1. RESEARCH PROCESS AND CONNECTIVITY IN THE INFORMATION SOCIETY

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One of the key objectives of the "Past, Present and Future" conference was to inject a note of realism in the run up to phase two of the World Summit on the Information Society. This might seem strange, given that the original sponsor of the event, the Society for Social Studies of Science, is an international, professional association whose members are often thought to advocate various forms of social constructivism. The conference brought together active scholars, who do research on global and national ICT issues, with policy makers, program managers, and senior organizational leaders. One of the constants throughout the three days of the meeting is not any particular theoretical, organizational, or ideological advocacy, but an overarching sense that the past, present, and future of research in an information society must include not only innovations in information technologies themselves, but also the ways in which these technologies interact with and are constituted by the social, political, and developmental contexts in which they are embedded. The "seamless web" of science, technology, and society was never more apparent than in the variety of presentations that follow.

The opening and closing plenary sessions were chaired by the Kenyan and South African coordinators of the World Science Project[1], while the "bookends" for the conference were two movies produced for the science and engineering events of Phase I and Phase II of WSIS. The Opening Plenary session reprised "Before the Horse," an ironic video essay on several paragraphs from the Summit documents that pertain to the globalization of

science through the Internet. The final event of the conference was "After the Fact," a meditation on the continuing problems of development in the specific context of scientific institutions and Internet connectivity.[2]

The sections that follow examine crucial issues in understanding the Information Society, with a special focus on the process of research and the institutions that conduct and support it. The contributions to the plenary sessions moved from the problems of connectivity in a small research institute in sub-Saharan Africa, to the WSIS process itself in relation to the research and educational sectors so important to the Information Society. The importance of capacity building for the scientific institutions of the developing world was a focus of several keynote speakers in the opening and closing sessions, with contributions from the private sector (Hewlett Packard), international organizations (OECD, ICSU, TWAS, and the Society for Social Studies of Science), as well as national research and academic organizations. These latter institutions possess remarkable potential for the collection, analysis and dissemination of data that could be harnessed, given the right conditions. Finally, speakers at the opening and closing sessions discussed barriers of access to scientific data and information, as well as the important and continuing issue of the "scientific" digital divide.

1.1 African Research Institutions And The Problem Of Connectivity?[3]

The Donor

The subject of our two-part discussion today is a research institute. All of you have seen a drawing of the view from its Guest House when you visited the web site of this conference: http://worldsci.net.[4] The name and identity of the research station does not matter: it is typical of many rural research institutes in Africa. About two dozen agricultural scientists are based here, in an arid region where farmers could benefit immensely from a portfolio of research projects on a variety of issues targeted at improving productivity. By the same token, it seems very much as if the scientists who make this their home and workplace could benefit immensely from a reliable, always-on connection to the Internet.

This research institute served as a symbol for our conference, a symbol of the constraints of connectivity, of the Information Society, of Africa, of development and reagency (Shrum, 2005). Several of the key paragraphs in the Plan of Action adopted at the Geneva phase of the World Summit on the Information Society (paragraphs seven, ten, and twenty three) refer explicitly to the importance of providing a connection to the Internet for

research institutes, universities, and schools. I first set eyes on the place in 1994, just after its new buildings were inaugurated. I visited again in 1999 and dreamed of seeing it fully connected, just as all universities and research institutes in Europe and the U.S. were, by then, online.

Partly inspired by this institute, we began what is now a six country project, investigating the effects of the Internet on research networks, communication, and collaboration—what some would call the globalization of science. Partly inspired by this institute, we began to work to make this connectivity happen, at least in the sub-Saharan African countries of our study. What if scientists at our institute could collaborate with scientists from abroad through email? What if they could have access to all the current agricultural research journals? What if they could just Talk Now with whomever they liked, and Have Unlimited Access to the information they needed on the web? We would help our partners build local area networks, funded by the U.S. National Science Foundation. Admittedly, by comparison with other donors—multilateral and bilateral organizations, international NGOs—we were small. But the amount of money needed was not large—a few thousand dollars could buy the hardware, the cables and connectors, a computer that could be employed as a server.

It was, to be sure, fun to have money—now try to engage some problems rather than just writing and talking about them! But there is a problem with the "wide-eyed and bushy-tailed" approach—that is, the first timers in Africa, Latin America, and Asia, who have come to "make a difference" They think doing projects is mainly about doing projects, rather than making money. Having spent enough time in the developing world, we saw what most donors and project managers see. You do not have to look very hard for it. Let us call it "leakage."[5] We decided to make a couple of commitments in the early days of our project. They are simple ones, really, but awfully hard to keep, since for most donors and NGOs spending a certain quantity of money within a given amount of time is a necessity. In this, we were lucky: our project is a research project and not a development project. The first commitment is that those from the developed world <u>should not earn any money</u> from the project—not even a per diem.[6] The second is that those from developing areas <u>should not earn any more than necessary</u> to accomplish project goals, based on local prices. There should be no leakage.

The irritating thing about sociologists—for those of you who are not sociologists—is that they will take that leakage, and make it the subject of another study.

