The Role of Science in the Information Society Conference

Part I — Plenary Sessions

Monday, 8 December 2003, 2.00 p.m. to 7.00 p.m.
Moderator: Frank Rose

1   Welcome to the RSIS Conference

Welcoming Address by Professor Luciano Maiani, Director-General of CERN

« Your Royal Highness, Mr Secretary-General of the International Telecommunication Union, Mr President of the Summit's Preparatory Committee, Mr Special Adviser to the Secretary-General of the United Nations, Mr Special Adviser to the Swiss Federal Council, Excellencies, Colleagues, Ladies and Gentlemen,

It is a pleasure to welcome you to CERN for the Conference on the Role of Science in the Information Society.

CERN's purpose is basic research, the quest for the ultimate constituents of matter.

CERN, today, is engaged in the construction of what will be the largest particle accelerator in the world, for at least a couple of decades to come.

We will be proud to show you the great pieces of hi-tech work related to the machine and to its detectors that are filling all empty spaces in the Laboratory, while waiting to be installed in their underground infrastructures.

Research in elementary particle physics has also led to major contributions to society.

CERN is basically a particle accelerator laboratory, one of the major centres for the progress of this technology. Fifty years ago, there were just a few particle accelerators in the world, used as tools of fundamental research.

Today, over half the world's particle accelerators are used in medicine. About 20 million people each year undergo diagnosis using radiopharmaceuticals which are produced by a particle accelerator.

The prime example of how important the role of science may be in the Information Society is undoubtedly the World-Wide Web. We are very glad that Tim Berners-Lee, the inventor of the Web, has agreed to come back to CERN on this occasion as a testimony of the importance of science for civil society.

A distinguished colleague of mine, Lev Okun from Moscow's Institute of Theoretical and Experimental Physics, wrote to me recently that, "the honey of knowledge is the product of science beehives", going on to add that "it is not an accident that the most advanced and the most international of such hives — CERN — became the cradle of the Web."

Invented at CERN in 1990 in response to the communications needs of the world's particle physics community, the Web has gone on to revolutionize the way we share information and do business. Its value to the world's economy would have paid for all the fundamental science done last century, many times over.

The Web has influenced the way in which science is done. A good example is the electronic arXiv repository in physics which is open to any user of the Web. You can post your hot new article on the arXiv.org site and the next day anybody on the globe who has access to the Web can print it out and respond to it (all free of charge!). This has drastically enhanced the pace of research and involved in it scientists from countries and institutions where ordinary scientific journals are unavailable.

The existence of electronic archives is especially important at a time when the price of journals (both paper and electronic versions) is soaring. A ray of light in this situation is the international electronic *Journal of High-Energy Physics*; access to it on the Web is free of charge.

Freedom of expression and freedom of opinion, the right to exchange information and ideas regardless of frontiers (as enshrined in the Universal Declaration of Human Rights) are the necessary premise of the information society. In building such a society, the ability for all to access and contribute their information, ideas, and knowledge is essential. The Web was built and developed along these principles, which are the basis of fundamental research and the basis of the Web's success. In a recent discussion at UNESCO, by the Ministers of Telecommunication, free access to the resources of the information society has been strongly advocated.

Particle physicists, at CERN and elsewhere, are committed to developing new tools, such as the Grid, with potential benefits for all countries on both sides of the digital divide, in the areas of science, education, medicine, technology, and economic development.

In line with the UNESCO Ministerial statement, we are fully convinced that benefits from these revolutionary developments can be obtained by all countries only on condition that:

– fundamental scientific information is made freely available;

– the software tools for disseminating this information are also made freely available;

– networking infrastructure for distributing this information is established world-wide;

– training of people and equipment to use this information is provided in the host nations.

To realize these conditions is a formidable challenge which will require close collaboration of science, industry and governments. We urge that these four topics be given suitable prominence in the discussions which will take place here, to serve as input to the World Summit, later this week.

On 7 March 2003, the UN Secretary-General, Kofi Annan, issued a challenge to the world's scientists to address the clear inequalities in scientific activities between advanced and developing countries. And here, I turn to another theoretical physicist. The late Pakistani Nobel Laureate, Abdus Salam, believed that the gap between rich and poor nations was one of science and technology, and much of his life was devoted to closing that gap. In 1988, he wrote that "in the final analysis, creation, mastery and utilisation of modern science and technology is basically what distinguishes the South from the North. On science and technology depend the standards of living of a nation."

Our conference, organized jointly by CERN, the International Council for Science (ICSU), the Third World Academy of Sciences (TWAS), and UNESCO, responds to Kofi Annan's challenge and continues Professor Salam's mission.

Before handing over to Adolf Ogi, I would like to thank our partners, ICSU, TWAS and UNESCO, and our sponsors the Oracle Corporation, the Republic and Canton of Geneva, the Swiss Agency for Development and Cooperation, the Santa Fe Institute, the UK's Engineering and Physical Sciences Research Council and Particle Physics and Astronomy Research Council, the Spanish Ministry of Science and Technology, the Swedish Research Council and the African Virtual University. I have every confidence that we scientists can answer the challenge set to us by Kofi Annan, and I wish you a successful conference.   »

2   Welcome from the Host Country

H E Mr Adolf Ogi, Special Adviser to the Swiss Federal Council on the World Summit on the Information Society, Under-Secretary-General and Special Adviser to the Secretary-General of the United Nations on Sport for Development and Peace

« When Thomas Edison invented the light bulb, his dream was to allow each household to have one. When Tim Berners-Lee invented the World-Wide Web, his dream was to connect every human being. And their dream was a great dream, because technology should benefit all human beings.

We are privileged to live in times of great technological advances. Thanks to scientific discoveries, and thanks to rapid access to information, doctors, for example, can now save lives they could not save before. Thanks to modern means of communication, they can even directly intervene on a patient across the oceans. This is just one example of what technology can achieve today. This implies great challenges for tomorrow.

We all know that the infrastructure of technology is just one part of the question. We all know that at the core of the debate is the human being. The real questions are: To whom do we choose to give access to the new technologies, at what price and for what purpose? Are we ready to take the necessary measures, so that each one, without discrimination, can have access to information, to scientific and technological progress? Are we truly determined to invest money, time, and energy into making universal access a reality? The international community is asked to provide answers to these questions.

Ladies and Gentlemen, I have no doubt that this summit will bring light to the debate.

Switzerland, the host country for the first phase of this Summit, is committed to making it a significant event, significant in terms of its outcome, significant in terms of its appeal, significant in terms of its innovative inclusiveness. For the first time, governments, the private sector and civil society all participate in the negotiating process. As in all democratic processes, the various parties do not always agree. It really is a superb democratic achievement that the disagreements can be voiced aloud, in public. I am proud of this democratic debate.

As a Swiss, I am proud that Switzerland is the home of CERN. When CERN was established fifty years ago, its founding idea was 'science sans frontières', science without borders. This vision was strengthened by UNESCO's role at the foundation of CERN, by an aim to foster international, collaborative research without boundaries.

CERN is also where the World-Wide Web began. This World-Wide Web, that allows unprecedented access to information, information that governments, the private sector and civil society will have to help place at the disposal of development worldwide, for the benefit of us all, for the benefit of our children and coming generations.

On behalf of the Swiss Federal Council, I welcome you all to Geneva, and I wish you fascinating, constructive and fruitful debates.   »

3   RSIS at the World Summit on the Information Society

H E Mr Adama Samassékou, President of the WSIS Preparatory Committee, President of the African Academy of Languages, Former Minister of Education of Mali

Towards a Genuine Knowledge and Shared Know-How Society

« Your Royal Highness, your Excellencies, Secretary-General of the ITU, Director-General of CERN, Ladies and Gentlemen,

I would like to begin by thanking the Director-General of CERN for having invited me to participate in the opening of the CERN Conference on the Role of Science in the Information Society, on the occasion of the first phase of the World Summit on the Information Society beginning the day after tomorrow.

It is both an honour and a pleasure for me, as President of the Preparatory Committee for the Summit, to be able to exchange views with you on an event that is important not only for the international community, but especially for you, as representatives of the world scientific community, who have a unique role in the information society that is now taking shape.

That unique role is one that you are already assuming by organizing this event. However, I am well aware that it is also fully consistent with the time-honoured tradition of the scientific community in general and that of CERN in particular.

Indeed, I am convinced that the scientific community has an exemplary record in many respects. Science is a collective and global enterprise. It knows no frontiers and relies on constant cooperation among all concerned. From the first exchanges of scientific correspondence in the seventeenth century to the wealth of exchanges that underpinned the fascinating progress made by the physical sciences in the 1920s and 1930s, and ultimately to the great multinational institutions like your own, scientists have always engaged in cross-border cooperation.

Another characteristic of science that is less well known to the general public, but no doubt familiar to you, is the spirit of competition. In your particular field of fundamental physics, as well as in nearly all scientific disciplines, the desire for discovery is a key source of motivation. At the individual or group level, making a discovery and thus being ahead of everyone else is a factor of major importance and opens the way to fame and, in some cases, many and various rewards. However, this competitive dimension has a paradoxical side to it, in that competing scientists must continue to collaborate, if only in order to validate their findings.

Even Einstein's articles on relativity had to be validated by his peers! What I consider important, therefore, is that the competitive aspect of scientific research should in no way detract from the tradition of cooperation and solidarity among researchers. This essential lesson is imparted to us by the scientific community in general and by CERN itself — a truly collective and multinational institution if ever there was one.

A third characteristic of science also deserves thoughtful consideration: science operates in networks. Researchers throughout the world are in constant communication with one another, it being essential that they remain in contact in order to test ideas, check facts, establish experimental protocols, validate results, and compare opinions.

As you are well aware, it was the very idea of a network to facilitate cooperation between researchers in the field of information technology that gave rise to the Internet, and indeed the World-Wide Web came into being right here, thanks to the brilliant intuition of Tim Berners-Lee in the service of an environment, that of CERN, which undoubtedly contributed to wide-ranging discussions on collaboration between networks. From this standpoint also, the world of science prefigures the information society and deserves our careful attention. A famous sociologist, Manuel Castells, has clearly shown that the information society will be a society of networks. We must therefore heed any lessons that the scientific community can impart to us in this respect.

But rather than continue with what for you is an entirely familiar line of thinking, let me invite you to consider some concerns that are perhaps not adequately taken into account in the world of science, or at least in some scientific communities. I refer to the glaring inequalities that are to be found in the realm of scientific development. UNESCO has published a series of world science reports which eloquently address this theme: in all areas of scientific research, where public and private investment and the number of graduates, researchers, patents and publications are concerned, the disparities are enormous and continue to grow, resulting in an alarmingly massive loss of intellectual — particularly scientific — resources.

In short, the brain-drain is assuming disastrous proportions. I know that many institutions, including your own, are making every effort to take in researchers from developing countries in order to train them and give them an opportunity to work in a suitable environment, and for this I would like here and now to thank them. However, the situation as a whole remains fraught with serious dangers for the future.

The Declaration of the World Summit on the Information Society makes it very clear that the future of that society lies in the capacity to create, invent and innovate, particularly in the fields of science and technology. The fact that many developing countries are at a disadvantage in this regard is a very bad omen. The already very substantial digital divide could well become a knowledge divide that is even more difficult to overcome.

Indeed, the disparity is no longer merely a matter of the technological tools, which are lifeless instruments, but of entire nations. The capacity to train engineers and researchers, make high-level scientific institutions operational, and file patents and licences requires considerable resources and a great deal of time. As you know better than I, research in the realm of physics has readily found applications in information technologies, for example flat screens or mass memory devices.

I therefore appeal to the entire scientific community to mobilize, on the occasion of the World Summit on the Information Society, on behalf of those countries that find themselves at a disadvantage in the great adventure of scientific research and the production of technological know-how.

I would like now to share with you another subject of concern, one perhaps even further removed from your specific area of interest, namely the question of traditional knowledge. While science has today come to assume collective dimensions at both the national and international levels, it is equally the case that indigenous knowledge has served human communities since time immemorial.

However, such traditional knowledge is now under threat. First of all, the arrival of 'western science', validated by complex methods, could end up sidelining, and subsequently obliterating from memory, traditional forms of knowledge that are just as valid. Secondly,

some western companies do not hesitate to appropriate such knowledge and reap commercial profit from it by having it patented. Both these phenomena are today clearly recognized.

The World Summit has not hesitated to draw the attention of the international community to this alarming trend, and I welcome that fact. I should like to take this opportunity to suggest that you examine this topic in detail. A symposium on the inter-linkages between traditional knowledge and contemporary scientific knowledge might perhaps serve to lay the groundwork for more far-reaching cooperation and more effective action in this field.

It remains for me to raise one last concern, which has to do with the ethical dimension of science. This is perhaps a less momentous issue in physics than in the biological, medical or environmental sciences, but its importance should not be underestimated. Scientific know-how is neutral to the extent that it explores reality and seeks to establish the laws governing its operation. However, science is not immune from dangerous aberrations for the present and future generations.

It is not without significance that the Summit's preparatory process has sought to address the ethical dimensions of the information society and use of information and communication technologies. This initiative is entirely consistent with that approach. From the most abstract science to everyday applications, we must be careful to comply with ethical standards that are geared to preserving the human dimension of our collective efforts.

On a broader scale, I welcome the fact that the preparatory process has brought to light a large number of difficult issues that are merely technical in origin but which are giving rise to political discussions and negotiations in which the stakes, on a global scale, are vital for the societies of the present and future. The implications of the information society are as much societal as they are technological.

This is a considerable achievement on the part of the preparatory process. Internet governance and network security are indeed burning issues, but the dawn of the information society causes us to look towards the very future of humankind. Yes, the preparation of the World Summit on the Information Society raises real difficulties and conflicts in respect of ideological and political values: what is the nature of the society that we wish to build for ourselves and for future generations?

The issues being addressed by the Summit are vital because they touch on the fundamental values of our societies — values which underpin our vision of the world and our political choices, and which frequently — as in the case of science — involve us in ethical choices. There cannot be many of us who ever imagined that this Summit would end up raising such issues. And even fewer had any inkling of the scope of the human dimensions — political, ethical and societal — of the Summit's themes.

The World Summit on the Information Society is not just another summit. It has long since ceased to be the summit on information and communication technologies. Its aim is to define nothing less than the future of humankind, by seeking to build a genuine momentum for partnership between the main stakeholders, namely governments, the business sector, civil society and intergovernmental organizations, at the national, regional and international levels. The support required from each individual is therefore essential.

It is necessary, as a matter of urgency, to define the contribution of science and of information and communication technologies to the development of our countries. They should accelerate the development process and contribute to the fight against poverty, disease and ignorance by ensuring access to information and education. They should

facilitate action to combat natural disasters and help protect the environment. They should contribute to the fight against unemployment, create jobs and open up markets. They should improve productivity and make our countries competitive on a global scale.

To my mind, the challenge of the World Summit on the Information Society is twofold, being both technological and human. It is necessary to narrow both the digital divide and the knowledge divide. The information society therefore has to be about sharing in the broadest sense of the term; sharing through communication and information exchanges, as well as enhancing the ability of human beings to participate in the creation of knowledge, access information and use that information productively by transforming it into new know-how.

I have sought to share with you today my vision of the information society — a society of communication between individuals, a society of knowledge and of shared know-how, and, above all, a society characterized by solidarity between all the inhabitants of our planet, following the example set by the world of science and scientific communities. Information and knowledge can already be exchanged, shared and communicated over global networks.

