DIGITAL INCLUSION

A Bright Future in ICTs
OPPORTUNITIES FOR A NEW GENERATION OF WOMEN

Report

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Telecommunication Development Sector

A bright future in ICT opportunities for a new generation of women

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Table of Contents

Foreword

Heads of state and governments resolved in the United Nations Millennium Declaration:

- To promote gender equality and the empowerment of women as effective ways to combat poverty, hunger and disease and to stimulate development that is truly sustainable.
- To develop and implement strategies that give young people everywhere a real chance to find decent and productive work.

Jobs in the ICT sector are lifting women out of poverty. In addition, a more gender-balanced sector offers fulfilling careers and enables talented women to achieve leadership positions. This is good for everyone. As UN Secretary-General Ban Ki-moon has acknowledged, "Equality for women and girls is not only a basic human right it is a social and economic imperative. Where women are educated and empowered, economies are more productive and strong. Where women are fully represented, societies are more peaceful and stable."

A panel of eminent persons set up by the UN Secretary-General as a part of a United Nations Youth Employment Network Initiative, identified information and communication technologies (ICT) as a means of creating more jobs for young people. Job opportunities in the digital economy continue to grow, and many countries and regions are anticipating growing demand for qualified personnel with mathematics, science, engineering, and computing skills. At the same time, companies are looking to increase the number of women in the sector.

We at the ITU have also identified this as an important area to support, and at the International Telecommunication Union 2010 Plenipotentiary Conference in Guadalajara, members agreed to celebrate 'Girls in ICT Day' on the fourth Thursday of every April. To support ICT initiatives for young women and girls, ITU has also developed the interactive on-line *Girls in ICT Portal* where information on a wide range of ICT related scholarships, training courses, internships, awards, online networks and national 'Girls in ICT Day' activities are posted. The Portal also links to a toolkit on running 'Girls in ICT Day' activities developed by the Global Network of Women ICT Decision Makers (WITNET); also established with ITU support on the occasion of its 2010 Plenipotentiary Conference in Guadalajara.

I believe that based on current developments and trends, as highlighted in this report and the *Girls in ICT Portal*, the next generation of ICT professionals can expect to tap into opportunities that call for innovative and entrepreneurial minds. The future, it appears, is in such fields as bioengineering, power grid informatics, digital media, and social and mobile application software, where interesting, creative and social 'mashed-up' hybrid jobs will combine ICT with business of every imaginable field. The challenge is to get this message out to students and young professionals alike. I encourage all ITU Members to make use of this study and the Girls in ICT Portal to ensure that more women play active professional roles in the ICT sector.

Brahima Sanou

BDT Director

Executive Summary

The future of the ICT sector is exciting. These are unchartered waters open to creativity, innovation and entirely new ways of working, interacting and learning that should appeal to women and men alike. The Institute for the Future[1] identifies six drivers most likely to shape the future workforce: longer life spans; a rise in smart devices and systems; advances in computational systems such as sensors and processing power; new multimedia technology; the continuing evolution of social media; and a globally connected world. The ICT sector clearly underpins this future.

This summary report surveys the global trends in women's professional development and employment in the information and communication technology (ICT) sector, and offers a sample of the range of national policies, training programmes and initiatives targeting girls and women as potential students and professionals.

Key findings – status report

The ICT sector remains a buoyant and growing sector for employment, and a key economic factor underpinning both national and international development. This growth in employment, however, has not yet led to a parallel increase in jobs for women in the ICT labour market, with the female to male ratio being particularly pronounced at senior levels. In fact, with the general growth of job opportunities in the sector, women's employment figures in advanced economies are in decline, which suggests that the issue is not just an entry level problem but may also be one of demotivation, of retention and/or lack of promotion of women within the sector at many levels.

It wasn't always so. For example, women were the original programmers of ENIAC, the US government's first ever computer and in the US in the 1980s, young women were earning 37 per cent of computer science degrees; today, that number has fallen to below 20 per cent. But while teenage girls now use computers and the Internet at rates similar to boys, they are five times less likely to consider a technology-related career.

The lack of trained female professionals means that in OECD countries, women now account for less than 20 per cent of ICT specialists. It also means that most developed countries are forecasting an alarming shortfall in the number of skilled staff to fill upcoming ICT jobs. The European Union calculates that in ten years' time there will be 700 000 more ICT jobs than there are professionals to fill them; globally, that shortfall is estimated to be closer to two million.

One of the reasons why the ICT sector continues to be generally perceived as a male-dominated industry is because most high-value and high-income jobs in this sector are occupied by men. Research conducted for this study in both developed and developing countries found classic cases of vertical gender segregation, with women strongly represented in lower level ICT occupations. Although women are making inroads into technical and senior professions, the study indicated a 'feminization' of lower level jobs. On average, this research found that women accounted for 30 per cent of operations technicians, only 15 per cent of managers and a mere 11 per cent of strategy and planning professionals.

There is also room for significant improvement in the number of women holding leadership positions at board and senior management levels.

Why we need to engage more women

Human talent with the right skill sets is the keystone of a vibrant and diversified ICT sector. That talent pool will need to be enriched through the nurturing and training of non-discriminatory human capital,

[1] www.iftf.org/

primarily in universities, research and development centres and trade or 'applied' schools, in order to respond to the ever-evolving needs of the ICT industry.

This suggests that ICT qualifications need to be extended to include a much broader spectrum that might attract the attention and interest of girls and women. Dr Hamadoun Touré, ITU Secretary-General, noted in launching the ITU Girls in ICT Portal, that "research consistently shows that girls tend to choose careers where they feel they can make a difference – healthcare, education, medicine. With this new portal, we're trying to show them that there's much more to ICTs than writing computer code … As we move towards an ICT-based knowledge society, the rise of apps and the explosion in telemedicine, remote learning systems and research and development make the ICT industry the most exciting choice any young person can make. We are entering unchartered waters of creativity, innovation and entirely new ways of working, interacting and learning. I hope our new portal will serve as a showcase to attract the many talented girls and young women in countries worldwide to this booming sector."

It is evident that the ICT sector needs to invest more resources in human capital development and to create an enabling environment for women and girls, and there are compelling economic reasons for engaging women more prominently. Improving the female to male employment ratio is good for economic growth.

Research indicates that the narrowing in the male-female employment gap has been an important driver of Europe's economic growth in the last decade. In the Asia and Pacific region, for example, restricting job opportunities for women is costing the region between USD 42 and USD 46 billion a year. World Bank findings demonstrate that similar restrictions have imposed massive costs throughout the Arab States region, where the gender gap in economic opportunity remains the widest in the world. The World Economic Forum maintains that countries which divide resources equitably between women and men, regardless of their level of resources, fare better than those that do not.

Engaging women and girls in ICT sector work is not only the right thing to do from the point of social justice. It is also smart economics.

Gender balance in high value ICT jobs in both management and on company boards has been proven to improve business performance. Studies exploring the link between women in leadership positions and business performance have shown a direct positive correlation between gender balance on top leadership teams and a company's financial results. More balanced teams make better informed decisions, leading to less risk-taking and more successful outcomes for companies. Over time, therefore, a nation's ICT competitiveness depends significantly on whether and how it educates and utilizes its non-discriminatory human capital.

Expanding horizons with government support

A combination of approaches to ensure benefits from pro-women policies and to prepare for future workforce needs, includes the need for training and career support at three distinct levels:

1. for entrance levels by way of education, training, recruitment, internship and career incentives, which require a national reassessment of educational infrastructure and delivery systems;
2. for mid-career levels through career promotion and training; and
3. for management and senior levels through mentorship, skill improvement and sponsorship programmes.

At the same time, parents, teachers, career guidance counsellors and recruiters need to be made aware of and acknowledge that ICT careers are an important and viable opportunity for girls. In order to secure initial gains made, women already active in the ICT sector need to take the time to engage with community initiatives to mentor girls and women and participate in virtual and face to face communities of practice.

Governments need to place a premium on promoting ICT skills in primary, secondary and higher education. The curricula need to reinforce each other at different levels, from computer camps for pre-

high school or secondary school students, to ICT classes for high school students, right through to mentoring and sponsoring. This needs to be complemented by investment in vocational training;

Governments need also to invest in on-the-job and industry-based training initiatives with a focus on promoting advanced ICT skills in and with the private sector;

The changing scope of ICT occupations has intensified the need to ensure that graduates emerge with skills that match employer demand. These demands are expanding from traditional ICT occupations (such as computer programmers) and towards business/ICT specialists, highly specialized ICT areas (such as micro-computing or quantum-computing) and multidisciplinary ICT occupations (such as bioinformatics and industrial design). This, however, is putting increased pressure on educators and the education sector to guide interested students into relevant ICT education and career paths.

In order to bring about a significant increase in girls' and women's engagement and employment across the board in the ICT sector, the core of current education systems and infrastructure needs to be restructured in four fundamental ways:

1. Instruction needs to be made more relevant – combining industry, science and the arts in curricula that focus not only on preparing for college education but also on vocational courses. A more technologically astute avenue for students that cater to their interests in engineering needs to be established. ICT courses need to be "hybrid" into all curricular offered by community colleges and technical schools.
2. Schools need to improve the quality of their execution, moving away from rote individualistic learning to hands-on, team-work and problem-solving teaching methods.
3. Schools need to ensure that students know about the continually evolving nature of the knowledge economy and that they need to carry on improving their skill base once basic schooling is completed. This also means that companies need to offer a more collaborative workplace experience engaging workers and giving them opportunities to continuously improve and seek productivity gains.
4. More funds or subsidies need to be placed for technical training and incubation programmes.

The future of the ICT job market

Since the dot-com bust at the beginning of the millennium, the demand for technology jobs has steadily increased. There are now more IT jobs in the United States than there were at the height of the dot-com boom. With an estimated 700 000 jobs in Europe, 800 000 in the US and 200 000 in Brazil alone, the ICT sector will be looking to hire at least 1.7 million people in the coming years.

The ICT sector has changed radically since the early days of computing – and the 'knowledge economy' is now taking on hitherto unseen dimensions where communication technologies have become forces of social change. Social media and its participatory formats are as much about the technologies as they are about their applications – bringing the virtual and physical worlds closer together in dynamic ways across several platforms.

The development of new goods and services is expected to drive demand from businesses, households and governments, with replacement ICT investments further boosting continuing demand. Much of the growth of the highly globalized ICT sector comes from the efficiencies gained from the global re-organization of research, development and production to provide new and improved ICT products and services to new and expanding markets. This includes the expanding use of software and extensive application of outsourcing. Additional ICT growth is expected to come from "green growth" through "smart" applications in buildings, transport, energy, and production which will translate into demand for customized applications.

As ICTs merge with sector-specific technologies across the economy, they produce "hybrid jobs". The expectation is that young women will show more interest in opportunities that use their creativity and intuition, in for example software application design. Their future is particularly promising in

bioengineering, power grid informatics, digital media, and social and mobile applications; these are interesting, fun and creative jobs that combine ICT with business of every imaginable field.

ICT employment opportunities for women in the post 2008 global economic era include high-speed internet, cloud computing, green ICT goods and services and their "smart" applications as these are presently heavily promoted by governments as a strategic response to the economic crisis.

The full report provides evidence to prove that a range of initiatives are already underway to support girls and women in the ICT sector as more governments recognize the importance and necessity of taking these deliberate steps. The most important determinant of a country's competitiveness is its human capital and talent - the skills, education and productivity of its workforce. Women account for one-half of the potential talent base throughout the world. Closing gender gaps is therefore not only a matter of human rights and equality; it is also one of efficiency and economic productivity. To maximize competitiveness and development potential, skills need to be seen as a key part of an economy's infrastructure, and the stronger infrastructure becomes the more robust and resilient the economy will be in response to opportunities and challenges.

The choices made by policymakers, enterprises and individuals on investment in education and training must strive for gender equality-that is, to give women the same rights, responsibilities and opportunities as men. Business leaders and policy-makers need to work together towards removing barriers to women's entry to the ICT workforce and putting in place practices and policies that will provide equal opportunities for rising to positions of leadership within the ICT sector. Such practices will ensure that all existing resources are used in the most efficient manner and that the right signals are sent regarding the future flow of talent.

Section I: Introduction to concepts and contexts

1.1 What the future holds for ICT professionals

The future is bright for ICT professionals! The IT sector is marked by a pressing need for a wide range of ICT talent. Many countries and regions are predicting a shortage of qualified employees and this bodes well for qualified women in technical fields.

According to a survey conducted by eSkills Monitor, Europe anticipates filling as many as 700 000 IT jobs by 2015[2] in the ICT and telecommunications field; among them such critical areas as security of communications, devices and information, as well as voice, data, video management, the management of both new network devices, and methods of communication.

In another example, and according to the Brazilian Agency for Promotion and Export of Software (Softex), the Brazilian ICT sector currently employs 600 000 people. It encountered a shortage of about 75 000 skilled professionals in 2010 and expects to run short of about 92 000 professionally trained workers in 2011 and 200 000 professionals by 2013.[3]

Before the 2008 global economic and finance crash, ICT sector growth in goods and services expanded steadily. It approached USD 4 trillion in 2008,[4] having tripled since 1996. The share of ICT trade peaked at 18 per cent in 2000, and fell to 12.5 per cent in 2008.[5] Long-term prospects for further growth in the ICT sector remain strong despite the 2008 crash-induced fall, as ICTs become increasingly fundamental to the economic and social infrastructure of all economies.

Box 1: The emerging ICT paradigm

On the demand side, the emerging ICT paradigm requires much more of ICT professionals than the constant upgrading of technical skills. Today's ICT professionals must have a sound understanding of technology and develop high-level business, management, and communication skills. Therefore, in order to make successful employment inroads, ICT professionals will need the know-how and the psychological make-up to function in a turbulent job market in which the boundaries and requirements will constantly change. The only constant in the sector is perpetual change.

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2 Monitoring eskills supply and demand in Europe, European Commission 2009, www.eskills-monitor.eu/

3 www.softex.br/softexEn/_about/background.asp

4 OECD Information Technology Outlook, p.65

5 In all, 44 economies were reported as bases for the top 250 ICT firms in 2009: 75 (30%) were based in the United States, 52 were based in Japan and 18 in Taiwan, Province of China. Nine were based in France, seven in Canada and the United Kingdom, and six in Germany, Korea, the Netherlands, Brazil and India. Regionally, the 98 firms based in the Asia-Pacific region accounted for 41% of revenue (USD 1 618 billion), 48% of employment, 21% of the overall net profit and 15% of the total net debt; the 93 firms based in the Americas accounted for 34% of top 250 revenues in 2009 (USD 1 372 billion), 29% of employment, 48% of the overall net profit and 19% of the total net debt; and the 51 firms based in Europe accounted for 24% of revenue (USD 945 billion), 23% of employment, 23% of the overall net profit, and 63% of overall net debt (mainly in telecommunications firms). Firm performance across economies has been mixed. Regionally, revenues have grown faster over the last nine years in Africa (16% a year) and the Middle East (14% a year), although from a low base, than in Americas and Europe (both 6.1% a year), and in the Asia-Pacific (5.6% a year). Top 250 firm revenues rose by more than 20% a year in Bermuda, the Cayman Islands, Egypt, India, Qatar, the Russian Federation and Taiwan, Province of China (Figure 3, page 28 of this report)). This reflects a number of factors, including GDP growth and ICT market growth, whether or not the firms are in high-growth sectors, and changing roles in global production systems. It reflects particularly the emergence of developing economies both as new growth markets and as locations for ICT production by indigenous as well as multinational firms; see OECD Information Technology Outlook 2010, p.30; Figure 1.6, and Box 1.2.

The development of new goods and services is expected to drive demand from businesses, households and governments; with replacement ICT investments further boosting continuing demand. Much of the growth of the highly globalized ICT sector comes from the efficiencies gained from the global reorganization of research, development and production to provide new and improved ICT products and services to new and expanding markets. This includes the expanding use of software and extensive application of outsourcing. Additional ICT growth is expected to come from "green growth" through "smart" applications in buildings, transport, energy, and production which will translate into demand for customized applications.[6]

ICTs are the leading factor in boosting innovation and creativity in value chains across industry and service sectors. They are essential to manage and administer the rise in demand for health and social care, in particular for people with special needs including the ageing population, and to modernize services in domains of public interest such as education and continual learning, cultural heritage, social inclusion, security, energy, transport and the environment. ICTs are also an indispensable tool for promoting accessibility and transparency of governance and policy development processes.[7] These aspects of ICT expansion all hold professional and career opportunities for women interested in the ICT sector broadly defined.

An added dimension to this expansion is that those jobs that incorporate ICTs generally offer more competitive pay than those that do not. The fact that these jobs require a high level of training across the board suggests that as the jobs become more sophisticated, with ICTs, they offer better terms of salary and working conditions.

Applied human talent with the right skill sets will continue to be the key for the building of a vibrant and diversified ICT sector. That talent pool will need to be enriched by the building and training of non-discriminatory, gender-neutral human capital primarily in universities, research and development centres as well as trade or 'applied' schools to respond to the evolving ICT industry. A report compiled for Bell Canada[8] clearly identified the growing need for a qualified labour force:

> "… the changing character of ICT occupations has intensified the need to ensure that graduates emerge with skills that match employer demand. These demands shift away from traditional ICT occupations (such as computer programmers) and towards business/ICT specialists, highly specialized ICT areas, and multidisciplinary ICT occupations (such as bioinformatics and industrial design), put increased pressure on educators and the sector to guide interested students into relevant ICT education and career paths. Moreover, the persistent under-representation of women in ICT and ICT-related fields calls for renewed efforts to engage female students early and effectively. In February 2009, for example, women accounted for only 25 per cent of all IT occupations-the exact same proportion of IT occupations held by women in March 2000. Understanding the drivers of women's ICT perceptions would contribute to the design of more effective and relevant attraction and recruitment strategies".

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6 OECD Information Technology Outlook 2010, p.40 and pp. 66-67.

7 European Commission, Information Society and Media, "Women and ICT – Status Report 2009, pp. 14-15. March 2010

8 *Connecting Students to Tomorrow's ICT Jobs and Careers: A Pan Canadian Dialogue with Grade Nine and Ten Students, Parents, and Secondary School Guidance/Career Counsellors* Prepared for: Bell Canada Inc. and Canadian Coalition for Tomorrow's ICT Skills Prepared by: The Conference Board of Canada *May 2009* http://ccict.ca/~ccictt/wp-content/uploads/2010/11/Connecting_Students_to_ICT_Careers_Report.pdf

Box 2: Definition of ICT

The OECD Guide to Measuring the Information Society 2011 sets out a definition of the ICT sector and reflecting the constantly changing sector has revised this definition several times since the initial 1998 version, and includes:

ICT manufacturing industries

- 2610 Manufacture of electronic components and boards
- 2620 Manufacture of computers and peripheral equipment
- 2630 Manufacture of communication equipment
- 2640 Manufacture of consumer electronics
- 2680 Manufacture of magnetic and optical media

ICT trade industries

- 4651 Wholesale of computers, computer peripheral equipment and software
- 4652 Wholesale of electronic and telecommunications equipment and parts

ICT services industries

- 5820 Software publishing
- 6110 Wired telecommunications activities
- 6120 Wireless telecommunications activities
- 6130 Satellite telecommunications activities
- 6190 Other telecommunications activities
- 6201 Computer programming activities
- 6202 Computer consultancy and computer facilities management activities
- 6209 Other information technology and computer service activities
- 6311 Data processing, hosting and related activities
- 6312 Web portals
- 9511 Repair of computers and peripheral equipment
- 9512 Repair of communication equipment

The Inter-American Development Bank (2011) in a recent publication (*Development Connections: Unveiling the Impact of New Information Technologies*) states that ICT can be broadly defined as "the application of both traditional and modern communications and computing technologies to the creation, management, and use of information. This definition encompasses both equipment and services that facilitate the electronic capture, processing, display, and transmission of information, and includes the computing industry, the Internet, electronic and display telecommunications and related services, and related audiovisual equipment".

