gender dimension has to be re-created a posteriori. Table 3-1 represents the share of female inventors in technological fields. The researchers initially identified ‘female inventors’ based on their first name. They then weighted the female inventors' participation based on the total number of authors in each application.

Table 3-1 represents the weighted share of female inventors from eight of fourteen countries57 (Australia, Austria, Belgium, Denmark, France, Germany, Ireland, Italy, New Zealand, Spain, Sweden, Switzerland, the United Kingdom and the USA) in patent applications recorded between 2003 and 2005. They focus on 19 technological fields and include the total for fourteen countries as well as individual percentages of female inventors for the 8 countries.

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57 The country refers to the address provided for the inventor. For the complete period covered by the study (1990-2005) the respective shares of inventors whose gender could be established (in % terms) were as follows: Austria (97.0), Australia (88.8), Germany (96.9), Italy (95.8), France (94.0), Switzerland (93.3), Spain (92.7), UK (92.1), New Zealand (90.6), Ireland (90.6), Belgium (89.0), Sweden (89.0), Denmark (88.2), USA (81.1).
with the largest shares of technology patents. The most relevant amongst the resulting percentages in the table, is that of the share of female inventors in the category denoted by "computers/office machinery" which includes a range of fields broadly inclusive of both "hardware" and "software" related applications. With an average female share of 5.4% across the 14 countries, the category is roughly in the middle ranking when compared with other technology categories included in the table.

5.4% is rather a low figure, especially when considering that it is equivalent to only one quarter of the share of female PhD holders in Computer Science and in Engineering across the EU, for roughly the same period\textsuperscript{58}. The same proportions also apply to the relation of "female inventors" to PhD graduate in those two fields for countries individually. Germany, for example, according to the table, has one of the lowest percentages with only 2.9% female inventors in "computers/office machinery", a little more than half the 14-country average. In 2002, Germany awards only 10% of PhDs in Engineering and 8% Computing PhDs to women, increasing to 10% and 12% respectively by 2006. For both fields and both years, Germany again does half as well as the EU27 average. This is all the more significant, since Germany has the largest share of employment in the ICT sector in the EU and is second only to the USA, in the share of patent applications examined for this study.

\textsuperscript{58} "She Figures 2009", p.54, Table 2.3: Evolution of the proportion of female PhD (ISCED6) graduates by narrow field of study in natural science and engineering 2002-2006. Computing: proportion of female PhD graduates for EU27 is 17% in 2002 and 18% in 2006 – Engineering: 17% in 2002 and 21% in 2006.
3.2.2.2 The "US" study

The US study is an analysis conducted by the US-based National Center for Women & Information Technology\textsuperscript{59}, investigating Female US IT Patents over time titled "Who invents IT?" (NCWIT: Ashcraft and Breitzman, 2007). The study based on patent submission data from the US Patent Office (USPTO) examined the gender and field of application by comparing data of two half decades at both ends of a 25 year period: 1980-1985 and 2000-2005. Overall "computer software" is the field for which an application, including women as authors, has seen the most significant growth (Fig. 3-6).

Since not all patent applications originate from the US, the study includes overall applications and a comparison of the women’s share between the two largest areas of origin represented: the US and Japan.

\textsuperscript{59} National Center for Women & Information Technology: a non-profit coalition of private and public sector institutions. www.ncwit.org.
As shown in Figure 3-6, US-based women inventors’ average share over 25 years is only 4.7% of the total U.S. invented patents (when counting fractionally). That percentage has increased steadily from 1.7% in 1980 to 6.1% in 2005—more than a 3.5 fold increase. The NCWIT notes that this increase contrasts with the share of women employed as IT professionals which was remaining flat over the same period. In the US, by this measure at least, women appeared to have been more successful at gaining recognition as inventors than carving out a proportionate part of professional employment.

3.3 WOMEN AND ICT EMPLOYMENT

This section examines the participation of women in the ICT workforce in the EU and the US where these professions have been established the longest. Employment statistics and related policies are looked at (Subsection 3.3.1) as well as the relevant EU statistics (3.3.2). US employment statistics are presented in 3.3.3.

3.3.1 Issues of Employment Statistics and Related Policies

Producing standard classifications for ICT occupations has proven a particular challenge, as documented through the latest efforts at European and international level to revise occupation classifications. Ironically, the need for better data on the ICT workforce was one of the main
drivers behind the revisions. Policies supporting the growth of high skill ICT employment require very detailed classifications. This proved difficult to reconcile with a classification system sufficiently general to encompass the great number of new occupations which appear between revisions. Furthermore, distinguishing between ICT skills and ICT knowledge is a challenge for the classification of ICT occupations as it is for ICT education.

Women’s participation in ICT, as a policy issue, presents yet another layer of difficulties. Policies aimed at encouraging women’s greater participation have stemmed from one or both of two public interest rationales: (1) as means for increasing the skilled-labour pool as a response to forecasted needs of employers, or (2) as means to increase women’s employment opportunities by addressing barriers to participation. Neither objective is adequately served by the current classification system which merely provides an indication of a broad under-representation but cannot meaningfully serve to correlate employment participation with educational attainment and fields.

The working paper on Gender and ICT produced by the OECD in 2007 provided an ad-hoc solution to the problem of aggregating data built on different national standards defining "occupations" by identifying three categories of ICT skilled-employment. On these three categories the authors mapped national nomenclatures for the countries in their study. The categories were defined as follows: (1) ICT specialists, who have the ability to develop, operate and maintain ICT systems. ICTs constitute the main part of their job; (2) Advanced users, competent users of advanced, and often sector-specific, software tools. ICTs are not the main job but a tool; (3) Basic users, competent users of generic tools needed for information and entertainment.

The low participation of women in ICT sector companies and ICT-related jobs has been a topic of discussion reaching well beyond academia and into the mainstream press especially since the Internet boom years of the late 1980s gave prominence and visibility to the wider ICT sector. Interest in addressing the imbalance as a social issue worth organising around is most prevalent in the US where a number of organisations carry out their own studies in
which they compile and comment on the very detailed employment statistics collected by the United States Census Bureau (2011).  

### 3.3.2 Relevant Employment Statistics for the European Union

Under the 2008 revision of the Statistical Classification of Economic Activities in the EU (NACE, 2008), a new Level 1 category was created: Information and Communication. This includes three Level 2 subcategories encompassing most of the ICT sector (technical services, professional services linked to networks, hardware and software and internet-related content).

On its public site, EUROSTAT (EUROSTAT, 2011) currently provides gender distribution of the employed persons across the EU27 area and beyond for Level 2 subcategories, but no further. The three relevant Level 2 subcategories were those used to extract the data included below. These subcategories are:

1. telecommunications;
2. computer programming, consultancy and related activities;
3. information service activities.

There are obvious substantial limitations to the value of the gender data on ICT-related employment in the EU, at least as it is available in the EUROSTAT public access sections. Prior to 2008, the Statistical Classification of Economic Activities in use does not permit an accurate matching of sub-categories with the broad ICT sector.

Data available on individual occupations from the Labour Force Statistics (LSF, 2011) is not gender-differentiated, which means that it is not possible to get a sense of the variety of jobs which the 1,104,000 women employed across all three sub-sectors actually occupy, a portion of which will inevitably be in non-ICT jobs. It is not possible to measure the number of women occupying ICT functions or professions in other sectors of activities from the EUROSTAT available data.

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60 U.S. Census Bureau, Annual Census Surveys.
62 LFS series - Detailed annual survey results.
Gender pay gap statistics, equally impossible to disaggregate by occupation, are only available at Level 1 of activity sectors which, in this case, combines the three subcategories above with two other subcategories, broadly covering "old media" in a single aggregate that is meaningless for our purpose.

Bearing in mind the substantial limitations mentioned above, EU statistics show significant under-representations of women in all three sectors but with significant differences between the distribution of men and women across them.

The introduction of the new version of NACE classification, from 2008, provides a more accurate coverage of ICT via these three subcategories which now exclude sectors such as Broadcasting. Both Table 3-2 and Figure 3-7, based on the latest available data (third quarter of 2011), show a substantially lower participation of women (27% of persons employed are women) in the ICT workforce as an aggregate of all three subsectors, compared to the overall workforce across all EU27 countries (46%).

As shown in Table 3-2 and Figure 3-7, on the third quarter of 2011, 1,157,800 women were employed within those three sectors combined, across EU27 countries, representing only 1.19% of the female workforce compared to 3,115,100 men, representing 2% of the male workforce.

While the largest pool of employment for both genders is the "Computer Programming, Consultancy & Related" sector, it is also the sector where women have the smallest share with only 22% of the jobs compared to 33% of the jobs in Telecom and 42% in Information Services.
The opportunity to exploit the data for trend analysis is limited as the change of classification came to effect in the first quarter of 2008. Nevertheless, the coverage of quarterly data permits an initial assessment of the changes occurring since the beginning of the current crisis (March 2008). This assessment starts the quarter, immediately before the first consequences of the crisis on employment could be seen. The Figures presented in Table 3-3 were calculated from quarterly employment statistics for the EU27 countries and provide an interesting insight into the change of distribution of employment both for men and women, from immediately before the crisis until the third quarter of 2011. We see that women and men fare rather differently over those quarters since the beginning of the crisis. In the wider economy of the EU27 countries, women did considerably better than men, by gaining over 900,000 jobs while the male workforce was reduced by more than 2.3 million. I believe that this might be due to the fact that men were better paid and were therefore the first to go. However, in the three combined ICT sectors, the situation is substantially different. While women’s ICT workforce increased at a much slower pace than in the overall economy (+0.34% in those sectors compared to +0.94 overall), men benefited from a much greater increase (+4%). Looking at absolute numbers, we note that in the third quarter of 2011, almost 120,000 more men than women (3,900) work in those sectors.

As illustrated in both Table 3-3 and Figure 3-8, the outcomes vary considerably at the level of subsectors. In the smallest subsector, "Information Services", women increased their share by benefiting from a larger increase but in the largest, the "Computer Programming, Consultancy
& Related” sector, where women were already significantly more under-represented, the gap grew larger as almost four fifths of the job increase went to men.

Table 3-3 Quarterly data on employment by gender and sector, changes from Q1 2008 to Q3 2011 (EUROSTAT)

<table>
<thead>
<tr>
<th>EU 27 COUNTRIES - Change from Q1 2008 to Q3 2011</th>
<th>ALL SECTORS (NACE ACTIVITIES)</th>
<th>ALL THREE ICT RELATED SECTORS</th>
<th>1 TELECOMMUNICATIONS</th>
<th>2 COMPUTER PROG., CONSULT. &amp; RELATED</th>
<th>3 INFORMATION SERVICE ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in Total employed</td>
<td>-1,417,100</td>
<td>123,900</td>
<td>-205,700</td>
<td>282,600</td>
<td>47,000</td>
</tr>
<tr>
<td>change for Men</td>
<td>-2,323,800</td>
<td>119,900</td>
<td>-136,000</td>
<td>234,700</td>
<td>21,200</td>
</tr>
<tr>
<td>change for Women</td>
<td>906,600</td>
<td>3,900</td>
<td>-69,700</td>
<td>47,800</td>
<td>25,800</td>
</tr>
<tr>
<td>% change for Total employed</td>
<td>-0.66%</td>
<td>2.99%</td>
<td>-14.28%</td>
<td>11.84%</td>
<td>14.57%</td>
</tr>
<tr>
<td>% change for Men</td>
<td>-1.95%</td>
<td>4.00%</td>
<td>-14.16%</td>
<td>12.74%</td>
<td>11.02%</td>
</tr>
<tr>
<td>% change for Women</td>
<td>0.84%</td>
<td>0.34%</td>
<td>-14.54%</td>
<td>8.78%</td>
<td>19.82%</td>
</tr>
</tbody>
</table>

As shown in Figure 3-8, probably the most striking loss was for the telecom sector for which both male and female workforces were reduced by nearly 15%. This is not a new trend however. The telecom sector includes the former state monopoly telecom operators, such as France Telecom and Deutsche Telekom, which had been amongst the largest employers in their countries, and have continuously reduced their workforce since the 1990s. Those jobs, which had been technical in nature, have often been outsourced to subcontractors. Despite much less favourable employment conditions, job holders in technical jobs, largely men, could at least retain employment in the sector. When the staff reduction affect non-technical jobs, job losses from traditional operators are more likely to affect women and lead to an exit from the sector altogether. Therefore, even at equal rates of losses, women and men are not equal in loss of employment opportunities.
3.3.3 Relevant Employment Statistics for the United States

In contrast to EU statistics, US statistics provide many details regarding the gender distribution across sectors, allowing for a more meaningful assessment and analysis of the nature of women’s participation in the ICT sector.

Perhaps the most useful data comes from the US federal Equal Opportunity Commission, which has published an annual dataset since 1998, entitled "Job Patterns for Minorities and Women in Private Industry (EEO-1, 2009)". This dataset is part of its regulatory enforcement mission. No such regulatory purpose exists in Europe, where employment regulatory issues addressing gender discrimination are still split between EU and National. There is no such requirement for a similar factual basis for enforcement decisions at EU level.

The relevant categories or sectors under the latest set available, EEO-1 (see US Equal Employment Opportunity, 2009) are two:

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64 The EEOC enforces Title VII of the Civil Rights Act of 1964 (Title VII), the Age Discrimination in Employment Act (ADEA), the Americans with Disabilities Act (ADA), the Equal Pay Act of 1963 (EPA), and the Rehabilitation Act of 1973.
1. Computer systems design and related services.
2. Telecommunications.

As shown in Table 3-4, there is a disparity between the subsectors in the share of women of
the overall subsector workforce with a similarly lower female participation in "Computer
Systems Design and Related Services" (33%) compared to the "Telecommunications"
subsector (45%). This disparity though is less pronounced than in the EU.

Table 3-4 US data on employment by gender for two sectors (EEO-1, 2009)

<table>
<thead>
<tr>
<th>US Labour Statistics - 2009</th>
<th>Total both sectors</th>
<th>Telecommunications</th>
<th>Computer Systems Design and Related Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total employed</td>
<td>1,272,485</td>
<td>624,495</td>
<td>647,990</td>
</tr>
<tr>
<td>Men employed</td>
<td>774,286</td>
<td>341,288</td>
<td>432,998</td>
</tr>
<tr>
<td>Women employed</td>
<td>498,199</td>
<td>283,207</td>
<td>214,992</td>
</tr>
<tr>
<td>% Males</td>
<td>61%</td>
<td>55%</td>
<td>67%</td>
</tr>
<tr>
<td>% Females</td>
<td>39%</td>
<td>45%</td>
<td>33%</td>
</tr>
</tbody>
</table>

For our purpose, the interest of the US data is in the fact that it provides much greater details
on the nature of the jobs held by men and women inside those two sub-sectors. The sectoral
data provides a detailed gender distribution of employment by job title/functions, organised in
hierarchy based on typical salary level and education attainment required.

From the US data on the "Computer Systems Design and Related Services" (Fig. 3-9) and
"Telecommunications" (Fig. 3-10) sectors, we learn that women are under-represented at all
functions in the sector with the striking exception of the "office & clerical worker" function
were they are largely over-represented with 69% of the jobs. In addition to being at the lower
end of the salary scale, though not the lowest, this function is clearly not ICT specific.

Not only are women significantly under-represented at management levels in both sectors
with 20% and 21% female managers respectively, but they have also a much lower share of
the professionals and mid-level managers jobs (30% in both cases compared to 45% of the
sector's overall jobs) in the "Computer Systems Design and Related Services".
3.4 **Women and Leadership: Missed Opportunities?**

Much of the global economic activity of the sector is still tightly connected to the US, which hosts the largest number of ICT sector businesses, has the highest concentration of the global ICT workforce, continues to receive a high portion of higher education enrolment from
students coming from other territories, and receives the lion's share of the patents applications worldwide.

For all these reasons, the trends affecting the make-up of the sector in the US will continue to impact and influence it globally.

Furthermore, the data available for the United States remains the most comprehensive in almost all aspects of women’s contribution to ICT, from education to employment. The same trends, either persistence of a significantly lower contribution by women, or the halting of growth, shown in much of the data discussed above, are mirrored in the representation of women in the ranks of the management and strategic functions in ICT. These functions, so-called "leadership" roles, are credited with longer-term influence over the sector at large.

The US-based advocacy body NCWIT (National Center for Women & Information Technology)\(^{65}\), drawing from academic studies, salary surveys and US national labour force statistics, has provided an analysis of the attrition of women employed in technical roles throughout typical career paths in private sector organisations since 2004, with yearly updates.

In its 2010 update (Ashcraft and Blithe, 2010) NCWIT assesses the extent of the drop out, especially that of mid-career women employed in technical roles. The findings of this report are rather striking, in that they highlight yet another major cause of the continued rarefaction of women in leadership positions, beyond the better known retention problems in ICT-related higher education programmes.

\(^{65}\) "NCWIT is the National Center for Women & Information Technology, a 501(c)(3) coalition that develops and amplifies efforts to increase diversity in IT and computing. We believe that inspiring greater diversity in IT will create a larger and more competitive workforce, and will foster the design of technology that is as broad and innovative as the population it serves. Our work focuses on the entire spectrum of K-12 through college education, from the workforce through entrepreneurial careers". From NCWIT: Who we are http://www.ncwit.org/pdf/WhatIsNCWIT_2011.pdf; accessed 5/10/2011.
3.4.1 Report Findings

Five of the main report findings and their analysis are listed and analysed hereafter.

1. Women leave at mid-career in much greater proportion than men.

56% of technical women leave at the "mid-level" point, of which the report note is "just when the loss of their talent is most costly to companies", and represent twice the rate of men leaving at the same stage. As shown in the Figure 3-11 this is also higher than the rate for all women in the science and engineering sectors.

According to NCWIT (Ashcraft and Blithe, 2010), this greater attrition is not just a problem for technical women but for all women with "SET\textsuperscript{66}" degrees employed by technology companies. The report notes that 41% of women leave technology companies after 10 years of experience, compared to only 17% of men.

![Figure 3-11 Female quit rate across science, engineering and technology sectors (from NCWIT, Ashcraft and Blithe, 2010)](image)

2. Furthermore, this problem seems specific to computing occupations.

The NWIT study also shows (Fig. 3-12) that the decline in the participation of women in computing occupations is a long-term trend and somewhat unique to those professions since while the share of women in computing occupations declines from 36% in 1991 to 25% in 2008, the share of women in almost all other science-related professions increased over that period (Ashcraft & Blithe, 2010, p.14).

\textsuperscript{66} SET – Science, Engineering and Technology
3. The attrition impacts women’s access to leadership positions

The attrition at the mid-career point is all the more significant when considering its impact to the proportion of women reaching the most senior technical positions and those management positions in technology companies for which 10 to 20 years experience are a pre-requisite.

4. The gender salary-gap increases at the top.

The NCWIT report (Ashcraft & Blithe, 2010, p.18) indicates that the salary gap (Table 3-5) grows with the length of experience and with the more senior positions in companies. In particular, the salary gap has the following characteristics:

1. It is almost 7% for those with less than a year’s experience.

2. It falls to approximately 2% between 2-5 years of experience.

3. It increases to nearly 7% by 11-14 years.

4. At 7%, by 11-14 years, it coincides with the "flight or fight moment", when women are most likely to leave.

5. It continues to increase to more than 11% after 15 years.
5. How many women hold leadership positions in technology?

According to the NCWIT (Ashcraft and Blithe, 2010, p.19):

1. Women hold 10% of corporate officer positions and make up 11% of the board of directors in Fortune 500 technology companies. In one study (Catalyst, 2008), the odds of being in a high-level position are 2.7 times greater for men than for women.

2. In another study (Baron et al., 2007) of Silicon Valley technology start-ups, women accounted for only 4% of senior management positions in technical or R&D departments. They accounted for 14% of senior management when including non-technical departments.

3. Women account for 9% of IT management positions (defined as CEO, CIO, CTO, VP, Director, Strategist, and Architect), (Ashcraft and Blithe, 2010).
3.4.2 2012 Women in Leadership Quantitative Analysis of Fortune 2000

The author identified the ICT companies in the 2012 Fortune 2000 list by sector, i.e., Services, Computer Storage Devices, Electronic, Hardware, Retail, Communication Equipment and Telecom Services, and examined the Managing Boards, Executive Boards and Management Committees. The aim was to find how many women were in these decision making bodies. In some cases, such as for Japanese and Chinese organisations it was not possible to identify women from men or the information was given in an unknown language. Table 3-6 presents the results of this analysis. Out of the 144 companies found, data for 110 was available.

<table>
<thead>
<tr>
<th>No of Organisations</th>
<th>Data</th>
<th>No data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Services</td>
<td>21</td>
<td>18</td>
</tr>
<tr>
<td>Computer Storage Devices</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Electronics</td>
<td>26</td>
<td>7</td>
</tr>
<tr>
<td>Hardware</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Retail</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Communications Equipment</td>
<td>17</td>
<td>16</td>
</tr>
<tr>
<td>Telecom Services</td>
<td>58</td>
<td>52</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>144</strong></td>
<td><strong>110</strong></td>
</tr>
</tbody>
</table>

The data I was able to obtain covered 76.39% of the organisations which may be considered valid.

1,433 members of management were identified, out of which only 176 were women. This amounts to 12.28%, i.e., less than a quarter. Table 3-7 provides all the information obtained by sector. It should also be noted that a number of these women managers worked in Human Resources or Finance.
Table 3-7 Percentage of Women in Management Positions (calculated from 2012 Fortune 2000)

<table>
<thead>
<tr>
<th>Area</th>
<th>Total</th>
<th>Women</th>
<th>% of Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Services</td>
<td>235</td>
<td>26</td>
<td>11.06</td>
</tr>
<tr>
<td>Computer Storage Devices</td>
<td>75</td>
<td>5</td>
<td>6.66</td>
</tr>
<tr>
<td>Electronics</td>
<td>118</td>
<td>17</td>
<td>14.41</td>
</tr>
<tr>
<td>Hardware</td>
<td>59</td>
<td>6</td>
<td>10.17</td>
</tr>
<tr>
<td>Retail</td>
<td>52</td>
<td>7</td>
<td>13.46</td>
</tr>
<tr>
<td>Communications Equipment</td>
<td>193</td>
<td>27</td>
<td>13.99</td>
</tr>
<tr>
<td>Telecom Services</td>
<td>701</td>
<td>88</td>
<td>12.55</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td>1433</td>
<td>176</td>
<td><strong>12.28</strong></td>
</tr>
</tbody>
</table>

In 2007, an analysis of 116 companies in the telecommunications sector in Europe found that the average percentage of women on the board of directors was 7%. More than three-quarters of companies had no women on the board of directors at all. A full set of results for each country is given hereafter. The data used in this analysis was collected based on a list of members of the International Telecommunication Union (ITU) in January 2007 (European Commission, 2008c).

Although the data was collected less extensively in the 2008 report, an approximate comparison indicates that there has been some improvement in the number of women in leadership. However, other parameters are needed in order to validate this observation.

### 3.5 PISA: A SURVEY

In 2009, the OECD ran its three-yearly survey of student knowledge and skills, called PISA (Programme for International Student Assessment). In general, PISA tests students’ ability to adapt school-acquired knowledge to real-life situations, instead of only investigating their knowledge of specific curricula. A background questionnaire also explores other factors which might influence performance and potential for life-long learning, such as social background. The organisation of schools is taken into account through a questionnaire filled out by school headmasters. The initial PISA surveys focused on the three subjects: Reading, Mathematics

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67 The Programme for International Student Assessment (PISA) is an internationally standardised assessment that was jointly developed by participating countries and administered to 15-year-olds in schools in the 30 OECD member countries and 27 partner countries. First data collection took place in 2000, second in 2003, third in 2006 and a fourth in 2009.
and Science. In the 2009 survey the subject was "Students' Performance in Mathematics, Reading and Science", with the emphasis on reading. The findings are as follows:

- Girls are as likely to be top performers as boys, in fact, across the OECD countries, the proportion of top performers across subjects is similar between girls and boys on average.

- Girls outperform boys as top performers on all three subjects (4.4% girls, 3.8% boys), whilst boys are found to be the majority of top performers in at least one subject area (15.6% girls, 17% boys).

- The gender gap difference amongst top performer students is only small in science (1.5% girls, 1.5% boys), but it is significant in Mathematics and Reading (3.4% girls, 6.6% boys and 2.8% girls, 0.5% boys, respectively).

- In general, the gender gap in Mathematics and Science is less important than that in reading. In most countries, the difference in science is insignificant whilst boys are ahead in Mathematics. In fact, in 37 out of 65 PISA countries, most differences are relatively small, with the exception of Belgium, Chile, the United Kingdom, the United States and the partner countries and economies, Colombia and Liechtenstein, where boys are at least 20 score points ahead of girls. It should be noted, however, that the gender differences in Mathematics are not significant in any of the highest-performing countries.

- No barriers were found which were preventing girls from performing well, overall.

- There is no "ceiling" of mathematical performance above which girls are bound to do worse than boys. The existing barriers are related to cultural and social factors rather than the distribution of natural ability.

The 2006 PISA survey dealt with the students who took part in the survey, who said that they were motivated to learn science. Further questioning revealed that only a minority aspired to a career involving science: 72% said it was important for them to do well in science; 67% enjoyed acquiring new knowledge in science; 56% said science was useful for further studies, but only 37% said they would like to work in a career involving science and 21% said they would like to spend their life doing advanced science.
Scientific and technological know-how, as we discussed, is one of the pillars of our economy, helping to drive growth in advanced economies and create the necessary conditions for development and growth in emerging ones. The results of PISA 2006 reveal wide variations in skills levels and attitudes to science which are crucial to countries’ economic potential in tomorrow’s world.

Some interesting findings from the PISA 2006 survey can be summarised as follows:

- The survey revealed widespread pessimism among secondary school students about environmental challenges and limited enthusiasm for scientific careers. This in part explains the small number of students following careers in Science and Technology.

- There were no significant differences between male and females in average science performance in the 22 OECD countries that participated in the survey. In fact, in twelve countries girls outperformed boys, whilst in eight countries boys outperformed girls. But in the OECD countries, the difference in both cases is less than twelve points in the Science scale, which is not considered significant in contrast with the Mathematics and Reading scales.

- Despite the insignificant difference in sciences, gender differences were found in attitudes. Males were significantly better at explaining scientific phenomena whilst females were better at identifying scientific issues.

- More females were found to attain higher-performing academic-oriented tracks and schools. Substantial gender differences in Science were therefore found within schools or programmes.

- Students were more inclined to like science and perhaps follow a scientific career if they had a parent in a science-related career.

An interesting fact which emerged from the survey is the students' self-concept regarding Science: **males thought significantly more highly of their science abilities than females.**

The survey identified considerable interest among students in some scientific issues. For example, most were aware of environmental issues, such as forest clearing and greenhouse gases. However, they were generally pessimistic about the future, with fewer than one in six
believing that problems such as air pollution and nuclear waste disposal would improve over
the next 20 years. Those who performed better in Science showed greater awareness of
environmental issues but were also more pessimistic.

The top performer in Science in PISA 2006 was Finland, followed by Hong Kong-China,
Canada, Chinese Taipei, Estonia, Japan and New Zealand. Australia, the Netherlands, Korea,
Germany, the United Kingdom, the Czech Republic, Switzerland, Austria, Belgium, Ireland,
Liechtenstein, Slovenia and Macao-China also scored above OECD average. It should be
noted that data for science in PISA 2006 are not directly comparable to data in the previous
studies as the nature of the tests has changed.

The future PISA surveys will have the following focuses: 2012 - Mathematics and 2015 -
Science.

3.6 CHAPTER CONCLUSIONS

From the statistical data presented above we may draw the following conclusions:

- The gender gap in abilities in Science and Mathematics between 15-year old boys and
girls is not significant on average. This indicates that girls and boys have the same
intellectual abilities.

- Women are the major graduates and undergraduates in tertiary education but only a
small percentage studies Science, Mathematics, Engineering and Computing. The
current trend is that the number of females studying computing is decreasing faster
than the number of women studying Science and Technology overall.

- The indicators relating to women as authors acknowledging pattern applications is not
reliable enough to allow us to draw valid conclusions on the number of women.

- Women leave the ICT sector much more than men (47% of females quit science work,
39% quit Engineering work and 56% quit Computing work).

- Female numbers in the ICT sector increased mainly in the services sector where the
work is mainly clerical or administrative (around 69%).
• The gender pay gap increases after the first five years of employment and is remarkable at the higher levels.

• Females are not adequately represented at the top in the sector. This might be due in part to the fact that they leave the sector early and therefore there is not enough talent available. It might also be due to the fact that women are discriminated.

As remarked in a recent paper addressing the gender imbalance in Computer Engineering (Leetauru, 2010), interest for the question of women in ICT-related fields has continually grown while, paradoxically, far from easing, the problem of women’s low participation appears to continue and grow worse.

The most salient fact that an examination of the statistical data available on women in ICT brings is the utter inadequacy of the data. This is further confirmed by the convolutions required to introduce, a posteriori, a gender dimension in patent data and, to a larger extent, by the difficulties encountered by the growing number of studies on these topics, to draw meaningful causality links from the statistics. Women and the gender dimension remain an afterthought introduced clumsily into existing questionnaires and data collections.

But there is still more cause for concern. Beyond studies, no policy intervention can be adequately designed or its results properly monitored, in the absence of relevant indicators built on appropriate data.

It should be mentioned here that the specific conclusions on RQs 1, 2, 3 and 4 are given at the end of Chapter 4 (together with information on Women's contribution to ICT).

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68 The National Engineering Education Delivery System, in collaboration with the Association for Computing Machinery’s Committee on Women in Computing, has indexed nearly 900 articles since 1980 on the subject of women and computing alone (NEEDS, online). A search of Google Scholar turns up more than 95,000 works containing the terms gender and engineering.
Chapter 4 looks at the issues of "Getting In" and "Staying In" the cyber community. The "Getting In" issue is handled in Getting In – ICT as a Career Choice (Section 4.1) and Education (4.2). The "Staying In" issue is investigated in Staying In (Section 4.3). In Section 4.4 (Chapter Conclusions) the relevance of the chapter in partly answering Research Questions 1, 2, 3 and 4 is presented as well as the conclusions drawn from the analysis made in connection to the RQs.

4.1 GETTING IN - ICT AS A CAREER CHOICE

The family is the place where children learn to interpret reality (Way and Rossmann, 1996b). Parents are the interpreters of information about the world, and are the first teachers in the socialisation process as well as the first "role models" that children see and imitate. I believe that the traditional family model where the father is the one who deals with technical or scientific requirements, be it helping the children with their Mathematics homework or changing a light bulb, and where the mother deals mainly with "feminine" caring duties, clearly defines from an early age the specific roles of males and females. Parents are also those who encourage and help develop their children's abilities. Researchers have studied the influence of family and parents on children's career choice and development. Much of this research has demonstrated that there are links between (1) career choice, (2) development and (3) family relationships (Ketterson and Blustein, 1997). Parents, within the family unit and under normal conditions, support and guide their children in general and in their choice of career in particular. Families with uninvolved (or inactive) parents "seem unable to function well either because they cannot set guidelines or because they do not pursue interests that involve places and persons outside the family" (Way and Rossmann, 1996a). Family functioning has a greater influence on career development than either family structure (size, birth order, number of parents), or parents' educational and occupational status (Fisher and Griggs, 1994; Trusty, Watts, and Erdman, 1997).

Parents are more likely to propagate the belief and image that science is less interesting and, most importantly, more difficult for their daughters than their sons. According to a study by
Tenenbaum and Leaper (2003) parents appear to use a different language when discussing science (and interpersonal relationships) with their sons and daughters. Fathers, when engaged in scientific activities with their children, use a simplified language with their daughters and a more challenging scientific language with their sons whilst mothers do not differentiate according to the gender of their offspring. Both mothers and fathers, however, shared the (unfounded) belief that science is of less interest to girls than boys and that science is more difficult for girls. Tenenbaum and Leaper argue that parents’ beliefs appear to affect children’s interests and performance in science and fathers are much more likely to uphold rigid, traditional gender roles.

There have been several studies tying career choice to family influences. Interesting research by Parr Lemkau (1983) found that women who work in male-dominated occupations had mothers who worked and had unusual opportunities to witness a broad range of male and female work models. These women were more likely to report the positive influence of men, including fathers and teachers.

Based on what was previously mentioned, it appears that parents support learning strategies that promote career readiness and start the initial contacts for what will later on become a career choice. According to Moses (1998) "children develop many of their initial ideas and beliefs about work on the basis of what they hear from their parents, as well as what they observe for themselves. Parents' intentional career-related actions are important in preparing children to be tomorrow's workers and tomorrow's citizens".