All the citizens of the world will tomorrow, if we secure the necessary resources, be able to dialogue freely, share their knowledge and know-how and enrich their life experience through cultural exchanges. They will be able to build knowledge societies based on the wealth of their past and present linguistic and cultural heritage, thereby establishing a new solidarity founded on enhanced mutual understanding. They will perhaps be able, at last, to select common objectives that respect the freedom and dignity of all.

Thus it is that this Summit, which could on the model of the Earth Summit, be called the World Summit on Solidarity, will lay the cornerstone for a new abode for humankind — the abode of universal solidarity and peace.

May God help us in this great task!   »

Mr Yoshio Utsumi, Secretary-General of the International Telecommunication Union

« Your Royal Highness, Excellencies, Ladies and Gentlemen. It is an honour to be invited to address the opening session of this Conference on the Role of Science in the Information Society. It is only right to highlight science's special role in driving access to information and communication technologies and it is appropriate to host this meeting at CERN, the birthplace of the World-Wide Web.

As close neighbours, the ITU and CERN have always shared an effective and fruitful working relationship on telecommunications and networking issues. Aristotle once said: "All men by nature desire knowledge." We can all agree with this. It is vital that we build an inclusive knowledge society that can satisfy the yearning of those billions of people who are still today excluded from extraordinary scientific and technological advances that humankind has achieved.

This is one of the reasons that the ITU proposed the United Nations to hold the World Summit on the Information Society. The ITU's responsibility for organizing the Summit places it at the centre of one of the great challenges of this millennium, making information and communication technologies or ICTs accessible to all citizens of the world.

Ladies and gentlemen, scientists are for the most part poorly funded. We are poor. Many promising experiments and projects fail for lack of funds. Governments feel they have to justify expenditure to their citizens and they are inevitably reluctant to back long-term projects. At the same time they are aware that the scientific and technological advances are key drivers to the growth of nations and societies.

So how should governments best support scientific research? About 30 years ago the British government attempted to answer this question. They asked a distinguished academic scientist, Sir Frederick Dainton, to write a report on the role of government-funded science. Sir Frederick's final report concentrated principally on funding pure science, on which the government of the day — and this is true of many governments even today — had difficulty in knowing how to act. So they asked for a second opinion.

The second opinion they sought was from Lord Victor Rothschild, a distinguished scientist who worked in industry. Rothschild was a no-nonsense, hard-headed type who argued for the virtues of funding focused applied sciences. The British government was perplexed at the two contradictory but worthy reports and they could not make up their minds which report to adopt. So it published both reports in a single volume called 'Green Paper' and put it out for discussion and consultation. As you can imagine the floodgates then opened. The letter columns of *The Times* and scientific journals had the most distinguished scientists giving their views, while later editions had equally distinguished scientists giving opposing views. The academic world threw itself into the debate. Eventually the British government came up with a science policy, which — not surprisingly — did not satisfy everyone. It represented a balance of many divergent views.

There are many parallels to this story within the process that has brought us to this first phase of the World Summit on the Information Society. Our world is full of divergent opinions and different, even conflicting world visions. Like the British government's experience, the bringing together of a shared vision of a global information society and an action plan has not been an easy task.

I would like to emphasize that we see this Summit as the beginning of a process, not an end. In some areas there has not been agreement. But, at least we are defining a process to reconcile diverging points of views before the next phase of the Summit in Tunis in 2005.

A couple of months ago, the ITU brought to Geneva 255 young students from developing countries, selected as likely future leaders in the telecommunications and ICT sectors. As their contribution to the Summit, these young people made a joint declaration of their hopes for the Summit. The opening passage of the declaration was a challenge to the eloquence of the most seasoned politicians:

"The world we live in is not fair at this moment. Some of us benefit daily from the empowering force of ICTs, while others, to whom simple communication could mean the difference between life and death, hope and downheartedness, a sparkling future and stagnation, do not have access to any form of ICTs. This is not our destiny."

I submit to you that constructing a world where everyone has access to scientific discoveries is not an act of generosity but principally a demonstration of good common sense.   »

4   Keynote Presentations

Nitin Desai, Special Adviser to Kofi Annan on WSIS

« Your Royal Highness, Director-General, my friends, Mr Ogi, Mr Samassékou, Mr Utsumi, all of those who have been working very hard for this Summit,

It is a pleasure for me to be here. I have organized many summits, so my status in this summit is a bit like an uncle at the wedding. As I said to Mr Samassékou, Mr Utsumi and Mr Ogi when they observed that the conference would be difficult: "Well, it is worth doing because it is difficult. If it had been easy it would not have been worth while." I am very happy that things are all in place and we look like getting an interesting programme and declaration of principles ready in time for the Summit.

The Moderator asked me what my worst nightmare was about the information society. Perhaps one of my worst nightmares about the information society is that the net result may be that we will lose our capacity to converse with one another, to talk to one another. We will be too busy reading our e-mails.

The first telegraph message sent was "What hath God wrought?" The first telephone message was sent by Alexander Graham Bell who managed to spill some acid while he was making his phone call and the first phone message was a barked message: "Mr Watson, come here I want to see you." And the first Internet message was two letters, LO, after which the computer crashed. And maybe this is what the future holds for us, that we will all end up talking in staccato English.

The Moderator also asked me: "What is it that excites you most about the possibilities of information technology?" And that is what I am going to focus on, that is what this Summit is about. And I am particularly happy to do it here at CERN, the place where the World-Wide Web was born: for many of us lay people, the Internet is the World-Wide Web and e-mail. This was a technology that was basically developed by scientists for the purposes of communicating with one another, for disseminating content and for collaboration.

This was later combined with a dramatic reduction in the cost of connectivity of computers during the 1990s. The development of faster communication, content dissemination and collaboration has had a tremendous impact in every area of life, whether in business, in government, education, health, or culture.

But the area that I am, of course, much more familiar with is governance. Much of the profound impact on governance was, of course, focused in terms of governments working better and in different parts of governments being able to connect with one another. Some of it was reflected in terms of governments interacting better with citizens.

But I want to stress and focus on a third dimension, namely on the impact that this technology has had on democratization and that it can have in terms of democratization in the future. We have looked a lot at the impact of this technology on the economy and productivity gains and of the way in which geographical barriers have been eliminated so that production can be organized in a completely different way. That is profoundly important. A lot of people have looked at the impact in terms of how large organizations like governments work more efficiently and more transparently. Let me give you a few examples.

In the Philippines there was an attempted *coup d'état* and do you know how the *coup d'état* was stopped? Quite simply with SMS messages on the telephone. People just mobilized quickly using SMS messages and stopped the *coup d'état*. What was the principal source of

information for people in Milosevic's Yugoslavia? It was the Internet. What has been our most important source of information out of Baghdad before, during, and after the war? A blogger called Salam Pax. What lies behind the Landmines Treaty? The use of the Internet by citizens groups in about 60 different countries who joined together through the Internet and created so much pressure that governments had to respond. And this capacity of the medium to provide better connection between people is, I think, the contribution that it is going to make, and this is basically what it really started as. That is exactly what the old scientific ARPANet was trying to do, to connect scientists working with one another on an equal footing in a collaborative way, and that I believe is the future of this technology and this sector.

But what are the problems? In some ways a Summit like this always talks about problems. The one big problem, which Mr Samassékou referred to, which many people have talked about, is the digital divide, that is the great disparity in computers, connectivity and the capacity to use both of these, in different parts of the world and within the same country. The digital divide is a relative term. We can speak of a digital divide within rich countries. In the United States, where I work a lot of the time, the measure of the digital divide is: do you have a home computer or not? If your only access to the computer is the one at your local library, you are considered a digital have-not. I promise you, a person who has access to a public service computer in a poor country is considered to be a digital have. Similarly, in the United States only 31 per cent of African Americans have an Internet-enabled computer whereas only one per cent of Africans have it. So in many ways what we call the digital divide is to some extent society-specific.

My second difficulty with the concept is: it tends to focus attention on the digital side, as if the solution were a digital one, but in many cases the solution is not a digital one but an organizational one. In many cases the gap is not simply that somebody does not have a computer or a telephone line, it is also the incapacity to use it or a lack of content that the person needs, whether in terms of land records, agricultural prices, or whatever. So the digital divide is not something that necessarily requires only a digital solution.

Thirdly, I want to stress that in many ways this Summit is not about a problem, it is about an opportunity. The opposite of division is multiplication, so in some ways instead of talking about the digital divide we should probably be talking about digital multiples. Your telephone becomes more valuable if I acquire a telephone. That is true in any network society. We should increasingly focus on the need for people to connect better with one another, both for the purposes of articulating their views, which is the democratization concept, but also for the purposes of their productivity and for their income-earning capacity and knowledge base.

Clearly, once we see this as essentially something that allows people to connect with one another and access knowledge, issues of access to knowledge become important. This is a prominent issue. For instance, we speak of access to information, namely to scientific information. Clearly, the days of the expensive published journal should be behind us. No scientist makes any money by publishing an article in a very expensive journal. Very few people can afford it. There is no reason why we cannot have a system of dissemination of scientific information with a full refereeing procedure available faster and more cheaply to people all over the world.

These are some of the issues that we also need to address if we are serious about improving access to information. At the same time, there are serious concerns about copyright, for instance by musicians and others, which will also have to be addressed. You as the scientific community can address one dimension of this concern, namely the issue of Internet governance. This has been a major area of controversy at the conference. They have found a

way through by requesting the Secretary-General of the UN to set up a working group to address the issue. Much of what we call management of the Internet is done by the scientific community, although industry is involved to some extent. Perhaps one of the issues that needs to be addressed is: how do we involve more people, particularly people who are now entering this field in other parts of the world? This is something else for you to address.

I believe these are all issues of digital opportunity and they provide great hope for many people in many parts of the world. But there is also a great risk that if you don't address it, people will get left behind because things are moving so fast. If a country gets two, three or four years behind, it is way behind. It is not like the old industrial revolution. When we held the Rio Conference in 1992 there was no World-Wide Web. By the time we held the 10th anniversary of Rio last year the Internet and the Web had revolutionized communications. The pace of change over this decade should tell us something about what we can expect in the next.

So, for all of these reasons, I believe that the scientific community has a crucial role to play. You are the people who basically got this technology going and I believe you are also the people who have the capacity to address some of the problems that people sense in the use of this technology. Even more important are the huge opportunities for many more people to have access to it. So I look forward to your work and I look forward to your continued help as we pursue the task from Geneva to Tunis. Thank you very much.   »

H R H Maha Chakri Sirindhorn, Princess of Thailand

Keynote Address on 'The Needs for ICTs in Developing Countries'

« Mr Adolf Ogi, Special Adviser to the Swiss Federal Council on WSIS, Mr Luciano Maiani, Director-General of CERN, H E Adama Samassékou, President of WSIS PrepCom, Mr Yoshio Utsumi, Secretary-General of the International Telecommunication Union, Mr Nitin Desai, Special Adviser to Kofi Annan on WSIS, Mr Walter Erdelen, Assistant Director-General for Natural Sciences, UNESCO, Distinguished Delegates, Honourable Guests, Ladies and Gentlemen,

I am very honoured to deliver a keynote address to this important gathering. First of all, allow me to express my deep appreciation to the Director-General of CERN and the Government of the Swiss Confederation for the excellent arrangements and warm hospitality.

In the information society, there are highly-developed Information and Communication Technology (ICT) networks. The access to information is equitable and ubiquitous. Appropriate content in accessible formats and effective communication can help people to achieve their potential, promote sustainable economic and social development, improve the quality of life for all, alleviate poverty and hunger, and facilitate participatory decision-making processes. The topic we will be discussing during this two-day conference is of the utmost importance because, I believe, without strong participation from the scientific community and continued scientific discovery, it would be very difficult for the majority of people of the world to realize our vision of the information society.

We are living in an increasingly globalized world where ICTs have played an important role in the development of our societies. Yet, I am sure we all agree that the benefits of globalization and technological advancement are, unfortunately, unequally shared. We have witnessed that, in many parts of the world, in particular those living in remote and rural areas, as well as those belonging to disadvantaged or under-privileged groups, are still

excluded from access to necessary technology, especially the Internet, or do not have the skills to use it in an effective and profitable way. The gap exists not only among countries but also within a country. In this respect, Thailand is no exception. The barriers to equitable access result from differences in education and literacy levels, age, income, and connectivity.

To overcome unequal access, we must take into account local conditions and specific needs and must proceed according to the sustainable principle. I wish to share with the distinguished delegates here, my experiences in science-driven ICTs and their applications in the education of the under-privileged and in social development in Thailand.

I have had the opportunity to follow His Majesty the King to almost every corner of the country, no matter how remote, since I was young. Through this experience, I have accumulated first-hand knowledge about people's way of life and living conditions. His Majesty has based his development work on scientific research and first-hand knowledge of the landscape and culture, and I have used the same approach in my work, including those related to IT, for the Thai people, especially those that are in need.

It is apparent that development must start with the empowerment of people. When I learned about IT and what it could do, I saw that it could be a potential solution for the purpose. This led me to set up, in 1996, a fund to be used in IT-related programmes. My greatest goal was to enable the under-privileged Thais such as rural school children and people with physical disabilities, to benefit from an increased use of IT so that they can have full participation in shaping political, economic, and social development.

Furthermore, my programme has focused on providing opportunities for the people to receive good education. The belief is that at the very least, they should be literate and be able to read official documents to gain knowledge about new technologies, because this would later help them to earn their living after completing compulsory education. In other words, it is important to equip young people with knowledge and skills to prepare them for full participation in the information society.

Presently, there are four groups of the under-privileged that I have focused my work on. Those are: rural school students, persons with disabilities, sick children in hospital, and prison inmates. In helping them to be IT literate and able to use IT as a tool in their education and learning of new knowledge, we provide computer facilities at various corresponding institutions, such as rural schools, schools for disabled persons, hospitals, and prisons, etc. Since teachers act as a gateway to the information society, their skills development and curriculum resources need support. Therefore, we help to train teachers and provide appropriate educational materials as needed.

To ensure that development is achieved, I started the programme on a small or pilot scale, and worked closely with each setting, frequently in a trial–errors–improvement mode, before further scaling up. And more important, I placed emphasis on monitoring and evaluation throughout the course of the programme to make sure that the programme as well as the evaluation teams worked in a cost-effective way. This also included procurement and maintenance of the equipment. When I am sure that the process is feasible I then give these tried and tested solutions to the administration in charge so they can scale them up to cover the entire population who can benefit from such undertakings.

Allow me to quickly highlight some of the achievements we have made over the course of our long endeavour, as follows:

– Students in more than 70 rural (and very remote) schools have the opportunity to learn and benefit from IT; many of them have won prizes in various national competitions; many have passed the examination to study engineering or computer sciences in universities of good standing; many have helped other young ones in their school and community to develop IT skills.

– Students in schools for the disabled have had the opportunity to learn and benefit from IT despite their "less-than-perfect" physical conditions, with the help of assistive technologies as appropriate, and some of them got IT-related jobs after graduation, some continued their studies in IT field at university level.

– More than 300 prison inmates have been trained in IT skills and have been able to take some typing or graphic design jobs which have generated income of over US$4,000 during the past three years. This income was partly reimbursed to prison inmates who did the jobs as bonuses which can be used to cover their living expenses while in prison.

– Female prison inmates who were trained specifically for this purpose have made more than 30 book titles into multimedia books in the DAISY format. These multimedia books will then be given to the library of the blind to add to their collection.

We also work with talented students, for example in science school, to encourage them to exercise their creativity. They can share knowledge with the public and enable them to succeed in their future studies.