There are three key issues common to most economies where the ICT sector continues to advance:

- There is a growing demand for a wide range of ICT skills;
- Opportunities exist to better equip employers and employees alike in filling new positions in the ICT sector;
- Programmes deliberately targeting and supporting women in ICT careers at all levels of the profession are key to a thriving ICT sector. These programmes need to reinforce each other at different levels, from computer camps for pre-high school or secondary school students, to ICT classes for high school students right through to mentoring and sponsoring of executive talents at the most senior levels of ICT professions.

Understanding why it is that women might not choose to make the dynamic ICT sector central to their career choice, and why it is that women might not stay in their chosen ICT career are central facets to redressing this gap.

1.2 Where are the jobs and where are the women?

The record is mixed, and so are the reasons. Both record and reasons are very country specific and need to be seen and understood in their larger socio-economic and ICT sector contexts. However, there are also commonalities.

One factor common to most countries is that the ICT sector in its narrowest sense is perceived to be a male-dominated industry. This is especially true of the technical professions and the higher management levels in the sector.[9] That said, certain sector trends can be directly linked to the level of socio-economic development in countries and the extent to which the ICT sector complements developments in other sectors in countries' economies – for example, in both manufacturing and the service sectors.

The sector is dynamic, swiftly growing and changing. Societal change and innovation can almost be said to advance at about the same pace as people's adoption and use of ICTs in everyday life and work. This creates twenty-first century ICT occupations that are incredibly diverse and include a wide variety of options: both jobs specialized in producing or managing ICTs, and all other jobs that rely heavily and directly on ICT in order to do or produce something. Many of these "ICT-enabled jobs," such as the work of a marketing manager, do not quite fit into the classical definition of an ICT career (i.e. jobs specialized in producing or managing ICT tools and infrastructure).

In developing countries, like Uganda or Nigeria, or in large emerging countries and economies with still untapped rural areas like Brazil, the conventional ICT sector is very much a growth sector, offering employment and income opportunities for skilled and qualified women. In 2008, Egyptian data recorded women as making up 30-40 per cent of total employment in the ICT sector; with 35 per cent in traditional, land-line communication and 27 per cent in mobile communications.[10] In Bangladesh women labourers have shifted from the garment factories to the micro-chip manufacturing factory lines as an alternative employment and income-generating source. Women also dominate data-entry, call centre and tele-marketing jobs in the country. Various programmes that target training for women have met with success, and women are increasingly stepping into these jobs although it is less clear whether this is on an equal footing with men.

In emerging economies like India, where women have been working in the software industry for over a decade, the sector appears to offer more gender-equitable work opportunities than do other forms of engineering, and women have been quick to take up this space.[11] Where a lot of ICT work was outsourced out of the UK and into Asia, the participation of women in ICT work grew as a whole.[12] In the software industry in India for instance, women worked as operators or programmers while men were predominant in managerial positions as project leaders or departmental managers.[13] In South Africa there appears to

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9 The International Labour Organization (ILO) 2001 report on *Work in the New Economy* makes the following observations about the ICT sector: patterns of gender segregation are being reproduced in the information economy where men hold the majority of high-skilled, high value-added jobs, and women are concentrated in the low skilled, lower value-added jobs. New inequalities are also emerging between women with ICT-related jobs skills and those without. A study of women working in European call centres found that, contrary to notions about skill development and flexible career advancement, women's data-processing work is often routinized, de-skilled, and devalued. Women in these centres rarely advance beyond team leader roles into more professional managerial positions.

10 Source: Ministry of Communications and Information Technology, Egypt 2008 accessed at www.itu.int/ITU-D/ict/events/geneva11/material/4_WSIS_Forum11.pdf August 27, 2011

11 In 2000, the software industry in India employed about 400 000 people, 70% of whom were involved in software development of which 20 to 35% were women (Arun and Arun 2002)

12 NASSCOM (2001) IT Industry in India, Delhi

13 Arun, Shoba and Thankom Arun (2002) ICTs, Gender and Development: Women in Software Production in Kerala, Journal of International Development

be "some positive growth in women managers overall, but it is still very much a 'man's world' in the ICT sector, with women only accounting for 10 – 12 per cent of total management."[14]

Box 3: Perspectives from a Project Manager

"In my years working on this sector I have encountered very few technical women, or women on management positions, most women work on support related roles (project administrators, finance support). Let me give you a brief summary of my experience. When I started university my major was system's engineering, my first year class was composed of 100 students, 10% of which were girls. I was lucky to find a job in a government agency as an IT manager; however, as it was a small agency I was the entire IT team. When I went to graduate school in Spain it was a shock to me that we were 25 students and only 4 girls (I thought that being an international environment it would be different). Over the years I have worked with mixed teams, the only place where my team was mainly female was in Vietnam.

Telecom is a boys club, we have so many PMs here, but only a handful of them are women, the same goes for executive or management roles, women dominate in the finance and human resource areas, but not in the technical ones. It is true, however, that in recent years I have encountered more and more young engineers, though I have been sad to see some of them stop working when they get pregnant (a common practice here in Japan). I have not received an award, nor have I ever been part of any program... and my only mentors over the years have been Vince and my Dad, who are my expert advisors when I have to make hairy career decisions. It is true there are more girls in the business, but still not a 50/50 ratio".

Extract of interview with Carola Aliaga
Project Manager, Ericsson, Japan. September 2011

In developed economies, employment in ICT manufacturing dropped by around 7 per cent year-on-year in most countries in 2009, with the United States recording the largest losses with 10 per cent. Sweden's 3 per cent decline on the ICT manufacturing job front is negligible by comparison. The sector reported a drop from a high point of 100 892 women in the country's ICT workforce in 1999 to 53 759 by 2003; an almost 50 per cent loss.[15] Moreover, although women are making inroads into technical and senior professions, there remains a 'feminization' of lower level jobs. The UK's Office of National Statistics (ONS) 2004 statistics indicate that women accounted for 30 per cent of IT operations technicians, a mere 15 per cent of ICT managers and only 11 per cent of IT strategy and planning professionals.

In 2007, an OECD report surmised that women have lower shares of ICT-specialist employment than men, and further, that these shares are in effect declining. It also reports that in the ICT-using occupations, women dominate in office and secretarial occupations and are much less visible in scientific and professional ones.[16]. In the United States for instance, computer programming used to be a field that attracted women; in the late 1970s the percentage of women in the field stood at 25 per cent – it is the

[14] http://women-in-ict.meraka.csir.co.za/images/7/76/National_print.pdf

[15] (2004) www.iris.salford.ac.uk/GRIS/depict/Documents/WomenAndTheITWorkplace.pdf

[16] OECD (2007) Directorate for Science, Technology and Industry, Committee for Information, Computer and Communications Policy. Working Party on the Information Economy – ICTs AND GENDER www.oecd.org/officialdocuments/displaydocumentpdf/?cote=DSTI/ICCP/IE%282006%299/FINAL&doclanguage=en (accessed August 18 2011)

same today. Women with computer science degrees peaked in 1984 at 37 per cent; since then women left computer science in droves, dipping to 20 per cent by 2006[17].

The picture is no different in Canada. According to a report commissioned by the Information and Communications Technology Council (ICTC) males dominate most jobs in the Canadian ICT sector except for writers and graphic designers or illustrators. While the number of women is increasing, it does so at a slower pace than the number of males; resulting in a decline in the overall percentage of women in the ICT sector. The report also states that women's participation at board and senior management levels is below the country's business community's average.

These are classic cases of vertical gender segregation, with women more strongly represented in lower level ICT occupations than in higher status and higher paid professions. In developed economies where the ICT sector has matured from 'robotic' and 'clerical' work to innovation and design, there is, for a variety of reasons, a clear trend in the number of women in ICT jobs declining over time[18]. The ensuing gaps have been filled with migrant labourers from emerging economies – some of whom are women.

Box 4: The career-family balance

Partly because it is so tricky to juggle kids and a career, many highly able women opt for jobs with predictable hours, such as human resources or accounting. They also gravitate towards fields where their skills are less likely to become obsolete if they take a career break, which is perhaps one reason why nearly two-thirds of new American law graduates are female but only 18 per cent of engineers.

Source: The Economist July 23rd 2011

It is this decline in the visibility of women in ICT professions in the more advanced, high-value chain economies coupled with a growing deficit of skills to fill vacancies in the sector that has led to a renewed interest in attracting more women into the ICT skilled labour force. In the past few years comprehensive national-level research studies conducted by government and the private sector point to the significance of the ICT sector to national economies, and the need for more targeted programmes to engage women into this sector to create more employment opportunities and income generating revenue. Gender studies conducted in South Africa[19], Canada[20] and seven European countries[21] echo common findings, challenges and opportunities despite very different domestic contexts.

And while studies document a startling absence of women in most ICT job categories, there are still regions where women are entirely absent from the ICT sector, where they face many obstacles that prevent them from entering the field of technology, adopting it as a career and working in the ICT sector. These obstacles play a significant role in shaping the decision-making of women and limiting their choices in the ICT space. They are also factors that have for a long time affected their awareness of their capacity and of the benefits of ICT to their social, career, and family lives. Persistent socio-cultural norms trap women's thinking and ability, and limit their mobility whether they are living in a thriving urban centre or a remote rural village. They are at a higher risk of being marginalized from today's Information Society,

17 ibid

18 In the UK, between 1995 and 2002 the number of women in ICT jobs declined from 25% to 22%, in Germany the number of women in the software engineering sector halved through the 1990s, and in the US the proportion of female computer/mathematical scientists employed in the country dropped from 37% in 1994 to 27% in 2004. (Source: Parvati Raghuran: (2008) Migrant Women in Male-Dominated Sectors of the Labour Maerk: A research agenda)

19 http://women-in-ict.meraka.csir.co.za/images/7/76/National_print.pdf

20 www.itac.ca/uploads/pdf/Women_and_ICT.pdf

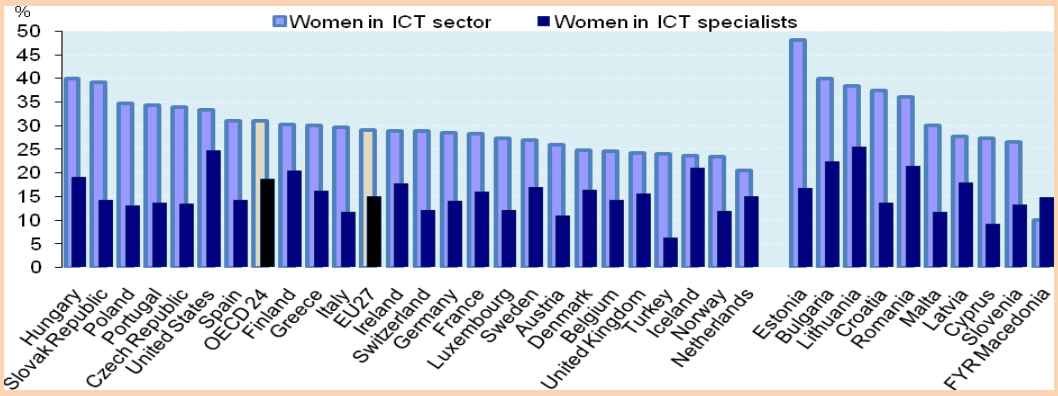
21 www.ftu-namur.org/fichiers/D12-print.pdf

due to unequal access to training, the lack of country-specific Internet content, high Internet connectivity costs, and the lack of awareness and policy advocacy.

Box 5: Women in ICT-related employment – Europe

Women still participate significantly less in the ICT sector and ICT specialist occupations than men, but their share in employment is increasing in most countries. In 2009, the share of women employed in the ICT sector was around 30 per cent in selected countries (see Figure 1). This is almost double the share of women employed as ICT specialists (around 18 per cent). With over one-third of females working in the ICT sector, central and eastern European countries are clearly above the OECD average. The picture is somewhat different for ICT specialist occupations; the highest shares of females working as ICT specialists are in the United States (almost 25 per cent), followed by Iceland, Finland and Hungary, each at around 20 per cent.

Figure 1: Share of women in the ICT sector and in ICT specialist occupations in selected countries, 2009



In sum, research shows that:

- The ICT sector remains a buoyant and growing sector for employment and a key sector underpinning development in the domestic and international economy.
- Employment in the ICT sector has continued to grow significantly in recent years. This growth, however, has not led to a parallel increase in women's presence in the ICT labour market, with the male-female gap being particularly pronounced at senior levels.
- In comparison to the general growth of the sector, women's employment figures in advanced economies are actually in decline, which suggests that the issue is not just an entry level problem but also one of demotivation, of retention and/or promotion of women within the sector at many levels.

1.3 Who is qualified for the ICT sector?

As more and more professions are ICT-enabled, more and more of the labour force work directly with a range of ICT tools and applications as an integral part of their occupation. Customized software has been developed for almost every single business sector, from farming to aerospace, and the industry is poised to expand into emerging sectors such as climate change, energy and environmental management. That said, there is no well-established definition of what comprises **ICT professions**. This is in part because the sector is dynamic, swiftly changing and increasingly overlapping with or becoming pervasive and indispensable functioning platforms to a plethora of other technical and non-technical professions.

Box 6: "ICT-skilled employment" as defined by the OECD

The OECD measures ICT-skilled employment in two ways, one based on ICT-specialist occupations and the other based on ICT-using occupations. One is a narrow measure, comprising specialists whose jobs focus is on ICTs, such as software engineers. The other is a broader measure of ICT-skilled employment, and concerns employees who use ICTs regularly as part of their jobs, but whose jobs do not focus on ICTs. This would include professions in the frontlines of media, as teachers in classrooms, as medical staff, or in the financial sector.

Source: OECD (2007) Directorate for Science, Technology and Industry, Committee for Information, Computer and Communications Policy. Working Party on the Information Economy – ICTs and Gender

The conventional foundation for all ICT professionals has tended to draw from disciplines including Information Systems, Computer Science, Software Engineering, Business Computing and Information Technology. Expected core competencies tend to include IT infrastructure and platforms; data and information management; networking; programming fundamentals; human-computer interaction; system building and acquisition; IT project management; and methods and tools for problem solving, abstraction, design, and implementation.[22] Microsoft[23], keen to get women students into its established workforce[24] illustrates its own career path progression as a certification ladder geared towards servicing Microsoft's software requirements.

The International Labour Organization (ILO) has also had to periodically redefine the dynamic ICT sector's "skill level for applications and software programmers, to the need to address the convergence between information and communications technology, and to the distinction between hardware engineers and software engineers".[25] Tech job portals such as http://jobsearchtech.about.com/od/careersintechnology/Technical_Job_Descriptions_and_Career_Paths.htm that have sprung up to cater to the demand for IT engineers, software architects, network developers and gaming designers illustrate the wide range of professions and openings in the sector.

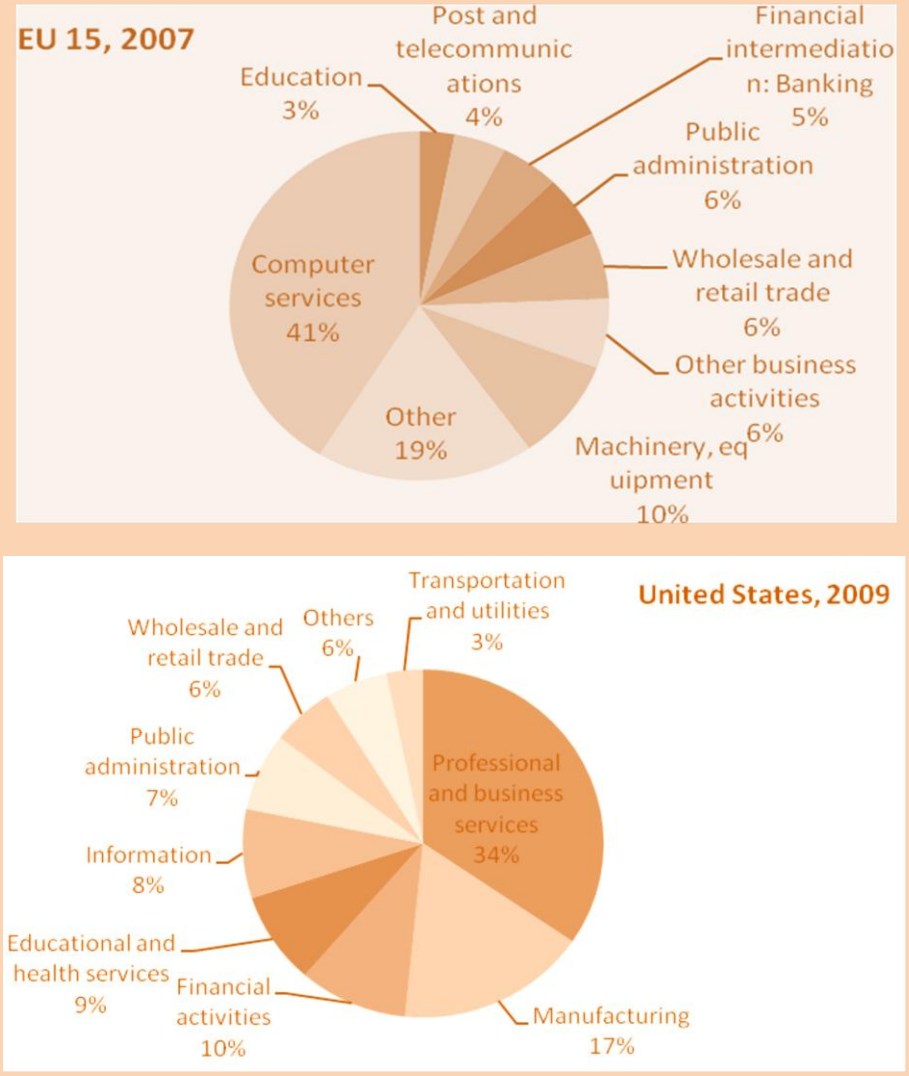
[22] See www.naccq.ac.nz/conferences/2008/15.pdf.

[23] See Microsoft ICT roadmap and website for ICT students at www.microsoft.com/learning/student-career/en/us/default.aspx

[24] http://download.microsoft.com/download/6/2/2/62264bcd-3a41-480a-9e74-d105dcd1b539/Download_Certification%20Readiness%20Guide%20for%20Academia.pdf

[25] 251 Software and applications developers and analysts; 2511 Systems analysts; 2512 Software developers; 2513 Web and multimedia developers; 2514 Applications programmers; 2519 Software and applications developers and analysts not elsewhere 252 Database and network professionals; 2521 Database designers and administrators; 2522 Systems administrators; 2523 Computer network professionals; 2529 Database and network professionals not elsewhere classified; see www.ilo.org/public/english/bureau/stat/isco/docs/ict.pdf.

Figure 2: Share of ICT specialists by sector



Source: OECD calculations from US Current Population Survey (CPS), December 2009; Didero et al. *(2009) based on Eurostat Labour Force Survey (LFS), 2007.*

Box 7: ICT skills set

ICT skill set demands and needs are also being defined. The Skills Framework for the Information Age (SFIA) Foundation [26] provides a comprehensive listing of professional skills framed across six broad categories of skills for the Information Age. These include strategy and architecture, business change, solution development and implementation, service management, procurement and management support, and client interface.

As ICTs become an increasingly central component or platform for the efficient delivery and monitoring of services, the profession itself is maturing and gaining importance. Different ICT career roles require different skills of a multi-disciplinary nature. And because the ICT sector is fast-paced and dynamic, the

[26] www.sfia.org.uk/cdv4/index.html

skills of the ICT workforce need also to keep up with the pace of change. A case in point is a parallel growth in those professions engaged in regulating, licensing and security of and within the ICT sector, which means a growing demand for lawyers, business managers, press and communication staff. This suggests that ICT qualifications need to be extended to include a much broader spectrum – which in turn suggests that there may potentially be more employment openings that might attract the attention and interest of girls and women.

In line with the dynamics of the ICT sector, this report defines ICTs beyond the classical computer related professions (system design, programming, implementation, development and maintenance) to include new professions and occupations linked with multimedia and Internet services, digital graphic design, e-publishing, e-business, and e-commerce.

