RIMAS Working Papers, No. 5/2011

CSR Activities and Impacts of the ICT Sector

André Martinuzzi, Robert Kudlak, Claus Faber, Adele Wiman

Sector profile based on a literature review
developed in the course of the FP7 Project
IMPACT - Impact Measurement and Performance Analysis of CSR

WIRTSCHAFTS UNIVERSITÄT WIEN VIENNA UNIVERSITY OF ECONOMICS AND BUSINESS

Authors:

André Martinuzzi
Robert Kudlak
Claus Faber
Adele Wiman

Keywords:

Literature review, sector profile, ICT sector, CSR, sustainable development, competitiveness, quality of jobs

Contact:

Research Institute for Managing Sustainability (RIMAS)
Vienna University of Economics and Business
Franz Klein Gasse 1, A-1190 Vienna, Austria

Acknowledgements:

The authors would like to thank Katrin Lepuschitz and Wolfgang Oberascher for preparing valuable background information during this study and Megan Ahearn for proofreading.

RIMAS Working Papers aim at stimulating the scientific debate about Corporate Sustainability and Sustainable Development Policies. They are the outcome of ongoing research activities at the Research Institute for Managing Sustainability at Vienna University of Economics and Business. They present preliminary results, which are open for debate and improvement for publication in scientific journals. All comments and suggestions are warmly welcome. The RIMAS Working Paper Series is edited by André Martinuzzi, head of the Research Institute for Managing Sustainability (andre.martinuzzi@wu.ac.at)

1. Abstract

The ICT sector is a major driver for growth and innovation in Europe. 5% of the total European GDP and 20% of productivity growth in the other sectors is related to the ICT sector. The share of ICT services is 80%, while 20% of the sector's turnover is caused by ICT manufacturing. Two forces of competition shape the European ICT sector:

- High importance of fast innovation cycles and high investments into R&D in an area shaped by strong competition with the US American ICT sector lead to corporate strategies in which R&D departments are kept in their (mostly Western European) home countries.

- Need for decreased production costs in an area shaped by strong competition with the Asian ICT sector results in relocation of standardized production processes to countries with low wages (e.g. Eastern Europe).

The main environmental impacts of ICT products are caused by material used in production (chemical substances) and energy consumption through production and usage of electronic products. The most important social issues of the ICT sector are poor working conditions outside Europe (e.g. mining of substances, production of electronic components, recycling and disposal of electronic waste). While the direct environmental and societal effects of the ICT sector can be assessed with comparative ease, the indirect and third-order effects of ICT products (e.g. by use of ICT products in other sectors and by consumers) are difficult to evaluate. While miniaturization, increased functionality and capacities are often claimed as good examples of (eco-) efficiency, several authors highlight that the gains tend to be offset by rebound effects.

Relative importance of issues related to quality of jobs varies strongly according to the type of job and the region. White collar workers have generally good intrinsic work quality but high concern about stress, workload, and personal performance responsibility. Due to quick innovation cycles, lack of training causes dissatisfaction. In contrast, for blue collar workers, intrinsic work quality is low due to monotonous and repetitive work and little or no control over tasks and working time. Concerning health and safety, ambient conditions (especially exposure to chemicals) are an issue. Equal treatment is an issue to a high vertical and horizontal gender employment gap and overrepresentation of the disadvantaged temporary workforce. Finally, due to high turnover, stability and job security are universal concerns. In the developing world, stability and health issues are an even stronger issue with a tendency to cross the red line into human rights issues. Human rights issues also emerge down the supply chain as several raw materials come from unstable territories.

2. Facts and figures

The Information and Communication Technology (ICT) sector is both an important part of European economy representing 5% of GDP (670 bln Euro) as well as a major contributor to overall productivity growth in other sectors, as ICT uptake drives 20% of total productivity growth (European Commission, 2010). The importance of the ICT sector has also been stressed in the new European economic strategy “Europe 2020”, as a key contributor to making Europe a dynamic, knowledge driven economy (European Commission, 2010) as well as contributing to the fight of the Economic crisis. Between 1995, and 2004, ICT is known to have been driving 50% of the EU total productivity gains in 840.000 enterprises, 92% of them in ICT services industry (ECORYS, 2009). The total value added of the European ICT industry, (2007 data) is estimated at 600 billion Euros (4.8 % of GDP) out of which 80% is coming from the ICT services and 20% from ICT manufacturing (ECORYS, 2009).

Detailed data is not available on the exact shares of sector value added and employment. However, according to European Commission (2010), the ICT manufacturing sector accounts for 1% of GDP and ICT services for 4% of GDP in 2007 – the latest observed date. In general, Europe and the US have been experiencing a much higher specialisation in ICT services than in manufacturing compared with Asian countries. However, ICT manufacturing companies are often global in nature and thus the European added value is often only a share of the total numbers (European Commission, 2010). Figure 1 shows five countries (DE, UK, FR, IT, and ES) accounted for more than 70% of total ICT value added (European Commission, 2010).

Figure 1 (following page) highlights the shares, which EU countries contribute to total value added and employment through ICT manufacturing and services in the year 2007 (European Commission, 2010). In Manufacturing, Germany is leading by far with 30% value added and 27% employment. In Services, the UK is leading with one quarter of all value added and 19% employment. The four leaders UK, Germany, France, and Italy dominate the sector, as they host almost two thirds of the ICT sector.

Sector employment: Until 2007 (latest data available) the total employment in the ICT sector has been growing (DG Enterprise, 2007b, p.7). The same group of five countries that produce the highest value added from ICT also account for the largest share of ICT employment – two-thirds in 2007. It is interesting to note the role of Germany, leading again with more than one-fourth of the entire share. A comparison between this ranking with the share of value added in manufacturing shows how emerging countries (Hungary, Czech Republic, and Poland) are “typically hosting mainly lower-end activities, or that the value added does not stay in the country” (European Commission, 2010, p.14). The telecommunication subsector accounts for 17% of total ICT sector employment and even more, 21% in ICT services sector (DG Enterprise, 2007b), according to the EU ICT task force report in 2006, telecommunications are also the largest market for ICT in Europe (2006).

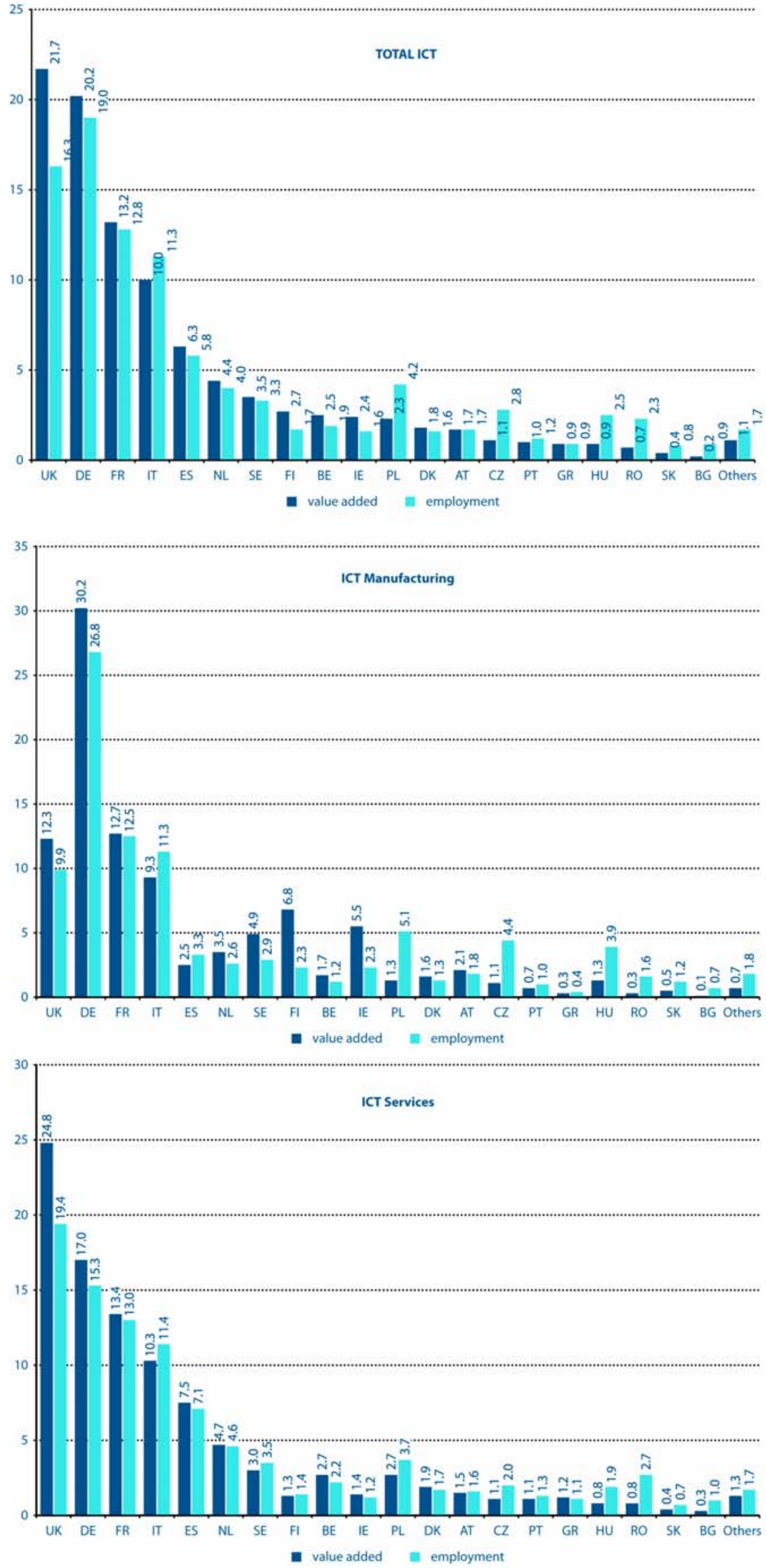

Figure 1: EU Country share of total ICT value added and employment. The group ‘Others’ includes SI, LT, LV, MT, EE, CY, LU. Source: (European Commission, 2010).

3. Growth and competitiveness

Due to the delay in official statistics, it is hard to estimate the effect of the global economic crisis on ICT companies. The first subsector to be hit by a worsening macroeconomic environment was the semiconductor industry, followed by telecom equipment and telecom operators. The only sub-sector that did not experience as significant declines were internet related services. On the positive side, the company financial reports for 2009 have already shown positive developments (European Commission, 2010).

