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Ict And Ecology: In Favour Of Research Based On The Responsibility Principle

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Abstract

The aim of this communication is to present new focuses for research in the field of Information Systems and Ecology. 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… Many questions about research are then liable to be developed, and this will be the subject of the third part: in favour of research into the principle of Responsibility, users, businesses and those who govern.

Keywords: *Information Systems, Ecology, ICT*

1 INTRODUCTION

The ecological imbalance that characterises the world we live in is now putting our planet in danger such as we have never known till now. What we do in the next twenty years could have a vital impact on the climate of the second half of this century (Intergovernmental Panel on Climate Change http://www.ipcc.ch/) 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 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. Most scientists and economists have thus started to realise what was for many years solely denounced by "ecologists". And it is essential that we retain the concept of a multiple analysis of a situation which is ecological, economic and social: 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), 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 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. This is the aim of the first part of this communication, where, through a review of the literature, we will discover the rather negative role ICT have on the environment.

Another series of questions on the potential for ICT must also 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. This is the aim of the second part: the rather positive role played by ICT on knowledge of the environment.

Many research questions are then liable to be developed. 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? What is the ecological responsibility of businesses? What legitimacy do sovereign states and non governmental organisations have for managing the links between ICT and ecology? 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: in favour of research into the principle of Responsibility.

2 THE RATHER NEGATIVE ROLE PLAYED BY I.C.T. ON THE ENVIRONMENT

What DeSanctis and Poole (1994) call the "Spirit" of ICT 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? With the small amount of hindsight at our disposal, what evaluations can we make?

2.1 The rather negative played by ICT on resources: the poor hypothesis for 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 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 Ispos Global 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 rather negative role played by ICT on travel: the poor hypothesis for replacement

The telephone was invented in 1876. It did not take long for someone to suggest that this invention could ultimately eliminate the need for travel: on 10 May 1879, in an editorial in *The Times*, the idea had already been expressed that the telephone would make life easier for managers by eliminating their need to 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 CO_2 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).

2.3 The rather negative role played by ICT on transport: the poor hypothesis of electronic trade

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 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).

2.4 The rather negative role played by ICT on electricity: the poor hypothèse of very low consumption

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 CO_2 emissions generated by the IT industry.

It thus seems difficult, at the present time, to establish a clear review of electricity consumption as the various sources give contrasting responses. The idea of minimal consumption nevertheless does not seem very probable.

2.5 The rather negative role played by ICT on waste: the poor hypothesis of immaterial 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 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*” market, and they encourage governments to support scientific projects 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 THE RATHER POSITIVE ROLE PLAYED BY I.C.T. ON KNOWLEDGE OF THE ENVIRONMENT

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 two different issues: the role of information technologies (digitisation and computing) and the role of communication technologies (networks and the Internet).

3.1 The rather positive role played by computing on knowledge of 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*" 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 GIEC-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 GIEC-ICCP on carbon/climate interactions is a well mediatised 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 resoucres 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/);

- finally, "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.

3.2 The rather positive role played by the Internet network on knowledge of the environment

Beyond the aspects of digitisation and calculation, the fact of generalised connections via the Internet network is a second aspect of ICT that may play a positive role in knowledge of the environment, particularly thanks to the traceability of objects and vigilant controls by certain NGO.

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 WEEE it will be possible to know immediately, by reading the electronic labels, exactly where to store these products or recycle them.

But ICT are not only communication infrastructures that convey content, they are also vectors for relationships where the key players are involved. 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 of the Internet (Web 2.0), it is no longer a question of a medium composed of isolated islets of information, but is instead a platform for exchanges between users, thanks to collaborative services such as blogs, wikis, digital social networks and so on.

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.

Conclusion of this second analysis: although ICT cannot, on their own, provide a response to ecological challenges, they do encourage knowledge of the environment and the mobilisation of the key players.

4 IN FAVOUR OF RESEARCH INTO THE PRINCIPLE OF RESPONSIBILITY

Two German philosophers have highlighted the principles of low legitimation and responsibility, which could open up new avenues for research into the links between ICT and ecology.