1.4 Why it is important to reach women and girls

"We need to get girls interested in computing by first grade. By fifth grade, it's game over. Computing has an image crisis. A boy geek subculture has grown up around gaming that involves violence. It's not something little girls aspire to. It's not about lack of educational opportunities for women. Smart girls graduate from high school with straight A's, go to college, and find themselves surrounded by guys who've been hacking for 10 years. So they're way behind. They get discouraged and go into law or medicine" (Audrey MacLean).[27]

Box 8: Girls qualifying in science

According to the European Commission's Information Society and Media directorate report on **Woman and ICT in 2009**, citing findings from the PISA 2006 survey, 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 12 countries girls outperformed boys, while in 8 countries boys outperformed girls. But in the OECD countries, the difference in both cases is less than 12 points in the science scale which is not considered significant in contrast with the mathematics and reading scales. There were no significant differences between male and females in average science performance in the 22 OECD countries that participated in the survey. Despite the non-significant difference in sciences, gender differences were found in attitudes. Males were significantly better in explaining scientific phenomena whilst females were better in identifying scientific issues. More females were found to attain higher performing academic oriented tracks An interesting fact which emerged from the survey is the students' self-concept regarding science: males thought significantly more highly about their science abilities than females. One important fact which emerged from the 2006 survey was that students were more inclined to like science and perhaps follow a scientific career if they had a parent in a science-related career. Looking at the number of women following undergraduate courses in science, mathematics and computing, they represent only 37.5 per cent of the total number of students in these courses and the percentage is even lower in engineering manufacturing and construction, only 24.7 per cent. The fact that the numbers decrease considerably at graduate and post-graduate levels indicates that many do not complete their degree courses.

There are a number of compelling economic reasons for engaging women in the ICT sector, among them:

- **Closing the male-female employment gap is good for economic growth.** Research indicates that the narrowing in the male-female employment gap has been an important driver of Europe's

[27] http://iae-pedia.org/Women_and_ICT#Content_not_Yet_Integrated_into_the_Document_11.2F11.2F09

economic growth in the last decade. In Asia and the Pacific, for example, restricting job opportunities for women is costing the region between USD 42 billion and USD 46 billion a year. World Bank findings demonstrate that similar restrictions have imposed massive costs throughout the Arab States, where the gender gap in economic opportunity remains the widest in the world today. In its 'Global Gender Gap Reports', for the past five years, the World Economic Forum has also been quantifying the magnitude of gender-based disparities. The report reveals those countries that are role models in dividing resources equitably between women and men, regardless of their level of resources, fare better than those that do not.

- **There is an overall increase in demand for technical workers.** Since the dot-com bust at the beginning of the millennium, the demand for technology jobs has improved dramatically. Indeed, as the National Center for Women and Information Technology (NCWIT) reports, "[t]here are now more IT jobs in the United States than there were at the height of the dot-com boom." Because of this increased demand for technical employees, as well as the context of increased corporate competitiveness, highly qualified women within technical fields have had significant opportunities available to them. Moreover, women in the field are largely satisfied with the work they do and generally satisfied with their employers.[28]
- **Gender diversity in leadership positions is good for business performance.** Studies exploring the link between women in leadership positions and business performance have shown a positive correlation between gender diversity on top leadership teams and a company's financial results. In recent years, in the midst of the global economic downturn, new themes have emerged about gender equality in the workplace and its impact. Biologists, behavioural economists and psychologists have contributed to discussions on some of the decisions and excesses that led to the financial crisis and have suggested that more diverse teams make better informed decisions, leading to less risk-taking and more successful outcomes for companies. Over time, therefore, a nation's competitiveness depends significantly on whether and how it educates and utilizes its female skills[29]. In the workplace, where only 3 per cent of Fortune 500 companies have a female CEO, companies would be wise to pay attention to how they attract and treat women: firms with at least some senior-level managers outperform those who don't. And, on average, women have done more with less funding, and have fewer failures in starting their own companies.

  The management expert Steve Denning argues that solving issues of women's equality in the workplace contribute directly to the overall productivity in the workplace, particularly in areas of social media and start-ups – two key drivers of innovation and employment, because not only does the overall intelligence of a group directly correlate with the percentage of women in that group, but also because women are naturally better in arenas of social media.[30]

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28 http://catalyst.org/file/15/2008%20women%20in%20high%20tech.pdf

29 As the projections show, women will become more highly qualified than men. To ensure that their potential will be used, it is not enough to redirect women to occupations that used to be dominated by men; social barriers and glass ceilings also need removing. Today, women's share in management positions is only 20%; only 2 to 3% of workers in top positions in the largest and most powerful companies are women. Policy measures to make combining work and family commitments easier are essential; see Linda Wirth, "Increasing the representation of women in senior management positions" in www.workinfo.com/free/Downloads/97.htm, 2009.

30 http://techchange.org/2011/03/08/women-in-tech-why-the-future-looks-bright/

Box 9: Canadian Trends

In Canada in 2006, women occupied only a quarter of the technical and business professional jobs in the ICT sector. Sector employers need to hire and promote more women. This is not just about social equity. Female participation is good for business. Limited recruiting of women means limited access to the skills and talents of half the population. Information technology is increasingly about collaboration and social intelligence. Women, as consumer leaders, increasingly make the technology buying decisions. So it behoves ICT vendors to have smart, creative women inside to design and market their solutions. All this is well known, or should be. Most major ICT firms strongly agree and want to hire more women into their ICT jobs. But there is a supply problem. While more young women have chosen law and medicine, their already low interest in technical ICT jobs has dropped. In 2005, 20 per cent of Ontario university computer science students were female. By 2009, the number was 15 per cent.

Source: Digital Economy Strategy 2010

- **As technology consumers, women are important market influencers.** As more and more women are using technology and related services, it makes sense for women to be the ones designing and developing more of the products and services available. It makes sense that women should be more equally represented on advisory boards and senior-level staff, as often women make up a significant, if not the majority demographic as consumers. The NCWIT cites a study which "determined that racial and gender diversity were associated with increased sales revenue, more customers, and greater profits." The survey scorecard also suggested that as more women enter fields of computing and technology, the pay gap will close as "comparable levels of experience, education, and job title are controlled for." Women have made inroads into the sector at all levels and have indicated an interest and capacity for certain specialist professions within the sector.

A more youth-focused definition of ICT careers can be found on the ITU Girls in ICT Portal www.girlsinict.org which suggests to girls and young women (as in Box 10) that they are already experts based on their de facto ICT use.

Box 10: You may already be an ICT expert if…

…you use social networking sites like Facebook and Twitter a lot; if you have a blog; if you are savvy at optimizing search engines or mixing dubstep tracks on the computer; if you know how to research and write a really good paper, starting with the Google and YouTube search box; if you stand out from the crowd by using social media to your advantage and to bring attention to things that are important to you; and if you expertly use ICTs to manage your life – everything from email to online entertainment, document storage and collaboration and social media.

Section II: Career opportunities and skill shortages – Regional comparisons

2.1 Overview

On a global scale, ICT markets are shifting towards non-OECD economies. The OECD[31] countries' share of the world market fell from 84 per cent in 2003 to 76 per cent in 2009 and this trend may continue. One driver that fuels this decline is the rapidly growing ICT markets outside of the OECD area. Today, the top 250 ICT corporations are increasingly non-OECD firms. There has been a larger decline in the number of United States-based firms in the 2009 top 250 firms[32] than in previous years,[33] in contrast to firms from France, Spain, Germany, Luxembourg, the Netherlands, Switzerland, Turkey, United Kingdom, as well as from Japan, Brazil, India, Argentina, Morocco, Philippines and Qatar.[34] China is by far the largest producer and exporter of ICT goods today, while India is the largest exporter of computer and information services[35].

A McKinsey[36] survey published this year found that of the countries which account for more than 70 per cent of global GDP, including G8 countries, the Republic of Korea and Sweden, and the large, high-growth economies of Brazil, China, and India appear to demonstrate that ICTs have delivered substantial economic growth and created jobs on a large scale. While the survey is by no means the final word on the impact of ICTs on the global economy, it found that the Internet is, and will remain over the coming decades, one of the biggest drivers of global economic growth. In fact, it shows that more than 75 per cent of the value added created by the Internet is in *traditional* industries that don't define themselves as pure Internet players. ICT's main impact is through the modernization of these *traditional* activities.

According to the McKinsey survey[37], the United States still captures more than 30 per cent of global Internet revenues and more than 40 per cent of net income. It is the country with the most diverse ICT ecosystem, with roughly equal contributions in hardware, software and services, and telecommunications. The United Kingdom and Sweden are adapting to the changing ICT environment; both countries have decided to focus on further developing the critical telecom sector. France, Canada, and Germany also have strong Internet usage, and are poised to increase their presence and visibility. India and China continue to strengthen their positions – powered by near double-digit GDP growth rates; both countries' Internet system has growth rates of more than 20 per cent. The Republic of Korea is also

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[31] Current OECD members are: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States.

[32] In 2009, the top 250 ICT firms employed more than 13 million worldwide (almost 70% of ICT sector employment in OECD countries). The average number of employees in the top 250 firms was more than 54 000. Large ICT services firms had on average the most employees (62 000 on average), followed by electronics and component firms (more than 60 000 on average). In contrast, the top Internet, semiconductor and software firms in the top 250 ICT firms had on average only 14 000, 22 000, and 30 000 employees, respectively. OECD Information Technology Outlook 2010, pp.132-133.

[33] Between 2000 and 2009, employment in the top Internet firms grew the fastest (by 21% a year), followed by ICT equipment firms (14% a year) and software firms (8% a year). In 2009, despite the downturn, ICT equipment, Internet and electronics and component firms increased employment on average by 6%, 4% and 2%, respectively. OECD Information Technology Database, compiled from annual reports, SEC filings and market financials.

[34] OECD Information Technology Outlook 2010, Table 1.1, p.32.

[35] OCED Information Technology Outlook 2010, p.60.

[36] See McKinsey & Company – McKinsey Global Institute : Internet matters: The Net's sweeping impact on growth, jobs, and prosperity, May 2011

[37] McKinsey & Company – McKinsey Global Institute: Internet matters: The Net's sweeping impact on growth, jobs, and prosperity, pp. 4-5., May 2011

accelerating its impact and influence on the global Internet economy, and it is doing so at a faster rate than its neighbour Japan. Brazil, Russia, and Italy are in the early stages of joining the global Internet supply chain with strong potentials for growth.

2.2 An enabling environment for ICT growth

To develop an ICT ecosystem that is poised to transform present economic and social stereotypes detrimental to gender equity and equality, and that will harness its 'equalizing force' for the common good, for all stakeholders, including women and girls, both public and private attention must be focused on the impediments to its development.

The building of **human capital**[38], both domestic and foreign, has enabled the United States to tap into a vast talent pool. Its top universities and research and development centres have attracted high-potential domestic and foreign ICT talent. Of all doctoral candidates in US science and engineering programmes, 43 per cent are foreign students taking up advanced studies in the United States on the strength and reputation of its universities and opportunities to earn high salaries, but also in response to its sophisticated scholastic marketing programmes of targeting foreign students and then easing their integration into their new surroundings. Other OECD countries like Sweden have started a number of initiatives to increase the number of highly qualified ICT graduates, including a programme that provided IT training to 75 000 primary and elementary schoolteachers, who then imparted these skills to students at all levels. The Swedish government also increased the capacity of university science and engineering programmes, facilitating a 7 per cent increase in graduate students studying science between 1998 and 2004, and it provided the financing for new positions in the Royal Institute of Technology. And while India and China have primarily invested in the engineering and manufacturing aspects of the ICT industry and the creation of technological clusters to increase the number of highly qualified ICT graduates significantly, the bulk of developing countries have yet to put in place national ICT action plans. They could greatly benefit from knowledge and technological exchanges particularly with emerging economies and leap-frog their ICT development stages by integrating gender-neutral policies and practices.

Equally critical is **access to financial capital**[39], particularly to small and medium sized ICT start-ups and enterprises. Access to affordable financial capital – through loans, venture capital investments, tax incentives like deferrals, advantageous credit facilities like government-backed loans, etc. – has been one of the four cornerstones for many countries to gain more visibility and voice in the ICT sector. Where access to financial capital is readily available, opportunities to compete improve. Countries that launched incentives to promote financing both from traditional sources such as banks or self-investment and from investors, such as venture capital funds, were performing well, according to a McKinsey survey.[40] The United States, for example, launched financing mechanisms targeted at supporting the growth of technology firms. The Advanced Technology Program, designed to organize co-financing between public and private sources for high-risk research and development projects is one such initiative. Between 1990 and 2004, it led to the funding of USD 576 million in electronics projects and USD 504 million in ICT projects. The Republic of Korea offered loan incentives to promote investment in carrier infrastructure and furthermore encouraged significant investment in local research and development; this resulted in an almost 10 per cent annual increase in investment between 1997 and 2007. Encouraging ICT-focused venture capital appears to also offer much needed access to financial capital. Israel, for example, advanced its ICT sector by creating alliances with Silicon Valley venture capitalists, who today have access

[38] McKinsey & Company – McKinsey Global Institute Internet matters: The Net's sweeping impact on growth, jobs, and prosperity, pp.30-32, May 2011

[39] McKinsey & Company – McKinsey Global Institute Internet matters: The Net's sweeping impact on growth, jobs, and prosperity, p. 4, May 2011

[40] McKinsey Global Institute: Internet matters: The Net's sweeping impact on growth, jobs, and prosperity, p.31, May 2011

to the country's superior ICT research and development work. And in East London, an ICT ecosystem is being developed with the involvement of 60 venture capital firms focusing on new ICT technologies.

Investments in small and medium-sized firms are particularly critical for new market entrants. Because lending processes are often geared towards big loans for big companies, SMEs find it difficult to expand to regional and global markets, which make it challenging to find global customers, partners and other ICT business development opportunities. To bridge that particular 'divide', the World Bank, the International Finance Corporation (IFC) and its multi-donor ICT for Development programme *info*Dev[41] facilitates access to capital and finance through its global network of ICT-enabled business incubators programme using technology platforms for discovery, interaction and matchmaking, such as *info*Dev 2011 Top 50 Innovative SMEs at Helsinki's Global Forum on Innovation and Technology Entrepreneurship.[42]

An additional prerequisite for providing ICT career opportunities for women and girls is the continuing evolution of network **infrastructure and software development –** which form the backbone and content of the ICT experience. While infrastructure development caters more to large-scale engineering and hardware programmes and projects often considered to be the reserve of male 'ownership', software development has been traditionally more open to female inputs, and it has been the prerogative of spawning innovation from the bottom of the pyramid. Software development has the potential to create opportunities for social goods – commonly a woman's domain – such as using new technologies to solve community problems. The software and computer services sector appears to be open to women mainly because it is facing a rather severe talent shortage[43].

Last but not least, it is critical to build the **'enabling' environment** designed to harness the equalizing force of ICTs. To bring in millions upon millions of additional ICT users and consumers is critical to the growth of the global ICT sector, and holding women and girls back will inevitably stall if not idle the entire ICT industry. A country cannot compete in an increasingly global ICT market if half of its talented citizens are not participating. Women need to be in the position to influence and direct the ICT sector. Moreover, the ICT industry is losing the talent of skilled women who can bring to it diversity of thought and perspective. Without women as an integral part of the workforce, the ICT industry is losing the many potential contributors to the design and formulation of government and research policy and the development of technology that benefits communities as a whole.

2.3 Emerging ICT growth sectors

Keeping these external factors in full view, predictions on ICT career opportunities for women must then look at ICTs both as a sector in itself (ICT connectivity, infrastructure, and ICT industries) and as an enabler of gender-neutral transformation processes across sectors. Prime areas of engagements in the short run therefore are sectors most in tune with where women in developed, emerging and developing countries already play a major role, e.g. in health, education,, social protection, agriculture and rural development, urban development, infrastructure, environment, and social development, among others.

The **health care** industry has been historically a primary domain for women's employment, and it is presently undergoing a significant transformation. It has traditionally relied on paper-based medical records and manual processes that make it difficult to gather, retrieve, and share information among doctors, with patients, and insurance companies. In the last few years however, the industry has begun to

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41 see www.infodev.org for the programs ICT development mandate and mission

42 The Top 50 innovative SMEs have the opportunity to pitch their companies to over a thousand participants including business angels, mentors, financiers, and established companies, other SMEs and *info*Dev/European Business & Innovation Centre Network (EBN) / National Business Incubation Association (NBIA) incubators. The Top 50 will then each have a tailored program to connect them with the most relevant funding and partnership opportunities. With an opportunity to compete for soft-landing packages and *info*Dev equity funding,

43 See European Commission's Information Society and Media directorate report on Woman and ICT in 2009, p. 46, March 2010.

invest in new health IT applications, sophisticated medical devices that capture and share digital results, and 'turn-key' administrative systems. The newly designed processes are particularly geared to play into the comparative advantages women have long held in the industry.

A potentially new area of professional ICT engagement for women is the nascent **green economy.** For most companies, going green is rapidly becoming an imperative, not an option. Greenhouse gas emissions proliferate, industrial pollution continues to menace the public, and waste from packaging materials, among others, saturate landfills. Businesses globally are facing calls from customers, regulators, and shareholders to do their part to minimize their impact on the environment. Women who are both the stewards of sustainably managing their families' and communities' lands and who dominate environmental studies in schools and universities are destined to play a leading role in the conversion to the green economy.

That said, information and communication technologies make up nearly 2 per cent of global CO2 emissions today, about the same level as the entire airline industry. The relatively short life cycle of ICT products, and the lack of thought given to dealing with their end-of-life use, has led to a growing dispersal of toxic chemicals. What's more, the number of PCs worldwide is projected to double between now and 2014, and mobile voice and data traffic is forecast to rise fourfold by 2012. As a result, total ICT emissions are on track for a 50 per cent increase by 2020.[44] Faced with these realities, producers and users of ICTs must reduce their carbon emissions and then make a real contribution to reducing the environmental footprint of both public and private sector operators by reducing the energy consumption of its operations through the application of ICT solutions to a wide variety of corporate functions, including buildings, logistics, energy, motors, transport, teleconferencing, and e-services.

2.4 Highlights from OECD countries

The ICT sector in the OECD countries has seen signs of new life in the wake of the 2008 global economic and finance crash. In total, all OECD countries are employing around 16 million people in the ICT sector, or 5.8 per cent of total OECD business sector employment[45] with 11 OECD countries (Republic of Korea, Finland, Ireland, Japan, Hungary, Sweden, the Slovak Republic, Germany, the Czech Republic, the United States and Mexico) producing the largest shares of ICT manufacturing value-added. Over 11 million people are employed in ICT services and almost 5 million in manufacturing. In the United States ICT sector employment accounted for more than 30 per cent of total OECD ICT sector employment in 2008, by far the largest share, followed by Japan (19 per cent) and Germany (8 per cent)[46]. The share of employment in the ICT sector however declined, for example, in Canada and the United States in response to increasing manufacturing and services trade and outsourcing with non-OECD economies.

In most OECD countries, increases in ICT **services** employment outweighed declines in ICT **manufacturing** employment, so that the ICT sector continued to increase its share of total business sector employment. In the United States, however, the increasing share of ICT services employment did not compensate for falling ICT manufacturing employment, so that the share of ICT employment in total business sector employment decreased from 5.8 per cent in 1995 to 5.5 per cent in 2007. In 2008, ICT employment in the United States accounted for 5.3 per cent of total business sector employment[47]. This in large part reflects anxiety in the business community and by consumers in the lead up to the 2008 economic and finance

[44] For a thorough discussion see OECD Information Technology Outlook 2010, "Greener and Smarter: ICTs, the Environment, and Climate Change, pp. 191 – 219.

[45] OECD Information Technology Outlook 2010, Table 3.1, p.129.