One more commitment had particular importance for Internet connectivity in sub-Saharan Africa. We decided that our project would not pay for variable connectivity charges (e.g., monthly phone or cable bills) in the places where we worked. It was simply not sustainable. By 2001, state

operated telecommunication monopolies were still charging exorbitant fees for data and connection services. At one time we calculated that the entire budget for our five year project would have been gone in one year if we had signed on with the standard monthly charges by Kenya telecom. Sometimes you just have to wait for the break up of these enterprises, but it is sometimes a long wait.

We bought sufficient hardware for the institute in 2002, and secured an agreement with a local partner to provide the installation. After a year had gone by, nothing substantial had happened. A full account of the project would involve not only technical problems such as the lack of a clear line of sight to a nearby town and a certain copper wire found to be unsuitable for carrying a signal. It would involve more robust details such as secret cabals, death threats (fortunately, of no consequence), theft (fortunately, not our equipment), installation of barbed wire surrounding a water tower that was considered (but never used) for a wireless connection point, threats of transfer to hardship posts, and an Italian named Paolo who believed the problem might be solved through a well-connected Internet café owner. Since most of these events happened before the first phase of the Summit—and given the Plan of Action that had been adopted in Geneva—it seemed a worthy goal to see whether this connectivity could be accomplished by the second, Tunis phase.

It saddens me—but now only a little—to report that if you go to the institute today, you do not have much chance to send an email, and browsing the web is not really an option. It will be on a slow, dialup connection, as before. And it will be through a phone call to town, from the office of one or two of the scientists who have funded projects. On the other hand, you can still sit on the veranda of the Guest House. And if you brought your materials with you, some very good work may be done.

The Recipient

Among the many reasons for low use of Internet by educational and research institutions in sub-Saharan Africa is inadequate appreciation of the true power and usefulness of this tool. Much of the third world countries still have very low rate of Internet connectivity, or the use of the Internet as a source or a means of exchanging information, compared to the rest of the world.

As we look back at what happened in our situation in a research centre in Katumani in Kenya, and as we observe other institutions, we see a number of factors that play part, and being responsible for this poor performance or low rate of progress. These factors can be multiplied and replayed in many parts of Africa, to varying degrees.

Low Budgetary Allocation to National Research Institutions

Dwindling government and donor funding to national research institutions means that top management must prioritize and limit funding to those areas perceived to have the potential to produce immediate and demonstrable results. Internet connectivity is rarely perceived as such. Institutions that have low capacity for revenue generation, and that rely on donations and financial goodwill, will not give priority to Internet connectivity at the expense of direct and field research.

Lack of Enthusiasm from the Scientists

Having failed to secure additional funding to support sustained Internet connectivity, we thought that we would use the power of demand to convince top management that scientists needed this facility, and that its provision would significantly increase their productivity. If we could demonstrate that an institution that is connected to the Internet is a highly productive society, then we could argue successfully for extra funds. Apart from formal awareness seminars for scientists, we constantly took advantage of our regular management meetings to urge for deeper interest in the use of Internet.

This approach, however, met with very minimal success. Quite a number of scientists had direct donor-funded projects, and were able to afford dial-up Internet connectivity for their offices. But increased interest did not happen. At one point in time,[7] Katumani had 48 research scientists (bachelors degree and above), consisting of 13 doctorates, 28 Masters, and seven bachelor degree holders. Of the 13 scientists with doctorate degrees, four were totally computer illiterate and six knew computing to varying degrees, and frequently used PCs (mainly for writing documents (word processing) or analysis of data (spreadsheet or statistical package). Of these six scientists two had maintained some email communication, using largely commercial cybercafé facilities (e.g. email with yahoo accounts). To the rest (and indeed the majority) of scientists in the centre, personal computers are nothing more than modern typewriters and large calculators.

Three scientists had desktop PCs in the offices, for their exclusive use. Of the three, only two maintained continuous Internet connectivity through a dial-up system to a Nairobi-based ISP (90 km away). We both maintained the Internet access through funds of our respective projects. Out of 48 scientists, only two had direct access to Internet connectivity in their offices. The rest were either uninterested in the Internet, or could not afford it.

Why the apathy among scientists in the use of Internet? To a very large extent, many scientists (and top managers included) in LDCs (Least Developed Countries) view the Internet merely as a part-time hobby, rather

than an essential tool for day-to-day performance. A few postulates can be developed from the Katumani experience:

- We have a system in Kenya that largely does not recognize and reward information usage. There are two examples to highlight this. First, promotion is rarely based on published works, or the frequency and quality of publication. Two, postgraduate theses/dissertations still cite old literature or "grey literature" without serious reprimand by supervisors and/or examiners. The use of the Internet for bibliographic search is simply still very minimal.
- In our research institutions the emphasis is mainly on technology transfer as opposed to research for the sake of generation of new knowledge. This emphasis results from the demands by donors and governments for demonstrable impacts of the funds spent on research. It is, then, commonly assumed that technology transfer to a resource-poor subsistence farmer in a rural African setting is less demanding of Internet resources than field/lab research. This may explain the general lack of interest in Internet connectivity among many scientific researchers in LDCs.

In summary, the problem of low Internet connectivity among research scientists in Africa is complex. The provision of broadband ICT infrastructure is only one part of solution. There is need to address a host of internal factors –social, economic, political, and environmental.