Taking into consideration the aforementioned research, I consider that one could define the role of the parent/carer as that of starting the process of socialisation, including the initial positioning of males and females in society. This initial socialisation would later on lead to the integration of the child in the social environment and, eventually, their career (Haier, 2005, 2007).

### 4.2 Education

The goal of the general education in today's schools is to create independent, self-thinking and efficient individuals, able to be efficient and contributing members of the modern society (Rasinen et al., 2006). This requires the school to function as an incubator of new ideas offering flexible and updated curricula and to provide knowledge in line with societal needs.
The conception of technology today includes both technical and scientific knowledge and interpretation. To this end, great emphasis is given to the acquisition of scientific know-how, including thinking, investigating and analysing, interpreting and understanding, leaving out the practical application of science and technology (Rasinen et al., 2006).

There has been a long debate about the under-representation of women in scientific careers (European Commission, 2010a). This under-representation has often been explained by suggesting that men are intrinsically better at science than women and that there is nothing that can be done against "nature" itself (Chavez, 2005; Haier et al., 2005). The start of likes and dislikes for young children is at home. These are further reinforced when children first go to school (Brown, 1996).

Technology is a topic closely related to the male gender stereotype and there is evidence of female avoidance of technological topics being connected to the process of identity formation (UPDATE Project, 2008). If identity traits are reinforced through existing educational models then women do not enter the ICT sector. Looking at what is happening at kindergarten and primary school we shall see if this assumption is true and thus would give a partial answer to RQ 3 (Why are women under-represented in the cyber-community?).

Children start to develop stereotypes about their role in society as early as two years old. By the time they start kindergarten or primary school these stereotypes have become almost identical to the cultural standards (set for them) of toys, activities and vocational roles. Simultaneously these stereotypes or standards are rather rigid and difficult to shift (Birch and Ladd, 1997). In the same way, children at the age of four to five show preferences for typical gender activities (Wetherell, 1996a).

Personality traits also appear to play a role in the context of early technological education. Girls appear to be less confident than boys and, in particular, at stereotypically male tasks (UPDATE Project, 2008). They tend to attribute failure to their own lack of abilities and success to their circumstances (Hannover, 2007).

In most countries, kindergarten and primary school teachers are mainly women. According to the available statistics from EUROSTAT (2008a)\(^69\), the percentage of female teachers in

\(^{69}\) This data is confirmed by the World Bank (2008).
Europe 27 for primary school ranges from 71.9% in Luxembourg to 97.2% in Lithuania. The same pattern is valid for lower secondary school teachers, ranging from 71.9% in the United Kingdom to 85.5% in Lithuania. According to the organisation Pay Equity, 98% of preschool and kindergarten teachers are women (2005). This means that from an early age, girls (and boys) are shown the model of a woman as a teacher – a carer, and a kind of mother replacement. The role model of the school teacher is important as it is the first real interaction of children with society outside the family circle. This interaction cements the social standing of women for young children, whether they are male or female. In most cases the image from the school, combined with the family model of the female carer, mother or grandmother, establishes the social hierarchy remaining for the rest of their life. It becomes the accepted social structure.

Looking at primary school curricula we notice that in almost all European countries there are no specific requirements or guidelines to teach technology (UPDATE Project, 2008). Data, collected in primary schools in Germany (UPDATE Project, 2008), indicates that a great deal of pedagogical latitude is given to the teachers in order to ensure that teaching is adapted to the abilities of the class. As a consequence teachers avoid topics which are related to technology or they just treat them rather marginally. According to Mamme (2004), natural scientific – and especially technological education – plays only a minor role in primary school.

Even though in the educational system technology is a neglected subject, boys seem to manage to keep their interest in it, whilst girls turn away at an early date (UPDATE Project, 2008). I believe that this interest found in boys must be kept alive by other sources, e.g., the parents or peers.

In the Subsections that follow we are going to explore the behaviour and treatment of girls at school (4.2.1), the issue of technophobia, which influences the way technology is taught and learned in school (4.2.2), and the training of the trainers (4.2.3) which as mentioned influences the number of women entering the ICT sector. This analysis would partly address RQ3.

4.2.1 Girls at School

Statistical evidence shows that there are no major differences between the performance of girls and boys at science subjects at school at an early age (Pisa Report, 2009a, 2003a). The gender gap measured in the 2009 Pisa report is largely related to reading skills (top girls 2.8%
to 0.5% top boys), but for Mathematics and Science it is much smaller (1.0% girls to 1.5% boys in science). 4.4% of girls are top performers in all three areas (Reading, Mathematics and Science), compared to 3.8% of boys (Pisa Report 2009a). According to Eccles et al. (1993), girls and boys, even at a young age, feel fairly competent in certain subjects. In the reference study, 1st, 2nd and 4th grade girls feel more competent in Reading and Music, whilst boys of the same age range feel more competent in Mathematics and Sports. This is part of the way teachers are presenting specific subjects to their students (Eccles, 1993).

Haworth and Plomin (2009) conducted a study aiming to disentangle the contributions of genetics and environment from the possible sex differences in Mathematics and Science achievement. The authors examined 2,600 pairs of British twins at 9, 10, and 12 years of age. They reviewed teacher reports and academic performance as well as the genetic and environmental predictors of "high science ability". The study yielded three major outcomes.

1. There were no differences in standardised achievement scores between sets of twin boys and twin girls in any of the three age groups examined70.

2. Although boys were more likely to be at the high end of performance at age 9, this sex difference was absent at ages 10 and 12.

3. More specific examination of monozygotic and dizygotic, male-only and female-only pairs indicated that both genetic and environmental factors have a similar effect on science performance for girls and boys.

The results of this study indicate that there are different environmental influences for girls and boys and this can be reinforced by the results of the Tenenbaum and Leaper (2003) study on the socialisation of gender previously mentioned.

Another recent research by Cheryan and her associates (Cheryan et al., 2009), resulted that the role that stereotypical environments play in career choice by positively or negatively reinforcing the sense of belonging to a community. In one of the four studies carried out in this research, the role of the stereotypical representation of computer science departments negatively influenced the choice of this particular study subject.

70 The large sample used would make the identification of significant differences much easier.
It should be noted that according to the OECD (Pisa Report 2006) tests of 15 year olds, systematic assessment of gender differences shows that students are still being held back by their own gender-related perceptions. Concerning Mathematics, girls and boys do equally well at the end of primary school. In Science, boys also perform equally well in most OECD countries; in Greece and Turkey, girls perform better. The patterns found mirror the motivation and attitudes of students. Girls appear to be more anxious about Mathematics although their general problem-solving abilities are identical to those of boys. The same study shows that girls and boys make choices about higher education and careers which reflect social stereotypes and not necessarily their ability. Angel Gurria, the OECD Secretary General commented as follows:

"Many countries have reason to be proud that girls and boys are now performing equally well in key school subjects. However, we cannot be complacent in the face of continuing gender stereotypes. Attitudes such as "reading is not for boys" or "maths is not for girls" must not be allowed to persist: they are too costly in terms of lost human potential".

(Gurria, 2006)

This statement brings us back to what was discussed in 4.1 and in the beginning of Section 4.2, i.e., that there are no innate differences between boys and girls towards science but any possible differences observed are social constructs. Studies have been carried out in order to assess the role that teachers play in encouraging girls to have a hands-on approach to science. Jovanovic and Steingach King (1998) performed an experiment including 53% female students, mean age 12.21 years old, in performance-based science classrooms. These classrooms were chosen based on the identification of teachers who were not only exemplary hands-on science instructors, but also sensitive to increasing girls' participation in science. The results of the study indicated that being actively involved in the performance-based science classrooms predicted the student's attitudes at the end of the year. The researchers noted that (1) the participation of girls and boys was not equal, (2) there was a variant participation of girls and (3) there was a decrease in the girls' science ability perception as the year progressed. The researchers consider these results as an indication that girls and boys experience the classrooms' dynamics differently.

Based on the results of this initial study, a survey was conducted by the Centre for Studies in Science and Mathematics at the University of Leeds on the same issue. This time there was a
comparison of "Science Performance and Uptake by Fifteen-year old Girls and boys in Co-educational and Single-sex schools" (University of Leeds, 2009). The survey found that girl pupils attending single-sex schools achieve higher scores. This might also be explained by the fact that many of the single-sex schools are independent or grammar schools, and the performance difference may have little to do with the composition of the class but more with the pre-selection by ability to attend them. When only comprehensive schools were considered, there were no significant differences in the pupil's mean performance. As other studies show that there is a significant difference in science performance for girls attending single-sex schools (Sax, 2005; Warrington and Younger, 2000), the results of the Leeds study are reinforced. The significant differences observed in science performance might be explained not only by easier participation in performance classes for girls in these schools, but also by the perception that the girls themselves might have of their own abilities.

4.2.2 Technophobia

In the beginning of this section, we looked at how technology is taught at primary schools. Looking back into the early 1990s, when computerised technology was introduced into the classroom, students and teachers alike treated it with mixed feelings. At the time, whilst most pupils, girls and boys, held positive attitudes about computers, many teachers expressed serious concerns and have been labelled "technophobic". Rosen and Weil (1995a) claim that 45% of primary and early secondary school teachers are technophobic. Considering the influence that teachers have as role models, as formerly discussed, it could be deduced that teacher technophobia passes on to their pupils and, in particular, to girls who are given similar messages both at home and from the media. In their empirical study, Rosen and Weil conclude that variables other than computer experience play a role in resistance to technology. In a second study, Rosen and Weil (1995b) conclude that many factors can be used to explain technophobia: availability of technology (lack of or abundance), culture characteristics, political structure and educational systems. It is interesting to note that in most of the countries that took part in the study, age was not an important factor.

The Rosen and Weil study (1995a) is one of the more comprehensive studies carried out on this subject and is still quoted as quite reliable today. The term "technophobia" mutated into also being called "computer anxiety" (Korukonda, 2007). Technophobia or computer anxiety has been measured in older adults (Hogan, 2006) or school principals (Baloğlu and Cevik,
2009). The latter investigated the ability of school administrators to be able to follow technological advancements in order to promote "the role of leadership with regard to technology in their institutions". The study showed that computer anxiety levels hinder many administrators from doing so.

In January 2008, in an article in *The Times*, Nicola Woolcock claims that despite the large amounts of money spent on ICT in schools, there is no real added value. The author attributes this failure to "teacher technophobia":

"Although in the developed world, ICT permeates middle class citizens' lives (including teachers') generally; 'technology for my work' is often different from 'technology for my life'."

(Woolcock, 2008)

She suggests that to ensure that ICT is properly used in schools and to obtain a real added value, technology needs to be designed, supported and run in a way which helps learners, schools, and teachers with the "stuff" of education. This leaves trainers, educators and teachers the task of finding ways to support learning, using specific technologies that students already use in real life and avoid introducing new schema. This is important for teachers, who although they may not be technophobic in their personal lives, feeling that they are in control of the technology they use, might become technophobic within their teaching environment. This may be due to the fact that teachers are not in control of the basic structure of their teaching curricula, and technology might appear in many cases as a disadvantage to their way of working.

Teachers do not incorporate, or incorporate rather few web resources into their teaching despite the fact that these resources have been empirically shown to increase mental functioning (Schmidt, 2010; Kamperidou et al., 2007; Pantouli, 2006; Tooley, 2003). This, of course, varies in different countries and different educational systems.

Further research on the subject of technophobia in the classroom today indicates that although extensive research is rather limited nowadays, the issue is still one that worries teachers. There are a number of blogs in the internet giving tips on how to fight teacher technophobia in the classroom, discussing issues such as *Technophobia and Cellphones in the*
Technophobia or the trendier "computer anxiety" were subjects of targeted research in recent years, such as the school principal study (Baloğlu and Cevik, 2009), and the older Irish study (Hogan, 2006). I consider that the over-familiarisation of the population with PCs and other technological gadgets used in everyday life hide the fact that people are scared or phobic of the technology behind them. This phobia emerges, in my view, in the decrease of girls and boys deciding to study and work in a sector with which they are, at least in theory, familiar.

It is interesting to note that the issue of technophobia only started being broadly discussed in the mid-nineties, with the emergence of the "fun" part of ICTs. With the popularisation of these, there was another quiet period and new discussions started around 2008 with the explosion of social networking. This could be explained as a subconscious exclusion of women from the parts which are not only work but are also enjoyable. This is a personal view of course!

### 4.2.3 Training the Trainers

The term "technophobia" is rather harsh for teachers, as most of them are technology users as already mentioned. The problem is more complex than using the new technologies as teaching tools. There is a need to change the learning culture in the classroom and make broad-based changes in order to accommodate and use the new technologies. This not only makes technical demands on the teachers, but also requires a more comprehensive effort, including some risk-taking on their part, especially in the case of older children who might be more competent technology users. New technologies should be introduced in standards-based, curriculum lessons, which means that teachers should in turn be taught not only the technical

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71 Article by Ben (no surname) including Power Point Presentation by Liz Kolb (Are you considering cell phones?) found in www.teacheng.us/p=34 accessed 29/05/2012.

72 Anonymous article in Ed Live found in www.higheredlive.com/there-is-a-cure-for-teacher-technophobia-and-his-name-is-richard-byrne accessed 29/05/2012.

73 Article written by La Barge who is identified as a third grade high school teacher but no other information is provided. La Barge might be a pseudonym. Found in www.cetechtalk.blogspot.com accessed 29/05/2012.

74 Statistical data about the declining numbers of young people following scientific studies and careers was presented in Chapter 3.
tools, but also how to develop strategies that will allow them to blend these new technologies into learning processes.

Phillips (2008) believes that the way technology is introduced into teaching presents many hurdles. Textbooks are resources for teachers and include many print and digital tips for the specific subject they are presenting, but there is no ready-made digital material available to facilitate the process. Such material would be a new resource, complementary to the textbooks, and it will not require additional work by the teacher. He also claims that there is a difference between technology integration and technology-infused instruction. Whilst the former means that the teacher needs to help her students to step into a hands-on relationship with the media and hardware available, in most cases in a project-based learning situation, the latter refers to teachers using the media and hardware as instructional tools. I agree with Phillips' argument that the process to integrate better technology is not only through its incorporation into national curricula, but also through the creation of specific teacher training courses. This would provide the instructors with ICT tools for teaching purposes and also to create the hands-on relationship previously mentioned.

4.3 STAYING IN

As the statistical evidence presented in Chapter 3 indicates, not many young girls decide to study and work in the ICT sector (3.1, 3.2). But even those who initially decide to have a technical career do not stay in the sector. The phenomenon of the "leaky pipeline" (Ryan, Pollock, Antonelli, 2009), the deviation from technical duties to more administrative ones, or even completely leaving the sector, further decreases the number of women with careers in ICT. A brief reminder: it is not important how many girls decide to study ICTs and how many enter in the "system", since they will not stay if the conditions to retain them are not met. The effect is similar to that of a pipeline, full of holes, where it does not matter how much liquid you put in, it still escapes. The "leaky pipeline" metaphor (Hanson, 1996) is useful in describing the obstacles that work against women's persistence in science-related careers.

In Subsection 4.3.1 we give a brief outline of the social cognitive theory relating to career choice. The social cognitive theory provides a theoretical framework relating career choice to family, role model and school influences. In Subsection 4.3.2 we show the key factors keeping women away from ICT careers, and in 4.3.3 we show the obstacles they face in the sector.
These Subsections answer RQ 2 (What are the problems women face when they are in the sector?) and RQ 3 (Why are women under-represented in the cyber-community?).

4.3.1 A Social Cognitive Model for Career Choice (SCCC)

Bandura (1986) developed a social cognitive theory based on the idea that (1) people learn by watching what others do, and (2) human thought processes are central to understanding personality. Social cognitive theory revolves around knowledge acquisition processes or learning and it correlates these processes to the observation of models based in interpersonal imitation or media sources. The basic ideas of social cognitive theory relate to the analyses in the previous sections about family influence and teacher influence in career choice, and this brief presentation aims to reinforce what was previously discussed.

The Bandura theory was expanded leading to A Social Cognitive Model for Career Choice by Lent, Brown and Hackett (1996, 1994). The model was tested by Flores and O'Brien (2002) on a sample of 364 Mexican American adolescent women, by running a path analysis. The path analysis aimed to determine the contextual and social cognitive variables influencing career aspiration, career choice prestige, and traditionalism. The model was partially supported by evidence on non-traditional career self-efficacy, parental support, barriers, acculturation and feminist attitudes, all of which predicted career choice prestige.

The notion of "self-efficacy" is central to social cognitive theory. Self-efficacy can be described as the belief that one is capable of performing in a certain manner in order to achieve specific goals (Ormrod, 2006). It is the belief that one has the ability to follow and achieve successfully specific actions and manage situations properly. Self-efficacy could be defined as one's personal assessment of one's own abilities to perform. We saw that young girls lack confidence in their ability to deal with technology or science and this creates avoidance of technological subjects (Section 4.2). Improved self-efficacy might lead into "daring" to take up a technical career.

Social cognition theorists agree that although there is an important influence by the learned behaviour and conditions of the growing-up environment, the individual and its cognitive abilities are just as important in determining moral development (Santrock, 2001).

Part of social cognitive theory relies on outcome expectancies influenced by the environment in which the observer grows up. It is obvious that according to the social cognitive theory,
role models are part of a child's learning acquisition. They are models both for material objectives but also for underlying curricula of virtuous living. Bandura (1988) stressed that the easiest way to display development would be by considering a number of different factors, social cognitive or environmental (Santrock, 2001). According to social cognitive theorists, learning will most likely occur if there is a close identification between the observers, in this case a child, and the model, parents, siblings or teachers (Bandura, 1988). However the role of the family, role models and kindergarten and primary teachers is, according to the specific theory, decisive.

Smith (2002) used Bandura’s work to link the social cognitive model to vocational interest in Information Technologies. She claims that a decision to participate in learning activities emerges from interests, and interests themselves lead to career-relevant activities and occupations (Hansen, 2004). Becoming proficient in technologies would therefore create interests which would in turn create self efficiency, and competencies in these technologies would thus expand career choices. Smith’s conclusions were drawn from a seminal study conducted by Miura (1987) and are still relevant today. Miura claims that

"Gender differences in perceived self-efficacy for computer use may help account for differential computer interest and course enrolment at the college level. … Men rated themselves higher than did women for perceived self-efficacy. They were also more positive on the cognitive outcome measures, but with computer self-efficacy held constant, the magnitude of these differences was decreased, suggesting that perceived self-efficacy may be an important consideration when examining gender differences in computer interest and use".

(Miura, 1987)

In other words, self-efficacy, which as previously mentioned, is one’s belief in one’s abilities to follow a specific career, creates interests in a specific subject, in this case computer use, which will eventually result in a relevant choice of profession. The fact that young men have a higher self-efficacy indicates that they are more confident in their abilities and therefore not scared of dealing with computers. Smith (2002) claims that the model of interest found in the social cognitive career theory could eventually contribute to information technology research and practice, and provide insight into the factors related to vocational interest in information technology.
DiDonato and O'Donnell (2006) wrote a paper linking the SCCC to the factors that influence the choice of students of technology studies and careers. In the paper they refer to the Eccles and Wingfield (2002) Expectancy-Value Model, defining "expectancy" as self-efficacy and "value" as the incentive to undertake a specific activity. DiDonato and O'Donnell concluded that research in the IT field validates the factors of both SCCC and the Expectancy-Value Model. The paper reporting the research specifically mentions the lack of female participants in the study and underlines the need to examine the absence of women in studying ICT-relevant subjects. A later study (McInerney et al., 2008) further investigates career choices targeting Information Technology Majors and Careers, using SCCC to explain and theoretically validate their findings.

From the above we may conclude that social cognitive theory emphasises the influence of the environment on shaping personal beliefs in one's own abilities. This influence through the family, school and media role models plays an important part in career choice. The influencing factors for girls or women in making a career choice appear to propagate stereotypes and keep young girls away from technical subjects. Girls in secondary and tertiary education develop "avoidance syndromes" which keep them away from the ICT-related labour market. One should note that the influences mentioned in SCCC are only part of what could explain the lack of women in the ICT sector (RQ 3). A second fact that should be borne in mind when investigating career choices is that most of the women working in the sector have no technical background (Lang et al., 2010), and an ICT career was not their first career choice which further delays or stops their progress (answers RQs 2 and 3).

### 4.3.2 Women’s Perceptions about ICT

In this Subsection, we investigate how women perceive the ICT sector and how the ICT sector, male-dominated as it is, perceives women. In Subsection 2.4.2, we looked briefly at certain stereotypical perceptions that women have about the sector and which they appear to propagate (Pascall, 2008b). To remind ourselves, we will mention them again.

1. Poor quality working conditions
2. No holidays, no spare time
3. Very male-dominated
4. No social or creativity content in ICT jobs

5. Being a mother and having maternal responsibilities is considered not to be compatible with a (demanding) career in ICT

The stereotypical perception about poor quality working conditions could be examined in connection with the perception of there being no holidays and no spare time. The development of ICTs in the last twenty years was rather fast indeed. The image of the initial use of the technology during and at the end of the World War II did not fade fast enough in order to allow the second or even third generation ICT worker image to emerge (Pascall, 2008b). In addition, the projected male geek image, spending all of his free time in front of the computer and using technologies for destruction rather than the common good, persisted through different media, including TV advertisements, films and books. Project work and emergencies such as the Millennium Bug occasionally require 24/7 work, which appears to have stuck to the sector.

Statistical evidence indicates that the ICT world is male-dominated and this is an expected outcome as women do not choose the sector as a career. Although a closing of the gender gap was observed since comparisons started to be made (Sections 3.2 and 3.3), this is not significant. The gap widens even more going up the hierarchy scale, and especially at the decision making level.

Perceptions about there being no social or creative jobs in the sector stem from deeper roots. The term ICT itself, "lacks clarity of definition" (Lang et al., 2010), and it is thus difficult to draw boundaries about what ICT occupations are. Additionally, the rapid rate of change makes conceptualisation of the industry complicated (Valenduc et al., 2004). ICT has both technical and non-technical descriptors which apply to many position types. With such a broad range of "professions" one tends to rely on the straightforward definition of working in ICT, i.e., "something to do with computers", deducing that this is something technical, most likely programming and therefore a solitary pursuit (Lang et al., 2010).

The sector is considered "dry", highly technical and asocial. Research and innovation in the sector involve the development of applications which have to do with the implementation of applications which have to do with the implementation of

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75 Interview with young girls-shadows (Cyberellas) in the 2009 "Cyberellas are IT" conference in Brussels.
ICTs for the benefit of the citizen (see 7th Framework Programme for Research and Development, 2006 - 2013). Creativity and innovation are basic requirements to work in the ICT sector. Research is carried out in fields such as health or the environment.

The stereotypical beliefs that the ICT sector has about women (Pascall, 2008b) are:

1. Technical incompetence
2. Lack of commitment and motivation to take up a challenging career
3. No managerial capacities in top positions
4. Being a mother and having maternal responsibilities is considered not to be compatible with a (demanding) career in ICT

We discuss all four stereotypical beliefs below.

The technical incompetence of women covering all technical sectors is a well-known stereotype. In Chapter 3 (Statistical Evidence) we saw that women have the same academic performance as men. In fact women have more degrees and PhDs than men (Section 3.1).

This belief – women's presumed lack of technical competence - is rather strong. It should be noted that although some of the reasons that women avoid the ICT sector were given previously, technical competence is a combination of different factors. We saw already that skills and competences stem from interests and attitudes (Sections 4.1 and 4.2). Mental capacity plays only a small part in achieving success.

1. Lack of Technical Competence

Whilst examining the first stereotypical belief, i.e., the lack of technical competence, we should be reminded that in 1946, ENIAC's six member programming team were all women76 and had the technical competence to do such work. Statistical evidence in 2011, when technology is part of everyday life indicates that girls make the same use of internet and technology as boys

(EUROSTAT, 2010). Technical competence therefore at least at this level is independent of gender.

2. **Lack of commitment and motivation to take up a challenging career**

The popular belief of women being satisfied only as homemakers and mothers has been belied by Freud himself (as reported by Erikson (1950)), who claimed that for men and women to be happy they need multiple sources of satisfaction. They need the satisfaction of interpersonal relationships as well as the acknowledgement and achievement in the outside world (Betz, 2005). Nowadays most families are two-earner families (EUROSTAT, 2011). Betz claims that the motivation of women to achieve and overachieve at work is somehow hindered by the gender-related stereotypes which are detrimental to the development of young girls. These stereotypes emphasise home making and de-emphasise educational achievement. They also lead to the choice of typical employment which is lower paid than the atypical one, for example, in a scientific position. In a survey launched by the European PWN (Professional Women Network) Think Tank Group (2008), women in employment tied their motivation to the recognition and reward of their efforts, parity of treatment and a merit-based culture in their place of employment. These were the key to women's satisfaction and motivation and seemed to be lacking in many places of employment.

3. **Lack of managerial capacities**

The third stereotypical belief of the ITC sector is that women lack managerial capacities to achieve and maintain top positions. This is a belief not limited to the sector but reinforced by the intellectual inferiority of women as far as technical competence is concerned. Amongst the basic attributes required in a successful manager are skills and abilities such as prioritising, problem solving, multitasking, empathy and many more which are in general considered "female" skills. There is no doubt that women have for centuries successfully managed families and children as well as other work at home and outside, even if this was not paid work. They have all the necessary tools, either due to nature or circumstances to make good managers, especially as their management style is different and they tend to go for transformational instead of transactional leadership.

Looking at women's leadership behaviours (Desvaux et al., 2008) and projecting those in general working practices we see that women apply more participative decision making and
efficient communication in comparison to men's individualistic decision making and control and corrective action. In every day working life, women might appear less ambitious and less interested in a demanding career as they approach it in a less "loud" and perhaps "aggressive" manner (Eagly and Johanessen-Schmidt, 2007; Eagly et al., 2003; Eagly et al., 1992). This is true both for general aspirations and when talking about managerial capacities. Women, in addition to their less "loud and aggressive" approach, encourage people development, role models, expectations and rewards. This different management and work style could be misinterpreted as lacking ambition and autonomy.

4. Compatibility

We looked at the two sets of stereotypical beliefs above, i.e., perceptions of women about the ICT sector and perceptions of the ICT sector about women. Although these perceptions are different there is one shared belief: the fact that being a mother and having maternal responsibilities is considered not to be compatible with a (demanding) career in ICT, and that having a career in the sector is not compatible with motherhood. One of the attributes given to the ICT sector is that it requires 24 hours work, seven days a week. This might result from the fact that projects and deadlines can lead to extra working hours occasionally. Additional working hours however, are required almost in any job and in any sector where project work and deadlines are involved. Sometimes, it is personal interest in technical work rather than necessity, which might increase working hours. Working conditions are similar to other sectors with limitations relevant to specific requirements.

The ICT sector is male-dominated for reasons we are looking at in this thesis (Sections 3.1, 3.2 and 3.4). This maleness contributes to women finding it difficult to enter and remain in the sector. Due to so many misconceptions about working in ICTs the sector eventually became a men's club and the entrance of women is considered to be interfering with the way this club functions. In the various conferences that the author of this work attended, she often heard men complain that the presence of women breaks the team spirit. This is in a way understandable as men feel constrained to behave differently. Besecke and Reilly (2006) consider that the scientific environment is "very similar to corporate America in that it is very much a boy's club". This club has its own traditions and rules with the purpose of keeping power exclusively to themselves. Being part of this "old boys' network" creates the conditions of being taken more seriously and some respect is granted to you de facto. Women have to fight for what is normally given to men.
4.3.3 The glass ceiling, the glass door, and the glass wall

In Chapter 2, Literature Review (2.5.1), the issues of the glass ceiling, door and wall were discussed, backed by the relevant literature. Now we will look at the scenario of women managing to break the glass door and enter in the ICT sector, with duties appropriate to their qualifications. Once in the sector, they face the phenomena of the glass wall and/or the glass ceiling.\(^{77}\)

The phenomenon of the glass wall refers to horizontal moving, i.e., moving to take up duties of the same or similar technical nature. The glass wall closes possibilities of moving\(^{78}\), as though there is mistrust in a woman’s ability to prove technical competence outside the specific area. The glass wall is not there when women decide to move out completely from technical tasks to more administrative ones. On the contrary, it is encouraged! In the different technical projects in the European Commission, aiming to keep a certain gender balance, there are a number of women working in the projects. Further analysis shows that most of them are working in administrative capacities such as project coordinators (European Commission, 2009c, 2001).

Moving up the career ladder is also tough for women (European Commission, 2010a). Looking at the top European companies, the number of women on top companies’ boards has shown little progress since 2004 (8\%)\(^{79}\). Data from the 4th quarter of 2010 shows that in the largest publicly-listed companies, 97\% of chair persons and 88\% of board members are men (European Commission, 2010). Published literature cannot support conscious discrimination but in countries such as Norway, where quotas are imposed, women make up almost 40\% of the board members of the largest companies (European Commission, 2010a). It should be noted that many organisations, in order to respect diversity, include women in their boards but give them non-technical, "softer" portfolios (European Commission, 2010b). In the European Commission, the number of women in senior and middle management is increasing due to a conscious effort to achieve equality (European Commission, 2010c).\(^{80}\)


\(^{79}\) The FTS Eurofirst 300 reported by the European Professional Women’s Network. Data based on a survey carried out by Egon Zehner International using data provided by BoardEx. To be found in Women and ICT, Status Report 2009a, European Commission, DG Information Society and Media, www.ec.europa.eu/itgirls, October 2009.

\(^{80}\) Internal Commission report from the Equality Unit DG HR – 2010.
Women middle and senior managers, though, are mainly found in non-technical areas such as human resources or communications, and the percentage of women having responsibilities in technological fields is rather small.

The statistical data mentioned in the previous paragraph could be justified in numerous ways. Basically, women appear to lack the ability to create networks in their area of work in order to have support when it is needed for promotions. When they look for career progression, often they change fields and move either outside the ICT sector or to non-related duties which are considered softer (Hewlett, 2007). This is frequently due to gendered cultures in the workplace where unwritten assumptions stemming from male workers and stereotypes make the model of the ideal worker. This ideal worker does not fit with the personal demands that most women have to face, i.e., looking after families. They are therefore obliged to leave behind their technical identity in order to move up the career ladder (Simard et al., 2008; Faulkner 2007).

4.4 Chapter Conclusions and Recommendations

In this chapter we looked at the position of women in the ICT sector. Emphasis was given to career choice (Section 4.1), education (Section 4.2) in order to investigate the "Getting In". In Section 4.3 we looked into the "Staying In" factor. Sections 4.1 and 4.2 provided answers to RQ 3 (Why are women under-represented in the cyber-community?) by looking at the role of family and schooling in career choice. RQ 1 (Which are the areas in the sector where women are most under-represented?) and 2 (What are the problems women face when they are in the sector?) are inter-related and answered in the "Staying In" (4.3) Section. RQ 4 (Has there been any improvement in recent years?) was touched upon in the same section.

The small number of girls in study programmes and jobs involving technology has been the subject of discussion many years. As we shall see in Chapter 6, a number of measures have been announced and/or implemented since the discussion about women in the cyber-community started but the result is too slow to come and not tangible enough. This can be interpreted in two ways: either the measures are not adequate not covering the entire spectrum for which action is needed, or they focus on and treat the effect rather than the cause. Given that the causes are socio-cultural and psychologically-constructed, it is difficult to come up with measures which can on the one hand be validated properly and on the other correctly assess their impact. In addition, there is little comparative, qualitative and meaningful data.
(Ginesté, 2005; Roustan-Jalin et al., 2002) regarding the relations between gender and curricula content, gender and teachers projection, gender and academic setup. This lack of concrete data makes a scientifically-based proposal of solutions more difficult. Moreover, the interpretation of available data is subjective based on which side of the "gender" fence one is standing (Halpern, 2004). This chapter's conclusions are based on the available data and try to incorporate obtained evidence. We tentatively conclude and recommend initiatives as follows:

1. Educational choices are gender constrained due to traditional anachronistic teaching methods and the technophobia found in many of the teachers or trainers independently of their sex (Section 4.2). Although career choices are personal decisions, a number of different factors influence these decisions (Section 4.1). Adequate methodological suggestions exist which can be used to update and modernise curricula for primary schools in terms of technology teaching. These would include: improvement of teacher technological education; specification and clearer definitions of curricula; improvement of equipment and teaching environment especially in terms of participation in the classroom; information and guidebooks, and enhancement of technological, or even advanced technological if necessary, teachers' training.