ICT is a very diverse sector. Therefore, competitiveness of each segment is at different states and has different prospects. According to the European Commission's Digital Competitiveness Report (2010), the telecom equipment market is in a process of change, with declining sales due to structural business change. The mobile phone market has also been shrinking in both mature and emerging markets.

ICT services and the ICT consulting market have also been hit by the gloomy macroeconomic environment, particularly in the second half of 2009 showing a decrease of 7%. This decline is explained by the fact that this subsector is mainly driven by businesses investment in IT, which has been postponed remarkably due to the economic crisis. The telecommunications sector in particular faces a big change due to the rise of internet communications.

The ICT sector is very heterogonous and complex. Usually, it is divided into services and manufacturing. However, in the case of large companies, this division is blurred as they are engaged in both. Heterogeneity is also visible within subsectors. In the case of manufacturing, it is reflected in the variety of produced goods – intermediate goods, investment goods and consumer goods (European Commission, 2006). Fast technological progress has shortened the life cycles of many ICT products that mature and become standardized after a short time. ICT manufacturing at its early stages is knowledge-intensive and requires good access to human capital and facilities for R&D and innovation development. Mature products are produced in large numbers, and relocated to low income countries. It showed that the most competitive ICT manufacturing industries are located in countries such as Philippines, Malaysia, Singapore, Taiwan, Korea, and China (European Commission, 2006, 2009). This suggests that after entering the maturity phase, manufacturing moves to low income countries. Thus, European and American companies no longer have competitive advantages over Asian ones, especially in low-technology products such as electronic parts, radio and TV sets, and consumer electronic goods (European Commission, 2005, 2009).

Meijers et al. (2008) found that the EU ICT manufacturing sector is much more competitive in high quality products such as electronic apparatus (Ireland, Netherlands) scientific instruments (German, UK) and telecommunications equipment (Finland, Sweden). The EU also keeps a strong position in automatic data processing machines, electro diagnostic apparatus for medical, surgical, dental or veterinary purposes, and radiological apparatus.

Wintjes and Dunnewijk (2008) found that the EU ICT manufacturing sector tends to import components or intermediate goods to produce final goods of higher quality, which are then exported. This can be illustrated by an average price (unit value) of imported ICT goods from China which is 12 € per kg, while the EU exports to China is worth of 43 € per kg. EU import from Japan is worth of 44, 5 €/kg, when at the same time its export to Japan is valued at 143,8 €/kg.

The European ICT manufacturing companies seem to be the most competitive in terms of R&D. An analysis performed by Meijers et al. (2008) revealed that most of the EU ICT research is located in the home country. Home country location is preferred by companies due to lower costs of coordination and control as well as due to better access to skilled labor and systems of innovation. This shows Europe's main vulnerability: Investments in human capital in countries like China can make relocation of R&D very attractive. At present, relocation of R&D activities abroad is justified by the willingness to adjust products to local needs and to provide development services for customers. However, foreign markets must be large enough to justify this relocation.

The European ICT sector is competing mainly with low cost Asian countries and the USA. The latter is more innovative, as about 7% of US GDP is spent on "investment in knowledge", while in Europe this proportion is about 4%, with some exceptions such as Sweden and Finland.

R&D and innovations are extremely costly: Each generation of ICs (e.g. microprocessors) requires new factories, which cost about 2-3 billion US Dollars to build. R&D Costs for one new generation of semiconductors is about one billion Dollars. After releasing the product to the market, an innovation soon becomes common knowledge and does not serve any longer as a competitive advantage for the company who invented it. As a consequence, competitive advantage is less related with the understanding of future technological development, but is rather linked with the degree of risk that a manufacturer is willing to undertake, in which product it specializes, and to which privileged market it has access to (Nguyen, Genthon, 2006).

The competitive position of European ICT manufacturing improved after the enlargement of EU. Enlargement resulted in the relocation of many ICT manufacturing firms to new member countries to take advantage of their skilled labor forces and lower wages. The new member states have competitive advantages in labor-intensive production (European Commission, 2006). This was also confirmed by FDI flow, which is present mainly in less knowledge-intensive sectors that have scale-intensive production (Meijers et al., 2008).

Investment and outsourcing of production are sometimes perceived as the main factors for competitiveness in this sector (European Commission, 2006). Meijers et al. (2008) also stressed the role of the necessity to adjust to local foreign markets and to access superior knowledge in locations with large supplies of science and technology personnel.

ISTAG (2006) named the EU's main industrial and technological strengths in global markets: traditional telecommunications and IP-Infrastructure embedded computing, micro- and nano-electronics and Microsystems, "smart" integrating systems, and multicultural audiovisual content. Threats to EU competitiveness in ICT include those arising from: slow user uptake of new technologies, growing investments in emerging economies, leading to the re-allocation of activities with lower value added, further expansion of US dominance in computing, and the innovativeness of American firms. Furthermore, he names strong technological niches occupied by Japanese companies. Knowing these threats, it was suggested that the EU should maintain and build its competitive position through the ability to develop frontier technologies and the facilitation of demand for them in potential lead markets.

In the ICT sector, processes of technological convergence and convergence in usage are also discussed (Nguyen, Genthon, 2006). These phenomena emerged because it is cost effective to integrate different communications, information processing, and entertainment systems and devices. Greenstein and Khanna (1998) concluded that convergence can take place "in substitutes" and "in complements". In the first case, products manufactured by different firms substitute each other. This leads to bigger competition and to market conditions favoring customers. In the second case, companies create new products and/or services that complement each other to provide customers with better or new possibilities for usage. However, as they rely on complementary assets, they reinforce each other's market position, and slowly lead to market monopoly.

Ali-Yrkkö (2001) underlined the role of cooperation with other organizations when strengthening the firm's competitive position. Using Nokia as a case study, the author shows how Nokia actively involved itself in building supplier networks, which was beneficial for both parties. Thanks to this cooperation, Nokia's suppliers grew fast in terms of net sales and a geographical expansion. Another important outcome of the networking was corporate learning and knowledge accumulation, which were two of the factors that placed Nokia among the world's biggest and most competitive ICT manufacturers.

Authors of report "Enhancing European competitiveness through corporate responsibility" (MacGillivray, et al., 2006) scrutinized the role of CSR as an opportunity to secure the position of the European ICT sector on the global market, especially that emerging economies such as China and India are growing enormously. The authors claim that the European ICT sector should bring environmental and societal issues to the forefront of its business approach, and by doing so take advantage of emerging market conditions. This would lead to enhancing the level of international competitiveness.

Finally, Technology clusters are perceived as a factor having an impact on innovation, productivity and competitiveness. Furthermore, they create indirect effects by job creation and supporting local economies (Innovation in…, 2006).

Table 1 below summarises **literature on the critical success factors** in ICT industry.

Critical Success Factors - ICT sector	Authors and year
Knowledge-intensity, access to human capital and facilities for R&D, innovation development	European Commission, 2006; Nguyen, Genthon, 2006
High-quality, innovative, and technologically advanced products	Meijers et al., 2008; Wintjes, Dunnewijk, 2008
Investments and sourcing of production abroad	European Commission, 2006
EU's ICT strengths: both traditional telecommunications, and iPinfrastructure, embedded computing, micro- and nano-electronics and microsystems, "smart" integrating systems; and multicultural audiovisual content	ISTAG, 2006
Technological convergence and convergence in usage	Greenstein, Khanna, 1998; Nguyen, Genthon, 2006
Networking and cooperation	Ali-Yrkkö, 2001
Technology clusters	*Innovation in…*, 2006
CSR engagement	MacGillivray, et al., 2006

Table 1: ICT sector: literature on Success Factors

4. Environmental issues

One of the most important contributions to the debate on the relationship between ICT and environmental impacts was Romm's paper "The internet and the new energy economy" (Romm, 2002). The author claimed that the recent decrease in energy use was caused by the emergence of IT and the internet economy. Romm also expressed an opinion that more GDP growth can be achieved with lower energy intensity due to IT applications. However, Rejeski (2002), in his introductory speech to a special edition of the Journal of Industrial Ecology on "E-commerce, the Internet and the Environment", critically examined the empirical evidence on the relationship between information technology and the environment. According to Rejeski, the empirical findings are ambiguous and there is no clear picture as to whether ICT can be a solution to environmental problems. The outcomes of ICT emergence and development are unclear. On the one hand, it can provide more perfect information and dematerialization, but on the other hand it stimulates more purchases and unsustainable consumption patterns (Roome, Park, 2000).

Undoubtedly, the ICT sector offers many applications that can bring numerous positive impacts for the natural environment. Some of them are: digitalization of information, dematerialization of transport, or reduction of warehouse and office space (Yi, Thomas, 2007). On the contrary, there are many environmental threats that cannot be denied: Computer devices are assembled from more than 1000 materials, many of which are very toxic (chlorinated and brominated substances, but also lead, mercury, arsenic, cadmium, selenium). It has been reported that workers engaged in chip manufacturing are more likely to suffer from cancer, and computer recyclers have more dangerous chemicals in their blood (SVTC, 2003). Malmodin et al. (2010) aimed at assessing global operational electricity use and GHG emissions in the ICT and Entertainment & Media sectors. They found that ICT sector is responsible for 1,3% of global CO_2 emissions and 3,9% (use phase only) of global electricity consumption in, 2007. They also revealed that for the ICT sector, operations lead to more GHG emissions than ICT manufacturing.

The environmental impacts of ICT largely depend on how the ICT applications perform when human behavior becomes a very important factor. Society should not be too optimistic about the positive role of ICT in economy without accounting for ICT's environmental impacts. The direct and especially higher order impacts have to be better understood and accounted for when making strategic decisions related to ICT.

Yi and Thomas (2007) stated that environmental impacts of e-business/ICT include the three-order-effects, which are the most frequently quoted categorizations in this field, and also a promising route to take research forward:

- **1st order effects (direct)** - the impacts and opportunities created by the physical existence of ICT, the infrastructure and the processes involved. Most of the impacts are associated with first order direct environmental impacts from ICT infrastructure, such as: GHG emissions, e-waste, hazardous substances, electromagnetic radiation, and resource consumption during manufacturing and disposal of hardware.
- **2nd order effects (indirect)** - the impacts and opportunities created by the ongoing use and application of ICT. Most of the environmental benefits of ICTs lie in the second order effects via the digitalization of products and services, effects on production and inventories (increased resource productivity, e-procurement, mass customization), and effects on logistics increased efficiency, transparency, speed of transactions, and so on. For instance, the average transatlantic business flight uses 80,000 to 100,000 lb of fossil fuel, which could easily be avoided by the use of teleconferencing.
- **3rd order effects -** the impacts and opportunities created by the aggregated effects of large numbers of people using ICT, resulting from the response of business and consumers to increased productivity and saved time from the use of ICT products (Yi, Thomas, 2007). These kinds of effects emerge when the rate of efficiency improvement is lower than the growth rate for consumption.