1.2 Role of Science and WSIS in the Establishment of Information Society[8]

An important question to ask about the relationship between WSIS and science is: What is the role of science in the creation of information society? First, science underpins ICT developments and so shapes the information society. Through scientific activities, scientists accumulate knowledge useful to the development of ICTs. Indeed, without science, it is difficult to promote technological innovations such as ICTs. Second, scientific progress is dependent on access to information and data. Scientists with easy access to information and data are the very ones with the highest potential to innovate. Indeed, the difference in productivity and innovations between scientists from developed and developing countries is largely explained by their differentials in access to information and data. Due to high rates of access to information and data, scientists from the developed countries are more productive and innovative.

Third, WSIS presents a unique opportunity to address the knowledge divide in science. Obviously, by bringing all stakeholders together, WSIS

has presented the problem of the digital divide as a global agenda for all. Fourth, to make WSIS successful in its mission, scientists need to engage with other stakeholders on information and data issues. To make good use of the strategy of sharing data scientists should not just talk among themselves; rather, they should engage with other stakeholders. Knowledge is more valuable when it is shared with others. Strategies for making WSIS more effective in the creation of Information Society include:

- Partnership with international organizations that focus on, generate, manage or analyze scientific data such as ICSU, UNESCO, CODATA, CERN, TWAS and others. What contributions can each of these stakeholders make? It is necessary to document the specific activities of each of these organizations and delineate their relevance in the WSIS process.
- Draw from past WSIS initiatives such as PrepCom1 and address the agreed upon concerns or principles.
- As proposed in March 2003, implement the defined agenda for action for science in the Information Society. The agenda has already been distributed widely and endorsed by national and international bodies.
- Draw from the several high profile science events in the Geneva Summit.

This discussion affirms that science has a critical role in the development of the Information Society. But we need an effective WSIS process to forge a strong linkage between science and IS; such a process should reduce the range of barriers that contribute to the persistent ICT-related problem of the digital divide. A recent editorial in *Science* (Iwata and Chen, 2005: 405) highlights the role of science in tackling the problem of digital divide by positing that: "Now, with the second phase of WSIS taking place in Tunis in November 2005, the scientific community needs to take lead in demonstrating how science –and universal access to scientific data, information, and knowledge– can make a critical difference in sustainable development and overcoming the "digital divide."

This is the greatest challenge of the WSIS process.

Geneva Declaration of Principles

The role of science in creating Information Society is well captured in the principles set forth in 2003 in Geneva. The principles were stated as follows:

- We recognize that science has a central role in the development of Information Society.
- We should remove barriers to equitable access to information for scientific activities and facilitate access to public domain information.

- We need to promote universal access with equal opportunities for all to scientific knowledge and the creation and dissemination of scientific information

While these are remarkable principles that reflect on the concerns to be addressed, they can only change the status quo if they are put on the ground and practised. Practically, more efforts should be directed in the identification of specific actors and their respective roles at different levels to tackle the problem of digital divide. Though the latter problem now looms large, particularly in the developing countries, to tackle it effectively requires the active participation of development actors from the developed countries. More resources must be harnessed from the North to liberate the South. How to do it and promote the development of ICT sector in the poor South is the challenge of WSIS process that targets the creation of an Information Society by 2015.

Agenda for Action: Overcoming the Problem of Digital Divide

Even with the launch of the WSIS documents in Geneva in 2003 that strongly affirmed the central role of science in developing an information society and supporting the principle of universal access with equal opportunities for all– the problem of the digital divide is still pervasive worldwide. How can it be tackled to remove barriers in the creation of an Information Society? The following courses of action are suggested (which can be challenged):

- *Provide affordable and reliable Internet connectivity for all universities and research institutes*: While this is a noble idea shared by many, the main challenge (especially in the developing countries) is to source the required resources to make things happen as suggested. Unless there are stakeholders from the rich North willing to help improve connectivity in the poor South, this course of action will not be tenable in some parts of the world.
- *Capacity building and education*: This is a very general strategy that needs to be unpackaged. For example, what aspects of capacity are lacking in the poor South and that need to be addressed? Who should build capacity? Should it be the State, private organizations, civil society or foreign experts? Past experiences have shown that capacity building is more effective when it is spearheaded by the local actors and when it is participatory.
- *Full and open access to public data*: While this is the ideal situation, there are existing barriers especially in the poor South that inhibit the realization of the ideal. The internal barriers such as illiteracy, minimal investment in ICTs and poor connectivity should first be overcome. There are also external barriers to be tackled –such as

exploitation of the developing countries by the rich North as well as operation of an ICT regulatory framework that favours the rich North.

- *Interoperability and metadata standards.*
- *Collection and preservation of digital data*: It is important to clarify the specific actors at all levels that should be charged with this responsibility.
- *Equitable access to scientific information*: As noted earlier, this is an ideal of the Information Society.
- *Promote scientific literacy*: This is doable internally and externally at different levels. However, the required resources should be identified.
- *Research on ICT use in key priority areas*: This idea is noble but the challenge in the developing countries is to raise money for research. Who should fund such research in developing countries?
- *Identify the role of scientists in decision-making in/for the Information Society*: To benefit from the proposed principles guiding the Information Society, scientists should be involved in decision making at all levels. Practically, the involvement of scientists in decision making could enhance Research & Development and ultimately, enhance scientific innovations.