[46] OECD Information Technology Outlook 2010, Table 3.2, and STAN and National Accounts Databases, June 2010; http://dx.doi.org/10.1787/888932328351

[47] See Woods, A.W. (2009), Industry Output and Employment Projections to 2018, in Monthly Labor Review: Employment Outlook: 2008-2018, November, US Bureau of Labor Statistics.

crash. By 2011, however, the United States estimated that the computing sector would have 1.5 million job openings over the next ten years, with some industry players predicting that over 800 000 of these openings could go unfilled[48].

Ireland remains the largest exporter of computer and information services, followed by the United Kingdom, and Germany. While economic growth figures remain in the single-digits, the sector's performance continues to outperform the business sector as a whole, the macroeconomic situation has improved since mid-2009.[49]

ICT hardware is the largest segment of OECD ICT goods trade, accounting for around 25 per cent of the total. The United States, the Netherlands and Germany are the biggest OECD exporters (in descending order of magnitude), with Japan and the United Kingdom having experienced declining exports since the mid-1990s, while the Republic of Korea, Ireland, Mexico, Hungary, and the Czech Republic generated export growth rates[50].

Major ICT **software** firms have experienced a slowing of investments, increasing the pressure for layoffs in the software industry or at least delaying hiring.[51] SAP and Microsoft, for example, reported significantly fewer people employed in the first half of 2009 compared to 2008. Both cut around 3 000 jobs compared to 2008 (6 per cent of SAP's workforce and 3 per cent of Microsoft's workforce). Microsoft, for instance, announced cuts of 5 000 jobs for 2009 and 2010 (more than 5 per cent of its employees), marking the first time that employment numbers at Microsoft, a bell-weather in the software market, had fallen. A higher number of employees at Amdocs and Oracle could not compensate total employment decreases among the top-10 software firms (Amdoc: +1 500, 9 per cent; Oracle: +1 700, +2per cent)[52]. Perhaps these reductions were short-lived. By May 2011, Microsoft had nearly 2 700 unfilled computer science positions[53].

However, signs of growth dominated the industry. It has benefitted from growing online transactions as a share of total retail purchases (Amazon, eBay, Expedia), advertising (Google, AOL, Yahoo!, IAC), and financial markets transactions (E*Trade, TD Ameritrade), as well as growth in broadband subscriber

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48 Written testimony of Dr. Daniel Reed, Corporate Vice President, Microsoft Corporation's Technology Policy Group before the Subcommittee on Technology and Innovation, Committee on Science, Space and Technology, U.S. House of Representatives, Hearing on the next IT Revolution? Cloud Computing Opportunities and Challenges, 21 September 2011 http://science.house.gov/sites/republicans.science.house.gov/files/documents/hearings/092111_Reed.pdf

49 Semiconductors are a leading indicator of hardware performance, and they have bounced back very rapidly from the decline. Sales are now well up despite global declines of 14% in 2009 due to the financial and economic crisis. On the PC side, sales volumes grew slowly in 2009 and PC revenues declined by over 10% with the shift to smaller and cheaper models and new mobile devices including netbooks. The outlook for the worldwide PC market in 2010 is very positive, with volumes growing rapidly (up 27% year on year in volume terms in the first quarter of 2010, and growth of around 20% foreseen for all of 2010), but market values will increase more slowly; see OECD Information Technology Outlook 2010.

50 Korean growth is largely based on strong indigenous ICT firms, whereas export growth for the Czech Republic and Hungary is almost entirely due to foreign assembly operations; see OECD Information Technology Outlook 2010, Figure 2.14.

51 OECD (2009d), "The Impact of the Crisis on ICTs and their Role in the Recovery", DSTI/ICCP/IE(2009)1/FINAL, www.oecd.org/dataoecd/33/20/43404360.pdf.

52 In the first half of 2009 top-10 software firms employed in total almost 310 000 people, which is around 3 000 people less than in 2008 (-1% of total workforce); see OECD (2009d), "The Impact of the Crisis on ICTs and their Role in the Recovery", DSTI/ICCP/IE(2009)1/FINAL, www.oecd.org/dataoecd/33/20/43404360.pdf

53 Written testimony of Dr. Daniel Reed, Corporate Vice President, Microsoft Corporation's Technology Policy Group before the Subcommittee on Technology and Innovation, Committee on Science, Space and Technology, U.S. House of Representatives, Hearing on the next IT Revolution? Cloud Computing Opportunities and Challenges, 21 September 2011 http://science.house.gov/sites/republicans.science.house.gov/files/documents/hearings/092111_Reed.pdf

numbers[54]. In the first half of 2009, top-ten Internet firms employed more than 94 000 people, almost the same number of employees as in 2008 (0.2 per cent of total workforce), but still almost 4 000 employees less than in 2007. Amazon, which accounted for almost 22 per cent of total employment in 2008, was the only firm reporting more employees in the first half of 2009 compared to 2008. In contrast, Google, the other top-ten company having a similarly high share of total employment in 2008, has reduced the number of its employees.

Communication equipment is the fastest-growing segment of ICT trade accounting for around 18.5 per cent of the industry's total. The Republic of Korea, the United States, Mexico and Finland are the biggest OECD exporters with the Netherlands, Germany and Hungary closing the gap. OECD exports of communication equipment increased from USD 57 billion in 1996 to USD 177 billion in 2008.[55] Its growth has been facilitated by product line diversification, ratcheting up both the scale and speed of heterogeneous trends in the sector.

These trends have also driven the diversification in the **telecommunications** industry. While fixed-line usage continues to decline, the number of mobile subscribers is increasing worldwide with mobile data services in particular driving revenue growth. Internet access and services continue their upward trend, as is total employment among the top-10 telecommunication firms. It has significantly increased in the first half of 2009 to up to 1.77 million employees. This is over 47 000 employees more than in 2008 (+3 per cent of total workforce)[56]. Meanwhile, the top-10 telecommunications firms have announced job cuts for 2009 and 2010. Telecom Italia announced cuts of 5 000 to 9 000 jobs by 2010 (or 6-12 per cent of its workforce), and British Telecom announced cuts of 15 000 to 30 000 jobs by 2010 (the equivalent of 10-20 per cent of its workforce).[57] All these announcements suggest that total employment by top-10 telecommunications firms could still slightly increase, by roughly 1-2per cent in 2010.

Consumer electronics trade is the second fastest-growing segment of ICT trade, accounting for around 15.5 per cent of the total, up from 11.1 per cent in 1996. Mexico, Japan, the United States and Germany are the biggest OECD exporters; with the United Kingdom and the Republic of Korea (repositioning its investment into faster-growing and higher-value products, notably communications equipment) experiencing declining exports over the 1996-2008 period.

As ICT manufacturing has moved to lower-cost locations in OECD countries (e.g. Republic of Korea) and Asian economies, the OECD ICT sector has shifted to computer and other ICT services.

These services account for more than two-thirds of total ICT sector value added in most countries[58]. Their share has increased and they have grown more rapidly than total business services. Gartner and

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[54] Total quarterly revenues of top-10 Internet firms increased throughout 2008 and the first half of 2009. Nevertheless, the majority of the top-10 Internet firms had falling quarterly revenues (year-on-year) increasing the pressure of lay-offs in the industry; see OECD (2009d), "The Impact of the Crisis on ICTs and their Role in the Recovery", DSTI/ICCP/IE(2009)1/ FINAL, www.oecd.org/dataoecd/33/20/43404360.pdf.

[55] OECD Information Technology Outlook 2010, Annex Table 2.A2.1.

[56] Acquisitions by Deutsche Telekom and Verizon Communications were the main drivers of that increase. Another top-10 telecommunication firm reporting an increased number of employees in the first half of 2009 compared with 2008 is Nippon Telegraph (+ 11.000, +6%); http://dx.doi.org/10.1787/888932329700

[57] *OECD Information Technology Database*, compiled from annual reports, SEC filings and market financials. http://dx.doi.org/10.1787/888932329700

[58] By sector, 73 (29%) of the total 250 firms in 2009 were telecommunication services providers, 68 (27%) were electronics manufacturers, 31 (12%) were IT equipment and systems producers, 28 were IT services providers, 18 were semiconductor firms, 16 were communication equipment and systems producers, 10 were software publishers and 6 were Internet firms. Telecommunication services firms and electronics firms accounted for the largest shares of top 250 revenues in 2009, at around 63% (USD 2 513 billion). IT equipment firms accounted for 15% (USD 588 billion), IT services firms for 8% (USD 323 billion), communications equipment firms for 6% (USD 258 billion), software and semiconductor firms for 3% each (USD 122 billion and USD 118 billion respectively), and Internet firms for 2% (USD 69 billion)); OECD Information Technology Outlook 2010, p.33.

Forrester, two of the world's leading information technology research and advisory companies, project growth rates of between 5 to 8 per cent in computer hardware, software, IT services, and communications services by 2010.[59]

General job strategies and policies included in OECD government economic stimulus packages aim to boost ICT-related employment. This includes, but is not limited to: the deployment of high-speed broadband networks and the development of semiconductors;[60] health applications; and "smart" applications such as "smart" grids, "smart" transport systems and "smart" buildings.[61] This also falls under the umbrella of what is referred to as green growth. ICT-related employment is expected to pick up in the short and medium term, given that "smart" applications rely directly on ICTs, and ICT skills are crucial for achieving the aims of many of these policies. Estimates have suggested that deployment of "smart" grids could create approximately 280 000 new jobs by 2012 in the United States. However, measuring jobs created by "smart" applications is a challenge, given that national statistics do not yet distinguish between jobs in "smart" applications and other ICT-related jobs. Nevertheless, private-sector demand for "smart" applications specialists in "smart" electricity grids has started to increase.

This indicates that the sector is becoming more data-intensive and that data management will become increasingly important to the electricity sector's functions. In motor vehicles and motor vehicle equipment manufacturing, for example, the share of ICT specialists has also increased significantly since 2007.The increase in ICT specialists suggests that motor vehicles and motor vehicle manufacturing are becoming "smarter". The share of ICT specialists has also increased in construction, primarily in the area of energy efficiency.[62]

The fact that the ICT sector has not suffered in the 2008 global crash as it did during the 2001 "dot.com bust" is a clear sign that ICTs continue to increase in importance for businesses and consumers and that the sector is by now well integrated into the "old" economy.[63] This makes ICT-related skills even more important for driving innovation, productivity growth and ensuring social inclusion; the latter being of particular relevance for rebalancing the persisting gender-divide in the ICT sector.

The attainment of marketable ICT skills is crucial to realizing employment opportunities for both men and women as general pressures on the labour market will remain in view of the slow recovery of the global economy. Governments' economic stimulus packages and the focus on sustainable employment growth

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[59] The worldwide decline in server shipments and revenues in 2009 was another sign of weakness in business investment. Servers are at the heart of the new computing and Internet networks, and shipments and revenues both declined by over 15% although they recovered at the end of 2009. (see, Gartner, Gartner (2010b), "Worldwide PC Shipments Grew 27 Percent in First Quarter of 2010"

[60] Despite the 2008 crash, firms continue to invest in green ICTs according to recent surveys (Gartner, 2009; Info-Tech Research, 2009; Datamonitor, 2009; Mines, 2009). As energy efficient semiconductors are the basis for green ICTs, among others, this trend could help revenues in the semiconductor industry and as a consequence it could support employment among semiconductor firms. Computer Processing Unit (CPU) manufacturers are taking advantage of that trend by upgrading existing or building new manufacturing facilities, to produce new energy efficient CPUs. Intel, for example, has announced that it will invest USD 7 billion in the next two years in four existing manufacturing sites in the United States, to be upgraded with the new 32 nanometer manufacturing technology enabling the production of faster and smaller energy efficient chips. Intel's investment "will support approximately 7 000 high-wage, high-skill jobs" (Intel, 2009b). Global Foundries, a joint venture between AMD and the Advanced Technology Investment Company (ATIC), expects to invest USD 4.2 billion to build Fab 2, a new semiconductor manufacturing facility in New York, United States. When operational in 2012, Fab 2 will provide 32 nanometers to chip-makers. It is expected to create "more than 1 400 high-tech manufacturing jobs, with an average annual salary of USD 60 000 per year" (AMD, 2009; GLOBALFOUNDRIES, 2009).

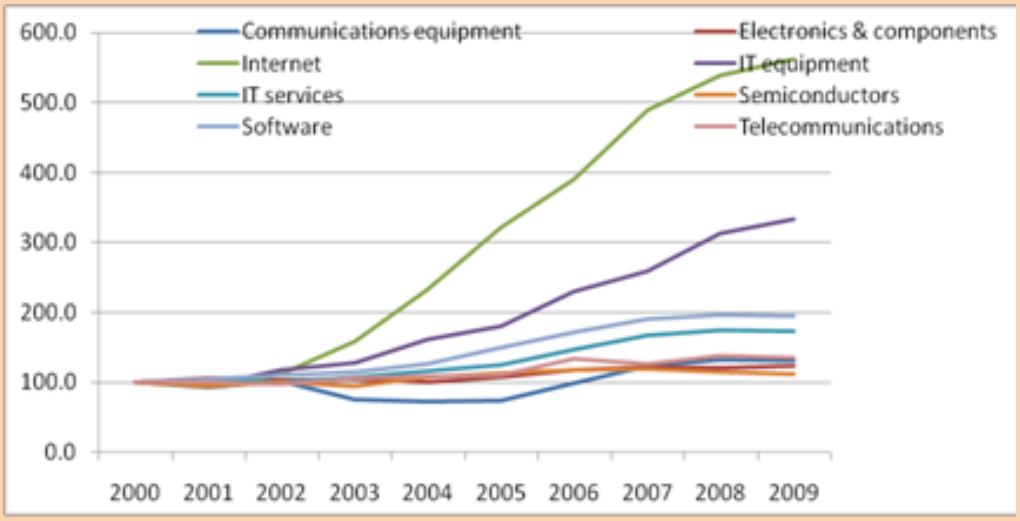
[61] OECD (2009d), "The Impact of the Crisis on ICTs and their Role in the Recovery", DSTI/ICCP/IE(2009)1/ FINAL, www.oecd.org/dataoecd/33/20/43404360.pdf.

[62] For an elaborate discussion on the subject, see OECD Information Technology Outlook 2010, pp.154/155

[63] See Didero, M., T. Hüsing and W.B. Korte (2009), "Monitoring E-skills Demand and Supply in Europe", August, www.e-skills-ilb.org/docs/MeSKILLS_WORKSHOP_2009_Programme.pdf.

can be expected to boost ICT-related jobs for years to come, particularly in the more labour-intensive IT services and software development sectors.[64]

Figure 3: Employment trends in the top 250 ICT firms by industries, 2002-2009
Average number of employees, index 2000 = 100



Source: OECD Information Technology Database, compiled from annual reports, SEC filings and market financials; in OECD Information Technology Outlook 2010, p. 134.

Box 11: OECD 2010 IT outlook report

ICT-using occupations make up over 20 per cent of total employment in most OECD countries and that number has remained constant. In contrast, only about 4 per cent of total employment in most OECD countries is accounted for by **ICT specialists**. The share has risen consistently in recent years and somewhat faster than growth in the share of ICT employment in the business sector. Among OECD ICT specialists, however, women still account for a relatively low share of 20 per cent.

The divergence between ICT specialists and ICT sector employment suggests that there is on-going occupational specialization at higher skill levels. These skills are needed as the ICT sector restructures constantly around more sophisticated products and activities; but, according to Eurostat Labour Force, they are also used to a greater extent across the wider non-ICT economy. This is because ICT specialist skills are required to produce both ICT products such as software in non-ICT sectors (financial services) and non-ICT products such as automobile systems with ICTs embedded in them.

Source: OECD Information Technology 2010, p. 127, see Box 2 on p.11 for definition

[64] Vacancies are indicators of future employment trends; they also point both to the ability of the ICT sector to find suitable employees and document the demand for ICT-related skills across the economy. Top ICT firms such as Accenture, HP, and Intel have announced hiring plans for 2010 and beyond. HP, for example, announced that it will hire more **sales personnel** to cope with higher demand for its products, in particular in the BRIC countries (Brazil, the Russian Federation, India and China). Accenture also plans to increase employment in Asia; see also Tkaczyk, C. "They're Hiring!", *Fortune Magazine*, 25 January 2010, http://money.cnn.com/galleries/2010/fortune/1001/gallery.bestcompanies_mosthiring.fortune/index.html

Surveys indicate that **vacancies for ICT specialists** are bouncing back after the 2008 global economic and finance crash,[65] with job openings for software engineers, computer programmers, systems analysts and computer support driving the vacancy market in the United States. In the United Kingdom ICT support jobs were the main source of the increase, owing in particular to skills needed for the development of Internet-based applications. Overall OECD vacancy figures suggest a relatively strong demand for developers and ICT support specialists.

There is also evidence that a large share of ICT personnel recruitment comes from contractors.[66] Contractor jobs for ICT specialists in the United Kingdom for example grew by 26 per cent compared to 0.8 per cent for permanent jobs. In the wake of the changes in the recruitment policies in the ICT sector, **part-time employment** can also be expected to rise as business use fewer labour inputs.[67] Changes in recruitment policies and the ensuing declining share of full-time employment in the ICT sector on the one hand and the increasing share of part-time employment on the other will have an impact on the growth in the **self-employed ICT labour market.** Here **self-employed workers** ("ICT contractors") are hired when companies are looking to fill a short term gap in their ICT expertise, or as part of a general strategy to outsource technical work.[68] Working as a contractor offers some benefits, such as more "freedom and choice" and often financial benefits. Entrepreneurial freedom however also brings higher risks, especially during an economic downturn. That said, ICT contractors are among the first to profit from a recovery, as firms take on these more flexible workers in times of uncertainty.[69]

Self-employment in the ICT industry could hold great promise for women, despite the inevitable market fluctuations. Given tighter market margins and fierce competition 'value for money' consideration trump gender concerns. Employment opportunities for women in the post 2008 global economic and finance crash era include high-speed internet, cloud computing,[70] green ICT goods and services and their "smart" applications as they are presently heavily promoted by governments as a strategic response to the

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65 See Knapp, C., S. Merritt, F. Hormozi and H. Seip (2010a), "Historic Behavior of the IT Job Categories, Pace/SkillPROOF IT Index (PSII), New York County (Manhattan)", Pace University, 20 January, http://support.csis.pace.edu/csisweb/docs/PSII/Historic_Behavior_Manhattan_2009_4Q.pdf.

66 Thomson, R. "Vacancies for IT Staff are Creeping Up", *ComputerWeekly*, 3-9 November 2009, p. 10.

67 The OECD defines part-time working in terms of usual working hours under 30 hours per week in their main job (see the Statistical Annex of the *OECD Employment Outlook*, OECD 2009a). Alternatively they are workers "whose normal hours of work are less than those of comparable full-time workers" (ILO, 1994); see also OECD calculations based on US Current Population Survey. http://dx.doi.org/10.1787/888932328693

68 Bytestart "How Much Will You Earn as an IT Contractor? IT Contract Rates", 23 June 2008; www.bytestart.co.uk/content/contractors/contractor-guides/it-contractor-market-rates.shtml

69 In 2009 United Kingdom employment came strongly from the contractor market. In the **United States**, the share of self-employed workers in the ICT sector increased from almost 7% in December 2008 to almost 10% in December 2009. The share of self-employed ICT specialists was almost the same as that of ICT workers; see OECD calculations based on US Current Population Survey. http://dx.doi.org/10.1787/888932328712

70 Cloud computing is one of the most discussed ICT technologies of recent years. Interest in cloud computing is mainly motivated by its potential to reduce capital expenditures and to deliver scalable IT services at lower variable costs. Typical ICT services delivered through the "cloud" include: *i)* hardware infrastructure (e.g. Infrastructure as a Service, IaaS), *ii)* platforms used for application development (e.g. Platform as a Service, PaaS), and *iii)* software applications (e.g. Software as a Service, SaaS). Amazon was one of the first companies to provide mass cloud computing services when it started selling spare IT capacity (IaaS) in 2006. By 2015, cloud computing could represent a USD 70 billion to USD 85 billion opportunity, with the market doubling every two years. Some technology watchers forecast that by 2015 cloud computing infrastructure and applications could account for 20 per cent of total spend in these areas. Cloud computing is mainly 'employed' to increase value added and growth rather than employment per se, although demand for cloud computing experts can be expected to increase in the ICT sector. Salesforce.com, a key actor in the new cloud computing industry, has increased its total employment since it went public in 2004: in 2009, it employed almost 4 000 people, 10% more than in 2008 and 52% more than in 2007, including a significant number of software developers. ICT specialist jobs related to the administration of standardized ICT services such as e-mail services may come under significant pressure with the deployment of cloud computing; see also OECD Information Technology Outlook 2010, p. 148.

economic crisis and as a means of enabling "green growth".[71] The development and use of green ICT goods and services that combine improved environmental performance with greater economic efficiency and long-term growth are also potential major employment growth areas. ICTs are powerful enablers of "green growth" in all sectors of the economy, and they offer tools for tackling such global challenges as climate change and sustainable resource management.

