SUSTAINABLE DEVELOPMENT AND INFORMATION TECHNOLOGY

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ABSTRACT

Information Technologies model the reality in such a way that information on it can be efficiently found and transported to the decision makers in a useful, readable form. There is still a need of standardization of nomenclatures, interchanging of formats and languages in order to accelerate the communicability of information so it can be useful for any decision maker or for the public.

But this standardization or modeling process increases the errors in interpreting the reality, which can lead to unsustainable decisions. However, the growing velocity of communication exchanges and the power of recent information technologies will probably reduce the standardization needs in time and allow a communication of less biased information that is more accurate for a better decision making process.

INFORMATION IN RELATION TO SUSTAINABLE DEVELOPMENT

The issue of sustainable development is at the heart of society setting the future course of humanity on the planet. This paper argues that irrespective of technological change--more powerful computers, satellite monitoring, even artificial intelligence--the issue of sustainable development will remain essentially the same in the high tech future of tomorrow. The concept of, as opposed to the term of, "sustainable development" is not new; the profound and complex problems subsumed by the term can be traced back to the earliest human civilizations and the perennial tension between population growth and economic development, on the one hand, and the use of natural resources and ecosystems on the other.

The term "sustainable development", however, is a recent invention, coming into common usage very recently. For example, the Brundtland Commission, which is responsible for most frequently cited definition of sustainable development states it to be the process “to meet the needs of the present without compromising the ability of future generations to meet their own needs".

The concept of sustainable development can be broken into two parts. On the one hand, "sustainability" relates to the question of the "carrying capacity" of the earth, while giving no attention to social issues, particularly those concerning equity and social justice. "Development", on the other hand, would appear to assume and even necessitate continual economic growth and ignore the question of ecological constraints or "carrying capacity". When these two concepts are put together, a very different one emerges, and the result is much more than the sum of the parts.

It is therefore a multi-dimensional concept, and it must be addressed at various levels simultaneously. Sustainability may be divided into three types: social, ecological and economic. The ecological definition is perhaps the clearest and most straightforward, measuring physical and biological processes and the continued functioning of ecosystems. Economic definitions are sharply contested between those who emphasize the "limits" to growth and carrying capacity and those who see essentially no limits.

In the narrowest sense, global sustainability means indefinite survival of the human species across all the regions of the world. A broader sense of the meaning specifies that virtually all humans, once born, live to adulthood and that their lives have quality beyond mere biological survival. The broadest sense of global sustainability includes the persistence of all components of the biosphere, even those with no apparent benefit to humanity**.**

IMPACT OF INFORMATION TECHNOLOGY

The development of novel and affordable information and communications technologies, and the emergence of information society with new economic models, has the potential for making major contributions towards sustainability of the earth’s ecosystems. Innovative use of information technology offers substitutes for travel and for the transportation of goods, and a major shift towards less resource-

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intensive production, consumption, trade, and services. Such changes can significantly reduce the environmental impact of industrial and commercial activities and thus contribute to sustainable development.

Today's information society is being built on technology, knowledge and intelligence. Information Technology (IT) empowers both people and machines with information, which is transformed into knowledge and intelligence. Appropriate use of the knowledge by both people and machines contributes to sustainable development. While informed and empowered people know their role as citizens in an environmentally sustainable society, empowered machines have the knowledge to minimize energy and material use, wastes, and pollutants.

Information technology facilitates fast, cheap, equitable, and resource-efficient access to information, accumulated knowledge, learning opportunities, and co-operation support tools for its citizens. Internet, today's cyberspace, facilitates people from across the globe to co-operate and perform various activities of human life and endeavour. Processing, storage, transmission, and sharing of information in electronic form, without any spatial or temporal constraints, empower people with instant information along desired lines. Information analysis contributes to knowledge and intelligence, which have increasingly become commodities in the information age. As information becomes accessible to anyone, and anywhere, it is increasingly becoming a basic economic resource and a structuring factor in today’s society.

Miniaturization and innovation in electronics have equipped machines with intelligence and communication technologies, enabling them to collaborate with each other in their work. By empowering machines, IT offers a high potential for making a positive contribution towards sustainability of our economy and environment, particularly by reducing the impacts arising from manufacturing and transportation activities. However, such opportunities are emerging in various other sectors too.

VIEWS OF ENVIRONMENT

1. Nature is Robust

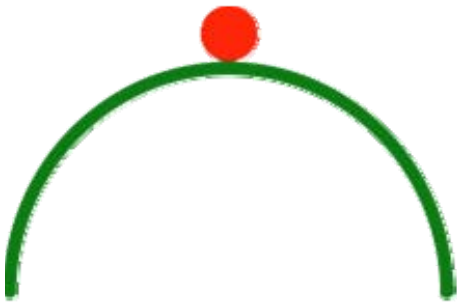
The environment is seen to be very forgiving of human impacts and is virtually inexhaustible as a resource base. Represented graphically, it can be represented by a ball rolling inside a steep-sided basin, where, no matter what changes affect the system, it ultimately returns to the bottom of the basin. In its purest form, this myth views global environmental change in terms of a positive challenge; as new opportunities for human ingenuity. It is assumed that green technology, will prevent, correct, or even restore, any unanticipated damage to the environment. This is essentially an individualist view of the world, in which the invisible hand of markets are seen to be the only necessary regulatory mechanism for the system. This view is broadly supported by many activities in business and industry. (*Technology and Sustainable Development)* [1]