2. From the evidence and literature presented above, teachers play an important role in gender equality and need to do more to promote it, both through strategies to build self-confidence in girls and by increasing motivation by reassessing their own expectations and standards (Section 4.2). Girls need appreciation and reinforcement in technical competences as well as an understanding of the connection of technology in everyday life. Making teachers themselves aware of "sub-conscious gender discrimination" as far as science subjects are concerned, is important. This could be achieved with brief training sections or even as part of the teachers' training curricula.

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81 The collection of gender-segregated statistics would require the changing of categories as well as national statistical offices. The newly set up European Gender Observatory will be working towards this goal.

82 "Recent" statistical evidence in many cases can go as far back as 2005. Some statistics are only collected ad hoc every few years, and most of the gender related ones fall under this category.
3. Evidence shows that family has considerable influence in career choice (Section 4.1). It is proven that most families tend to maintain the “status quo” and proscribe to accepted roles, i.e., science and technology for boys and more caring professions for girls. Considering that the young girls have as first role models their mothers and teachers, they are the ones who need to promote science and technology, break stereotypes, and provide support for atypical career choices.

4. The image of the sector is deterring possible new "recruits" (Section 4.3). It is considered as a sector which is incompatible with family life, male-oriented and one with no social content. The sector itself has also perceptions about women which are not correct and are based on prejudice. It is imperative to improve the image of the sector in order to attract more young people (men and women).

5. There is no clear description of what working in the ICT sector means. Curricula and professions have not been updated or expanded for a long time making choice really difficult. Parents and teachers, the main influences for profession choice, have limited understanding of what it is available, and also of where technical competence is needed. The definition of ICT professions should be done with the participation of industry and academia, mapping needs and skills required.

6. The issues of career change and progression in the sector need to be closely monitored in order to ensure that there are no injustices and that the leaking pipeline is mended.

RQs 1, 2, 3, and 4 will be revisited and analysed further in following chapters (5, 6, and 7) in order to look at additional elements for our analysis as well as look at the evidence obtained through the questionnaire prepared for this work.
In this chapter we are going to look at the way women are shown in popular literature, including women’s magazines and the media. Literature and media play an important role in presenting role models and constructing societal images. In order to understand better their role, emphasis will be given to the stereotypes which are propagated through the centuries, not only by defining women’s role in society but also by "stereotyping by omission" and presenting specific role models. The work in this chapter will reinforce what was presented in Chapter 4 and RQ 3, in particular, i.e., why are women under-represented in the cyber-community. We saw that one of the reasons was that girls do not choose careers in the ICT sector. The main argument presented in this chapter will be that the way women are represented in the mass media creates a culture which is not conducive to empowerment and progress, and encourages young girls to model themselves and act on stereotypes. It is interesting to see that within this plethora of representations, women are not given incentives to look at the cyber-community as a tool for progress. Teenagers see instead stereotypes of women as the femme fatale, supermoms, sex kittens, the bitchy type, the nasty corporate climber or even the rich, adulterous and scheming wife. Independently of the roles propagated or the media used, the representation remains within the boundaries of the usually white, desperately thin, impeccably dressed and mainly passive woman or girl.

We are first going to look at stereotypes and their role in forming the public opinion and maintaining the status quo, this latter, excluding women from the cyber-community. We shall also look at role models as presented and overly emphasised in literature and the media, including inverse stereotyping (stereotyping by omission).

Specifically, in Section 5.1 we are going to examine the concept of stereotypes. In Section 5.2 we are going to see how women are used as symbols in society and then we shall examine the notion of "geek". In section 5.3 we shall see images of women and their use underlining the prevailing culture. We shall continue investigating the presence of women in the media (5.4). Section 5.5 deals with women in popular literature and Section 5.6 with Critical Discourse Analysis. In Section 5.7 we look at women and the internet whilst in Section 5.8 we discuss
social Media. We close by summarising the discussion in the chapter and presenting some tentative conclusions that can be derived (Section 5.9).

5.1 STEREOTYPES

A stereotype can be defined as a simplified and/or standardised conception or image with specific meaning, often held in common by people about another group. A stereotype can be a conventional and oversimplified conception, opinion or image, based on the assumption that there are attributes that members of the other group hold in common. They are generalisations which are based on limited knowledge about the other group and, although they may be negative or positive, the overall effect is often negative. The main categories of stereotyping are based on gender, racial group, ethnicity, religion, sexual orientation, and age (Hogg and Vaughnan, 2011; Hamilton, 1981).

Hurst (2007) states that, “one reason for stereotypes is the lack of personal, concrete familiarity that individuals have with persons in other racial or ethnic groups. Lack of familiarity encourages the lumping together of unknown individuals” (Brewer, 2003). Different disciplines give different accounts of how stereotypes develop. For instance, psychologists focus on experience with groups, patterns of communication about the groups and intergroup conflict, whilst sociologists focus on the relations among groups and the position of different groups in a social structure (Brown, 1996). Psychoanalytically-oriented humanists have argued (e.g., Gilman 1985, 1995) that in stereotypes, by definition, the representations are not accurate, but a projection of one to another.

As mentioned above, stereotypes are not accurate representations of groups. They arise as a means of explaining and justifying differences between groups, or system justification. Social status or group position determines stereotype content, not the actual personal characteristics of group members. Groups which enjoy fewer social and economic advantages will be stereotyped in a way which helps explain disparities, such as lower employment rates or, in the case of women, their lack of empowerment. The fact that disadvantaged group members may have greater difficulties to achieve their goals, e.g., finding a job due to in-group favouritism, racism, and related social forces, the disadvantaged group member is unjustifiably characterised as "unmotivated" (he could find a job if he looked hard enough), "unintelligent" (he is not smart enough to have that job), and "lazy" (he would rather take hand-outs than work) (Wetherell, 1996b). Affirmative action is a term that has a lot to do with stereotyping.
This is when the negative effects of discrimination are proactively countered. Under this plan, according to Oliner in his MIT paper *Cognitive Roots of Stereotyping*, the traits that were once undesirable are now the desirable traits to possess (Oliner, 2001). Affirmative action is called "employment policy" in the US (United States Department of Labour, 2002), whilst in Europe there have been discussions for years about positive discrimination for women and quotas. Some countries, such as Norway, have already introduced quotas in order to ensure that women are equally represented at all levels of society.

For as long as there has been a human species, individuals have been different from one another. Persons have gravitated to groups of other persons like themselves. People have created and developed categories of qualities by which to classify the groups; some were based on ancestry. Many of these groupings have become the key factors in determining which groups have political, social, and economic power in the world.

Stereotypes can be self-fulfilling to at least some extent (e.g., group 1 treats group 2 in a more hostile way because they are afraid of the dangerous nature they are supposed to display; people from group 2 accordingly react more aggressively, thus confirming the stereotype). One could also argue that stereotyping might also cover an unconscious fear of the other group.

Stereotypes can be deeply embedded in a culture. The term "stereotype" is more often used once those perceived truths are put into arguments.

Often the terms "stereotype" and "prejudice" are confused. Stereotypes are "standardised" and "simplified" conceptions of groups, based on some prior assumptions, and shared among a group of people. Stereotypes are created based on some idea of abstract familiarity. Prejudices are like stereotypes, but might be held only by one individual rather than a group.

Below we mention four possible prejudicial effects of stereotypes.

- Justification of ill-founded prejudices or ignorance.
- Unwillingness to rethink one's attitudes and behaviour towards a stereotyped group.
- Self-fulfilling prophecy for both stereotyping and stereotyped group.
Preventing some people from stereotyped groups from succeeding in activities or fields (Cheryan et al., 2009; Smith and Mackie, 2007).

A fairly recent study considered the issue of stereotyping by comparing men in stereotypically "female" studies (English) and women in stereotypically "male" ones (Computer Science). The study looks at what we have already seen in Chapter 4 (SCCC model and self-efficacy) but goes further in explaining how social identity feels threatened when moving outside "its comfort zone" (Cheryan and Plaut, 2010). The results of the study indicated that "a sense of similarity or perceived similarity" were important predictors of interest in choosing certain fields. This further confirms the findings of previous research (Cheryan et al., 2009; Margolis and Fisher 2002; Schott and Selwyn, 2000) that stereotypes are "an effective carrier of who does and does not belong in the field (of Computer Science)".

After the general description of stereotypes we are ready to investigate one example in depth, viz. gender stereotyping (Subsection 5.1.1).

### 5.1.1 Gender Stereotyping

Even though sex and gender stereotyping are often classified in women studies as a single idea and initial studies did not clearly distinguish between sex and gender, these concepts should not be dealt with as one notion. One could draw a developing path which gives birth to women studies as they are found to be today:

Asexual symmetries ⇒ women studies ⇒ feminist theories ⇒ psychology ⇒ essentialists (Pascall, 2008d).

Although sex is usually defined as a person's biological traits, gender is defined as how a person identifies themselves to the world, and it relates to those affectations that are attributed to men and those affectations that are attributed to women. Gender is a purely societal construct. It is important to understand that it requires a social structure that tends to enforce a binary sex and gender role based on a person’s biological characteristics. Moi (2001) emphasises the fact that women experience the effects of the asymmetrical values assigned to a social structure.

Gender stereotypes are those ideas, usually imposed by society, of what is expected of men and women in the social structure. Men are expected to be tough, unfeeling, insensitive,
combative, the owner or ruler of the home. Other traits associated with men are assertiveness and being risk-takers. Women are expected to be the nurturers, caregivers, demure, polite, and the family homemaker. As such, looking at gender roles, all women are weak and all men are strong.

Much of this discussion goes parallel to the discussion on gender roles because they primarily impact people in a negative way, such as the view that all women are weak and that all men are strong. This might be affected by our biology but is not true in all cases. Men who have little physical strength and women who are physically strong can be found. The notion of "woman" and "man" is as much social as psychological.

5.2 SYMBOLS OF WOMEN IN SOCIETY

We are living in a society of symbols which are used to present people or reinforce images. Pretty often symbols act as stereotypes. In the case of women, many of these symbols, especially those used in expressions, are degrading. Although such expressions are without real meaning, they still label and categorise women in a derogatory and degrading manner.

Skinny, blond, ditzy, annoying, uneducated, easy, fat, stupid, etc. are typical qualities which might be attributed to a woman. These are the women one frequently sees on television and in magazines or in movies. And here is where symbolism can become a rather potent tool for the empowerment of women. It is true that nowadays there are not many women represented as staying at home, but those who do are the ones represented as happy and fulfilled! Images and symbols, though, are still unrealistic.

The notion of “geek”

What is a geek? The word geek is a slang term, noting individuals as "peculiar or otherwise odd person, especially one who is perceived to be overly obsessed with one or more things including those of intellectuality, electronics, gaming, etc." It is also defined as "a person who is single-minded or accomplished in scientific or technical pursuits but is felt to be socially inept" (The American Heritage Dictionary, 2008). The usual representation of the computer-literate engineer or scientist is that of a geek, untidy in appearance, with big or metal-framed

83 This is another purely male stereotype. A synonym also often used is "nerd".
glasses, unkempt hair and a puny look. The image is of a socially dysfunctional man with no other interest than the cyber-world. It is interesting to note, though, that there are no images of "geek girls", perhaps due to the popular perception that they are not part of the scientific intelligent world. This image of the geek is one which puts off many young people from choosing and eventually sticking to a career in the ICT sector.

In *The Guardian* there was an edifying article on Friday 23 May, 2008, written by Leonie Cooper, who interviewed Sarah Blow, a software programmer for a medical company. I include part of this article, which is quite interesting as it shows how stereotypes lead to assumptions and propagate specific behaviours.

"In 2005, Sarah Blow attended an event called Geek Dinners, a technology gathering with industry speakers, and found that she was one of only 20 women in a crowd of 150 people. She was perturbed by the reactions to her presence. Blow is a software programmer for a medical company, and the other guests 'either assumed I was in marketing or completely incompetent and that I didn't have a clue about any of the stuff they were talking about,' she says. 'I was stood next to one of my male friends, and was cut out of the conversation to the point where it was like: 'You don't know this stuff, this is absolutely nothing to do with you - you just sit there and look pretty.'"

The men's conversation turned to Blow's area of expertise, the programming language C#. When they finished talking, Blow seized the moment. She showed them the binary watch she was wearing: 'I lit it up, and they didn't say a word; absolute silence. Then they went completely white and apologised profusely for what they'd done. I said, 'don't make assumptions about people, because you never know who they are, or what they know - so whether I look like a techie or not shouldn't matter.' At that point they changed their attitude to all the females in the room".

*(The Guardian, Friday May 23, 2008)*

Geek dinners are social/networking events established recently to create some kind of network for people working in this sector. These are exclusively male and the few women

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84 An initiative to promote women in ICT is that of the girl geek dinners and geekettes. Similar events also took place in Portugal with the support of the European Commission - Women in ICT initiative http://londongirlgeekdinners.co.uk.
present accompany the men. A female therefore at a geek dinner cannot be an engineer herself. This type of attitude is usual at all sorts of professional and networking social events, unless of course it specifically caters for women, such as the recently established *Geek Girls Dinners*.

### 5.3 Women in the Press

One can see images of women and especially of women’s bodies everywhere. Women advertise everything from food to cars. New standards of beauty and behaviour are imposed. However, these new standards continue to propagate stereotypes about the role of women in society.

Switching on prime time television in the evening before the news, one could find in nine out of ten channels, and in nine out of ten countries, a series of games where the players win money in one way or another. The presenters of the games, almost all the time, with the exception of Angela Robinson (BBC1 and BBC2 – The Weakest Link) are helped with a series of "valettes"\(^\text{85}\). These valettes are usually rather thin, blonde, surgically enhanced and lack any intelligent conversation. The image projected is the woman playing a secondary role, subordinate and servile. In addition, and this is perhaps more damaging, it may create a special, "female culture". This special female culture, to which young girls are particularly susceptible, is propagated not only on television but also in women’s magazines, the fashion industry and the cinema. Let us briefly look at the all-prevailing "culture of thinness", considered by many the root for many young people's *anorexia nervosa* (Subsection 5.3.1), at the culture of newspapers and magazines (5.3.2), at the avatar of women’s magazines (5.3.3) and at the presence of women in the press, including television (5.3.4).

#### 5.3.1 The Culture of Thinness in TV and Magazines

"We don’t need Afghan-style burqas, to disappear as women. We disappear in reverse—by revamping and revealing our bodies to meet externally imposed visions of female beauty".

**Source:** Robin Gerber, author and motivational speaker (2002).

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\(^\text{85}\) Young ladies who have no other role in a television programme or show than "valet" service, i.e., leading the contestants in, have a little dance and in general act as decorations. The term is used in several European countries, most probably initiated in Italy. In some other countries, less favourable terms are used such "glastra" (flower pot) in Greece.
As I grow older, smaller and rounder, popular film and television actresses are becoming younger, taller and thinner. Some have even been known to faint on the set from lack of food. Women’s magazines are full of articles urging that if they can just lose those last 20 pounds, they will have it all - the perfect marriage, loving children, great sex and a rewarding career.

The importance of a thin body is further reinforced by the movie industry and, of course, television. Every woman identified herself with the efforts of Bridget Jones (Fielding, 2000,1997) to look thinner. Here we have a representation of a normal woman who only reaches her goals when she manages to change as near as possible to the "fashionable image" of the media. The acceptance of the reader/viewer greatly contributes to maintaining the stereotype. Canadian researchers Vaughnan and Fouts (2008) report that over three-quarters of the female characters in TV situation comedies are underweight, and only one in twenty are above average in size. Heavier actresses usually receive negative comments from male characters about their appearances and mainly about the shape of their bodies. 80% of these negative comments are followed by canned audience laughter.

For several years, efforts were made in the media industry in general, and mainly in the magazines, to stop and even reverse this trend. Looking at popular British magazines, such as Woman or Woman's Own, you find many articles about heavier British TV or cinema actresses who "are comfortable with their weight", provided they are fit and healthy. But lifestyle magazines, considered less “working class”, and which are international, such as Vogue or Cosmopolitan, continue perpetuating the stereotypical image of women as objects of beauty. Nowadays, Photoshop and technology are used to maintain the “Barbie” image.

Women's magazines have ten and a half times more advertisements and articles promoting weight loss and dieting than men's. On their covers one can see that they include at least one message on how a woman can change her appearance either by cosmetic surgery, exercise or simply by dieting. This indicates that these issues are of primary importance and sell (Media Awareness, 2008). As advertising rules the market place and thin is "in", today's anorexic models, weighting 23% less than the average woman, help sell magazines (Media Awareness, 2008). The Australian magazine New Woman recently included the picture of a heavier model on the cover, receiving for this a great deal of praise from the readers, but due to complaints from advertisers had to return to using stick thin models.
I investigated the magazines at the stands at the airport of Brussels on two different occasions (May and July 2008), and almost all women's\(^{86}\) and in some cases men's\(^{87}\) magazines had a front page headline referring to how one could achieve a thin, toned body. Magazines and other media are feeding women (and men!) this model of thinness amongst other "light" matters, to keep them away from more serious issues where they could make a difference.

### 5.3.2 Women's Magazines – Newspapers

Magazines date back to the 17th century and have survived a number of different social upheavals, including wars (McClelland, 2008). Their aim was and is, at least in the case of women, to advise, inform in a limited number of areas as we are going to see later, and entertain. Although their circulation has considerably decreased in the last years, perhaps due to the possibility of getting the same information on the Internet, they still go strong. Indicatively, we provide some circulation numbers for the five top women's monthlies (glossies) of the UK (Table 5-1).

<table>
<thead>
<tr>
<th>Title</th>
<th>Publisher</th>
<th>ABC Figure*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glamour</td>
<td>Conde Nast</td>
<td>585,984</td>
</tr>
<tr>
<td>Good Housekeeping</td>
<td>The National Magazine Company</td>
<td>468,579</td>
</tr>
<tr>
<td>Cosmopolitan</td>
<td>The National Magazine Company</td>
<td>461,610</td>
</tr>
<tr>
<td>Yours</td>
<td>EMAP Esprit</td>
<td>421,438</td>
</tr>
<tr>
<td>Marie Claire</td>
<td>European Magazines (IPC/Marie Claire)</td>
<td>371,444</td>
</tr>
</tbody>
</table>

Source: [http://magforum.com](http://magforum.com)

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\(^{86}\) Vogue, Cosmopolitan, Hello, OK, Marie-Claire

\(^{87}\) Men's Health, GQ
A brief analysis of the content and general cultural of magazines was presented above but some general information is still necessary to have a more specific idea of what these magazines are selling us and to what purpose (see 5.3.3).

5.3.3 The Avatar of Women's Magazines

"It is as much a source of amazement as of income to me that readers of the women's magazines have such an insatiable thirst for reading the same information over and over again, despite the fact that any one's year reading they must inevitably give enough information about the technique of being a woman to see one through a lifetime".

(Marghanita Laski – Atlantic Monthly 1950)

The last twenty years changed the face of society drastically and, one would also like to believe, the position of women in it. Women work in more prestigious jobs, have more qualifications and can plan their own lives, at least in most of the developed countries. One would expect that their subjects of interest would shift accordingly to mirror this new era of emancipation. Women's magazines should in principle evolve to cover these new interests. The abstract of an article written in 1950 by the British journalist Marghanita Laski, criticises the repetition found in the magazines of the time. In February 2008, Meg Greenhalgh, doing research for a paper, realised that comparing the summary of content of the 1950s to present ones showed little had changed. Comments from readers proved this point and, in fact, went further by saying that even celebrity interviews were interchangeable in terms of messages passed on. A second fact which emerges from the comments is that in the past, more prestigious women's magazines had some cultural content whilst today even those are limited to gossip, and fashion tips and seem to have changed their target readers. In fact many of these magazines, such as Vogue, Marie-Claire, and Cosmopolitan, more expensive in the past, targeting middle and upper-middle classes, became more "democratically" priced and addressed much wider audiences.

Women's magazines started life in 1673 with "The Women's Mercury" (McClelland, 2008), which then soon folded, and women had to wait for almost a century for replacements. It is interesting to see that the content of magazines was the same as before (household advice, make-overs, dress making, etc.), even in different advertisements.
In the article mentioned previously, McClelland (2008) talks about a recently made film, commissioned by a magazine with a specific interactive version of a quiz ("How Liberated are You"), which was a reproduction of a quiz first published in 1978 in *Cosmopolitan*. Not much change there!

Advertising was and still is a huge and lucrative aspect of the magazine industry, despite various commissions which have been set up in recent years to fight what they found to be "obstructing content". New-age magazines which tried to survive without advertising, found it difficult to survive in this system geared to make money.

Some advertisements in older magazines were identified and examined (found in web.uk online, 2008). Unsurprisingly, there was an advertisement on how to be "Inches Slimmer – the streamline Way" (advertisement for corsets), which is the equivalent of the advertisements for push-up bras or slimming tights one finds today. Some ads like those for Palmolive or Pears soap have remained the same for the last hundred years, at least.

No magazine addressed to women, past or present, would be complete without the Problem Page. They were there, and from "My husband said I was a wet blanket" (1955) (web.uk online, 2008), to "I am attracted to my best friend's husband", and from Claire Rayner to Jordan, things have not changed much (OK, 2008).

*Cosmopolitan, Glamour, Hello* or *OK*, regardless of which one is reading, depict a world where the worst problem a woman can face is her increasing weight and their need for improvement to capture the man and the lifestyle of their dreams. Doubtless some of their content present other perhaps more useful issues but this is still a low percentage of the total. What is presented to the girls and young women of today is a culture which does not see beyond the surface. I should perhaps emphasise here that I do not refer to specialised but general women's magazines. They focus on the awesome selling power of a celebrity face or scandal and continue to promote a culture of submission and servitude.

### 5.3.4 Women and the Press (printed or TV)

A recent report commissioned by the French Government analysed amongst other topics the print-space given to women at the daily press (French Government, 2008). The results are staggering. First of all, most editors in the biggest daily newspapers in France are men. Secondly, the space allocated to reporting issues related to women is minimal, with the
exception of scandal reporting, mainly in the tabloids. Roughly speaking, women are given between 1/5 to 1/3 of the total space of a daily, which does not include the sports and stock exchange pages (Le Monde, 2008; The Times, 2008). It is necessary to take into account the representation of women in some of the tabloid papers, such as, the UK's The Sun where a whole page is allocated to women (page 3). Page 3 girls are famous in the UK for showing their busts!

Briefly what the report states is that, despite progress, women still remain "invisible" or "secondary" in the media. According to the commission which worked on the report (French Government, 2008), women represent only 37% the media and have much less time to speak than men (7 %!). In the written press, only 10% of the articles centre on women against 50% of those on men. Photographs of men are shown three times more than those of women. We are talking here about proper media coverage and serious daily or weekly press (excluding female magazines).

Looking at serious daily newspapers, we see that most of the reporters, like the editors, are men. When articles referring to women are to be found they are usually referring to health issues or politics. It is possible that the ratios given above are even lower, as the newspapers were examined at a time when Hillary Clinton and Segolène Royal were a great deal in the news. It is also interesting to note the fact that women's names are often not repeated in the course of an article in the same way as men's names are (French Government, 2008). The importance of the influence of newspapers should not be underestimated even these days of "net information (or misinformation)". Although the traditional model of newspaper influence no longer works and household penetration declined, they still fit in the model of societal and commercial influence (Meyer, 2004) especially as many newspapers have electronic versions.88

Although there has been a steady increase in the number of women professionals, most mainstream press coverage continues to rely on men as experts in the fields of business, politics and economics. Women in the news are more likely to be featured in stories about accidents, natural disasters and domestic violence rather than in stories about professional abilities or expertise. In the same way, women in politics are similarly side-lined. Canadian

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88 This influence motivates the use of newspaper articles as part of the references of this thesis.
journalist Jenn Goddu, in her 15 year study of newspaper and magazine coverage of three women’s lobby groups, found that journalists tend to focus on the more domestic aspects of the politically active women (Media Awareness Network, 2008).

In 2000, the Association of Women Journalists studied news coverage of women and women’s issues in 70 countries, and reported that only 18% of the stories reported quote women and that the number of stories relevant to women barely covers 10% of news coverage (Media Awareness Network, 2008). Inadequate serious coverage of women issues appears to be a worldwide phenomenon.

Women athletes are treated in the same way (97% of commentators in sport are men!). Margaret Carlisle Duncan (2005), reports that only 9% of airtime was devoted to women’s sports. It was also noted that media images of women in sports are quite different from those of men. Whilst male athletes are shown in action, women are usually photographed in what Professor Pat Griffin (Crank Holste, 2000) calls “hyper-sexualised poses”.

Women were just 14% of the guests on the Sunday public affairs television programmes in the USA, between November 2004 and July 2005 (Media Report, 2008). A second interesting factor is that women were less likely to make repeat appearances in these programmes, and in general appeared in the later part of the programmes. This percentage represents a three-point increase since 2001 (White House, 2005).

In the Media Report to Women (2008) it is stated that the percentage of women in daily newsrooms increased slightly to 37.7% of newsroom professionals in 2001, and increased to just 40% in 2005, despite the fact that women in the USA have been the majority of college journalism majors since 1977 (Association for Editors in Journalism and Mass Communications, 2008).

5.4 WOMEN IN THE MEDIA

The representation of women in women’s magazines and in the press was discussed at some length in the previous section. The representation of women on television and British TV (5.4.1), and films (5.4.2), which are the popular media of today, is going to be investigated next. One should note that in many cases, especially in the cinema and TV, the “halo effect” (The Economist, 2009; Nisbett and Wilson, 1977) is used. This means, for example, that attractive or rich people are assumed to be happier, stronger or nicer people.
Despite progress made, women continue to be significantly under-represented both on television and in the movies. For example, in the USA women were awarded only 38% of roles cast in 2003, which is consistent to the castings of previous years. There was an increase in supporting roles but there was a decrease in the casting of older women (11% for women over 40 compared to 25% of men) (Screen Actors Guild, 2004).

5.4.1 Women in TV Programmes and Powerful Women in British TV

I shall not look at the valettes to be found in prime time TV in most European channels. I shall specifically look at TV programmes – sitcoms (situation comedies), serials and series as well as news-reporting and morning television (Classic TV Information, 2008).

It is interesting to see the top 10 TV classics in order to see what are the messages passed to young girls concerning the role of women in society (relevant to answering RQ 3).

Absolute top, number 1, is the all-time classic *I Love Lucy* (1951-1961). No need to stress that Lucy is the caricature of the typical American housewife of the time who makes one blunder after the other, helped by her friend, who is of the same calibre. They are both saved by their husbands!

Number 5 in this classification is *Cheers* (1983-1993), which shows life in a bar. From the 11 main characters three are women. They have all expected female attributes.

Number 7 is *The Mary Tyler Moore Show* (1970-77), depicting the life of a TV worker, and number 8 is *Bewitched* (1964-1972), which is again the typical housewife stereotype, on top of being a witch.

From the rest of the shows in the top 100 list, we find *Murphy Brown* (1988-1998), who is a rather controversial Figure as she is a difficult person. Needless to say that she has all "necessary" attributes such as having been a cheer leader and Miss America. She is empowered and successful in her job as a magazine reporter. *Roseanne* (1988-1997) is another powerful woman who started from nothing and set up her own business.

It is interesting to note that the only series that had a woman who happened to be using technology, *The Bionic Woman*, is not within the 100 best, whilst the parallel story, *The Bionic Man*, is.
Situation comedies (sitcoms)

As sitcoms are mainly based on caricaturing both men and women, it is obvious that they emphasise all the bad or strange parts of one's personality, especially for women. In the case of men, the underlying trend is to present them as the long suffering heroes. There are many examples to be given here but only a few would be mentioned. These are all BBC1 (UK) shows, were shown a few years apart and were chosen because of their popularity and success, which has been indicated by many repeats over the years.

**Keeping up Appearances**: the heroine lives in a world of her own and tries to show that she is upper-middle class, instead of working class. This deception leads to a series of funny incidents, whilst her long suffering husband tries to "put out fires". The series was first shown in the late nineties and continued until almost 2005.

**The Mistress**: the long suffering mistress makes her lover suffer with her demands. She is also shown to be weak, servile and all-accepting (around 1989).

**The Good Life**: an upper class lady makes her much gentler husband suffer with her whims (around 1975).

In all the comedies previously mentioned, the women are shown to be demanding, deceiving, conceited or plain weak. In the sitcoms where men are caricatured, women were shown to be ugly, fat, all-controlling, stupid or "bitches". Nora in the *Last of the Summer Wine* (1990 to as late as 2006) is ugly, her friend is fat and they are both trying to control everybody around them. The wife in *Faulty Towers* is all-controlling, indifferent and cold (1970s). Michele, from *Some Mothers Do 'Ave 'Em* (from the early 1970s), is stupid and admires her good-for-nothing and clumsy husband.

Women are represented in popular television in roles in a way which is degrading and lacking respect. In the sitcom *Absolutely Fabulous* (late 1990s – early 2000s), exceptionally, there is a young lady (in a supporting role) who is studious and likes sciences but is shown to be a boring character, as well as a prude. The two main characters are drunkards, disorganised and generally unstable.

Similar sitcoms and representations can be found in other countries, but the British example is used here as many of these sitcoms are shown in other countries.
Serials

The examples of the two long running serials in the UK – Coronation Street (running since the mid-fifties), and Eastenders (running since mid-eighties), are used as case studies for this work. Both have as their focal point a pub and, of course, the important women are barmaids. The serials during the years tried to move with times but their main women characters basically remained stationary. They might move out of the pub to work in a factory, but the ones that actually managed to get any kind of education were either killed off or moved away. If or when women obtain qualifications they are either in arts or practical professions, such as nursing or secretarial, and rarely at university level.

The contrast between UK serials, which usually portray working class environments or rural communities, and the ones in other countries, especially the USA, which are more glamorous, is interesting. Turkish serials are new import in the serial market, at least at the Balkan countries and are mainly, with few exceptions, of a glamorous nature.

Looking at Greek serials, such as Lampsi or Vera sto Dexi, the female characters are educated in general (law, economics, business), but they follow the same model of "weak" or "bitchy" women, despite the fact that their social situation is rather different to that of the British ones. They are usually wives, daughters or girlfriends of pretty rich people.

Series

The two best-known series, almost classics now, where women were energetic, are Dallas and Dynasty. As both are well-known I will give some examples of the powerful women – Alexis in Dynasty, who is seriously bad, and Sue Ellen in Dallas, who, on top of being a drunk, is scheming, unreliable and shot JR! The "good" ladies like Pamela or Chrystal, where some character substance can be detected, are represented as the long suffering victims taken advantage of by men and women equally.

In the late nineties, BBC1 had a series called Howard's Way which showed the designing of sailing boats in a shipyard. According to Professor Ross (2008), the number of students who enrolled in Naval Engineering at the University of Solvent in Southampton UK almost doubled after the second year of the series. The same is said to be true for students enrolling in forensic science after the screening of CBS's NCIS. In this, women are young, trendy and successful but the brilliant MIT computer graduate is a man!
No, it is not Margaret Thatcher! Looking at the VideoVista (Cheshire, 2008) electronic magazine, the 10 Top Female Icons in British TV in 2002 were: pub ladies, e.g., Pat St Clement (Eastenders) or Julie Goodyear (Coronation Street), caricatures such as Liz Smith in (The Royle Family) and Mollie Sugden (Are you Being Served), or good-looking women, such as Linda Thorson (The Avengers). Their suitability to be role models for the young women of the 21st century is questionable but they are the epitome of strength and power as presented in popular British TV of today.

5.4.2 Women in Films

One would have thought that stereotyping in films would have disappeared in line with the social evolution during the last fifty years. This is not so! I shall make only a brief reference to research on the issue of how women are represented in films at the end of the 20th and beginning of the 21st centuries (Pascall, 2002).

Three films were thoroughly examined: Four Weddings and a Funeral, Bridget Jones' Diary, and Brass Band. The two first were box office hits and the latter was a low budget, intellectual film looking at social and unemployment problems in the North of England. The three films were different and represented women in different situations and from different social classes. Properly analysing the films showed that the typical stereotypical representations were there. In Four Weddings and a Funeral, the heroine, a liberated professional woman, ends up following her heart and lives happily ever after with the "bachelor" of her dreams. In Bridget Jones' Diary, based on the book with the same title (Fielding, 1997) (Chick Lit), the heroine is trying to fight her insecurities and better her life. Her main issues are her weight and finding a man, which she does at the end. Brass Band is a different film altogether. Women are secondary characters. They are living in the shadow of their husbands or partners, and although they are the ones that make things happen, they are also the ones who are expected to serve (Pascall, 2002).