Herewith, may I summarize and give my perspectives, which I have developed through the course of implementing such programmes. The main principle is to set the foundation for empowering those who are less advantaged by providing sufficient access to ICTs, by facilitating talented and enthusiastic people whose nature is the thirst for knowledge, and by encouraging them to participate fully in such endeavours. Being less advantaged can be caused either by their socio-economic status, geographic location, or physical condition. In the long run, it is hoped that these individuals will become more proactive in forging their own development and the development of their communities.

The challenge in all these undertakings is that there is no ready-made and no single formula for development that will suit the needs of everyone, everywhere. I do believe, developing a country must be done step by step. First, we have to build the fundamentals. Only when people have enough to eat and can meet their basic needs will they have a healthy and creative mind to accept other things or take on other challenges that are introduced to them, ICTs in this case. Throughout the course of development, a scientific approach and method as well as strong commitments are needed in order to achieve a successful and workable solution for development under each circumstance.

Lastly, let me conclude by emphasizing once again how important this conference is for the future of our global community. I am certain that Thailand is ready to work with you all to realize our common vision, that is, to free people from poverty and to achieve sustainable development of the information society for all.   **»**

Walter Erdelen, Assistant Director-General for Natural Sciences, UNESCO

« Your Royal Highness, Excellencies, Ladies and Gentlemen, colleagues and friends,

It is a great honour and pleasure for me on behalf of the Director-General of UNESCO to take part in the opening ceremony of this important conference on the role of science in the information society. I wish to thank CERN for organizing and hosting this meeting, which is to discuss a number of issues that I see as crucial to the ways in which the knowledge society develops. I shall refer to the contribution of science to development and what it can do in particular to ensure that the benefits of that development are made available to all, notably by virtue of the tools of new technology.

UNESCO is indeed emphasizing the importance of equity, access and content in its overall contribution to the World Summit on the Information Society, which of course goes beyond scientific matters alone. This specific vision stems from the Organization's constitutional responsibilities and from its three current main strategic thrusts: developing universal principles and norms to protect and strengthen the common good; promoting pluralism and ensuring equitable access; capacity building and sharing of scientific knowledge.

It is undeniable that the world is in the throes of profound changes that are creating enormous new opportunities while posing equally daunting challenges. On the one side, advances in science combined with a digital revolution have the power to transform many aspects of our individual and collective lives. However, the digital divide is depriving countries and peoples in the developing world of the benefits, including the potential economic benefits, of these advances. The limited availability of information and communication technologies is thus a direct and major obstacle to knowledge-building and -sharing and consequently a denial of this very basic human right to enlightenment, learning, and empowerment.

The scope and effectiveness of UNESCO's action is of course limited and it seeks to make a difference in certain specific areas working in partnership with others where at all possible. In the scientific domain I can mention, for example, concrete initiatives aimed at improving science education and training and at disseminating scientific knowledge, including through the creation of multimedia courseware, virtual laboratories and virtual universities. I would also refer to the development of open-source technologies.

I would like to take this opportunity to inform you that UNESCO is launching a new programme in basic sciences known as the International Basic Sciences Programme (IBSP). This programme will be oriented towards two principal goals: building national capacities for basic research and promotion of science education. It aims at facilitating the transfer and sharing of scientific information, promoting excellence in national science, fostering awareness of science by society at large and providing the necessary international scientific expertise to Member States. IBSP will be based on the networking of existing centres of excellence or benchmark institutions in the basic sciences and science education. ICTs will play a decisive role in making such networking a reality and in fostering international scientific co-operation.

This new programme, like many other activities carried out by UNESCO, stems from our conviction that the flow of knowledge should not be a one-way process but that local and traditional knowledge and other expertise available in the South should be exchanged.

It is these and other issues of content that we hope will be at the centre of the first stage of this Summit here in Geneva and perhaps more so in Tunis in two years' time. I look forward to the Declaration and the Plan of Action that this Conference will produce and wish your meeting every success.   »

5   Visionary Presentation

Esther Dyson, Chair of EDventure Holdings and founding Chair of ICANN, the Internet Corporation for Assigned Names and Numbers

« Your Royal Highness, your Excellencies, Ladies and Gentlemen,

Talk of Internet governance is in the air. The recent United Nations-sponsored World Summit on the Information Society, held in Geneva, issued a statement saying that "authority for Internet-related public policy issues is the sovereign right of States". It concludes by calling for a study that will make recommendations — at the end of 2005. For some of us, that's a rather long time. And government authority is the wrong conclusion. Taking place at the same time as the WSIS was a smaller and more productive meeting of the Internet-policy working group at the Aspen Institute, a non-profit leadership organization. Through the miracles of modern transportation (and despite a couple of snowstorms), I managed to take part in both.

A Civil Solution

In Aspen, our small group of government, business and nonprofit folks started with a more practical and urgent approach, considering three big Internet problems (eschewing domain names, for once): spam, privacy, and overall security against viruses and other intrusions. The approach we came up with is 'the accountable Net' — an Internet of people, companies and services that are accountable to one another rather than to some omniscient central authority. Many of the states contemplated by the WSIS document are not completely democratic. And even if governments were all as benign as we could wish, they cannot provide the kind of flexible, responsive feedback to foster good behaviour that we can provide for ourselves.

The idea is simple: people on the Internet should be accountable to one another, and they are free to decide whom to interact with. The goal is not a free-for-all, anarchic Net, but one where good behaviour is fostered effectively — and locally.

In the real world, good behaviour is fostered by a combination of government regulations and society standards. But the Internet is no longer the community it once was. It has become too large for people to really know one another. The solution is not necessarily more government, but rather more visibility of the kind we used to have: People need to know one another, and they need to be able to decide whom they want to know. (The new social networking tools are one manifestation of this desire, but we also need to be able to communicate safely with people we may not consider friends or business partners, but whom we wouldn't shy away from on the street.)

The default anonymity of the Internet makes it easy for individuals to do bad things — send spam, invade people's privacy and send data around the Net, launch viruses and other attacks. And that same anonymity makes it hard to enforce laws against those actions, even as it preserves our freedom.

But the Internet's technology also makes it easier for individuals to protect themselves: they can take their safety and privacy into their own hands with tools such as firewalls and spam blockers. And, of course, on the Internet, it's easier for people to get up and move to a virtual neighbourhood that they like better.

Let the People Rule

Sounds great, but how does it really work? What I'm proposing is not a rule-free society, but one in which rules come from the bottom up: generally enforced by peers, with governments in the background. Nor is this a world of individuals only. There are other players: Internet service providers, for example, who collect money from their customers, then vouch for their behaviour and deal with the more technical aspects of Internet security and spam deterrence. Vendors of software also play a role. They need to make their products more secure from such threats as viruses and spam.

The basic rule is transparency: you need to know whom you are dealing with, or be able to take proper measures to protect yourself. The accountable Net is a complex system of interacting parts, where users answer not just to some central authority, but to the people and organizations whom they affect.

That keeps each person's Internet small enough to allow for individual choice, but at the same time part of a whole large enough to sustain regimes for various tastes. To the extent that one community's actions affect another, each community can decide whether to interact. To make this work, we need government at the back end, ready to prosecute extreme cases of fraud and misrepresentation (as well as crimes such as identity theft, antitrust violations and other traditionally offline crimes). We also need a robust technical architecture, with effective means for authentication of users where necessary, strong security for keeping data and communications safe, and effective systems for keeping track of what's going on.

Note that the right to anonymity and freedom of speech can and must be preserved, along with other people's freedom to ignore those speakers (and the government's obligation to go after criminals). The default is to keep out anyone or anything that might not be worthy of your trust — but to accept parties rated positively by the people you do trust. As in real life, that amounts to a pretty broad circle.

We live in a complicated world, and there are no simple solutions. But there is a simple approach: keep control local to the extent possible, so that people can take care of themselves. Give them powerful tools. Understand the roles of government (central authority) and of the market (individual choice), and that the strongest force lies between the two: society, where people interact with one another.

Most people, given the choice, do want to interact constructively with other people they trust. Let's create a world of accountability on a human level. Online or offline, that's a worthy goal.   **»**

During the question and answer session, in response to questions on the role of ICANN, Esther Dyson replied:

« ICANN's role is limited and should stay limited. It should remain independent and should not attempt to deal with broader questions of governance and social policy that it is not equipped to handle. On the other hand, ICANN should be (and is becoming) open to input from individuals. As scientists, you can play a role as individuals (rather than through your governments) in helping ICANN to come up with appropriate policies in its limited technical domain. Help it stay focused!

There are obviously political, linguistic and cultural implications in the domain-name system. Mr Ogi referred to 'science sans frontières'. What ICANN is trying to do is create a domain-name system 'sans frontières' open to all people. I don't think governments are necessarily the best representatives of all the individuals who use the Internet without borders, trying to reach across countries. The domain-name system is organized in part by country, the country codes, and in part according to the other domains. One of ICANN's tasks has been to open up the domain-name system to new names. It has not done that very well but it has done it to some extent. It would probably do so faster if it remains small and lightweight. It should do so in response to what the users are asking for. Again ICANN is a mechanism whereby users, individuals, NGOs, businesses, governments in their capacity as users can address a body directly and try to reach some consensus on this one issue. Democracy does not mean that everybody gets his way. It means that everybody has a voice and feels that they have played some part in reaching a compromise. That is the kind of institution that ICANN is trying to be.   »

6   How the Information Society Fosters Research and Learning

Dr Ismail Serageldin, Director-General of the Library of Alexandria

«   Your Royal Highness, Excellencies, Ladies and Gentlemen,

Libraries are a fundamental part of the cultural landscape of any country. They preserve the achievements of the past and provide access to that common heritage of humanity. They are fundamental components of the education and training system, and increasingly an important instrument for spreading the values of rationality, tolerance and the scientific outlook. Many libraries have important public outreach functions. However, they are also an essential part of the scientific research and development efforts that drive contemporary economic growth.

Less-developed countries face problems of access to recent research (mostly in journals) and to reference material (mostly in libraries) and to databases (some of which are proprietary), all of which severely constrains their aspiring scientists or practising researchers. The costs are too high for their national budget, and frequently lack of foreign currency further limits their ability to purchase the needed materials, even for central institutions such as national or university libraries. This issue has been rapidly exacerbated in the last decade by the rapidly multiplying amounts of information, journals and publications. However, libraries are currently undergoing a major transformation in the wake of the digital revolution. Indeed, the digital revolution and the enormous advances in ICT have opened up opportunities for remedying this as never before.

The current approach to have books and other written materials collected in a usable fashion in fixed locations, where interested persons can have access to the materials has long suffered from several constraints:

– the huge costs involved in collecting the materials, cataloguing and maintaining them;

– the limited choice available in any one location;

– the difficulty of accessing the material in the truly large collections (e.g. Library of Congress, BNF, the British Library, etc.) where the person who manages to get there physically and requests the book sometimes has to wait as long as one hour, only to be told that it is being used by another reader.

These constraints of space and time are suddenly falling away in the wake of the Information and Communications Technology (ICT) revolution and the widespread use of new digital technology for the production and dissemination of the products of the human mind: text, data, music, image, voice … all are now unified in bits and bytes spelled in the language of ones and zeros. The ICT breakthroughs, especially in terms of the connectivity that comes from the Internet and the ease of use of Web-based interfaces, have revolutionized the practice of science. Material is instantaneously available to researchers everywhere at all times by posting on the Web. Downloading is easy, and the work is commented on by many all over the world almost instantaneously.

Within this context, many questions arose for the idea of a library and for the legal framework within which the utilization of the material takes place. The Intellectual Property Rights (IPR) regimes that we have come to know and use increasingly seem under challenge as the libraries start moving towards hybrid systems where they continue the traditional functions of the lending or reference library of printed materials as well as the new functions of providers of online digital material.

The advantages of digital libraries based on the new technologies are manifest:

– immediate and easy access to materials on-line 24 hours a day, 7 days a week;

– no need to be physically located at the location of the digital materials;

– copies of the material available in any library can be made available to the other libraries at almost no cost, and with the same quality as the original material;

– searching for information is infinitely easier in the digital format;

– keeping material up to date is no longer an issue especially for locations previously considered remote from the centres of publication and dissemination of knowledge; and

– thanks to the efforts led by the Carnegie-Mellon Foundation, the back issues of scientific journals are presently being made available for free to the poor developing countries, a major gift that is not sufficiently appreciated.

But several problems are emerging:

– problems of physical obsolescence of the material;

– problems of technical obsolescence of the material;

– problems of the establishment of common standards for the digitization, filing and maintenance of the material so that it can be easily accessed on a common basis; and

– the issue of IPR in the digital age.

The first three of these problems are being handled by a number of major libraries and archives that have a direct interest in establishing a proper system of managing digital resources that are growing much faster than anything we have experienced in human history. Already the amount of material produced in electronic form exceeds all that has been produced in written paper form and the volume is growing by as much as 10% per year. Libraries in developing countries will probably have to follow suit and adhere to the common standard, and it is possible that some institutions — such as the newly founded Library of Alexandria — may join the leading institutions in developing that common standard.

A more complex issue is the management of IPR in the digital age. That was the topic of a major study in 2000, which carefully framed the issues but did not come up with firm recommendations on the most troubling of these issues. Specifically, the choice today is between those who seek to use the new technologies to maintain the system of 'copyright'

which has evolved during the long era of the print medium, and those who believe that the new digital materials require a different approach that is suited to the possibilities of the new technology.

New technologies require new business models. The achievements of Henry Ford, Bill Gates, Michael Dell are examples of how the business model was suited to the technological innovation/change and thus worked well. In their cases (the assembly line, the Operating System of the PC, and the use of Web-based sales to cut out the distributor), the adaptation of the business model to the new technology is what allowed them to outdistance their rivals.

In the domain of research and publishing, the digital revolution is so profound that it challenges the very concept of the organization of knowledge. Today, the density of hyperlinks in the material within a coherent domain of knowledge is far more important that the sheer size of the material. The presence of powerful search engines like Google makes the search enterprise different. If your material does not exist in this particular organized domain, it is as if you did not exist at all! This exclusionary aspect will become more serious as the size of these domains become larger and the users far more numerous.

The very presence of a digital archive for the World-Wide Web (Brewster Kahle's Internet Archive) is already making use of available digital material moot. The duplication of this material in several centres, including the Library of Alexandria, will ensure its availability against physical or political disasters that could destroy that record.

The willingness of some distinguished institutions (e.g. MIT) to think of putting their course material on-line, or creating communities of practice that would produce an enormous body of material to be used by researchers and teachers everywhere in the world (e.g. the health epidemiology course materials initiative and the future BA Science Supercourse) is opening enormous new opportunities for researchers around the whole world, especially those in the developing world who until now have been enormously disadvantaged compared with their colleagues in the industrialized countries.

Today when we stand at the threshold of the new ICT revolution and can barely see the contours of the new organization of knowledge, we must be willing to re-invest ourselves and to think of radical change, not just incremental change.

Some well-established concepts have to be reviewed in the light of the new technologies:

– publication

– peer review

– copyright

– fair use

– inter-library loan.

All of these are central to the practice of science and to the spread of the scientific enterprise throughout the world. It is therefore pertinent to review each of them in a little more detail.

Publication

The ICT revolution has blurred the distinctions between private and public printing/publishing/distributing. Is material posted on a personal website published? Anybody can post anything on the Web, and frequently most people do.

What are the impacts of having material in both formats (digital and print) at the same time? After all, the movie companies are now releasing films in traditional theatres/screens that are subsequently shown on TV and sold in video and DVD formats. The studios have simply changed their business model in the light of the changing technology.

Print on Demand, already available in its preliminary forms, may well be the way of the future rather than, or in addition to, the e-book. But whatever it will be, I am convinced that the traditional way of publishing and selling books will go the way of the dodo! Our interest in this panel should be that the new models for publication are implemented in such a way as to ensure maximum access to all information everywhere.