NATURE IS ROBUST
Individualist

Figure - 1(a)

2. Nature is Fragile

The environment is seen to be vulnerable to irreversible collapse due to ecological degradation or natural resource exploitation. Graphically, it can be represented by a ball precariously balanced on an upturned bowl. In its purest form, this myth views global environmental change as a manifestation of the multiple negative human impacts on the environment. It is assumed that a continued advance along society's current materialist path will ultimately lead to the irreversible destruction of the planet. This view is an egalitarian one and has been embraced by the deep ecologist movement, which suggests that a fundamental transformation of contemporary society is necessary; either through the return to the frugality of traditional societies or through the creation of a universal "earth ethic" with strict moral principles. Fragility images are also used by other groups.

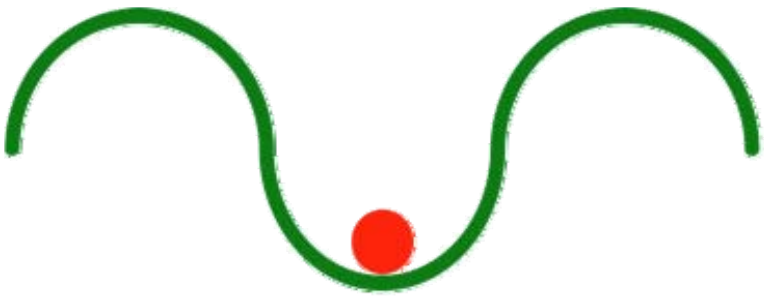


NATURE IS FRAGILE
Egalitiarian

Figure - 1(b)

3. Nature is Robust Within Limits

The environment is believed to be resilient within identifiable limits that must, however, not be surpassed. Graphically, the ball is most likely to remain at the stable point at the centre of its system, but the sides of this depression cannot exclude the ball from being bumped over one of the edges. This view is essentially a hierarchic one, which assumes that ecological degradation and the use of natural resources need to be carefully monitored and managed by a specific body. It assumes that global catastrophe can be avoided through the accurate scientific understanding of ecological limits and the establishment of standard operating procedures. This view is particularly popular amongst some governments and the United Nations system, which envisage a type of global bureaucracy to manage the environment. Economic growth can be maintained through rational management.



NATURE IS ROBUST WITHIN LIMITS
Hierarchist

Figure - 1(c)

4. **Nature is Chaotic**

The system is seen to be essentially chaotic and unpredictable. Graphically, the ball indiscriminately moves on a flat plane, devoid of vertical perturbations, continuing on a flat plane forever (there are no edges to fall off). Meaningful or significant change is impossible. This is a fatalist view; life is like a lottery: It is driven by luck, not skill. For obvious reasons, proponents of this view do not often articulate their views, because management strategies, in any common sense of the word, are reduced to just surviving as best as one can.

NATURE IS CHAOTIC
Fatalist

Figure - 1(d)

If one of these four views were actually the correct one, we can assume that eventually all opponents would be converted to that belief system simply by experience and the occasional surprise. Yet, among the competing views, although they wax and wane, one never obliterates the others, nor does any view simply fade away --they persist. Instead, the fact that we continue to be surprised suggests that the natural world has many, ever-changing faces, fitting each of the different views at different times. Various groups hold different perspectives on "sustainable development". Each of these views is given as "proof" for the necessity of a particular strategy or action. Opposing interpretations are rejected. Other views are not seen as simply misguided, but are instead perceived to be blatantly wrong and threatening. Many people who adhere to a particular view of the environment --although they might deny this categorization-- are so firmly (or blindly) committed to their own view that they refuse to recognize competing views as having any legitimacy. We need a more open debate on sustainable development; one which is based on the rejection of a single world view or environmental strategy. There is validity in each viewpoint, and each is correct in different contexts.

The multiple views of sustainable development are not only equally legitimate, but absolutely necessary to the health of the debate. Sustainable development can be successfully implemented only if each view makes its unique contribution to the solution. Since each represents only a part-truth, there is no single solution to a given environmental problem. In other words, sustainable development strategies cannot be attained through the dominance of a single view or by the exclusion of others; instead they require continual evolution and exchange.

SOME STATISTICS IN GRAPHICS

The following are some graphical representations of IT penetration and usage in various sectors of economy in various countries of the world:

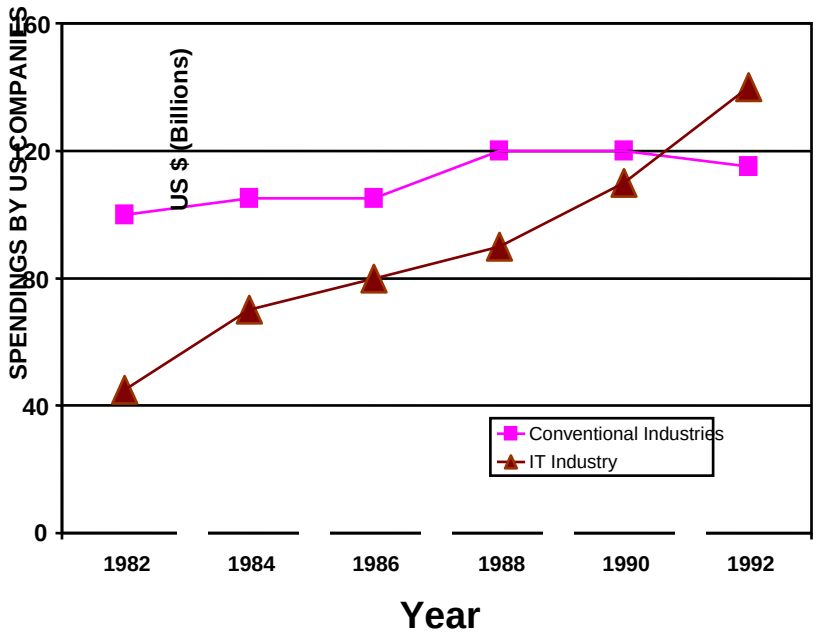


Figure - 2: Spending by US Companies in Conventional Industries vis-à-vis IT Industry)[2]

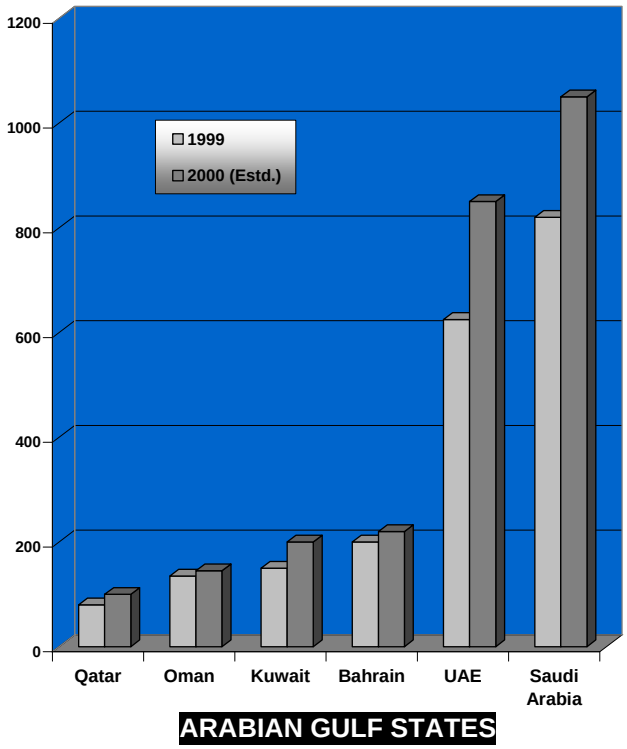


Fig - 3: Histogram Showing Market Size (IT) in Various Arab Countries[3]

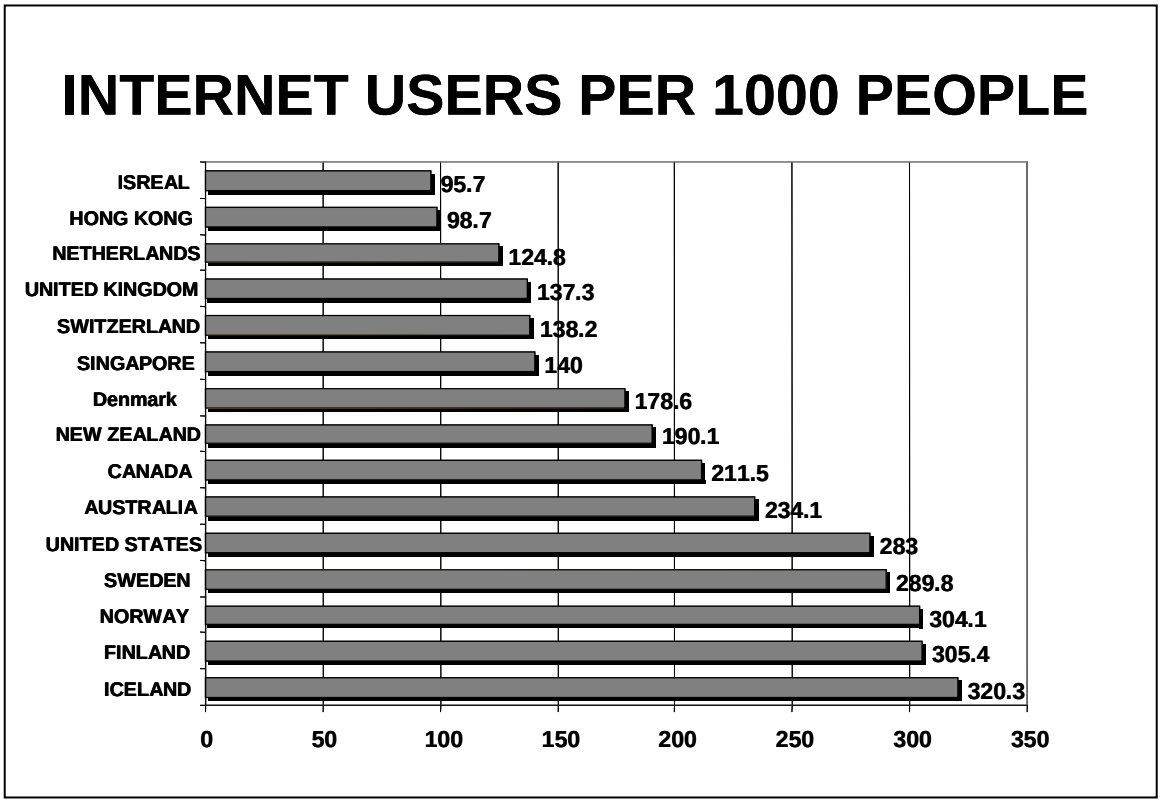


Figure - 4: Graphical Representation (i) of Internet Usage Per One Thousand Persons in Various Developed Countries[4]