All three films, despite their different story lines, characters and backgrounds show the same image of "weak" heroines, with each one in their own way acting in what can be characterised as stereotypical for their gender. The film industry did not evolve in the representation of women on the big screen but it continues with the same model, albeit mutated, of the

89 Women on British Television: Top 10 Female Icons by Ellen Cheshire, found in http://www.videovista.net/articles/femaleicons.html accessed 15/05/2008
"weaker" sex. This is not conducive to helping girls going outside their comfort zone as it has been socially constructed.

5.5 WOMEN IN POPULAR LITERATURE

For the purpose of the present analysis, the definition to be used for popular literature is the one found in Canadian Encyclopaedia Online (2008), considered to be the most suitable. "Popular literature in English is writing which has shown wide and continued acceptance, measured by sales, frequent imitation, adaptation to other cultural forms and general commercial success. The word 'popular' is meant as a synonym for 'successful', not as an antonym for 'serious'...". What is going to be investigated here, therefore, is how women are presented in popular literature, i.e., which has commercial success, and if this representation is stereotypical.

Popular literature of today has a number of different genres. According to the Canadian Encyclopaedia Online (2008), we see five different genres: reference books, cookbooks, romantic fiction, mysteries and fantastic fiction. In a consumer research study on book purchasing which was commissioned by the book industry in 2001 (Book Industry Study Group, 2010) it was found that 50% of all books sold that year were popular fiction, 9% cooking crafts, 10% religious non-fiction and the remaining reference or educational books, including dictionaries. Although this data is rather dated, the figures have not changed much. More recent but less investigated data shows that in the United States, in 2006, 26.4% of books sold were romance fiction, a genre belonging to popular literature. Data from 2011 (American Library Association), indicates that women surpassed men in reading, as they represent 62% of the book buyers and 67% of the paperback market. Women lead men in overall purchases, contributing 64% of the sales. Even among detective and thriller genres, women top 60% of the sales whilst in fantasy fiction women have equalled men (Milone, 2011). In addition, research by the University of Dayton (Jackson, 2010) indicates that 53% of all book readers read fiction and 55% of all fiction buyers are women. 19% of fiction bought according to the same research is mystery or suspense (Source: Publishers Weekly). 21% of the books in the market are romances (Jackson, 2010). The way women are represented in romantic fiction is therefore crucial as it reaches a wide female audience which subconsciously might use the heroines as role models.

Looking at the World Best Seller list published weekly in the New York Times (2008) we see in the fiction section that in the Hardcover Fiction at the top ten there are five detective stories,
In the paperback list, there is one crime romance novel (4th), two romances (1st and 9th places) and two detective stories. In the 2011 Best Sellers List, Hawes Publications, (2011) shows that out of the 30 fiction best sellers for this year 13 are crime or thriller and 5 are chick lit. The historical, chick lit and romance, are mixing with crime fiction in some of these books. This statistical information shows that some genres such as romances and detective novels are distinctly popular and the way women are represented could influence career and life choices.

Before closing this section I shall mention some statistics relevant to e-books as I believe that these books are used by people who are not afraid of technology and are ready to try something new. This is important in our analysis as it indicates that the reading of fiction including romances covers a broad part of the population independently of their social class. According to a study carried out by the Book Industry Study Group (2010), 55% of e-books sold are fiction. The majority of the readers are still women (more than 60%). It is important to know that women in the 30-44 years old age bracket are the more avid readers, with a close second the 18-29 years old age bracket. This indicates on the one hand that women are not afraid of technology when presented as an application, and on the other, that the way women are represented in popular literature has the potential to influence younger and not so young female readers.

We are going to focus on romance fiction (5.5.1), chick lit (5.5.2), and Crimes, Thrillers and Mystery (5.5.3) for our analysis of the representation of women in literature. I am going to look mainly at literature written in English as they cover, either in the original language or translated, more than 50% of the book market (Povoledo, 2004).

5.5.1 Romance Fiction

Romance fiction in many countries is identified by the publishing houses Mills & Boon, Harlequin (a Mills & Boon subsidiary), Silhouette, etc. (Povoledo, 2004). The brand name is different in some countries, almost all the companies are M&B subsidiaries. Mills & Boon is a famous British publisher of romance novels founded in 1908. It was taken over in 1971 by Harlequin Enterprises with whom the company had had a long informal partnership. M&B has a number of imprints which between them account for about three-quarters of the romance paperbacks published in Britain (Mills and Boon official site, 2011).
The books produced were and are still criticised for plot repetition, inevitable happy endings and simple writing style. It has also been argued that the genre promotes misogyny and the sexual submission of women to men. Their books are highly branded and are frequently found in separate sections in bookshops or libraries. The underlying theme is time and again that of the rich, regularly ennobled and unattainable male (habitually Mediterranean and, in particular, of Greek origin), and a number of commonplace adventures which inevitably lead to the heroine finding happiness by finally making the hero realise the futility of his ways. What is of interest in this kind of literature, which as previously seen constitutes the majority of reading material for women, is that the heroines are always submissive, with a low educational level or, if educated, their qualifications are in a "womanly" profession such as nurses (medical genre), and cooks (modern) (Regis, 2007; McAleer, 1999).

One supposes that such books are aimed at working class, unemployed or uneducated women. This is not always the case. But even if one accepts this assumption, looking at the publishing lists and bookshops in five countries in Europe (UK, Italy, Greece, France and Belgium)\(^90\), I found that a great number of books which do not appear to be "penny romances"\(^91\), and are supposed to be light literature, still propagate the same theme but present it in a different way.

The analysis of romances and the literary genres which follow, aim to provide a better insight into the way stereotypes are propagated and influence career choices giving another angle to the answer of **RQ 3** (Why are women under-represented in the cyber-community?).

### 5.5.2 Chick Lit

Chick lit is a term used to denote a genre of women's fiction written for and marketed to young women, especially single, working women in their twenties and thirties. The setting is usually urban (NYC, London), it sometimes contains romantic elements, it is humorous, and often features women's friendships (Milone, 2011)\(^92\). The genre sells well, with chick lit titles

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90 Author's research in different bookshops and newsagents.

91 The term indicates cheap romantic books and comes from the books or leaflets sold for one pence (one penny) in Britain at the end of the eighteenth and beginning of nineteenth centuries. They were bought by women who were in service (housemaids, maids, etc.).

92 A new trend in chick lit is what is called "mummy lit" revolving around young mothers with babies instead of the single women which was the usual pattern.
topping bestseller lists and the creation of imprints devoted entirely to it. It generally deals with the issues of modern women humorously and light-heartedly and appears to present female empowerment. According to Diane Goodman, in her paper *What is chick-lit* (2005), depending on the place of the hyphen and the intonation of the words, the term might mean a number of different things: with the hyphen and the accent on the first word we have a reductive term, more reductive than the “broad” or “babe” slang terms found in the evolving spectrum of demeaning endearments for young women. Without the hyphen (as used here), we have one word which aims to have a more powerful meaning and might in some cases be classified as post-feminist fiction (Goodman, 2005). Goodman goes even further to place the notion of Chick Lit in the genre of New Women’s fiction. The term “New Women”, stemming from the revolution of the 1960s, aims to equal "liberated". It is rather unfortunate that this term was used so much in feminist and post-feminist literature and was absorbed into so many current feminist languages, that it appears archaic nowadays (Barker, 2008).

Chick Lit has been described, more mundanely perhaps, as a "safe substitute" for spending time on real romance, or other cultural demands on women, such as homemaking, finding Mr. Right, having thin waists and sexual fidelity (Ferris and Young, 2005; Vnuk, 2005).

Before closing this brief reference to Chick Lit, I would like to mention that, despite the claims made that this kind of literature, which includes romantic elements, is not generally considered a direct subcategory of the romance novel genre, because the heroine's relationship with her family or friends may be equally as important as her relationship with the hero, for me it is another version of the romance novel. The genre began targeted at white, single, young females, but variations have developed to appeal to specific audiences, such as "Chica Lit", aimed at English-dominant, middle-class American Latinas, the top-seller being novelist and film writer and producer Alisa Valdes-Rodriguez; Christian Chick Lit, Matron Lit (aka Hen Lit) for middle-aged women, Young Adult Chick Lit (also Teen Lit) and Indian chick lit.

I would like to give as an example of Chick Lit the books of Cathy Kelly (2011, 2010, 2008, and 2007)93. The heroines are usually journalists, or cooks (it appears to be a favourite!). They are badly treated by their husbands/fiancés/lovers and with the help and support of female friends manage to start a new successful career, bring up well balanced, mature children and

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93 See bibliography Cornwell, Grafton, Reichts.
finally find the perfect man. A subgenre of these "empowerment" books includes the ones about the suburban housewife who slowly betters herself. Needless to say, the expected prince in shining armour appears somewhere near the end of the book, and, lo and behold, it is a happy ending.

I would put books like *Bridget Jones Diary* (the first and second book, Fielding, 2000, 1997) in the same category. These are also books where women accept their weaknesses and work towards bettering themselves and/or accepting them. The desired effect is again finding perfect happiness through the ideal couple.

I would like to mention that there is nothing wrong in having a perfect relationship, or looking for one, but my objection to this type of book is that somehow the core of the book appears to be this perfect coupling and the rest is just supporting material.

5.5.3 Crime, Thrillers and Mystery

In the last twenty years, perhaps due to the success of Agatha Christie's Miss Marple books, a new genre of *Crime, Thrillers and Mystery (CTM)* emerged: the female detective or private investigator, forensic doctor or lawyer, as well as other profession/hobby related ones. All these books are written by women. The first group includes the alphabetical series of books written by Sue Grafton, the Scarpetta books by Patricia Cornwell, the Tempe Brennan novels by Kathy Reichs, etc. These are well written, and remain mainly within the CTM genre, presenting at the same time a more personal story and a character insight. Characters grow with each book and the reader learns and follows their personal story.

The second CTM genre which emerged in the last few years, mainly in the USA, is one about professions\textsuperscript{94}. These books are rather "democratic" as their heroines are usually women who make a choice to live in different, usually rather small, places and either choose a new profession, or continue, but under different conditions. I suppose that they are popular, at least in the States, as new ones are written and published almost every year, to continue with the personal story. In these books there is an accountant who turns to knitting, a middle-aged...

\textsuperscript{94} A list of the books examined and quoted is given in the bibliography under Carl (2005, 2010), Fluke (2007, 2009), Mott Davidson (2000, 2011) and Swanson (2000, 2011).
woman\textsuperscript{95} who takes over a crafts shop, a school psychologist, an entrepreneurial chef, a journalist, a coffee shop owner and many others. The books are comforting as they show that women can succeed if they want to, even when the odds are against them. What is interesting in these series of books is that things start with problems with a man, maybe divorce or abandonment, and somewhere along the way Prince Charming arrives to support the weak woman. One could accept that they are books which encourage women and present role models for success or even ideas on how to map one's life, but what is presented is limited.

In all these books, I only managed to find two characters, one main and one supporting who had something to do with ICT. The first one, in the Debutante dropout mysteries (McBride)\textsuperscript{96}, is a graphic designer, and the second is in the Dr Scarpetta novels (Cornwell). The way they are represented in literature is as role models to be avoided rather than followed. This constantly reinforces the answer given to RQ 3 (Why are women under-represented in the cyber-community?) via the discussion in this part of the chapter.

The Debutante series presents Andrea, who is a graphic designer against the wishes of her family. She is a rebel, having shunned her own coming out ball, and just manages to survive doing her job. It should be noted though that her graphic design job was in many cases a hindrance, rather than a help, in her endeavours as an amateur detective. It is also interesting that her job is more of a hobby than a real job, as she usually works \textit{pro bono} (the equivalent of her "socialite" mother's charity work). Even her name can be used both for males and females in some countries.

In the Dr Scarpetta series, the main character has a niece, Lucy, who is an ICT genius and has made a large amount of money through her abilities. She is extremely good looking, intelligent, drives a Ferrari but she is also difficult to work with, was sacked from her job in FBI, is gay with many relationship problems, self-mutilating at one time and, above all, is not happy. She might be a computer genius but also a misfit.

The Millennium Trilogy books (Larsson, 2008, 2009, 2010) are an exception in the representation of a woman's skills in Computing and Mathematics. The heroine is extremely

\textsuperscript{95} Monica Ferries (2009, 2010) Needlecraft Mysteries, see bibliography.

\textsuperscript{96} Susan McBride (2008, 2009) The Debutante Dropout Mysteries, see bibliography.
intelligent and a pure genius. It still goes to a similar pattern, though, as she is dysfunctional, not able to have any relations and in addition she is sly and cheats the system.

The reason for this rather extensive analysis of women represented in the CTM genre is to show that there are no role models to promote women in the ICT sector. The two women found to be working in the sector do not inspire. Lucy, who is the dominant representation between the two, due to her difficulties and the unhappy life she is living, and Andrea because her profession is, at least in the books I read, unrelated to the important facts of the story. As for the Larsson heroine, she is the less inspirational.

One other consideration is that these books (at least some) are also read by men and thus I believe that we have an additional bias, the propagation of the role of women in society as not technological and technophobic.

5.6 **Critical Discourse Analysis**

In the previous sections women’s representation in the media including press and literature as well as stereotyping was discussed. These representations go in parallel with the use of language as presented in Critical Discourse Analysis (CDA). Most specifically, CDA aims to "demystify ideologies and power through the systematic investigation of semiotic data be they written, spoken or visual" (Wodak, 2004). CDA sees language as used in writing and speech as a form of "social practice" indicating the dialectical relationship of a particular event and the situation(s), institution(s) and social structure(s) framing it. Situation comedies could be considered a good illustration of CDA.

It should be emphasised that CDA is a multidisciplinary critical analysis of social problems and an effort to explain them in terms of properties of social interaction and more in particular social structure (Van Dijk, 1993). Van Dijk emphasizes the notion of power and social power of institutions. He further distinguishes types of power in terms of the resources used to exercise it. Van Dijk specifically mentions as power resources the discourse of the media and the discourse of science. He mentions that critical analysts reject the notion of "value-free" science and argue that it is "inherently part of and influenced by social structure, and produced in social interaction. … Instead of denying or ignoring such a relation between scholarship and society, they plead that such relations should be studied and accounted for in
their own right …" (Van Dijk, 1993). The notion of engendering technology fits to this concept of CDA.

Blommaert and Bulcaen (2000) also refer to the relations of power and inequality in language. They identify nine topics and domains of analysis amongst which the following could be considered relevant to the scope of this thesis: Gender, Institutional Discourse, Education, Economic Discourse, Advertisement and promotional culture, and Media language. In all these we can identify issues of power asymmetries, exploitation, manipulation and structural inequalities, as seen in Chapter two in the brief discussion on feminist theories.

Blommaert and Bulcaen (2000) also refer to Fairclough’s (1992a) contentions about the categorisation of developments in political discourse. The categories identified are: democratisation, commodification and technologisation. This development relates to the infiltration and movement of discourse genres from one domain to another. Although this allows for more effective communication it "obscures 'objective' power relationships by suggesting the equality of conversational rapport in asymmetrical institutional interactions".

5.7 WOMEN AND THE INTERNET

Women and men have an approximately equal rate of computer use, since the year 2000, especially in the younger age groups (European Commission, 2008b). Differences in use and type of use are noted much later in life and in the use of the Internet. Some interesting facts from a longitudinal study carried out by Pew Internet and American Life97 (2000 – 2005) shows that women caught up with men in using the internet, with younger and black women using it more than their peers. Older women still lag behind. Women use the internet more for information, personal problems, advice on health and medical issues and communication. For different transactions the use is almost the same. A summary of the findings of the study is presented in Figure 5-1.

### How Women and Men Use the Internet: Summary of Findings at a Glance

<table>
<thead>
<tr>
<th><strong>Shifting internet demographics:</strong></th>
<th>Women have caught up to men in being online. Younger women and black women outpace their male peers. Older women lag dramatically.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patterns of internet use:</strong></td>
<td>Men are slightly more intense internet users than women.</td>
</tr>
<tr>
<td><strong>Online activities:</strong></td>
<td>Men are more likely than women to use the internet for many online activities, but women are catching up.</td>
</tr>
<tr>
<td><strong>Using the internet to communicate:</strong></td>
<td>More than men, women are enthusiastic online communicators and they use email more in a more robust way.</td>
</tr>
<tr>
<td><strong>Using the internet for transactions:</strong></td>
<td>More men than women perform online transactions, although both share a rapidly growing enthusiasm for the internet's function as a tool of commerce.</td>
</tr>
<tr>
<td><strong>Using the internet to get information:</strong></td>
<td>Men pursue and consume information online more aggressively than women.</td>
</tr>
<tr>
<td><strong>Using the internet for entertainment:</strong></td>
<td>Men use the internet more than women as a destination for recreation.</td>
</tr>
<tr>
<td><strong>Issues about gender and the internet:</strong></td>
<td>Men are more interested in technology than women, and they are also more tech savvy. Men value the internet for the breadth of experience it offers; women value it for enriching their relationships, but are more concerned about its risks.</td>
</tr>
</tbody>
</table>


In order to assess the influence of what is found on the Internet, computer games will be investigated in 5.6.1 in general and in 5.6.2 in the Web.

#### 5.7.1 Computer Games

Computer games are a major issue for women in the cyber-community. According to one study (Blum et al., 2005), 85% of games are designed for men – even those thought of and designed by women! In the same study and others referenced, it is shown that women prefer different types of games to those that men prefer. Computer games, like all products, are market driven, which means that it will be much harder to bridge the gap. I believe though that it is not a question of the game itself that plays a major role, but the fact that games are tools which can be used to create social networks among younger people and even help them

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98 Fallows Deborah 2005 Report, see bibliography.
acquire skills and knowledge useful for their schooling. It is interesting to note here that recent studies (Centrax, 2010; Science Daily, 2008) published at the Second-Life e-conference, show that games help to increase children's knowledge in geography and biology.

Computer games, like conventional ones, are therefore important tools to give children skills in sociability, co-operation and other areas. They are also a means of providing knowledge and information, but at the same time may be propagating stereotypical role models.

In Subsection 5.6.2 we investigate computer games to be found on the web.

5.7.2 Looking at Computer Games on the Web

There are numbers of sites where one can find games, both single and multiplayer. It is interesting to see some of the top classification of most played games in the different sites accessed in order to be able to assess whether the kind of games young people choose to play promote stereotypes (ignoring the ideology that some of these games might propagate, e.g., violence), and are any of these games designed specifically to address girls.

- Miniclip.com: Low level adventure/arcade games
- Club Penguin: Low level adventure/arcade games
- Dino run: Dexterity game, dinosaurs to escape natural catastrophes
- Presidential Pound: Dexterity game (Hitting President Bush)
- Mallet Mania: Low level adventure/arcade games
- Armada Tanks: Dexterity game (in combat context)

Most of the games target young boys or are neutral. Even in neutral games though, such as Phantom Mansion99, the hero, Hector is a male. In arcade games, as well, the actors appear to be male.

Looking at games which were big successes for years, such as the series of the Sierra games, in most cases the hero is male. In 1999, at the IST event in Helsinki\textsuperscript{100} of the ESPRIT awards, the second prize went to a PC game. One of the reasons that the game was awarded was that it aimed to attract girls to playing computer games. It is indicative that the game was around a girl searching to find a diamond. Looking at what diamonds mean to girls (diamond ring – engagement – marriage – family, i.e., stereotyping), the game was sexist.

5.8 Social Media

The term social media refers to the use of ICT and the web, in particular, for interactive communication. Kaplan and Haenlein (2010) define social media as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user-generated content". They go further and categorise social media in six different types:

1. Collaborative projects (e.g., Wikipedia)
2. Blogs and micro blogs (e.g., Twitter)
3. Content communities (e.g., YouTube)
4. Social networking sites (e.g., Facebook)
5. Virtual game worlds (e.g., World of Warcraft)
6. Virtual social worlds (e.g., Second Life)

Different technologies are used such as blogs, wall postings, emails, instant messaging, and many of the social media can be integrated via social network aggregation.

Statistical evidence shows that more women than men use Facebook and Twitter to update friends and family – 68% of women compared to 54% of men (McMillan, 2011; see Figure 5.2). Although men are early users of technologies, women are the forerunners of social media

\textsuperscript{100} Annual event organised by the European Commission with participants from the research world. The ESPRIT awards were annual prizes for the best invention relating to Information and Communication Technologies. The awards were stopped in the 7th Framework Programme.
This means that new products or innovation in social media are likely to target women, and, as such, the gender gap will widen.

According to many theorists, the increase in the use of social media opens a number of opportunities for women to take leadership and use the new technologies to better their situation (Carter, 2010).

5.9 **CHAPTER CONCLUSIONS**

The aim of this chapter was to answer **RQ 3** (Why are women under-represented in the cyber-community?) Taking into account the representation of women in the media (TV, press, films), and in popular literature, our findings can be summarised as follows:

1. According to statistics, the average girl or boy spends approximately 11 hours per day being exposed to and interacting with various media such as TV, videotapes, DVDs, internet, etc. (Nielsen Online, 2009), indicating an increase of 63% since 2004. This is more time spent through a lifetime than the time spent with parents or teachers. It is clear that the influence of the media is rather important, both for role model representation and to provide information. According to the Media Report to Women (2008), many media images and messages seen and heard enter the brain quite quickly, and can make lasting impressions at a subconscious rather than a conscious level. This
is called passive versus active processing of information. The influence therefore of the media such as TV, Internet and DVDs is very important as the subconscious level is "formatted" with representations which are not related to ICT studies and career.

2. The barrage of messages about thinness, dieting and beauty in women's magazines, television and films, tells "ordinary" women that they are always in need of adjustment - and that the female body is an object to be perfected. Women learn to compare themselves to other women and compete with them for male attention. Kilbourne (2010, 1999) argues that the overwhelming presence of media images of painfully thin women means that real women’s bodies have become invisible in the mass media. The real tragedy, Kilbourne concludes, is that many women internalise these stereotypes and judge themselves by the standards of the beauty industry. Women learn to compare themselves to other women, and to compete with them for male attention. This focus on beauty and desirability “effectively destroys any awareness and action that might help to change that climate”. Relating to the finding under 1 we are faced again with a passive processing of information which creates a different culture for young girls focusing their attention on "less serious" issues such as external appearance. This specific culture does not include creating awareness about technology and its importance.

3. Both men and women respond to stereotypes embedded in culture and society for thousands of years and presently enhanced by the tools provided by the development of information technologies. Obviously the most prominent stereotype that of women being housewives, and men the "bread winners", remains and is propagated and further reinforced by the model of a woman Barbie doll, continuously presented by the media. Since women were born they have been brainwashed from a tender age by fairy tales about their helplessness. To use the fairy-tale of Cinderella as an example, we see that if a girl is a housewife, this makes her beautiful and desirable. Women who do not do housework, such as the step-sisters, are ugly, rude and ill-mannered. Cinderella was sweet and beautiful but also a stupid dummy with no mind of her own. The stepmother ruled a household without being ruled by a man but this was not
shown in the story. Yet, no modern day fairy tale shows how a Cinderella becomes Cyberella.  

4. The media and literature do not provide role models dealing with engineering or sciences, but are limited in such a way so as to promote superficial images. It is important therefore to provide young people with role models that are valid and present young girls with new role models. These should be of women researchers, engineers, scientists and technology specialists who are happy, glamorous and, above all, normal, having the same inspirations as all other women.

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101 The concept of Cyberella was presented in Chapter 2
This chapter has an "informative character" and presents some European and international initiatives relating to equal opportunities. The chapter starts by presenting general initiatives (legislative and other) in order to show the existing framework. In that framework I shall subsequently focus on those which are relevant to women in the ICT sector. In this chapter we aim at answering RQ 4 (Has there been any improvement in recent years?).

The chapter starts by presenting the legislative framework and the activities initiated and supported by the European Commission (Section 6.1). Section 6.2 looks at different European initiatives, and Section 6.3 looks at international initiatives. The chapter closes in Section 6.4 presenting conclusions drawn from the discussion about these initiatives. The list of initiatives, despite covering both the public and private domains, is by no means exhaustive. The choices are guided by expected improvements in relation to RQ 4. The expectations are to be credited to the author and therefore I used the notion of "informative character" in the first sentence.

6.1 THE EUROPEAN COMMISSION INITIATIVES

This Section presents the work of the Directorates Generals for Justice (JUST) (Subsection 6.1.1), for Research and Development (RTD) (6.1.2), for Information Society and Media (INFSO) (6.1.3) as well as the work of EUROSTAT (6.1.4), and that of the European Institute for Gender Equality (6.1.5).

Equality between men and women is a fundamental right of the European Union. It is a necessary condition for the objectives of growth and social cohesion. The original Treaty of the European Common Market, Treaty of Rome 1957, included an article referring to equal pay between men and women for equal work (Article 119). Subsequent Treaties integrated increasingly this aspect of equal opportunities. Simultaneously, a number of initiatives emerged aiming to implement the Article. The Directorate General which, until recently,

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102 The Equal Opportunities file was transferred from Directorate General Employment to Directorate General Justice in the second part of 2010.

mainly dealt with Equal Opportunities in terms of policy was DG Employment, Social Affairs and Equal Opportunities (DG EMPL). The work of this DG was transferred to Directorate General for Justice (DG JUST). Once the transfer was complete the work of the two Directorates General will be dealt with together under the heading DG JUST (6.1.1).

The Directorates General for Research (DG RTD) and for Information Society and Media (DG INFSO) deal specifically with the issues of women in ICT and research and science, and technology respectively.

Other Directorates General deal with equal opportunities in the framework of their policies, e.g., Regional Policy (DG REGIO), Health and Consumer Protection (DG SANCO), Education and Culture (DG EAC), Development (DG DEV) and EuropeAid (DG AIDCO). It should be noted here that Equal Opportunities is a horizontally cross-cutting policy and the responsibility for its implementation lies with all the Directorates General of the European Commission, according to the principles of mainstreaming. Mainstreaming will be analysed in detail later in Subsection 6.1.1. It would be beyond the scope of this work to examine all the initiatives in detail.

The Directorate General for Human Resources deals with issues of equal opportunities within the European Commission. It should be noted that all Directorates General of the Commission have to introduce the gender element in the formulation of their policies.

The Commission’s framework legal base for the promotion of equal opportunities can be summarised as follows:

The Treaty of the European Union (Treaty of Maastricht).

- **Article 2**: promote equality between men and women

- **Article 3**: eliminate equalities and promote equality between men and women

- **Article 13**: appropriate actions to combat discrimination based on sex, etc.

- **Article 141**: principle of equal pay for male and female workers for equal work of equal value and measures for specific advantages in order to make it easier for the under-represented sex
The Treaty of Amsterdam consolidated this provision, especially in Article 6, where it extended non-discrimination for gender, sexual orientation, religion and race. The Treaty of Lisbon further incorporated the issue of equal opportunities and non-discrimination.\(^{104}\)

The EU Charter of Fundamental Rights (European Commission, 2000) in Article 23 also emphasises equality in all areas, including pay and adoption of special measures for the under-represented sex.

The articles in the Treaties and consolidated Treaties provide the legislative framework which is the basis of the policies instigated by the European Commission.

### 6.1.1 The Directorate General for Justice (DG JUST)

In 1981, an Equal Opportunities Unit was established in the DG EMPL (then DG V). The first Equal Opportunities Action Programme was launched covering the period 1982 – 1985 (European Commission, 1981).\(^{105}\)

As seen in the legislative framework, equality between women and men is a common value of the EU. Although inequalities exist, the EU has made significant progress over recent decades in initiating and implementing policies and working towards achieving equality. This is mainly thanks to (A) Gender Mainstreaming, (B) Strategy for Equality between Women and Men which is part of the equal treatment legislation already discussed, (C) Specific Measures for the Advancement of Women, and (D) Activities within the Framework of Equal Opportunities between Women and Men and not only those. These will be discussed in more detail below.

#### A: Gender Mainstreaming

In the Commission Communication (European Commission, COM [96] 67, 1996) mainstreaming is defined as:

"Not restricting efforts to promote equality to the implementation of specific measures, but mobilising all general policies and measures specifically for the purpose of achieving equality. The gender and

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\(^{105}\) Many of the texts and documents mentioned in the historical background for activities in the European Commission can only be found in paper form in the Commission archives.
equality dimension should be taken into account in all policies and activities; in the planning, implementation, monitoring and evaluation phases”.

A more recent definition to be found in the internet page of DG JUST is as follows:

"The integration of the gender perspective into every stage of policy processes – design, implementation, monitoring and evaluation – with a view to promoting equality between women and men. It means assessing how policies impact on the life and position of both women and men – and taking responsibility to re-address them if necessary. This is the way to make gender equality a concrete reality in the lives of women and men creating space for everyone within the organisation as well as in communities - to contribute to the process of articulating a shared vision of sustainable human development and translating it into reality".

(European Commission, 2010a)

Although the label "gender mainstreaming" was at the time rather difficult to understand and interpret, this first activity introducing the concept of equal opportunities to be integrated into the different policies, independently of their area, was important in order to raise awareness of the gender problem. It also acted as the catalyst for including the gender factor in the formulation of policies. The implementation of mainstreaming should be based on two different tools which are to be used as gauges. These are: Checking Gender Relevance and Gender Impact Assessment. More details about the tools are given in Appendix I.

B: Strategy for Equality between Women and Men

The Strategy for Equality between Women and Men uses the experience gained by the implementation of The Roadmap for Equality between Women and Men 2006-2010 (European Commission, 2006a). The strategy highlights the importance of gender equality to economic growth and sustainable development, as per the Treaties. It also supports the gender equality dimension in the Europe 2020 Strategy. It represents the work programme on gender equality for the period 2010-2015 and provides a comprehensive framework which commits the Commission to promote gender equality in all its policies, based on specific thematic priorities which are as follows:

- Equal economic independence for women and men
• Equal pay for work of equal value

• Equality in decision making

• Dignity, integrity and ending gender violence

• Promoting gender equality beyond the EU

• Horizontal issues (gender roles, legislation and governance tools).

The Strategy is the main tool which will help the Commission to address some of the remaining gender gaps and it will also build on the priorities of the Women's Charter, which was adopted on 5th March, 2010. The Chart is accompanied by a specific action plan\textsuperscript{106}. The progress of this work will be reported every year in a Report on Equality between Women and Men.

C: Specific Measures for the Advancement of Women

It should be mentioned that within the framework of the Roadmap and the Europe 2020 Strategy, a communication entitled \textit{New Skills for New Jobs} (European Commission, 2008a)\textsuperscript{107} was adopted in 2008, to examine how to achieve a better match of skills and labour market needs. This communication aimed to start activities to provide equal opportunities for professional choices, which would not be influenced by traditional gender paths. The communication aims to reduce gender imbalances in sectors and occupations where they are quite pronounced. It also aims to address as far as possible future skills shortages, particularly in technical and managerial occupations, and especially in the ICT sector. Specific measures included the following:

• Forecasts by the European Centre for the Development of Vocational Training (CEDEFOP, 2009).


\textsuperscript{107} COM(2008) 868/3.
• Analysis of emerging trends at sectoral level and the development of sectoral skills councils.

• European Framework for key competences for lifelong learning - defining the eight key competences that everyone should have to thrive in a knowledge society.

• On-going research with the ILO and the OECD.

• ESCO - Classification of European Skills/Competences, qualifications and Occupations – currently under development – will describe the most relevant skills, competences and qualifications of occupations.

• European Qualifications Framework – This defines qualifications on the basis of learning outcomes so that everyone can understand what they mean in practical terms.

• EU funding – via the European Social Fund and the Lifelong Learning Programme.

• University-Business forum – encourages dialogue between business and education and training providers\(^{108}\).

\[D: \text{Activities within the Framework of Equal Opportunities between Men and Women}\]

DGs JUST and EMPL have a number of additional activities which might be indirectly related to the full integration of women in the ICT sector. Enhancing reconciliation of work, private and family life is one of the priorities of DG EMPL, and is particularly relevant to women in ICT as one of the misconceptions that women (and men) have about the sector is that it is not possible to combine family life and working in this area (Pascall, 2010). Work is being carried out in order to offer flexible working arrangements, and better reconciliation policies, for women and men. The Commission presented a framework communication in order to provide "stronger support for reconciling professional, private and family life",\(^{109}\) and to achieve the Union's growth and employment objectives. In October 2008, after consultation with the European Social Partners, two legislative proposals\(^{110}\) to modernise the current


\[\text{\footnotesize 109 COM(2008) 635 final.}\]

\[\text{\footnotesize 110 COM (2008) 636 and 637.}\]
legislation relevant in the field of reconciliation between private and professional life were presented. It also proposed to update the Directive on maternity protection and maternity leave\textsuperscript{111}, establishing the principle of full pay. A proposal for a Directive was presented to ensure equal treatment for self-employed workers and assisting spouses and to entitle them to maternity leave\textsuperscript{112}. Furthermore the social partners, in 2009, reached an agreement to adapt the current framework on parental leave to evolving family structures and to encourage fathers to take a greater share of family responsibilities.