Berkhout and Hertin (2004) did a similar exercise and divided the environmental impacts of ICT and the Internet into three categories:

- **direct impacts** of the production and use of ICTs on the environment (resource use and pollution related to the production of infrastructure and devices, electricity consumption of hardware, electronic waste disposal);

- **indirect impacts** related to the effect of ICTs on production processes, products and distribution systems (de-materialization, substitution of information goods for material goods, and substitution of communication at a distance for travel);
- **structural / behavioral impacts**, mainly through the stimulation of structural change and growth in the economy by ICTs, and through impacts on life styles and value systems.

One of the most frequently discussed environmental issues linked with the ICT sector is e-waste. The major categories of materials included in e-waste are ferrous metals, non-ferrous metals, glass, and plastics. The environmental problems resulting from e-waste creation come not only from the amount, but also from the toxins included in e-waste, which are responsible for brain damage, allergic reactions, and cancer (Puckett, Smith, 2002). However, next to harmful substances, e-waste also consists of valuable materials such as gold, copper, aluminum, iron, and steel, which become more and more attractive for re-use.

In 2004, more than 180 million personal computers we sold worldwide. In the same year, about 100 million computers became waste. In 2004, an average EU 15 citizen created between 4 to 20 kg of e-waste. And this trend is skyrocketing. It is estimated that in the period of 1994 – 2003, about 500 million PC's ended their lives (Widmer et al., 2005). This amount corresponds with about 2,872,000 t of plastics, 718,000 t of lead, 1363 t of cadmium, and 287 t of mercury (Puckett, Smith, 2002). And it is worth of remembering that PC's represent only a part of all e-waste, which include also mobile phones, MP3 players, peripherals etc.

Yu et al. (2010) assessed IT market development in China. Due to booming mobile phone ownership and a short product innovation cycle, waste mobile phones are flooding China. In 2008, about 560 million mobile phones were produced worldwide. These large numbers mean that discharging and disposal of mobile phones has the potential to have significant impacts on the environment. In 2008, around 77 million units of waste mobile phones were generated in China. To manage this energy use and recover valuable materials, recommendations are made to increase lifespan, improve energy efficiency during use, and ensure recycling. On the policy side, there is much work needed to develop appropriate take-back, reuse, and recycling systems for China.

Oiva et al. (2000) explored the environmental impacts of a mobile phone. They documented that heavy metals such as copper, nickel, and lead are the main sources of toxicity and should be recycled. Similar research performed by RANDA consulting group (2000) revealed that the production phase dominates over the use phase significantly, and environmental pressure stemming from the battery is most harmful. Canadian National Office of Pollution Prevention evaluated the environmental impacts of wired phones and concluded that energy consumption during the use phase and depletion of raw material, as well as water eutrophication (during the component manufacturing phase) was of key importance (NOPP, 2000).

A study carried by Fishbein (2002) focused on waste problems resulting from the use of cell phones and other wireless devices. The author came up with few important recommendations such as:

- no further reduction of the size of user terminals such as mobile phones, because of the increasing susceptibility to be thrown directly in the dust bin and thus being lost for material recovery,
- no introduction of disposable mobile phones, because this would further increase the waste stream,
- substitution of persistent and bio-accumulative chemicals, and encouraging consumer participation in take-back schemes.

Emmenegger et al. (2006) concluded that the mobile phone is the most important element of the mobile communication network, and its short life cycle is an important environmental issue. They suggested that extending the utilization period by leasing, re-use, or increasing the innovation cycle could be very beneficial for the natural environment. In their view, the manufacturing of electronic components, the life-time of the appliances, and energy consumption are the most important environmental issues in the case of the communication network.

Conrad (2000) studied environmental impacts resulting from end-of-life treatment of personal computers. The most important threats revealed were: toxic components, increasing amount of electronic and electrical equipment (EEE), and lack of recycling infrastructure. The report underlined that the speed of innovation and the dynamism of product manufacturing led to a shortening product life cycle. Thus computers (and other ICT products) become obsolete in less than two years, which makes the EEE waste problem even more crucial. Streicher-Porte et al., (2005) analyzed an e-waste recycling system in Delhi and came up with similar conclusion - prolonged life span of the PC’s would have a significant influence on the mass flow rate of the whole system, and this seems to be the easiest and most efficient way to decrease the amount of created e-waste and the amount of hazardous emissions to the environment.

Positive environmental effects (second order) resulting from digitalization of products and services are far from being comprehensible and verified. Greusing and Zangl (2000, cited in Fichter, 2002, p. 29) noted that electronic media are not so much a substitute than a supplement to printed and other media, so we risk an incomplete substitution and a coexistence of both types. ICT effects in production and inventories stem from fields such as e-procurement and mass customization (Fichter, 2002). For example, Behrendt et al. (2002, cited in Fichter, 2002, p. 30) found that e-commerce in the procurement and sales sector can have a positive influence on resource productivity. According to the authors, up to a 5% reduction of material use per unit of final product sold is possible as an effect of a reduction in the scrapping of stocks for products subject to rapid obsolescence.

The European Commission tried to explore and analyze the ICT potential to increase energy efficiency and reduce GHG emissions in European energy-intensive industries (basic metal and fabricated metal; pulp, paper, printing and paper products; chemicals, rubber, plastics and coke; glass, ceramics, and cement; transport and storage). The study found highly significant structural differences and structural change, both among and within sectors. They also concluded that Eastern European EU members are employing ICT solutions with less focus on sustainability. At the end, however, it was found that ICT has a limited, but acute impact on energy use and

GHG emissions in energy intensive industries. Nevertheless, the report stressed also the fact that using ICT to reduce GHG emissions is relatively expensive when compared to other abatement technologies (European Commission, 2009b).

Also, the influence of ICT development on logistics is cited as an example of a field with a high potential for improvement. To date, studies focused on business to consumer relationship in traditional vs. e-retail of books (Matthews, Hendrickson, 2001; Reichling, Otto, 2002; Williams, Tagani, 2002) or grocery shopping (Bratt, Persson, 2001; Fichter, 2002). In the case of book retail, there was no final evidence on which type of logistics is better for the environment. Environmental performance is influenced by shipping distance, shopping allocations, population density, mode of transport, etc. Much more potential has been found in the e-commerce of groceries.

Toffel and Horvath (2004) compared environmental effects resulting from reading a traditional newspaper and newspaper content from a personal digital assistant, as well as wireless teleconferencing with business travel. They found that using ICT technology for reading a newspaper releases 32-140 times less CO_2, several orders of magnitude less NO_x and SO_x, as well as 26-67 times less water.

Hilty et al. (2006) presented a simulation study on ICT environmental effects in 2020. Their findings are ambiguous. On the one hand, they revealed some important areas in which the ICT sector is able to contribute to decreasing adverse impact on the natural environment, e.g. ICT applications for heating management or ICT applications for passenger transport efficiency. On the other hand, fast development of ICT sector stimulates more consumption, which leads to increased waste flow, boosted energy use etc. The authors concluded that on an aggregated level, positive and negative effects tend to cancel each other.

Herring and Roy, (2002) and Plepys, (2002) focused on rebound effects. The former based their argumentation on cultural aspects of consumption and highlighted the need for (energy) sufficiency. The latter distinguishes impacts related to the life cycle of ICT hardware and impacts related to the way the ICT applications are being used.

The rebound effects can stem e.g. from constantly expanding the market potential of e-commerce applications or decreasing prices of microchips. Eventually, these types of effects can lead to a structural change in the whole economy and peoples' lifestyles. An example of such a positive rebound effect can be decoupling economic growth from energy consumption as presented by Romm (2002). On the contrary, development of office computerization did not decrease the use of the paper. In fact, between 1988 and 1998 the average per capita consumption of printing and writing paper rose by 24% (Fichter, 2002). Furthermore, evidence shows that as ICT products are miniaturized, more devices than ever are manufactured. For example, reducing the average physical mass of a mobile from over 350 g, (1990) to 80g, (2005) represented a reduction by a factor of 4.4. But at the same time, the number of subscribers increased dramatically, which led to a growth of a total mass flow by a factor of 8.0 (Som et al., 2005). As the average price per unit fell, higher demand for these devices was stimulated, which overcompensated positive effects of miniaturization in terms of mass flow (a rebound effect). It can be questioned if a shift from the traditional economy to a knowledge-based economy (which is strongly based on ICT development) will actually decrease the environmental impacts. Hilty et al. (2004) presented long term policy scenarios (to 2020) concerning the future impact of ICT on environmental sustainability. They concluded that even in the scenario that assumed that environmental regulation would internalize external effects of ICT development, the mass flow will increase by a factor of 2.7 - 4.0 (compared to the year, 2000). In the scenario without any regulations, the mass flow will rise by a factor of 3.1 - 7.0.

Herrin and Roy (2002) also concluded that the common belief that the use of ICT will lead to improved efficiency of resource use is disputable, and far from being accurate. They analyzed the effects of long-distance learning and found that this kind of higher education involve 90% less energy and CO2 emissions, but on the other hand, the rebound effects resulting from use of computers and home heating cancel the positive, first round effects.

Table 2 summarises **environmental issues** in the ICT sector.

Environmental issues - ICT sector	**Authors**
Eco-friendly ICT products, eco-friendly production	European Commission, 2009
The three-order-effects of ICT	Yi and Thomas, 2007
Energy use, waste	Yu et al., 2010
Rebound effects in the ICT sector	Plepys, 2002; Herring, Roy, 2002
E-waste	Conrad, 2000; Fishbein, 2002; Puckett, Smith, 2002; Streicher-Portea et al., 2005; Widmer et al., 2005
Energy use and GHG emissions	Malmodin et al., 2010
LCA of a wired/wireless phone	Oiva et al., 2000; RANDA, 2000; NOPP, 2000; Emmenegger et al., 2006
Environmental benefits from using ICT services	Toffel, Horvath, 2004
Environmental effects of e-commerce	Bratt, Persson, 2001; Matthews, Hendrickson, 2001; Fichter, 2002; Reichling, Otto, 2002; Williams, Tagani, 2002
Mass flow caused by development of ICT sector	Hilty et al., 2004; Som et al., 2005
Workers' exposure to dangerous substances	SVTC, 2003
Future environmental impacts: waste flow, boosted energy use	Hilty et al., 2006
Direct, indirect and structural effects of ICT	Berkhout, Hertin, 2004

Table 2: ICT sector: literature on environmental issues

5. Quality of jobs issues

The ITC industry is shaped by fast innovation and production cycles, and (at least partly) a worldwide mass market. This mix of influences creates production systems that separate the workforce between white and blue collar workers. The former have good ambient conditions, but considerable time pressure and stress from highly complex work with tight deadlines. The latter bear the burden of manufacturing large quantities on short notice under intense time and cost pressure, most of them in developing countries.