Major Unresolved Issues

Despite the preparatory actions in Johannesburg (2002) and the formulation of remarkable principles in WSIS in Geneva (2003), the grand march towards the Information Society is still faced with major unresolved issues including:

- *Internet governance and freedom of the press*: The central issue here is to formulate a global functional framework to oversee Internet governance and the freedom of the press. This will entail establishment of a globally accepted authority to take charge of the Internet and freedom of press that could easily be abused.
- *Solidarity fund*: Efforts must be put to raise this fund that is required, *inter alia*, to implement the principles of WSIS.
- *Role of open-access publishing and open-source software*: Further, there is need to address the issue of using political agreements to implement e-science actions locally and internationally.

Beyond identification of these unresolved issues, we need viable means to address them. As a way forward, WSIS should establish a body (e.g., a commission) to address the general problem of implementation of its principles. Such a body should draw membership from North and South to

enrich its understanding of the real barriers facing the WSIS process worldwide.

Partnership between WSIS and ICSU

How can ICSU contribute effectively to the WSIS process? Through its various units, ICSU can add value to the WSIS process by enhancing access to data among all stakeholders. More specifically, the role of selected units is as follows:

- CODATA –deals with policy and management.
- INASP –focuses on information access.
- World Data Centres and Services –these facilitate data collection, analysis and dissemination worldwide.
- Global Observing Systems and GEO.
- Global Environmental Change Programmes.

Through these outlets, ICSU promotes the generation, analysis and dissemination of scientific data required to promote, *inter alia*, the development of ICT sectors. The policies of ICSU include: (1) full and open access to scientific data, and (2) universal and equitable access to scientific publications. These policies are congruent to those of the WSIS. To enhance full and open access to scientific data, ICSU suggests the following actions:

- establishment of two way access;
- constraints must be minimized;
- establishment of stable systems for providing universal access to quality data;
- need to develop new economic models;
- involve scientists in policy development; and
- address the diverse needs of scientists in developing countries.

To accomplish all these actions:

- long-term planning and investments by all stakeholders (besides the State);
- professional data management to insure integrity of scientific findings;
- Modernization of current infrastructures and systems of data management;
- develop new infrastructures in some areas or regions;
- enhance international, interdisciplinary coordination; and
- support national and international policies.

Overall, these constitute an impressive package of actions, but unless they are implemented, these actions will not add value to the WSIS process. There is a need to specify the actors responsible for the suggested action and a time frame to indicate timings for specific actions. In line with suggestions

and as the way forward the *creation of a coordinated global initiative* to undertake the following is essential:

1. Develop a long-term strategic framework.
2. Create an International Scientific Data and Information Forum (SciDIF).
3. Create a new ad hoc strategic committee to make it happen.

As a critical note, we observe that rather than create too many new bodies or initiatives, WSIS should endeavour to harness the potential of the existing bodies –say in data collection, analysis and dissemination. This would enable the WSIS process to save much-needed resources and work with fewer stakeholders. Creation of new bodies should be limited to fields that are currently underserved by the existing ones.

1.3 Open Access And Capacity Building In Science And Technology

In the information age, a country's prosperity and international competitiveness basically derive from its scientific and technological strength and its innovativeness. Therefore, most developing countries consider capacity building in science and technology an urgent task and increase their investment in S&T. Increase in investments is indispensable while the formation of public policy that is facilitating the effective flow and application of information and knowledge seems more important for the elevation of ability in putting knowledge to use quickly, effectively and creatively.

There are many public policy issues of a global nature that are impacting the dissemination of information and knowledge. Among them a very important one is the issue of IPR (Intellectual Property Rights) protection. In this issue there are three factors that are often ignored:

1. IPR protection in developing countries should be a gradual process that is commensurate with the level of general development. The history of developed countries reveals that they also underwent such a transition from a time when IPR were inadequately protected to a time when they were. But the policy evolution taken by developing countries is not understood and accepted by the developed world today. The pressure causes the protection of IPR in some developing countries to exceed the level of their development, even to exceed what is required by the WTO and is practiced in developed countries. This trend still continues to be strengthened.

2. In developed countries antitrust laws and laws protecting the rights and interests of consumers coexist with laws protecting IPR. These play a counterbalancing and restrictive role to benefit IPR users. But many developing countries do not have sound antitrust and consumer interest

protection laws. At present, most knowledge products and IPR belong to developed countries or to trans-national corporations located in developed areas, so they have the prerequisites for a knowledge monopoly. This objective possibility has sometimes turned into a real knowledge monopoly in developing areas because of the lack of balancing policies.

3. In many developing countries there are no laws and regulations for sharing knowledge. This situation further increases the lack of balance between withholding and sharing knowledge.

These factors worsen knowledge sharing and capacity building in S&T. An example is the sharp and persistent elevation of the price for scientific periodicals. During the past 16 years, under an average inflation rate of 3.1 percent, the average growth of periodical subscription prices has been 9.5 percent. Since the 1990s many activities have taken place to promote the Open Access to scientific knowledge and information. The promulgation of the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities in October 2003 has been supported and signed by 55 countries and regions including China. As a new model for scholarly exchange and publication, open access policy is considerably improving the free flow of scientific information and findings, elevating the effectiveness of scientific research activities and at the same time greatly promoting the S&T capacity building.