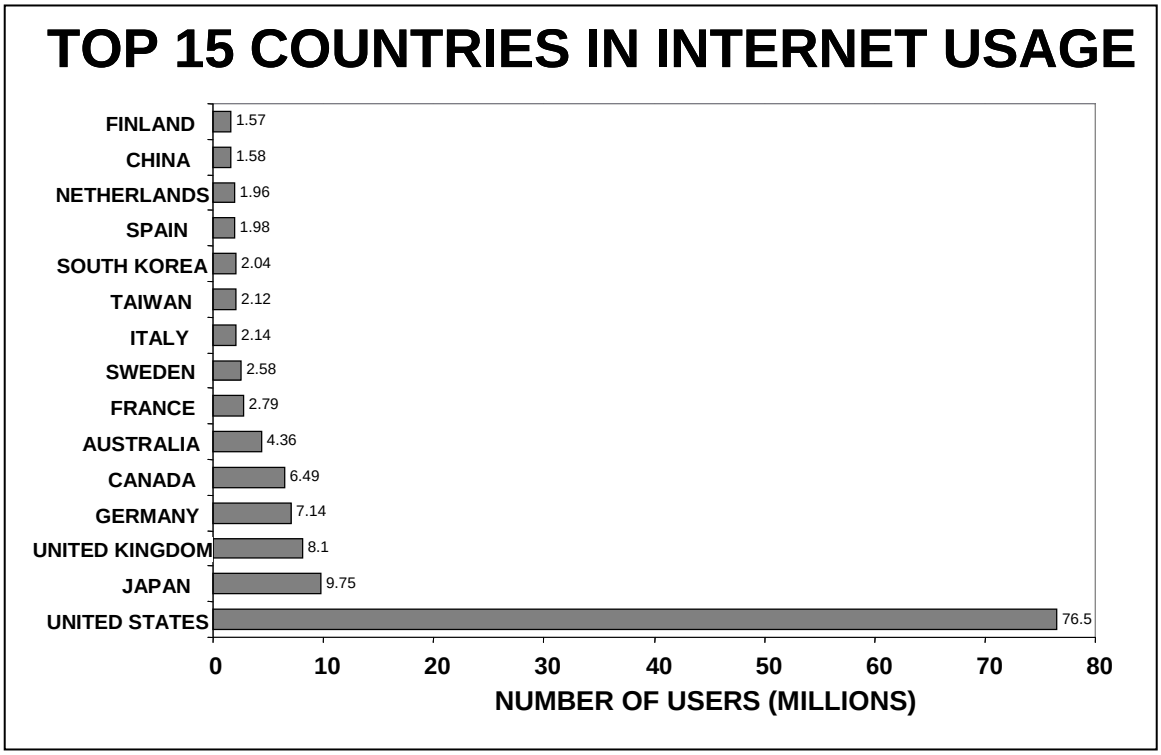


Figure - 5: Graph Indicating Top 15 Countries In Terms of Internet Usage[4]

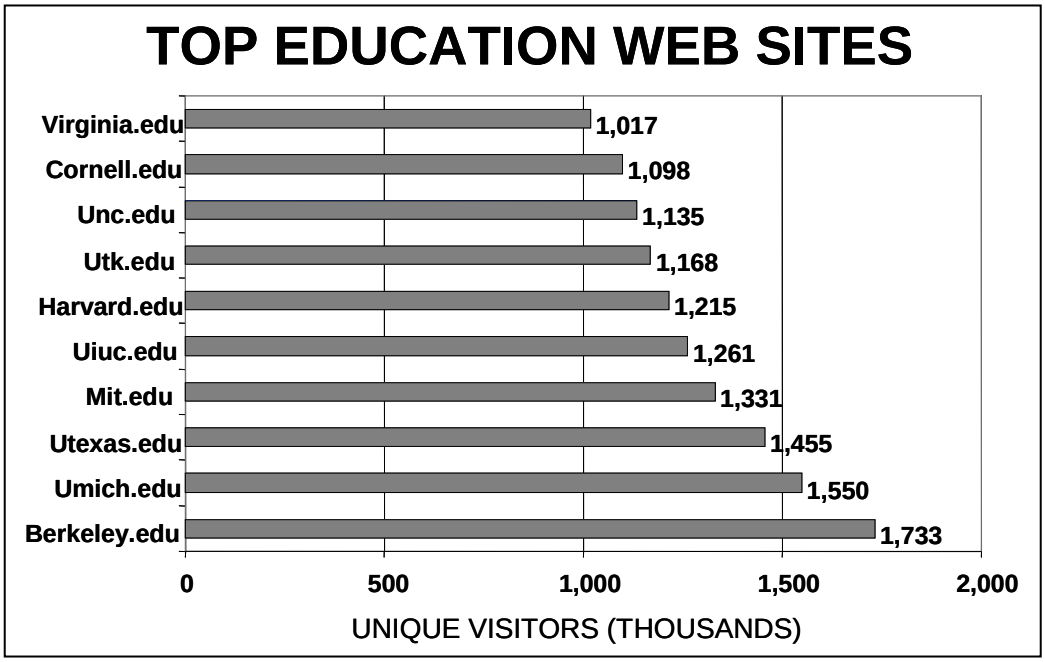


Figure - 6: Top Education Websites In Terms of Visitors[4]