Table 1: Selection of priority areas for ICT research and development

Australia	Converging technologies and scientific disciplines – CSIRO ICT Centre	Researches ICT-based applications for national challenges in areas such as water and energy management
Austria	FIT-IT programme	Focuses on trust in IT systems
Canada	CANARIE Inc. Network Infrastructures	A broadband network connecting over 50 000 researchers, including dedicated broadband research programmes
Egypt	Center of Excellence in Nanotechnology	A partnership between two ministries and IBM
Germany	Computing systems and architecture	Programme to promote R&D for intelligent tools and systems that are capable of autonomous action and with particular focus on the needs of small and medium-sized enterprises (SMEs) (*Autonomik*)
Germany	Theseus Programme	R&D on semantic web applications
Japan	ICT Hatoyama Plan	Focuses on all-optical networks and next-generation cloud networking as part of the Digital Japan Creation Project
Korea	Physical foundations of computing	Focuses on semiconductor R&D as part of the Industrial Source Technology Development Projects.
Spain/Portugal	Iberian Nanotechnology Laboratory (INL)	Crosses disciplinary boundaries to include ICT-related research.
USA	Networking and Information Technology Research and Development Program (NITRD).	High-end computing research and Human-computer interfaces

The low hanging fruits of a green ICT-driven economy include jobs in the R&D and manufacturing of energy-efficient semiconductors and semiconductors for clean technologies such as photo-voltaics and wind power, and in firms providing services for reuse, refurbishment and recycling of old ICT equipment. How the United States Federal Government, for example, disposes of a million worn-out computers and countless other electronic devices every year may determine how fast the present USD 5 billion electronics recycling industry with presently 30 000 people 'on the job' will expand.[72] Further research is

[71] The OECD *Declaration on Green Growth* (OECD, 2009h) specifically mentions the role of ICTs in meeting environmental challenges: "In order for countries to advance the move towards sustainable low-carbon economies, international co-operation will be crucial in areas such as… *application of green ICT* for raising energy efficiency" (paragraph 2); and "We recognise that special efforts need to be made at the international level for co-operation on developing clean technology, including by *reinforcing green ICT activities*…" (paragraph 8)

[72] "Recyclers, haulers vie for U.S. electronics – Companies await agencies' rules on export of e-waste", in Washington Post, 19 September 2011, p. A15.

needed to optimize how ICTs can contribute to reaching environmental goals to improve global public goods.[73]

Box 12: Select Education Policies on ICT-related jobs

The promotion of ICT education and on-the-job training ranks high in OECD government policies. In most cases governments are upgrading existing education programmes in order to promote (IT) education for more people, with a particular focus on the unemployed.

- In Holland, the Digital Skills and Digital Awareness Programme provides IT education for people with a low level of ICT skills. More activities target the unemployed.
- In **Sweden**, existing education and on-the-job training programmes have been up-scaled in order to offer IT education to a larger number of people.
- The 2009 **US** Recovery and Reinvestment Act (ARRA) for example, allocates USD 750 million for disbursement by the Department of Labor under the Competitive Grants for Worker Training program, the majority of which is for promoting skills for "green" jobs (including ICT-related green jobs).
- In **Switzerland**, the third economic recovery package promotes use of the Swiss Unified Company Identifier in order to boost e-government applications. It is expected that this will raise demand for ICT skills.

Skills demand will grow in green ICT services and software development and most organizations will be seeking to deploy green ICTs effectively.[74] This creates opportunities for consulting and service advice, including environmental impact assessments, development and evaluation of green ICT strategies, carbon reporting and offsetting, green procurement, server consolidation and optimization of data centres. Estimates suggest that green ICT consulting revenues could reach USD 4.8 billion by 2013, with associated demand for ICT-related environmental skills.[75] Employment in services with a focus on the analysis and deployment of green ICTs may also rise.[76]

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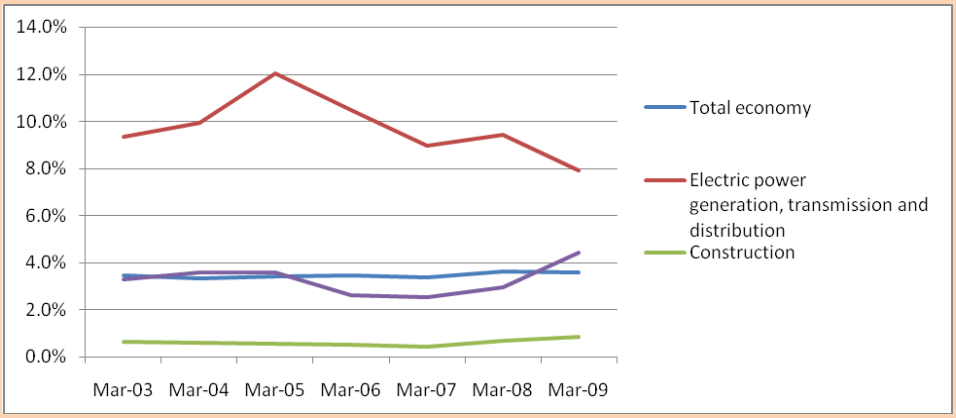
[73] Green ICTs are increasingly part of larger green technology initiatives. The European Commission's European Cars Initiatives, for example, provides the automotive industry EUR 5 billion to promote the deployment of green cars. This is expected to support ICT-related green jobs in the areas of automotive embedded systems and integration of electric mobility systems. In Austria, the Federal Ministry of Agriculture, Forestry, Environment and Water Management promotes environmental technology industries, with an expected positive impact on the creation of green jobs. Initiatives explicitly promoting ICT-related green jobs include: Korea's support for green technologies in its IT Research Center Fostering and Supporting Program. The Korea Communications Commission (KCC) has also established a Master Plan for Green Communication which promotes, among others, ICT-related experts on eco-efficiency. ICT-related green jobs are also explicitly emphasized in Portugal, where the promotion of developers of energy management systems for "smart" buildings is being considered.

[74] IDC –Dell (2008), *Green IT Barometer: European Organisations and the Business Imperatives of Deploying a Green and Sustainable IT Strategy*, IDC, White Paper, September, *www.dell.com/downloads/global/corporate/environ/comply/IDCWP28Q.pdf*.; and Wikberg, J., "Grön IT-policy blir ofta fiasko på svenska företag", *CIO Sweden*, 18 June 2008, http://www.idg.se/2.1085/1.166188.

[75] Mines, C. "Market Overview: Green IT Services: A Bright Outlook for IT Sustainability Consulting", 24 April 2009, www.forrester.com/Research/Document/Excerpt/0,7211,46824,00.html.

[76] OECD (2009f), "Towards Green ICT Strategies: Assessing Policies and Programmes on ICTs and the Environment", DSTI/ICCP/IE(2009)3/FINAL, www.oecd.org/dataoecd/47/12/42825130.pdf

Figure 4: Share of ICT specialists in electric power generation, transmission and distribution, construction, and motor vehicles and motor vehicle equipment manufacturing in the United States



Source: OECD Information Technology Data Base, compiled from annual reports, SAC findings and market financials OECD 2010

Employment related discussions of the growth of green ICT services routinely only capture green ICTs in its narrow sense, those with direct effects of ICTs. They do not take "smart" infrastructures and the wider enabling environmental capabilities of ICTs into consideration. A broader definition would increase both the scope and total value of the consulting market for green ICTs considerably and the range of needed green ICT-related skills. The deployment of "smart" grids[77], for example, could create approximately 280 000 new jobs by 2012 in the United States[78] alone. This includes job creation by "smart" application providers and by contractors and suppliers of the underlying technologies and services[79].

Skill forecasts are based on past trends and behaviour patterns, and skill and supply needs need to be contextualized, as they are embedded in dynamic interactions between the broader economic and social context and development of human resources. For OECD countries this has meant thus far a continuing shift to knowledge- and skills-intensive occupations, such as the ICT sector.[80] If history is any reliable guide for future prognoses, OECD countries will need to take measures to scale up skills and employment

[77] Smart grid refers to the class of technology that uses computer-based remote control and automation. This can be applied to industry's across the board

[78] KEMA "The US Smart Grid Revolution: KEMA's Perspectives for Job Creation", 13 January 2009.

[79] However, measuring jobs created by "smart" applications is a challenge, given that national statistics do not distinguish between jobs in "smart" applications and other ICT-related jobs; see OECD Information Technology Outlook 2010, p. 155

[80] The basic trends observed in recent years are expected to continue. Most projected increases are expected for high-skilled non-manual occupations, such as management, professional and associate professional jobs – more than 8.5 million in total between 2010 and 2020. Technicians and associate professionals (including physical, engineering, life science, health and teaching associate professionals) have the highest potential for job creation in the next decade (around 4.5 million), followed by professionals (such as physical, mathematical and life-science engineers, health and teaching professionals) (2.7 million) and legislators, senior officials and managers (1.4 million). Currently almost 40% of people are employed in these knowledge- and skills-intensive occupations and this trend is expected to continue to reach a share of more than 42% of total employment in 2020. What exactly is behind these developments still needs to be analysed. Sectoral change is one of the key drivers of occupational structures, but globalization, technological and organisational changes as well as new patterns of international trade also contribute substantially. Whether people have the right skills to match these jobs, remains to be seen. See European Centre for the Development of Vocational Training, 2010;
www.evri.com/news/for?query=European+Centre+for+the+Development+of+Vocational+ Training%2C+2010

opportunities in the ICT sector by focusing on policies to promote ICT education and on-the-job training to supply the up to seven million additional jobs being created in the knowledge and skill-intensive industries between 2010 and 2020.[81]

In response to the 2008 global economic and finance crash, both the private and public sector have encouraged ICT education.[82] Its promotion is considered essential for achieving both the long-term objectives of information societies and the future employability of men and women, boys and girls. At the same time, European Commission data shows that employers **do not recruit people based only on their formal qualifications** (vocational or academic), but also look for other competences that add value to their organization. Employers prefer workers able to adapt quickly to unforeseen changes. Ideally, individual skills profiles should include specific skills needed for a job with core skills such as the ability to analyse and organize complex information, take responsibility, manage risks and take decisive actions. Most OECD governments promote ICT skills primarily in **higher education**. Higher education institutions are generally encouraged (and sometimes obliged) to consider industry needs when developing and offering graduate programmes. The Norwegian government, for instance, promotes ICT education as part of its national *Strategy for a Joint Promotion of Mathematics, Science and Technology (MST)*. The Republic of Korea's Ministry of Knowledge Economy (MKE) supports innovation in university education programmes through co-operation and information exchange between universities and companies. Its *"Nurturing Excellent Engineers in Information Technology" (NEXT)* programme allows universities to quickly adapt to ICT firms' skills demands. Governments also promote ICT skills by upgrading ICT infrastructure in higher education institutions (along with other education institutions) and by increasing the deployment of e-learning applications. The Australian Government *Education Investment Fund*, for example, plans to invest AUD 4 billion over 2008-13 for strategic capital infrastructure investments to improve education and research capacity in education institutions.[83]

Box 13: China, Japan, Republic of Korea - highlights

- In 2003, for Asian countries/economies, the proportion of first university degrees earned in science and engineering was higher than in the United States.
- For the past three decades, S&E (Science and Engineering) degrees have made up about one-third of US bachelor degrees. The corresponding figures were considerably higher for China (59 per cent in 2001), the Republic of Korea (46 per cent in 2000), and Japan (66 per cent in 2001).
- In Japan, Taiwan, Province of China, and the Republic of Korea, women earn first university degrees at a rate similar to that in many European countries.

Vocational training ranks high among government measures to promote ICT education. Initiatives focus on specific target groups such as ICT specialists, employees with limited ICT skills, or the unemployed. In Switzerland, the *I-CH* project promotes vocational training for ICT professionals, with over 100 modules.

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[81] See European Centre for the Development of Vocational Training, 2010; www.evri.com/news/ for?query=European+Centre+for+the+Development+of+Vocational+Training%2C+2010

[82] A range of approaches to assess future skill needs is required. They need to encompass both quantitative and qualitative methods and serve a broad range of audiences, including policy-makers, education and training providers, other stakeholders such as public employment and guidance services, social partners, sectoral organizations, practitioners in education and training institutions and enterprises and analysts. It is important to recognize forecasts' limits. They can help inform labour market participants and actors and help labour markets work better. But they cannot provide detailed data to guide investment decisions at grassroots level, for example the future number of jobs in very specific occupations or the wide range of competences, skills and knowledge required in a particular job.

[83] OECD Information Technology Outlook 2010, p. 265.

Hungary promotes e-business skills through its five-year *Training Framework Program for Increased Adaptability in the Information Society (TITAN)*. The Belgian Government focuses on the unemployed through the *Flemish Institute for Employment (VDAB).* In Austria, the Labour Market Service finances IT training measures, including for the unemployed. Egypt's *Finishing School* programme provides training for around 900 engineers a year in various IT services areas as well as soft skills in collaboration with multinationals and local ICT outsourcing companies[84]. **The growing emphasis on matching skill needs with market/consumer demands will require a parallel emphasis on vocational programmes that target women.**

In Canada and the United States, there is increasing focus on capacity building for women in the ICT sector. In Canada, in particular, efforts to support women who are either interested in entering or are already in "non-traditional" occupations are being aided by flexible ICT instruments. Job opportunities, such as ICT analyst, consultant, technology marketing, and ICT management jobs in all sectors, which already enjoy above average female participation, have grown at a compound rate of 8 per cent for the past ten years while ICT programmer jobs are flat. The trend shows no sign of stopping.

As ICTs merge with sector-specific technologies across the economy, they produce "hybrid jobs". The expectation is that the next generation of ICT professionals will be more interested in opportunities to be creative and make a difference than, for example, in generic ICT engineering. The future, it appears, is in bioengineering, power grid informatics, digital media, and social and mobile apps. In other words, it is in interesting, fun, creative and social mashed-up hybrid jobs that combine ICT with business of every imaginable field. **The challenge is to connect to students and to get this message out.**[85]

Box 14: Germany's National Pact for Women

Germany promotes ICT skills for female employees through the National Pact for Women in occupations in mathematics, informatics, natural sciences and technology; this programme supports young talent irrespective of gender through the initiative *Germany: IT Powerhouse*; and, for older workers, facilitates the initiative IT 50 plus in collaboration with the ICT business association BITKOM and the national metalworkers' union.

Other Canadian initiatives include career information programmes for women and girls in non-traditional occupations; although very few offer a specific focus on ICT[86]. Programmes include 'Canadian Coalition for Tomorrow's ICT Skills' (CCICT), a public-private effort involving several entities: employers, universities, industry associations, and the private sector. CCICT programmes are developed to achieve practical solutions to a Canadian finding of overall decline in ICT-related post-secondary enrolments (30-40% drop in both male and female cohorts), as well as historically low female participation (25%). One of its programmes, a new undergraduate degree programme offers a university degree in "Business Technology Management." Responding to the finding that young women tend to be more interested in careers that are social and communicative, where they can "make a difference," and that today's hybrid technology and business technology management careers require precisely the skills of communication, collaboration and contribution that young women tend to value, i.e. business analyst, project manager, change management, consultant, entrepreneur, and IT manager. Canadian organizations employ over 200 000 people with this profile and this is the fastest growing segment of ICT occupational growth.

[84] OECD Information Technology Outlook 2010, p. 266.

[85] See David Ticol's 2009 Conference Board ITC report for Canadian labor market, and here the second attachment entitled " Digital Economy Strategy", pp. 19 ff, 2010

[86] See Canadian Coalition for Tomorrow's ICTSkills' (CCICT) http://ccict.ca/ccict-strategy/btm

Box 15: Grace Hopper Celebration of Women in Computing

This is a series of conferences designed to bring the research and career interests of women in computing to the forefront. Presenters are leaders in their respective fields, representing industrial, academic and government communities. Leading researchers present their current work, while special sessions focus on the role of women in today's technology fields, including computer science, IT, research and engineering. Scholarships, sponsorships, workshops for K-12 computing teachers, mentoring and university prep are a few of the opportunities offered.

Source: http://gracehopper.org/2011/

A majority of OECD governments also invest in **on-the-job and industry-based training** initiatives with a focus on promoting advanced rather than basic ICT skills in the private sector. ICT-related training in the civil service has attracted less attention. Most on-the-job and industry-based training programmes serve as ICT certification programmes. The Republic of Korea's *New-ICT Internship Programme*, for example, supports traineeships to develop ICT skills. In Mexico, the Ministry of the Economy launched the *MEXICO FIRST (Federal Institute for Remote Services and Technology)* initiative seeks to develop sufficient human capital for the ICT outsourcing industry. The initiative aims to certify over 12 000 students a year. Initiatives focusing on ICT-related training in civil services include, for example, the Slovak Republic's *Education of Employees in the Public Administration* project.

Making inroads in placing more women in the ICT sector requires timely **gender disaggregated labour market information;** this is critical for matching demand with supply of ICT workers. A growing number of on-line career portals are matching up employee skills with employer needs. The Korean Government has established the *HANIUM programme* which can be used by university students for recruitment as well as for securing ICT mentoring and internships, and online lectures. In Canada, the *Labour Market Information portal* provides detailed and timely labour market information about job and skill requirements, wages and salaries, as well as employment prospects by occupations and locations. In the EU, the *EURES portal* of the European Commission provides information, advice and job-matching services for workers and employers. Its objective is, among others, 'to stimulate interest in ICT careers in young people by raising awareness and offering incentives with a view to promote ICT education, careers and jobs to young people as well as to foster digital literacy among citizens and ICT training for the workforce and the adoption of best practices'[87]. And with the initiation of the *Digital Agenda for Europe* the Commission intends to "[p]romote a higher participation of young women and women returners in the ICT workforce through support for web-based training resources, game-based eLearning and social networking".[88] As with all web-based entities, the viability and sustainability of these portals depend on their scale of use. More promising and of enduring value are the various scholarships and exchange programmes in the EU, though they are not primarily dedicated to ICT studies, nor are they gender specific (e.g. Germany Study and Internship Programme (SIP) Scholarship[89]).

Beyond these types of Commission initiatives, the EU has put in place a plethora of country specific cooperation schemes without however tying gender targets or quota to their dispersal. (e.g. France-US Technology Transfer Exchange program).

87 A Digital Agenda for Europe. European Commission, Brussels 2010

88 A Digital Agenda for Europe. European Commission, Brussels 2010

89 www.uas7.org/scholarships/study-a-internship-program.html

Box 16: Microsoft DigiGirlz

Microsoft DigiGirlz programmes give high school girls the opportunity to learn about careers in technology, connect with Microsoft employees, and participate in hands-on computer and technology workshops. Its website provides access to online courses, events, pedagogy tools and tech camps. Other initiatives include 'Gr8 Designs for Gr8 Girls'; professional networks to encourage women towards an ICT career include the Canadian women in Technology (CanWIT); and peer-led groups to support women currently employed in ICT through branches of professional national associations that serve both men and women (e.g. 'Women and IT initiative' of ICTC, CanWIT); or informal and local/city groups that are part of larger international networks (e.g. 'Geek Girl Dinners'). They also comprise ICT industry-led reports that identify issues and strategies for women's participation and retention in ICT as a result of skills shortages (e.g. 'NCWIT- US National Center for Women & Information Technology'; 'ICT and Women by ITAC'; and 'CCICT-Canadian Coalition for Tomorrow's ICT Skills').

