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I.C.T. and Environment :

Bad Assumptions and Recent Hypotheses

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Abstract

The aim of this communication is to present new focuses for research in the field of Environment and Information Communication Technology. In the first part, we will present, through a review of the literature, the rather negative role played by ICT on the environment: paper, transportation, consumption, waste... The aim of the second part is to discuss the rather positive role played by ICT with regard to knowledge of the environment: simulation, traceability, information... Research on the concept of responsibility are then liable to be developed, and this will be the subject of the third part.

Keywords: Information Technology, Ecology, Environment, Sustainable development

1 INTRODUCTION

“Don’t throw your old PC in the trash: it contains 4 grams of gold!”. Such is the grip of an article on e-waste in “The Hindu”¹. But if it contains 4 grams of gold, it also contains toxic heavy materials such as mercury, lead, cadmium. India is one of the countries where the obsolete computers piling sent by rich countries. The e-waste are stored, dismantled and / or incinerated in the wild. Mostly it is women and children who lead these operations in the slums. The analysis of a sample of soil in and around New Delhi where e-waste incinerated has revealed that it contained enough mercury and lead poisoning in the soil for 500 years. When we discredited our “obsolete” PC after two years of use, do we know how the computer will continue its life cycle? Asking the question is already an awareness. But this awareness does have a real impact on the environment if it is not followed by a responsible attitude, to examine its mode of operation, mode of consumption, its relationship to the object computer ? The organization of a system for recycling e-waste can lead to "good conscience". But doing so, the user confirms there not a dysfunctional system? A good conscience is it not a way to put the balm where it hurts, without really questioning the nature of evil?

Most scientists and economists have started to realise what was for many years solely denounced by “ecologists”. Everybody knows that what we do in the next twenty years could have a vital impact on the climate of the second half of this century (IPCC, Intergovernmental Panel on Climate Change (<http://www.ipcc.ch>)). But with the report written by Nicholas Stern, former Vice-President of the World Bank (<http://www.hm-treasury.gov.uk>), it is now not only scientists who are raising the alarm, but also economists and financiers. If there is no

¹ « Meet on handling e-waste opens in city », The Hindu, 17/08/2004.

² Source IPCC: to limit global warming, it would be necessary to reduce emissions to less than 3 “carbon equivalent” gigatonnes per year, representing a “right to emit” of 500kg in carbon equivalent per year/per world citizen. At present, each inhabitant of the USA emits 11 times more, a German 6 times more, each British citizen 5 times more, a French citizen 4 times more and a Chinese citizen 1.5 times more.

immediate and possible reaction (that is, taxes on carbon and reduced taxes for non polluting activities, stopping deforestation, scientific and economic cooperation agreements, etc.), the cost of climate change over ten years would be, at the global level, 5.5 billion euros, and more than 200 million people will be obliged to leave their homes to find refuge.

And it is essential that we retain a multiple analysis of a situation which is ecological, economic and social³: 40% of the planet lacks drinking water, 2/3 of all waste is simply thrown into rubbish dumps, 2/3 of the world's population lives on less than 2 dollars a day...This reminder of the data justifies our decision to ask questions in every field with regard to the ecological impact of our various lifestyles. Information and Communication Technologies (ICT)⁴, however, have long remained on the periphery of this issue, well hidden behind slogans such as immaterial products, silicon industry, zero paper, teleworking, electronic trade, etc.

The aim of the first part of this communication, through a review of the literature, is to analyse the negative role ICT have on the environment. The time for ignorance seems to have past, and it is now necessary to examine in detail to what extent ICT, and the use that is made of them, play a part in the destruction or protection of the environment.

The aim of the second part: is to analyse the positive role played by ICT on knowledge of the environment. A series of questions on the potential for ICT must be envisaged, that of protecting the environment through greater knowledge of the environment. This includes using increasingly advanced software to simulate or control the environment, the role that the Internet can play in creating networks for citizens and monitoring the sites at risk, using ICT for the traceability of dangerous products, etc.

If ICT have not played a part in building a world that is more respectful of the environment, is this directly linked to the behaviour of those who use ICT? Responsibility and legitimation, these questions remain, at present, too absent from the concerns of teacher-researchers in the field of Information Systems (IS), though they are at the very heart of the third part of this communication: What is the ecological responsibility of businesses and of individuals? What legitimacy do sovereign states and non governmental organisations have for managing the links between ICT and ecology?

2 FIVE BAD ASSUMPTIONS ON THE ROLE OF I.C.T.

What DeSanctis and Poole (1994) call the "Spirit of the technology" was the source of much hope: ICT were going to replace paper and create a society where "zero paper" would be the general rule. ICT would replace people transportation (as well as the transportation of goods thanks to electronic trade) and this in turn would help reduce the pollution associated with travel as well as reduce the consumption of the planet's natural resources. Were these hopes justified?