Figure - 7: Top Shopping Websites In Terms of Number of Visitors[4]

POTENTIAL OF IT TOOLS IN SOME SELECTED SECTORS

1. Manufacturing

Because they provide flexibility, open systems will be the key for the manufacturing organization of 2020 and beyond. Typically, one has to design a product to meet a particular need, then quickly hone in on the

design, sacrifice design flexibility and create a product that cannot evolve and meet new needs. The Information Revolution gives the flexibility to postpone commitment of resources to a particular course of action until the last minute, allowing us to make better decisions about our design before the freedom to make those decisions is lost.

Competitive advantage will go to companies that provide exactly what their customers want at a low cost. For most people, it's the latter and they shouldn't have to pay more for it. Such flexibility means the future of manufacturing could hold economies of scope, in which cost reductions on a group of products are achieved through components which are shared by all the products. This approach differs from the concept of economies of scale, which today offers large amounts of a specific product.

2. Transport

a. Tele-working and telecommuting can be acceptable substitutes for local and long distance travel.
b. Microprocessor engine control systems can save fossil fuel and reduce pollution.
c. Advanced transport tele-matics (ATT) can improve transport efficiency and road safety.
d. Intelligent transport systems can reduce travel time, improve traffic flow and help to make the roads safer.

Some of these technologies are fibre optics, computers, networks, improved human-computer interfaces, digital transmission and compression, communication satellites and cellular devices. They are influencing interactions among states, international governmental organizations such as the United Nations, multinational corporations and non-governmental organizations.

3. Agriculture

Modern agricultural production systems continue to demand increasing levels of intensive management, to help farmers maintain a competitive edge. Computer programs are used by farmers to assist in record keeping and enterprise analysis. However, many computer packages which are available are used to record activities in progress in the production process or financial activities.

There are few which express the production process in financial terms.

Sustainable food system benefits from the responsible use of resources by farmers who perform a wide variety of tasks as part of crop management. These tasks can be facilitated by expert systems with the knowledge, designed and built with the help of local expertise. Land information system prepared using Geographic Information Systems (GIS) and remote sensing can help farmers plan their activity and facilitate decision making and planning at the local level.

4. Environment

IT systems can provide improved access to environmental information to citizens, authorities at every level, NGOs, and businesses for environmental monitoring and management. GIS and remote sensing can be used to map resources, land-use patterns and environmental factors. This could help bring about more effective planning, management, and decision-making with regard to the environment.

Moreover Information systems can facilitate a national and worldwide dialogue about policies needed to ensure that sectoral growths are consistent with an improved environment. The environmental community has been painfully slow to recognize the power that information tools can bring to this debate.

5. Education

“Education technologies" is a phrase commonly used to refer to whatever the most advanced technologies available are for teaching and learning in a particular era. Throughout history, humans have invented technologies that radically change what they're able to see, do, and think about over significant time scales.
Microscopes-medicine-health; the printing press-books-literacy and news-we've used technologies to

craft new environments in which we live, which then change human life by changing what we do in fundamental ways, and even what we think about what humans are. Consider artificial intelligence and biotechnology efforts such as the human genome project

In this context, we see a redefining of the very roots of learning and education underway with new computing and communications tools. Education in the context of such societal transformation as this should not be "business as usual," only making the learning of the past achieved through greater efficiency. For example, technology is changing the "what" of learning by introducing new concepts, techniques, and tools for understanding and also making the world-for inquiry, design, creative expression. These innovations include computer-aided design, simulations of physical systems that model climate change, the origins of the universe, or ecosystem population dynamics, as well as new ways to visualize and integrate data and to carry out radically new forms of inquiry that weren't possible until recently. Micro-worlds provide children in these early years with understandings of Newtonian mechanics and about sensors and graphing and feedback in complex systems. In addition to shifting the time and place of learning through wide-area networking, new participants in on-line communities are also learning from one another across school and age boundaries, including scientists, scholars, parents, and senior citizens.

Yet technology in and of itself is not a panacea for education and its applications can surely be misguided. Computers and communication technologies are clearly not solutions alone, nor do they automatically foster utopias. Technologies can carry or promote virtually any value system into the classroom, including outmoded methods of instruction. And, of course, it takes more than computers and Internet access per se to improve education. We can get beyond that.