Source: www.microsoft.com/about/diversity/en/us/programs/digigirlz/default.aspx

The United Kingdom is in the process of setting itself apart from the more gender-neutral targeting of ICT sector initiatives. In 2008/09 just 19 per cent of Computer Science higher education students were female, with total enrolments (96 280) down by over 30 per cent compared to 2003/04[90] while employment in the ICT industry is forecast to grow nearly five times faster than UK average employment.[91] Awareness of the problem of underrepresentation of women is high and the country has put into practice a number of gender specific programmes and resources. Multiple projects aiming to introduce youth and girls to information and communication technologies and their applications have been put in place (e.g. *Computer Clubs for Girls CC4G*)[92], as are scholarships for women in the technology and engineering fields (e.g. *WES Doris Gray Scholarships for women in Engineering*[93]) and ICT online projects for youth and girls (e.g. *BigAmbition).*[94]

2.5 Africa: highlights

The ICT sector has seen nothing short of a revolution over the past decade on the African continent. Through policy reforms, infrastructure development and human capacity support, access to information has been made affordable and the delivery of information and a wide range of public and social services made possible. As understanding of the benefits of ICT has grown, African governments are prioritizing the provision of affordable ICT services to as many people as possible. In the introduction to Rwanda's 2006 ICT strategy, President Paul Kagame wrote: "We have high expectations of ICT and its transformative

90 HESA Student Record, www.hesa.ac.uk

91 The percentage of women employed as IT & Telecoms professionals has declined from 22% in 2001 to just 18% in 2010. By comparison just under half (47%) of people working in the UK during the second quarter of 2010 were female. Gender imbalance is prevalent across IT related courses, and this is worsening over time throughout the education system. 15% of acceptances to Computing degree courses are female and the proportion of females taking Computing A-level remains low at 9%. As female representation within the IT & Telecoms professions has declined, so too has their presence within the IT & Telecoms industry, and while 27% of those working within IT & Telecoms firms in 2001 were female, this figure has fallen to 25% by the second quarter of this year. Full time male IT & Telecoms professionals earn 13% more than their female equivalents. However, the gender pay gap is less pronounced than that within the workforce as a whole, where at GBP 530 per week, the median weekly male income is 23% higher than that of a female worker; see also Technology Insights 2011: Trends and UK Skills Implications

92 www.cc4g.net/About-CC4G/

93 www.wes.org.uk/content/doris-gray-scotland-awards

94 www.bigambition.co.uk/About/About-Us/

effects in all areas of the economy and society. Communications technology has fundamentally changed the way people live, work, and interact socially, and we in Rwanda have no intention of being left behind or standing still as the rest of the globe moves forward at an ever increasing pace."[95]

Box 17: Telecom penetration in Africa

The explosion in access to telecommunications services has been most prominent in the mobile market. Mobile penetration rates increased from less than 1 per cent of the population in 1998 to almost one-third by 2008 and since then have continued to increase. The same applies to fixed-broadband penetration rates. Four countries – Cape Verde, Mauritius, the Seychelles, and South Africa – have a penetration rate of above 1 per cent. One of the main impediments for growth is the limited number of fixed-telephone line and the absence of cable networks.

Source: See International Telecommunication Union report: "Measuring the Information Society 2011, p.41.

Moreover, rapid growth has occurred throughout the region. Low-income countries, where telecommunications services were once accessible only to a privileged few, are quickly catching up with their richer neighbours, such as Namibia and South Africa. In 1998, at the start of Africa's telecommunications revolution, South Africa accounted for 86 per cent of all subscribers on the continent, but by 2008, that figure was down to 18 per cent; Nigeria overtook South Africa as the region's biggest telecommunications market in 2008.[96]

According to ITU, many African countries have doubled or tripled their international bandwidth capacity, with some countries having achieved a tenfold increase. A number of countries, including Rwanda, Senegal, Tanzania, and Zimbabwe, have increased their mobile penetration rate by over 30 per cent. Nonetheless there is still much to be done. While all of sub-Saharan Africa witnessed an increase in the number of households with a computer and Internet access, overall penetration rates remain quite low. Except for Angola, Gabon, Mauritius, Nigeria, the Seychelles, and South Africa, all countries have less than 5 per cent of their households connected to the Internet.[97]

Box 18: Uganda's Makerere University Female Scholarship Foundation (FSF)

FSF was launched in 2010 as a continuation of the Makerere University Female Scholarship Initiative (FSI). With USD 4 million support from the Carnegie Corporation of New York, FSI supported 691 girls from disadvantaged background to access higher education. In November 2010, Makerere University made an appeal to the Government of Uganda to avail UGX 1.5 billion from the Peace, Recovery and Development Plan (PRDP) for 150 scholarships for girls from Greater Northern Uganda to access higher education at the University, including engineering.

Source: http://scholarship-positions.com/makerere-university-female-scholarship-foundation-uganda/2011/08/16/

[95] As cited in World Bank, 2009 Information and Communication for Development – Extending Reach and Increasing Impact, 2009, p. 51

[96] "Africa's ICT Infrastructure – *Building on the* Mobile Revolution", World Bank report, 2011, p.3

[97] See International Telecommunication Union report: "Measuring the Information Society 2011, p. 42.

That said, ICTs have emerged as a major driver of employment and an important pillar for economic growth in South Africa. The country has a fairly well established ICT infrastructure in a number of regions and population hubs, but it suffers from a relatively small base of highly skilled ICT professionals, still predominantly male. A more demographically representative workforce does appear to be emerging, particularly at the lower end of the ICT skills spectrum, but the challenge in South Africa is to obtain accurate and timely data to inform policy decisions about the building of a robust and broadly-based ICT sector. The demand for ICT skills will revolve around designing and putting in place ICT infrastructure and the required enabling regulations.

A national report from South Africa indicates that "gender has been placed on the government ICT agenda quite extensively – through numerous sector- and gender-specific policies. Likewise the ICT sector appears to be undertaking more activities that are designated to see stronger support for women in the ICT sector, both young women entering the sector and those who wish to advance their careers. Numerous efforts have been undertaken through various government departments (education, communications, trade and industry, communications and science and technology) to target women through focused interventions.

For the immediate future, the continent's two most important broad policy objectives for the ICT sector in Africa continue to be to expand network coverage to all rural areas and to make affordable broadband Internet available to all. This will require a broad range of skills, highly sophisticated and technical as well as manual and administrative.

A small number of initiatives by national governments and multilateral and bilateral development organizations have focused on rolling out ICT education at the school, college and adult education level, or on providing skills training for government officials, entrepreneurs and community and civil society groups. The low number of initiatives compounded by limited resources perpetuates the scant availability of relevant skills; which in turn are a binding constraint on the continent's ability to more quickly develop its national and local ICT sectors. One of the key impediments to Internet access is income inequality. ITU points out that in Botswana, for example, Internet access for those earning in the first three quartiles, in terms of disposable income, is only 2 per cent while this jumps to 19 per cent for people earning in the top quartile. And comparisons between countries on the continent documented that this finding is representative of all countries surveyed in Africa.[98]

Box 19: University of Botswana

In the Faculty of Science (FoS) at the University of Botswana, out of an enrolment of 1044 learners (2003/4), only 340 were women. This matches the female staff ratio in the same Faculty (around 30 per cent) which indicates the absence of role models for the learners. This was the reason the University of Botswana, in collaboration with the Ministry of Education and the Education Democracy and Development Initiative (EDDI) launched a Women in Science Project that was based in the FoS and Faculty of Education. In addition, the University established the Gender Policy and Programmes Committee (GPPC) to oversee the engendering of its programmes, to ensure that gender-sensitive materials are used and to monitor the teaching and learning environment.

Source: www.un.org/womenwatch/daw/csw/csw55/panels/Panel1-Mpuchane-Sesae.pdf

The other key driver – or inhibitor – is education, or the lack thereof and access to ICTs in schools. In Rwanda, for example, the political leadership has determined that ICT is a key development priority, and the country has initiated a number of projects with the assistance of multilateral development agencies to

[98] See International Telecommunication Union report: "Measuring the Information Society 2011, pp. 111-112.

connect schools and universities to the Internet, and to equip students with computers and laptops[99]. These efforts are designed to bring more students online. Put together, the Internet presently remains the private reserve of people with a university education and correspondingly higher incomes compared with those who only have acquired a primary or secondary education.[100]

The promise of ICTs to enhance economic opportunities for the poor in Africa, improve delivery of services to the underserved, enhance government efficiency and transparency, and affect social change has yet to be fully realized.

The World Bank is placing renewed emphasis on building partnerships with leading companies in the ICT industry to facilitate technical skills training for an ICT workforce. In a collaborative effort, its Africa Region Human Development Department, the Finance and Private Sector Development Department, and the ICT Sector Unit initiated the **New Economy Skills for Africa Program (NESAPICT),** which is presently being implemented in eight African countries with notable progress in Ghana, Kenya and Nigeria. The World Bank has also supported a programme of knowledge sharing events to help build capacity of leaders and practitioners in the ICT area irrespective of their gender affiliation. In addition to these efforts, the International Finance Corporation, the private sector arm of the World Bank, invests in the development of much needed ICT capacity.

2.6 Asia and Pacific region: highlights

The ICT sector in Asia and the Pacific has gained substantial ground in a wide range of different sectors including education, health, social protection, agriculture and rural development, urban development, infrastructure, environment, social development, public sector management and governance, economic management, finance, and private sector development.

In general, the major emerging economies of Asia have performed well during the crisis. China has shown consistent growth in ICT goods with a focus on computer and communication equipment, while India has specialized in generating information technology services. According to data produced by the OECD, IMF (International Monetary Fund) and the World Bank, real gross domestic product (GDP) was set to grow at over 8 per cent in both 2010 and 2011 across the region, and 11 per cent and 8 per cent in China and in India, respectively. The 2008 crash accelerated the shift in production and trade towards non-OECD economies – a trend that is likely to continue as countries such as China and India move from simply being assembly platforms for export to providing more advanced goods and services to both foreign and domestic markets[101].

In 2006, China's exports of ICT goods were only slightly behind the combined exports of Japan. It was largely driven by foreign investment and outsourcing arrangements while India's exports of computer and information services were fuelled by the growth of its domestic firms. Although the level of exports of ICT goods and services does not necessarily reflect high rates of ICT use in countries, it does indicate the importance of a country's ICT sector and its international competitiveness. As barriers to trade in ICT goods and services are removed, opportunities for developing countries to benefit from such exports will

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[99] Rwanda's policy is in line with the ITU Connect a School, Connect a Community initiative, which seeks to build political support for connecting all schools to the internet by 2015. See www.connectaschool.org

[100] See International Telecommunication Union report: "Measuring the Information Society 2011, pp. 113-114.

[101] Asia has made significant inroads into the ICT sector's manufacturing base at the expense of the OECD share of ICT products and services. In 2009 OECD countries' share of the ICT world market declined to 76% (from 84% in 2003), as growth in non-OECD economies decoupled from growth in OECD countries. Continuing globalization and the restructuring of the ICT sector in its wake is reflected in an increasing number of top 250 ICT firms in Asia - and in emerging economies elsewhere. As part of this shift the top 250 ICT firms include more non-OECD firms, among them manufacturing firms in Taiwan, Province of China, which have partly driven the rise of China as the major exporter of ICT goods, ICT services firms from India, and telecommunication services providers from a range of non-OECD economies in Asia; see also OECD Information Technology Outlook 2010, p.60.

likely grow. Some Asia and Pacific countries have already become key exporters of ICT goods and services (China (USD 299 billion); Hong Kong/China (USD 136 billion); Japan (USD 125 billion); and Singapore (USD 124 billion)). In terms of the share of ICT goods exports to total goods exports, the economies in the East Asia and Pacific region were also leaders: the Philippines (56 per cent); Singapore (46 per cent); Malaysia (45 per cent); Hong Kong, China (42 per cent); and China (31 per cent). [102]

Box 20: Women and technology in Malaysia

In Malaysia, jobs in technology are regarded as appropriate for women. Computing and programming are considered "women-friendly" professions today although it was initially a rocky road for women to gain a foothold in the sector. Initially, women left their villages to seek urban opportunities in the electronics industry, where their dexterity and willingness to take on indoor production work created a massive new workforce. As electronics jobs were replaced by technological ones, the field opened up to newly educated women who assumed positions of authority in a field that is non-traditional by nature.

The country's decision to build a Multimedia Super Corridor in a special administrative zone that is governed by different – more liberal – rules and regulations facilitated the engagement of women in the ICT sector. The critical mass of women in computer sciences provides a role model for other women and establishes "a symbolic space" that demonstrated that women can – and do – excel in the field. And because the ICT boom has caused a critical shortage of well-trained computer and information technology specialists, the country's ICT sector welcomed women as new members of the formerly male-dominated ICT community.

Source: www.stanford.edu/group/gender/cgi-bin/wordpressblog/2010/02/malaysian-women-redefine-gender-roles-in-technology/

India's ICT industry has grown from USD 2 billion worth in export revenues in 1998 to USD 47 billion in 2007, representing nearly 6 per cent of the country's GDP and employing over two million people; in 2009 the ICT sector was expected to represent almost 10 per cent of GDP by 2010. It makes up one quarter of the country's total exports and nearly half of its service exports.[103] Additional opportunities for the Indian ICT sector appear to be evolving in the public sector, healthcare, media, utilities, small and medium businesses, and through greater outsourcing in primarily the BRIC[104] countries, the Gulf Cooperation Council and Japan. On the back of its exports, India's domestic ICT industry is also expected to experience significant growth with a four-fold increase in revenues from USD 12 billion in 2008 to USD 50 billion by 2020. The country could emerge as an innovation hub with a focus on, among others, clinical research, mobile applications, energy efficiency, and climate change solutions. Women's representation in the technical fields is growing. For example, the percentage of women engineers graduating from ITT Bombay has grown from 1.8 per cent in 1972 to 8 per cent in 2005.[105]

[102] See World Bank "Information and Communication for Development 2009: Extending Reach and Increasing Impact", 2009, pp. 119/120

[103] See *IC4D 2009: Extending Reach and Increasing Impact,* www.worldbank.org/ic4d; and "Perspectives 2020, in http://www.nasscom.in/NASSCOM-PERSPECTIVE-2020-Outlines-Transformation-Roadmap-for-The-Indian-Technology-and-Business-Services-Industries-56269?id=56269

[104] Acronym for Brazil, Russia, India and China

[105] http://anitaborg.org/files/womenhightechworld.pdf

Box 21: Pride project – ICT programmes for small Pacific island states

The Project is a collaborative partnership implemented by the Institute of Education at the University of the South Pacific. The Project is jointly funded by the European Union (EU) through the European Development Fund (EDF) and New Zealand through New Zealand Agency for International Development (NZAID). PRIDE serves; Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu and Vanuatu. EXAMPLE OF A PRIDE PROJECT: Development of ICT Programme at Bikenibeu Junior Secondary School – Creating a computer lab for the school, training teachers, distance learning programmes.

Source: www.usp.ac.fj/index.php?id=pride_home0

In all, India's ICT sector has played – and continues to play – a pivotal role in bridging the gender divide in the country's workforce by helping to overcome biases against women and girls in general, and women with rural or uneducated backgrounds in particular. It has not only been at the forefront in Asia in offering women access to the country's ICT sector through numerous educational and practical, hands-on pro-gender initiatives (like encouraging girls and women to enter computer and ICT engineering courses; offering special 'pick-and-drop' taxi facilities; establishing anti-sexual harassment committees; providing maternity leave during pregnancy and creating exclusive web portals for females, etc.), it has also achieved one of the highest gender ratios of the general workforce (31 per cent in 2009) in the region and is making managerial positions open to women (20 per cent in 2009).[106]

The Philippines is another important ICT player in Asia and the Pacific. Growth of the sector in the Philippines has been impressive: total ICT services and revenues reached USD 6 billion in 2008, up from USD 100 million in 2001. As of mid-2008, the country's ICT sector employed 345 000 people, up from 100 000 in 2004. Moreover, in the Philippines, as in India, workers in this sector are typically paid 50 to 100 per cent more than in other service jobs and tend to fall into the top income quintile. The World Bank expects the Philippines to continue their rapid growth, doubling their combined share of the global market from 5 per cent to 10 per cent and producing revenues of about USD 13 billion and direct employment for close to 1 million people by the end of 2010.

Box 22: The Computer Clubhouse in New Zealand

The Computer Clubhouse in New Zealand provides a creative and safe community-based learning environment where young people work with adult mentors to explore their own ideas, develop skills and build confidence through the use of technology. Geared for 10-18 year olds, the Clubhouse provides young people with the opportunity to gain work place experience and access to Clubhouse scholarships, breaking down barriers for youth in underserved communities to participate in higher learning opportunities. Programmes offered include: Clubhouse to Career, Clubhouse to College (C2C); Field trips to local companies and to local colleges and universities; "Job shadows" at companies where youth can shadow an employee throughout the workday; "Visiting technologist" days, in which the Clubhouse hosts visits from professionals who utilize technology in their careers; Professional internship and job opportunities for Clubhouse Members Workshops in resume-writing, interviewing skills, goal setting, and educational planning.

Source: www.computerclubhouse.org.nz/

[106] 'Impact of IT-BPO Industry in India: A Decade in Review', pp. 12-13; http://nasscom.in/upload/68924/Impact_Study_2010_Exec_Summary.pdf

Employment of this scale means that the sector would account for 27 per cent of all new jobs created in the country by 2010. Each new job created in IT services and IT-enabled services in the Philippines results in two to three new jobs in other sectors. An increase in direct employment of 600 000 people by 2010 would therefore create 1.2 million–1.8 million additional new jobs indirectly as employees consume housing, food, transport, and consumer goods and employers invest in telecommunications, building rentals, water, and other core services. By 2010, the IT services and ICT enabled industries was on target to represent 8.5 per cent of GDP.[107]

Another important positive impact of the growth of IT services and IT-enabled services is on the status of women. Women account for about 65 per cent of the total professional and technical workers in IT services and IT-enabled services in the Philippines. In India, women make up 30 per cent of the IT services and IT-enabled workforce workforce—a much higher rate of female participation than in the services sector in general—and this share is expected to grow to 45 per cent by 2010. More than half of call centre employees are women. In both countries, women fill a greater number of high-paying jobs in IT services and IT-enabled services than in most other sectors of the economy.[108]

Public policy in Asia and the Pacific will have an important impact on countries' competitiveness in this industry, notably through interventions aimed at developing ICT skills and connectivity, as well as urban infrastructure (e.g. high-technology parks). Critical is also the public sector's pro-active engagement to remove administrative constraints and red tape for both private and public investments.[109]

Partnerships with the private sector are critical in the development of capacity. Various governments in Asia have played a critical role in encouraging ICT-related partnerships with the private sector and academic institutions. Singapore has been one of the most proactive in this regard, starting with the creation of the Industrial Training Board in 1973. The Board established an extensive system of training advisory committees with industry participation; introduced industry-based training schemes in partnership with companies; and established arrangements for keeping training staff abreast of the latest technological developments. Cooperating have been 'blue chip' companies, including Mitsubishi Electric Asia, Robert Bosch, Siemens, IBM, Cisco, and Sun Microsystems. In addition, the country's InfoComm Development Agency has been active in forging global partnerships to improve ICT sector skills. For instance, in 2006 it partnered with Carnegie Mellon University's Entertainment Technology Center and the National University of Singapore's School of Computing in order to develop a degree programme in interactive digital media.

In Malaysia, the Penang Skills Development Centre/PSDC was established as a joint partnership between the government, academia, and industry. It has a membership of about 140 companies and is led by the private sector. And in Bangladesh, the Chittagong Skills Development Centre is a similar public-private partnership focused on skills development for the ICT, manufacturing, and services sectors. The centre was established in 2006 in partnership with government agencies, industry associations, and ICT companies such as Alcatel, Ericsson, Huawei, and ZTE.