Three lines of action have been developed: (1) to ensure better access of women to finance; (2) development of female entrepreneurial networks, and (3) the adoption of the "Small Business Act"\textsuperscript{113} aiming to promote women entrepreneurs. It provides for measures to establish an EU network of female entrepreneurship ambassadors and to promote entrepreneurship among women graduates. Female entrepreneurship is also encouraged through the adoption in 2008 of a regulation\textsuperscript{114} regarding block exemption for state aids, notably in the case of small enterprises, created by women entrepreneurs. As many start-ups are in the domain of ICT, this is important for promoting women in the sector.

Practices and legislation under the mandate of DG EMPL are supported in the context of the business-led European Alliance for corporate social responsibility (CSR), with laboratories on "mainstreaming diversity in the company" and "equality between women and men". A study on women innovators and entrepreneurship was also finalised in 2008, to analyse how to make better use of women’s potential and their contribution to Europe’s competitiveness.

DG JUST maintains a database on women and men in decision making which takes stock and monitors the progress achieved, and collects and disseminates comparable data at EU level. In March 2011 a \textit{Women on the Board Pledge for Europe} was launched in order to ensure that companies would develop self-regulatory initiatives to get more women into top jobs in order to reach the target of 30% of women on boardrooms of listed companies by 2015 and 40% by 2020. The Network of Women in Decision making in Politics and the Economy was set up,
providing a platform at EU level for discussion of successful practices and best practices to improve gender balance in decision making positions. The importance of mentoring, networking, role models and the gender pay gap are issues which are debated in the network. These initiatives of the European Commission were approved by the European Parliament with its vote on the Report on Women and Business Leadership in July 2011 (European Parliament, 2011).

6.1.2 The Directorate General for Research and Technological Development (DG RTD)

In DG RTD the recognition of the lack of women in science and research has been recognised since 1999 and this led to the creation of the Women in Science unit (Scientific Culture and Gender Issues). DG RTD aims to promote women in science and research within the Seventh Framework Programme for Research115 (FP7)116. The promotion of gender equality in FP7 is twofold. Firstly, it aims to encourage women's participation in the research (projects) and, secondly, to look at the relevance of gender in specific research topics. The yearly work programmes highlight and encourage both aspects. More specifically, large projects are encouraged to include gender equality actions (costs of which are covered by the project funding).

In order to facilitate the inclusion of gender issues, a training toolkit was prepared to inform the scientific community and the research administrators about the gender relevance of certain research topics. Projects are funded to identify best practices in gender management in research institutions, introducing a new focus on the structural change that the research institutions have to face. A European conference was co-organised with the Czech Presidency in May 2009 on Changing research landscapes to make the most of human potential - 10 Years of EU activities in Women in Science - and beyond (Makarov, 2009). It offered the opportunity to highlight the diversity and gender management solutions that private and public research institutions are implementing to improve their efficiency, with the view to adapt and transfer them in other institutions and/or countries.

The report Mapping the maze: Getting more women to the top in research (European Communities, 2008) reviewed positive actions and gender equality measures, at both institutional and

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116 The ICT part of FP7 is part of the DG INFSO work.
national levels, to promote women. In addition, the data on female research workforce in universities broken down by gender (*She Figures*) are regularly updated: at the end of 2009, and at the end of 2011. A report was also published in 2009 on selection procedures for the allocation of research funds (*Gender Challenge in Research Funding*) (*European Communities, 2009b*).

The DG has set up a working group of experts on reconciling work and private life and on "dual careers" in the sciences and technology domain of the private sector. This working group analysed the correlation between the "leaky pipeline" and work/life balance policies for women in scientific or engineering careers. A report on the "leaky pipeline and work/life balance policies" was published in May 2009 (*Women in science and technology: Creating sustainable careers*) (*European Commission, 2009d*). In order to support women's careers in science, the language used by companies in marketing and recruitment material was checked to analyse whether it was biased or gender stereotyped. Actions to reduce gender inequalities in scientific education were promoted as part of the "learning to learn" process. A gender summit to gauge progress took place in November 2011.

The above activities are reported here in order to demonstrate the importance that is given by the European policy-makers to the lack of women in science and research.

### 6.1.3 The Directorate General for Information Society and Media (DG INFSO)

DG INFSO identified the lack of women in the ICT sector as early as 1991, with the then new Commission which put equal opportunities for women as one of the priorities of its working agenda[^117]. For historical reasons, (A) some background on the first initial actions is briefly presented together with (B) the activities between 2005 and 2009.

**A: Historical Background**

The first workshop on women and ICT by the then DG XIII was organised in July 1995 (*The Impact of Advanced Communication Technologies on the Role of Women in Society*)[^118]. The workshop identified the industry as sex-segregated and also identified women's lack of interest in the

[^117]: The work programme Commission was published in December 1991 and can now only be found the Commission's historical archives.

[^118]: The proceedings of the workshop published in July 1995 can only be found in the DG's historical archives.
sector. It is interesting to note that despite all the efforts made, the underlying problems 20 years later are still the same.

A second workshop was organised in January 1996 (Information Highways: Are women in the slow lane?) In the workshop, Members of the European Parliament, such as the Honourables Erika Mann and Charlotte Cederfeldt, recognised the problem and set a future agenda based on awareness-raising activities, underlining the need for more women in the different FP programme committees.

In the Information Society Technologies Conference and Exhibition, in December 1998 in Vienna, Austria, there was a workshop on Gender and the Information Society (Shaping the Cyberspace) (European Commission, 1998). The European Commission in co-operation with the German Ministry of Research and Education issued the Vienna Declaration.

DGs INFSO and RTD (XIII and XII respectively at the time) launched in 1998 a first series of studies to measure the Gender Impact Assessment of the Specific Programmes of the 5th Framework Programme. The DG INFSO study resulted in a number of recommendations including the co-ordination an analysis of the socio-economic profile of IST users and promotion of the gender sensitivity issues. A model suggesting where the Commission could intervene in project management was presented (European Commission, 2001).

Based on the results of the different studies, the concept of Gender Action Plans (GAP), compulsory for Integrated Projects (IPs) was introduced in FP6 (2000-2006). The GAP was an obligation of the project, which required the proposal submitted for financing to include a plan on how the gender issue would be handled within the project. Despite the fact that the GAP was compulsory, only few projects presented concrete plans with roadmaps for implementation. There was no provision to discontinue financing if the GAP was not implemented. One could deduce that the projects did not consider the issue important, and were reluctant to spend time and money on it. This indicates that such activities could only be successful if they are part of the contractual obligations of the project and a penalty is attached.

A second series of gender-monitoring studies were launched during FP6, (five lots, each covering several activity areas by DG RTD and a separate study for DG INFSO), designed to monitor progress towards gender equality and gender relevance awareness in FP6. The studies
examined both the participation of women in FP6 activities and the gender dimension of the research content, the aim being to assess the success of current gender mainstreaming strategies and to provide recommendations for future activities in this field. The gender equality dimension in the ICT domain was examined and a number of recommendations were made, mainly on the way the gender aspect is integrated into the research that is financed under FP6. At the same time the added value of the GAPS was assessed (European Commission, 2009d). It should be noted that GAPS were not included in FP7 (2007-2013).

DG INFSO started to gender-monitor all of its promoted events, such as the annual and then bi-annual IST Conferences and Exhibitions. A conscious effort was made to ensure that there were female speakers in all the sessions, including the plenaries, and that gender-related sessions were hosted. There has been considerable improvement in the number of women in the different management committees (around 30%)¹¹⁹, and an increase in the number of women used as evaluators and reviewers¹²⁰.

B: Activities 2005 – 2009

The work concerning women in ICT really took off in DG INFSO during the period 2005 to 2009. The portfolio for Information Society and Media was given to Commissioner Viviane Reding, who was particularly sensitive about the issue. A policy was formulated to increase awareness with a number of activities. The formulation of the policy was established in a workshop in May 2005, in Brussels. In November 2006 the first Shadowing activity took place in Helsinki, Finland. In "Shadowing" a young girl spends a day in a company, in most cases an ICT company, following the work of a female engineer, being her shadow¹²¹. The Shadowing exercises have now become a tradition, with more than 1,500 participants. The Shadowing DVD, March 2009, was put on YouTube¹²² with more than 6,000 hits in a year. Considering that this was a European Commission film, the number of hits is important, especially as there has been a long debate about what was presented. The Shadowing effect is not limited to the

¹¹⁹ DG INFSO data.

¹²⁰ Depending on the year, from the 8% average of FP3, there was an average of around 18% at the end of FP6. The percentages vary from 14% to 28% according to the area of the programme. This data is collected by DG INFSO.

¹²¹ All the DVDs about shadowing and other activities for DG INFSO can be found on www.ec.europa.eu/itgirls.

¹²² http://www.youtube.com/watch?v=Mmhe36xwS-Y – The DVD was removed in March 2011.
number of girls who participated in the days but is subject to the multiplier effect when they go back to school and talk about their experience.

In addition to the Shadowing initiative, DG INFSO has an annual conference to celebrate International Women's Day\textsuperscript{123}. These conferences, the proceedings of which can be found on the IT Girls website\textsuperscript{124}, aim to assess progress, and work towards future actions and policy. The last conference was in Budapest under the auspices of the Hungarian Presidency of the European Council. It should be noted that in this particular conference the number of corporate participants was impressive. They all indicated that the predicted lack of skills was in fact a reality and they were willing to promote women in the sector in order to bridge the skills’ gap.

At the International Women's Day conference of 2008, Commissioner Reding announced the setting up of an Industry Group which would work towards the drafting of a Code of Best Practices for Women in ICT\textsuperscript{125}. The Industry Group consisted of seven companies, five of which presented the signed Code to the Commissioner in March 2009. These founding companies were: Alcatel Lucent, IMEC, Microsoft, MOTOROLA, and Orange FT. Since then, more than 60 companies have signed the Code, including NGOs, universities, associations, SMEs, small ICT companies and consultancies, as well as some of the bigger names of the sector. A list of all signatories up to the present can be found on the IT Girls website under the Shadowing reference in the site. The practices used to draft the Code were identified through a study financed by DG INFSO, which collected gender-relevant best practices from the 27 Member States. There has been a regular follow-up of progress made on the Code by the signatories, with a workshop, in September 2010, in order to monitor progress and to create synergies for better impact.

One of the main problems identified during the preparation of policies was the lack of clear and credible statistics. To remedy this, a study was launched to collect European and, if possible, international statistics about the presence of women in the ICT sector. The results of

\textsuperscript{123} The 8th of March is the International Women's Day.

\textsuperscript{124} http://www.ec.europa.eu/itgirls accessed 01/03/2012.

the study were published in a report in January 2008 (European Commission, 2008d), and a second updated report was published in March 2010\textsuperscript{126}.

Women and ICT activities needed an identity. To this end, a logo was commissioned and designed and used as conference material as well as the posters for every conference. "Cyberella" is one of the poster characters as well as the slogan, “Gre@t Careers 4 Gre@t Women”, using IT symbols combined with mobile messaging language. The slogan, logo and posters helped in the building of a constituency and a common goal.

Recommendations on best practices regarding women's participation in the information and communication technologies (ICT) sector as well as statistical evidence (European Commission, 2008c) have also been presented to the Davos Economic Forum (2008). This gave publicity and importance to the issue at an international level. Participants in the specific gender sessions included Hilary Clinton.

DG INFSO, having noticed the fragmentation of activities in the area of women in ICT, commissioned the European Directory for Women in ICT (EUD), which was launched in Brussels in October 2009.

6.1.4 EUROSTAT

EUROSTAT is the statistical office of the European Union and is situated in Luxembourg. Its task is to provide the European Union with statistics at a European level that enable comparisons between countries and regions.

The availability of statistics for women in the science and technology sector has improved with the agreement on the contents of the 2010 Labour Force Survey \textit{ad hoc} module on "reconciliation between work and family life", and the corresponding Regulation has been adopted\textsuperscript{127}. Moreover, EUROSTAT will shortly be releasing a publication analysing the 2005 module on the same subject.

Eurobarometer surveys published often look at the position of women in society, examining specific areas such as women in politics, in decision making positions, etc.

\textsuperscript{126} Both reports can be found in www.ec.europa.eu/itgirls.

The problem with the work of EUROSTAT is that, as data is not collected on a regular basis as far as gender statistics is concerned, it is difficult to assess trends by measuring variations. Gender relevant statistics and surveys should be collected regularly to facilitate statistical analysis.

6.1.5 European Institute for Gender Equality

The European Institute for Gender Equality is a European agency mandated to support the Member States and the European institutions, particularly the Commission, in their efforts to promote gender equality, fight discrimination based on sex and raise awareness of gender issues.

The Institute for Gender Equality is an agency of the European Commission, which was set up in order to collect and analyse comparable data on gender issues, to develop methodological tools, in particular for the integration of the gender dimension in all policy areas, to facilitate the exchange of best practices and dialogue among stakeholders, and to raise awareness among EU citizens.

The Institute's budget for the period 2007-2013 is €52.5 million.

6.2 European Initiatives and Programmes

In this section we are going to see some of the activities across Europe and, more specifically, the European Centre for Women and Technology (6.2.1), the Millennia 2015: Women actors of development for the Global Challenge (6.2.2) and some other activities (6.2.3) such as The European Platform of Women Scientists.

6.2.1 The European Centre for Women and Technology

The European Centre for Women and Technology (ECWT) has been set up to be a sustainable European multi-stakeholder partnership, representing both high-level expertise in women and also technology development from business, government, academia and non-profit sectors. One of its main scopes is to support regional innovation through leveraging resources, research, best practices and services.[128] Supported by industry and government

bodies, ECWT aims to be a focal point for activities relating to the proper integration of women in the world of technology. It aims to increase their participation not only as users of technology, but also as active members in its design and production and at decision making level.

The ECWT was established after a series of meetings at an international level, co-ordinated by the International Taskforce for Women and ICTs (ITF) – Europe in May 2008. It functions as the European Regional Point of Contact (R-POC), one of the Ten Regional Centres presently being established around the world, which together constitute Global Women and Technology (GWT). At the same time ECWT advocates the establishment of a National Point of Contact (N-POC) in each country which would function as a national platform of multi-stakeholders to ensure women's full participation in ICT and related sectors. They describe their aim in setting up ECWT as follows:

"Our vision is an information society for sustainable global development that fosters the potential for success of all its members. The overarching goal is to ensure women's full participation in our inclusive information and knowledge based society as leaders and creators, as well as users of IC".29

ECWT is a European non-profit organisation registered under Norwegian law with its main offices in Drammen, Norway.

6.2.2 Millennia 2015: Women Actors of Development for the Global Challenges

Millennia 2015 is a partner project of the project organised by the Destrée Institute (Belgium) and its partners in the Millennium Project. The project organisers used the term Millennia (feminine version of "Millennium") in order to emphasise the important role that women have to play in the new era.30 The project defines itself as follows:

"Millennia 2015 is a research process about on the topic of "Women actors of development for the global challenges".

129 Idem.

The work of Millennia 2015 is structured around three international conferences aiming at building, by 2015, a positive vision of the future by women for the entire world at the horizon 2025.

"Millennia 2015 works with foresight as a method and the information society as context"\(^\text{131}\).

The first conference had as a theme "Transfer Information", including the exchange and transmission of data as well the analysis of collected or built data. The second conference on an action plan for women's empowerment is planned for December 2012 (3-4/12/2012) in Paris (UNESCO), and the third and final one on construction of Intelligence Platforms is scheduled for 2015 in New York (United Nations).

Millennia 2015 has activities which are not focused on women in the ICT sector, but by definition its goal is to empower women worldwide. As the project was conceived during the process of the International Summit on the Information Society, the role of the ICTs is at the very centre of the work done, and new technologies are the main tools of the work in progress.

Millennia 2015 is led by an international Steering Committee\(^\text{132}\), and it aims to build, through a foresight approach, some answers to the divides linked to gender, in a world overwhelmed by technology which is often synonymous with higher complexity.

The issues around the technological aspect are related to the following three groups of topics.

- Political (respect of human rights, participation in the decision process).

- Economic and social (knowledge economy, social integration, equality in employment, health care and biotechnology, solutions against poverty, action against violence).

- Educational and cultural (access to knowledge and promotion of skills, training in ICT, access to education and to culture, access to life-long learning, openness to cultural diversity).

\(^{131}\) Idem.

\(^{132}\) The author is a member of the Steering Committee.
Activities centre on the following ten topics.

- Access to information and knowledge: enhancing capacities for women.
- The long-term challenges for women assessed by the Millennium Project.
- Women and sustainable development.
- Enhancing women's rights, ethics, gender equality, and political empowerment.
- Female entrepreneurship and new participative competences.
- International Women's Day.
- Cultural and linguistic diversity, women and the governance of the Internet.
- Education, research, training, and e-learning.
- Towards a knowledge society: creativity, cultures, and media.
- Women actors of development and change, women architects of the future.

Millennia 2015 is in line with the achievements of the United Nations World Conference of Women held in New York in 2005 (commemorating and reporting on the progress of the Beijing 1995 4rth conference on women organised by the United Nations -Beijing +10, and looking to the next stage which will be in 2015), and will try to contribute to the United Nations Millennium Development Goals and to the "Tunis Agenda for the Information Society" approved by the World Summit on the Information Society (WSIS). Millennia 2015 is a European initiative with a global purpose.

6.2.3 Other Local European Initiatives

Before looking at the international scene, three other European initiatives are going to be briefly presented in this session. These initiatives were selected as best practice examples based on the nature of work. They are (A) The European Platform of Women Scientists; (B) Portia ltd, and (C) Women in Leadership. The list of European initiatives presented here is by no means exhaustive.
The European Platform of Women Scientists (EPWS) is a non-profit umbrella organisation representing the needs, concerns, interests and aspirations of women scientists in Europe across their professional path, and in all scientific disciplines. EWPS represents more than 12,000 women scientists, not only in Europe but across the globe.

EPWS was set up in 2005, and consists of more than 100 networks of women scientists and organisations promoting women in science from 40 countries. The platform aims to give women scientists a voice in European research policy and to build a structural link between women scientists and policy-makers both in European and national research.

EPWS stemmed from the European Commission’s 1999 Communication, "Women and Science: mobilising women to enrich European Research". In the preparation of the communication, preliminary work identified networks of women scientists, which led to the publication of a Network Guide containing their profiles and co-ordinates. These networks were brought together in the conference organised in June the same year, and a Declaration was issued which emphasised the importance of gender balance in research policy. This can be perceived from three different perspectives: "research by, for and about women".

The EPWS was the result of an open call from the European Commission, the express purpose of which was to create the European Platform of Women Scientists. The aim of the EPWS is to provide a framework within which there will be an exchange of experience and good practice. EPWS aims to facilitate cooperation and consultation across sciences, and it has created a mechanism to involve women scientists more actively in the policy process. The Platform disseminates information and supports lobbying and advocacy work. It aims to empower women scientists in their careers with training actions and networking activities, a database of role models and mentors, campaigns, and awareness-raising initiatives.

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Portia Ltd. started at the initiative of the Department of Trade in Industry (DTI) in the United Kingdom. It was led by a group of female scientists at Imperial College London. Portia’s aim was to act as an umbrella organisation for women’s groups in Science and Technology (SET).

The main objectives for which Portia was established are as follows:

- To advance the understanding and appreciation of science, engineering and technology and information technology among all sections of the population, particularly women and girls;

- To promote the participation of all sections of the population, particularly women and girls, in activities related to science, engineering, technology and information technology;

- To support and to attract girls and women to careers in science, engineering, technology and information technology;

- To link and support young people, especially girls, in accessing information related to science, engineering, technology and information technology;

- To link and support entrepreneurs, especially women, with respect to businesses related to science, engineering, technology and information technology.

- To enable better access to skilled personnel, particularly women, in sectors of science, engineering, technology, and information.

Portia has had considerable success in realising its objectives and has delivered a range of innovative projects in partnership with a broad network of stakeholders. Its subsidiary EQUALITEC originated through the funding from the European Social Fund Equal Programme. EQUALITEC mainly focuses on promoting equality in the ICT sector.

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Three other projects of Portia are:

- *Getting You Back to IT*: a recruitment scheme involving in-house training in software development for women returners.

- *Knowledge and Skills for a Digital Future*: a campaign to help individuals, as well as organisations, to contribute more fully to a technological and socio-cultural change.

- *Career Clinics*: a tool developed to assist individuals with short-term and long-term career planning and managing decisions and opportunities, by reassessing the three careers "As" – Attitudes, Aptitudes and Aspirations.

C: Women in Leadership

The INSEAD Gender Diversity initiative, groups the INSEAD faculty and researchers with all business disciplines in order to investigate a range of topics relating to gender diversity in organisations. INSEAD works with external stakeholders such as the corporate, public national and European sector and non-profit organisations to encourage research in gender diversity. The work focuses mainly on women and leadership, diversity and organisational performance, career and talent management, women and entrepreneurship and women and economic development. The initiative started its work with a mentoring plan which was rather successful in its first year.

6.3 INTERNATIONAL INITIATIVES

In this section four international initiatives are to be presented, namely the United Nations Division for the Advancement of Women (6.3.1), the International Taskforce on Women and Information and Communication Technologies (6.3.2), the Global Women and Technology Initiative (6.3.3), and the United Nations Fourth World Conference on Women (6.3.4), known as the Beijing Platform. Although this latter took place more than 15 years ago it is mentioned as it is still one of the most important initiatives, which set the agenda for the 21st century.
6.3.1 The United Nations Division for the Advancement of Women

Grounded in the vision of equality of the United Nations Charter, the Division for the Advancement of Women (DAW)\textsuperscript{137} advocates the improvement of women’s status across the globe and their being equal actors, partners and beneficiaries with men in all areas of sustainable development, human rights, security and peace. The unit works together with other entities of the United Nations systems, governments, non-governmental organisations, and civil society. Its aims are to advance the global agenda on women’s rights, gender equality and women’s empowerment and also to ensure that their voices are heard in the international policy arena.

DAW’s main responsibilities are as follows:

- To support the formulation of policy, global standards and norms on gender equality and women’s empowerment at global level, including through analysis and research.

- To promote, support and monitor the implementation of international agreements on gender equality and the empowerment of women, including the Beijing Platform for Action, at international and national levels.

- To support the implementation of the Convention of the Elimination of all Forms of Discrimination against Women, and its optional protocol.

- To promote the mainstreaming of gender perspectives across all sectors, both within and outside the United Nations system.

The main activities are to carry out analysis and research, provide substantive support to the Commission on the Status of Women, support the implementation of the Beijing Declaration and the Platform for Action (1995), provide information to interested parties such as NGOs and civil society stakeholders, act as a facilitator for participation in different committees and provide technical assistance.

6.3.2 The International Taskforce on Women and Information and Communication Technologies

The International Taskforce on Women and Information and Communication Technologies (ITF) is a community of expertise of organisations, institutions, businesses, academia and individuals working to increase the economic, social and educational opportunities for women and girls in the knowledge society in a measurable way. The ITF is recognized as a Community of Expertise (CoE) by the UN Global Alliance for ICT and Development (UN GAID).

The members of the ITF represent a broad range of initiatives with a range of sectoral expertise and regional representation. It is a think tank that can be drawn on for expanding current efforts and identifying and filling gaps in the world of women and IT.

Although the Taskforce was not set up as a permanent institution, members have agreed that it will remain active as long as it serves a useful function, either on the international stage, interacting with international organisations and/or in relation to Global Women and Technology (GWT). The regional centres that together create the GWT will collaborate with the global ITF Steering Committee.

ITF is guided by the principles signed by the founders and laid down in the Declaration of Agreement. ITF members act with the ultimate goal to increase measurably and significantly the number of girls and women in technology and in the knowledge based economy, by the end of 2015. ITF Membership is open to all who subscribe to the ITF Declaration of Agreement and Guiding Principles.

The ITF was launched in June 2005 in Baltimore MD, USA, and through a series of high-profile global activities – including major conferences in Paris and Kuala Lumpur in 2006-2007 – has mobilised over 100 stakeholders from around the globe, including high-level decision makers of the United Nations, UNESCO, the European Commission, the World Bank, the Inter-American Development Bank. This is in addition to major multinational

companies including HP, Texas Instruments, Cisco, Microsoft, IBM, AT&T, Dell and NOKIA, as well as regional public key actors in universities, research institutes, global and regional NGOs from all continents.

6.3.3 **Global Women and Technology Initiative**

The Global Women and Technology Initiative (GWT-I), as previously mentioned, is an initiative resulting from the work of the ITF after the Kuala Lumpur conference. Its basic aims are to increase measurably and significantly the participation of women in technology. The goals of GWT-I are to set up 10 Regional Centres around the world, which will be based on a multi-stakeholder organisation, and will be customised according to the specific needs of the region they represent. Each centre will be working on a Bold Global Multi-stakeholder Strategy and Action Plan aiming to increase female participation in the knowledge-based economy.

6.3.4 **The United Nations Fourth World Conference on Women**\(^\text{139}\)

The United Nations Fourth World Conference on Women took place in Beijing, China in September 1995. It set up a Platform for Action which is an agenda for women's empowerment through the acceleration of the implementation of the *Nairobi Forward-looking Strategies for the Advancement of Women*\(^\text{140}\) and by removing "all the obstacles to women's active participation in all spheres of public and private life through a full and equal share in economic, social, cultural and political decision making".

In order to monitor if these resolutions were being implemented, international workshops were set up at intervals of five years. The workshops assess the impact of trends of global change on gender equality, development and peace in terms of the implementation of the Platform, and recommended measures to address the emerging challenges. Recommendations are formulated related to five categories: attitudes and practices; governance; alliances and coalitions; social and economic justice; and peace-building.

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The conference set up the agenda for the following 20 years and managed to unite all interested parties (there were more than 50,000 participants) into setting up a common agenda which would be revised according to needs. It is considered to be a massive step in including gender issues in the international political agenda.

**6.4 Chapter Conclusions**

In this chapter some activities concerning equal opportunities between men and women and, in particular, women in ICT, were presented. Although only part of the European and international activities was presented, it is clear that a conscious effort is made at all levels and by all concerned to increase the participation of women in the ICT sector. What is not so clear, however, is the impact, if any, that can be measured from these actions. Statistical evidence shows that conditions for women in the ICT sector are improving but whether this is a result of the measures taken or a natural consequence, still remains to be seen. Hence, based on the initiatives presented in this chapter, we may draw the following six conclusions.

1. The need to encourage women to play a more active role in the ICT sector has been recognised.

2. European official bodies, such as the European Commission, set up legislative frameworks as well as the necessary instruments to promote and raise awareness of the issue of women in the ICT sector.

3. Concerted actions were set up in order to create synergies between the different actors (industry, academia, European and international organisations and NGOs).

4. The industry is willing to participate actively in order to increase the number of women in the ICT sector.

5. Measures taken are not always successful as they are not implemented and they remain only on paper - formalising them might make their implementation easier.

6. No follow up or impact assessment mechanisms have been set up in order to evaluate if activities made any difference or any change is the result of natural evolution.

This chapter provided information about different initiatives at European and international level. It gave the background to RQ 4 providing a framework for activities improving the
landscape for women in the sector. This work did not deal with any possible drawbacks of the initiatives taken.
In this chapter, I aim to answer **RQ2** (*What are the problems women face when they are in the sector?*) by demonstrating that hidden and implicit biases often exist and produce cumulative disadvantages for women. There is a real dearth of good data on the nature of discrimination experienced by women at university, the place of work or in the labour market in general. One of the latest pieces of research is the study of gender attitudes in Physics Departments conducted by the Institute of Physics - IOP, in the UK (IOP, 2010). The underlying picture is complicated. We all have unarticulated, often subconscious ideas about gender that affect both our behaviour and, perhaps even more importantly, our evaluations of one another. As a result, men are consistently overrated and women underrated by co-workers, bosses and themselves. The resulting advantages and disadvantages may be small, but they accrue over time to create large gaps in advancement (Valian, 1999). The field work carried out as part of this thesis aims to help give a bird's eye view, albeit limited in the Western world, of the situation as it stands at the moment.

One should note that the investigation of the role of social institutions, such as the influence of the family, peers and equality policies, for example the EC directives of: Equal Pay (1975), Equal Treatment (1976), Pregnant Workers (1992), Equal Treatment in Employment (2002), and Equal Treatment in Employment and Occupations (2006), is both outside the scope of this thesis and needs more extensive work. The present exploratory work however will provide us with some data which would help us draw some provisionary conclusions on the actual situation and possible trends.

The chapter starts by outlining the methodology used to design a questionnaire and get answers by a sample of women randomly selected (Section 7.1). It continues with the classification of the results obtained (7.2) and then the qualitative analysis of the results to the open questions (7.3). In Section 7.4 the research challenges of this work are presented and the chapter concludes with some provisional chapter conclusions (7.5).
7.1 **Methodology**

For many women the features of everyday life which may be taken for granted, such as family, social interactions, education and paid work are the priorities in their lives. The negotiations between the experiences of each of these worlds are part of the process of defining women’s identities. During the last two decades women’s participation in higher education and in the labour market has greatly increased, but not in the ICT field (see chapter 3). The methodology used in this study combines a questionnaire for quantitative analysis (Subsection 7.1.1), and a qualitative analysis with three in-depth interviews (7.1.2), to help identify core experiences that impact on women’s career decisions answering thus what are the problems women face when they are in the sector (RQ 2).

### 7.1.1 The Questionnaire

The questionnaire was designed around three pillars.

1. Look at the influence of the family in the career choice.
2. Investigate any possible discrimination at university and at the place of work.
3. See if there have been any changes in attitudes over time.

These three pillars used to design the questionnaire were identified during the literature and desk top research. More specifically, the findings of the "ICT Getting in-Staying in" model as defined in Chapter 1, PISA reports where the issue of discrimination is mentioned (Chapter 2), the role of teaching and education as analysed in Chapter 4, and data as exposed in the analysis of the role models and stereotypes (Chapter 4).

The respondent sample was randomly acquired from a broad constituency of women working in the ICT sector.

The questionnaire was disseminated as follows:

- Around 1000 questionnaires were sent out or forwarded by colleagues to members of their project management constituency, university friends and colleagues and old school networks.
The questionnaire was posted on the following sites: British Computer Society, IT Girls (European Commission), European Women's Platform, European Centre for Women in ICT, and the World Computer Forum.

A link to the questionnaire was provided in the electronic G-news Newsletter.

This dissemination method aimed to ensure that the questionnaire would reach women active in the sector (through postings on web sites and electronic newsletters), and those who might have moved away (the friends' network), without the one excluding the other. The questionnaire was only addressed to women with questions pertinent to their experiences. All the respondents were female.

For evaluation purposes the questionnaire was designed in a multiple choice form and was designed in three parts:

1. The questionnaire looks at specific facts such as age, country of origin, study and work, and type and level of qualifications. Age would supply a common denominator in order to compare attitudes and establish career or study trends within the tree time brackets. The country of origin, study and work question aims to distinguish whether specific behaviours could be detected in different countries.

2. The questionnaire aims to assess possible influences from the family in studies or career choices. It also continues to establish whether women were discriminated during their studies and, if they were, in what way.

3. The questionnaire investigates work conditions and any possible discrimination. Forms of discrimination could be assessed through the questions on the level of responsibility, the number of promotions or salary increases in comparison with the years in the organisation, indirect bias or direct discrimination through a number of specific activities.

An open question part was added to the questionnaire in order to be used as part of the qualitative analysis complementing the in-depth interviews.

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The questionnaire can be found in Appendix II (first part).

7.1.2 The Interviews

Out of the questionnaires received, three (one from each age group) were chosen for the in-depth interviews. A number was given to each questionnaire, and then one number was randomly drawn from each group. The respondent was given a set of open questions which were discussed during the interview. The author transcribed the interviews and showed them to the respondent for agreement.

The open questions and the transcription of the in-depths interviews can be found in Appendix II (second part).