1.4 The Role of TWAS in Developing the Information Society[10]

The Academy of Sciences for the Developing World (TWAS), formerly known as the Third World Academy of Sciences, is a merit-based science academy located in Trieste, Italy. It operates under the auspices of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and receives most of its core funding from the Italian government. The Academy was created in 1983 and recently celebrated its 20th anniversary in the Great Hall of the People in Beijing, China.

TWAS largely functions like other merit-based science academies –for example, the Royal Society in the United Kingdom, the US National Academy of Sciences and the Chinese Academy of Sciences. But there are two significant differences. First, it is globally, not nationally, based. And second, it honours scientists across the developing world. Today, the Academy has more than 800 members living in 90 countries. Eighty-five percent of its members come from the developing world and 15 percent from the developed world. The latter are scientists who were born in the developing world and who now work in the developed world, or scientists

from the developed world whose research focuses on issues of particular importance to the developing world.

The membership profile of TWAS is virtually the mirror image of the global profile of scientists in which 75 percent of the scientists are from the developed world and 25 percent from the developing world. These proportions are now undergoing a steady shift thanks largely to the growth of science in Brazil, China, India, and several other developing countries. In addition to serving its membership, TWAS sponsors a wide-ranging set of capacity building programmes for scientists from the developing world, including one of the world's largest South-South (developing world to developing world) fellowship programmes for doctoral and post-doctoral students. This programme, under which 250 fellowships are made available each year, is largely sponsored by the governments of Brazil, China, and India.

TWAS also provides administrative support for several other international scientific organizations that share the Academy's mandate for the promotion of science, especially in the developing world. These organizations are:

- The Third World Organization for Women in Science (TWOWS) seeks to increase the presence of women in science, especially in leadership positions. With more than 3,000 members, it is the largest organization of women scientists in the world. TWOWS held its 3rd general assembly and international conference in Bangalore, India, in November 2005.
- The Third World Network of Scientific Organizations (TWNSO), which is an institutional network of science ministries and research councils that serves as the diplomatic arm of TWAS. The purpose of TWNSO is to encourage governments to invest greater resources in science and to make science a critical tool in their economic development efforts. TWNSO currently has about 157 members.
- The Inter-Academy Panel on International Issues (IAP), which is a network of merit-based science academies from both the developed and developing world that seeks to build the capacity of its member institutions, especially their capacity to raise the profile and influence of science academies in the corridors of their governments and international institutions. IAP currently has 92 members.
- The Inter Academy Medical Panel (IAMP), which is a network of merit-based medical academies or medical divisions within national science academies from both the developed and developing worlds, carries a similar mandate to that of IAP but focuses exclusively on medical and public-health issues. IAMP has 51 members.

The Academy's expertise in information and communication technologies (ICTs) is found among its members and the members of its

affiliated organizations. Like virtually all organizations worldwide, however, TWAS has been dramatically affected by the revolutionary changes that have taken place over the past several decades, causing it to alter its strategy in light of the rapidly changing conditions in the developing world.

First, as an enabling technology, ICTs have "enabled" a number of developing countries –notably, Brazil, China and India– to make significant progress both in building the capacities of their scientific communities and in effectively pursuing science-based economic development strategies. Second, as the success of these scientifically proficient countries mounts, other developing countries have become more interested in investing in science and technology.

These trends have led TWAS: (1) to increasingly target its resources and programmatic initiatives towards the scientifically laggard among the developing countries, especially those in sub-Saharan Africa, and (2) to develop programmes, often in partnership with its affiliated organizations, TWNSO, TWOWS, IAP and IAMP, that seek to put science to work to help lay the groundwork for sustainable economic growth. These programmes take the form of describing best practices in addressing such critical societal problems as access to safe drinking water, development of renewable energies and the conservation and wise use of indigenous and medicinal plants; the issuing of statements and reports on critical global issues in which science plays a critical role (for example, HIV/AIDS in Africa and the opportunities and risks posed by genetically modified plants); and the sponsorship of workshops that help scientists develop the necessary skills to deal effectively with public officials and the public at large.

TWAS's recent effort to broaden the range of its activities parallels, to some extent, parallel policy trends in ICTs when it comes to developing countries in the following ways:

First, there is increasing discussion of targeting at least a portion of the funds invested in ICTs on nations and regions that are lagging behind so that they can be brought up to speed, enabling this global technology to become truly global. Second, there is increasing interest in encouraging developing nations that are proficient in ICTs to lend a hand to developing nations that are not. Third, there is growing recognition that focusing solely on efforts that make ICTs more readily accessible, while important, is not enoughMore attention must be paid to how this new technology can be put to use to help advance the economic and social well-being of people.

TWAS stands ready to help advance a broad-based ICT global policy and would welcome an opportunity to:

- Make available a number of its South-South fellowships to graduate and post graduate students seeking degrees and advanced training in ICTs.

- Assist in the preparation of a monograph that highlights the most successful initiatives in ICTs that address real-life problems in the developing world.
- Help in the creation of an electronic portal offering extensive information on ICT fellowship opportunities, upcoming conferences, university programmes, and job openings. This portal would serve as a one-stop site for a broad-range of information on ICTs, seeking to make the enormous amount of information that is now available more accessible.
- Support the creation of ICT centers of excellence in the least developed countries, especially in countries in sub-Saharan Africa.