6. Others

a. Saving paper: Electronic information processing and dissemination can save the forests.
b. Arresting urbanization: Ready and adequate access to information, knowledge, and telecommunications in rural areas would discourage urbanization.
c. Tele-medicine: Tele-medicine can provide medical care to people in their homes, and to patients in remote areas.
d. Empowering citizens with information: By creating suitable contents on cyberspace and making it available at info kiosks in their close proximity, preferably in the local language and covering local issues among others, will empower citizens with the knowledge to act to bring about sustainable development.

TRANSLATION TOOL OF INFORMATION TECHNOLOGY

We will concentrate here on one 'translation' tool that would have a positive effect on the communication for a more sustainable world. (Technology Tools for Sustainable Development) [5]

The Information Paradox

Each language is a modelisation of the reality that reflects the culture behind it. The modelisation of the reality through information accelerates the possibility to manage it. More the real world is modeled, quicker the management of information is and so is the response and further impact to reality. But also, further is the answer from the reality, and bigger is the risk of error. This information paradox cannot be solved, but information technology could help to reduce its size.

Figure 7 illustrates the process of making synthetic information by successive modelling of the reality. Agenda 21 (UNEP, 1992) and the United Nations Commission on Sustainable Development (1995) agreed that a set of new indicators would be necessary for sustainable decisions. Basic data are more close to the reality, but are not workable for the decision makers. Derived data, indicators and indices give a more readable image of the reality and can be compared, aggregated, combined, discussed, presented in charts and maps for a better implication of the different actors involved in the decision making process. Indices and indicators are more visible, even if they are far from the reality. It is the information paradox.

Here we face a problem of standardisation of the metadata: if each library, each catalogue, each address list uses other conventions, no communicability is possible, no information can be found by external people, which is not the goal of Agenda 21 statements. The necessary standardization of data format is stated by all international agencies, but also within countries, e.g. between regions or administrations.

Metadata standardization is easy if only a small set of descriptive elements are used: author, title or name, address, keywords, summary. It is difficult if more details on the source are given (for example: which language to use for full text description?). The cost of listing a lot of data sources is also much lower if a single title or name is used, but a catalogue of data sources is more useful if more descriptions are given.

We face the paradox of data retrieval pyramid, illustrated in the figure: on the lowest level, data are well described (the extreme is that the data themselves are stored), but difficult to harmonize or to collect within a single system, on the highest level, it is easier to make comprehensive lists, but the metadata are too far from the data they are suppose to describe.

This paradox of describing and retrieving data and information is also not solvable: more modeling of the reality gives more visibility and communicability but are more biased and does not represent well the quality of a data source. But information technology, and in addition the generalization of metadata standards, can also help to reduce the size of the paradox.

INFORMATION COMMUNICATION-STANDARDIZATION

The Figure 8 shows the structure of information interchanges today on the Internet, with a view to the future. Standardization seems to be one of the crucial points to solve today. If English is already the main key language of the Internet, the system is evolving to the use of metadata standards in the header of each document, in order to allow the search engines to find the relevant information from the users point of view.

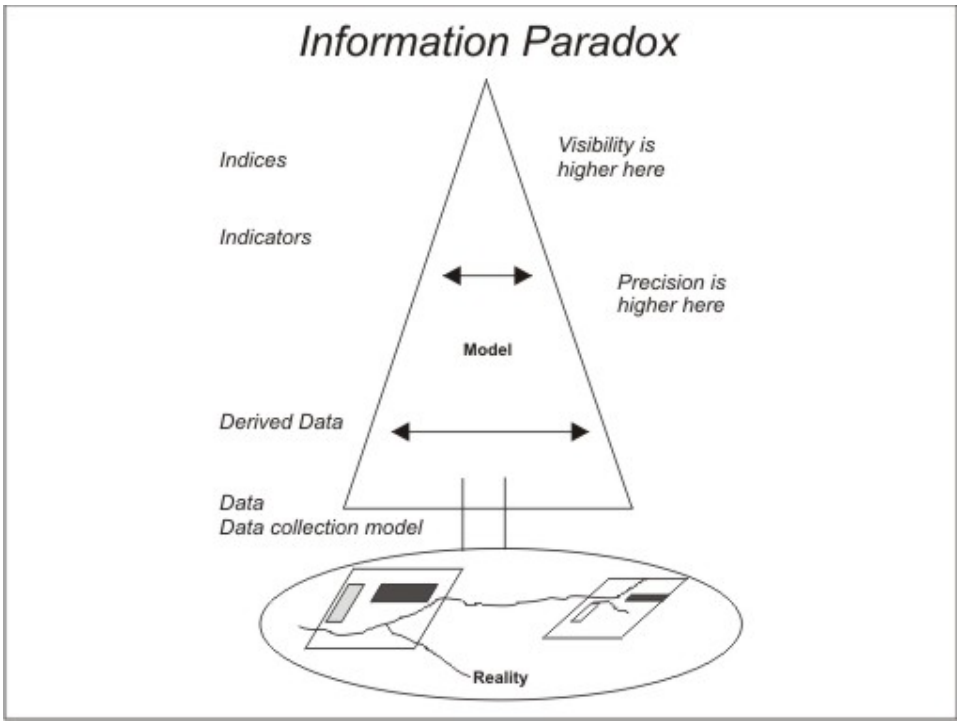


Figure - 8: Communication Through the World-Wide Computer Network.

Data about data are called metadata. The role of meta-databases is to accelerate the research of information for specific use. A good example is the bibliographical meta-databases used by the libraries.