7.2 Classification of Questionnaire Results

In total, 140 answers were received which, although they are too small a sample to be significant, still show some trends and help us draw some provisional conclusions. We acknowledge that a response of 14% only is remarkably low. Admittedly, 14% is reached via a favourable calculation. Although, we have not investigated what the possible reasons for the low response are, a possibility which could be considered is that the lack of time of many professionals which deters them from answering questionnaires as well as the amount of surveys on line carried out which makes a lot of people to ignore them. It should be noted that most of the answers were sent by respondents who found the questionnaire in one of the different sites on which it was posted. It should be also mentioned that since the presented analysis, the number of the questionnaires answered increased to 157. As the results correspond to the ones presented the analysis in this chapter remained as it was. All data is presented in a table form in Appendix IV.

We are initially going to see in Subsection 7.2.1 a compilation of the responses received in terms of age, country of origin, and work. We continue with an analysis of the educational level of the respondents (7.2.2) and then with the responses to the third part of the questionnaire (7.2.3). This section closes with a comparison of the 109 respondents who were ICT educated (7.2.4).
7.2.1 The Compilation of the Responses

A classification of the responses received by age group shows that the majority of respondents were in the middle range group, i.e., 40-54 years old representing 45% (63 respondents), with the 25-39 years old group coming a close second with 42.14% (59), while only 12.86% were from the older group (18). Table 7-1 presents the age distribution and Figure 7-1 give a graphical representation of this distribution.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-39</td>
<td>59</td>
<td>42.14</td>
</tr>
<tr>
<td>40-54</td>
<td>63</td>
<td>45.00</td>
</tr>
<tr>
<td>55-75</td>
<td>18</td>
<td>12.86</td>
</tr>
<tr>
<td>Total</td>
<td>140</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 7-2 and Figure 7-2 show a detailed list of the countries of origin of the respondents.

\[ ^{142} \text{Not all 140 respondents replied to all questions. This explains the difference in having either 140 or 139 respondents.} \]
Table 7-2 Country of origin of respondents

<table>
<thead>
<tr>
<th>Countries</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU-27</td>
<td>91</td>
<td>66.92</td>
</tr>
<tr>
<td>Norway</td>
<td>2</td>
<td>1.50</td>
</tr>
<tr>
<td>Switzerland</td>
<td>2</td>
<td>1.50</td>
</tr>
<tr>
<td>Outside Europe</td>
<td>45</td>
<td>30.08</td>
</tr>
<tr>
<td>Total</td>
<td>140</td>
<td>100.00</td>
</tr>
</tbody>
</table>

66.92% of the respondents originated from one of the 27 Member States of the European Union (91). The remaining respondents were divided amongst other countries around the globe, with a 1.5% representation for Switzerland and Norway (2 respondents each). 30.08% of the respondents originated from countries outside Europe (45). The data shows that the distribution of respondents across the countries of EU 27 is the largest in Italy and Hungary with 14.29% and 10.53% respectively. The sample can however be considered as representative for the countries and associated countries of the European Union, since it covers all the Member States.

An analytical table of distribution of respondents by country of origin can be found in Appendix III (Table AIII.1).

Table 7-3 and Figure 7-3 show where the respondents work. 69.1% work in EU-27 or in one of the associated countries. One of the respondents did not indicate if the country of work
was different from the country of origin or which one it was. The data analysis was carried out on 139 respondents.

Number of respondents who answered the question: 139

Table 7-3 Country of work of respondents

<table>
<thead>
<tr>
<th>Countries</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU-27</td>
<td>89</td>
<td>64.0</td>
</tr>
<tr>
<td>Norway</td>
<td>4</td>
<td>2.9</td>
</tr>
<tr>
<td>Switzerland</td>
<td>3</td>
<td>2.2</td>
</tr>
<tr>
<td>Outside Europe</td>
<td>43</td>
<td>30.9</td>
</tr>
<tr>
<td>Total</td>
<td>139</td>
<td>100</td>
</tr>
</tbody>
</table>

Figure 7-3 Country of work of respondents

The country of workplace, especially for those outside EU27 or the associated countries, could give some indication whether there exists common problems that women might face in the ICT sector across continents.

Comparing the country of origin and country of workplace it should be noted that many women remain in their country of origin. Whether this is due to limited mobility opportunities or their unwillingness to move, it is not possible to assess from the available data.
An analytical table with the number of respondents in the different countries of workplace can be found in Appendix III (Table AIII.2).

### 7.2.2 The Educational Level of the Respondents

Figure 7-4 shows the level of education of the respondents and Table 7-4 presents the level of degree obtained analytically.

![Figure 7-4 Level of education of respondents](image)

<table>
<thead>
<tr>
<th>Level of Studies</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduate</td>
<td>29</td>
<td>20.86</td>
</tr>
<tr>
<td>Masters</td>
<td>58</td>
<td>41.73</td>
</tr>
<tr>
<td>PhD</td>
<td>52</td>
<td>37.41</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>139</td>
<td>100</td>
</tr>
</tbody>
</table>

The table shows that the majority of the respondents hold a Masters degree (41.73% - 58 respondents). 37.41% (52 respondents hold a PhD). It is important to know, however, if these qualifications are relevant to the work of the sector. This will also indicate how many respondents came into the sector with different qualifications.
Table 7-5 shows the field(s) of study of the respondents.

<table>
<thead>
<tr>
<th>Fields of Studies:</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Science</td>
<td>50</td>
<td>35.97</td>
</tr>
<tr>
<td>Electrical and Electronic Engineering</td>
<td>20</td>
<td>14.39</td>
</tr>
<tr>
<td>Telecommunication</td>
<td>12</td>
<td>8.63</td>
</tr>
<tr>
<td>Other</td>
<td>57</td>
<td>41.01</td>
</tr>
<tr>
<td>Total</td>
<td>139</td>
<td>100</td>
</tr>
</tbody>
</table>

The majority of respondents working in the ICT sector hold qualifications in relevant fields of study, i.e., Computer Science, Telecommunications, and Electrical and Electronic Engineering (68.99 %, or 82 respondents). This could be considered as recognition of their intellectual talent and capacity to undertake highly technical jobs. The remaining 57 respondents (41.01%) came into the sector with other qualifications which can be considered as an indication that technical knowledge is not necessarily a prerequisite in order to work in the sector. Looking at the table of the analytical answers of each respondent (Appendix IV), we can see that in the 25-39 age group, 20 out of the 59 respondents (33.9%) did not study ICT-related subjects, the majority (14) studied completely irrelevant subjects, whilst 6 studied Science (such as Biotechnology, Geophysics and Biology). In the middle group, only 4 out of the 63 respondents (6.35%) studied non-ICT-related subjects which indicates less flexibility. In the last group, 5 out of the 18 respondents (27.7%) came from a completely different discipline. Figure 7.5 gives a graphic representation of the fields of studies.
The majority of the respondents, 41.43%, chose these studies or careers because they liked science and 30% were good in science subjects. Only 15.71 % considered career prospects. This suggests that schools have an important role to play in helping overcome the gender gap in ICTs, by demonstrating the relevance of computing in the context of Science as well as encouraging girls to like and therefore study Science. Given the strong influence of family attitudes, which we are going to see further in this chapter, these data suggest the choice of
study and career has been much less influenced by strategic considerations: only 15.71% of the women looked at career prospects.

Before closing this second part of the questionnaire we shall examine the influence of the family in study or career choice. Table 7-7 presents possible family influence in study choices.

<table>
<thead>
<tr>
<th>Answers</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Yes:</td>
<td>53</td>
<td>38.13</td>
</tr>
<tr>
<td>• No:</td>
<td>86</td>
<td>61.87</td>
</tr>
<tr>
<td>Total</td>
<td>139</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Answers</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Father</td>
<td>15</td>
<td>28.95</td>
</tr>
<tr>
<td>Brother</td>
<td>13</td>
<td>25.45</td>
</tr>
<tr>
<td>Sister</td>
<td>5</td>
<td>9.85</td>
</tr>
<tr>
<td>Husband, fiancé</td>
<td>14</td>
<td>27.95</td>
</tr>
<tr>
<td>Friend</td>
<td>5</td>
<td>9.85</td>
</tr>
<tr>
<td>Uncle</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>53</td>
<td>100</td>
</tr>
</tbody>
</table>

Figure 7-6 shows the influence that the family has in the choice of study and eventually profession. 38.13% (53) of the respondents had a family member or a friend in the sector or in Science in general. Out of the 38.13%, 28.95% had a father who worked as an engineer, closely followed by a husband or a fiancé (27.95%). Third, but rather near as well, comes a brother (25.45%). Sisters appear to have little influence (9.85%), as have friends (9.85%). The fact that in each and every age group there is a male family member who might be considered as one of the influences for study choice suggests the potential importance of male role models in career decisions. Peer influence has been identified by 9.95% of respondents. This is in contrast to the findings from other studies of women’s career decision choices in engineering, which show that the peer group influence can be as strong as that of parents.
(Kvasny et al., 2011). In this context, one explanation for the apparent low-level peer influence may be that it demonstrates that social perceptions of ICTs are ambiguous. Further study would be required to examine this relationship since it may play an important role in the design of future interventions.

Examination of the questionnaires revealed that there are 109 respondents who studied ICT-related subjects, such as Electrical Engineering, Biotechnology and Computer Science. 30% of these had at least one member of their family who had studied Science. The social impact of the "family" on women’s participation in ICT and in the labour market is one of the most critical factors influencing their place and status in society.

Figure 7-6 Parents/siblings in science

<table>
<thead>
<tr>
<th>Relation</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Father</td>
<td>15, 28%</td>
</tr>
<tr>
<td>Sister</td>
<td>5, 10%</td>
</tr>
<tr>
<td>Brother</td>
<td>13, 25%</td>
</tr>
<tr>
<td>Husband/fiance</td>
<td>14, 20%</td>
</tr>
<tr>
<td>Uncle</td>
<td>1, 2%</td>
</tr>
<tr>
<td>Friend</td>
<td>5, 9%</td>
</tr>
</tbody>
</table>

7.2.3 Third part of the Questionnaire

We will now look at the third part of the questionnaire dealing with the issues of discrimination. Table 7-8 shows the respondents' perception of possible discrimination in tertiary education.
Table 7-8 Discrimination in tertiary education

<table>
<thead>
<tr>
<th>Answers</th>
<th>No</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Yes:</td>
<td>20</td>
<td>14.29</td>
</tr>
<tr>
<td>• No:</td>
<td>120</td>
<td>85.71</td>
</tr>
<tr>
<td>Total</td>
<td>140</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Answers</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Got lower marks for same course results</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>Was not given the opportunity to follow academic career</td>
<td>10</td>
<td>52</td>
</tr>
<tr>
<td>Not retained for research degree</td>
<td>1</td>
<td>11.8</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>32</td>
</tr>
<tr>
<td>Total</td>
<td>19(^{143})</td>
<td>100</td>
</tr>
</tbody>
</table>

Only 20 respondents felt that they were discriminated during their university studies (14.29%). The main discriminatory practice identified was "not to be given a possibility to follow an academic career" and "not retained for a research degree" (52+11.8 = 63.8%). It should be noted that one respondent did not answer the second part of the question, regarding the kind of discrimination.

Figure 7-7 graphically shows the four main discriminatory practices at university: (1) lower mark attribution for the same work, (2) non-retention for a research degree, (3) non-opportunity to follow academic career, and (4) other which is not specified. As the non-retention for a research degree is also a blockage for academic career, 63.8% of the respondents, who thought that they have been discriminated whilst at university, were not given access to an academic career. These findings reflect the observations of the British Institute of Physics study (IOP, 2010) of the experiences of women in Physics departments whose work and achievements have also been undervalued compared to that of male students. Even in situations where women achieved much better degrees, their male colleagues would be selected. Further reinforcement concerning the discrimination of women in science faculties can be found in a recent study where faculty assessors rated male applicants as more

\(^{143}\) One of the 20 respondents did not answer the second part of the question.
competent and hireable than the identical female applicants (Moss-Racusin et al., 2012). Furthermore, this bias was demonstrated equally by female and male assessors.

![Figure 7-7 Ways of discrimination](image)

Looking at the data of Table 7-9 we see that 22.86% of the respondents worked as teachers or professors, either in schools or universities. 11.43% do technical work, 27.14% research, 12.14% administrative work and 26.43%, or one quarter, other work which is specified in the individual questionnaires (see Appendix IV). All these activities are within the ICT sector.

<table>
<thead>
<tr>
<th>Answers</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative</td>
<td>17</td>
<td>12.14</td>
</tr>
<tr>
<td>University/school teaching</td>
<td>32</td>
<td>22.86</td>
</tr>
<tr>
<td>Technical</td>
<td>16</td>
<td>11.43</td>
</tr>
<tr>
<td>Research</td>
<td>38</td>
<td>27.14</td>
</tr>
<tr>
<td>Other</td>
<td>37</td>
<td>26.43</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>140</td>
<td>100</td>
</tr>
</tbody>
</table>

The results are presented in a graphical form in Figure 7-8.
Discriminatory practices in the workplace are rather difficult to pinpoint as in many cases it is not a direct bias, against which in most EU countries there is the formal protection of non-discrimination laws, but indirect, demonstrated usually as a combination of "micro-biases", which are implicit and not easy to detect. This question of discrimination will be further examined in more depth later on.

One indication of discrimination concerns vertical segregation, demonstrated by the number of women at top positions. Among the respondents, 12.15% of women are in senior management positions, which is similar to the proportion of women on corporate boards. 27.14% of the respondents are in middle management roles (see Appendix IV), where the risk of a shift to another career is high.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>No. of respondents</th>
<th>Family Member Scientist</th>
<th>Discrimination Studies</th>
<th>Discrimination Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-39</td>
<td>42</td>
<td>13</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>40-54</td>
<td>54</td>
<td>22</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>55-75</td>
<td>13</td>
<td>5</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>109</td>
<td>40</td>
<td>14</td>
<td>43</td>
</tr>
</tbody>
</table>
A Comparison of 109 ICT-educated Respondents

A comparison of the 109 respondents who studied ICT-related subjects (see Table 7-10), shows that 38.5 % (42 out of 109) belong to the 25-39 age group, whose exposure and familiarity with ICTs has been much more extensive than for the other two groups. Their experiences and views provide insights into future trends in the engagement of women with ICT as a career.

The data indicates that the influence of the family for this younger group is around 31% (13 out of 42), which is considerable, compared to the 40.7% of the 40-54 age group claiming the influence of the family. This suggests that the social role of the "family" persists despite technological and wider societal changes influencing women. A more detailed examination of the relationship between girls’ aspirations towards technical careers and their family background is needed.

In general, measures deployed to attract girls and women to careers in ICT have relied on female role models. This suggests that the potential influence of male role models has been overlooked, and that further research is needed to unpick the decision making process involving male family members.

Looking at the discrimination at work it is interesting to see that 47.9% of the 25-39 work in technical or research jobs and 28.6 % of all respondents in this group declare that they have been discriminated against. The types of discrimination reported are: "earning less than their male colleagues" which goes in most cases together with "passed over for promotions" and "not taken seriously". There was also one case of sexual harassment.

It should be noted, though, that discrimination at the place of work was indicated by women who have been in their jobs for more than 15 years (58.3 % of those discriminated). Based on this information we may conclude that there is a change in attitudes between early and later career stages. This has been confirmed by studies conducted at the MIT on the attitudes of women scientists at different stages of their career (MIT, 2011, 2002).

Among the 40-54 year-old group, 53.7 % work in a technical capacity or research, and 22.2 % as university or school teachers in a science sector. This indicates that 75.9 % remained in the
technical part of the sector, which is an important indication that the choice of profession was made due to preferences for technical subjects. There is a need for further research to increase our understanding of how these preferences can be influenced.

Investigating the discrimination factors, 46.29\% faced discrimination and 52\% of those have been in their present job more than 10 years. This suggests that "age-related" stereotypes combined with women-technology stereotypes have influences on biases affecting women. Only 28.57\% of the younger group declared themselves to have been discriminated against, which indicates that work cultures have been changing and gender equality measures are beginning to have a positive impact. However, the reasons given by the younger respondents for discrimination are similar to the other groups, namely "earned less" and "not taken seriously and not given enough responsibility", as the core measures of the inequalities that women experience at the workplace. This suggests specific recommendations for improvement that universities and employers can take.

The last part of this analysis is on the last group of 55 – 75 years of age. Here the sample is rather small - only 13 respondents, out of which 15.38 \% were discriminated against at university and 46.12 \% discriminated against in their work. This strengthens the argument that "age" becomes an additional factor that impacts on women’s careers more than that of men. They claimed that discrimination at work was mainly "not taken seriously" and "passed over for promotion".

The views expressed by respondents with regard to their experiences of ICT as a career option need to be seen against the efforts to improve the position of women in society, and in particular their participation in the labour force, over the last four decades. Instrumental to these changes has been a string of EC directives as previously mentioned. The mandatory character of EC law and the mechanisms of judicial protection in the EU have been crucial to the introduction of gender discrimination laws in Member States. However, all studies including this work show that they appear to have had little impact on the ICT sector, despite the fact that policy makers have connected gender imbalances in scientific and engineering fields with the need to introduce equality laws.
7.3 Qualitative Analysis

Qualitative analysis was used to supplement the results produced by the questionnaire study, in order to add cumulatively to the understanding of RQ 2 (What are the problems women face when they are in the sector?). The above data was the basis for the interview questions. The participants interviewed provided detailed descriptions and direct quotations, stressing women's experiences and knowledge in the ICT sector. This qualitative approach allows a person’s experience to be formulated in the context of situations, events, relationships feelings, values and beliefs.

Before going into the in-depth interviews, we should look at the general comments put in the specific section of the general questionnaire\(^{144}\) (Subsection 7.3.1). Then the three in-depth interviews which were carried out, one from each age group are presented. The cases chosen for the interviews were from the sample where discriminatory practices were declared. They are to be found in Subsections 7.3.2, 7.3.3 and 7.3.4. Subsection 7.3.5 states a part of a fourth interview with one of the respondents who leaves and works in one of the Eastern countries. The section closes with Subsection 7.3.6 that looks at discrimination at school and university.

7.3.1 Open Comments of the Questionnaire

Some interesting comments are made, such as those relating to the entry level in the labour market, the lack of support by family and infrastructure for mothers, smart discrimination and also a few comments about the questionnaire design.

- The questions in this test are very few, and do not get the picture of the situation.

- In Georgia I haven’t noticed the discrimination yet.

- More awareness raising around role models in the media.

- Both positive and negative discrimination.

- People accept it is inappropriate to discriminate on the basis of gender, which sends much of it underground.

\(^{144}\) The spelling and original expressions are kept.
• Women are seldom supported by their families and colleagues to go for a scientific career. Women also seldom get credits, instead they have to deliver more than men. I support quota! Otherwise difficult to improve gender equality.

• Even I never had a direct discrimination, I realise that to be possible for other women in a direct or indirect way.

• It depends rather a lot on the individual workplace itself.

• In an academic environment discrimination is not "evident" but "smart". But over the years a lot has changed and today the problem is mainly with women and their view on their role in life.

• The entry level for women is lower at the start -promotions are given but if the start grade is lower the discrimination is at the outset.

• Discrimination still exists, women having small children (2-7 years) have less career opportunities and get less paid.

• Pregnancy and then to be a mother is indeed a challenge but also a good reason for not giving you great responsibilities. Due to family needs the number of extra hours spent at work is less than in the past - and that is not appreciated by the employer.

• Discrimination was evident but not because I was a woman per se but because I did not have a "technical" education despite doing the same work as those with such education (i.e., project management).

• Discrimination comes from the top down: if management is not discriminatory, the organisation (in most cases) will not be either.

• Even as CEO of my company, I find it challenging to close deals with IT Managers who are male.

• More girl students than boys, similar teachers, much less women professors than men.
• The questionnaire is too simplistic and doesn’t offer enough choices. Also, without knowing whether I work in the public or the private sector, the answer to 12 doesn’t mean much. Conciliation work and family issue is demanding.

• Would be good to have a place for "don't know", because I don't know if I was discriminated against (people rarely broadcast these things). Also would be good to have a place where you can tick more than one option (e.g., why did you study science). Thanks.

• Being a full professor excludes from salary increases -- this is no discrimination.

• I have found the IT field to be rewarding and not gender-biased.

• MY TWO DAUGHTERS ARE STUDYING SCIENCE.

• The most important way is to be out of men’s networks in which they decide lots of things; women may not be given equal opportunities due to possible maternity leaves.

• I work in a large team of developers and IT Support, the team is 40 strong of which 5 are women.

• In my opinion it’s an advantage for a girl to study a technical field, as not many girls choose it, so teachers and students care about them more and help them a lot and support them, that’s my experience.

• WOMEN SHOULD DO THEIR WORK AND NOT LOOK FOR SYMPATHY. THIS WILL EARN THEM THE RESPECT THEY DESERVE.

7.3.2 Interview with Anna

Interview with Anna145, an engineer – age group 25-39 – working in the ICT domain for 5-10 years:

145 Names have been changed to respect anonymity.
"I liked science and Mathematics at school and it was only natural that I would go and study something relevant. I chose Civil Engineer as it was considered more suitable to women than mechanical or electrical. The fact that civil engineering includes something of both appears to escape everybody".

"For my first degree there was no problem as half of the students were women. When I went on to do my PhD, I was always second or third name in the publications, many times my name did not even appear despite the fact that I might have done all the work. My supervisor would put the names of some of my colleagues who have done very little or no work at all in the preparation of the paper".

"I was very soon attributed administrative rather than technical work or given work which required very little technical knowledge. My expertise was not used to its full capacity. In the meantime I had two children. Every time I was on maternity leave, the most interesting part of my work was ’temporarily’ passed on to one of my male colleagues. Although the administrative and ’boring’ parts of the work were passed back to me upon my return, the technical parts kept disappearing. This meant that as the technical work was considered to be more important I was lagging behind in promotions and was only promoted when it was unavoidable and delays could not further be justified. My progress reports were always excellent and the usual justification was ’softer’, non-technical work or something to this effect. At home I was responsible for the kids and Sundays were my husband’s technical catch-up time. I happily did that for many years until I realised that I was throwing away many years of study and letting my brain waste away".

Anna studied in two countries and moved to a third, where she lives and works now.

7.3.3 Interview with Jane

Fragments from the interview with Jane, an engineer – age group 40-54 – working in the ICT domain for more than 15 years, follow.

"When I went to secondary school I was good in all subjects including Mathematics and Physics. When the time came to choose between classic and scientific I was informed by my parents that I would attend the scientific section. I did not object as I like maths, it was an obvious choice (good students did science) and all my friends were going to the scientific orientation section. It was an "all girls" school so there was no competition between boys and girls. It is important to note that 44 girls went for classical
studies and 31 for scientific so the difference was not that great. In my home country, women doctors, physicists, mathematicians, chemists were normal. Many of the science students finished off as secondary school teachers. Engineers were less in numbers but this was mainly due to the very few places at the technical universities and the competition was very big. Studying engineering came naturally as both my father and brother were engineers”.

"My career progressed much more slowly in comparison to my male colleagues especially as I was going up the career ladder. I always had to do double the amount of work and continuously prove myself at different levels”.

Jane grew up in one country, studied and worked a little in another, and now lives and works in a third country.

7.3.4 Interview with Emily

Some parts of the interview with Emily who is in the older group and who studied and worked in four different countries are presented.

"I was interested in an academic career so after my post-doc, I returned to my home country where I applied to join the university as a lecturer. At the time I did not feel that I was discriminated but looking back I can see very subtle signs which I did not have the experience to understand at the time. For example having a slower promotion rate to that of my male colleagues and being told by my bosses every time that they really had to fight for me in order to become say a senior researcher or an assistant professor. As at the time I was young, just married and had a lot of work outside the university which kept me busy, none of these had any importance. Perhaps subconsciously I understood that things were not progressing as they should as I had decided not to have any children until my career really took off which happened much later”.

"I was blatantly discriminated for the first time when I applied for a job outside academia. I applied for a head of division post as well as a post in the division itself. I passed the necessary interviews and the assessment centre with flying colours as I learned later on but was recruited for the division and did not get the management post. The person selected who was later my boss did not have half of my working experience in the specific subject. Additionally they had to wait for more than six months for him to join whilst I joined in less than half this time. We were the only two shortlisted. The gentleman who was the acting head of division was also an applicant but not shortlisted. He made my life very
The transcripts of the three in-depth interviews are to be found in their totality in Appendix II.

7.3.5 Interview with Maria

I would like to include part of an in-depth interview with Maria. Maria studied and lives and works in the same ex-Communist country. She belongs in the final 55-75 years old group. The interview is not included in the detailed transcript but it is interesting to see that even in the so-called gender equality countries, the same problems existed.

"My father was an engineer and it seemed normal, as I liked science, to follow in his footsteps. There was no discrimination at school or university due to the regime of the State. I chose an academic career where my research possibilities were limited, and thus had to do a lot of teaching. Despite the laws for equal pay I earned less, there was always some male colleague who did this little bit more. I was not taken seriously most of the time, but I would do it all again!"

7.3.6 Discrimination at school/university

Discrimination at the place of study is limited and can be seen more in women who studied ICT-related subjects rather than in those who moved to ICT from other sectors. The main expressions of discrimination identified by the respondents were that they were not given the opportunity to work towards a research degree and therefore towards an academic career. The persistence of the gender bias in academic departments which disadvantages women is further confirmed by the answers to the questionnaire: many women who continued in an academic career were almost exclusively limited to teaching roles with only a few opportunities to develop careers in research.

7.3.7 Discrimination at the place of work

From the in-depth interviews and from the questionnaire, one main form of discrimination at work emerges, which is, the difference in the money earned. When there is discrimination, in most cases the comment that follows was "earned less". However, this is the case for all
sectors and not only for the ICT one. The Gender Pay Gap\textsuperscript{146} (GPG) is around 17% around Europe\textsuperscript{147}. An analysis of the gender pay gap in the UK showed that 30% of the 18% gap could not be explained through relevant mechanisms. That is certain differences persisted even after such factors as part-time work and time away from a career have been taken into account.

The second and most common discriminatory behaviour is "not be taken seriously", and then "passed over for promotion". Those two are closely linked: if a woman is not taken seriously as a professional, she is not given enough responsibility, which in itself would lead to a disadvantage in relation to a promotion. It also means that women experience career success less often than men, affecting their confidence and self-efficacy beliefs. Over time, not getting a promotion will lead to a loss of earnings. This is a vicious cycle.

An interesting comment made by a communications engineer working in her present job as a team leader for a relatively short time (1-3 years), and in the age group 25-39, goes to the point of how discrimination is experienced:

"I think most discrimination happens 'in secret' or it is unspoken. People accept that it is inappropriate to discriminate on the basis of gender, which sends much of it underground".

The observations made by the women who were interviewed confirm findings of studies which looked at the position of women in engineering and science fields (MIT,2011; IOP, 2010; MIT, 2002). The unconscious bias has been found in many cases and companies. During the course of this research a woman engineer took the questionnaire to post it on her company's internal website and, after discussion with her colleagues, decided that as it dealt a lot with discrimination it was not appropriate for them and it was not going to be disseminated there. The company, in fact, has excellent facilities for all employees to balance professional and family life and many services which are of particular help to women. On the surface, there is no difference between men and women. More in-depth discussions on other issues with some women from this company showed there were almost no women in management and decision making roles, and there were delays in promotions.

\textsuperscript{146} See definitions.

\textsuperscript{147} European Commission DG EMPL Data.
One participant made the following comment:

"Not taken seriously; Degraded from a managerial position during maternity leave"

The question of maternal leave and children is rather important as many women engineers feel that they are "passed over", as their goals and priorities compared to those of their male colleagues are different.

7.4 RESEARCH CHALLENGES

The questionnaire used as part of this work revisited some of the issues considered to affect women’s position as professionals, and their career pathways in the ICT sector discussed in earlier chapters. We mention amongst them the lack of promotion, not been taken seriously, considered to have different priorities, given administrative instead of technical work. The results of this chapter suggest the need for the following further investigation by refining the research methodology.

1. A male comparison group would help put women’s perceptions and experiences, particularly those highlighting promotions and family influences, in a better context to draw conclusions regarding work practices

2. A male-group comparison would also help show if men’s career strategies are different, for example, whether they move from one job to another more frequently than women and use this as a strategy for promotion and pay increases

3. The qualitative analysis will need to be extended to help unpick and make clearer the nature of family influences in career-related decisions

4. The qualitative analysis will need to be extended to help make a link between time spent in the job and opportunities for promotion

One of the respondents did observe that more questions were necessary in order to obtain a clearer picture. However, in-depth analysis of women’s experiences in ICT careers was outside the scope of this research.

One important issue that future studies need to consider, is how to identify the target sample, which covers both the geographical spread of EU27 and the different age-groups. As ICTs
encroach on almost every field of human activity, there is no clear definition of the population working in the ICT sector.

It should be noted that the questionnaire did not aim to thoroughly research the issues concerning women in ICT and draw definite conclusions. It mainly had an affirmative role for the issues which have been discussed in the previous chapters (mainly Chapters 4 and 5) as well as the model presented in Chapter 1.

7.5 SOME PROVISIONAL CHAPTER CONCLUSIONS

From the questionnaire and the qualitative analysis we may tentatively affirm eight results.

1. Family could be considered to be instrumental in the choice of studies and profession.

2. Some discriminatory practices can be found at school and university in the form of denying or making more difficult access to an academic career, and not being taken seriously.

3. Women earn less than their male counterparts.

4. Women are often not taken seriously in their place of work.

5. Women have fewer promotions.

6. Women are given administrative or what are considered to be "feminine" jobs such as teaching, even when they are working in a technical environment.

7. Discrimination at the place of work appears less towards women who work in ICT but have moved into the sector from different areas of expertise.

8. Attitudes appear to be changing and the younger generation of women experience fewer obstacles in their education and careers than more senior women.

This field work was on a limited scale, and conclusions resulting from it are therefore open to error as well as research bias. The tentative confirmation of the results presented however is useful in order to give us an "instant picture" of the present situation. This explains the fact that no multivariate analysis has been carried out.
In this final chapter, the conclusions of the research reported in this thesis will be presented together with six recommendations. The answers to the five research questions that emerged from the research carried out are presented (8.1), then the problem statement is addressed (8.2). The findings of this work are grouped together and discussed (8.3). It is followed by the main conclusions of this study (8.4) and the recommendations for future interventions (8.5).

### 8.1 SUMMARY OF FINDINGS ON THE RESEARCH QUESTIONS

**Research Question 1:** Which are the areas in the sector where women are most under-represented?

This question was investigated in Chapters 2, 3, 4 and 5. Statistical evidence shows that for a variety of reasons women do not choose to study ICT-related subjects, though the word “choice” should be treated carefully. From an early stage, therefore, there is a lack of females who would then provide a sufficient talent pool to provide input for women in higher positions in the sector. Additionally, the phenomenon of the leaky pipeline increases as time passes, as more and more women leave the sector due to the limited progress in addressing the obstacles to their careers, especially when reaching managerial or high academia levels. This leaky pipeline is not balanced by women joining the sector from other areas. These are two reasons why women are under-represented in the sector and this initial supply and "leaking" is more evident in the following areas:

1. **Management:** There are few women in the managing boards in the sector and therefore there are few women in decision making positions.

2. **Design and Production of Technology:** Women are under-represented in many of the technical areas and are not allowed to design and produce technology "fit" for female users.

3. **Higher Academia:** Due to discriminatory practices women do not progress according to their abilities in the academic hierarchy.
4. **Research Work**: Women are not encouraged/promoted enough in their research work and often are not given enough/any visibility.

**Research Question 2**: *What are the problems women face when they are in the sector?*

This question was investigated in Chapters 2, 3, 5 and 7. Women face discriminatory practices at school/university and work. The main problems summarised are:

1. Women who have studied ICT-related courses often face the problem of discriminatory behaviour during the period of their studies, in terms of assessment of their capabilities and work. This discriminatory behaviour is not homogenous across the European Union Member States, and is linked to prevalent socio-cultural norms. There is no evidence that such behaviour is intentional. By being implicit rather than explicit, however, it is harder to address.

2. In the professional domain, there are persistent indications that there is discrimination in (1) recruitment, (2) salaries, (3) career development, and (4) level of responsibility.

3. Due to their nature and role as the main family carers (intentional or not), having children without the necessary support infrastructure often obliges them to leave the sector as too demanding.