Table 3 below summarises the key issues related to quality of jobs that are mentioned in literature:

Work quality issues in ICT sector	Authors and year
Intrinsic work quality: job complexity, job rotation	Appleyard, Brown, 2001; Hürtgen et al., 2009; Bayo-Morinoes, 2010
Monotonous and repetitive work, military-style work organization	SACOM, 2010
Skill reproduction in a fast-turning knowledge sector	Rose, 2007; Scholarios et al., 2008
Equal treatment for women and minorities	Eurostat, 2010; Webster, 2007; Healy, Schwarz-Woelzl, 2007
Temporary workforce and working conditions	Seibert, 2007; Lüthje et al.,2004; Ferus-Comelo, 2008; Plank et al., 2009; Lüthje, 2002; Mitlacher, 2008; Euro fund, 2007; Green et al., 2010; SOMO, 2009
Health and safety in developing countries	Watterson, 2006; Hürtgen et al., 2009; McCourt, 2006
Stress and work pressure, parallel tasks	Gerlmaier, 2009; Koch, Leitner, 2008
Health issues in nanotechnologies	Ostiguy et al., 2010; Rickerby, Morrison, 2007
High turnover	Korunka, 2008
Social dialogue and worker representation	Rigby, Smith, 1999; Steiert, 2006; Boes, Baukowith, 2002; Lüthje et al., 2004
Wages	SOMO, 2009; Chan et al., 2008.
Human rights in mineral resources in developing countries	Van het Kaar and Grünell, 2001; Pöyhönen, Simola, 2007; Pöyhönen, 2009; Pöyhönen et al., 2010; Nordbrand, Bolme, 2007; SOMO, 2007; Steinweg, de Haan, 2007
Human rights in assembly plants in developing countries	SACOM, 2010; Nordbrand, 2009; SOMO, 2010; de Haan, Schipper, 2009
Health and working conditions	Ahlers, Trautwein-Kalms, 2002 p.24f
Work life balance	Ho et al., 2009; FEM, 2010

Table 3: ICT sector: literature on Quality of Jobs issues

Intrinsic work quality is a high issue for blue collar workers at contract manufacturing workplaces, which have a high degree of monotonous and repetitive tasks. Nevertheless, the comparably highly specialized European sector fosters stronger involvement of blue-collar workers in production processes, lowering polarization between engineers, technicians and blue-collar workforcee (Lüthje, 2002, p. 233ff). Moreover, advanced production techniques were recognized to increase job complexity as well as leading to job rotation and job enlargement (Appleyard, Brown, 2001, p. 436; Hürtgen et al., 2009, p.234; Bayo-Morinoes, 2010 p.7).

Skills and employability is an issue for knowledge “white collar” workers. As ICT is driven by fast technological innovation and short production cycles, only constant acquisition and renewal of professional skills keeps up employability. By not providing sufficient training opportunities, companies put the individual’s employability at stake, leading to a decline in job satisfaction (Rose, 2007, p.377f). Especially in European SMEs, representing almost 99% of sectoral companies, strategic career development programs are scarce, yet existent, focussing primarily on key employees (Scholarios et al., 2008, p.1051ff).

Equal treatment is somewhat of an issue, though commonly a blind spot within the industry. Women, older, and migrant workers are underrepresented (employment gap) and discriminated against concerning pay and appropriate work structures (Eurostat, 2010, p234; Webster, 2007, p.5ff; Healy, Schwarz-Woelzl, 2007, p.22ff). Women and migrant workers are often strongly represented in the high proportion of the temporary workforce, experiencing lower-pay and doubtful working conditions (Seibert, 2007 p.33; Lüthje et al., 2004, p.275f.; Ferus-Comelo, 2008 p.43ff.; Plank et al., 2009, p.44ff).

Health and working conditions are an issue for blue collar workers at the production level, given that typically chemicals are involved in ICT production processes. Large differences in conditions can be observed, ranging from „quite safe“ to severe health risks due to absent safety precautions, especially in developing countries (Watterson, 2006, p.96 ff; Hürtgen et al., 2009, p.235 ff; McCourt, 2006, p.139ff) Looking ahead, the emergence of nanotechnologies in ICT might pose a threat to workers (Ostiguy et al., 2010, p.19ff; Rickerby, Morrison, 2007, p.19ff). For knowledge workers, other health issues gain attention, as psychological disorders are on the rise. Stress, chronic exhaustion, and an increasing imbalance between private and work-life have been ascertained by a survey of German ICT company works councils (Ahlers, Trautwein-Kalms, 2002 p.24f). The main reasons are project-oriented work structures as well as a more stringent accountability of the individual (Gerlmaier, 2009 p.43ff). In the ICT producing sector, the pressure of innovation frequently leads to the development of multiple project entities, which in turn requires employees to work on parallel tasks (Koch, Leitner, 2008 p.62f).

Flexibility, stability and security are an issue due to high fluctuation in demand and fast production cycles. This leads to a high degree of contingent and temporary work in the sector (Lüthje, 2002, p.234f). Temporary workers are typically without unionization, relatively easy to substitute, and therefore often discriminated against full-time employees (Mitlacher, 2008, p.449ff). Overall job satisfaction ranges lower, compared to the permanently-employed (Eurofound, 2007, p.80; Green et al., 2010, p.622f). With knowledge workers, turnover intention is a widespread issue. Korunka et al. (2008, p.409ff) demonstrate the dependencies between job and organizational characteristics and the intention of leaving the employer. Temporary employment agencies are widespread in the Electronics industry. Research from SOMO (2009) in Poland and Czech Republic shows that temporary employment is exceptionally high, and working conditions as well as union representation are considerably lower.

Inclusion and access to the labour market: There is no research on this topic, as it is a political issue that is not taken up by academics.

Work-life-balance: There is no research focusing explicitly on this topic in the ICT sector. We can expect to see major collisions between family and work responsibilities with women workers in developing countries, facing long shifts and working hours. This was reported by SACOM (2010) from China's Foxconn (a company employing close to 1 million employees) and other companies in China (Nordbrand, 2009; Ho et al., 2009) and the Philippines (de Haan, Schipper, 2009). The European Metalworkers' Federation recommended telework as a way to improve work-life balance in the ICT sector (FEM, 2010).

Social dialogue and worker involvement has little evidence in literature. *Rigby* and *Smith* (1999, p.9) found, by interviewing 60 union representatives (GER, ITA, ESP, UK), a predominant focus on quantitative topics, such as pay and job security. Qualitative issues like training are reported important, whereas humanization of work, equal opportunities, and environmental themes, prominent in the 1980s, are considered secondary. Union representation shows a stronger presence in production compared to the "younger" service sector (Steiert, 2006, p.193; Boes, Baukowitz, 2002, p.147; Lüthje et al., 2004, p.276f). Quite commonly, strong national differences in unionizations exist. Van het Kaar and Grünell, (2001) from EIRO provide a detailed county specific analysis. Not too common in Europe, repression on Union activity is exceptionally strong in developing countries (see the section on human rights).

Wages is not particularly an issue in Western Europe. In contrast, there are reports about growing pressure in Eastern Europe (SOMO, 2009). Also in contrast, wages at about 1/3 of living costs are reported in a study of 6 production plants in China and the Philippines (Chan et al., 2008, de Haan, Schipper, 2009).

Human Rights are an issue down the value chain: First, several rare metals for electronic components come from civil war areas. Detailed reports are from the Democratic Republic of Congo (Pöyhönen, Simola, 2007; Pöyhönen, 2010, where warlords control mines and their workers, thereby financing weapons), Zambia (Nordbrand, Bolme, 2007 with report from cobalt mining and appalling working conditions), South Africa (SOMO, >2007) on workers' rights in platinum mines in the Limpopo province; Steinweg, de Haan, (2007) found extreme health and safety conditions in a case study on a PGM mine), and the tin-mining islands Bangka and Belitung in Indonesia (Pöihönen, 2007, 2009). This situation is an issue in a sector where most of the companies, which are present on the end user markets, have high brand values and are vulnerable. Two industry associations (EICC, GeSI) have consequently accepted accountability for the extractives phase of their supply chains (Pöyhönen, 2010). Second, up the production chain, there are widely reported incidents affecting blue-collar workers in assembly plants in developing countries like China (SACOM, 2010 on working conditions and workers rights at Foxconn, Nordbrand (2009) with similar results on two suppliers and Ho et al., 2009 on four suppliers in Guangdong Province), India (SOMO, 2010 on wages, workers rights and safety in seven plants), Philippines (de Haan, Schipper, 2009 on freedom to organize, wages, and overtime in Export Production Zones).

6. CSR issues

CSR in the ICT sector is shaped by voluntary behaviour of firms on the one hand, and by instruments of public policies on the other. Institutional regulatory initiatives such as the WEEE directive (Waste from Electrical and Electronical Equipment – 2002/96/EC), RoHS (Restriction of Hazardous Substances – 2002/95/EC), REACH legislation (Registration, Evaluation, and Authorisation of Chemicals) and The EuP (the energy using Products directive) directly or indirectly address ICT manufactures' responsibility, yet leave a wide range of implementation possibilities (Schipper, de Haan, 2005). All EU initiatives mentioned above aim at environmental issues such as waste creation, disposal and recycling, and hazardous substances and chemicals.

There are also some international treaties affecting the ICT sector: the Basel Convention on the trans-boundary movement of hazardous wastes, the London Convention Protocol forbidding most forms of ocean dumping, the Rotterdam Convention requiring prior informed consent on the export of certain dangerous product chemicals, and the Stockholm Convention concerning the release of Persistent Organic Pollutants (POPs).

Broader, farther-reaching concepts, understood as beyond compliance techniques like the Electronics Industry Code of Conduct (EICC), refer to environmental performance along the supply chain as well as working conditions. The world's largest ICT manufacturers such as Dell, IBM, or Hewlett-Packard implemented their own codes of conduct. However, the EICC approach is criticised for not referring to internationally accepted standards, the lack of enforcement mechanisms and verification requirements, and a rather low level of commitment among the suppliers (Schipper, de Haan, 2005).

Concerning academic literature within European boundaries, a strong focus on environmental issues can be observed, whereas social issues are mostly indirectly addressed, calling for responsible business partners overseas. Environmental performance thereby encompasses product design, manufacturing, use, and waste disposal along the full product life cycle (European Commission, 2009).