1.5 The Information Society After the WSIS: The Role of OECD[11]

It is now a fact that the application of Information and Communication Technologies (ICT) globally, presents the fastest means of creating an information society. Due to barriers of access to ICT, the problem of the digital divide is prevalent within and between countries. In response to this concern, the first World Summit on Information Society (WSIS), held in Geneva in 2003, set out eleven principles to help countries of the world navigate through global and borderless cyberspace. Indeed, a Plan of Action was adopted during the summit that promised to put all the villages of the world online by 2015. In his official opening speech, the UN Secretary General found the Geneva summit as unique and noted: "where most global conferences focus on global threats, this one will consider how best to use a new global asset" (Stauffacher & Kleinwachter, 2005: vii). The Geneva summit underscored the potential of ICT in improving the lives of people worldwide; but this is achievable when people are empowered to access ICT from where they are – homes, villages, schools, and business.

The second phase of WSIS, held in Tunis from 16-18 November 2005, was a follow-up to the Geneva (2003) summit. Before the official opening of WSIS II, the World Science Project[1] (sponsored largely by the Society for Social Studies of Science and Hewlett Packard) held an official side event on Science and Technology in Tunis from 13-15 November 2005. The overarching theme of the side event (that preceded WSIS II) was *Past, Present and Future of Research in the Information Society.*

In its operations, OECD utilizes its think-tank and policy coordination system that enable it to extend its networks. Through OECD, governments of advanced economies think together on common (social and economic)

challenges. Its work programme is fact-based and oriented to forward-looking policy development. Practically, OECD is engaged in:

- the development of comparable (development) indicators;
- economic and policy analyses;
- peer review and persuasion;
- recommending guidelines, non-biding soft law, conventions and codes;
- dialogue to create networks (in science and IT) with policy makers and practioners; and
- the outreach activities to create partnerships with other IGOs.

Challenges of Creating a Knowledge Economy and an Information Society

In a global world whose navigation is largely dependent on the available knowledge and information, the term development entails creating knowledge economies and information societies. This conceptualization of development lays emphasis on the role of ICT that is instrumental in the generation of knowledge through research and the sharing of information through connectivity to various ICT devices. How do countries meet the challenges of creating knowledge economies and information societies?

There are lynchpins (economic fundamentals) of the transformations entailed: globalization, Research and Development (R&D), Internet connectivity and highly skilled human power. By investing in R&D, a country should come up with innovations to facilitate, for example, economic transformation. The investment in ICT should expand Internet connectivity while training of human resource should boost human capacity in all fields. To perfect these transformations, efforts should be put to improve the quality of government policy making at strategic levels viz, regional or sub-national levels.

To facilitate the suggested transformations, OECD has found the need to formulate its ICT policy. This policy is under the jurisdiction of the OECD's Committee for Information, Computer and Communications Policy that contributes to:

- growth studies;
- globalization and structural adjustment;
- intellectual assets and value creation; and
- OECD country review.

It is imperative to note the critical role of ICT policy in the creation of knowledge economy and information society. Yet in many developing countries, ICT policy is non-existent. Where the ICT policy has been formulated, there is lukewarm support from the government making it

difficult to effectively implement the policy. One of the biggest challenges in the developing countries is to strengthen ICT policy formulation and implementation. This would eventually expand connectivity, promote R&D, facilitate globalization, and expand knowledge-based and information-led development.

Internet Infrastructure: Then and Now

Over the recent past, what notable changes have taken place in the Internet sub-sector?

- Rapid *decline in the price of computing and communications* (explained by the availability of new technology and heightened competition in the market).
- As an impact of the first change, *growth of the ICT sector.* This has significantly affected businesses, government and individuals.
- As networks converge towards the Internet, we have *increased our trust* in the Internet as a source of information and reliable means of communication.

All these could be regarded as positive changes for they enable countries to overcome the challenges of creating knowledge economies and information societies. There is a critical question here: what does this mean for the "digital divide?" Globally, these positive changes within the ICT sector have not been experienced evenly. In particular, the developing countries have only experienced modest changes in their ICT sector. Practically, in these countries, 50 percent of the population lives in poverty; only a few can afford to access the Internet. Further, due to poor ICT infrastructure, only a tiny fraction of the population is connected to the Internet. This has limited the impact of ICT at all levels. These realities facing the developing countries affirm the existence of the digital divide. The latter connotes a contradictory situation where developed countries on one hand, have adequate ICT infrastructure to serve their citizens while, on the other hand, the developing countries have inadequate and underdeveloped ICT sectors. This underscores the enormous challenges facing the developing countries in their endeavours to create knowledge-based economies and information-led societies. How can the problems associated with the digital divide be addressed to evolve a global world better served by the ICT infrastructure?

The price of "always on" has dropped from $0.36 in 1997 to $0.01 in 2005. The net sales of amazon.com –a company whose sales are largely transacted through the Internet– increased tremendously from 1997 to 2004. There was also impressive growth in the contributions of ICT investment to

GDP growth for developed countries like Sweden, United States and Denmark.