For J. Habermas (2001), a new regime of global governance has now appeared in the transition from a regime of high legitimation to one of low legitimation. (Klein and Huynh, 2004). In the first case (high legitimation), the various partners in a traditional nation-State could count on their past experience in the motivations and preferences of their other partners to interpret them and form the basis for trust. In the second case (low legitimation), this reference to a world of common experiences is impossible. It is thus essential that trust be established on another basis, by extrapolating this new common world from experiences acquired in the new regimes of negotiation.

H. Jonas (1985) 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: 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).

We can thus try to analyse the three levels at which these principles of low legitimation and responsibility require new research: the level of the users, companies and those who govern.

4.1 The "USR": the Users Social Responsibility

There has never been technological determinism. Technology is not "instrinsically" 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. Elgan 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.

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 dysfunctioning 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 dysfunctioning: 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?

4.2 The "CSR": the Corporate Social Responsibility

The concept of the Social Responsibility of Businesses is strongly linked to the concept of sustainable development. The law on New Economic Regulations in France and in particular its article 116 make it obligatory for businesses to publish information on the social and environmental consequences of their

activities. 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". This expression ("responsible n'est pas coupable") became famous in France during the scandal of the contaminated blood affair. For sure, businesses are asked to prove that they are responsible and to "demonstrate" it by increasingly legalised means. Yet the notion of guilt in the face of possible social, economic or environmental deterioration is not at stake. 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 SRB, suggests that there is a risk that the SRB will end up being nothing more than a "branch" of the Communication and Public Relations department. And the study by Vitari *et al*. (2008) showed that with regard to large companies, and despite the availability of new generation ICT, communication on the SRB still remains a showcase that is not particularly favourable for debates and interactivity. A study conducted on 124 businesses in the United States and Europe thus shows that "*although 85% of the businesses affirmed that environmental factors play an important part in the planning and scheduling of their IT operations, only one quarter declared that they had included ecological criteria in their purchasing processes*".

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 a speech given at the TIC21 conference, André Jean Guérin, a representative of the French State Department for Ecology and Sustainable Development condemned "*the moronic state of consumerism*" to which we are subjected.

Beyond the SRB, new research avenues are thus opening up to researchers in the field of Information Systems as a means of going deeper into the principle of business responsibility in ICT: the polluter-payer principle, the precaution principle, the prevention principle and the negotiation principle. What is the responsibility of supply in relation to that of demand? What is the obsolescence limit for products? What place do freeware communities have in relation to businesses? Must we always talk of ownership rights, or can we also talk of world public assets? Can knowledge be patented? Must we always talk of deregulation or could there also be a cultural exception?

4.3 The "GSR": the Govern Social Responsibility

In order to analyse the principle of responsibility at the level of those who govern (governments, intergovernmental organisations, regional and local collectivities), it is first of all 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 societ**ies** to that of information societ**y**).

It is also essential, in line with Rodhain and Llena (2005), 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 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 mystificatory antinomy of the expression*" (page 51).

"The American way of life is not negociable". This was the famous declaration made by the American president George W. Bush 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. 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. 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. In the face of "the arrogance of the economist" (Latouche, 1989) and the instrumentalisation of the concept of sustainable development by productivist thought, the question of decrease and reflections on how to achieve it thus seem pertinent: a convivial relationship as part of a dynamic of giving and qualitative exchange (the relational goods described by Mauro Bonaïuti, 2003), a non-rival economy (Gensollen, 2004), the rediscovery of *economics* through "*self-organisation*" that values the principles of reciprocity and non monetary economics, a return to what is local through better knowledge of local hard and "soft" skills…

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 negociation of these experiences and reversibility in all the decisions made.

5 CONCLUSION

The aim of this proposition was to present new areas for research in the field of information systems and ecology. Our exploration clearly suffers from a number of limitations, as the literature available in this field, particularly in the field of IS, is for the moment relatively poor and the themes covered are done so in a relatively succinct manner. The first two parts of this communication have nevertheless 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.

In order to respond to the research questions raised here, it would be pointless to search in a single scientific field, and equally pointless to remain strictly within the realm of academia. For a social problem of this extent, it is important that we mobilise all the key players in the field and vulgarise the questions and results of any research (Rowe, 2009).

To conclude, it appears to us that individual responsibility is the most fundamental aspect. Raising awareness at the level of nations 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.

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