Practical application of Eco-design/Design for Environment (DfE) within the European electronics industry are provided by Mathieux et al. (2001), based on 24 case studies, establishing five principles to reflect Eco-design (life cycle thinking, Eco-design process, tools and methods, Eco-design strategies, dialogue and partnership). Tukker et al. (2001) provide a comparative analysis on the country level.

Preuss (2001) approached environmental issues via the purchasing function of Scottish manufacturing firms, concluding that both the supplier as well as the buyer can environmentally "educate" the business partner, but purchasing often lacks the operational resources to do so. Nagel (2003) discussed environmental management systems (ISO 14000 series, EMAS) from an OEM's perspective, and introduced a new environmental performance tools for supplier evaluation.

Although EU legislation (primarily WEEE) requires manufacturers to bear the cost of properly disposing of their products and avoiding certain hazardous substances, e-waste is still a problem (Deaves, 2004; Price, 2006; Allan, 2008). The EU admits that only one-third of e-waste is collected and treated properly, and considers a revision of WEEE (http://ec.europa.eu/environment/waste/weee/index_en.htm). Though prohibited by the Basel Convention, an uncertain proportion (insiders' estimates range around 60%; Puckett, 2006) of the e-waste is exported from developed to developing countries for final disposal (van Huijstee, de Haan, 2009; Cobbing, 2008; Nordbrand, de Haan, 2009).

E-waste has become an international problem, since a great share of it is transferred to developing countries. In 1989, the trans-boundary movement of e–waste was regulated by the Basel Convention. About 34% (data from, 2000) of all e-waste in Western Europe was represented by ICT waste (Widmer et al., 2005). There are also other initiatives focusing on e-waste issues: UN-led StEP initiative, WEEE Forum, National Electronics Product Stewardship Initiative, Electronics Product Stewardship Canada, European Recycling Platform (Widmer et al., 2005).

There are also some environmental campaigns monitoring the ICT manufacturing and the processes involved. The Basel Action Network (BAN) is an international network of activists around the world tracing the illegal trade of hazardous waste from developed to developing countries. Silicon Valley Toxics Coalition (SVTC) is an organisation involved in research and advocacy of environmental and human health problems resulting from the growth of high-tech electronics.

Table 4 below summarises **literature on CSR issues in** ICT industry.

CSR issues - ICT sector	**Authors and year**
WEEE and electronic waste	Deaves, 2004; Widmer et al., 2005; Schipper, de Haan, 2005, 2006; Cobbing, 2008; Price, 2006; Allan, 2008; Nordbramd, 2009; van Huijstee, de Haan, 2009
Eco-design/Design for Environment	Mathieux et al., 2001, Tukker et al., 2001
Environmental management systems	Nagel, 2003
Supply chain management	Preuss, 2001

Table 4: ICT sector: literature on CSR issues

7. Trends and Future Prospects

Many studies regarding ICT futures are centered on the possibilities offered by further development of: telecommunication network infrastructure, especially internet, and the overcoming need to adapt it to increase demand. From a macroeconomic point of view, the European market is exposed to pressure in terms of competition despite the increasing demand. (Tafazolli, 2011)

In short terms, the ICT sector will probably look at open platforms for the development of innovative, internet-empowered applications and new Web and Internet-based services, taking advantage of the new generations of smart phones, networked sensors and convergence around IP (Internet Protocol) that can ensure access to new ideas and rapid market uptake of innovations. According to Tafazolli (2011), this process requires the improvement of networks access, simplicity in accessing devices, security etc. Future challenges are therefore oriented towards a digital single market based on E-Technologies (E-services reliability: health and tele-care system, E-government, Intelligent transport system, privacy, safety, and security).

This E-networking development process should be flexible to customers who fall under the "poverty of connection": while it is necessary to address those challenges required to transform the internet, the infrastructure (internet) needs to adapt to the increase in demand and to be made accessible in ways that people want to access it. (European Future Initiative, 2009)

In the long term, the ICT sector will look for alternative paths to components and systems development - including nano-electronics, more integration of functionalities on chips, and the use of new materials and progress in photonics (like all-optical networks combined with advances in wireless communication, sensor networks, computing, autonomic network/service management capabilities, new network E-architectures, and systems, etc). (European Commission Research Directorate-General, 2007)

In terms of economics, the European ICT Industry shows the trend to be endangered by the cost advantages of Asian countries on the one hand, and by the inventiveness and dynamism of the US industry on the other. Regarding market size, it is foreseen that North America remains the dominant market, the European ICT sector shows the tendency to grow, and China is expected to become the major player in the electronics manufacturing sector. Still, the European ICT industry is marked by unfavorable macroeconomic conditions due to the weakness of European firms regarding costs compared to Asian firms, and inventiveness and system control compared to US firms. Finally, it is notable that the market size consists of about 455 million quite wealthy individuals. Therefore, there is potential for innovation and investment. (Dang et. Genthon, 2006)

ICT is considered to be part of a new global development paradigm, namely "Knowledge based society". It is based on four pillars: the institutional evolution to develop a stable macroeconomic framework, innovation, the use of ICT, and the education of manpower. This concept of “Knowledge based Society” is also strongly supported by the OECD. The European Union also endorses this strategy and consequently launched the “eEurope” Program with the target of stimulating the usage of ICT within the Union. Clearly, investment in knowledge is a prerequisite of “Knowledge based society” and is defined as the sum of expenditure on R&D, higher education and software. However, whereas the US invests 7% of their GDP, Europe spends only 4%, which is a rather unsatisfying number. (Graham, 2002)

ICT sector improvement is seen as a major mechanism for responding to societal challenges such as an ageing population, sustainable health and social care, inclusion, education, and security, as well as the fight against climate change. The impact of ICT on social behaviors, democratic processes, and creativity will continue to grow with the wider diffusion of web-based social networking and user-generated content and services, driven by the roll-out of broadband. (European Commission Research Directorate-General, 2007)

Moreover, the ICT sector has been identified as a potential major player in the fight against climate change – in particular its role in improving energy efficiency, and as the engine for sustainable growth in a low carbon economy because of improved information transparency (European Commission Research Directorate-General, 2007)

Trends and Future Prospects – ICT Sector	**Authors**	**Year**
Economic Outlook for the European ICT Sector, Industrial Policy, competition, regimes, knowledge based society	Dang, Genthon	2006
ICT Sector, components and systems development, ICT Sector as response to societal changes	European Commission Research Directorate-General	2007
ICT Sector as a powerful driver of sustainable growth, ICT Sector’s role in boosting innovation and competitiveness	European Future Internet Initiative	Assumed 2009
Competitiveness of the ICT Sector, policy implementation and electronic technologies	Graham	2002
Open platforms for the development of innovative internet-empowered applications, Internet and ICT	Tafazolli	2011

Table 5: ICT Sector: Literature on Future Trends

8. Literature

Ahlers, E., Trautwein-Kalms, G., (2002) Entwicklung von Arbeit und Leistung in IT-Unternehmen - Betriebsratsinformationen aus erster Hand, Hans Böckler Stiftung (http://www.boeckler.de/pdf/p_edition_hbs_62.pdf) (downloaded 21.09.2010)

Ali-Yrkkö J., (2001) Nokia's network – gaining competitiveness from co-operation. Helsinki: Taloustieto Oy.

Allan, K., (2008) System Failure. Engineering & Technology, 22 November - 5 December, pp. 66-67.

Appleyard, M.M., Brown, C., (2001) Employment Practices and Semiconductor Manufacturing Performance. Industrial Relations, Vol. 40, No. 3, pp. 436-471.

Bayo-Moriones, A., Bello-Pintado, A., Merino-Díaz-de-Cerio, J., (2010) The effects of integrated manufacturing on job characteristics. New Technology, Work and Employment, Vol. 25, No. 1, pp. 63-79.

Behrendt, S., Fichter K., Heinze M., Jonuschat H., (2002) Literaturbericht zu den o¨kologischen Folgen des E-Commerce. [Report on the environmental effects of e-commerce.] Commissioned by the German parliament and the Of.ce for Technology Assessment (TAB). Berlin: IZT.

Berkhout F., Hertin J., (2004) De-materializing and re-materializing: digital technologies and the environment. Futures, Vol. 36 (8), pp. 903–920.

Boes, A., Baukowitz, A., (2002) Arbeitsbeziehungen in der IT-Industrie – Erosion oder Innovation der Mitbestimmung? BERLIN, edition sigma.

Bratt, M., Persson A., (2001) Future CO2 savings from on-line shopping jeopardized by bad planning. http://www.scanamerica.net/www/ftp/E-EffLogisticsSweden.pdf Downloaded 27.12.2010

Chan, J., de Haan, E., Nordbrand, S., Torstensson, A., (2008) Silenced to deliver. Mobile phone manufacturing in China and the Philippines. SOMO and SwedWatch for the makeITfair initiative, September 2008 (http://makeitfair.org/the-facts/reports, 12/2010)

Cobbing, M, (2008) Toxic Tech: Not in Our Backyard - Uncovering the Hidden Flows of e-Waste,http://goodelectronics.org/publications-en/Publication_2470/?searchterm=europe, (29.09.2010)

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS on mobilizing Information and Communication Technologies to facilitate the transition to an energy-efficient, low-carbon economy (2009)(http://ec.europa.eu/information_society/activities/sustainable_growth/docs/com_2009_111/com2009-111-en.pdf) (downloaded 29.09.2010)

Conrad, R., (2000) Background document on recycling waste from computers. Randall Conrad & Assoc. Ltd., Alberta.

Dang Nquyen G., Genthon C. (2006) Has the European ICT sector a chance to be competitive? Bruges European Economic Policy Briefings. College of Europe. BEEP briefing n° 14 March 2006.

Deaves, M., (2003/2004) Taking back the WEEE. IEE Manufacturing Engineer, December, pp. 38-41.

DG Enterprise and Industry, (2007a) The ICT activity index 2006.

DG Enterprise and Industry, (2007b) the ICT Activity Index 2007.

ECORYS, (2009) FWC Sector Competitiveness Studies - Competitiveness of the EU SMEs in the ICT services industry. Final Report for the Directorate-General Enterprise & Industry.

Emmenegger M.F., Frischknecht R., Stutz M., Guggisberg M.,Witschi R., Otto T., (2006) Life Cycle Assessment of the Mobile Communication System UMTS. Towards Eco-Efficient Systems. International Journal of Life Cycle Assessment, Vol. 11, No.4, pp. 265-276.