**Research Question 3**: *Why are women under-represented in the cyber-community?*

Chapters 2 and 3 provide statistical evidence and a broad literature review on the initial fact that women are under-represented in the ICT sector. The reasons could be summarised as follows.

Under-representation may start at university level. Although there the women are a majority in tertiary education, however few attend scientific courses and in particular engineering and computing. This is due to the (1) way girls are brought up, (2) the influence of parents and teachers, (3) technophobia transmitted at school at an early age, (4) stereotypical representation of women in technology, and (5) career and study choice which is biased due to the four reasons stated previously.

The under-representation pattern is identified in research work, academia and employment. Here the reasons are (1) misconception about job and job requirements especially in terms of
technical requirements and personal life, (2) career stagnation (lack of promotions and/or mobility), (3) difficult access to research, (4) no progress in the academic hierarchy, and (5) no recognition of technical qualification, i.e., many women who are Engineering/Computer Science graduates have administrative/non-technical jobs.

**Research Question 4: Has there been any improvement in recent years?**

Chapters 2 and 6 investigate this question. A number of initiatives such as the European Centre for Women and Technology, The Code of Best Practices for Women and ICT, mainstreaming activities and others, were launched in order to increase the number of women in the ICT sector over the last decade. Estimations and some statistical evidence indicate that some improvement can be seen but it is necessary to set up impact measuring mechanisms in order to assess effectiveness and sustainability of the measures that have produced positive results.

**Research Question 5: What measures can be taken to improve the representation of women in the cyber-community, both qualitatively and quantitatively?**

The research has identified four persistent issues such as (1) stereotyping, (2) women engineers and computer scientists are not taken seriously, (3) non appreciation and use of technical knowledge, and (4) most importantly no access in management positions which show some improvement. All of these can be classified under bias or discrimination. Measures such as (1) mentoring, (2) intervention at family level, and (3) retraining of women returners are some of the possibilities to be considered. These are summarised in section (8.2), in the context of the problem statement.

### 8.2 Summary Findings on the Problem Statement

**Problem Statement: Would engendering technology, i.e., increasing the number of women in the production, design and use of technology, lead to empowering women?**

The present research indicates that the ICT sector is a key driver for growth and jobs in the EU economy. It contributes around 50% to productivity and growth (European Commission, 2010b) and in the current financial crisis, ICT is one of the sectors that it is still growing and still has the lowest job loss figures. It should be noted that almost 70% of ICT-related jobs are to be found outside the ICT sector.
Engendering technology as stated in the problem statement, denotes more women in the design, production and use of technology. It should be underlined that this vision of engendered technology, as it has already been mentioned (Chapter 1), is only situated in the Western/developed world and other arising and perhaps more mundane issues that women in other geographical areas have not been examined. This "engendering of technology" entails the creation of new dynamic communities (female) shaped by the rapid development of technology producers, consumers, entrepreneurs, and of course, users. Haraway (1985) (2.1.3.2) emphasises that technology leads to empowerment as the modification of circumstances can provide increased strength and control over constructs. Post feminists and in particular Turkle (2011) claim that the engendered construction of technology guarantees that we do anything we want in any place. Van Herik, Lamers and Verbeek (2011) draw our attention though to the possible conflict between technology and society.

Engendering deals with employment and therefore financial empowerment of women, as well as additional issues such as entertainment, information and consumer power. All these contribute to empowering women in a holistic manner, be it in their professional or private life.

If we are to revisit Chapter 1 (Subsection 1.4.2 – Empowering Women) we shall see the capabilities that according to Thomas and Velthouse (1990) constitute empowerment. The research in this thesis verifies that engendering technology as defined would lead to such empowerment. More specifically the abilities to "make decision about personal/collective circumstances; to access information and resources for decision making; to consider a range of options from which to choose; to exercise assertiveness in collective decision making" may be obtained by being given the options through technical/scientific studies especially in terms of meaningful employment and involvement in leadership. The abilities "to learn and access skills for improving personal/collective circumstances; and to inform other's perceptions through exchange, education and engagement" may be achieved through using ICT tools and instruments to obtain information and acquire new skills. Finally, as far as personal development is concerned, the four abilities (1) exercise assertiveness in collective decision making; (2) to be involved in the growth process and changes that never-ending and self-initiated; (3) increase one's positive self-image and overcome a stigma; and (4) increase one's ability in discrete thinking to sort out right and wrong, may be obtained through a well-paid
and interesting job where the employee's contribution is both valid and tangible giving her thus increased self-confidence.

In simpler terms, women "first time employees" and women with young dependants are amongst the worst hit by unemployment. Unemployment is not conducive to empowerment. Training and re-training/career reorienting women as ICT professionals and/or as proficient ICT users would increase their employability and provide them with the opportunity to find a job in a sector that continues to grow, albeit in a slower rate, even in the middle of a European financial crisis. Encouraging young girls and women to pursue a career in the ICT sector means a better paid job, more job security as well as an opportunity for the sector itself to benefit of their hitherto untapped creativity and talent.

Although empowerment is considered and examined through the means of engendering technology, at a more general one up level, the issues raised by the First, Second and Third/Post Modern Wave feminist writers indicate that social inequality and lack of empowerment is due to structural defects (de Beauvoir, 1972) and are socially imposed and constructed (Irigaray, 1985). The idea of structural defects and female empowerment through economic development and, in the specific case through the engendering of technology, is further supported by socialist-feminist theory (Labovsky Kennedy, 2008; Wharton 1991). Social justice and equality would only be achieved through cooperative mechanisms and not through conflicting and competitive ones. Although Third Wave feminism deals with concrete issues such as harassment, support for single mothers, glass ceiling etc., (Munden, 2003) and the discriminatory practices in the cyber society (Braidotti, 1996), empowering women through the engendering of technology is but a small part of the required female empowerment and this could only be achieved through structural changes in society and with the participation of both females and males.

The work of the thesis the end of which coincides with a major financial crisis in Europe and not only, indicates that there exist an interesting paradox. Despite the feminist activists and what is considered female empowerment, the first victims of this crisis are women. Unemployment figures across Europe indicate that in the last quarter of 2011 (EUROSTAT, 2012) female unemployment increased and there is an upward trend. This suggests that women remain in their "set" social and professional trajectories.
8.3 FINDINGS OF THIS THESIS

Drawing from the summary findings stated above for each of the research questions, and from the conclusions stated at the end of each chapter, the model presented in chapter 1 (Fig 1.7) of influences on women’s participation in ICT can be completed by adding the areas of intervention.

Just to remind us, the model starts with the main influences in career choice for individuals. These are family, school and teachers, peers and finally the media. All of these factors combine to lead to career choice, whether within or outside of the ICT sector. Some young people go to university, some follow vocational training and some others stop studying and go to work. This latter group are often girls, who might see marriage and having a family as a proper "career" option for women. At this first stage of the career-decision pathway there is already a segregation of perceptions about the future, with small numbers of young men and women choosing ICT as the preferred profession, and young women doing so at considerably lower numbers than young men.

The "leaky pipeline" starts to be more noticeable at university, when many young women either change their chosen study orientation or stop altogether. When entering the labour market, a great number of women who have studied ICT-related subjects opt for jobs which are not relevant to their studies or they move away from the sector, which has the reputation of being a difficult one for women, to jobs which are considered softer, such as administration or HR. Many women who remain in the sector of scientific research end up doing mainly teaching jobs. There is, though, some influx of women who are job returners or of those who, lacking a job, decide to retrain for a career in ICT.

The model of Getting in – Staying in the ICT sector (revisited at the initial stages) is given in Figure 8 – 1.
Looking at the model, and the four main career choice influencing factors, eleven conclusions may be drawn from the work of this thesis.

1. Career preferences, as seen in the literature review and in the answers to the questionnaire, start being shaped at a very early age, and the parental education and family environment play a significant role in this process.

2. There are misunderstandings among the general population as to the activities of the ICT sector. There appears to be rather little effort in the sector to engage with the public in any other way than as consumers of technology, rather than participants in the innovation process, for example.
3. ICT scientists are negatively stereotyped and women, in particular, are featured as atypical of their sex. In fact there are no role models of women in science in general, or in the ICT sector, specifically.

4. Girls are treated differently in mixed sex schools and perform worse in sciences than in unisex schools.

5. Stereotyping and implicit bias in university departments lead to cases of discrimination against women studying "atypical" subjects, e.g., engineering.

6. Women are not very good at setting up and using professional and collaborative networks for career development.

7. There is a serious lack of up-to-date, informative and useful career advice that could help young people and women in general to orient their aspirations towards ICT.

8. There is a lack of transparency in recruitment processes and how companies manage their labour force requirements.

9. There is a lack of progression pathways in ICT, which leads to many women leaving the sector or choosing to work in non-technical areas such as administration.

10. A considerable gender salary gap exists at all levels, as well as a serious lack of women at senior positions (CEOs or management boards).

11. In general, there is inadequate provision of social institutions and infrastructure to support individuals in balancing professional responsibilities with family life, which disadvantages women in particular.

It should be noted that many of these conclusions are true for other employment sectors as well. They are simply more accentuated in the ICT sector, and more interesting given the dramatic advancement of digital technologies, and their impact on every area of work and social activity.
8.4 **Main Conclusions**

The principal conclusions based on the analyses and research carried out are (1) that an increased representation and involvement of women in the ICT sector will lead to their empowerment as technology users and leaders, and (2) that in order to increase the number of women in the sector, specific changes need to be made to the way technology is portrayed, understood, and deployed, i.e., engendering technology.

8.5 **Recommendations**

Having seen the main influences on career choice, as well as the key factors which tend to lead women away from the ICT sector, the areas where intervention is possible have been identified. The areas of intervention in the model can then be added as mentioned in Figure 8 – 2. Nine areas of intervention have been identified and 15 possible interventions are listed. We consider the implementation of the 15 interventions as our recommendations.

Interventions could be made in the following areas:

- School.
- Family.
- Peers.
- Media/Environment.
- Vocational Training.
- No career/no employment.
- University.
- Leaving the labour market.
- ICT sector employment.
- Industry.
- Academia.
- Government

The recommended interventions are:

<table>
<thead>
<tr>
<th>Intervention 1: Fight technophobia (train the trainers).</th>
<th>Intervention 6: Use social networking to raise awareness.</th>
<th>Intervention 11: Cooperation with industry, relevant curricula, flexible courses.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention 5: Same treatment boys and girls.</td>
<td>Intervention 10: Provide incentives for training.</td>
<td>Intervention 15: projection of future employment needs (job content).</td>
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</tbody>
</table>
Looking at the model, the recommendations are presented in greater detail in four Subsections: 8.5.1 School, 8.5.2 Family, 8.5.3 Peers, 8.5.4 Media/Environment, 8.5. No Career, No Employment, 8.5.6 University, 8.5.7 Vocational Training, 8.5.8 Leaving the Labour Market, and 8.5.9 ICT Sector Employment, Industry, Academia, Government. We complete the thesis with a Summary (8.5.10) of the recommendations and interventions made.

8.5.1 School

**Intervention 1:** It is in the classroom that children acquire their initial perceptions of the role of women in society and their relationship with technology. It is therefore essential to ensure that teachers, both male and female, are aware of the sensitivity of the relationship of females with technology, and the important role they play in encouraging young people to learn and love science. The first step, therefore, would be to fight the technophobia of teachers themselves. This can be achieved through tailor-made awareness-raising and training seminars.

**Intervention 2:** In order to ensure that the breadth and benefits of science and technology are properly internalised, and recognised not only as classroom experiences, but also in real-life contexts, girls should be given opportunities to participate actively in science-related activities such as science projects, and increase their self-confidence and understanding.
Particular attention to this work should be paid in mixed sex (boys and girls) schools and the possibility of having unisex teaching, when it is an option, should be considered.

**Intervention 3:** Career orientation classes are necessary in each school or region from a young age, in order for children to understand what each career involves. As the content of many traditional careers is *grosso modo* known, the different careers in technology should be listed, analysed and simplified in order to be presented in a way that children can understand.

Mini-mentoring projects and presentation of role models within the schoolwork framework is important to help younger girls discuss future career plans. These exercises should of course be monitored in some way, both in order to see their impact, and also to avoid any complications that might arise at an interpersonal relations level or to monitor for any potentially undesirable influences.

**8.5.2 Family**

**Intervention 4:** Influencing the role that parents play in shaping the attitude of their children is, of course, difficult as there are no mechanisms to do so. Parent information about parental behaviour concerning science and technology could be organised at school level, combined with career orientation days, but more preferably when children start nursery school, as early childhood influences play an important role in child development. These "seminars" can be organised by local authorities and presented in the schools as information evenings.

A better eSkills competence would broaden parents' horizons and help to make them aware of the possibilities of the ICT sector. These need to be centrally organised and financed by the state or local authorities.

**Intervention 5:** Within the family environment it is necessary that parents treat boys and girls in the same manner avoiding to allocate socially pre-defined roles, i.e., boys to play computer games and girls to help in the kitchen. Although with the passing of time girls are more involved in using electronic gadgets, they should be also be encourage to create interests in science or technology.

**8.5.3 Peers**

**Intervention 6:** Social media should be used to promote the social face of technology, demystify the technical part of the information society and raise awareness. This information
would be shared amongst young people and peer support by the ones more interested in technology should be generated. The involvement of young boys in such activities is very valuable.

As seen in Subsection 7.2.2 the low-level peer influence in deciding to study science shows that the social perception of ICT is ambiguous. Further research in this area could be important for further interventions.

8.5.4 Media/environment

**Intervention 7:** Considering the role that the Media play in our everyday life and always respecting the freedom of expression, female role models should be presented and more quality space should be allocated to women on TV, radio and in printed media.

**Intervention 8:** It is necessary to fight the "geek" stereotype for women in ICT. This can be achieved through activities such as "shadowing" or "girls' days", but also through advertising, particularly on television.

It should be noted that the four influencing factors for career choice (School, Family, Peers and Media/Environment) do not stand alone. They interact dynamically with one another leading into study and career choices.

The second part of interventions presented in the model deals with a co-operation of the academic and corporate worlds, in order to look at the multifaceted problem of the leaky pipeline.

8.5.5 No Career – No employment

**Intervention 9:** ICT-related jobs do not necessarily require intense technical training. The deployment of the applications of ICT technologies especially nowadays is oriented towards the citizen (eHealth and eGovernment applications for example). Unemployed who wish to enter the labour market need to be made aware of the opportunities offered as well as the different facets of employment in the sector.

**Intervention 10:** Training in the sector needs to be accompanying with incentives to encouraged unemployed to take it. Incentives could be internship after training, possible employment if the training takes place in the private sector as well as support for family
obligations for example baby and toddler care centres. It is necessary for the State to be involved in either providing training centres with certified qualifications or give incentives to the private trainers/employers such as tax reductions. This already happens in some countries such as Belgium to name one. In most cases the necessary infrastructure for child care also needs to be provided by the State.

8.5.6 University

**Intervention 11**: Revised curricula need to be envisaged in order to reflect, on the one hand, the needs of the industry and, on the other, the particular genetic make-up of women. This means that on top of the basic educational needs at a scientific university or vocational course, specific courses covering subjects nearer to female talent should be added.

Academia should move from the 20th century model of education, which is very valuable for most subjects, to a more flexible curriculum which would be able to follow and predict the development of technology. The fact that working in the ICT sector does not necessarily require a technical background should be taken into account and explored within the framework of different kind of courses.

Mentoring support for university or vocational training students should be envisaged and should also include industry-based traineeships. Mentors need to be part of the academic world to start with, but might be replaced nearer the end of training or studying by professional people who will be able to guide and encourage graduates for job orientation, recruitment, etc.

The issue of re-qualifying women returners should be considered in order to create in a short time, ICT-relevant profiles. This could be achieved in cooperation with the sector's industry.

8.5.7 Vocational Training

The interventions presented here are mainly under the responsibility of the industry and employers although some of the interventions presented under Subsection 8.5.5 are also valid.

**Intervention 12**: It is important that vocational training would result into secure employment and traineeships as well as flexible courses which could be followed easily by employees who
either have private responsibilities e.g. children, or continue working and wish to change after the training.

**Intervention 13**: Taking into account the stereotypical representation of working in the ICT sector, it is important to improve career prospects and working conditions. Practices such as transparency in recruitment and management training, as well as support to balance family and professional life, are imperative for organisations to keep their talent. Career orientation and facilitating progress are necessary. The issue of the gender pay gap should be resolved too.

### 8.5.8 Leaving the Labour Market

The interventions suggested in Subsection 8.5.7 and those to be suggested in Subsections 8.5.9 and 8.5.10 cover what is needed to encourage women to remain in the labour market and in particular to remain in the ICT sector.

#### 8.5.9 ICT Sector Employment, Industry, Academia, Government

**Intervention 14**: Despite efforts in recent years there is still no clear picture of women's participation and involvement in the ICT sector. The available data is either too fragmented (such as in patents) or too general (Computer Science, Electrical Engineering and Manufacturing all in one sector). It is necessary to target the collection of segregated statistical data in order to have an up to date picture and facilitate intervention. The role of the government or European/International institutions to initiate new codes and NUTS is imperative.

**Intervention 15**: Industry could cooperate with Academia in order to create (1) tailored courses which would cater for the lack of skills that is at the moment one of the problems of the industry, and (2) to provide placements for at least two years to give young women the necessary experience which would help them to find a permanent job.

Industry needs to define its requirements and in cooperation with Academia investigate the possibility of re-training women returners. This could be achieved through vocational training combined with academic education.

Finally, the sector itself should work towards evaluating future skills needs – future job projection – and define the work content.
8.5.10 Summary

Indicators and benchmarking are important in order to be able to know exactly the impact of the different actions. This is not possible at the moment. The collection of segregated statistics as mentioned in Subsection 8.5.9 will also give a better insight into the status quo, enabling policy-makers to adjust or develop new policies.

The recommendations made could be grouped under two main titles:

1. Reframe the question of the under-representation of women in the ICT sector and present it as part of the technology equity policy.

2. Look for legislative intervention efforts, which will focus on awareness-raising and training of all concerned parties, in order to influence career choices and stop the phenomenon of the "leaky pipeline" and, in addition, feed it.

Apart from the model summarising the influences and possible interventions related to attracting and retaining women in the ICT sector, there is a need to launch measures which will investigate the "few, slow and low" (Ranga and Etzkowitz, 2010), or "two steps forward, one step back" (Ayre et al., 2011) syndromes. The research in this thesis refers to many different initiatives from the last 20 years, which have been trying to improve the position of women in the sector. The progress made according to the statistical evidence available is inadequate, and perhaps disproportionate to the effort. The reasons for this hampered progress need to be investigated in more detail. This would mean that longitudinal studies measuring the impact of implemented and envisaged initiatives should be launched identifying and remedying thus errors in the processes used.

Additionally, the need to have an exact image of what is happening in the sector, in terms of female representation at all levels, is imperative. This point was identified in many instances in this thesis. Reliable and regularly updated statistics would be one of the instruments which would contribute towards measuring the impact of the different activities.

The recommendations and interventions identified should be part of a non-linear but of a multilevel framework of treating the issue of "Engendering Technology Empowering Women".
The work in this thesis has responded to the five research questions initially set, and went on to contribute to the expansion of knowledge in this particular area.
REFERENCES

The references contain (1) books and journal articles, (2) policy papers, working papers, government papers, courses, reports and (3) web articles. We warn the reader that she might expect to find a reference under (1) whereas this reference is placed under (3).

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POLICY PAPERS, WORKING PAPERS, GOVERNMENT PAPERS, COURSES, REPORTS


EUROSTAT, (2012). europa.eu/statistics_explained/index.php/Unemployment_statistics#Recent_developments_in_unemployment_at_a_European_and_Member_State_level


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WEB ARTICLES


SITES CONSULTED

The sites are listed in antichronological order of the time of consultation.


http://londongirlgeekdinners.co.uk accessed 10/10/2011.


http://www.egs.edu/faculty/helene-cixous/biography/, accessed 06/04/2011


OTHER WORKS CONSULTED


APPENDICES

APPENDIX I: Checking Gender Relevance

Gender Impact Assessment

APPENDIX II: Questionnaire Information

In-depth interviews

APPENDIX III: Tables with the analytical results of the questionnaires

APPENDIX IV: Detailed answers to questionnaires
APPENDIX I: CHECKING GENDER RELEVANCE

The first step in a gender mainstreaming process is to establish whether gender is relevant to the policy on which you are working. In order to check gender relevance, you need to obtain and study sex-disaggregated data and to ask the right questions:

* Does the proposal concern one or more target groups? Will it affect the daily life of part(s) of the population?

* Are there differences between women and men in this policy field (with regard to rights, resources, participation, values and norms related to gender)?

If the answer to any of these two questions is positive, gender is relevant to your issue. An assessment should be made of the potential gender impact of the policy proposal.

Policy decisions that appear gender-neutral may have a differential impact on women and men, even when such an effect was neither intended nor envisaged. Gender impact assessment is carried out to avoid unintended negative consequences and improve the quality and efficiency of policies.

The Global Platform for Action, adopted at the Fourth World Conference on Women in Beijing 1995, requests Governments and other actors to mainstream a gender perspective into all policies and programmes, so that, before decisions are taken, an analysis is made of the effects on women and men respectively. Gender impact assessment is a tool for realising this. In February 1996 the Commission adopted a Communication on Mainstreaming was a first step towards implementing the commitment of the EU to gender mainstreaming at the Community level. In the follow up Strategy Paper, agreed by the Inter-service Group on Equal Opportunities for Women and Men in February 1997, gender impact assessment in the Commission services is mentioned among the core measures. The Treaty of Amsterdam formalises the mainstreaming commitment at the European level, as it explicitly mentions the elimination of inequalities and the promotion of equality between women and men among the tasks and objectives of the Community (Articles 2 and 3).
Gender impact assessment has been widely used in the area of development cooperation, where appropriate training and tools have been applied. In the wake of the Beijing conference gender impact assessment has been adopted by a number of European governments as a tool for implementing mainstreaming. The present guide draws heavily on existing experience, and in particular, on the work of Mieke Verloo, Chair of the Group of Specialists on Mainstreaming of the Council of Europe. This guide to gender impact assessment is intended for adaptation to the specific needs of each Directorate General and policy area, as appropriate. Relevant examples from all Directorates General and policy areas could in the future be annexed to the guide to improve its utility.

**GENDER IMPACT ASSESSMENT**

Gender impact assessment should be carried out once it is established that a certain policy has implications for gender relations. It is most successfully carried out at an early stage of the decision making process, to allow for changes, and even major reorientation, of policies, when appropriate.

*Gender impact assessment means to compare and assess, according to gender relevant criteria, the current situation and trend with the expected development resulting from the introduction of the proposed policy.*

In order to carry out gender impact assessment you will take into account the existing differences between women and men, which are relevant to your policy area, in order to ensure that the policy proposal you are working on contributes to eliminate inequalities and promote the Community objective of equality between women and men, embedded in Articles 2 and 3 of the Treaty of Amsterdam.
APPENDIX II: QUESTIONNAIRE INFORMATION

Questionnaire sent to participants of the survey:
1st in-depth interview

Anna

Age: 37

**How did you choose your tertiary education orientation?**

I liked Science and Mathematics at school and it was only natural that I would go and study something relevant. I chose Civil Engineering as it was considered more suitable to women than mechanical or electrical. The fact that civil engineering includes something of both appears to escape everybody.

**Did you face any discrimination when at university/postgraduate?**

For my first degree there was no problem as half of the students were women. When I went on to do my PhD, I was always second or third name in the publications, many times my name did not even appear despite the fact that I might have done all the work. My supervisor would put the names of some of my colleagues who have done very little or no work at all in the preparation of the paper.

**How did you start your career?**

I met my husband whilst I was doing my PhD and both found a job as free lances in a research institute, he was thinking about an academic career. He had an offer to stay on at the university but did not accept at the end as he thought that I was unfairly treated. Working in the research institute there was no discrimination.

**You are now working in the ICT sector, how did this happen?**

My husband and I both took an open competition to join an international organisation. The subject of our PhD was ICT-related. We both passed and started interviews to join. We applied for different posts. Due to the similarity of our qualifications we were invited to the same interviews. I should say that we do not have the same surname so they did not know we were a couple. We were both selected to join but he was offered immediately a permanent contract whilst I was offered a more precarious one (free lancing). When I refused the offer which was repeated several times, I was also given a permanent contract.
When I joined, I found out that it was not a matter of available budget. They wanted to use the available post for a man who finally joined on a free-lance contract and became permanent later on. This was my first indication that there might be discrimination.

**How is your career progressing in relation to that of your male colleagues?**

I was very soon attributed administrative rather than technical work or given work which required very little technical knowledge. My expertise was not used to its full capacity. In the meantime I had two children. Every time I was on maternity leave, the most interesting part of my work was "temporarily" passed on to one of my male colleagues. Although the administrative and "boring" parts of the work were passed back to me upon my return, the technical parts kept disappearing. This meant that as the technical work was considered to be more important I was lagging behind in promotions and was only promoted when it was unavoidable and delays could not further be justified. My progress reports were always excellent and the usual justification was "softer", non-technical work or something to this effect. At home I was responsible for the kids and Sundays were my husband's technical catch-up time. I happily did that for many years until I realised that I was throwing away many years of study and letting my brain waste away.

**Do you feel that there are things that need to change in the sector as far as women are concerned?**

Anything that needs to change needs to change in cooperation between men and women in order not create ghettos and ensure that men will not resent any measures taken. The ICT sector needs to lose its image of unfashionable and nerdy. The social side of the sector and the advantages for the citizen should be underlined. The sector is not only technical but also social. The increase in the use of social media would help a lot.

**Is it important for women to be more represented in the sector?**

Women have different talents than men. Male and female talents are complementary and should be used to the advantage of the sector. Production and development should be based on the requirement of the whole of the society. There is a tendency to classify women as a minority and this is wrong. Women are more than 50% of the population and their needs should be taken into account.
What can be done to improve things?

As I said before we need to ensure that men are included in all the changes envisaged as improving the sector is something which concerns both males and females. Interventions should be made very early both in the way families treat their female children. School is another area where early intervention is important. Science and Mathematics should be taught in the same neutral way as reading and writing. Teachers should have the same expectations from girls as from boys. Gender discrimination should also be eliminated. Finally we should adopt measures which appear to work, for example quotas as seen in some countries. To do this we should be able to assess the impact of the different measures and initiatives. This presupposes that we have adequate statistical data.

Any other suggestions?

Follow up what started! Initiatives should start and followed up. Some of them might need a long time before they show any results. This means that we need to persevere.

2\textsuperscript{nd} in-depth interview

Jane

Age: 53

How did you choose your tertiary education orientation?

When I went to secondary school I was good in all subjects including Mathematics and Physics. When the time came to choose between classic and scientific I was informed by my parents that I would attend the scientific section. I did not object as I like maths, it was an obvious choice (good students did science) and all my friends were going to the scientific orientation section. It was an "all girls" school so there was no competition between boys and girls. It is important to note that 44 girls went for classical studies and 31 for scientific so the difference was not that great. In my home country, women doctors, physicists, mathematicians, chemists were normal. Many of the science students finished off as secondary school teachers. Engineers were less in numbers but this was mainly due to the very few places at the technical universities and the competition was very big. Studying engineering came naturally as both my father and brother were engineers.
Did you face any discrimination when at university/postgraduate?

I went to university not in my home country and was really surprised by the differences I saw. In the preparatory courses we were only three girls (two in Maths, two in Physics and two in Chemistry including myself who was in all three). One of the girls wanted to become an economist so she was preparing in Maths and the other a doctor and took the Physics and Chemistry courses. I started university reading Applied Physics hoping to specialise in Non-Destructive Testing. As from the first day I was discouraged as this was not "a job for a woman" and "you will not be able to have any children". I only had one female professor and she was teaching photography! At the end of the first year I changed into Electrical and Electronic Engineering where I thought that as the classes were bigger I would draw less attention to myself. During my Physics year I had to do industrial training where although people were very kind to me, they did not really take me seriously and tried to discourage me giving me to do jobs which were physically demanding and which could be done with machines, e.g., cleaning pressure tanks. In the engineering course there were 98 boys and me! At the beginning the boys tried to shock me by showing me play-boy pictures etc., but after a while they tried to help me with computer programme preparation, in the labs etc. The professors were very hard as they under-marked my papers. For example when handing in lab work my fellow male student would get an 85% and I would get a 70% with the same results and a much better presentation. I was feeling pressurised and at some stages very insecure about myself. The result was that I did not complete my studies and after a gap year took a completely different path which strangely enough led me to engineering and ICT later on.

How did you start your career?

I start working in a company which dealt with quality and quantity control. I was taken due to my scientific background and one of the things was to evaluate non-destructive testing!

You are now working in the ICT sector, how did this happen?

I made a career choice to move again and found what was on offer interesting and took it up. Although I worked initially in the administration I moved into technical and then strategic work during the years. It was one of those things that just happened.

How is your career progressing in relation to that of your male colleagues?
My career progressed much more slowly in comparison to my male colleagues especially as I was going up the career ladder. I always had to do double the amount of work and continuously prove myself at different levels. When I had my child, a colleague came to me and asked me to take over my job as I might have serious problems during labour. It was a sensitive touch!

Do you feel that there are things that need to change in the sector as far as women are concerned?

The moment that we do not feel that we need to become "men" in order to be accepted in the job and that we do not have to justify ourselves for our professional choices, will be the moment we reached equality. There is not need for extreme measures as we risk to create resentment about the whole thing, it is already happening. It is important that people with the same qualifications, skills, experience and ability are treated equally and are given the same chances. The ICT sector is not something women should be afraid of in the same way they should not be afraid to ask for what is due to them.

Is it important for women to be more represented in the sector?

The technology produced addresses both men and women and should take into account the interests, needs and wishes of all. It is not enough to "pink it and shrink it" in order to address female consumers. There are more fundamental differences than that. Also, a lot of the research for example in the health sector does not take into account the needs of women who are different physiologically.

What can be done to improve things?

It is discussed all the time, nothing out of the ordinary. Mentoring, networking and awareness campaigns are helpful tools. Even introducing quotas in some cases would help especially at leadership levels. But what is done should be done with the cooperation of men and not individually. We need to know though how big the problem is, and how it is developing which means we need to have a better collection of targeted and regular statistics.
Any other suggestions?

It is time to act now that the economy needs women and that the sector is continuously expanding. Women should avoid falling into the trap of accepting less than what is due to them.

3rd in-depth interview

Emily

Age: 62

How did you choose your tertiary education orientation?

I was always fascinated with Mathematics and my father who was a mathematician encouraged this interest. It was normal to choose a relevant university course.

Did you face any discrimination when at university/postgraduate?

Despite the fact that my university years are long behind me, I do not remember any discrimination when I was at university not during my PhD and post-doc work which I carried out in two different countries. So I studied in three different countries but did not feel any discrimination.

How did you start your career?

I was interested in an academic career so after my post-doc, I returned to my home country where I applied to join the university as a lecturer. At the time I did not feel that I was discriminated but looking back I can see very subtle signs which I did not have the experience to understand at the time. For example having a slower promotion rate to that of my male colleagues and being told by my bosses every time that they really had to fight for me in order to become say a senior researcher or an assistant professor. As at the time I was young, just married and had a lot of work outside the university which kept me busy, none of these had any importance. Perhaps subconsciously I understood that things were not progressing as they should as I had decided not to have any children until my career really took off which happened much later. In fact, I have no children.
You are now working in the ICT sector, how did this happen?

ICT and computing was a natural path to follow for one who studied Mathematics back in the 60s. It was something new, very exciting and with huge potential. For me computing was intellectually challenging and the future of the world so I wanted to be part of it. This led me to move out of an academic career into policy and implementation of technologies.

How is your career progressing in relation to that of your male colleagues?

I was blatantly discriminated for the first time when I applied for a job outside academia. I applied for a head of division post as well as a post in the division itself. I passed the necessary interviews and the assessment centre with flying colours as I learned later on but was recruited for the division and did not get the management post. The person selected who was later my boss did not have half of my working experience in the specific subject. Additionally they had to wait for more than six months for him to join whilst I joined in less than half this time. We were the only two shortlisted. The gentleman who was the acting head of division was also an applicant but not shortlisted. He made my life very difficult especially as he was the one to prepare my probationary report and it was only with the help of an informal network that I managed to survive that period. It is interesting that as soon as the head of division arrived, my colleague changed jobs! At the time all the women working with me were supporting administrative staff and I was taken as such many times. In big meetings, I was politely but clearly asked to serve the coffee or clean the board. This was never asked from my male colleagues. My ideas in brainstorming sessions were "too visionary", "too technical" or "too vague" but were later used at higher management meetings. As I liked what I was doing I decided early on not to be competitive and gave up for a management post which would have also given me a promotion as I was recruited at the highest level outside management structures.