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[107] See World Bank "Information and Communication for Development 2009: Extending Reach and Increasing Impact", 2009, pp. 106-107

[108] See World Bank "Information and Communication for Development 2009: Extending Reach and Increasing Impact", 2009, p. 7

[109] While the 2008 global economic and finance crash has put ICT goods and services under some pressure, it has accelerated outsourcing to the Asian continent. Against this background, Indian firms providing outsourcing services have maintained their employment growth as they change their service product mix to adapt to changing market demands. Tata Consultancy Services (TCS), for instance, employed almost 142 000 people in the first quarter of 2009, and it announced plans to hire 30 000 additional ICT professionals in India, but also in Latin America, Australia and the United States; see also Tkaczyk, C. (2010), "They're Hiring!", *Fortune Magazine*, 25 January, http://money.cnn.com/galleries/2010/fortune/1001/gallery.bestcompanies_mosthiring.fortune/index.html; *The Economic Times* (2010), "Tata Consultancy Services to Hire 30,000 People Next Fiscal", 10 February, http://economictimes.indiatimes.com/news/news-by-industry/jobs/Tata-Consultancy-Services-to-hire30000-people-next-fiscal.

In the Indian state of Andhra Pradesh the government became a lead player in setting up the International Institute of Information Technology/IIIT in Hyderabad, a private-public-partnership. The IIIT has become an autonomous, self-supporting institution and has developed active relationships with major IT companies including IBM, Signal Tree, Motorola, Oracle, and Satyam; all of which have set up corporate schools on the campus. Andhra Pradesh has also partnered with Dell and GE to offer company-specific training courses in colleges to prepare students for eventual recruitment by those companies.[110]

2.7 Commonwealth of Independent States / CIS and Russia: highlights

In Russia and the CIS pro-active government policies for women customarily revolve around traditional family, health and motherhood themes. They also target issues such as overcoming educational disparities; increasing women's representation in politics and top management; eliminating gender employment discrimination; preventing violence against women; closing the gap in life expectancy (men's is lower than women's); and reducing the negative impacts of alcohol, drug abuse and other socially dangerous behaviour affecting life expectancy and health primarily in the male population.[111] Employment and education policies, for example, seek to address disparities such as women making up 57 per cent of college and university graduates[112] while being paid on average 65 per cent of men's average pay[113]. Likewise, women comprise 74-81 per cent of students in the social sciences, education, medicine, and the arts, while men take up to 79-94 per cent of available placements in the studies of geology, energy, aviation, space and technology.[114]

While there do not appear to be government or industry programmes specifically aimed at increasing the number and level of women in the ICT sector, industry experts have called for overcoming traditional male – female job separation, noting that women represent a minority in the sector. Moreover, there is evidence that directing young talent to the sciences and ICTs is being supported by the government, companies and academic institutions through such programmes as *Step into the Future*[115] which is funded by the Russian Government and championed by its president. The most visible and popular programmes in Russia are its many science and innovation contests and Olympiads (e.g. *All-Siberia Student Olympiad*) offering scholarships and university admission for the winners[116] as well as grants for youth science projects from various sources (e.g. *Dev Generation grant*)[117]. Other popular youth programmes dedicated to mathematics and science are summer camps, where placements are competitive and based on academic achievement (e.g.*: IT summer school*[118] and *Computeria camp*)[119].

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[110] See www.psdc.com.my/index.cfm; www.csdc.com.bd

[111] Development of human potential in Russia. Millennium development goals: look into the future. UNDP Russia, UNFPA. 2010

[112] Development of human potential in Russia. Millennium development goals: look into the future. UNDP Russia, UNFPA. 2010

[113] Development of human potential in Russia. Millennium development goals: look into the future. UNDP Russia, UNFPA. 2010

[114] Development of human potential in Russia. Millennium development goals: look into the future. UNDP Russia, UNFPA. 2010

[115] www.step-into-the-future.ru/1_7rus.php

[116] vsesib.nsesc.ru/about.html

[117] softlinevp.com/devgeneration/

[118] www.aptechsar.com/education.php?id=53

[119] www.computeria.ru/content/pages/2.htm

The few exemplary programmes targeting women in the ICT sector are offered by international corporations such as Microsoft and Cisco and international NGOs (e.g. *IREX Tech Age Girls (TAG*[120]). While these initiatives are commendable, there is an opportunity for a more systematic and pro-active engagement by governments, NGOs, industry think tanks, and funding organizations to encourage more women to enter and progress in the ICT sector.

2.8 Latin America and the Caribbean region: highlights

As already noted, the globalization of ICT goods and services has been characterized by the rapid development of new production locations and markets particularly in emerging economies. The overall pattern has been for electronics production to move towards either lower-cost OECD or non-OECD economies. Whereas the Asia-Pacific region has been the main beneficiary of this process, Latin American countries like Argentina, Brazil, and Mexico have also seen very significant increases in electronics production.[121]

That said, the region continues to suffer from a scarcity of both general and gender-segregated programmes that focus on building professional capacity in ICTs, promoting ICT as a career option, or exposing young women and girls to literacy in information and communication technologies and future employment opportunities. Available statistics generally indicate similar levels of access and availability of ICT services for women and men, and in some cases, higher levels for women than for men. The majority of existing programmes and research is gender neutral and/or focus on themes of improving universal access to the internet, national ICT infrastructures, creating an enabling regulatory environment, institutions, digital literacy, closing the digital divide, and applying ICT applications for development (use of ICT in health, education and marketplace initiatives, mobile phone applications).

Brazil's ICT sector grew in 2009 between 6 per cent and 8 per cent. According to the Brazilian Association of Information Technology and Communication Companies (Brasscom) it could grow by as much as 13 per cent in 2011 to USD 8.5 billion. Excluding telecommunications, it generated revenues of USD 65 billion, which makes Brazil the eighth largest ICT market globally. Including telecommunications, the sector's revenues reached USD 140 billion, representing between 7 per cent and 8 per cent of the country's GDP. These growth rates put enormous strain on Brazil's ICT workforce; there is a serious ICT skill gap to cover expected future growth. According to the Brazilian Agency for Promotion and Export of Software (Softex), the Brazilian ICT sector currently employs 600 000 people. It encountered a shortage of about 75 000 skilled professionals in 2010 and expects to run short of about 92 000 professionally trained workers in 2011 and 200 000 professionals by 2013[122].

At present, Brazilian universities offer some 2 000 IT-related courses with around 300 000 students studying these subjects, producing some 2 250 masters and 320 PhDs in computer science between 2004 and 2007. User firms claim however, that there appears to be a disconnect between the calibre of ICT professionals supplied by these courses and the skills that companies require.[123] Other challenges suggest that Brazilian ICT professionals are not very mobile; lack proficiency in English and other languages; and wages[124] and salary disputes appear to lead to an increased turnover in the ICT sector. The ICT skill shortage in Brazil has now been put at the top of the government's agenda[125]. Skills development in the

[120] www.irex.org/project/tech-age-girls-tag

[121] See Reed Electronics Research, http://dx.doi.org/10.1787/888932327990; and OECD Technology Outlook 2010, p.87.

[122] www.softex.br/softexEn/_about/background.asp

[123] http://itdecs.com/2011/07/is-brazil-ready-for-a-knowledge-economy/

[124] With increasing pressure to do more with less and salaries on the rise – statistics from the recruitment firm Robert Half suggest that ICT salaries in Brazil have seen a 20% increase in 2011.

[125] http://itdecs.com/2011/03/education-and-innovation-high-up-on-dilmas-agenda/

information and communications technology field is one of the pillars of *Brasil Maior* which includes three flagship programmes for vocational and technical education: the *National Program for Access to Technical Schools*, the *National Pro-Engineering Plan*, and the *Science without Borders* programme.

Box 23: Female IT Professionals in Brazil

São Paulo is considered to be the hub of technology in Brazil and many Brazilian women are finding jobs in the growing technology industry there. In January 2011, ten interviews were conducted with women in São Paulo working in information technology (IT) careers. Interviewees were asked for their personal stories, perceptions, views, and opinions on career choice, work/personal life balance, employment history, and education. The majority of the responses revealed a similar situation and similar perceptions to those expressed in the United States. Participation by females in the male-dominated IT sector in Brazil has been decreasing over the past decades; reasons for low female participation in IT are complex. Interviews revealed that 1) women working in technical careers believe that IT jobs are considered appropriate for Brazilian women, but that technical programmes and workplaces are mainly occupied by men, 2) Brazilian women feel constrained by the expectation for women to be primary caretakers of domestic responsibilities even when both partners work full time, and 3) women are considered to be better communicators in Brazil, but most upper-level leadership positions in IT are held by men.

Source: Swim, Jamie (2011) Female IT professionals in Brazil

The two most relevant programmes for ICT are Pronatec, which will offer 3.5 million scholarships[126] to provide students with technical expertise while up-skilling individuals who are already in the workforce, and Science without Borders, which is offering 100 000 scholarships for exchange students[127], from high school children up to post-doctoral researchers. The federal government expects to meet the cost of 75 per cent of the scholarships with the private sector contributing the remainder. In addition, the *National Service for Industrial Training* is expected to expand its curriculum by offering research and training opportunities to meet domestic industry needs. In the meantime, vendors like the software firm Totvs are taking steps to increase their attractiveness to young professionals by offering to train 500 recent graduates across the country to work in ICT analyst functions.

Brazil's response to the acute high-skilled labour shortages in the ICT sector is symptomatic of the other emerging economies in Latin America. The region's women are acquiring equal or superior levels of education and training when compared to their male counterparts. Latin American countries are making investments in capacity building and the use of ICTs in the classroom from an early age.

In Argentina some 30 per cent of the students in secondary technical schools are girls. Whether they will continue and pursue related university degrees and hold technical jobs in companies and the government remains to be seen. For that to happen, deliberate incentives and policies targeting women will need to be put in place as the realms of engineering and technology continue to be male domains. The hope is that equal opportunity in tertiary schooling in the field of science and technology will become a reality, and that it will eventually lead to equal employment prospects for girls in the knowledge and high-skill intensive ICT industries.

[126] http://itdecs.com/2011/04/r-1bn-technical-education-program-launches/

[127] http://itdecs.com/2011/08/science-without-borders-sending-students-overseas/

Box 24: ICTS Pervade Life in Argentina

In Argentina, women do jobs that include simple tasks like stocking merchandise and recording inventory and sales by computer; or pumping gas in a service station and charging customers with credit cards; or providing home delivery of food, where orders are received by way of the internet, registered in computers, and charged using credit or debit cards. To take these experiences as a launching pad to establish women in the more sophisticated and better paying ICT-driven jobs remains a challenge. Policy incentives are clearly required to put women on a level playing field in the industry, and continued advocacy by civil society groups will be indispensable to give more voice and visibility to the promotion of women in the ICT sector.

But domestic talent and educational policies and initiatives alone will not be able to supply the dynamic ICT sector with present day demands. Brazil, for example, has indicated that it will recruit highly-skilled workers from Europe and other fast developing nations as part of the global race for talent; Argentina can be expected to follow the same approach.[128]

[128] See article by the Brazilian Association of Information Technology and Communication Companies, "Brazil's IT Sector grows unexpectedly 8% in 2009", in BazzilMag, January 2010.

Section III: A new generation of jobs for a new generation of women – what can be done?

"... the nature of these jobs is not just closing your door and doing coding ... in fact, the greatest missing skill is somebody who's both good at understanding the engineering and has good relationships with the hard-core engineers, and bridges that to working with the customers and the marketing and things like that. And so that sort of engineering management career track, even amongst all the people we have, we still fall short of finding people who want to do that ... And so I'd love to have people who come to these jobs wanting to exercise people management, people dynamics, as well as basic engineering skills. That would be absolutely amazing. And we can promise those people within two years of starting that career most of what they're doing won't be coding ..." Bill Gates 2005.[129]

The future of the ICT sector is exciting. These are unchartered waters open to creativity, innovation and entirely new ways of working, interacting and learning that should appeal to women and men alike. The Institute for the Future (IFTF) has identified six drivers that are likely to shape the future workforce: longer life spans; a rise in smart devices and systems; advances in computational systems such as sensors and processing power; new multimedia technology; the continuing evolution of social media; and a globally connected world. The ICT sector clearly underpins this future.

A combination of approaches that ensure that more girls and women benefit from policy prescriptions and are prepared for the future workforce underscores the need for training and education at three distinct levels:

1) Entrance levels by way of education, training, recruitment, technology camps and public campaigns, internship and career incentives – which require a national reassessment of educational infrastructure and delivery systems.
2) Mid-career levels through career promotion and training – the continued feminization of lower level clerical jobs with a female minority in managerial and technical roles needs to be redressed through a combination of policies designed to enable women to further develop their careers. Women are too often prompted to leave their ICT jobs primarily because a heavy workload, long hours, the high stress levels and working in a predominantly young and male environment is not conducive to their dual roles of motherhood and professionals. Some women did not find the work 'meaningful' in the sense that it was not perceived as 'contributing to society'. Now the character of emerging ICTs is such that the tools themselves provide part of the solution.
3) Management and senior levels through mentorship, sponsorship programmes and targeted management quotas

Box 25: CEMC Workshop in Computer Science,

Canada targets younger women (grade 9 and 10, ages 15/16) at a time when they may be forming preferences and could use extra support in computer science. The programme is "designed to ignite enthusiasm for computer science in interested female students from across Canada. Young women learn that computer science is about much more than using and programming computers. Through lectures, labs and hands-on activities, the workshop explores the foundations and applications of computer science that have a profound effect on the world today". It also advertises other things that are important to girls: "Lasting friendships develop as participants stay in on-campus residences for one week and enjoy many social events."

[129] Remarks by Bill Gates, Chairman and Chief Software Architect, Microsoft Corporation Microsoft Research Faculty Summit 2005, Princeton University Redmond, Washington July 18, 2005

At the same time parents, teachers, career guidance counsellors and recruiters need to shift their own mindsets acknowledging that ICT careers are an important and viable opportunity for girls. And in order to secure initial gains made, women already active in the ICT sector need to take time to engage with community initiatives to mentor girls and young women and participate in virtual and face-to-face communities of practice[130]. All too often girls and young women are unaware of many of the available opportunities therefore efforts are needed to make them far more visible through both social media and the more traditional distribution of career and course information instruments. This multi-pronged approach must be reflected in national strategies and policy initiatives.

Box 26: The Budapest IWD Centenary Declaration 2011 – In Support of a Gender Action Plan for the Digital Agenda

The Joint High-level Conference "Women in Science, Innovation and Technology in the Digital Age" organized by the European Commission's Directorate-General for Information Society and Media and the Hungarian EU Presidency was held in Budapest on 6-8 March 2011 marking the 100th Anniversary of International Women's Day.

"…

VI. We invite key actors in politics and industries interested in measurably and significantly increasing the number of girls and women in science, innovation and technology to support:

1. Actionable and sustainable projects and practices that advance, strengthen and promote technical and scientific talents and skills;
2. Flexible academic structures and pathways for new gender relations and scientific careers;
3. Education as a key instrument of getting more girls in STEM and closing the digital gap via curricular reforms in schools and teachers' training and supporting early acquisition of Digital Literacy, coaching of teachers and employees of STEM, and implementing better functioning systems for parents' information;
4. Set targets for EU Member States on female entrepreneurship including membership on executive and advisory boards, to enforce gender specific awareness for example in technology incubators, in public and private financing institutions;
5. Engagement in careers in STEM through mentorship, internship, recruitment, transparency in career opportunities;
6. Integration of gender in research and innovation processes, increasing thereby the potential for creativity, new research content and user centered design;
7. Creation of positive images through role models, awareness campaigns, media presence like TV program series, comics, video games and a joint 'Women Tech Pavilion' at World Expo 2015;
8. European level benchmarking, monitoring and reporting through an annual 'European Gender in Science, Innovation and Technology Scorecard';
9. Global collaboration projects between EU, Africa, Asia-Pacific and Latin-America to support women's entrepreneurship in the Digital Age."

Source: www.asszisztencia.hu/ntit/index.php?menu=9

[130] See www.mobilemonday.net

In South Africa, for example, a manual[131] on possible interventions identifies six areas for simultaneous action: Establishing a South African Resource Centre for Women in ICTs; Strengthening the Research Capacity in Women and ICTs; Developing a Workable and Integrated System for Measuring ICT in Working Life and the Education System; Training Programmes for Schoolteachers; Training Programmes for Girls and Young women; Dissemination and Awareness Raising Activities. A catalogue of similar action items and recommendations was suggested by both the Budapest International Women's Day Declaration and Korea's Women in Science and Technology Policy (see table) in the course of a conference organized by Gender IT[132].

3.1 Revitalizing education for ICT futures

In order to bring about a significant increase in girls' and women's engagement and employment across the board in the ICT sector, the core of current education systems and infrastructure needs to be restructured in four fundamental ways:

- Instruction needs to be made more relevant – combining industry, science and the arts in curricula that focus equally on college education and vocational courses and trainings. A more technologically astute avenue for students that cater to their interests in engineering needs to be established. ICT courses need to be "hybrid" and in all curricula offered by community colleges and technical schools.
- Schools need to improve the quality of their execution, away from rote individualistic learning to hands-on, team-work and problem-solving teaching methods. This can be taken to very practical levels when regular communication between industrial leaders and local colleges collaborate to develop talent and skills.
- Schools need to ensure that students know about the continually evolving nature of the knowledge economy and that learning does not stop once basic schooling is completed. This also means that companies need to offer a more collaborative workplace experience engaging workers and giving them opportunities to continuously improve and seek productivity gains. "By giving young people more information about career possibilities and a tangible sense of where they can go in life these types of programs are likely to lead to more motivated learning, better career starts and a more highly skilled workforce".[133]
- More funds or subsidies need to be placed for technical training programmes.[134] In the United States, grants, loans and tax credits to undergraduate and graduate students total roughly USD 160 billion a year; in contrast in 2004 federal state and local spending on employment and training programmes only totalled USD 7 billion – an inflation-adjusted decline of about 75 per cent since 1978.[135]

Today's generation of college-bound females regardless of race and ethnicity appear to be significantly less interested than boys are in computing. More girls tend to associate the field with 'typing, math and boredom' while boys are more likely to think of computing in terms of 'video games, design, electronics, solving problems and interesting'.[136] The same study found that **girls were most interested in the computing field when they were given the message that "… with computing, you will be able to connect**

[131] http://women-in-ict.meraka.csir.co.za/images/b/b5/Manual_print.pdf

[132] http://ec.europa.eu/information_society/activities/itgirls/doc/conference_results.pdf; see http://www.gender-it.eu

[133] "Can the Middle Class be Saved?" in The Atlantic – Sept 2011 p.76

[134] More on this topic can be found at www.strategy-business/operation_and_manufacturing

[135] "Can the Middle Class be Saved?" in The Atlantic – September 2011 – p.72

[136] WGBH Educational Foundation and the Association for Computing Machinery (ACM) (2009) New Image for Computing – Report on Market Research

technology to your community and make a world of difference – reducing energy consumption, improving health care, enhancing security, reducing pollution and advancing learning and education." In the category of "creators" girls' comfort levels with activities such as website and graphic design is almost the same as it is for boys – though they are less interested in the more technical or 'techie" aspects of setting up computers or wireless networks, computer repair or writing software.[137]

Box 27: Republic of Korea – SET policies and targets

Republic of Korea's Women in Science and Technology policy was implemented between 2004 and 2008. The 2nd Basic Plan (2009-2013) is currently being implemented. It includes establishing one national organization and four regional organizations called Institute for Supporting Women in Science and Technology. Following the Report on Economic Activity Status and Participation Rate (Statistics Korea, 2008), which noted that the participation rate of women in economic activity is very low in all ages over 30, the Act on the Promotion of the Economic Activities of Career-Break Women was enacted.