Peer Review

Is there a responsibility in the community of scientists to enforce some sort of minimum standard in electronic posting (the electronic equivalent of the peer-reviewed scholarly journals)? How would this be done?

If on the other hand the community of practising scientists does not address that issue, what are the risks inherent in getting creationism alongside evolution, and astrology alongside astronomy? Is there a responsibility for the community of science to make public the distinction between science and quackery? If so, how, in an environment where anyone — literally anyone — can set up a website with a more or less scientific name.

The scholarly journals are in financial crisis. The specialist journals cannot be issued conventionally without enormous cost, putting their subscription rates beyond the scope of all but a few libraries and individuals. The narrowing subscriber base further pushes up the unit price. This cannot go on, at a time when precisely the new ICT revolution should be allowing plentiful avenues to disseminate specialized research to relatively small and far-flung communities of scholars and researches.

Peer review practices are among the frequently cited obstacles to allowing these kinds of digital journals to prosper. But surely it is possible to allow the peer review process to occur on certain postings on certain gateways and also use some other means of evaluation for the material that may be produced by communities of practice, a needed variation if we are to allow for a large volume of reservoirs of knowledge to be made available as it comes on-line.

Copyright and IPR

As much as possible of the scientific literature should be put on the Web in digital form for access from remote areas. New approaches to replacing copyright with more suitable ways of protecting IPR and rewarding innovators while supporting the public interest in having broad access to knowledge should be developed as rapidly as possible.

I believe that many of the presently stated copyright fears are largely unfounded. Evidence shows that sales of books posted on the Web are increasing rather than decreasing. That is the experience of the NAS with its report. Last century the same fears that broadcasting songs on radio would result in people not paying for the records proved groundless. (The Napster case is primarily a business model issue, and has been overtaken by p2p technologies and Apple's i-store.)

Fair Use

The doctrine of fair use is under challenge. Between those who see it as a fundamental right once something is made public (published in the conventional sense) and those who see fair use as an exception to an absolute monopoly granted to the author/publisher of the material. I personally stand on the more liberal definition, although many jurists disagree with any such 'rights' approach to the fair use issue. Those who agree with this view base it on the idea that the copyright is granted as part of a dual objective: rewarding the innovator and ensuring public access to the innovation.

However, extensive access to the results of scientific research can and should be used widely — short of plagiarism. Copies made for education, lectures and/or discussion and debate should be encouraged within all possible bounds to the extent that there is no commercial piracy of the work or substantial loss to the author/publisher.

The digital libraries of the future should be handling grey literature electronically. They should be willing to maintain gateways for the sharing of teaching materials. Such electronic gateways, managed by some libraries, should be used to organize the sharing of information digitally between teachers and researchers through a model based on a community of practice sharing and improving the material being made available for all on the gateway.

Inter-Library Loan

Long accepted as a means for libraries to enrich the material they can offer their readers, it is being seen as fraught with danger when the material is electronic. Yet this should not be so. Inter-library loans should be encouraged electronically. This would be more efficient and effective, and various models of handling the access copying fears, ranging from using established conventions to self-limiting or time-bound software, can be explored.

Recommendations

The times we live in suggest some important recommendations:

1. The efforts to provide digital copies of back issues of the scientific journals should be intensified and the full range of that material posted for free and universal access.

2. The journals that are still publishing should be encouraged to allow the posting of selected articles concurrently with the paper publication and reduce the time between the appearance of the latest issue of the journal and posting in electronic form, and bring it down to say six months.

3. A major international effort should be launched to ensure that a digital-format, basic science library is made available to libraries in the developing countries.

4. As much as possible of the scientific literature should be put on the Web in digital form for access from remote areas. New approaches must be found to replace copyright with more suitable ways of protecting IPR and reward innovators while supporting the public interest in having broad access to knowledge as rapidly as possible.

5. Inter-library loans should be encouraged electronically. This would be more efficient and effective, and various models of handling the excess copying fears, ranging from using established conventions to self-limiting or time-bound software, can be explored.

6. Major hubs in the developing world can be organized whereby they share the management of large amounts of digital information with advanced research institutions in the industrialized world. The backing up of material in this fashion is eminently sensible and facilitates the access to certain types of material (video, image) that require large bandwidth not necessarily available everywhere.

7. A significant reduction in the cost of connectivity must be pursued for institutions and individuals, and especially the cost of high-bandwidth connectivity for leading institutional hubs in the developing world.

8. Electronic gateways managed by some libraries should be used to organize the sharing of information digitally between teachers and researchers through a model based on a community of practice sharing and improving the material being made available for all on the gateway. »

7   Bridging the Digital Divide

Santiago Borrero, Secretary-General, Pan American Institute of Geography and History (PAIGH)

Spatial Data Infrastructures (SDIs): Bridging the Digital Divide

« Your Royal Highness, your Excellencies, Ladies and Gentlemen,

I would like to start by expressing my sincere appreciation to the organizers of this event: CERN, especially to its Director-General and conference leader, Mr Luciano Maiani, ICSU, TWAS and UNESCO. It is my desire that the conclusions of these two days of work will shape the role science must play at WSIS deliberations and, more importantly, the role of science during the implementation phase that follows the Summit.

In the context of today's knowledge society, I come from a very distant place, the developing nations.

Nonetheless, the reflections and recommendations I am about to share with you are based upon the empirical knowledge gained from years of exposure in Colombia as the senior executive in charge of mapping, land information, geography and from working in the area of information and development with non-governmental organizations in the region and across the international community.

Allow me now to begin by taking advantage of a situation that some of you could judge as merely anecdotal. The day I started to prepare this intervention, the initial thing I did was to check the 'Guidelines for Speakers' provided by the organizers. The first instruction reads as follows:

"Click here for information on how to get to CERN."

By clicking here, I was immediately connected to a basic map of Geneva, with a zoom capacity that allows the user to easily identify the location of CERN and the facilities where this plenary session is taking place. The information even indicates exactly where the CERN Fire Brigade is located!

This is geographically referenced information and it is an important kind of information. In fact, this type of information is available for the majority of developed regions and is relevant to many — endless — applications. The term spatial is often used interchangeably with the word geographic.

But, then I thought, what if this event would have taken place on the other side of the digital divide, for instance, in Mogadishu (Somalia), Ho Chi Min City (Vietnam) or La Paz (Bolivia)? Most probably there would be a significant difference in terms of the geo-referenced information available.

There is a completely contrasting situation if we look for more detailed and complex data. There are many developed cities, for instance, Hamilton, Canada or Melbourne, Australia, just to mention a couple, in which the user can have relatively easy access to high-quality property ownership and topographic information that allows one to review and apply data about a specific neighbourhood, square by square, parcel by parcel, even to link each lot to property rights.

The opposite situation is found in many urban areas where such digital location-based information is not existent or not available to the community, not to mention the many cases in which this situation is also the consequence of not having secure property titles or not having recognized property rights at all. Property ownership and rights have been a major factor responsible for the political instability of many developing countries.

Some of you may not agree with these examples or, as I have heard from colleagues working on international development, are of the opinion that having such databases and the corresponding information infrastructure is a luxury that costs too much for the poorest societies, at a time in which they must attend to other priorities and fulfil basic needs.

However, the facts are:

Developing a nation's information and communication infrastructure is significant, but equally important within a nation's development strategy and its opportunities for progress, is the need to carefully pay attention to geo-information content, including geographic data that better describes each nation's territory and its resources. This is important for governments, as there is a direct relationship between economic options and improved geographic information and for each citizen in terms of education, participation and democracy, by empowering ordinary people to participate in decision-making.

Today it is a truism that no matter whether there are many or few digital datasets available, developed and developing nations understand that their geographic data must be accessible, documented, structured, and reliable. Otherwise, such information in practice is non-existent because it is unavailable.

This is especially true for developing nations as they need to expand their knowledge base not only locally, but need to access the information accumulated by the leading economies, either via international cooperation, technology licensing, or foreign investment. Often, this includes information on the developing country itself.

To avoid even more isolation and a wider technological gap, every developing nation must design, advance and, more importantly, sustain actions encompassing the policies, organizational remits, data, technologies, standards, delivery mechanisms and financial and human resources required to ensure that all those working with data are not impeded in meeting their objectives.

It is my belief that spatial data infrastructures at the local, national, regional and global levels provide the integrating synergy required to bridge the digital divide.

In terms of geographic information, this is commonly referred to as the *'Spatial Data Infrastructure — SDI',* a concept advanced by the Global Spatial Data Infrastructure (GSDI) since 1996, that promotes complementary policies, common standards for the development of interoperable digital geographic data and technologies to support decision-making and global access to geographic information. Of course, the prerequisite is that the relevant basic geographic information must be readily available.

As a consequence, the concepts and the processes by which Spatial Data Infrastructures are built today are an essential part of geography all around the world. From local to global levels and vice versa, SDI is changing the way geographic data is being produced, organized and analysed, and has greatly facilitated the broad and dynamic exchange of ideas, leading to a better understanding of natural and cultural diversity, impacting on decision-making, territorial planning and sustainable development. This development is being promoted by the Global Spatial Data Infrastructure (GSDI), the International Steering Committee on Global Mapping (ISCGM), the International Organization for Standardization (ISO) Technical

Committee 211, the Geographic information/Geomatics, International Federation of Surveyors (FIG), the Pan-American Institute for Geography and History (PAIGH), the International Cartographic Association (ICA) and other international organizations.

After six years of work, there are today more than 20 global SDI initiatives, 15 at the regional level, with over 65 nations with documented infrastructures and many more at the state, city, local and corporate levels.

If this is the case, what are the barriers to the development of Spatial Data Infrastructures in developing economies?

First, there is a need to realize that to establish and, more importantly, to sustain Spatial Data Infrastructures is not an easy task in developed or developing nations.

Technology itself does not ensure the successful use and application of digital data. For instance, case studies clearly indicate the existence of a significant gap between the technology tools available and poor levels of geographic data use due to low availability of specialized human resources and, to some extent, the quality of technical assistance.

The crucial reasons are institutional, political, organizational, cultural, and economic.

In India, organizer of the forthcoming 7th Global Spatial Data Conference, Hungary, Mexico, or Chile, the national organization responsible for geographic information is already internationally oriented, well immersed in ICT technology and stands out as a key organization for institutional development and innovation, corresponding to societies in which the use of geographic information is expanding as there is a growing consciousness that information is only important if it is accessible to users.

The vast majority of other countries are still characterized by high and inefficient production costs, lack of standards, data-quality problems, poor documentation, problems affecting data maintenance and hardware and software updates, increasing data obsolescence, and frequent basic data production slopes.

A substantial amount of new thematic data sets is available but the data are often unstructured, distracting the government from the production of basic information with national coverage. There is even a deceptive way in which low-quality data is frequently used to formulate relevant policy. Very frequently, policy-making scenarios appear to be determined more by the quality of the presentation rather than that of the underlying data.

Culturally speaking, there is a particular problem of attitude: a history of isolation, ill-defined ideas, language barriers, and financial challenges.

The political component is quite influential. Policy-makers everywhere make relevant decisions without complete information. Yet in emerging regions, due to the chronic absence of core geographic information, the risks taken are even higher. Geographic information is not playing a better role in the decision-making process, and specialized entities have been marginalized because of reduced budget allocations. Most nations have not formally adopted a national policy concerning use of geo-information, including the ways in which it should be used to promote wealth and development according to local needs.

What, then, should be done?

In conclusion, what are the lessons I have learned from SDIs that can be widely applied in order to narrow the digital divide?

A Revised Approach to Capacity-Building

In developing countries, there is always an initial need for capacity-building. The programmes funded by many of the multilateral bank loans include substantial funding for education and quality training, thereby providing vast opportunities for facilitating technology transfer and ultimate self-reliance for the developing communities. Yet, in many ways capacity-building is a much-abused term in need of rehabilitation. The term 'capacity-building' is so often mentioned in the implementation document from the World Summit for Sustainable Development (WSSD) that it can imply everything and nothing at the same time.

In SDI development, there is a need to adjust the concept and the methodology for capacity-building, as often there is a total absence of sustained financial, organizational and human resources efforts.

International Technical Co-operation:
A Demand for Improved Co-operation, Co-ordination and Integration of Initiatives

Advances in information and communication technologies are accessible to everyone. However, within this realm, there is a proliferation of similar organizations, initiatives and projects that are making the whole process inefficient and, evidently, not at all well articulated. There is a lack of sufficient co-operation, co-ordination and integration action to achieve individual goals, avoid duplication of investment and increment the benefits. The principal goals of co-operation are to take advantage of proven practices and exchange of experiences.

Need for National Information Policy

Policy-makers still need to be coached as to why the linking of geographic data infrastructures across local, national, regional and global levels is fundamental to maximizing economic, social, and environmental benefits from geographic information. Many of the current difficulties will only be resolved if, at the highest level in governments, there is sustained interest and deliberate intervention in developing sound policy to organize the information sector as such.

Need to Strengthen the Institutions Addressing Information Problems

Although multilateral organizations may decide to promote data-sharing, ultimately, in terms of 'how to share' data to reach everyone in society, there is a direct responsibility of the recipient nation, and this aspect requires or will be optimized if SDI conditions are available.

Be Practical

Promote low-cost technology, enabling computing with geographic data, donated, public domain, or open-source geographic information systems (GIS) software for general use; develop 'easy to see and understand' decision support aids for politicians — in local languages; and pay attention to the needs of the disadvantaged communities.

We all know that geography has historically been a common language. In this age, however, the successful integration of information systems, technology, and infrastructure within nations and regions requires the introduction of standards and interoperability to facilitate this way of sharing the Earth and connecting us all.

While more information technology and infrastructure may become available, users do not have the availability of and access to better geographic information about their local area, their own country or region. Moreover, information technology, infrastructure and connectivity do not necessarily equate to information access and a real bridging of the digital divide.

I trust that those representing the interests of geographic information will take the lead in the developments and outcomes of the World Summit on the Information Society (WSIS), as the future of developing nations is in many ways linked to its ability to collect and share geographic information that is accurate, consistent and reliable in the long term.   »

8   The Return to Society

Nico Stehr, Center for Advanced Cultural Studies, Essen, Germany

« Ladies and Gentlemen,

New social realities require a new perspective: among these new realities is that the ability of large social institutions that have significantly shaped the nature of the twentieth century to get things done has diminished in the last couple of decades. Moreover, in advanced societies, and not only here, the capacity of the individual to say no has increased considerably. We are witnessing a change from social realities in which 'things' at least from the point of view of most individuals simply 'happened' to a social world in which more and more things are 'made' to happen. In this contribution, these new realities are described as representing the emergence of knowledge-based societies. I will also stress that the changes are not so much technology-induced as driven by societal transformations, especially by what may be described as the greater 'knowledgeability' of many actors.

First, I will refer to the concept of knowledge societies and examine the notion of knowledge societies. I propose to define knowledge as a capacity to act. I will refer to the reasons for the importance of scientific knowledge before turning to those consequences of the advancing 'knowledgeability' of actors in modern society that give rise to the growing fragility of modern societies.

Objections

The term 'knowledge society' is a broad historical concept. Aside from the claim that there are much more appropriate conceptual labels to describe modern society, there are at least two not entirely unrelated and apparently powerful objections to the term 'knowledge society'. The most frequently heard criticism is that of historical repetition. Power and authority, for example, even in historical societies, was never merely a process based on physical superiority alone. The second objection, as a rule, refers to the concept of knowledge, which is seen as too problematic, perhaps as too ambivalent and contradictory to allow the construction of a theory of society.