2.1 The bad assumption of "zero paper"

Between 1988 and 1998, consumption of paper increased by 24% in industrialised countries (Cohen, 2001). During this same period, however, the capacity for electronic information storage developed considerably. In Great Britain, Huws (1999) showed that paper consumption more than doubled between 1984 and 1995, whilst Canada, the world's number one exporter of

³ Governmental and non governmental sources: PNUE 2003, Global Environment Facility 2002, WWF, Worldwatch Institute, an article by Lee 2002

⁴ Here, we consider ICT in both their aspects: Information and Communication (we could also say the digitisation aspect and the network aspect, or the computer aspect and the internet aspect).

paper, has more than doubled its sales in the last 15 years. According to Erkman (1998), in the United States annual paper consumption rose from 7 to 22 million tonnes between 1956 and 1986.

If there is indeed a replacement effect, for example when documents are sent electronically rather than by traditional postal services, how can this increase in paper consumption be explained? Because the effects are marginal in relation to the increased possibilities for printing offered by using ICT (Moktarian, 2003). A study conducted by Ipsos Global⁵ thus estimates that 43% of French people print up to 50 pages a day thanks to easy access to information, 20% admit to printing out all the documents they receive, and 38% admit to printing out all the electronic mail they receive so as to be able to read it on paper. In the private sector, the prize for paper wasting is given to the supermarket sector, with 40% of pages printed out unnecessarily.

2.2 The bad assumption of substitution for travel

More recently, the number of telephone calls has continued to climb, but the number of kilometres travelled by plane has increased at roughly the same rate, and the number of kilometres travelled by car has increased twice as quickly (Pierce, 1977). On certain occasions, a telephone call can replace a trip, but more communication, and quicker communication, have resulted in more activities and more interactions, in turn resulting in a greater number of journeys.

Although certain studies that take an interest in the impact of telecommunications on travel have indeed been able to show that telecommunications have a “replacement effect” on travel, Moktarian (2003) shows that these studies, as they are limited in their methodological approach (short term and focusing on a single application), have missed the more subtle, long term and indirect effects that can be found in studies of the holistic type. According to the author, there is no empirical proof that shows that telecommunications have replaced travel (Hu and Young 1999, Zumkeller 1996). According to Yim (2000), one of the most common uses for mobile phones is planning and scheduling meetings.

Kitou and Horvath (2006) calculated that teleworking could reduce by 90% the emissions of CO₂ associated with travel, but this would be accompanied by a parallel increase in domestic energy consumption, thus significantly reducing the positive effects of teleworking. According to Harvey and Taylor (2000), individuals need social contacts and, if they do not have a workplace for such contacts, they will therefore seek them elsewhere, requiring travel. Direct communication, the main reason given for travel, is only one reason, and is not necessarily the most important when it comes to deciding to travel (Day, 1973). There are “meta motivations” for travelling, including trips to visit family or friends, interesting sites, as well as the desire to escape from the home or work environment (Button and Maggi, 1994; Moktharian, 1988, 2003).

2.2 The bad assumption of e-Commerce effect on transport

A certain number of scientific studies, particularly in the field of Industrial Ecology, have been published on the question of electronic trade. Matthews *et al.* (2001) focused on the sale of books in the United States and compared the traditional system with electronic trade. One of the main results of their analysis was that there is indeed a certain amount of energy saving by suppressing the need to travel to the book shop, but that these savings are very much compensated for by the transportation of the books by aeroplane. It is thus the transportation of merchandise that makes the energy bill higher.

Williams and Tagami (2001) focused on the same sector, and compared the case of the USA with that of Japan. In the United States, they found that 73 megajoule (MJ) per book were

⁵ Study conducted by Ipsos Global on behalf of Lexmark (printer manufacturer) on 1000 European SME-SMI and large companies in April 2005 (see <http://www.lexmark.fr>).

consumed by electronic trade whereas only 53 megajoule were consumed per book for traditional trade. In Japan, electronic trade still consumed more energy than traditional trade for buying books, but particularly in the highly urbanised areas such as the centre of Tokyo: no savings in terms of individual transport (used very little in cities in any case), but on the contrary a significant loss of energy because of the packaging (much more costly for electronic trade than traditional trade).

2.3 The bad assumption of low power and low carbon footprint

According to the figures found in the literature on Industrial Ecology, it would appear that electricity consumption for ICT is not as high as originally feared. Laitner (2003) demonstrated that ICT represent only 3% of total electricity consumption in the USA. Koomey (2000) produced the same figure of 3% for the USA and established that it is 1% for Germany, although consumption in Germany could attain 2 to 6% by 2010 depending on the energy saving measures adopted between now and then (Langrock *et al.*, 2001). At a more local level, Gard and Keolian (2003), who studied in detail the energy consumption of an on line university library, showed that the infrastructures of the networks ultimately had little impact on the system's total energy consumption. According to their analyses, only less than 0.2% of an on line library's total energy consumption pertains to the electricity needed to operate the various machines (gateways, servers, stations, etc.).