Enhancing European competitiveness though corporate responsibility (2006) URL: http://docs.google.com/viewer?a=v&q=cache:a2j5UR72RMIJ:www.accountability.org/images/content/1/0/101/Responsible%2520Competitiveness%2520in%2520Europe-%2520Summary.pdf+responsible+competitiveness&hl=de&gl=at&pid=bl&srcid=ADGEESgqVtwfLnDLl5Mnh6NMH1tvxhD5wEMl2N7aQqC0JRjALtHfcKENZrhzQ9ceGLdOfS1FoOfQO0syNTCWY3HeI_V8k5BrxLvb5z8rH9NayXwm36UZQ3v-v-0tCsMdqVGEYWyJR3eT&sig=AHIEtbSBp-Cdpvek7-V5EHte3CAtjjPxwg (downloaded 15.05.2011)

European Future Internet Initiative (assumed 2009) Future Internet – A Call for Action.

European Commission, (2005) Rising International Economic Integration. Opportunities and Challenges. The EU Economy 2005 Review. Directorate– General for Economic and Financial Affairs, Brussels.

European Commission, (2006) European Competitiveness Report. Communication from the Commission, COM, (2006) 697 final.

European Commission Research Directorate-General. (2007) The seventh Framework Program (FP7). www.crc.gc.ca/en/html/crc/home/partners/ncp/ict/programme; called on the 1st October 2011.

European Commission, (2009a) European industry in a changing word. Updated sectoral overview, 2009. SEC, (2009) 1111 final.

European Commission, (2009b) ICT impact on greenhouse gas emissions in energy-intensive industries. Impact Study No. 1/2009. A Sectoral e-Business Watch study by DIW Econ, Final Report.

European Commission, (2010) Europe's Digital Competitiveness Report Vol. I. Commission Staff Working Document SEC, (2010) 627

Eurofound, (2007) Fourth European Working Conditions Survey, 2007. European Foundation for the Improvement of Living and Working Conditions (http://www.eurofound.europa.eu/pubdocs/2006/98/en/2/ef0698en.pdf) (14.07.2010)

European Metalworkers' Federation (EMF) (2010) EMF position paper on telework in the ICT industry. FEM 7/2010, Brussels.

Ferus-Comelo, A., (2008) Mission impossible? Raising Labor Standards in the ICT Sector, Labor Studies Journal, Vol. 33, No. 2, pp. 141-162.

Fichter K., (2002) E-commerce. Sorting out the environmental consequences. Journal of Industrial Ecology, Vol. 6, No. 2, pp. 25-41.

Fishbein, B.K., (2002) Waste in the Wireless World: The Challenge of Cell Phones. INFORM Inc, New York.

GENDER ASPECTS - Production of Next-generation electronics in Poland - http://makeitfair.org/die-fakten/studien/studien?set_language=de (27.09.2019)

Gerlmaier, A., (2009) Gesund bleiben bei Projektarbeit: Ein Arbeitsleben lang!? In: Hochseilakt – Leben und Arbeiten in der IT Branche, ver.di – Bereich Innovationen und Gute Arbeit. (http://www.verdi-gute-arbeit.de/upload/m4a3775bb92212_verweis1.pdf) (15.09.2010)

Graham S. (2002) Bridging Urban Digital Divides? Urban Polarisation and Information and Communications Technologies (ICTs). Urban Studies. Vol. 29, Issue 1, pp. 22-56.

Green, C., Kler, P., Leeves, G., (2010) Flexible contract workers in inferior jobs: Reappraising the evidence. British Journal of Industrial Relations, Vol. 48, No. 3, pp. 605-629.

Greenstein S. and Khanna T., (1998) What does industry convergence mean? In: D.B. Yoffie (ed.), Competing in the Age of Digital Convergence, Harvard Business School Press, Boston.

Greusing, I., Zangl, S., (2000) Vergleich von Print- und Online-Katalogen: Akzeptanz, o¨kologische, und o¨konomische Analyse. IZT-Werkstattbericht Nr.44 [Comparing Print- and Online-Mail Order Catalogues, Costumer Acceptance, Environmental and Economical Analysis, IZT-Discussion Paper No. 44]. Berlin: IZT.

de Haan, E., Schipper, I., (2009) Configuring Labor Rights. Labor Conditions in the production of Computer Parts in the Philippines. SOMO (Centre for Research on Multinational Corporations) and WAC for the makeITfair initiative, July, 2009 (http://makeitfair.org/the-facts/reports, 12/2010)

Healy, M., Schwarz-Woelzl, M., (2007) Recruitment policies and practices in the context of demographic change - Critical issues in the ICT sector and recommendations (http://www.mature-project.eu/attach/1mature_final_report_2007.pdf) (10.09.2010)

Herring, H., Roy, R., (2002) Sustainable services, electronic education and the rebound effect. Environmental Impact Assessment Review, Vol. 22, pp. 525–542.

Hilty, M.L., Arnfalk, P., Erdmann, L., Goodman, J., Lehmann, M., Wager, A., (2006) The relevance of information and communication technologies for environmental sustainability. A prospective simulation study. Environmental Modeling and Software, Vol. 21, No. 11, pp. 1618-1629.

Hilty, L.M., Wager, P., Lehmann, M., Hischier, R., Ruddy, T., Binswanger, M. (2004) The future impact ICT on environmental sustainability. Refinement and quantification. Fourth Interim Report; Institute for Prospective Technological Studies (IPTS), Seville, available at: http://cleantech.jrc.es/pages/ct8.htm; downloaded 18.12.2010.

Ho, C. K., Pöyhönen P., Simola, E., (2009) Playing with labor rights. Music player and game console manufacturing in China. Finn Watch & SACOM & SOMO for the makeITfair initiative, Amsterdam, November, 2009 (http://makeitfair.org/the-facts/reports, 12/2010)

Hürtgen, S., Lüthje, B., Schumm, W., Sproll, M., (2009) Von Silicon Valley nach Shenzen – Globale Produktion und Arbeit in der IT – Industrie. Hamburg, VSA Verlag.

Innovation in R&D, manufacturing and services, (2006) Topic Paper.

Koch, R., Leitner, K.-H., (2008) The Dynamics and Functions of Self-Organization in the Fuzzy Front End: Empirical Evidence from the Austrian Semiconductor Industry. Creativity and Innovation Management, Vol. 17, No. 3, pp. 216-226.

Korunka, C., Hoonakker, P., Carayon, P., (2008) Quality of Working Life and Turnover Intention in Information Technology Work. Human Factors and Ergonomics in Manufacturing, Vol. 18, No. 4, pp. 409–423.

Lüthje, B., (2002) Electronics contract manufacturing: Global production and the international division of labor in the age of the internet. Industry and Innovation, Vol. 9, Issue 3, pp. 227-247.

Lüthje, B., Schumm, W., Sproll, M., (2004) Contract Manufacturing – Transnationale Produktion und Industriearbeit in der IT-Branche. FRANKFURT/NEW YORK, Campus.

MacGillivray, A., Martens, H., Rudinger, K., Vilanova, M., Zollo, M., Begley, P., Zadek, S. (2006) Responsible competitiveness in Europe. Enhancing European competitiveness through corporate responsibility.

Malmodin J., Moberg A., Lunden D., Finnweden G., Lovehagen N., (2010) Greenhouse gas emissions and operational electricity use in the ICT and Entertainment & Media sectors. Journal of Industrial Ecology, Vol. 14, No. 5, pp. 770-790.

Mathieux, F., Rebitzer, G., Ferrendier, S., Simon, M., Froelich, D., (2001) Eco-design in the European Electr(on)ics Industry: An analysis of the current practices based on cases studies - An analysis of the current practices based on cases studies. The Journal of Sustainable Product Design, Vol. 1, pp. 233–245.

Matthews H.S., Hendrickson C.T., (2001) Economic and environmental implications of online retailing in the United States. Downloaded 28.12.2010 from http://www.oecd.org/dataoecd/56/19/2662057.pdf

McCourt, J., (2006) Worker Health at National Semiconductor, Greenock (Scotland) – Freedom to Kill?, in: Smith, T., Sonnenfeld, D.A., Pellow, D.N. (eds.), Challenging the Chip – Labor Rights and Environmental Justice in the global Electronics Industry. PHILADELPHIA, Temple University Press, pp. 139-149

Meijers, H., Dachs B., Welfens, P., (2008) Internationalization of European ICT Activities. Springer.

Mitlacher, L.W., (2008) Job quality and temporary agency work: Challenges for human resource management in triangular employment relations in Germany. International Journal of Human Resource Management, Vol. 19, No. 3, pp. 446-460.

Nagel, M.H., (2003) Managing the environmental performance of production facilities in the electronics industry: more than application of the concept of cleaner production. Journal of Cleaner Production, Vol. 11, pp. 11–26.

Nguyen G.D., Genthon C., (2006) Has the European ICT sector a chance to be competitive? Bruges European Economic Policy Briefings.

NOPP, (2000) Understanding the Environmental Aspects of Electronic Products: A Life Cycle Assessment Case Study of a Business Telephone. National Office of Pollution Prevention, Ottawa, Canada.

Nordbrand S., (2009) Out of control: E-waste trade flows from the EU to developing countries. SwedWatch.

Nordbrand, S, Bolme, P., (2007) Powering the mobile world. Cobalt production for batteries in the DR Congo and Zambia. Report by SwedWatch for the makeITfair initiative, November, 2007 (http://makeitfair.org/the-facts/reports, 12/2010)

Nordbrand, S., de Haan, E., (2009) Mobile phone production in China. A follow up report on two suppliers in Guangdong. Report by SwedWatch & Somo for the “Make IT fair” initiative.(http://makeitfair.org/the-facts/reports, 12/2010)

Oiva L, Oppermann W, Middendorf A, Zuber K-H, Stobbe I., (2000) Case study on the environmental impacts of a mobile phone. In: Proceedings of the Electronics Goes Green 2000+, 2000, Berlin, pp. 749–752 (http://www.arp.net.au/envcha.php)

Ostiguy, C., Roberge, B., Woods, C., Soucy, B., Chemical Substances and Biological Agents - Studies and Research Projects: Engineered Nanoparticles -- Current Knowledge about OHS Risks and Prevention Measures (http://www.irsst.qc.ca/files/documents/PubIRSST/R-656.pdf) (29.09.2010)

Plank, L., Staritz, C., Lukas, K. (2009) Labor rights in global Production networks: An Analysis of the Apparel and Electronics Sector in Romania (http://goodelectronics.org/publications-en/Publication_3102/?searchterm=europe) (downloaded 29.09.2010)

Plepys A., (2002) The grey side of ICT. Environmental Impact Assessment Review, Vol. 22, pp. 509–523.