The first objection is fair but hardly decisive. Knowledge has indeed always played an important role in human relations. This, therefore, is not at issue. What needs to be asked is why the role of knowledge has recently emerged as constitutive and increasingly displaced those factors that have until now been basic to social existence. The material foundations of social action are being displaced by symbolic foundations. Capital largely deposed land

during the industrial revolution; today knowledge diminishes the significance of both factors. Knowledge is constitutive for social integration as well for the creation of new economic value.

Despite the fact that there have also been societies in the past based on knowledge-intensive action, the idea that modern society is increasingly a knowledge society is meaningful and has practical relevance. It is as meaningful to refer to modern society as a knowledge society as it was to refer to 'industrial societies', even though previous social systems had been based on the work of 'machines'.

Loss of Political Power Through Knowledge

In the 1950s the German sociologist Helmut Schelsky sketched out his version of a nightmare: the use of electronic calculating machines raises the spectre of the totalitarian state, he claimed. Half a century later, the American entrepreneur and futurologist Bill Joy is warning us of a development that possesses similarly nightmarish characteristics: his greatest fear is that nanotechnology might start to evolve independently of its human creators.

The assessments of Schelsky, Joy and many others are the result of a symptomatic overestimation of the power of modern knowledge and technology. Paradoxically it is precisely knowledge and technology that are perhaps the most significant sources of the open, indeterminate society that is growing up around us today. Despite all pessimistic predictions we now find ourselves witnessing the end of the hegemony of such monolithic institutions as the state, the church and the military. Controlling, planning and predicting social conditions are becoming increasingly more difficult. Society has become more 'fragile'. Yet it is neither globalization nor the economization of social relations that is responsible for this state of affairs but the loss of political power through knowledge.

Knowledge About Knowledge

One can define knowledge as 'the capacity to act', as the potential to 'start something going'. Knowledge is a model for, not of, reality. The privileged status of scientific and technical knowledge in modern society is derived not from the fact that scientific discoveries are generally considered to be credible, objective, in conformity with reality, or even indisputable, but from the fact that this form of knowledge, more than any other, incessantly creates new opportunities for action. These opportunities may be appropriated either by private individuals, or corporations, or the state — although frequently such appropriation is only temporary.

Living in Knowledge Societies

This trend towards the development of fragile social systems is clearly the result of an (uneven) extension of individuals' capacity for action in modern societies. The power of large institutions is being increasingly undermined and replaced by small groups with a growing capacity for action. Using the term 'fragility' to designate this state of affairs is intended to underline the fact that not only has the capacity of supposedly powerful institutions to 'control' society declined but so has their capacity to predict social developments. But what has caused society's centre of gravity to shift in this way? What forms is this development taking, and what consequences will it have? I believe that these social changes are coming about because knowledge is no longer simply a means of accessing, of unlocking, the world's secrets but itself represents a world in the process of coming into being. In other words, we now organize our reality based on the knowledge we possess.

Knowledge societies arise not as the result of simple, one-dimensional processes of social change. Their creation does not follow any single, easily recognizable pattern of development. Although modern developments in communication and transportation technology have brought people closer together, regions, cities and villages are still by and large isolated from each other. The world may be opening up, and the circulation of fashions, goods and people becoming more intense, but differing convictions as to what is 'sacred' still create insurmountable barriers to communication. The meanings of such concepts as 'time' and 'place' are undergoing transformation, but borders separating people continue to be objects of intense respect and even celebration. Modern societies are characterized above all by 'self-generated' structures and the capacity to determine their futures themselves.

The Fragility of Society

One peculiarity of the many and varied debates on the roles of knowledge, information, and technological know-how in modern society is, as we have seen, their one-sidedness. They mostly emphasize the problems caused by the individual's being cut off from specialist knowledge and technical competence — resulting in the individual's allegedly being forced into the role of 'victim': exploited consumer, alienated tourist, incapacitated patient, bored school kid, or manipulated voter.

Yet dire prophecies that large social institutions would establish themselves in unassailable positions of power and authority have not been fulfilled. An objective evaluation of the social role of knowledge must come to the conclusion that the spread of knowledge has not only brought with it 'enormous' risks and uncertainty but also a 'liberating capacity for action'.

Uncertainty Through Knowledge

But all this does not mean that from now on every consumer, patient and school kid will immediately be able to recognize, understand and control opportunities for action that come their way on an everyday basis. An increase in opportunities for social action should not be misconstrued as bringing with it the elimination of all risk, accident, and arbitrariness — in general of all circumstances over which the individual has little control.

The flip side of emancipation through knowledge is the risk posed by the emancipatory potential of knowledge. The increasing spread of knowledge in society and the concomitant growth in opportunities for action also generate social uncertainty. For science cannot provide us with 'truths', only with more or less well-founded hypotheses and probabilities. Thus, far from being a source of secure knowledge, of certainty, science is a source of uncertainty and thus of social and political problems. Knowledge societies of the future will be characterized by a wide range of imponderabilia, unexpected reversals and surprises. The increasing fragility of knowledge societies will generate new kinds of moral questions, as well as questions as to who or what is responsible for our society's oft-cited political stagnation?

If knowledge is the main constitutive characteristic of modern society, then the production, reproduction, distribution and realization of knowledge cannot avoid becoming politicized. Thus one of the most important questions facing us in the next decade will be how to monitor and control knowledge. This will entail the development of a new branch of political science: knowledge policy. Knowledge policy as a new political field will attempt to regulate the rapidly growing volume of new knowledge in our society and attempt to influence its development.   »

Onno Purbo, Indonesia, on Sabbatical leave at International Development Research Center (IDRC) (Email: onno@indo.net.id)

Information Society in High Places[1]

« Coming from Indonesia, a developing country, it is an honour and it is a piece of good fortune to be able to attend a large Information Society gathering at WSIS. It has been made possible by full support from friends at the International Development Research Center (IDRC), Ottawa, and CERN, Geneva. Thank you IDRC and CERN.

My ten (10+) years' background as a practical grass-roots ICT activist have really shaped my reflection on WSIS 2003.

I normally deal with people in real ICT need on the ground, with those needing low-cost Internet connection, knowledge of how to set up wireless ISP, knowledge of VoIP infrastructure, etc. Disseminating practical know-how, such as, http://sandbox.bellanet.org/~onno/the-guide/ or via mailing list, such as, wifi4d@dgroups.org, would be a simple solution for most of their needs.

It is not surprising to see the ICT4D pavilion fit quite nicely into my profile.

Until the WSIS, I did not realize that there is quite a big crowd of people sitting in high places in the world of the information society. They are neatly dressed and quite formal in presenting themselves.

They spoke mainly of dreams, visions, objectives, goals and targets. I am very envious to see that they are even more highly paid to talk on such subjects.

Sure, it is nice to have these people in high places shaping the mind-set of the regulators in developing countries. Well, to be honest, the Indonesian regulator is shaken by the world's objectives, such as, to connect at least half of the population to the Internet by 2015.

For WSIS 2003, being a stubborn ICT maverick, I brought all my main ICT equipment, such as Wireless Access Point, four (4) ports Internet Telephony Gateway (ITG), Kodak DC4800 digital camera, Cheez Webcam, and telephone handset, in my knapsack and am running a real-life demonstration to show people that by using such equipment we can build our own community-based ICT infrastructure. With only a few slides used during the demonstration, all real-life activities, I can run WiFi and VoIP simultaneously on the demo infrastructure. I find that a demo is a much more convincing approach than words on slides.

Unfortunately, I have had to pay dearly for my stubbornness, as I didn't realize that there is knapsack thief around during WSIS. I lost my equipment including my wallet and cell phone in the knapsack a few hours after running the demo. Well, that's life I guess. I hope for the best in the coming years.

On 9 January 2004, the Indonesian Ministry of Information and Communication organized a seminar to report the results of WSIS 2003 to Indonesian societies. Not much strategic and tactical plan was presented. In the seminar, considering current Indonesian conditions, I argued that my practical experiences indicated that we can easily achieve the WSIS's objectives if we relax the regulatory framework and enable Indonesians to build their own ICT infrastructure, using their own money. No World Bank, no IMF funding is necessary. All the silly, stumbling regulatory framework, such as taxing US$270/year to run a US$200 Access Point, has to be removed.

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1. Talk submitted in February 2004.

The key strategic policies are people's education and relaxing the telecommunication act to enable community-based ICT infrastructures.

I really do place my hopes in the upcoming 2005 Summit and look forward to seeing more real examples and exchange of knowledge among ICT4D activists. I also hope to hear fewer dreams and complaints, as real people need simpler solutions and real examples.   »

9   The Next Steps

Juan Rada, Senior Vice-President of the Oracle Corporation for Europe, the Middle East and Africa

The Implications of Science-Driven Technologies for the Creation and Diffusion of Knowledge

« Ladies and Gentlemen,

It is a pleasure to be here and I thank the organisers and CERN for the invitation to address this distinguished audience.

Today I would like to consider how technology, rooted in science, is having a very significant impact — not only on the way we create and access knowledge — but also on the way in which knowledge is structured and represented. I will conclude with observations on how this impacts the priorities for the modernization of education, which is one of the key consequences of this process.

Knowledge has been the cornerstone of all societies. Until recently all of these sources of knowledge and the access to them were bound to a locality by geographic, temporal and economic factors.

This has changed with the digitization of knowledge. The ability to catalogue vast arrays of knowledge through powerful new technologies, to efficiently store, categorize and search through plain language queries, has created access to a knowledge base unparallelled by all the libraries of the modern world. Increasingly powerful search engines and technology are making this not only hyper-linked but hyper-easy as well.

Although this technology has lowered the barrier to access, this barrier is still not low enough — as witnessed by current levels of Internet penetration (not to speak of broadband) and the lack of even basic connectivity infrastructure in much of the world. This happens at the time when economic welfare is becoming increasingly rooted in knowledge.

Much of this, however, is closely related to non-technological factors such as regulatory frameworks, and to open and competitive markets, a factor which also needs to be addressed.

The technological developments of the 20th century have essentially been based on scientific developments in physics and chemistry. Not the least example of this is the understanding of semiconductivity and crystallography that underpins information technology. This will, of course, continue in many new directions including photonics and nanotechnology. Both are areas where our host institution — CERN — will no doubt make seminal contributions.

For this century we can expect much technological development based on the breakthroughs that have already taken place, and continue to take place, in biology. In all these cases, science is generating volumes of information beyond anything we have seen before. This is just the beginning as this area is in many respects still at an embryonic stage.

The management and interpretation of these terabytes and petabytes of data is made possible today by the development of Grid Computing. The Grid architecture effectively pools large numbers of servers and storage into a flexible, on-demand resource. Oracle has worked with CERN on the development of Grid computing technologies and has now recently brought onto the market the first commercially available Grid-ready product. This is an example of how a pioneering technical development has rapidly become mainstream.

Grid computing is not only essential to harness the necessary processing power to undertake such data-intensive analysis, it also makes such processing power available to more institutions by dramatically reducing the cost of computing.

In the commercial arena, Grid computing will have applications in the analysis and manipulation of data that will underpin the next waves of computing and internet technologies. One can go on and describe the many, many areas of industry and commerce that this will affect. I would like to focus on one key area by posing a question seldom asked, and this is — whether and how are technologies changing the way we represent knowledge and what effect this will have? In my view, this is a critical question to understand the priorities for change in information technology for education and research.

The use of powerful processing and transmission technology allows us to envisage the 'mass commoditization' of multimedia in daily life, at least for the time being in a small part of the world. This has significant consequences.

Multimedia, by using images, sound, text and graphics, convey knowledge in a highly synthetic and powerful manner, collapsing into one medium the book, the museum, the gallery, the film, the photograph, the spoken word, the sense of place and sound. Suddenly, learning and perceiving become much closer to the daily experience of living, and by doing so have a much higher pedagogical and retention impact. One form of it, the use of 'virtual' environments, is a popular expression of this.

The cost of production of material based on rich multimedia is decreasing rapidly. The digital camera on mobile phones is an anecdotal example of this, although it is only in its first generation at the moment. The future is here if you care to look. We already know that the technology will leap forward in the next few years with the combination of the Grid, broadband, and the developments taking place for PCs as well as other devices, such as phones. This is not the occasion to enumerate the many areas of education affected by this but, in higher education, for example, it goes from medicine to statistics and from engineering to the arts.

Put simply, a new concept of literacy is emerging, encompassing a much broader set of skills than our traditional reading and writing. A new classification of knowledge is emerging, with a much higher degree of complexity and abstraction, including a multimedia view of previously separated subject matters. The current taxonomy of knowledge and the use of indexes corresponds to the sequential technology rooted in the nature of the book. This is changing as we create new 'indexes' for a world that does not distinguish between the vehicles that convey knowledge, but draws on many technological infrastructures from words in books to three-dimensional objects in museums. We are entering the world of hyper-linked knowledge and hyper-threaded thought. This is a fundamental transition in that it is currently fully engaged and that it implies a change in our way of thinking.

We had similar transitions in the past. For example, scholars of the classics have illuminated us regarding the enormous consequences on our history of the Greeks' technological and intellectual transition from a pre-literate to a literate culture, showing the impact of the introduction of the alphabet as the written word replaced the oral in the literature of Greece,

and later Europe as a whole. This transition had consequences that scholars, as usual, still and will continue to debate, but it is safe to say that in it lies the very root of our current mindset.

Professor Eric Havelock, a specialist in this domain, calls it the 'alphabetic mind'.

The alphabet converted the spoken tongue into an artefact, separating it from the speaker and making it into a 'language', into an object available for inspection, reflection and analysis. This language meant that things could be preserved without recourse to memory and that the bits and pieces of these memories could be re-arranged, cut, added and re-stated. This new world was conceptual. Philosophy was possible and with it logic and thus a key element of what we will call today, the epistemology of science and our view of modernity.

It is hard to recount here in a brief manner the enormous impact that these historical processes have had on our way of being and thinking.

While the alphabet created the basis for the 'alphabetic' mind, the invention of printing by Gutenberg, and most importantly the development of the portable book by Aldus Manutius (1450–1515) of Venice, created the personal library and revolutionized forever the control of knowledge. A new technological and intellectual transition started.

The difference in the current transition is that the power of multimedia makes the process one that is sensorial in nature; the language is one of the subjective, the perceptive, of the senses, and thus not simply conceptual or reflective in the meaning of the world of the literate.

Moreover, and with increasing complexity, the creation and diffusion of knowledge today is a collaborative activity. Current information management technology allows us to do this in a seamless way and create a world where knowledge can be built collaboratively. Collaboration is becoming intrinsic to the creation of knowledge and key to current and future developments. This is already being facilitated by collaboration platforms.

The combination of developments in Grid computing, broadband, decreasing cost of all forms of multimedia, and the availability in the next few years of equipment and systems to take advantage of the dramatic reduction in cost that these changes permit will mark the end of what will be regarded as the first phase of the transition to the information society. These new capabilities will allow not only the ability to perform functions better than in the past but entirely new forms of combining functions.

What does this mean for education in general and in developing countries in particular?

The first aspect is to realize that the changes are more profound than simply a change of medium. These in turn imply the need for a much better understanding of the pedagogical effect of how information and knowledge is represented.

For developing countries and their educational systems the challenge becomes even greater. Connectivity, a yet-to-be-achieved objective for the majority, is essential and urgent. It is possible to achieve this, with much more creativity on the part of the regulatory system, and by opening up the connectivity opportunities to all types of infrastructure.