A title, a summary and keywords help to index the data sources. It works well within a single library, because the keywords used are adapted to the needs of the specific user's community. But for the description of other types of data or information sources, such as organizations, experts, databases, samples, satellite images, projects etc., the system of the libraries is not sufficient, and a more complex set of descriptive elements are needed (quality and size information, languages used, formats, addresses). Otherwise, the relevant data sources are not found by the users. In a world wide environment, where potential data providers and users are not of the same culture and do not speak the same language, this problem is even more accurate.

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INFORMATION COMMUNICATION: TODAY & TOMORROW

This implies that to allow communication for sustainable development, it is necessary today to improve:

- *Information storage and processing infrastructure,*
- *Communication channels and terminals (80% of the world's population have no access to the telephone);*
- *Interactive communication efficiency and velocity.*
- *Standardization (of data, of metadata, of interchange protocols and formats);*

The two first points will depend on:

- *Reduction of the costs of IT;*
- *Policy of equal distribution between the rich and the poor.*

The evolution of the IT market shows a drastic reduction of the costs implied (if compared with their performances): telephone terminals and televisions are now accessible for average villages in Africa, radio receivers are accessible to individuals; but computer or Internet terminals are already too expensive for even the poorest people even in the richest countries. The cost for telephone lines are however too high for mainly African users, and already cut them from the digital information sources.

INFORMATION TECHNOLOGY - ISSUES AND CHALLENGES

The rapid development and use of information and communication technologies are causing major repercussions on all aspects of the private and public life in all countries. This development is transforming the traditional ways of functioning of our contemporary societies and is providing new opportunities and challenges for all. This situation makes it important for developing countries to keep abreast of the new ethical, legal and societal issues and opportunities offered by the Information Society.

1. Societal and Psychological Challenges

- The analysis of impact of IT focuses both on structural changes and changes for the individual at work and on the role as citizen. The main humanistic focus is on possibilities and prerequisites, related to IT, for influencing one's own life conditions, for social belonging, for a meaningful life content, and for learning and developing oneself.
- The Information Gap: Looking at our society as a whole, there are noticeable inequalities or "gaps" in the distribution of information and information technology. For various reasons, some people appear

poised to garner greater benefits from technological advances than others. Observers have pointed to gaps that appear along several dimensions, including socio-economic status or income level, ethnic background, gender lines, or geographic gaps. Domestically, the geographic gap refers to a division between our urban metropolitan areas and rural regions. On an international level, it refers to the inequitable global distribution of technology and information. In other words, some nations have enormous technological prowess and capabilities, while other nations do not.

2. Ethical Issues

Ethical issues and concerns have always underscored the utilization, management and control of information. In the age of information, political and societal tensions will increasingly surface and coalesce, creating significant differences among groups within nations, as well as among nations. The quality of information content will be deliberated by the perceived haves and the have-nots. Who controls information will be a major issue for 21st century scholars and politicians.

There are many unique challenges we face in this age of information. They stem from the nature of information itself. Information forms the intellectual capital from which human beings craft their lives and secure dignity. However, the building of intellectual capital is vulnerable in many ways. The ethical issues involved are many and varied. However, it is helpful to focus on just four and leave it to ourselves the search for their answers:

Privacy: What information about one's self or one's associations must a person reveal to others, under what conditions and with what safeguards? What things can people keep to them and not be forced to reveal to others?

Accuracy: Who is responsible for the authenticity, fidelity and accuracy of information? Similarly, who is to be held accountable for errors in information and how is the injured party to be made whole?

Property: Who owns information? What are the just and fair prices for its exchange? Who owns the channels, especially the airways, through which information is transmitted? How should access to this scarce resource be allocated?

Accessibility: What information does a person or an organization have a right or a privilege to obtain, under what conditions and with what safeguards?

DISCUSSION

As information technology becomes increasingly indispensable for the development of society, the Developing World in particular can least afford to squander the vast opportunities presented by the ongoing information revolution. Faced with globalisation and the fact that IT has been proved to be the engine of development, the question is no longer if the IT is applicable to less developed regions, rather the critical question is how should the developing countries adopt the new information technologies in order to meet the economic development challenges?

Our rationale for participating in the information age is simple and strong: unless developing countries become full actors in the global information, they stand the risk of being excluded from the emerging global economy or suffering severe disadvantage in the competitiveness of their goods and services. Participating in the information age offers many opportunities for developing countries to "gain time on time"—to leapfrog over past development deficiencies into the future. A sizable number of developing countries have already made progress in their Internet links that have put them on the global connectivity roadmap.

Development can be seen as an increase of knowledge and skills and creative potentials that can be applied to improve the quality of life. Research shows that low levels of knowledge and inadequate innovative skills at lower, middle and higher levels have contributed to the continuous failures in African countries in all spheres. Information and knowledge are interrelated. Well-informed, knowledgeable and innovative citizens are causes for human centered development. Information technology facilitates the

flow of knowledge in modern society. Observing the impact of information technology on economies, developing block cannot afford to persist in a state of information poverty. Information technology, if properly harnessed, will help bridge the information gap and will give impetus to faster development in virtually all sectors.