However, in 2007, the Institut National de la Consommation (French national consumer institute, INC) became concerned about the electricity consumption of the "multiservice boxes" provided by broadband operators as these boxes are never turned off and consume between 143 and 263 kW/h per year, depending on the model. According to the INC, all such boxes taken together consume a total of 1.51 billion kW/h per year (the equivalent of two and half months' production for a nuclear reactor). Rakesh Kumar, Vice-President of the Gartner Group (2006) estimated that the electricity consumption needed to supply and cool the data centres in the world represented almost a quarter of all the CO₂ emissions generated by the IT industry.

There are still a decade, we could relativize that took place ICT in power consumption, the figures today show that consumption has already reached significant proportions and that it continues to grow. The latest figures show that consumption of ICT now accounts for 13.5% of French electricity in 2008, this consumption is growing at a steady pace, about 10% per annum over the last ten years⁶, and the figures for 2012 will be 20%. In terms of carbon footprint, this report said, with a margin of error of + / - 30%, that ICTs contribute overall to 5% of CO₂ production in France despite a large use of nuclear power (and excluding the print production of electronic equipment, they are mostly imported).

2.4 The bad assumption on e-waste : no "intangible" products

In the life cycle of ICT, several stages result in pollution. The first is the production stage, followed by the usage stage and finally that of the end of life stage.

If we look at the production phase, we can see that this activity is highly polluting, given that only 2% of the raw materials used in the production of ICT can be found in the finished product, with the remaining 98% transformed into waste (Hitly and Ruddy 2000). A computer contains 1,000 different materials from all over the world, including lead, cadmium, barium, beryllium... If the life expectancy of a computer in 1997 was 6 ans, it was only two years in 2005, and it is calculated that there will be 1.3 billion computers in the world by 2013 (Flipo *et al.*, 2007). According to a recent study by the Gartner Group (2006), ICT are responsible for 2% of all world emissions of carbonic gas into the atmosphere, which corresponds to the level of emissions of one of the sectors considered to pollute the most: air transport. Finally, there is the end of life phase, in which the reuse or recycling of ICT is extremely rare (Fichter 2003). It has been observed that 90% of the waste obtained from electrical or electronic equipment is either

⁶ Breuil H, Burette D., Flüry-Hérard B, Cueugnet J, Vignolles D. (2008)

incinerated or covered without any form of pre-treatment (Fichter, 2003). Many of the pollutants found in municipal dumps come from electrical or electronic equipment (CEC, 2000), and from this electrical or electronic waste, 12% comes from ICT. According to Consumer Reports, only 10% of the computers thrown away are recycled “in a responsible manner”. Roughly 80% of the electronic objects thrown away are currently sent to developing countries such as China, India and Kenya, where people (including young children) dismantle them, often with their bare hands, to extract the components and metals inside.

Environmental groups such as the Silicon Valley Toxics Coalition, Friends of the Earth, the Basel Action Network, Greenpeace, etc, have made headlines recently, reprimanding the manufacturers of electronic equipment in general, and Apple in particular (arsenic and mercury used to manufacture Macintosh computer screens, chlorinated plastic and brominated flame retardants used in the iPhone mobile telephone...). The negative impact of such documents on consumers is now taken seriously. They draw attention to the growing mountain of computers, mobile telephones and other toxic electronic waste found in waste storage areas. They encourage companies to explore the “*Green IT*” market⁷, and they encourage governments to support scientific projects⁸ and adopt “green” regulations. In France, these regulations come in two levels. The first, which is part of the ROHS (Restriction Of the use of certain Hazardous Substances) directive, is aimed at IT professionals. Its aim, since 01 July 2006, is to limit the presence of hazardous substances in electrical and electronic equipment. The second aspect of the regulations is that since 13 August 2005, businesses and private users are forbidden from abandoning WEEE (Waste Electrical and Electronic Equipment) at municipal dumps. Within this context, the law imposes strict rules on how to depollute any equipment that must be destroyed. For the products marketed after this date, suppliers are obliged to propose a recycling service. In addition, there must be institutional communication regarding these elements (an obligation for companies on the stock exchange, dictated by the French law on New Economic Regulations).

Conclusion of this initial analysis: there are no data that make it possible to show that ICT play a part in creating a world that is more respectful of the environment. In reality, the hopes associated with “zero paper”, “zero travel”, “zero waste”, etc. turned out to be unfounded.