The need for urgency is because, as is probably clear by now, the changes are not only that what we do today will be faster and cheaper, but that the capacity exists to create and convey information and knowledge in different ways and with high impact. This difference will increase day by day, and according to the rhythm of technical change. This is a dramatic change in the way people are educated.

From a priority point of view this reflection means that higher education must be the area of focus, particularly in developing countries. Modernizing the universities is essential to ensure that the new generations of professionals are as close as possible to what is state-of-the-art, and that the institutions are capable of creating a critical mass by using collaborative platforms and all forms of e-learning to lower the cost of distributing education and training.

Oracle has successfully used such technology on a worldwide basis for our own educational and training infrastructure. These professionals will also be the ones who in the future will help to shape the rest of the educational system.

In my experience we still see too many of the higher education institutions behaving like medieval castles and isolated citadels, when it is evident that in order to achieve their objective of obtaining the best IT infrastructure and connectivity, they need to move into shared services systems. This is not a technological issue but a necessary change in mindset. Interestingly the universities in some of the richest developed countries have understood that this is the only way forward to be able to achieve a level of excellence in their technological infrastructure and to confront the challenges outlined above. Behind this comes secondary education and then primary. Ideally one should do all of them. This is not always possible.

As a company we have been involved in all these areas, from universities across the world to primary and secondary education. Oracle has set up several initiatives throughout the world. One such initiative is ThinkQuest, a five-year-old competition that has engaged students in 23 countries in authoring over 6,000 educational websites for a free online public library. These websites offer a rich online resource used worldwide by teachers to inspire learning.

Another example is Oracle Think.com, a free, online learning community where students and teachers share ideas, create websites, and interact in a protected environment. The ability of children to mould how they use their Think environment also enables educators to better understand how children use the Internet to learn. Think.com to date has been launched in the UK, South Africa, Chile, Paraguay, Australia, New Zealand, India, China and Thailand.

In closing, I would like to re-iterate that today, science-driven technologies are altering the shape and nature of knowledge, and managing the wealth of information that now resides online for global access. These technologies are here today, *available* to everyone. What is not available is the *access*. Throughout this week the issues of access to bridge the 'digital divide' are being explored and debated. We must ensure that the richness, diversity and potential of our knowledge does not remain limited to small pockets of the world population.   **»**

H E Lidia M. R. A. Brito, Minister of Higher Education, Science and Technology, Mozambique

The Needs of the Developing Countries

« Distinguished members of the panel, distinguished participants,

It is a great honour to be with you today and I would like to thank CERN and the other organizers for inviting me to address you on an important and difficult topic: How do developing countries see the ICTs working for them? I shall try to answer that question from a Mozambique perspective.

But let me start by reminding ourselves what our major challenges and problems are. Developing countries have high incidences of poverty, which in turn brings a high incidence of diseases, such as HIV/AIDS that is robbing our babies of their parents, our schools of their teachers and our health centres of their nurses and doctors, of child malnutrition and of

death of women in childbirth. Poverty is also in many ways the result of the high illiteracy rates and the low scientific and technological capacity that we see in the developing countries. Nico Stehr defined knowledge as the capacity to act. I would add that knowledge is to have many options. In many cases we have only one option and it is not necessarily the best one. Sometimes we have many options but we cannot recognize them and cannot therefore choose the best one for us.

We also need to have a governance that is more inclusive, democratic and efficient, for which we need more informed, better educated assistance, people with knowledge and people able to act.

Knowledge must be relevant to the resolution of poverty in its many shapes, appearance and impacts. We all recognize the staggering knowledge gap but we still have to recognize that developing countries contain untapped human talents and cognitive and natural resources that need to be mobilized against poverty. We need to use our local knowledge systems. We need to make sure that the knowledge that exists in our countries is systematized and shared with the rest of the world.

Identifying solutions that work in our countries is not only important for us *per se,* it is also a matter of pride in knowing that we can contribute to constantly growing global knowledge. If we do not seek to identify such solutions, we will keep lagging ever further and further behind.

We also know that knowledge is not enough. Knowledge can only be viable if it is accompanied by skills. We need to have skills to acquire knowledge, we need skills to apply knowledge and to develop knowledge, sometimes even to recognize knowledge. We need to cover a range of skills, from the very basic to the very complex such as computer programming, biotechnology and nanotechnology.

So, what can ICTs do in this framework? What worries me a lot but what also reassures me is that ICTs imply two extremes, one good, one bad, with many intermediate stages. Thus ICTs can inform but they also can misinform. ICTs can save time but can also make you waste time. ICTs can stimulate thinking but can also induce intellectual laziness. ICTs can promote global citizenship but can also enable worldwide terrorism.

Today populations in the developing countries have low rates of access to any level of education and thus smaller numbers of scientists and educators. Although developing countries account for some 80 per cent of the world's population, they have only 27 per cent of the world's researchers. We have limited resources available for research and technological developments. We are dependent on external providers of knowledge and investment, and local resources are either under-valued or under-exploited. What then can we do?

One scenario is that we get the bad extreme in terms of ICTs, that we will never develop an internal knowledge capacity and never be able to reduce poverty because our dependency on external services of knowledge and investment will grow with our people living in ever poorer conditions.

We in Mozambique believe that there is another much better scenario, namely, making sure that we increase participation in education by developing domestic research and technological capacity in the country and the region and throughout the continent. If we can invest in human resources and make sure that our universities and higher education and research institutions have the capacity, we will certainly create the conditions necessary to

increase our gross domestic product and ensure that we become less dependent on external sources. Our people will then be living in much better conditions and our societies will be much more democratic than they are today.

We in Mozambique are using ICTs to strengthen our rural extension services so that we can provide farmers and small- and medium-sized enterprises with technological, market and other essential information. We are also making sure that people communicate with each other, not only for social reasons but also as business partners.

We are also starting to use ICTs in order to improve the quality and range of medical services. The three major cities of Mozambique are already linked by a telemedicine network which allows surgeons to work with each other over great distances. We hope that this network will be extended to our rural health centres.

We are also using ICTs to help us to expand education at all levels. We have a distance learning strategy, which is a very important component of ICTs. I agree with Juan Rada when he says that this technology will change the way we educate the people but it will above all change the way we learn. This is, I think, a wonderful characteristic of ICT technologies because they can ensure not only education for all but access to high-quality education for all because learning becomes much more interactive, allowing us, individually and collectively, to learn at our own pace, according to our needs and wishes.

We are also starting to develop virtual libraries as an important tool for researchers, educators and students alike, as well as a science and technology network to allow us to define a national science policy based on the 'bottom up' principle that takes account of the specificities of each region of our very diverse country.

We have also been using ICTs for education and education for ICTs. Thus the aims of the school net programme, which is a very important part of the e-school programme in Mozambique, are to develop young people's ICT skills as well as ensuring that ICTs create a better quality environment for learning.

We are constantly examining how ICT technologies can be used to best advantage in the conditions of our countries. Thus, as fixed lines are very expensive and it takes a long time to install them throughout the country, we have introduced mobile phone coverage even in rural areas where there is no fixed line network and we have seen an amazing expansion in the use of mobile phones. When Mozambique experienced the terrible floods of 2000, all the fixed lines were down before people had time to call. It was the cell phone network that allowed us to save a lot of people and avoid a high loss of life.

E-commerce is another aspect of our ICT policy and e-strategy, principally in the field of tourism development. Similarly, e-government is being used to improve public services. The resulting inclusion of our citizens in the decision-making processes and also in monitoring government actions is making our citizens much more proactive and government much more responsive to the needs of the country and the people.

However, perhaps the biggest challenge is how to make ICTs work for us. We know that there are many things that we cannot do yet because of the constraints. Thus, Juan Rada talked about how the universities in the developed nations have forged ahead by realizing that they can save money by sharing networks. But, we have a saying in Mozambique: "In order for you to save money, you first have to have the money to spend." In many cases, this is sadly true for developing countries. We cannot save because we do not have the money to spend and usually, even if there is money to be invested, it is not our money and we cannot therefore invest any savings on something else.

So, affordability of the technology and the equipment and connectivity are important issues: if we do not achieve them, we will not have access and if we do not have access, the first future scenario will be realized: namely the one where we are misinformed and waste our time and become increasingly poor and ever more dependent.

We also need human resources and skills to acquire, use and improve. An Indian colleague told me: "In order to have 1,000 good ICT people, you need to train a critical mass of 20,000." At present, we in Mozambique train 10–15 ICT people a year. When are we going to have the 1,000? If we do not invest and obtain support to obtain the critical mass of human resources, we will continue to lag far behind. Thus it is not only ICTs that we need: we also need to be critical about the information that we obtain from these new technologies in order to make the right choices. For that, we need human resources.

We must also make sure that our policies are integrated. Thus, our ICT policy and e-strategy must be integrated with our science policy, with our education policy, with our industrial development policy and so on. We must also work on developing more and more relevant content.

The educator, Paulo Freire, wrote: "poor are those among us who lose their capacity to dream, to create their courage to denounce and announce." So let me finish, Mr Chair, by denouncing and announcing.

The first thing I would like to denounce is worldwide monopolies and in that respect I am very happy to see that companies like Oracle and Microsoft are becoming more and more socially responsible.

Secondly, we need to invest heavily in human resources, hardware, software and connectivity in developing countries and ensure fair trade, including in access to knowledge.

Finally, I would like to announce the political will that exists at all levels. We in Mozambique know that we are very far away from attaining our dreams. We are willing to proceed but we cannot do it alone. So please proceed with us. Thank you.   »

Robert Kahn, President of the Corporation for National Research Initiatives

Reflections on the Role of Science in the Information Society

« Ladies and gentlemen, I am delighted to be here. Although I am a scientist by background, I am going to comment on a very related topic, namely the role of technology in the information society because science basically makes its predominant appearance in society through technology and its applications as well as through education.

Historically, science has been very closely connected with the creation of knowledge, although the linkage of science and technology has always been very strong. Over the years scientific knowledge has progressed primarily through the willingness and ability of governments to provide the funding, while technology has benefited largely from private sector investment. It is some of the most advanced technological developments — and I think the Internet is an example, certainly in its early days — for which the return on investments seems too far in the future, that have also been the result of government funding.

There are really four technological pillars of this information society that we are talking about today:

– the computing technology (and I include both hardware and software here) that we all use;

– the digital communication technology with both tethered and untethered connections, namely fibre wires and radio links by which information can now be sent not only around the world but also into outer space and back;

– the networks that have been created in recent years and the network-based applications that link all the computers and individuals together and make them useful;

– the devices of all kinds that basically support our users, namely the printers, the routers, the displays and mobile radios.

In this context the Internet plays a very prominent role along with the applications such as the World-Wide Web, electronic mail and the increasing commitment to the management of information in the form of digital objects and other media. And supporting all four of these pillars of technology are the scientific theories that enable advanced component technologies to be developed and used, such as semiconductors, all optical devices, micromechanical devices and even nanotechnologies.

But far from being the whole story or even the last word, this is merely the latest word. Science is continually unfolding, revealing the secrets of the Universe to generations of inquisitive minds. It seems clear — to me at least — that scientific researchers all over the world cannot stand still and will not rest on the laurels of their predecessors. This is the creative genius of mankind which will determine what all our future technical options are.

So I would like to focus here on two ways in which the creative potential of these technologies may be unlocked. The first way is by exploring new options for using existing forms of information such as we typically access on paper or on radio or television and for collaboration, either through meetings, teleconferencing and so forth. The second way is to investigate new units of creativity and new forms of expression that have no real-world counterparts today.

I might point out that something like the World-Wide Web has created a forum that really did not exist before and there are many others that are waiting in the wings to be uncovered as well.

In the first context we might typically identify a machine to interact with today on the Internet, even if our real goal is to interact with an individual or a specific file on a given machine. For example, consider the possibility of sending an e-mail to a book and asking it a question and then expecting that it might give you a response to that question. This is a new way of dealing with existing media in a network context. If one can identify the book itself, there is a data structure on the Net independent of its location. One ought to be able to put the identity of the data structure, namely the book, in the two fields of an e-mail message and expect to receive an answer from the book directly with no human intervention in between.

I hesitate to speculate on whether this is a good business opportunity or whether it is a capability best offered by digital libraries. Either way, this is not something that a typical user of the Internet is able to do today. Limited forms of collaboration and information sharing can be organized across the Internet but we are still a long way from the type of meeting or event where literally everything that transpires at the meeting can be captured and recorded in real time, and accessed in real time, with or without deferred access at a later time.

We may certainly wish to limit access to such information for, say, administrative purposes. It may be a private meeting, for example, but we are still a long way from this being a commonplace capability.

In the second context we were talking about things that have no counterpart in the real world. All that we can really do is speculate about the nature of future inventions and innovations that may have the ability to change the very way we interact with the outside world or even think about it. The Internet is now about 30 years old. As a technology it is about 20 years old and has been regularly used for about 20 years as a global information system. The very existence of a conference like this or the follow-on from this conference is really testimony to the way in which one scientific achievement can change critical aspects of the world in which we live.

The information society that we are all helping to develop is increasingly the product of co-operation between individuals and organizations in the public and private sector all over the world. For this environment to grow and to evolve, it needs to be nurtured by all of those in a position to co-operate in this way. The Internet really is the foundation of today's information society. This may change in the future, but with what we have already we have the potential to really improve the ways in which we live and to bring us all closer together.

Increasingly the primary financial investments in the infrastructure, the technology and the applications required to support and develop the information society are likely to come from the private sector, but I believe there will continue to be important roles for governments all around the world in encouraging people take advantage of the Internet and thereby promoting, enhancing and stimulating both our economic and social systems.

As to what is coming next, let me in closing encourage all of you to consider these issues and especially the possibilities where there are both potential technological and social dimensions and for which there is no equivalent in today's world. I believe that their development will depend critically on the insights and the contributions of the world's most talented individuals.

So, in closing, I would like to say that I very much appreciate the opportunity to have a chance to address this plenary and to share these thoughts with you. I wish you all the best.   **»**

Dr Juergen Renn, Director of the Max Planck Institute for the History of Science and General Co-ordinator of European Cultural Heritage On-line (ECHO)

Towards a Web of Culture and Science

« Excellencies, Ladies and Gentlemen, distinguished participants,

It is a great honour to address you and I would like to thank the organizers for providing me with the opportunity to present to you an open-access initiative by the German Max Planck Society, the French CNRS and other major international science and education organizations.

I will describe the crisis which culture and science are facing in what is still the beginning of the Internet Age. I will also present to you a vision of how to overcome this crisis, and I will indicate steps towards the implementation of this vision, in particular the Berlin Declaration on open access to science and culture, signed by many international organizations.

Crisis

Let me begin by describing the crisis and first turn to the crisis of culture on the Web. It has two dimensions. The medium of today and tomorrow, the Internet, might leave behind a culture which is the heritage of our past but urgently needs to meet the challenges of the future. This cultural heritage is presently in danger of being left behind, of missing the boat of the rapid technological developments carrying us into a new information age. The bulk of information which forms the core of cultural heritage is largely excluded from the information system that constitutes the backbone of an increasingly knowledge-based world.

The great works of art and literature, the multitude of languages of this world, traditions reaching back sometimes over millennia, the treasures of scientific, scholarly and philosophical writings going back to the dawn of our civilization are not being as substantially transferred to the new medium as is necessary for their preservation in view of wars and dwindling public funds that threaten them with rapid degradation.

Cultural Techniques

The deficit in the extent to which cultural information is available on the Web is accompanied by the underdevelopment of cultural techniques adequate to the new technologies. Reading, writing and calculation, the traditional cultural techniques, have to be complemented by new cultural techniques allowing every single individual to optimally exploit the Internet as a representation of collective human knowledge. The question is, of course, how to overcome this crisis that threatens the link between our past and our future. Before coming to the answers, let me turn to the second major crisis of this transitional period, the crisis of science.