- The Recruitment Target System (RTS) for women in SET was promoted by the National Science and Technology Council (NSTC) and applied to 25 government-funded S&T institutes in 2001.
- Since 2003 this policy has applied to all 99 national and governmental S&T institutes.
- The RTS is under the supervision of the Ministry of Education, Science and Technology, and the aim is to increase the average rate of women recruits of 99 institutes to 30 per cent by 2013.

Source: http://genderandset.open.ac.uk/index.php/genderandset/article/viewFile/95/122

CISCO pays special attention to the crucial 'pre-university' age of 15-18, when secondary-school girls are making decisions about subject specialization while in upper secondary and selecting university courses for further studies. The **European Commission's Code of Good Practice** recommends targeting girl students from pre-secondary high schools right through to higher levels of university education.[138]

One promising approach is the development of 'career academies'. Schools of 100 to 150 students within larger high schools offering a curriculum that mixes academic coursework with hands-on technical courses designed to build work skills. Studies show that career academy students develop firmer roots in the job market than their peers.

It is critical that students are prepared for an ICT workplace that is highly dynamic and always changing. A significant number of students perceive many negative aspects to an ICT career including change itself, a tough and competitive job market, long hours, and very low levels of job satisfaction. Many students are demoralized and question why they should devote long hours to studying technologies that may be obsolete before they leave university. There is also evidence to suggest that some ICT students have only a vague idea about the nature of an ICT career. This perception is of particular concern because people who are fundamentally unsuited to an ICT career may be investing a lot of time and money in obtaining a tertiary qualification that may never be useful.

[137] ibid

[138] See EU (2009) http://ec.europa.eu/information_society/activities/itgirls/doc/code.pdf

Box 28: University of Illinois Girls Adventures in Mathematics, Engineering, and Science

G.A.M.E.S is an annual week- long camp, designed to give academically talented high school aged girls an opportunity to explore exciting engineering and scientific fields through demonstrations, classroom presentations, hands-on activities, and contacts with women in these technical fields.

Some of the reasons women do not pursue careers in engineering and sciences are because they do not perceive the social validity of these fields. Since a student's future achievement in science and math is correlated to the strength of the student's early attitudes toward the subject, the promotion of positive science attitudes in precollege students is critically important. In an effort to reach the talent pipeline in this most critical stage the Women In Engineering Program at the College of Engineering developed the Girls' Adventures in Math, Engineering, and Science (G.A.M.E.S.) to promote positive math and science attitudes among young students by exposing them to interactive hands-on, socially relevant engineering curriculum that focuses on solving important problems of health, justice and protection of the environment.

Source: https://wiki.engr.illinois.edu/display/games/About+Us

One example designed to 'counter' the counter-productive perception problems from Australia is the combining of science with other disciplines, such as law or marketing, to attract more young students.[139] As one Australian scientist put it, "The whole world recognizes that there is the need for more people that are trained in science, technology and engineering. Most young people want to live in a world where they can feel they can influence and they want to make a difference and, indeed, if that is something that a young person feels is important, then science must be one of the top fields these days." Australia has already realized that more interdisciplinary science is key to increasing its attractiveness. The same scientist predicted that "we will witness new sorts of job opportunities for people that are interested in science"[140].

3.2 Recruiting and developing talent

Barriers to women's participation and retention in the sector remain despite a multitude of efforts in the policy arena and on the front line in the field to open the doors for women to enter the sector since the early 1990s. One main perception among girls of school age is that computer games, computer work and the technical aspects of computer functions were boring, nerdy, and generally uninteresting. A lack of female mentors or champions of women in ICT feed the general perception that ICTs might not be the most attractive sector for girls. Training materials, teaching methods and teachers themselves might reinforce a perception or message that ICTs are not for girls.

Targeting recruitment at women

"Recruiters at top companies are only beginning to recognize how much their words matter when it comes to attracting female candidates. Frequently women who major in computer science do not think they are qualified for opportunities advertised in highly competitive language, so they opt out of applying. When I spoke with a female intern this summer she recounted how in 2006 a GNOME project, a free and open source software project, received almost 200 Google Summer of Code applicants, all male. When GNOME advertised an identical programme for women, they received more than 100 highly qualified

[139] www.euractiv.com/en/science/australia-top-scientist-science-attractive-young-people/article-178796 (accessed Sept 6th 2011)

[140] ibid

female applicants for three spots. The intern also suggested that the company slogan "We help the world's best developers make better software" might alienate prospective female candidates who do not apply because they already assume that the 'best developers' are naturally 'guys'! [141]

Box 29: The American Physical Society and IBM Research internship

A co-sponsored a research internship programme for undergraduate women. The goal is to encourage women students to pursue graduate studies in science and engineering. Applicants must be

- female with sophomore or junior standing at a U.S. college or university at the time of application
- majoring in chemistry, physics, materials science or engineering, computer science or engineering, chemical, electrical, mechanical engineering, or biology, if it has an emphasis on one of the other areas listed
- have a minimum 3.0 GPA
- no citizenship restriction

Source: www.aps.org/programs/women/scholarships/ibm/index.cfm

Box 30: Orange France setting management quotas

In an interview with Delphine Ernotte, Executive Director, Orange France, Ms Ernotte draws out the potential benefits of a 35 per cent quota of female representation at all levels of management. She says, "While women make up 35 per cent of our employees overall, we want to reach this proportion at every management level, in all departments. For instance, 20 per cent of our executive positions, of which there are 300, are filled by women. This percentage is already high for a telecom company; however we are determined to push it to 35 per cent by 2015. This is why we've set up a Diversity Committee at executive level, which comes up with proposed solutions to improve recruitment policies, give equal access to training and career orientation, in addition to developing gender-friendly management practices". When asked how this would be achieved, Ms Ernotte's response is "First, we need to make sure that there is a gender mix beginning with the recruitment process. This is particularly critical for technical jobs, as we are competing with the whole industry to attract a scarce number of female graduates of technical studies. In that aim, we've set up partnerships with engineering schools so as to promote our career opportunities to young women, but also to work together towards bringing more girls into science classes. At this point, we can already notice a sort of bias against jobs with generally high responsibilities, driven by the fear of not being able to balance their professional and personal life. Our duty is to break these stereotypes and give a clearer picture of the diverse daily tasks in a telecom company. Second, management practices need to be adapted to different work styles. We are aware that women provide most of the family care in our society, a fact which compels them to have a different schedule than most men. Technology today enables us to adapt our working schedule to our other responsibilities; yet its usage is determined by the practices of each manager who can either put pressure on employees by setting up late calls/meetings, or set rules of work that are adapted to them".

Source: www.wileurope.org/articles/details/5-Minutes-with-Delphine-Ernotte--Executive-Director-Orange-France

[141] Anna Lewis, "Why don't more women become computer geeks?" in The Washington Post, 29 August 2011

The business case At the management level, there is a powerful business case for hiring more women to run companies. There is evidence that companies with more women in top jobs perform better that those run by men only. McKinsey recently looked at 89 listed companies in Europe and concluded that firms enjoying a higher return on equity also had a high proportion of women in senior management posts.

According to one study women are 37 per cent of middle managers in big American firms, 28 per cent of senior managers and just 14 per cent of executive-committee members. The way patronage and promotion work in the corporate world might condemn women to a slow and rocky climb up the professional career path. The same study goes on to suggest how women at leadership levels could be further reinforced by 'mentorship' or 'sponsorship' by their more experienced peers.

A study by the Centre for Work-Life policy found that in 2009, 31 per cent of American women had taken a career break (for an average of 2.7 years) and 66 per cent had shifted to working part time in order to balance work and family. Deutsche Telecom, Germany's leading telecommunication company has declared that 30 per cent of its middle and upper management jobs will be filled by women by 2015. Women made up 30 per cent of Deutsche Telekom's staff and 13 per cent of the company's top managers when the policy was introduced last year[142].

A survey conducted by McKinsey compiled eight useful measures for promoting gender diversity in the workplace – reproduced in table 2 below:

Table 2: The most effective measures promoting gender diversity focus on women's development and appraisal

	Measure	Measure implementing effect on women representation Number of points
CEO commitment	Visible monitoring by the CEO and the executive team of the progress in gender-diversity programs	22
Women's individual development programs	Skill-building programs aimed specifically at women	19
	Encouragement or mandates for senior executives to mentor junior women	18
Collective enablers	Performance evaluation systems that neutralize the impact of parental leaves and or flexible work arrangements	17
	Options for flexible working conditions (e.g., part-time programs) and or locations (e.g., telecommuting)	13
	Support programs and facilities to help reconcile work and family life (e.g., childcare, spouse relocation)	12
	Assessing indicators of the company's performance in hiring, retaining, promoting, and developing women	11
	Gender-specific hiring goals and programs	10

Source: 2010 Women Matter global survey, September 2010, McKinsey & Company

[142] Economist 23 July 2011

Conclusions and future directions

"*Women make up half the world's population, they use technology as much as men, and they are innovative technical thinkers-so if we want the best technology that we can get, we need diversity at the design table.*"
(Lucy Sanders, NCWIT CEO http://research.microsoft.com/en-us/collaboration/focus/cs/talent_sanders.aspx)

"We need to unlock a vital source of growth that can power our economy in the decades to come, and that vital source of growth is women. By increasing women's part in the economy and enhancing their efficiency and productivity, we can bring about a dramatic effect to the competitiveness and growth of our economies."
(Hilary Clinton, Asia-Pacific Economic Cooperation conference, San Francisco, 22 September 2011)

In the Western world, right up to the 1960s, computer programming was perceived as a natural career choice for savvy young women. *Cosmopolitan Magazine* urged their fashionable female readership to consider careers in programming - describing the field as offering better job opportunities for women than many other professional careers. James Adams, then director of education for the Association for Computing Machinery[143] commented: "I don't know of any other field, outside of teaching, where there's as much opportunity for a woman."[144]

Since that time, however, the image of a computer programmer in western countries has shifted to an archetypal computer "geek" – typically a socially-awkward male, a nocturnal creature, passing sleepless nights writing computer code. According to workplace researchers[145], this stereotype of the lone male computer whiz is self-perpetuating, and it keeps the computer field overwhelmingly male. Not only do hiring managers tend to favour male applicants, but women themselves are less likely to pursue careers in a field where they feel like misfits and outsiders. This is an interesting development given that the earliest computer programmers were women and that the programming field was once stereotyped as *female*.

The ICT sector has changed radically since those early computing days – and the 'knowledge economy' as it is referred to is now taking on hitherto unseen dimensions where communication technologies are forces behind social change through software tools, content and connectivity delivered over multiple mobile channels. Social media and its participatory formats are as much about the technologies as they are about their applications – bringing the virtual and physical worlds closer together in dynamic ways across several platforms. Fluid work spaces will mean radicalized but also regulated policies around privacy and security issues – which could open up new opportunities in the ICT sector for women professionals.

The most important determinant of a country's competitiveness is its human capital and talent - the skills, education and productivity of its workforce. Women account for one-half of the potential talent base throughout the world. Closing gender gaps is therefore not only a matter of human rights and equity, it is also one of efficiency and economic productivity. To maximize its competitiveness and development potential, skills need to be seen as a key part of an economy's infrastructure, and the more sound that infrastructure is the more robust and resilient the economy will be in response to opportunities and challenges. The choices made by policymakers, enterprises and individuals on investment in education and training must strive for gender equality—that is, to give women the same rights, responsibilities and opportunities as men. Business leaders and policy-makers need to work together towards removing barriers to women's entry to the ICT workforce and putting in place practices and policies that will provide equal opportunities for rising to positions of leadership within the ICT sector. Such practices will ensure

[143] www.acm.org/

[144] www.stanford.edu/group/gender/cgi-bin/wordpressblog/2011/06/researcher-reveals-how-computer-geeks-replaced-computer-girls/

[145] www.stanford.edu/group/gender/cgi-bin/wordpressblog/2011/02/negative-math-stereotypes-too-few-women/

that all existing resources are used in the most efficient manner and that the right signals are sent regarding the future flow of talent.

In Guadalajara in 2010, on the occasion of the ITU Plenipotentiary Conference, its members resolved to recognize Girls in ICT Day on the fourth Thursday of every April. These days will be dedicated to hosting events where girls and university students are invited to spend the day at the office of ICT companies and government agencies so they better understand the opportunities the ICT sector holds for their future. To ensure that interested students can find more information about such events in their country, the ICT Studies and Careers Section of the ITU Girls in ICT portal[146] includes links to national Girls in ICT Day activities.

Box 31: Extract from interview with Managing Director in Australia

"As I write this, it is school holidays in Australia and I have one of my daughters here with me at work. To me that's one of the great aspects about being a female working at Microsoft: it's a company that supports my needs as a working mum. Bigger picture, the ICT industry is one where you can bring your personal ambition and passions together with an industry to make a huge difference in the world. It also offers independence and economic freedom for women to go anywhere and do anything".

Extract from profile on ITU Girls in ICT Portal at www.girlsinict.org.

[146] The Girls in ICT Portal is designed to encourage girls and young women to take up careers in the ICT sector. Students and young professionals will find practical information on scholarship programmes, internships and training opportunities, online networks, Girls in ICT Day activities and other resources. This portal will also explain why preparing for a career in ICTs is good for women and girls, good for business and good for societies. Annex A provides an introductory outline of the portal.

Recommendations

National governments, private sector, donors, civil society and education actors need to acknowledge and support the central role professional women can play in further developing and servicing a dynamic and competitive ICT sector. The growing demand for a range of ICT skills around the globe present a unique window of opportunity to properly position girls and women in the industry and provide them with the tools necessary to succeed. The following recommendations apply to all ITU member groups (government, industry and academic institutions) and can be customized and adapted to suit national and regional priorities and the different gender contexts outlined in the report.

I. Recommendations to the governments including ministries responsible for communications, broadcasting, education, science and technology, employment, women and youth affairs, and national regulatory authorities for ICTs and broadcasting

1. Develop and implement national policies to restructure current education systems and infrastructure with the objective/aim/goal of integrating science and ICT-related subjects with mainstream curricula, to better respond to both present industry needs and standards as well as future ICT workforce requirements;
2. Establish and support policies and programmes that place a premium on promoting ICTs skills among girl students in primary, secondary and higher education with complementary investment in vocational training;
3. Relevant government ministries and agencies should prioritise the implementation of policies that develop human talent and the right skill sets for the building of a vibrant and diversified ICT sector, engaging women and girls at all levels in order to fully utilize and promote the full spectrum of talent in the country. This could include the following:
    a. Ensuring closer collaborative links on ICT policies and initiatives among Ministries of Information and Communication Technologies, Communications, Science and Technology, and Ministries of Education and Youth/Women's Affairs;
    b. Launching awareness raising campaigns, including posters, videos, broadcasts and the staging of public events to encourage girls into taking up ICT studies and careers;
    c. Targeting more funds and providing scholarships and subsidies towards technical training and incubation programmes;
    d. Participation in and support of Girls in ICT Days events every year on the fourth Thursday of April where girls and university students, along with their teachers, are invited to spend the day at the office of ICT companies and government agencies so they better understand the opportunities the ICT sector holds for their future.
4. Work with all stakeholders to change the dominant public (mis)conceptions about the industry and the employment and career opportunities it holds for both girls and women.

II. Recommendations to schools, colleges and academic institutions

5. The core education system and infrastructure needs to ensure that:
    a. Courses offered are constantly upgraded to ensure relevance to industry needs – this includes integrating science with other subjects;
    b. Teaching pedagogies shift away from rote individualistic and 'silo'- learning to holistic and hands-on team-work and problem-solving teaching methods;
    c. Concepts of life-long learning beyond basic schooling are promoted;

   d. Theoretical and practical modes of learning are brought closer together through internships, mentoring and social networking.

   e. Feedback loops are put in place enabling the private sector and government to advise schools, colleges and academic institutions on the skills and courses required to better meet industry/government needs.

6. Put in place learning opportunities for middle and high school girls about the ICT sector in the form of potential careers and courses through:

   a. Participation in and support of Girls in ICT Days every year through hosting of local events (guidelines provided in on-line kit at www.witnet.org);

   b. Using the ITU Girls in ICT Portal www.girlsinict.org on a regular basis to advertise programmes and events including scholarships, awards, internships and courses;

   c. Advertising the Girls in ICT Portal www.girlsinict.org in career guidance counsellor offices;

   d. Other awareness programmes involving local champions, private sector and students.

7. Provide training, awareness raising and materials, including online videos and brochures, for parents, teachers, career guidance counsellors and recruiters to shift their own mindsets, attitudes and preconceived notions about ICT careers for girls;

8. Host school-based events that target students, parents, teachers and career counsellors.

III. Recommendations to ICT enterprises, industry, private sector interests and investors

1. Develop and nurture partnerships with both governments and educational bodies with the objective to invest in advanced on-the-job ICT skills and industry-based training initiatives and to provide feedback to educational bodies related to the type of skills and training required on the job;

2. Engage in career development in Science Technology, Engineering and Math (STEM) through learning-by-doing training, mentorship, internship, creating online networks of girls and women in ICT, and other sponsorship programmes for girls and women;

3. Involve women in research and innovation processes to increase the potential for creativity, new research content and user-centred design and application;

4. Create positive images through role models, awareness campaigns, use of all media platforms, including, movies, television shows, online videos, comics and video games;

5. Companies of all sizes should be encouraged to refer to the McKinsey 2010 "Most effective measures promoting gender diversity" report[147] that enable and support women to establish a healthy and effective balance between work and other responsibilities;

6. Participate in ITU's Girls in ICT Day events every year through invitations to local schools and vocational/technical colleges, small and medium ICT enterprises as well as regulatory bodies, the larger information and communication industry, including broadcasters, and related professional organizations.

[147] www.mckinsey.com/locations/swiss/news_publications/pdf/women_matter_2010_4.pdf

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ANNEX A: Why a Girls in ICT Portal?

This Portal is designed to encourage girls and young women to take up careers in the information and communication technology (ICT) sector. Students and young professionals will find **practical information on scholarship programmes, internships and training opportunities, online networks, Girls in ICT Day activities and other resources** in the ICT Studies and Careers section of the Portal. The homepage provides links to online **videos** about young women and girls in the ICT sector. Users looking for white papers, trends and analysis, as well as **profiles of successful women** active in a full range of ICT careers will find them in the Trends, Analysis and Profiles section of the Portal. **Companies, governments and organizations running programmes to encourage women into the ICT sector are invited to keep this information current and expand the available resources.**

Why is it important to encourage more women and girls into the ICT sector?

One of the best reasons is that there are job opportunities in the ICT sector! The sector is marked by a pressing need for a wide range of ICT talents. This means that highly qualified women in technical fields have significant opportunities available to them. The European Commission, for example, has predicted a skills gap of over a half million ICT jobs in Europe and countries like Brazil expect to run short of about 200,000 professionally trained ICT workers by 2013. **The ICT sector needs new talent!** This is because not enough students are preparing themselves for studies in math, engineering, computing, and sciences. Compounding this problem, the number of female technical students is disproportionately low.

ICT companies are looking to attract and promote women because achieving greater workforce diversity is good for business. The lack of young women attracted to ICT studies is reflected in ICT companies and government agencies around the world. The ICT sector is currently male dominated, especially at senior levels. Where women are present, it is often in low-level, low-skilled jobs. Fortunately, many companies are looking to increase the numbers of women in the sector. A broad range of organizations and companies have concluded that increasing women at the top positively impacts financial performance, while those that ignore diversity issues risk ongoing labour shortages. The International Telecommunication Union (ITU), as the leading United Nations agency for telecommunications and ICTs, seeks to encourage gender balance in the ICT sector at all levels of the profession.

Supporting the education of women and girls in the ICT sector is also in line with United Nations Millennium Development Goal 3 to promote gender equality and the empowerment of women. Not only are jobs in the ICT sector lifting women out of poverty, a more gender-balanced sector offers fulfilling mid and high-level careers, and enables highly talented women to springboard to the top of the career ladder. This is good for everyone. As UN Secretary General Ban Ki-moon has said, *"Equality for women and girls is not only a basic human right it is a social and economic imperative. Where women are educated and empowered, economies are more productive and strong. Where women are fully represented, societies are more peaceful and stable."*

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