3 THREE RECENT HYPOTHESES ON THE ROLE OF I.C.T.

Although ICT have not contributed to creating a world that is more respectful of the environment, we might at least be able to think that they have had a positive impact on knowledge, and thus on knowledge of the environment. Can ICT help predict and manage environmental risks? To answer this question, we must look at three different issues: the role of information technologies to preserve the environment, the role of technological innovation to improve energy efficiency, and the role of communication technologies to mobilize citizens

3.1 The hypothesis on the computer as a means of preserving the environment

In decision-making procedures, computerised simulation tools can play a key role in preventing the serious consequences of trial and error and make learning of the “*learning by simulating*”

⁷ Hewlett-Packard has thus reacted to competition from printer ink cartridges proposed at half price and made with recyclable consumables: HP has in turn launched a recycling programme for its cartridges, and this has contributed to improving its profit margins. Industrialists have already understood the *Green business* market <http://www.greenbiz.com/> and green marketing is starting to appear...

⁸ <http://www.defra.gov.uk/environment/business/scp/research/index.htm>
<http://www.it-environment.org/index.html>

type possible. For example, since 2006, the supercalculator TERA-10 (50,000 billion operations per second), the radiographic machine Airix and the Megajoule laser thus make it possible to simulate nuclear tests under laboratory conditions, with the aim of continuing France's nuclear rearmament programme (despite the Comprehensive Nuclear-Test-Ban Treaty, CNTBT and the Non-Proliferation Treaty, NPT). But is this calculation power a positive aspect (or at least an ambiguous aspect) of the information technologies used to predict and manage environmental risks? The report produced by the ICCP demonstrates very clearly that technological innovation cannot, on its own, provide a solution on the horizon of 2100 (<http://www.ipcc.ch/>). Nevertheless, several types of simulation tool do have a certain positive aspect in terms of managing the environment and natural resources:

- certain barometers provide users with the possibility of measuring their own contribution to the greenhouse effect, the use of a common resource, water pollution, etc. The software Phyt'Amibe, developed at the C3ED, is based for example on the environmental indicators from INRA and is used to compare the practices of farmers with their use of phytosanitary products <http://www.c3ed.uvsq.fr/>;

- "Scenario generators" make it possible, on the basis of linear or dynamic programming models, to explore a certain number of alternative options (technological, regulatory, climatic,...) and to visualise the effects of these options through curves, graphs or maps. The work of the ICCP on carbon/climate interactions is a well mediated example of scenario generation <http://www.ipcc.ch/>;

- "Multi-agent systems" make models of reciprocal interactions in the behaviour of key players and natural resources. An agent is a computer programme that perceives and acts in an autonomous manner, in relation to its "experience". In multi-agent systems, the agents share common resources and communicate with each other. At the CIRAD, for example, Cormas simulates the effects of a modification to the environment, a decision-making rule, the behaviour of the agents, etc. and couples this social and environmental model with a learning process for users confronted with using or regulating natural resources <http://cormas.cirad.fr/>;

- "Virtual reality" systems put users in the place of someone using a resource (or even in the place of the resource itself) and guide them in their explorations: for example, the European Alarm project on biodiversity (<http://keralarm.c3ed.uvsq.fr/>), or the European project Virtualis on learning about ecosystems and natural resources (<http://www.virtualis-eu.com/>);

- "Geographical Information Systems" (GIS) make it possible to represent and process data and meta-data referenced in a given geographical area. GIS make it possible to study and control the environment, anticipate evolution (climatology, geology, town planning, employment, transport, epidemiology, desertification,...) and, ultimately, raise the alarm in case of problems. Technological progress in the field of sensors will be used increasingly to control air and water quality, as well as climate changes, the ozone layer, the marine environment and so on, plus all the ecosystems. In the Gulf of Gabès in Tunisia, SPOT and LANDSAT images have, for example, revealed the disappearance of plant cover in one of the country's richest halieutic milieux.

Finally, we are now entering the era of the Internet of objects. As bar codes are being replaced by intelligent radiofrequency labels, all goods and merchandise will progressively be connected to the Internet via the ONS, the *Object Naming Service*, which is a new technology derived from DNS (Domain Name System) domains and which today manages only the addresses of individual computers. Geographical tracking (that is, localising a product, a dossier or a person) and historic tracing (reconstituting a history, an origin, an activity, a control...) will then be envisageable permanently on the Internet. This traceability will make it possible to control the use of chemical products, the dismantling of nuclear power stations, food safety, pharmaceutical safety and more. To sort and manage e-waste, it will be possible to know immediately, by reading the electronic labels, exactly where to store these products or recycle them.

3.2 The hypothesis on technological innovation to improve energy efficiency

Will we be saved by ICT? The "Smart 2020" study, often cited, argues that ICT pollute, of course, but they are also the best way for all other sectors to reduce their CO₂ emissions. The OECD argues that innovation and technology (ICT, Internet ..) play a crucial role in a "new" growth (OECD 2000). On its Web site the french professional organisation Syntec has not published its "white paper" but now its "green paper".