Pöyhönen, P., Simola, E., (2007) Connecting components, dividing communities. Tin Production for Consumer Electronics in the DR Congo and Indonesia. Study by Finn Watch & FANC for the makeITfair initiative, December, 2007 (http://makeitfair.org/the-facts/reports, 12/2010)

Pöihönen, P., (2009) Legal and Illegal Blurred – Update on tin production for consumer electronics in Indonesia. Study for the MakeITFair initiative by Finn watch. (http://makeitfair.org/the-facts/reports/voices-from-the-inside/at_download/file, 12/2010)

Pöihönen, P., Bjurling, K.A., Cuvelier, J., (2010) Voices from the Inside. Local views on mining reform in Eastern DR Congo. Study for Make IT Fair by Finn watch and Swedwatch. (http://makeitfair.org/the-facts/reports/voices-from-the-inside/at_download/file, 12/2010)

Preuss, L., (2001) In dirty chains? Purchasing and greener manufacturing. Journal of Business Ethics, Vol. 34, No. 3/4, pp. 345-359.

Price, P., (2005/2006) Taking back the Trash. IEE Electronics Systems and Software, December/January, pp. 36-39.

Puckett, J., (2006) High-Tech’s Dirty Little Secret: The Economics and Ethics of the Electronic Waste Trade, In: Challenging the chip – labor rights and environmental justice in the global electronics industry: Philadelphia: Temple University Press, pp. 225-233.

Puckett J, Smith T., (2002) Exporting harm: the high-tech trashing of Asia The Basel Action Network. Seattle Silicon Valley Toxics Coalition.

RANDA-GROUP, (2000) Life Cycle Assessment of a Mobile Phone. Telefónica Servicios Móviles S.A., Barcelona

Reichling, M. Otto T., (2002) The environmental impact of the new economy. In: J. Park, N. Roome (eds.) The ecology of the new economy. Shefield, UK: Greenleaf.

Rejeski D., (2002) E-commerce, the internet, and the environment. Journal of Industrial Ecology, Vol. 6, No. 2, pp. 1-3.

Rickerby, D.G., Morrison, M., (2007) Nanotechnology and the environment: A European perspective. Science and Technology of Advanced Materials, Vol. 8, pp. 19–24.

Rigby, M., Smith, R. (1999) Union responses in electronics: a globalised environment. Industrial Relations Journal, Vol. 30, No. 1, pp. 2-15.

Roome N., Park J., (2000) Global sustainability and information economy: old challenges, new perspectives. Greener Management International, Vol. 32, pp. 24-32.

Romm, J., (2002) The Internet and the new energy economy. Resources, Conservation and Recycling, Vol. 36, No. 3, pp.197–210.

Rose, M., (2007) Why so fed up and footloose in IT? Spelling out the associations between occupation and overall job satisfaction shown by WERS 2004. Industrial Relations Journal, Vol. 38, No. 4, pp. 356–384.

SACOM, (2010) Workers as Machines: Military Management in Foxconn. Report for the “Make IT Fair” initiative. SACOM, Hong Kong, 12 October 2010. (http://makeitfair.org/the-facts/reports, 12/2010)

Eurostat (2010) Science, technology and innovation in Europe – 2010 edition (http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-EM-10-001/EN/KS-EM-10-001-EN.PDF) (11.09.2010)

Shaping Europe’s Future through ICT, (2006) Information Society Technologies Advisory Group, ISTAG, Directorate-General Information Society, Brussels.

Schipper, I., de Haan, E., (2005) CSR issues in the ICT hardware manufacturing sector. Centre for Research on Multinational Corporations, ICT Sector Report http://www.genderchangers.org/docs/ICT_Sector_Report.pdf (14.07.2010)

Scholarios, D., van der Heijden, B.I.J.M. ,van der Schoot, E.,Bozionelos, N., Epitropaki, O., Jedrzejowicz, P., Knauth, P. Marzec, I., Mikkelsen, A., van der Heijde, C.M., (2008) Employability and the Psychological Contract. The International Journal of Human Resource Management, Vol. 19, No. 6, pp. 1035–1055.

Seibert, A, (2007) Gender Aspects. Production of Next-generation electronics in Poland. Karat Coalition, Warszawa, December, 2007. Report for the “Make IT Fair” initiative (http://makeitfair.org/the-facts/reports, 12/2010).

Som, C., Hiltz, L.M., Ruddy, T.F. (2005) The precautionary principle in the information society. Human and Ecological Risk Assessment, Vol. 10, pp. 787-799.

SOMO, (>2007) Platinum under our feet. Dissenting Voices And Images Of Community Struggles Against Platinum Mining Companies In South Africa’s Limpopo Province. (No publication date), SOMO (Centre for Research on Multinational Corporations) (http://makeitfair.org/the-facts/reports, 12/2010)

SOMO, (2009) On the Move. The Electronics Industry in Central and Eastern Europe. Report for the “Make IT Fair” initiative. 12 October, 2010. SOMO (Centre for Research on Multinational Corporations), Amsterdam, November 2009 (http://makeitfair.org/the-facts/reports, 12/2010)

SOMO, (2010) Changing Industrial Relations in India’s Mobile Phone Manufacturing Industry. Report for the makeITfair initiative, SOMO (Centre for Research on Multinational Corporations), Amsterdam, September 2010 (http://makeitfair.org/the-facts/reports, 12/2010)

Steiert, R., Unionizing Electronics – The Need for New Strategies, in: Smith, T., Sonnenfeld, D.A., Pellow, D.N., Challenging the Chip – Labor Rights and Environmental Justice in the global Electronics Industry: PHILADELPHIA, (2006), Temple University Press, pp.191-199

Steinweg, T., de Haan, E., (2007) Capacitating electronics. The corrosive effects of platinum and palladium mining on labor rights and communities. Report by SOMO (Centre for Research on Multinational Corporations) for the makeITfair initiative, November 2007 (http://makeitfair.org/the-facts/reports, 12/2010)

Streicher-Portea, M., Widmerb, R., Jainc, A., Baderd, H.P., Scheideggere, R., Kytziaf, S., (2005) Key drivers of the e-waste recycling system: Assessing and modelling e-waste processing in the informal sector in Delhi. Environmental Impact Assessment Review, Vol. 25, No. 5, pp. 472-491.

SVTC. Just say no to e-waste: background document on hazards and waste from computers; 2003 [online]. Available at: b URL: http://www.svtc.org/cleancc/pubs/sayno.htm (Downloaded: 31.12.2010).

Tafazolli R. (2011) Europe’s Research and Innovation Strategy. Networks of Future. Net!Works Technology Platform. University of Surrey (UK).

Toffel M.W., Horvath A., (2004) Environmental implications of wireless technologies: news delivery and business meetings. Environmental Science and Technology, Vol. 38, No. 11, pp. 2961-2970.

Tukker, A., Eder, P., Charter, M., Haag, E., Vercalsteren, A., Wiedmann, T., (2001) Eco-design: The State of Implementation in Europe Conclusions of a State of the Art Study for IPTS. The Journal of Sustainable Product Design, Vol. 1, No. 3, pp. 147-161.

van Huijstee, M., de Haan, E., (2009) Fair phones in the Netherlands: it’s your call. How Dutch and European mobile network operators can improve responsibility for their supply chain. Report, Centre for Research on Multinational Corporations (http://goodelectronics.org/publications-en/Publication_3217/?searchterm=europe) (29.09.2010)

van het Kaar, R., Grünell, M., Arbeitsbeziehungen im Sektor der Informations- und Kommunikationstechnologie (http://www.eurofound.europa.eu/eiro/2001/08/study/tn0108100s.htm) (20.09.2010)

Webster, J., Diversity Management in the ICT Industry – Challenges and Issues for Social Dialogue (http://www.mature-project.eu/materials/DiversityManagement_en.pdf) (downloaded 13.09.2010)

Watterson, A. (2006) Out of the Shadows and into the Gloom? Worker and Community Health in and around Central and Eastern Europe's Semiconductor Plants, in: Smith, T., Sonnenfeld, D.A., Pellow, D.N., Challenging the Chip – Labor Rights and Environmental Justice in the global Electronics Industry: PHILADELPHIA: Temple University Press, pp.96-106

Widmer R., Oswald-Knapf H., Sihna-Khetriwal D., Schnellmann M., Boni H., (2005) Global perspective on e-waste. Environmental Impact Assessment Review, Vol. 25, No. 5, pp. 436-458.

Williams E., Tagani T., (2002) Energy use in sales and distribution via e-commerce and conventional retail: a case study of the Japanese book sector. Journal of Industrial Ecology, Vol. 6, No. 2, pp. 99-114.

Wintjes R., Dunnewijk T., (2008) Sectoral innovation systems in Europe: the case of the ICT sector. Europe Innova.

Yi L., Thomas H. R., (2007) Review of research on the environmental impact of e-business and ICT, Environment International, Vol. 33, pp. 841–849.

Yu J., Williams E., Ju M., (2010) Analysis of material and energy consumption of mobile phones in China, Energy Policy, Vol. 38, pp. 4135–4141.

9. Annex

The following table shows the ICT sub-sectors according to NACE 1.1 version

Sector	NACE 1.1	Sub-sector
ICT Services	I64	Post and telecommunications
	I64.1	Post and courier activities
	I64.11	National post activities
	I64.12	Courier activities other than national post activities
	I64.2	Telecommunications
	I64.20	Telecommunications
	I72	Computer and related activities
	I72.1	Hardware consultancy
	I72.10	Hardware consultancy
	I72.2	Software consultancy and supply
	I72.21	Publishing of software
	I72.22	Other software consultancy and supply
	I72.3	Data processing
	I72.30	Data processing
	I72.4	Database activities
	I72.40	Database activities
	I72.5	Maintenance and repair office, accounting and computing machinery
	I72.50	Maintenance and repair office, accounting and computing machinery
	I72.6	Other computer related activities
	I72.60	Other computer related activities
ICT Manufacturing	DL30	Manufacture of office machinery and computers
	DL30.0	Manufacture of office machinery and computers
	DL30.1	Manufacture of office machinery
	DL30.02	Manufacture of computers and other information processing equipment
	DL31	Manufacture of electrical machinery and apparatus n.e.c.
	DL31.1	Manufacture of electric motors, generators, and transformers
	DL31.10	Manufacture of electric motors, generators, and transformers
	DL.31.2	Manufacture of electricity distribution and control apparatus