Gutenberg

The crisis is most visible in the rising journal prices which effectively make science increasingly inaccessible, particularly to developing countries but more generally to all those who have produced scientific knowledge, mostly with public funds. Scientific organizations are in fact forced to repurchase the information they produced in the first place. Effectively, the 'journals crisis' amounts to a complete breakdown of the traditional distribution of labour in the traditional information circuit. According to this traditional model, research results are produced by scientists. This is and will remain the most cost-intensive element of the information circuit. The results of research are disseminated by publishers and archived by libraries. Information is filtered by a process of evaluation performed by scientists (peers) and organized by publishers. Only that which survives this filtering process is disseminated. This well-established traditional system is now endangered by technological changes with radical consequences.

Even within the system of printed information, these technological changes are reflected in the rising prices charged by publishers for dissemination, which scientific organizations are no longer able to cover and which dramatically increase the divide between industrialized and developing countries with regard to the availability of scientific information.

Unexploited Potential

The information revolution has radically changed the technical and economic basis for maintaining the scientific information flow. This radical change is evident from the as yet unexploited potential of the Web for scientific communication. Dissemination is no longer a cost-intensive component. It can, in principle, be handled by scientists without the services of the publishers. In the electronic medium, evaluation follows, and does not precede, dissemination. It no longer has to amount to a simple in/out decision about publication.

There is no longer any reason to preclude access to the information hinterland, to observational and experimental data, software tools, or to historical sources, which currently only serve as a logistic background for published research results. Making such additional information available will help to ensure the reliability of scientific information, to broaden the scope of available resources, and to avoid duplication of effort. Moreover, the Web offers completely new forms of scholarly publication, from digital libraries of cuneiform tablets to entries in biological databases. The new medium could facilitate and improve the quality of the selection process. The immediacy, and in principle unrestricted, scope of electronic dissemination increases the likelihood of rapid responses, distinguishing valuable from non-valuable contributions.

The Present Dissemination Crisis

Against the background of this impressive potential of the Web for scientific communication, it becomes particularly evident that what is wrong in the present system of scientific dissemination is that it is dominated by publishers with a quasi-monopolistic status. First, there is the increasing cost of scholarly journals, eating up capital urgently needed to build up a more adequate and efficient infrastructure for scientific dissemination. This increased cost represents a waste of public money. Then there are the commercial barriers to the connectivity of knowledge, enforcing a fragmented landscape of information islands rather than fostering the development of a global representation of human knowledge, consisting of interoperable contributions by all players.

It is also important not to forget that publishers do not offer a guarantee for the long-term archiving of information. Again this is a challenge with which public institutions are left to grapple. We also lack adequate access and retrieval infrastructures corresponding to the needs of scientists and educators.

Finally, mapping the traditional commercial publication system into the new medium perpetuates the digital divide in science. In fact, simply creating a mirror image on the Web of the traditional system amounts to erecting an artificial boundary cutting off developing countries from the flow of scientific information.

The Insufficiency of Existing Solutions

Let us now turn to approaches towards resolving the double crisis of culture and science on the Web. The two standard solutions are the big player solution and the scout solution. Both have failed to create an adequate infrastructure fostering the dynamics that are imperative for the transfer of scientific and cultural content from the old medium to the new.

The Big Player Solution

The big player solution is most familiar from the present debates on electronic journals where a few publishers use their near monopoly to erect new barriers of accessibility. But for the digital availability of cultural heritage, the situation is perhaps even more problematic, resembling a gold rush where everybody is trying to stake out claims. The big players have in fact long since begun to secure exclusive rights on the reproduction of cultural artefacts, be they manuscripts of Leonardo da Vinci or representations of traditional cultures. But in spite of their eagerness to control large domains of cultural heritage, the big players have so far failed to create an infrastructure that guarantees a steady and reliable flow of content from the old media into the new, an infrastructure offering equitable access to all nations and peoples, often deprived of their heritage by the pitfalls of history.

The Scout Solution

The scout solution, on the other hand, is based on the assumption that the transfer of cultural and scientific content to the new medium can essentially be achieved by pilot ventures. It amounts to the realization that bringing culture and science to the Internet means settling a new continent, rather than just exploiting its resources in a gold rush. But it also amounts to the problematic assumption that this can be done by merely sending out a few scouts to survey the new territory. As a matter of fact, the scout solution has also largely failed to launch self-sustaining dynamics of culture and science on the Web.

Vision

The right solution to the double crisis can be found only if we have a vision. The vision I would like to sketch here is that of a Web of Culture and Science.

Agora, Semantic Web

This is a vision concerning both the enrichment of the Web with content and its future technological development, hopefully turning it into a global and accessible representation of human knowledge. In order to create self-sustaining dynamics that enrich the Web with meaningful content represented in adequate structures, we need a support programme for open access aimed at building up a technical and social infrastructure. Such a support programme is the core of what we have called the Agora solution, by analogy with an institution of Ancient Greece where the common good emerged from the contributions of all citizens. In order to create the tools that make it possible to adequately exploit this content for science and education, we need to develop the Semantic Web, allowing future users to truly interact with the content they find.

Agora Solution

The Agora solution aims to build up an infrastructure that increasingly turns the consumers of the Web into producers. In fact, we urgently need support to create an open-access infrastructure to make resources freely available online with little effort and in a way that guarantees the interoperability with other content and tools, thus creating added value for every user.

Towards and Beyond the Semantic Web

I have no time to discuss why and how we have to go beyond the vision of the Semantic Web as it is presently discussed. Let me say only this much: the future transformation of the Web will be driven not only by technical issues of speed and bandwidth but by innovative usage scenarios, just as was the case when the Web itself was invented here in Geneva at CERN. Making the Web more democratic, for instance, will also create a technological drive from the client–server asymmetry to peer-to-peer interactions, from browsers used by essentially passive clients to knowledge weavers used by active citizens.

Implementation of the Vision

Let me conclude with some words on the implementation of this vision and mention the Berlin Declaration.

The Berlin Declaration

The Berlin Declaration was signed in October 2003 by major national and international governmental, scientific, cultural, and educational organizations. They consider their mission only half complete if the information they produce is not made freely available to society. Otherwise, according to their view, science is simply unable to reveal its full impact so that investments in science fail to achieve the returns they could in principle attain. Let me quote from the Berlin Declaration:

"In order to realize the vision of a global and accessible representation of knowledge, the future Web has to be sustainable, interactive, and transparent. Content and software tools must be openly accessible and compatible."

"Our organizations are interested in the further promotion of the new open-access paradigm to gain the most benefit for science and society."

Recommendations

The Berlin Declaration also recommends specific measures for implementing the open-access paradigm. Scientists are being encouraged to publish their work in line with the principles of the open-access paradigm. The holders of cultural heritage are encouraged to support open access by providing their resources on the Internet.

ECHO Infrastructure

As regards my own field, the humanities, the Berlin Declaration has provided great encouragement for many archives, museums, libraries, and research institutions to make their contents freely available. However, it is also crucial that we have been able, within the context of the ECHO Initiative, to offer such institutions an open-access infrastructure in the spirit of the Agora solution, helping these institutions to overcome the competence and technology thresholds separating them from the Web. The infrastructure built up by the European Cultural Heritage Online (ECHO) Initiative allows Web-based collaboration on images and texts and automatically creates, for instance, links from any text embedded in the infrastructure to dictionaries for a variety of languages ranging from Ancient Greek to Chinese.

Dual Strategy

In the context of implementing the Berlin Declaration, the Max Planck Society has in fact followed a double strategy, aimed at fostering access to electronic information in the traditional journal format and, secondly, developing innovative models of open-access electronic dissemination with the support of a newly founded innovation centre.

German Signatories

Let me briefly comment on the present signatories of the Berlin Declaration. On the German side, it has been signed not only by the Max Planck Society but also by all major research agencies associated with the Max Planck Society, such as the German Research Foundation, the Fraunhofer Society, the Leibniz and the Helmholtz Associations, the German Science Council, and the Association of Universities. Together these institutions organize and fund the lion's share of German basic and applied research.

The Berlin Declaration has also been signed by the Berlin Brandenburg Academy, one of the national galleries and the German Library Association. All these institutions are under pressure from the ever-increasing scarcity of funding for science and culture to use their resources as effectively as possible and to regain control over the knowledge they produce.

International Signatories

At the international level, the Berlin Declaration has been signed by the French CNRS, the National Hellenic Research Foundation, as well as by other major research funding and governmental organizations from Belgium, Spain, Austria, Norway, Italy and Hungary. It is likely that Croatia will sign shortly. The Declaration has also been signed by transnational organizations such as the Academia Europea.

The core text of the Berlin Declaration has been closely agreed upon with the American Bethesda Group representing major research organizations in the US such as the Howard Hughes Foundation, the National Institutes of Health and the University of California. An international follow-up conference in 2004 will be staged together with the Bethesda initiative to achieve a closer co-ordination between all players involved.

The Next Steps

What are the next steps? This is very easy to answer: you can join the Berlin process, thus helping to pave the way to the science of the future, which will have to be based on the open-access paradigm if we want to exploit our scientific and cultural resources as effectively as possible in order to meet the global challenges of humankind.

How to Join the Berlin Process

Governments, universities, research institutions, funding agencies, foundations, libraries, museums, archives, learned societies and professional associations are invited to join the present signatories.

If you wish to do so, please contact the President of the Max Planck Society, Professor Peter Gruss, who has offered to co-ordinate the process. For further information, also about contact addresses, either consult the website of the Max Planck Society or the brochure we have brought with us. Thank you for your attention and do not forget:

Science is above all communication.   »

H E Professor Atta-ur-Rahman, Minister of Science and Education for Pakistan

« Ladies and gentlemen. About three years ago, President Musharraf asked me to take charge of the Ministry of Science and Technology. I am a professor of organic chemistry heading a chemistry research centre. I asked him one question: "Sir, are you serious about science?" He said: "Of course I am." I said: "If you are serious, let it be reflected in the budget that is going to be announced very soon by the government." The result, ladies and gentlemen, was a 6,000 per cent increase in the budget for science and technology for Pakistan and I think this is historic. I think there must be very few countries which have had such a large budgetary increase, and work began in earnest.

The pace of development over the last three years has been rather intense. Two and a half years ago only 29 cities in Pakistan had Internet access. Today 1,600 towns and cities and villages in Pakistan, covering about 97 per cent of the country, have Internet access. Two and a half years ago only 40 cities had fibre. Today there are 600 cities and towns on fibre. Two and a half years ago the price of bandwidth was $US 87,000 for a 2 megabit line, today it is $US 3,800 for a 2 megabit line, making us by far the cheapest in that part of the world.

The latest UN report, the UNCTAD 2003, acknowledges that Pakistan is well ahead of most countries in that part of the world in terms of ITC diffusion and IT spread.

Science is magical in the way that it informs our lives. But in order for the magic of science to work, we have to have the Merlins, and the Merlins are our bright young men and women. We therefore must have opportunities to train them and to provide them with opportunities to serve within our countries. So we have launched massive programmes. Pakistan produces about 200 PhDs in the sciences every year. We are ramping that up to 1500 to 1600 per year over the next five years by identifying 500 supervisors and allocating each of them three students plus major research plans.

We have started a massive programme to send some 300 to 400 young people every year to study, mainly at European universities. We hope that about 100 will be coming to Switzerland next October. In five years' time I anticipate many changes taking place as they come back.

But we have to provide the facilities, the infrastructure, and also the salaries to ensure that they do come back. We have therefore introduced a tenure track system of appointments, which involves a 600 per cent increase in salary. Professors in our universities will be getting about 125,000 rupees a month, which is about five or six times more than they currently get, but it will be a performance-linked system.

We have also introduced a research productivity allowance, which is a rather creative way of rewarding the best people. We use impact factors and science journals as a science citation index and on the basis of that we have been giving allowances, which are about five times the normal salary. So a young man working in one of our universities or research centres can be getting a much higher salary than an older man who is not so productive.

Simultaneously with all this we have a satellite in space, which is at 38° East, largely for education. We are launching four new TV channels. Two of them will start broadcasting within the next four weeks for distance learning. The other two channels will also come on-line within the next six or eight months for the virtual university. So we will have four channels devoted to education. All the universities are being connected up with fibre. Forty universities are already connected up, which means that a lecture given 2000 miles north can now be listened to 2000 miles south. We are now connecting up so that we can access lectures given by professors in USA or Europe via the satellite.

Of course, to make all these exciting things possible we have to have the funding. The necessary infrastructure is now being created in the universities. With a population of 150 million, our real resource is our young people and our children and change will come if we provide them with the opportunities to educate themselves and to serve their country.

I would like to make three or four very brief recommendations for what I would like to see happen. Firstly, I would like to see free access to the literature, but this is not going to happen very easily because the publishers want to make money. So I would like to propose that journals that are more than a year old be made available free to the developing world. That, I think, would be a step in the right direction.

Secondly, universities in Europe and the USA should emulate MIT's example of open courseware, by making their information and lectures freely available on the Internet. In Pakistan, we have downloaded all the MIT open courseware and distributed it to our universities.

Thirdly, we should try and establish well-funded networks in different disciplines like physics, chemistry, biology and mathematics, to which international organizations and member countries should contribute so that they can really prove powerful resource-sharing tools.

Ladies and Gentlemen, we are moving very rapidly towards a largely paperless world. I am myself the editor of five European science journals and I am starting up two new online journals. One is called *Letters in Drug Design and Discovery* and the second *Letters in Organic Chemistry*, which will start publication next month. I am also starting a series of books that will be exclusively available online called *Advances, Frontiers in Medicine and Chemistry*. That is the way we are going and I would like to join hands with many of you in some of these exciting initiatives.   »

H E B. S. Ngubane, Minister of Arts, Culture, Science and Technology, South Africa, and Chairman of the Commonwealth Science Council

« South Africa has established a new research and development strategy that shifts the country from an armaments-based type of recession development to one that addresses a better quality of life for the people, global competitiveness and technology for poverty eradication.

I believe that there are two goals for which we must strive in order to ensure that the information society is to benefit the poor as well as the rich, young and old, and indeed those who need the services of their governments and the agencies for development. We speak here from a developing world perspective, seeking to build effective and useful partnerships to deliver on the promise of the information age.

First, in order to achieve our goals, the developing world must participate fully in partnerships, networks, discourse, and debates around the information society. Such a role requires the ability for developing countries to influence the outcomes of the information society's development and for our people to participate at all levels within the information society. Closely tied to this is the need to move from a consumption or consumer role in the information society to creative and innovative modes of participation. This would be possible through proactive attention to the capacity for the utilization of science precision technology in the developing world. The foundations upon which these goals rest is access, and their attainment depends on access to information, access to services, and access to opportunities. This will underpin the information revolution that will help the developing countries to move significantly forward. Lack of access fuels the digital divide, exacerbates development backlogs, and denies future generations' full participation in the benefits of the information age.

Access to information requires information equity for all, irrespective of economic status, gender or geographic location or indeed educational attainment. An example of such an initiative is South Africa's digital Minimally Invasive Education project where, through a variety of partnerships, we are exploring ways of facilitating access and fostering computer literacy in areas where people have been excluded from the benefits of the information age.

Access to information, however, is not limited to these types of activities but also requires access to knowledge resources such as scientific journals, which I can tell you are increasingly out of reach in terms of cost to many African and developing world universities and colleges. Surely we can be more creative and effective in this area. The solutions to these challenges cannot be sought unilaterally but will result from a spirit of generosity and new types of partnership between creators, owners, distributors, and users of these resources and the product group of beneficiaries.