There are notable *social costs* of the growth of the ICT worldwide. For example, we have ample evidence of the increasing complaints of fraud. In this regard, Internet-related fraud complaints to the US Federal Trade Commission rose from 55,727 in 2001 to 205,568 in 2004. In addition, there are other social costs that include escalating attacks of the Internet that have become more sophisticated. Such attacks take the form of root compromise, user compromise, denial of service/distributed denial of service attacks, website defacement, detection of malicious logic, introduction of a virus/worm into a network, misuse of resources, spam email and fraudulent email. How are we going to deal with the social costs of the ICT growth and its impacts? To enhance the world's increasing trust and dependence on ICT, it is mandatory to invest in endeavours to overcome the human-made obstructions meant to incapacitate the sector. Admittedly, such obstructions cause havoc in developing countries where the capacity to protect the ICT sector is limited –making them the first targets of all forms of attacks. OECD could initiate networks focusing on ways of making the ICT increasingly reliable globally or strengthen existing ones that work to protect the sector from various threats and attacks.

OECD and WSIS

How can OECD contribute to the World Summit on the Information Society? To start with, we need to enhance understanding of the Information Society (IS), its measurement and analysis. Thus far, OECD has developed the capacity to measure and analyze all kinds of variables (concepts) and hence, could contribute in the operationalization and measurement of IS. Further, OECD could contribute significantly in the following:

- Collaborate on measuring ICT for development;
- Analyze the impacts of governments and other stakeholders in the promotion of ICT development;
- Team up in building confidence in the use of ICT (e.g., in the management of obstructions) – this would increase trust in ICT globally; and
- Improve access to data and information – in particular, OECD could spearhead the regulatory reforms required to bridge the digital divide; it could also facilitate access to publicly funded research data.

To tackle the identified tasks successfully, a functional partnership should evolve between OECD and WSIS representatives. Thereafter, an

operational framework should be drawn specifying the specific roles, obligations and responsibilities of each party. Only then can WSIS access the wealth of information currently under the custody of OECD. On the other hand, through such a partnership, OECD can disseminate its massive data worldwide, easily and cheaply.

After the WSIS

The objectives of the WSIS (e.g., MDGs) are entirely consistent with the OECD mission; this suggests that the two organizations could easily complement each other if they forged a partnership. However, such a partnership could largely serve the interests of the developed countries given that OECD membership is limited in its memberhip to these countries. Nevertheless, there are other drawbacks facing the OECD. It does not have operations on the ground and is rarely seen to take action. We must ask how can these limitations of OECD be addressed to: (1) improve its global image; (2) contribute to the development of the ICT sector and reduce the impacts of the digital divide? These limitations require a reformulation of the OECD mission and restructuring of its operations to make it an all-inclusive organization. As well put by Kofi Annan (2005: viii): "The future of the IT industry lies not so much in the developed world, where markets are saturated, as in reaching the billions of people in the developing world who remain untouched by the information revolution."

Despite the documented limitations of OECD, the following contributions consistent with its current role:

- collection of key development indicators worldwide and analysis of the same; since the OECD is a reputable organization in data gathering and analysis; WSIS could draw from its best practices and policy;
- establish an Internet governance forum;
- establish a UN global alliance;
- facilitate integration of ICT into ODA strategies; and
- participate in other strategic follow-up mechanisms?

Overall, OECD has great potential in the development of the ICT sector worldwide. However, to tackle the persistent problem of the digital divide, it is essential to restructure the organization, review membership criteria and reformulate its mission. These measures would make it an all inclusive organization to serve the globe. Through its effective networks, OECD is able to collect accurate data worldwide required for the measurement of key development indicators. Currently, with a well developed ICT sector, the world could benefit by accessing the various data bases that OECD has developed over time. This is part of the challenge to be tackled in building

the information society. As Utsumi (2005: xi) rightly says: "The digital revolution, particularly in the fields of information and communication, has extended the frontiers of global village, making a profound impact on how the world functions and interacts. Unfortunately, too many communities still remain unhooked from this phenomenon, creating a new knowledge gap."

Accordingly, certain barriers must be cleared for the world to benefit from the stock of knowledge and massive data under the custody of OECD. As part of ICT development, the WSIS should address such barriers and improve connectivity worldwide. However, as noted by Kleinwachter and Stauffacher (2005:1): "WSIS is much more than the digital divide. The information society is not a single-issue problem. The information revolution penetrates all parts of our lives. It affects the way we learn, work, communicate, do business, educate our children and entertain ourselves. The WSIS process is about how we are going to organize the globalized world of tomorrow where the Internet makes everybody neighbours, just one click away."

1.6 University Relations For Capacity Building And Economic Development[12]

There are really two important topics under this theme: first the overall subject of globalization and second, Hewlett-Packard's (HP) response through university relations.

First, let's define globalization. It is the process in which geographic distance becomes a factor of diminishing importance in establishing and maintaining cross border political and socio-cultural relations. It can be thought of as widening, intensifying, speeding up and growing worldwide interconnectedness.