The first possible hypothesis is the optimization of the existing. The replacement of traditional technologies by ICT allows reductions in the amount of physical resources consumed (Faucheux et al, 2001) by replacing electronic components with mechanical components, products become lighter, smaller and less polluting (music, photography digital fluorescent light bulbs, boiler control microprocessor ...). The bulk of CO₂ emissions caused by humans is attributable to electricity generation and transport: ICT has the potential to increase the efficiency of the transmission infrastructure and electricity distribution in buildings, factories and distribution networks of goods. With the technology of attachment or burying CO₂, artificial photosynthesis, the introduction of agricultural plant species resistant to drought and salt ... ICT is increasingly applied in improving energy efficiency traditional.

The second hypothesis is the possible change in use. With efficient systems of organization, ICT has a role to play in "just in time", "Just for you" and "just enough" (online banks, reduced storage, rental of telephones or textiles professionals, intermodal transport, additional terminal board ...).

In the IPCC report, ICCP clearly demonstrates that technological innovation can not be alone, a response to the 2100 (<http://www.ipcc.ch/>). The Kaya equation plays a central role in the work of the IPCC, as it allows the problem well :

The total emissions of CO₂ can be expressed as the product of four factors: the intensity of CO₂, the emissions per unit of energy, the energy intensity per unit of GNP, the GNP per capita, and the population P :

$$\text{Total CO}_2 = \text{CO}_2/\text{TOE} * \text{TOE} / \text{GNP} * \text{GNP} / \text{P} * \text{P}$$

Knowing that we can not filter the air to remove the gases already emitted, it will halve production of CO₂, just to stop enriching the atmosphere with carbon dioxide, both before 2050 to avoid a warming exceeds 3 °. Considering that it is difficult to divide the **population P** by 2 (a falling meteor? nuclear war? massive epidemic? ... or more likely 9 billion in 2050), we deduce the constraints on the other "free" variables, so therefore should be divided by 3: global energy consumption, energy production techniques and GDP.

Divide the output per capita (**GNP / P**) by 3? Hard to believe, while economists already screaming when growth approaches 0%, and that China and India equip themselves in automobiles. Even with growth "selective" limited to 2% annual GDP per capita, the rest of the other two factors on the right side of the equation (which corresponds to the CO₂ content of the economy) must now be divided by 9.

The ICT can divide by 9 the CO₂ content of the economy? The term **TOE/ GNP** (Tonne of Oil Equivalent / Gross National Product) represents everything that ICT can do to provide clean cars, houses more efficient .. is energy efficiency (although such progress in 15 years on the motor car have been completely nullified by the fact that people bought cars more comfortable, air conditioned and more powerful!). When the term **CO₂/TOE** it represents everything that ICT can do to reduce the "carbon intensity" of energy, but it would then lose 75% of carbon by 2050, increasing by 7 supply from renewables (wood, hydro, wind, solar) or from nuclear (or 6 to 10 times the current fleet of 450 reactors...!).

We understand that technological innovation can not be alone, the answer. The report "ICT and Sustainable Development"⁹ acknowledges if, overall, ICTs have a positive contribution to

⁹ Breuil H, Burette D., Flüry-Hérard B, Cueugnet J, Vignolles D. (2008)

reducing emissions of greenhouse gases (CO2 equivalents), it is extremely difficult to accurately quantify this contribution. ICT could help to save 1 to 4 times their own emissions, and transport sectors and reduce the building "probably" their emissions through ICT.

The proof is clear: ICTs will not save the world alone, they must be accompanied by profound changes in lifestyle and it will act on all factors. The decrease in GNP will be very difficult to avoid, not by ideology but because the world is finite. Even if we reject, we can avoid it? It would then probably forget the urgency of GNP for hope. : Today we hear about many of Human Development Index, HDI calculated by the UN since 1990, the GNH or Gross National Happiness index, proposed by the exotic Bhutan since 1972 ...

3.3. The hypothesis on the role of the Internet to mobilize citizens.

Beyond scanning and calculation, beyond the possible innovations to increase energy efficiency, the generalized connection over the Internet is the third aspect of ICT which can have a positive role in mobilizing citizens and the watchful eye of some NGOs. The I.C.T. are not only communications infrastructure conveying content, but also a place where relationships are involved actors.

The Internet has thus become a vigilance network that is accessible to all citizens, a source of information for the media, a surveillance network for sites at risk, a network for denouncing institutions that fail in their environmental responsibilities, a tool for diffusing training to citizens, businesses, administrations, etc. With the second generation (Web 2.0) Internet is no longer just isolated islands of information, but a platform for exchanges between users through collaborative services: blogs, wikis, networks digital social ... In the absence of a genuine alternative model and the margins of world politics of representative democracy, a movement of social experimentation is taking place. It is not about "communities of practice" based on common interest, but the Internet citizen activist, who can "face collectively" the associative principle, going beyond the contract and by partnering in a flexible manner on common projects, and by questioning the two convictions now led to an impasse: the belief that anything can always find a price and a market (public goods to patents on life ...) and the belief that everything that is technically possible must be in any case developed (technoscience boundless from GMOs to nanotechnology ...).