	DL31.20	Manufacture of electricity distribution and control apparatus
	DL.31.3	Manufacture of insulated wire and cable
	DL31.30	Manufacture of insulated wire and cable
	DL31.4	Manufacture of accumulators, primary cells, and primary batteries
	DL31.40	Manufacture of accumulators, primary cells, and primary batteries
	DL31.5	Manufacture of lightning equipment and electric lamps
	DL31.50	Manufacture of lightning equipment and electric lamps
	DL31.6	Manufacture of electrical equipment n.e.c.
	DL31.61	Manufacture of electrical equipment for engines and vehicles n.e.c.
	DL31.62	Manufacture of other electrical equipment n.e.c.
	DL32	Manufacture of radio, television, and communication equipment and apparatus
	DL32.1	Manufacture of electronic valves and tubes and other electronic components
	DL.32.10	Manufacture of electronic valves and tubes and other electronic components
	DL32.2	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy
	DL32.20	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy
	DL32.3	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus, and associated goods
	DL32.30	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus, and associated goods
	DL33	Manufacture of medical, precision, and optical instruments, watches and clocks
	DL33.1	Manufacture of medical and surgical equipment and orthopaedic appliances
	DL33.10	Manufacture of medical and surgical equipment and orthopaedic appliances
	DL33.2	Manufacture of instruments and appliances for measuring, checking, testing, navigating, and other purposes, except industrial process control equipment
	DL33.20	Manufacture of instruments and appliances for measuring, checking, testing, navigating, and other purposes, except industrial process control equipment
	DL33.3	Manufacture of industrial process control equipment

	DL33.30	Manufacture of industrial process control equipment
	DL33.4	Manufacture of optical instruments and photographic equipment
	Dl33.40	Manufacture of optical instruments and photographic equipment
	DL33.5	Manufacture of watches and clocks
	DL33.50	Manufacture of watches and clocks

The following table shows the ICT sub-sectors according to NACE 2.0 version

Sector	NACE 2.0	Sub-sector
ICT Services	J61	Telecommunications
	J61.1	Wired telecommunications activities
	J61.1.0	Wired telecommunications activities
	J61.2	Wireless telecommunications activities
	J61.2.0	Wireless telecommunications activities
	J61.3	Satellite telecommunications activities
	J61.3.0	Satellite telecommunications activities
	J61.9	Other telecommunications activities
	J61.9.0	Other telecommunications activities
	J62	Computer programming, consultancy, and related activities
	J62.0	Computer programming, consultancy, and related activities
	J62.0.1	Computer programming activities
	J62.0.2	Computer consultancy activities
	J62.0.3	Computer facilities management activities
	J62.0.9	Other information technology and computer service activities
	J63	Information service activities
	J63.1	Data processing, hosting, and related activities; web portals
	J63.1.1	Data processing, hosting, and related activities
	J63.1.2	Web portals
	J63.9	Other information activities
	J63.9.1	News agency activities
	J63.9.9	Other information service activities n.e.c.
ICT Manufacturing	C26	Manufacture of computers, electronic, and optical products
	C26.1	Manufacture of electronic components and boards
	C26.1.1	Manufacture of electronic components
	C26.1.2	Manufacture of loaded electronic boards

	C26.2	Manufacture of computers and peripheral equipment
	C26.2.0	Manufacture of computers and peripheral equipment
	C26.3	Manufacture of communication equipment
	C26.3.0	Manufacture of communication equipment
	C26.4	Manufacture of consumer electronics
	C26.4.0	Manufacture of consumer electronics
	C26.5	Manufacture of instruments and appliances for measuring, testing and navigation; watches and clocks
	C26.5.1	Manufacture of instruments and appliances for measuring, testing and navigation
	C26.5.2	Manufacture of watches and clocks
	C26.6	Manufacture of irradiation, electromedical and electrotherapeutic equipment
	C26.6.0	Manufacture of irradiation, electromedical and electrotherapeutic equipment
	C26.7	Manufacture of optical instruments and photographic equipment
	C26.7.0	Manufacture of optical instruments and photographic equipment
	C26.8	Manufacture of magnetic and optical media
	C26.8	Manufacture of magnetic and optical media
	C27	Manufacture of electrical equipment
	C27.1	Manufacture of electric motors generators, transformers and electricity distribution and control apparatus
	C27.1.1	Manufacture of electric motors generators, transformers
	C27.1.2	Manufacture of distribution and control apparatus
	C27.2	Manufacture of batteries and accumulators
	C27.2.0	Manufacture of batteries and accumulators
	C27.3	Manufacture of wiring and wiring devices
	C27.3.1	Manufacture of fibre optic cables
	C27.3.2	Manufacture of other electronic and electric wires and cables
	C27.3.3	Manufacture of wiring devices
	C27.4	Manufacture of electric lighting equipment
	C27.4.0	Manufacture of electric lighting equipment
	C27.5	Manufacture of domestic appliances
	C27.5.1	Manufacture of electric domestic appliances
	C27.5.2	Manufacture of non-electrical domestic appliances
	C27.9	Manufacture of other electrical equipment
	C27.9.0	Manufacture of other electrical equipment

The EU biggest ICT companies in 2009

	Company Name	Country	NACE 2.0 Code
1.	SIEMENS AKTIENGESELLSCHAFT BERLIN UND MÜNCHEN	DE	2611
2.	DEUTSCHE TELEKOM AG	DE	6190
3.	TELEFONICA SA	ES	6120
4.	VODAFONE GROUP PUBLIC LIMITED COMPANY	GB	6190
5.	FRANCE TELECOM	FR	6110
6.	NOKIA OYJ	FI	2630
7.	TELECOM ITALIA SPA	IT	6100
8.	INTEL IRELAND LIMITED	IE	2620
9.	BT GROUP PLC	GB	6190
10.	BRITISH TELECOMMUNICATIONS PUBLIC LIMITED COMPANY	GB	6190
11.	KONINKLIJKE PHILIPS ELECTRONICS N.V.	NL	2700
12.	CISCO SYSTEMS INTERNATIONAL B.V.	NL	6202
13.	STE FRANCAISE DE RADIOTELEPHONE	FR	6120
14.	TELIASONERA AB	SE	6110
15.	TELEFONICA DE ESPANA SA	ES	6110
16.	DELL PRODUCTS	IE	2620
17.	MICROSOFT IRELAND OPERATIONS LIMITED	IE	2620
18.	SAP AG	DE	6201
19.	AB ELECTROLUX	SE	2751
20.	ORANGE FRANCE	FR	6120
21.	ERICSSON AB	SE	2630
22.	VODAFONE OMNITEL N.V.	IT	6100
23.	ICA AB	SE	6203
24.	TELEFONICA MOVILES ESPANA SAU	ES	6120
25.	BSH BOSCH UND SIEMENS HAUSGERÄTE GMBH	DE	2751
26.	GENERAL ELECTRIC INTERNATIONAL INC.	IE	2740
27.	GOOGLE IRELAND LIMITED	IE	6190
28.	VODAFONE D2 GMBH	DE	6120
29.	MMO2 PLC	GB	6190
30.	NOKIA SIEMENS NETWORKS OY	FI	2620

Source: Amadeus Database

Sectoral Institutions and Initiatives

- i2010 High Level Group (http://ec.europa.eu/information_society/eeurope/i2010/high_level_group/index_en.htm),
- Information Society Technology Advisory Group (http://cordis.europa.eu/fp7/ict/istag/home_en.html),
- European Technology Platforms,
- European Internet Foundation (www.eifonline.org),
- Digital Europe (www.digitaleurope.org),
- European Competitive Telecommunication Association (www.ectaportal.com),
- European Electronic Components Manufacturers Association (EECA) (eeca.uniweb.be),
- European Semiconductor Industry Association (ESIA) (http://eeca.uniweb.be/index.php/esia_home/en/),
- Electronic Industry Citizenship Coalition (www.eicc.info),
- European Association of Electrical and Electronic Waste Take Back System (www.weee-forum.org/),
- Electronics Industry Code of Conduct (www.eicc.info/EICC%20CODE.htm),
- The European Recycling Platform (www.erp-recycling.at/home).

Major European legal frameworks relevant to the sector

EU legislation affecting environmental issues

- Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS),
- Directive 2005/32/EC on the eco-design of Energy-using Products (EuP),
- Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH),
- Directive 2006/121/EC amending Council Directive 67/548/EEC on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labeling of dangerous substances,
- Directive 2002/96/ on collection, recovery, re-use and recycling targets on waste from electrical and electronic equipment (WEEE),
- Directive 2008/1/EC of the European Parliament and of the Council concerning integrated pollution prevention and control (IPCC),
- Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community,

EU legislation affecting quality of work

- Directive 91/533/EEC on an employer's obligation to inform employees of the conditions applicable to the contract or employment relationship,
- Council Directive 1999/70/EC of 28 June 1999 concerning the framework agreement on fixed-term,
- Council Directive 97/81/EC of 15 December 1997 concerning the Framework Agreement on part-time work,

- Directive 2008/104/EC of the European Parliament and of the Council of 19 November 2008 on temporary agency work,
- Directives aimed at improving health and safety at work: 89/391 (Framework), 89/654 (Workplaces), 89/655 (Work Equipment), 89/656 (Personal Protective Equipment), 90/269 (Manual Handling of Loads) and 90/270 (Display Screen Equipment), Directive 91/383/EEC,
- Council Directive 94/33/EC of 22 June 1994 on the protection of young people at work,
- Directive 2003/88/EC of the European Parliament and of the Council of 4 November 2003 concerning certain aspects of the organisation of working time,
- Directive 96/71/EC of the European Parliament and of the Council of 16 December 1996 concerning the posting of workers in the framework of the provision of services,
- Directive 2008/94/EC of the European Parliament and of the Council of 22 October 2008 on the protection of employees in the event of the insolvency of their employer,
- Council Directive 2001/23/EC of 12 March 2001 on the approximation of the laws of the Member States relating to the safeguarding of employees' rights in the event of transfers of undertakings, businesses or parts of undertakings or businesses,
- The Framework on Information and Consultation (Directive 2002/14/EC) grants basic principles, definitions and arrangements for information of employees at the enterprise level,
- Council Directive 98/59/EC of 20 July 1998 on the approximation of the laws of the Member States relating to collective redundancies.

Databases relevant in the sector

5 major European databases exist on job satisfaction, which meet the restrictive criteria: European in scope, periodically updated and statistically representative. They are not sector specific.

- European Labour Force Survey (ELFS),
- European Working Conditions Survey (EWCS),
- European Survey on Income and Living Conditions (EU-SILC),
- European Structure of Earnings Survey (ESES),
- International Social Survey Programme (ISSP).
- World Telecommunication/ICT Indicators Database, (www.itu.int/ITU-D/ict/publications/world/world.html),
- The European Market Intelligence Group database, (www.emi-group.com/emig/emig.php)