Do you feel that there are things that need to change in the sector as far as women are concerned?

The sector needs to see women as valuable resources contributing to organisational growth. Once management realises that women are unused talent and potential then things will change. Female skills including softer management skills are needed in a labour sector where a serious lack of skills has been observed and is expected to increase. Their role as
consumers is also very important and should be taken into account when designing, researching or producing technology. Changes should be made in the image of the sector as well so that it should be shown for what it is, i.e., friendly and socially caring.

**Is it important for women to be more represented in the sector?**

For women themselves it is important to equally participate as they will get jobs, which are more interesting, better paid and a good income. But research should also be carried out which is targeted to women resulting in the relevant applications.

**What can be done to improve things?**

From my personal experience it is important to have a supporting network which would pass on experience and provide a "shoulder to cry on". Mentoring would help and it should be made semi-compulsory if companies wish to retain good staff or ensure that people are not de-motivated or give up as I did. An idea would be to have an "independent body" to monitor recruitment and career progress or women. I do not believe in positive discrimination but I believe in fair treatment.

**Any other suggestions?**

Just a bit of advice to the young ones: don't give up! You are as intelligent, capable and skilled as your male colleagues and you should be given the same chances. Join networks, use all the available means within your organisations not to be on your own and do not believe that there is no problem. There is one but we tend to forget it!
APPENDIX III: TABLES WITH THE ANALYTICAL RESULTS OF THE QUESTIONNAIRE

The tables below list in detail the number of respondents per country (Table AIII.1) and further per country of origin (Table AIII.2) and per country of work (Table AIII.3). These tables help identify the distribution of respondents per country.

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<thead>
<tr>
<th>Country</th>
<th>No.</th>
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<tbody>
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Table AIII.1: Respondents by country of origin

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</tr>
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</tr>
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<td>0,72</td>
</tr>
<tr>
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<td>13,67</td>
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Table AIII.2: Respondents per country of workplace

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<th>Country</th>
<th>No.</th>
<th>%</th>
</tr>
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<tr>
<td>Portugal</td>
<td>1</td>
<td>0,75</td>
</tr>
<tr>
<td>Romania</td>
<td>3</td>
<td>2,26</td>
</tr>
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<td>Slovakia</td>
<td>1</td>
<td>0,75</td>
</tr>
<tr>
<td>Spain</td>
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<td>3,01</td>
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<tr>
<td>Sweden</td>
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<td>3,76</td>
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<td>The Netherlands</td>
<td>2</td>
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</tr>
<tr>
<td>UK</td>
<td>9</td>
<td>6,77</td>
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<tr>
<td>EU-27</td>
<td>91</td>
<td>66,91</td>
</tr>
<tr>
<td>Norway</td>
<td>2</td>
<td>1,50</td>
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<tr>
<td>Switzerland</td>
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<td>1,50</td>
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<td>Outside Europe</td>
<td>45</td>
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<tr>
<td>Total</td>
<td>140</td>
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Table AIII.3: Respondents by country of workplace
Table AIII.3: Respondents – time of work in present job

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<th>Answers</th>
<th>No.</th>
<th>%</th>
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</thead>
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<tr>
<td>1-3 years</td>
<td>32</td>
<td>22,86</td>
</tr>
<tr>
<td>3-5 years</td>
<td>18</td>
<td>12,86</td>
</tr>
<tr>
<td>5-10 years</td>
<td>37</td>
<td>26,43</td>
</tr>
<tr>
<td>10-15 years</td>
<td>27</td>
<td>19,29</td>
</tr>
<tr>
<td>More</td>
<td>23</td>
<td>16,43</td>
</tr>
<tr>
<td>Pensioner</td>
<td>3</td>
<td>2,14</td>
</tr>
</tbody>
</table>

Table AIII.4 indicates the level of responsibility for all respondents.

Table AIII.4: Level of responsibility

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<tr>
<th>Answers</th>
<th>No.</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>Director General</td>
<td>6</td>
<td>4,29</td>
</tr>
<tr>
<td>Director</td>
<td>11</td>
<td>7,86</td>
</tr>
<tr>
<td>Head of Division/Department</td>
<td>38</td>
<td>27,14</td>
</tr>
<tr>
<td>Team leader</td>
<td>34</td>
<td>24,29</td>
</tr>
<tr>
<td>Other</td>
<td>51</td>
<td>36,43</td>
</tr>
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</table>

Table AIII.5: Number of promotions/salary increases per respondent in present organisation

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<tr>
<th>Answers</th>
<th>No</th>
<th>%</th>
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<td>None</td>
<td>23</td>
<td>16,43</td>
</tr>
<tr>
<td>One</td>
<td>33</td>
<td>23,57</td>
</tr>
<tr>
<td>Two</td>
<td>28</td>
<td>20,00</td>
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<tr>
<td>More</td>
<td>56</td>
<td>40,00</td>
</tr>
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</table>

Table AIII.5 shows the number of promotions the respondents had during their working life in their present job.
Table AIII.6 shows how many of the respondents faced any discrimination (if any) and in what form.

<table>
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<th>Answers</th>
<th>No</th>
<th>%</th>
</tr>
</thead>
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<td>Yes</td>
<td>51</td>
<td>36.43</td>
</tr>
<tr>
<td>No</td>
<td>89</td>
<td>63.57</td>
</tr>
<tr>
<td>Answers</td>
<td>No</td>
<td>%</td>
</tr>
<tr>
<td>Earned less</td>
<td>29</td>
<td>56.86</td>
</tr>
<tr>
<td>Passed over for promotion</td>
<td>15</td>
<td>29.41</td>
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<tr>
<td>Not given enough responsibility</td>
<td>14</td>
<td>31.37</td>
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<tr>
<td>Not taken seriously</td>
<td>25</td>
<td>50.98</td>
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<td>Other</td>
<td>9</td>
<td>17.65</td>
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</table>

Table AIII.6: Discrimination at work
Table AIV.1 analytically presents the respondent's personal data (age group, country of origin and work, level and area of studies) and looks at the question of family and peer influence to the choice of study.

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<tr>
<th>Age Group</th>
<th>Country of Origin</th>
<th>Country of Work</th>
<th>Level of Studies</th>
<th>Area of Study</th>
<th>Has one of your parents/siblings studied science</th>
<th>If yes, what and who</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-39</td>
<td>Georgia</td>
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<td>Graduate</td>
<td>English Language and Philology</td>
<td>Yes</td>
<td>Computer Science, Electrical and Electronic Engineering, Telecommunication</td>
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<td>Georgia</td>
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<td>Computer Science</td>
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<td></td>
</tr>
<tr>
<td>25-39</td>
<td>Georgia</td>
<td>Georgia</td>
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<td>Telecommunication</td>
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<td>Masters</td>
<td>Life science</td>
<td>Yes</td>
<td>My fiancé, life science</td>
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<td>The sister, Business</td>
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- my sister and brothers
- Father - electrical & power engineering
- father & brother engineer, husband physicist, son mathematician
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Table A IV.1 – Age, Countries of Origin and work and Family members with Science background.

Table A IV.2 looks at the reasons why the respondents chose their career and whether they have been discriminated during their studies and if this was the case in what way.

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<th>Age Group</th>
<th>How did you choose your degree studies</th>
<th>During your studies, were you ever discriminated because you are a woman</th>
<th>If yes, please answer the following: (more than one answer is possible). How</th>
<th>Area of work</th>
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Negative comments in successful situations:
- Researcher and Lecturer University/school teaching
- Administrative Technical University/school teaching
- Research University/school teaching

Was not given the opportunity to follow academic career consultancy:
- University/school teaching
- Administrative Technical
- Business accountant
- Houswife at present time University/school teaching
- Research University/school teaching
- Research University/school teaching
- Research University/school teaching
- Research University/school teaching
Happened by accident - started off learning to use a word processor and colleague noticed I had an aptitudee No Research

It was a pressure of one of my professors No Research

oriented by teachers No company services innovation consultancy

40-54 Liked sciences No Link between corporate sector and university and research institutes

40-54 Good in science subjects No University/school teaching

40-54 Looking at career prospects No University/school teaching

40-54 Looking at career prospects No Research

40-54 Good in science subjects No Research

40-54 Liked sciences No Research

Like sciences, to be with my school friends, home pressure Yes Got lower marks for same course results Administrative

40-54 Liked sciences No Technical

40-54 random wanderings Yes Was not given the opportunity to follow academic career, sexually harassed Administrative

40-54 Good in science subjects No Research

40-54 Good in science subjects No Administrative

40-54 Liked sciences No Technical

40-54 Liked sciences No Technical

40-54 Liked sciences No Research

40-54 Liked sciences No National Research Council

40-54 Liked sciences No University/school teaching

40-54 Liked sciences No Technical Was not given the opportunity to follow academic career

40-54 Liked sciences Yes Research
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<th>Career Interest</th>
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<td>Research</td>
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Was not given the opportunity to follow academic career, Not retained for research degree, Told girls not good in teh lab. All the women in the class advised to be school teachers (men advised to do PhDs, go into industry etc)
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<th>Experience</th>
<th>Discrimination</th>
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Table AIV.2: Study Choice and possible discrimination at University

Table AIV.3 looks at the area of work assessing any possible discrimination both with data on level of responsibility and time at the place of work, and through the respondents' own perception.
<table>
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<tr>
<th>Age Group</th>
<th>Area of work</th>
<th>How long are you in your present job</th>
<th>Level of responsibility</th>
<th>How many promotions/salary increases (excluding indexation) did you have since joining the organisation</th>
<th>At your present and past places of work, were you ever discriminated because you are a woman</th>
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<td>40-54</td>
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<td>Other</td>
<td>More</td>
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<tr>
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</tr>
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<td>3-5 years</td>
<td>Team leader</td>
<td>One</td>
<td>No</td>
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<td>10-15 years</td>
<td>Team leader</td>
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<tr>
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<td>Other</td>
<td>Two</td>
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</tr>
<tr>
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<tr>
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<td>5-10 years</td>
<td>Team leader</td>
<td>None</td>
<td>Yes</td>
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<td>40-54</td>
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<td>3-5 years</td>
<td>Team leader</td>
<td>One</td>
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<td>40-54</td>
<td>Research</td>
<td>10-15 years</td>
<td>Head of Division/Department</td>
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<td>Yes</td>
</tr>
<tr>
<td>40-54</td>
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<td>Other</td>
<td>More</td>
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<td>5-10 years</td>
<td>Team leader</td>
<td>One</td>
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<td>40-54</td>
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<td>Yes</td>
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<td>40-54</td>
<td>product management</td>
<td>years</td>
<td>Team leader</td>
<td>More</td>
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<td>40-54</td>
<td>Business Owner</td>
<td>3-5 years</td>
<td>Director General</td>
<td>None</td>
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<td>40-54</td>
<td>University/school teaching</td>
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<td>Other</td>
<td>More</td>
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<td>40-54</td>
<td>Corporate Learning and Development</td>
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<td>5-10 years</td>
<td>Other</td>
<td>None</td>
<td>Yes</td>
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<tr>
<td>40-54</td>
<td>Administrative</td>
<td>3-5 years</td>
<td>Director General</td>
<td>Two</td>
<td>No</td>
</tr>
<tr>
<td>40-54</td>
<td>Research</td>
<td>1-3 years</td>
<td>Other</td>
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<td>Yes</td>
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<tr>
<td>40-54</td>
<td>Software industry</td>
<td>10-15 years</td>
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<td>40-54</td>
<td>Research</td>
<td>3-5 years</td>
<td>Other</td>
<td>One</td>
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<tr>
<td>40-54</td>
<td>Research</td>
<td>1-3 years</td>
<td>Team leader</td>
<td>Two</td>
<td>No</td>
</tr>
<tr>
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<td>Information</td>
<td>3-5 years</td>
<td>Team leader</td>
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<td>No</td>
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<td>Head of Division/Department</td>
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<td>No</td>
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<tr>
<td>40-54</td>
<td>Information</td>
<td>3-5 years</td>
<td>Team leader</td>
<td>None</td>
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<tr>
<td>Management / Corporate Social Responsibility</td>
<td>Head of Division/Department</td>
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<tr>
<td>40-54</td>
<td>University/school teaching</td>
<td>1-3 years</td>
<td>Head of Division/Department</td>
<td>One</td>
<td>No</td>
</tr>
<tr>
<td>40-54</td>
<td>University/school teaching</td>
<td>10-15 years</td>
<td>Head of Division/Department</td>
<td>More</td>
<td>No</td>
</tr>
<tr>
<td>Public authority, agency for Research and Innovation systems</td>
<td>1-3 years</td>
<td>Team leader</td>
<td>One</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>
Finally, Table AIV.4 shows how many respondents considered that they were discriminated against and how they perceived this discrimination.

Table AIV.3: Possible discrimination at the work place.
At your present and past places of work, were you ever discriminated because you are a woman?

<table>
<thead>
<tr>
<th>Age Group</th>
<th>If yes, please answer the following (more than one answer is possible) How</th>
<th>To help with the qualitative analysis, please put any comments you think pertinent</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-39</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>25-39</td>
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<tr>
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<td>25-39</td>
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<td>25-39</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>25-39</td>
<td>Yes, Earned less, Passed over for promotion, Not taken seriously</td>
<td></td>
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<tr>
<td>25-39</td>
<td>No</td>
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</tr>
<tr>
<td>25-39</td>
<td>Yes, Earned less</td>
<td></td>
</tr>
<tr>
<td>25-39</td>
<td>No</td>
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<tr>
<td>25-39</td>
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<td>25-39</td>
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<tr>
<td>25-39</td>
<td>No</td>
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</tr>
<tr>
<td>25-39</td>
<td>Yes, Earned less, Not taken seriously</td>
<td></td>
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<tr>
<td>25-39</td>
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<tr>
<td>25-39</td>
<td>No</td>
<td></td>
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<tr>
<td>25-39</td>
<td>I think most discrimination happens &quot;in secret&quot; or is unspoken.</td>
<td>People accept it is inappropriate to discriminate on the basis of gender, which sends much of it underground</td>
</tr>
<tr>
<td>25-39</td>
<td>Yes, Earned less</td>
<td></td>
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<tr>
<td>25-39</td>
<td>No</td>
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<td>25-39</td>
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<tr>
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<td>25-39</td>
<td>Yes, Earned less, Passed over for promotion, Not taken seriously</td>
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</table>

nr 8: both positive and negative discrimination

The entry level for women lower at the start -promotion are given but if the start grade is lower the discrimination is at the outset.
<table>
<thead>
<tr>
<th>Age Group</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-39</td>
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<td>25-39</td>
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<tr>
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<tr>
<td>25-39</td>
<td>No</td>
</tr>
<tr>
<td>40-54</td>
<td>No</td>
</tr>
</tbody>
</table>

Had to do secretarial work because the secretary was on vacation

Not given enough responsibility, Not taken seriously

Not given enough responsibility, Present ok

Discrimination comes from the top down: if management is not discriminatory, the organisation (in most cases) will not be either

Earned less

Effective promotion, Not given enough responsibility, Not taken seriously

Even as CEO of my company, I find it challenging to close deals with IT managers who are male.

Would be good to have a place for "don't know", because I don't know if I was discriminated against (people rarely broadcast these things). Also would be good to have a place where you can tick more than one option (e.g. why did you study science)? Thanks.

Women may not be given equal opportunities due to possible maternity leaves

I work in a large team of developers and IT Support, the team is 40 strong of which 5 are women.

In my opinion it's an advantage for a girl to study a technical field, as not many girls choose it, so teachers and students care about them more and help them a lot and support them, that's my experience.

The questions in this test are very very few, and do not get the picture of the situation.
<table>
<thead>
<tr>
<th>Age Group</th>
<th>Experience</th>
<th>Reason</th>
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<tr>
<td>40-54</td>
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<td></td>
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<tr>
<td>40-54</td>
<td>Yes</td>
<td>Sexual harassment</td>
</tr>
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<td>40-54</td>
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<td>Earned less</td>
</tr>
<tr>
<td>40-54</td>
<td>Yes</td>
<td>Earned less</td>
</tr>
<tr>
<td>40-54</td>
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<td></td>
</tr>
<tr>
<td>40-54</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Women are seldom supported by their families and colleagues to go for a scientific career. Women also seldom get credits, instead they have to deliver more than men. I support quota! Otherwise difficult to improve gender equality.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-54</td>
<td>Yes</td>
<td>Earned less, Passed over for promotion, Not given enough responsibility</td>
</tr>
<tr>
<td>40-54</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>40-54</td>
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<td>Earned less</td>
</tr>
<tr>
<td>40-54</td>
<td>No</td>
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<td>40-54</td>
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<td>40-54</td>
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<td>Earned less</td>
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<td></td>
</tr>
<tr>
<td>40-54</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>It depends very much on the individual workplace itself.</td>
<td></td>
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<tr>
<td>40-54</td>
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<tr>
<td>40-54</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>In an academic environment discrimination is not &quot;evident&quot; but &quot;smart&quot;. But over the years a lot has changed and today the problem is mainly with women and their view on their role in life</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-54</td>
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<td></td>
</tr>
<tr>
<td>40-54</td>
<td>Yes</td>
<td>Not given enough responsibility, Not taken seriously</td>
</tr>
<tr>
<td>40-54</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

In Georgia I haven't noticed the discrimination yet.
<table>
<thead>
<tr>
<th>Age Group</th>
<th>Response</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>40-54 Yes</td>
<td>Passed over for promotion, Not given enough responsibility, Not taken seriously</td>
<td></td>
</tr>
<tr>
<td>40-54 Yes</td>
<td>Not taken seriously, Earned less, Passed over for promotion, Not given enough responsibility, Not taken seriously, large successes seen as a fluke, even when repeated</td>
<td></td>
</tr>
<tr>
<td>40-54 Yes</td>
<td>Passed over for promotion</td>
<td>Discrimination still exists, women having small children (2-7 years) have less career opportunities and get less paid</td>
</tr>
<tr>
<td>40-54 Yes</td>
<td>Passed over for promotion</td>
<td>Pregnancy and then to be a mother is indeed a challenge but also a good reason for not giving you great responsibilities. Due to family needs the number of extra hours spent at work is less then in the past - and that is not appreciated by the employer</td>
</tr>
<tr>
<td>40-54 Yes</td>
<td>Earned less</td>
<td>More girl students than boys, similar teachers, much less professors women than men</td>
</tr>
<tr>
<td>40-54 Yes</td>
<td>Not taken seriously, Earned less</td>
<td>The questionnaire is too simplistic and doesn't offer enough choices. Also, without knowing whether I work in the public or the private sector, the answer to 12. doesn't mean much.</td>
</tr>
<tr>
<td>40-54 Yes</td>
<td>Earned less, Passed over for promotion, Not given enough responsibility, Not taken seriously, Given a much harder time than a man in equivalent position - the glass cliff effect</td>
<td>Conciliation work and family issue is demanding</td>
</tr>
<tr>
<td>40-54 Yes</td>
<td>Not taken seriously</td>
<td>Being a full professor excludes from salary increases -- this is no discrimination.</td>
</tr>
<tr>
<td>40-54 Yes</td>
<td>Passed over for promotion, Not taken seriously</td>
<td>I have found the IT field to be rewarding and not gender-biased</td>
</tr>
</tbody>
</table>
40-54 Yes  
could not get work in my field  
Earned less, Passed over for promotion, Not given enough responsibility, Not taken seriously  
The most important way is to be out of men's networks in which they decide lots of things.

40-54 Yes  
Earned less, Not given enough responsibility, Not taken seriously

40-54 No  
Passed over for promotion, Not taken seriously

40-54 Yes  
Earned less, Not taken seriously

40-54 Yes  
Not taken seriously, Degraded from a managerial position during maternity leave.

55-75 Yes  
Earned less  
More awareness raising around role models in the media

55-75 Yes  
Earned less

55-75 No  
Earned less

55-75 No  
Passed over for promotion, Not taken seriously

55-75 Yes  
Passed over for promotion, Not given enough responsibility, Not taken seriously

55-75 No  
Not taken seriously

WOMEN SHOULD DO THEIR WORK AND NOT LOOK FOR SYMPATHY. THIS WILL EARN THEM THE RESPECT THEY DESERVE
Discrimination was evident but not because I was a woman per se but because I did not have a "technical" education despite doing the same work as those with such education (i.e. project management).

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Response</th>
<th>Issue Case</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>55-75</td>
<td>No</td>
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<td>Not given enough responsibility, Not taken seriously</td>
</tr>
<tr>
<td>55-75</td>
<td>Yes</td>
<td></td>
<td>MY TWO DAUGHTERS ARE STUDYING SCIENCE</td>
</tr>
<tr>
<td>55-75</td>
<td>Yes</td>
<td>Not taken seriously</td>
<td></td>
</tr>
<tr>
<td>55-75</td>
<td>No</td>
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<td></td>
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<tr>
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SUMMARY

The thesis examines issues affecting the presence of women in the Information and Communications Technologies (ICT) sector. Statistical data was presented to investigate whether women are under-represented in the sector, thus not taking advantage of all its benefits, be it in education, employment, leisure or personal satisfaction domains. The reasons for this under-representation are examined, together with the various measures that have been put in place over the last decade to remedy the situation at European and international level.

The thesis is based on the following Problem Statement:

Would engendering technology, i.e., increasing the number of women in the production, design, and use of technology, lead to empowering women?

From the above Problem Statement, we derived five research questions.

**Research Question 1:** Which are the areas in the ICT sector where women are most under-represented?

**Research Question 2:** What are the problems women face when they are in the sector?

**Research Question 3:** Why are women under-represented in the ICT sector?

**Research Question 4:** Has there been any improvement in recent years?

**Research Question 5:** What measures can be taken to improve the representation of women in the cyber-community, both qualitatively and quantitatively?

The Research Questions can be mapped out in chapters, as below:

RQ1: 1, 2, 4, 5, 9

RQ2: 1, 2, 4, 7, 9

RQ3: 1, 2, 3, 9

RQ4: 1, 2, 6, 9

RQ5: 1, 2, 9

RQ6: 1, 2, 8, 9
Chapter 1 presents a brief history of the ICT sector, the methodology of the research and a brief outline of subsequent chapters. The presence of women in the sector is investigated in specific areas such as education, industry, relevant academia and research, as well as their conditions of employment and career progress.

Chapter 2 presents a review of the relevant literature on how the presence of women in the ICT sector is seen and analysed, through the perspectives of first, second and post-feminism movements.

Chapter 3 examines available statistical evidence concerning the participation of women in the sector. Progress here was made difficult through the general lack of reliable, gender-disaggregated statistical data and indicators. Chapters 2 and 3 examine available evidence relating to the presence of women in the ICT sector by analysing published research findings and statistical sources.

Chapter 4 examines a number of socio-cultural factors contributing to the gender imbalance in ICT and related sectors. It examines the constraints affecting educational choices, such as traditional and anachronistic teaching methods, the issue of technophobia, and finally how the family influences women’s preferences with regard to career directions.

Chapter 5 analyses the influence of the female gender stereotype, as found in literature and media, and the attitudes towards women’s roles related to technological advancement. Men and women from a young age are affected by and respond to different gender stereotypes, which are embedded in our culture and society, and influence society’s opinions on the behaviours acceptable for women and men.

Chapter 6 analyses a number of initiatives at national, European and international level aiming to increase the number of women in the ICT sector, which are particularly concerned with breaking gender stereotypes. They demonstrate the possibilities for empowerment of women within the ICT sector and at the same time break down the myths surrounding it.

Chapter 7 describes the outputs from a questionnaire study, designed to collect evidence from the experience of women working in the sector. A quantitative analysis was carried out to establish patterns and trends in the collected data, which were supplemented by a further qualitative analysis to establish how these results compared to the conclusions of published research analysed in earlier chapters. One key aim here was to compare the responses to the
questionnaires to the main research findings dealing with observed improvement in the sector, to see if the experiences reported by the respondents confirm that some of the measures and initiatives introduced during recent years have indeed had an impact. This is the reason that this empirical work is presented in this chapter which is to be found almost at the end of the thesis.

Chapter 8 updates the model presenting all the key factors shown to influence the presence of women in the ICT sector as well as formulating some recommendations for possible areas of intervention. Specific recommendations are also made for future research to increase our understanding of career-decision processes. The thesis demonstrates the impact on women’s aspirations and perceptions starting from school, in the context of the family, when in academia or industry, and finally in the context of the employment market.

The research carried out in this thesis, shows that the benefit of increasing the number of women in the sector, and of engendering ICTs, is a much greater available talent potential than what is available at present. The future will bring us women who can fully participate in and benefit from technological advances underpinning the Information Society.
SAMENVATTING

De thesis onderzoekt zaken die te maken hebben met de aanwezigheid van vrouwen in de sector van de informatie- en communicatietechnologie (ICT). Er worden statistische gegevens geproduceerd om te onderzoeken of vrouwen ondervertegenwoordigd zijn in de sector en dus niet van alle voordelen genieten, hetzij op het vlak van opleiding, tewerkstelling, vrije tijd of persoonlijke tevredenheid. De redenen voor dit ondervertegenwoordigd zijn worden onderzocht, samen met de verschillende maatregelen die in het voorbije decennium zijn uitgevaardigd om de situatie op Europees en internationaal niveau op te lossen.

De thesis is gebaseerd op de volgende probleemstelling:

Zou het verborgen van het aantal vrouwen in de productie, het ontwerp en het gebruik van technologie vrouwen mondiger maken?

Om bovenstaande probleemstelling te beantwoorden hebben we er vijf onderzoeksvragen van afgeleid.

**Onderzoeksvraag 1:** In welke domeinen van de ICT-sector zijn vrouwen het meest ondervertegenwoordigd?

**Onderzoeksvraag 2:** Met welke problemen worden vrouwen geconfronteerd in de sector?

**Onderzoeksvraag 3:** Waarom zijn vrouwen ondervertegenwoordigd in de ICT-sector?

**Onderzoeksvraag 4:** Is het de voorbije jaren verbeterd?

**Onderzoeksvraag 5:** Welke maatregelen kunnen genomen worden om de vertegenwoordiging van vrouwen in de cyber-gemeenschap zowel kwalitatief als kwantitatief te verbeteren?

De onderzoeksvragen zijn in hoofdstukken onderverdeeld zoals hieronder is aangegeven:

OV1: 1, 2, 4, 5, 9

OV2: 1, 2, 4, 7, 9

OV3: 1, 2, 3, 9

OV4: 1, 2, 6, 9

OV5: 1, 2, 9
Hoofdstuk 1 geeft een beknopte geschiedenis van de ICT-sector, de onderzoeksmethode en een kort overzicht van de volgende hoofdstukken. De aanwezigheid van vrouwen in de sector wordt onderzocht in specifieke domeinen zoals opleiding, industrie, relevante academische sectoren en onderzoek evenals hun tewerkstellingsvoorwaarden en loopbaanontwikkeling.

Hoofdstuk 2 geeft een overzicht van de relevante literatuur over hoe de aanwezigheid van vrouwen in de ICT-sector wordt gezien en geanalyseerd vanuit het standpunt van de eerste, tweede en post-feministische bewegingen.

Hoofdstuk 3 onderzoekt beschikbaar statistisch bewijs over de deelname van vrouwen in de sector. De vooruitgang werd hier bemoeilijk door het algemene gebrek aan beschikbare statistische gegevens en indicatoren waarin een onderscheid tussen mannen en vrouwen is gemaakt. Hoofdstuk 2 en 3 onderzoeken beschikbaar bewijsmateriaal over de aanwezigheid van vrouwen in de ICT-sector door gepubliceerde onderzoeksresultaten en statistische bronnen te analyseren.

Hoofdstuk 4 onderzoekt een aantal socio-culturele factoren die bijdragen aan een onevenredige verdering over de geslachten in de ICT en aanverwante sectoren. Het onderzoekt de beperkingen die de opleidingskeuze beïnvloeden, zoals traditionele en anachronistische onderwijsmethodes, het probleem van de technofobie, en ten slotte hoe familie de voorkeuren van vrouwen met betrekking tot hun loopbaankeuze beïnvloedt.

Hoofdstuk 5 analyseert de invloed van het vrouwelijke geslachtsstereotype zoals dat gevonden is in de literatuur en de media, en de houdingen ten opzichte van de rol van vrouwen inzake technologische vooruitgang. Mannen en vrouwen zijn van jongsaf beïnvloed door en beantwoorden aan verschillende geslachtsstereotypes die in onze cultuur en samenleving verankerd zitten en de meningen van de samenleving over aanvaardbaar gedrag voor vrouwen en mannen beïnvloeden.

Hoofdstuk 6 analyseert een aantal initiatieven op nationaal, Europees en internationaal niveau die tot doel hebben het aantal vrouwen in de ICT-sector te verhogen en die vooral de geslachtsstereotypes willen doorbreken. Ze tonen de mogelijkheden om vrouwen in de ICT-sector mondiger te maken en tegelijkertijd de mythes er omheen af te breken.
Hoofdstuk 7 beschrijft de resultaten van een enquête die werd opgesteld om bewijzen te verzamelen vanuit de ervaring van vrouwen die in de sector werken. Een kwantitatieve analyse werd uitgevoerd om patronen en trends te detecteren in de verzamelde gegevens die werden aangevuld door een verdere kwalitatieve analyse om vast te stellen hoe deze resultaten overeenstemmen met de conclusies van de gepubliceerde onderzoeken die in de vorige hoofdstukken zijn geanalyseerd. Dit had onder andere tot doel de antwoorden op de enquêtes te vergelijken met de voornaamste onderzoeksresultaten in verband met vastgestelde verbeteringen in de sector, om te zien of de ervaringen die de respondenten deelden, bevestigen dat sommige maatregelen en initiatieven die de voorbije jaren werden geïntroduceerd, wel degelijk effect hebben. Daarom wordt dit empirische werk voorgesteld in dit hoofdstuk dat zich bijna helemaal aan het einde van de thesis bevindt.

Hoofdstuk 8 werkt het model bij dat alle belangrijke factoren voorstelt die de aanwezigheid van vrouwen in de ICT-sector blijken te beïnvloeden en formuleert enkele aanbevelingen voor domeinen waar interventie mogelijk is. Daarnaast worden specifieke aanbevelingen gedaan voor toekomstig onderzoek om beter te begrijpen volgens welke processen loopbaanbeslissingen worden genomen. De thesis toont de impact van de ambitie en perceptie van vrouwen aan in de school, in familiecontext, in de academische wereld of de industrie, en ten slotte in de context van de tewerkstellingsmarkt.

Het onderzoek dat in deze thesis wordt beschreven, toont aan dat een groter aantal vrouwen in de sector en het voortbrengen van ICT-professionals het voordeel heeft dat er veel meer potentieel talent beschikbaar is dan vandaag en dat vrouwen die er ten volle aan deelnemen, beter kunnen genieten van de technologische ontwikkelingen waarop de informatiemaatschappij steunt.
CURRICULUM VITAE

Athanacia Nancy Pascall

Nancy was born in Greece and attended primary and secondary school there. After completing her secondary education she moved to England where she did her A-Levels in Physics, Chemistry and Pure Mathematics preparing for University. She studied Applied Physics and Electrical and Electronic Engineering before making a complete study change.

Nancy holds a BSc in Psychology, an MSc in Culture and Media, and an MBA as well as a number of other graduate and post graduate diplomas, as well as language qualifications. Nancy speaks fluently Greek, English, French and Italian as well as Spanish and German and a smattering of Swedish. She is a great believer in lifelong learning.

She moved back to Greece where she worked in a multinational company dealing with certification (quality and quantity control). She moved on to become a Purchasing Manager in a Greek company manufacturing clothes labels. In 1984 she joined the European Commission in the then ESPRIT Task Force. The Task Force evolved to become DG XIII and later on DG INFSO (Information Society and Media) where she still works as a policy officer.

During her time in DG INFSO, Nancy dealt with different files and responsibilities such as HR management, study and project management and finally policy. As from 1992 she has been involved in the development for policies for Women in ICT. She is currently involved in Regional Digital Growth policy,

In her spare time Nancy enjoys dress making, theatre costume design, cooking and reading. She does a lot of charity work including grief counselling.

Nancy is a recognised poet with a number of Greek and European awards and is published as one of the "100 contemporary Greek poets". She has written one theatre play which was performed in Brussels and hoping to finish her half written novel and theatre play once this PhD work is over.
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