Information technology can improve economic performance, expand and sustain health services, promote education and research, enhance food security and gender balance in development, strengthen and diversify ties with trade partners, invigorate culture and tourism and alleviate man-made crises and natural disasters. In the area of human capital development, for instance, the systems of education in many Developing Countries suffer from serious shortcoming including low teacher-student ratios; limited availability of instructional material; and poor quality of education, related to inadequate funding and inefficient use of available resources.

Information technology offers a wide range of low-cost solutions, through for instance, distance education given its flexibility, and suitability for its widely scattered student bodies, particularly among rural schools where both teachers and students have no access to libraries, reading materials or communication with the outside world. Clearly, although ICT will not bring development overnight, it will certainly permit those who use it to be players in the world economy.

Information technology has created challenges and implicit solutions. The challenges involve adaptation of the technology to needs and the implied solutions are the possibilities of using the technology to attack the perennial problems of underdevelopment: poverty, low-productivity, inequality and environmental degradation. Though there is now growing recognition of the far-reaching impact of telecommunications and networking on the economies of Developing Countries, a number of problems restrict its diffusion through public institutions. It includes socio-economic problems crippling equal access to information and communication technologies, the resource at the disposal of governments are mostly directed to dealing with emergencies with little left for long-term investments in sectors that could trigger socio- economic development. Education, information and communication are some of the sectors that need immediate attention for development in Developing Countries.

The absence of an efficient telecommunication infrastructure though most of the countries have established Internet links, access is mostly restricted to the capital cities and it is extremely expensive mainly because of the inefficiency of telephone services. Those in rural areas remain electronically isolated. Ironically, as a result of the quantum leap in technology, the inadequate state of telecommunications in many of our countries can be transformed into a great advantage if properly managed. The fact that the telecommunications sector is lacking in both coverage and density means also that the country is not burdened with extensive networks, built on obsolete technology, they can push to the cutting edge by ensuring that new infrastructure is based on the latest technology. The inadequate policies and incompetence of telecommunications management in most countries blocks achievement of the right to communicate socio-economic development and universal access.

The high cost of computers and software represents another serious impediment. But experts in the field suggest that bare-bone computers and stripped-down software perfectly serviceable for Internet connections, word processing, and graphics can be built today for a price, which is many times lower than current prices. And one way to induce producers to comply with such requirements is 'bulk-purchasing', which should be feasible given the potential market size of Developing Countries.

Unfortunately, most developing countries do not have any explicit plans or policies on information technology. The acquisition of information technology and software is a result of isolated initiatives without preconceived strategies and policies with little coordination and planning. There is thus a pressing need to devise clear national and regional long-term strategies and policies that cover the acquisition of information technology, its enabling environment and its applications. The strategies should quantify the investment requirements of the countries and identify the required changes in institutional, training, legal and regulatory frameworks that will foster the development of the information societies in the region. Such strategies would also serve as an explicit recognition of the challenges of the information technology and as instruments for attracting and coordinating donor assistance in this domain.

Entering the information age is not only about getting connected to the Internet and receiving information from the rest of the world. Developing Countries should have the material that will travel in the opposite direction, if they are to benefit from the global information system. Thus, national institutions responsible for data collection and processing need to be strengthened and their information collection and dissemination structures modernized. The local content of information would need to be developed even at rural community levels in as many languages as necessary given the pluri-linguistic and multicultural nature of many Developing Countries. This will encourage participation and speed information diffusion to benefit the majority of people. Information exchanges among developing countries would need to be encouraged. Sub-regional information systems would need to be developed and improved to provide meaningful backing to national efforts in this area.

Equally important is the question of sustainability. It is pertinent, therefore, to invest in low-cost and locally adapted solutions, such as the use of solar driven appliances. It is also important to make the users pay, from the very beginning, for the services they receive.

Measures to expedite Developing Countries' entry into the global information system must also address factors constraining the development of the information infrastructure. Reviewing the regulatory frameworks is important to encourage private participation not only in cellular telephony, but also in the operations of the state-owned telecommunication enterprises. Removing legal and regulatory barriers to the use of information and telecommunication technologies would promote interest on the part of the private sector.

CONCLUSIONS

The promises of various socio-technical progresses of information technology (from the networking to the translation tools) is a chance for global sustainable development, if the society really wants equity and finds a way to solve the possible interest conflicts mentioned above. The ideal situation for sustainable development would be if anybody could speak to anybody using such a language that he/she can be sure to be understood, and take decisions knowing exactly which would be the effects of this decision on the present and future environment or societies.

Improving information technology is a way to improve the decision making process to be more reliable and less risky in its results, because it would accelerate the way of making reliable information from ground measurements, and allow more transparency in the modeling processes. Higher the communication capacity, higher the potential of humanity's sustainable development. Information technology gives powerful tools – and no solution - for sustainable development.

In the light of above discussion, it can be safely assumed that it is not merely a matter of identifying what kind of knowledge and expertise is required, in fact the important aspect is to understand the pros and cons associated with the options. This will enable us to beware of the issues and challenges ahead, and would enable us to prepare accordingly. This can be summed up by quoting Socrates:

"Knowledge: Knowing how to use a tool
Wisdom: Knowing how to best use knowledge"

This implies that knowledge without wisdom won't be enough and vice versa.

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