On the Greenpeace website, for example, there are petitions and many contributions: "Stop the illegal wood trade in France", "Working for greener computing", "Lay down your challenge for industry", etc. For this alterglobalist NGO, as well as for the NGO that work to preserve the environment, the Internet has become a tool used to mobilise people, from "proximity gateways for citizens" to major world demonstrations such as Porto Alegre. The Aarhus convention, signed in 1998 by 39 States, focuses on access to information, the participation of the public in decision-making processes and access to justice in terms of the environment. The directives stipulate that all collectivities (including the sovereign States involved) must give access to any information they have about the environment to anyone who so requests it : beyond the collective awareness? Beyond ICT for strategic action ?

Conclusion of this second analysis: ICT will not be by themselves a response to environmental challenges. But computer simulations can promote awareness of the environment, technological innovation can improve energy efficiency, and the Internet may allow mobilization of the different actors.

4 RESPONSIBLE BUT NOT GUILTY?

In "The Imperative of Responsibility" (1985), H. Jonas proposes the following: "Act in such a way that the effects of your action are compatible with the permanence of a genuinely human

life on earth". According to Jonas, the new power given to man by technoscience is an issue to which a new form of responsibility must respond. It is to this new form of responsibility, both individual and collective, that all men must adhere, making it forbidden to undertake any action that could put into danger either the existence of future generations, or the quality of future existence on earth.

Since 1985 the principle of responsibility has been extensively both in academic (on Google Scholar term CSR refers to the 203.000 publications) at the level of political debate with discussion about the polluter-payer principle (he who spoils must pay), the precaution principle (predicting potential risks), the prevention principle (preventing proven risks) and the negotiation principle (all those concerned, all decision-makers, all key players).

But "responsible is not guilty"? We remember that now famous phrase as well from the Minister of Health during the scandal of contaminated blood scandal in France as from the Prime Minister after the genocide in the International Criminal Tribunal for Rwanda. And we can consider that the institutionalization of "social responsibility" (highlighted by example today in the draft ISO 26000 or in the Copenhagen conference in 2009 ...) gives rise to a real "game of responsibility" like in the classic Old Maid game where the aim is not to end up with the "Old Maid" card in your hand.

Responsibility plays itself out in three areas of issues : between the government and people this is the issue of democracy, between companies and governments people this is the issue of regulation, among enterprises and individuals this is the issue of justification (figure 1).

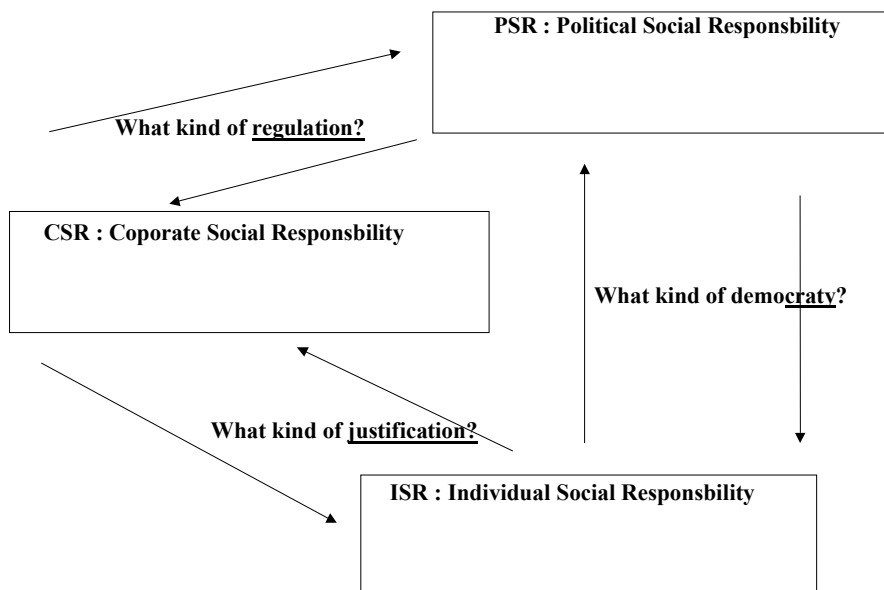


Figure 1 : Responsibility in three areas of issues

To understand the Individual Social Responsibility (ISR) we need do remember that technologies are not "intrinsically" either ecological or non ecological. An object cannot be given a positive or negative value, it all depends on what use is made of it. The lack of technological determinism can in particular be explained by the rebound, or boomerang, effect, which shows that the improved performances obtained through technological progress often lead to an increase in consumerism, and rarely a decrease, unlike what is generally predicted. Thus, technology that makes it possible to reduce a vehicle's consumption of energy is often accompanied, in a second phase, by an increase in consumption as the consumer's "rationality" pushes him to drive more. The rebound effect exists only because of the behaviour of users, who determine their consumption in relation to the possibilities provided and not in relation to their real needs, in a society that encourages this way of acting. For this reason, it appears derisory to search only for technical performance as a means of solving ecological problems.