And of course it means also that the developing countries themselves must commit at least one per cent of GDP to science and technology and we did achieve this in our declarations at the NEPAD ministerial meeting held in Johannesburg in November. Access to services such as e-government, telemedicine and health information, educational services and e-business has been much discussed in many fora. And we welcome this.

The partnerships that will develop substantive and sustainable social services, infrastructures based on the information age, of course are not yet in place. As much as we promote the importance of public–private partnerships we should not forget that both the Internet and the associated World-Wide Web will develop from public investments in defence and nuclear research, particularly here. To establish effective partnerships in defining and delivering these services requires global public investment, not just in pilot studies but in large-scale demonstrations of these technologies in the service of mankind.

The ICT linkages and networks connecting universities and research centres are critical. While some developing world institutions still have no reliable connections, the use of high-speed research networks such as the GEANT network of the European Union and the Internet II infrastructure in the United States is moving ahead dramatically. Surely this growing divide can be addressed through global partnership. Our universities and research institutions are primary nodes of knowledge transfer and they need to be connected.

The importance of ICT networks for research and education cannot be underestimated. South Africa is establishing its own national research and education network and will link to GEANT. Similarly we need to develop Southern African Development Community (SADC) networks and an African research and education network. This was the subject of a new agreement at a recent NEPAD science and technology ministerial meeting in Johannesburg.

Market failure, especially in the telecommunications domain, leaves large sections of our society without access to information services and opportunities. Normal market forces will not rectify this. Interventions both from a business and technology perspective need to be made. Access to opportunities creates the basis of sustainable participation. The intellectual property regime that we need for this to succeed should foster the development of the creative and innovation roles of the developing world. Local content development and the technologies and processes that support this, such as human language technologies, are key components of such opportunities. We need to learn from global success stories and replicate these and maximize the benefit of opportunities provided by these successes to all.

One example of this is the closing of the gap between the developed and the developing world in the area of weather forecasting. This has happened over 20 years because in this case the availability of no-cost or low-cost access to remote-sensing data enabled us within the space of one decade to achieve parity in terms of the effectiveness of weather forecasting. We moved from being accurate within seven days prediction to five days and now we are at the level of three days' accuracy, which is almost exactly similar to the northern hemisphere countries. This was built on a consensus in the global weather community of free sharing of all relevant data, driven in part by the need for safe travel and the prediction of extreme weather events.

If only we had the same consensus about poverty, disease and ignorance we would certainly move the developing countries from the mire of underdevelopment and backwardness.

South Africa strongly embraces the open-source philosophy and this is supported by the national strategy on open source based on recommendations from the National Advisory Council on Innovation and other government structures. Open source is the ability to lower the barriers of entry into the information society. It provides access to a huge basis of knowledge resources and supports the philosophy of joint open development.

In conclusion, this is not 'business as usual' and incremental approaches will not take us to our goals. We need to understand and embrace the interrelated issues. Actions will range from increased science investment by developing nations through to implementation and new global partnerships. Human resource development, capacity building, a fair intellectual property regime, access and sustainability will be addressed. Within this new paradigm we need to guard against creating environments that will allow the mistakes of the past to be repeated. Again I stress that we need to move from developing world ICT consumption to creation and innovation by all to realize the equitable information society that is our future.

Thank you very much for the invitation to participate in this very important conference. We have a lot to offer, we want to be partners.   »

Professor Fidel Castro Diaz-Balart, Member of the Cuban Academy of Sciences and Scientific Adviser to the President of the Council of State of Cuba

« Excellencies, Honourable members of the Panel, Distinguished participants in the RSIS, Ladies and Gentlemen,

I wish to express my deep appreciation to the patrons of this Conference and the Swiss Confederation for their warm hospitality. To all participants in RSIS, I am pleased to say how privileged I am to attend a conference of such importance and timely relevance.

Why Are We Here?

Around the world we are witnessing a technological, economic and social gap between rich and poor nations that is regrettably increasing. As pointed out in the RSIS Conference programme, on 7 March 2003 United Nations Secretary-General, Kofi Annan, challenged the World's scientists to address the 'clear inequalities' in scientific activity that exist between advanced and developing countries. One of the outcomes of the present Conference could be to draft a response to that challenge which must involve long-term strategies focusing on finding effective solutions to the problems currently under consideration.

The Background

I want to summarize for you the contents and highlight the main points of a document, which is a contribution to the RSIS and WSIS Conferences, entitled *Information Societies, Towards a South Perspective,* written in response to a request made to me by Professor Boutros Boutros Ghali, Chairman of the South Centre on behalf of its board. To draft it, I sought the collaboration of a group of internationally renowned experts, to whom I convey my gratitude for their valuable contributions. The document consists of four sections, a list of conclusions and recommendations, and an Executive Summary.

Challenges of Globalization

Throughout most of the South, the objective of putting science and technology at the service of development suffered a set-back during the 1990s under the impact of neo-liberal globalization, which despite its promises has weakened the nation state in critical areas and left the world vulnerable to disruptive capital flows and the vagaries of the market. The development of ICTs, on the other hand, has permeated the modern world scenario, leading to the emergence of information societies, but creating the digital and knowledge divide.

The building of information-knowledge societies is an essential means for achieving equitable and peaceful global communities, which, in combination with adequate infrastructure and economic development, prepare the conditions needed to humanize the process of globalization. But the construction of these societies is undertaken in a real world that is plagued with challenging problems. In fact, at the dawn of the 21st century, 20% of the world's population controls most of the world's resources.

The human population is growing and demanding an ever greater amount of energy. It has been estimated that by the year 2100 the world's population will be between 11 and 12 billion. Most of the demographic increase will occur in developing countries. Between 2030 and 2050, the total energy demand will double the present energy consumption, equivalent to ten billion tonnes of oil per year. Also, the composition and temperature of the atmosphere is being altered, leading to irreversible climate changes. At present, food sources for 1.2 billion people in many countries are threatened by desertification and water scarcity; these people include many of the world's poorest, most marginalized, and politically underpowered citizens.

As a consequence of this growing inequality the world is confronted with increasing violence committed by both state and non-state actors. Unless some drastic steps are taken to address this gap, the world faces a very uncertain future of wars and civil unrest.

So, the present generation of decision-makers is asked to act in response to a danger that will have a serious impact on succeeding generations. Solutions which find a basis in science are needed to solve real-life problems such as the eradication of poverty, the improvement of health care, the raising of educational levels, the introduction of technological innovations, and promoting wide-reaching and comprehensive education.

In this sense *our report expresses the very deep and strong desire of South scientists to construct information societies and to develop knowledge-based economies in our countries*.

Some developing countries are now engaged in the resolute pursuit of the goals of developing national science and technology capabilities and harnessing these in the service of national development, as part and parcel of comprehensive long-term national development strategies, with notable results. These advances have been essential ingredients in their ability to cope with contemporary challenges, including those presented by neo-liberal globalization.

But, in a significant number of developing countries, the situation has been aggravated by broader socio-economic problems such as high levels of external debt, the instability of financial markets, and financial crises with regional and global repercussions.

Education, Science and Technology

Over 850 million people, that is to say, 26% of all adults, are illiterate. It is necessary to begin massive educational campaigns that start with the eradication of illiteracy. This is essential to create a minimum cultural background, as the foundations on which higher education, scientific and technical programmes can be promoted. To create information societies, it is also crucial to eliminate illiteracy in terms of use of ICTs.

There is a disparity in investments, in outputs and in human resources in science and technology between South and North. Northern countries invest between 2 and 2.5% of their GDP in research, development, and application of science and technology. The investments of the Southern countries range from under 0.3% to 0.5%. In the North, 0.2% of the population is involved in science and technology, while in most South countries this figure is around 0.05%. As a consequence of this, South countries' total output of scientific publications and patents is below 10% of the world's share.

World science always brings a diversity of benefits, which can be intertwined with the specific characteristics of the societies in which it is developed. The present tendency to use the intellectual property system as a tool for the privatization of knowledge is threatening the efficiency and productivity of scientific creation on a global scale and jeopardizing it. Since science is increasingly becoming an essential part of modern general culture by putting boundaries on the above-mentioned diversity, it becomes an essential part of this problem, together with the intensification of the brain drain.

The document I am summarizing states that all these trends have weakened or eliminated the elements needed for self-reliance and for developing knowledge societies, which in turn undermines the ability of affected societies to use and harness modern science and technological advances in the service of development, as well as to overcome these challenges.

A Dual Challenge

We conclude that the challenge today is a dual one, namely: to use and benefit from the potential of information in knowledge societies and tackle the development problems and needs of the South, and to prevent this 'society' from becoming an additional source of divisions, inequalities, domination, backwardness and disempowerment in the contemporary world and within individual countries. As experience has shown us, the latter is a serious risk within the dominant globalization paradigm of unrestricted markets and 'level playing fields' in which grossly unequal players supposedly 'compete' with each other.

What can be done to respond to this dual challenge is our key policy message. It is addressed first and foremost to developing countries and calls for greater efforts to engage in self-reliant action, including efforts to promote South–South co-operation. Drawing on the experience and advances of some developing countries to assist others has a massive potential.

We believe that if ICTs are properly used, they can be of great help in efforts aimed at bridging the divide, especially in the area of science and research.

Outcome of the WSIS

In my concluding remarks, I want briefly to enumerate a number of conclusions and recommendations of our policy document:

– Developing countries must establish a set of strategic objectives for which the pre-requisite must be the implementation of massive education programmes.

– The mastering of science and technology must be guided by the most qualified groups of scientists and technicians. Scientific literature, particularly in electronic form, should be made more broadly accessible to South countries.

– Political will and access to financial resources are equally essential to guarantee sustainable development.

The development of all science-based high technologies requires a national core group of experts in the area of basic sciences. The upgrading of universities and technological schools is another step. The link between the development of science and science education, making use of technological innovations, must be emphasized. It is necessary to promote the creation of research institutes where a considerable part of all scientific activity is devoted to applying international science to the search for solutions to local problems. The creation of scientific and technological parks (or even techno-cells), as a link between universities, research institutes and industry, must also be promoted whenever possible.

Possible routes to achieve the South's empowerment and developing synergies could be:

– The creation of an organization for mutual scientific and technical advice and assistance in the South.

– The creation of various regional centres of international standard for training scientists of neighbouring countries in several areas of science and technology.

– The establishment of joint mechanisms for creating or improving already existing research centres of excellence and research groups, to promote South–South exchange of scientists.

– Improvement of our capacity to negotiate with Northern institutions for access to world science and technology, including free availability of scientific and technical journals by Internet for most countries in the South.

I would like to conclude my intervention by considering the following core question that the expert panel which I represent addressed to itself:

"Is it possible to have information societies in the South?"

We believe it is possible, but it is necessary, although perhaps not sufficient, to heed our recommendations, many of which together with other approaches, are not new for the developing world.

Regarding science and technology development, a political decision is needed to *create, master and use modern science and technology, including ICTs*. However, despite their efforts, only a few Southern countries have been able to make substantial progress in implementing them. It is time to find the way to start working systematically to allow the entire developing world to achieve these goals.

I feel all of us in this conference are committed to working towards achieving Knowledge Societies for All, but how to do it in a better and more equal and just way, this is our challenge.   »

Dinner Speech

Malcolm Harbour, Member of the European Parliament

The Legislative Framework for Electronic Communications

It is absolutely essential for the dissemination of information that legislators get the legislative framework for electronic communications right. The EU provides a good model. The crucial policy is to provide a single framework for all electronic communication formats to encourage cross platform competition and to encompass convergent technologies. Information delivery mechanisms will keep changing rapidly. Some formats may be only transitory — the commercial models will change. Legislators should have the courage to let the market work. They should only intervene to deal with cases of demonstrated monopoly power or dominant position. They should use interventions, such as mandatory network access, that encourage competition. Above all they should be technology neutral — it is not the job of politicians to mandate regulation of technologies. Scientists will hopefully support this approach and lobby politicians if they feel that communications regulation is going in the wrong direction.

Research

The European Union has given high priority to information and communication technology research in its Framework Research Programmes. These programmes add value to national research efforts. In ICTs, they have been particularly successful in developing the technology and standards for mobile communications, which has given the EU a leading global role. In the current programme 3.6 billion euros will be invested in ICT research between 2003 and 2007, with 1 billion euros just released for a whole range of new projects.

To underpin this research, the EU has also invested in the GÉANT broadband research network and has been actively promoting global network development to link research centres. A crucial point made on Day 1 of the RSIS Conference is the need to stimulate research in every country to develop ICT projects that address local needs. Solutions must be tailored to geography, culture, infrastructure and language, to name but four factors. But ICT work can be greatly helped by access to technologies from other knowledge centres and solutions developed in one country can be shared with others. Researchers can also conduct remote experiments using facilities in other countries and analyse the data generated. A key outcome of the World Summit should be the clear endorsement of the creation of a global research network and the commitment by the key players to develop and fund it.

Knowledge-Driven Economy

It is clear from all the discussions at the RSIS Conference that, in a knowledge-driven economy, the information technology makes an impact at all levels in society and also encompasses the past, present and future. It is also clear that the evolution of the information society will proceed in very different ways in developed and developing worlds. In the developed world, our challenge is to stimulate personal consumers to use the technologies for commercial and public service applications. This growth should stimulate investment in technology and infrastructure. By contrast, in developing countries, the delivery of public services will be the key driver of infrastructure and investment. However, common to all IT applications is the need for data security and for citizens to be able to exert control over their personal data. Citizens will not interact with public authorities unless they feel secure about releasing highly sensitive health, financial or education records. They also want to control who sees their data within the different parts of the public administration! For commercial interactions, similar considerations also apply. Consumers are often reluctant to buy on-line because of worries about the security of their financial data.

Security issues also impact on intellectual property considerations. We want creative minds to generate exciting new content for all kinds of electronic delivery mechanisms. But they will also expect their returns. New business models have been developed to enable creators to realize value. These will reflect changes in consumer attitudes brought about by digital delivery. Musicians, for example, will have to adjust to the reality that on-line distribution enables them to release value from their works over a much longer period, because back catalogues can be made easily and freely available. But short-term revenue from new releases is being dramatically reduced by illicit circulation of private copies.

We also saw examples from RSIS presentations about the importance of applying IT to cataloguing and archiving our cultural history. Much of this will be a free resource but there are commercial opportunities here as well. But we need to encompass all areas of information technology in our thinking because they are generating large amounts of revenue. Take computer games. It was reported in 2002 that visual reality and visual reality games generated a staggering US$ 36 billion world-wide revenue. Interactive games are generating high levels of broadband traffic, stimulating infrastructure growth. The investment in virtual reality will spin off important tools for society, in medical training, in road safety and in building design. The latest growth in computing games is coming from avatars where game players can make virtual reality models of themselves or any other person they want to be and insert themselves into their game scenes. This opens lots of possibilities for combining historic events with new technology; we could recreate ourselves kicking the winning drop goal that gave England the World Rugby Cup! Or we can recreate and replay historic football games. I use these examples to emphasize that we must be creative in our whole approach to the knowledge economy. We must encourage creativity to get innovative people to grasp the tools available and exploit them. The computer games played in the developed world stimulate technological and infrastructure investment that can help the developing world.

Conclusions

CERN is to be congratulated for seizing the opportunity to bring us together for such a stimulating and wide-ranging event. As a European politician involved in IT policy-making, I am conscious that there are many lessons to be absorbed. But the key one is that the politicians must play an enabling role, not a controlling one. We can set the rules of the game and encourage strategic research. But we should be brave enough to give innovators their head.