If we take the example of the management of computer waste, more efficient management of this waste runs the risk of producing a rebound effect: increasing consumption with a clear conscience. Why limit one's consumption as the computer will be recycled once it has been thrown away. What can be done to reduce this ecological footprint? Should we choose the "sustainable development" route by searching for efficiency as Saar and Thomas (2003) describe for waste management? Or should we rather choose "to decrease", by changing our consumption or indeed our way of life, as proposed for example by M. Elgan¹⁰ in his defence of revaluing (through retrofitting and the second hand market), thus wrong-footing the arguments for recycling ICT? For Elgan, recycling pollutes, does not stop production, requires considerable amounts of virtue, does not improve products and encourages lazy storage.

The concept of the Corporate Social Responsibility (CSR) is strongly linked to the concept of sustainable development. Today, businesses are thus asked to justify their acts and their behaviour, and to reflect on the social, economic and environmental consequences of their actions. But "responsible" does not mean "guilty party". A report published by the NGO, *Christian Aid*, (<http://www.christian-aid.org.uk/indepth/0401csr/index.htm>), and which is highly critical of communication practices regarding the CSR, suggests that there is a risk that the CSR will end up being nothing more than a "branch" of the Communication and Public Relations department. According to Klaus Toepfer, the executive director of the United Nations Environment Programme (UNEP), the situation is as it is because of the priority given to the market by the world's directors. He, as well as the 1,100 scientists who published a UN report (2003), thus ask for markets to take second place to man and nature.

In order to analyse the Political Social Responsibility (PSR) at the level of those who govern (governments, intergovernmental organisations, regional and local collectivities), it is necessary to ask questions in a critical manner about three notions that are sustained by those who govern, and which are considered to be evident today: the Information Society, Sustainable Development and ultimately Development itself.

The Information Society concept has been in preparation since the end of the second world war through fundamental background work by the military, scientists, industrialists and intellectuals. Today, it has taken on a certain evidence in international organisations, without any real debate. When ATT was dismantled in 1984 by the Reagan administration, it was the starting gun for transfrontier networks and the deregulation of public services. In 1998, the WTO agreement was the consecration for the opening up of the telecommunications market. In 1994, the project for global information highways was launched by the Clinton administration, and in 2000 the G8 summit in Okinawa finally launched a charter for a "global information society" (even if one third of humanity still does not have access to electricity...). It was thus "quite natural" that the UN entrusted the piloting of the WSIS (World Summit on the Information Society) held first in Geneva in 2003 and then in Tunis in 2005 to UIT, the UN agency representing the technical vision for telecommunications (with the following key words: information highway, new economy, globalisation, access logic, merchandisation, deregulation,...), and not to UNESCO, another UN agency competent in "information and communication" (but more political, more sensitive to the respect of human rights, cultural and cooperation imperatives, less focused on the interests of private operators and free exercise of market rules... and which also prefers the concept of knowledge societies to that of information society).

It is also essential also to raise questions about the concept of Sustainable Development and how it has been adopted by every institution. As development as we know it at the present time and in light of how it is practised is, in essence, not sustainable, attaching the word "sustainable" to it becomes an imposture that irritates a large number of ecologists, activists, intellectuals and even former senior officials from international institutions such as the World Bank or even the IMF. Is the term sustainable, when attached to a term such as development, not merely a means of not asking questions about the urgency of the matter? This new concept appears to be heaven-sent, to the extent that it makes it possible to stop asking questions and

¹⁰<http://www.lemondeinformatique.fr/dossiers/imprimer-pourquoi-l-it-viendra-a-l-ecologie-31-page-3.html>

to stop debating precisely what needs to be debated: development itself. According to Latouche (1989), when we talk of sustainable development “we are dealing with a verbal monstrosity because of the antinomy of the expression”.

De Rivero (2003) explains how development, as relayed by media power and scientist power, via the West’s desire for ideological domination, has progressively imposed itself as the ultimate objective for all the world’s peoples. “The American way of life is not negotiable”. This was the famous declaration made by the American president George Bush Sr. in reference to the Kyoto protocol. At the same time, the United States were officially advocating access for “under-developed” countries to the American way of life on the basis of the consumer society. Yet, if the world population as a whole were to adopt the American way of life, we would not need one but seven planets to satisfy our consumer needs (Figure 2). In short, as Serge Latouche (1989) says, development is the westernisation of the world. Rahnema (2003) thus states that wretched poverty chases poverty in the countries of the South.

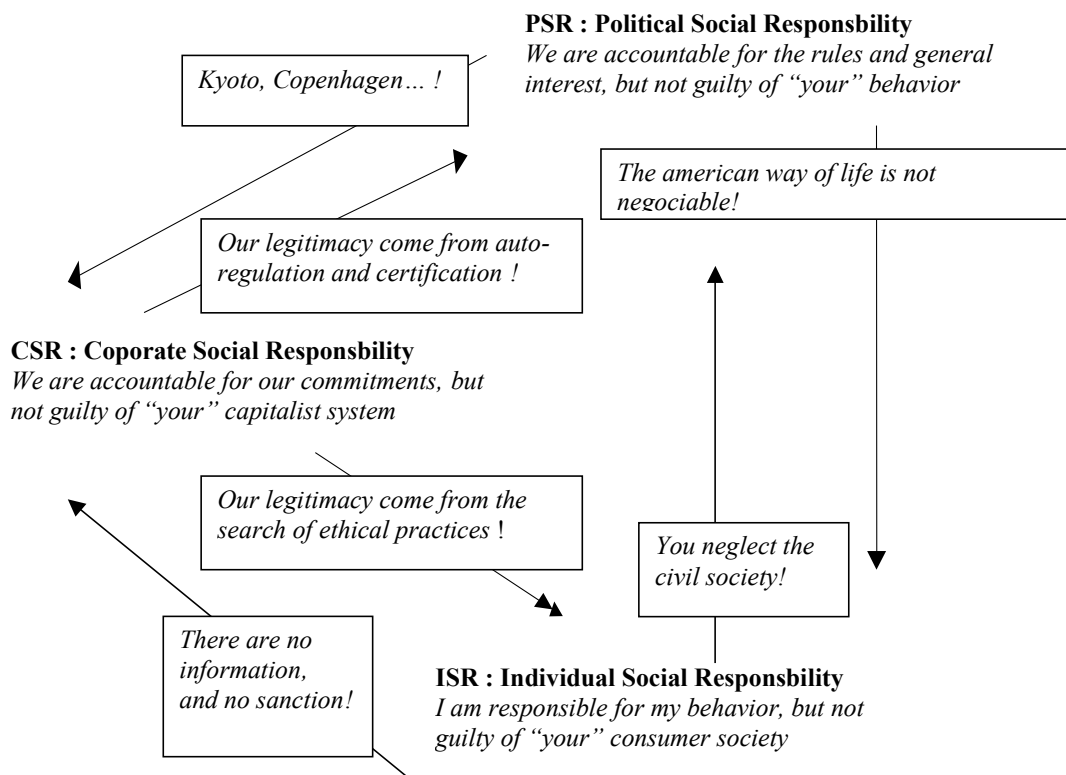


Figure 2 . Responsibility : the "Old Maid" card in your hand

It is thus work on these concepts of information society, sustainable development and even development itself that must open up new avenues of research on the principle of the responsibility of those who govern and stop the “juggernaut of modernity”, to borrow the expression used by A. Giddens (1991). The principle of responsibility and that of the low legitimation of nation-states thus justifies systematic valuing of social experiments, continuous negotiation of these experiences and reversibility in all the decisions made. To conclude, it appears to us that individual responsibility is the most fundamental aspect. Raising awareness at the level of nations-states or business would have no impact if there were not first and foremost raised awareness at the individual level. Any change would be meaningless if there were no real individual awareness. Instead of change, we would merely be patching over the cracks.

5 CONCLUSION

The first two parts of this communication have shown the rather negative role that ICT have on the environment and the rather positive role they have on knowledge of the environment. We thus proposed, in the third part, three work areas for covering in greater depth the concept of responsibility: at the level of individuals, businesses and those who govern.

We can thus imagine research questions at the level of individual behaviour, remembering the two types of change identified by Watzlawick *et al.* (1975). These researchers from the famous Palo Alto school differentiate “false” changes, referred to as type 1 change, from “real” changes, referred to as type 2 change. Why are type 1 changes ineffective? Because their aim is an identical preservation of the structure of the dysfunctional system. Here are examples of research questions on the responsibilities of ICT users that could be classified in the category of type 1 changes: What quantities of energy are used by ICT? How can we reduce the energy used by ICT? How can we use bar codes for more efficient management of waste? Can we use recycled paper when we print? Other research questions can be classified as being type 2, the aim of which is to distance oneself from the logic of the system that is dysfunctional: How can we encourage a change in users’ attitude? To what economic system can the environment adapt? Does the development of ICT represent a new form of world colonisation? Should we talk of responsible usage or appropriation? What share of the responsibility can individuals take within associations and NGO?

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