Critical for developing countries in an era of globalization is capacity building. Economic development involves influencing growth and restructuring of an economy to enhance economic well-being of a community, region, state or nation and its citizens. Capacity building is a part of economic development, and in a knowledge-based economy means connecting jobs and people. Local jobs reduce the brain drain. To attract jobs into a region and secure employment, people need to develop skills, competencies and values aligning with a complete value chain that extends from basic research, to advanced development, to commercialization, and to manufacturing, marketing, distribution and sales. Capacity building develops and employs a region's knowledge and educational resources across the whole value chain to gain economic advantage in the global economy.

The World Bank identifies four pillars to a knowledge economy and education and training underpin them all. Engineering education plays a key role in capacity building. If technology and knowledge form the basis for meaningful economic development in the future (and economic studies have shown that technology change drives as much as 85 percent of per capita income growth), and if economic success in knowledge based economies depends largely on the capabilities of people credentialed in meaningful and consistent ways, then engineers are the kingpins for taking knowledge and generating output that results in sustainable growth.

Looking at engineering graduates based on the most recent data from the NRC Science and Engineering Centers Report of 2004, the number of engineers graduated around the world varies widely. China is approaching 300,000, India 200,000, and the US 59,000. Even smaller countries such as Korea graduated over 56,000 students. The China picture is particularly compelling: there are more students in colleges and universities in China (20 million) than there are in the US., Russia and Japan combined. Further, China doubled the number of science and engineering Ph.Ds from 1996 to 2001 to more than 8,000.

Korea shows similar dramatic changes based on its investment in education and research. In 1963 the total R&D investment in South Korea was $4 million dollars. In 2003, it was $16 billion dollars. The research work force grew from zero in 1963 to over 198,000 in 2003. Korean investment in science and technology development in this period grew from less than a quarter of a percent of GNP to almost 3 percent, with a profound effect on the number of jobs for its citizens. Similarly, Taiwan invested 520 million dollars in the Hsinchu Science-Based Industrial Park in 1980. The Park now employs 90,000 people and has created a large number of spin-off companies, at last count over 300.

So the question for HP is what should corporations like us do about all this? What is our contribution? Let us briefly discuss this.

As a reference, HP is a very large Fortune 11 size company with operations in 170 countries with 43 currencies and 15 languages. Worldwide there are six HP Labs operations and the company produces 11 patents per day. HP's University Relations reports into R&D which reports directly into the office of the Chairman. The HP University Relations staff of 24 people spans the globe. Our mission is to deliver talent, technology and sales opportunities to HP by fostering university relationships worldwide that integrate investments in research, recruiting, philanthropy and public advocacy. We manage an upstream knowledge transfer process by managing the whole "Knowledge Supply Chain," similar to the material supply chains we hear often discussed.

We have three major strategies: relationship development, technology programmes and external engagements.

Relationship development results in intellectual capital, HP market-technology and thought leadership. Relationship begins with traditional tactical engagements and moves over time into richer relationships until it reaches what we call 'strategic partnership,' where both partners work together to tackle world challenges beyond either the university or the company, but relevant to the business of both. We represent this development graphically with our "University Relations Partnership Continuum." Relationship development occurs through programme managers who align the strategic interests of HP stakeholders (R&D, recruiting, philanthropy, marketing, sales and research) with the particular strategic goals of each university. Currently we have relationships with between 70 and 100 universities worldwide.

Our second strategy, technology programmes, integrates HP research, philanthropy and sales programmes with university research directions. Programmes vary in maturity and scope and include the Gelato Federation to encourage research on Itanium over Linux, Digital Publishing to research new enterprise and educational applications, Tiramisu to enhance grid participation, and research programmes in security, digital entertainment and planet scale computing, nanotechnology and mobility that align with university priorities.

The third strategy is external engagement to affect policy and address challenges related to higher level education. We focus on four areas: intellectual property and government partnerships, engineering accreditation and education, the engineering/science pipeline, and learning science. Some of our engagements involve all four areas. For example, we drove the early stages of a major development in Latin America called, "Engineering for the Americas," an engineering education quality assurance and capacity building initiative. One output of the long-term engagement is the Lima Declaration, whose intent is to build local engineering capacity to create knowledge that insures the solution of local needs and opens the chance to compete for global opportunities. This HP initiative now has sponsorship by the Organization of American States, the United States Trade and Development Agency, the World Federation of Engineering Organizations (WFEO), the Western Hemisphere Initiative, and by the major education accrediting agencies in the US, Canada and Mexico and experts and volunteers from across the universities and the Americas.

To conclude, HP is a company that believes that capacity building and globalization will provide significant economic advantage for the world and will contribute to HP's global mission and sales opportunities worldwide.

1.7 Conclusion

The opening and closing plenary sessions of the PPF conference reflected a diversity of viewpoints on the WSIS initiative in relation to the globalization process and the way in which the research sector may address the developmental and technological needs of developing areas. In particular, the globalization process has transformed communication technologies and presented the world with unprecedented opportunities for the exchange of information. Countries with fully developed ICT sectors are forging ahead in the creation of an Information Society and the educational and scientific sectors have always been at the forefront of these developments. However the concern is that these same sectors in some developing countries, particularly those in sub-Saharan Africa, ICTs have yet to benefit the majority of scientists and researchers. When even the educational and research sectors themselves experience such problems, it is not hard to understand why the majority of people in developing areas have yet to benefit from connectivity and access to information. This is the biggest challenge we face today. It is hoped that improved access and connectivity will considerably improve the flow of scientific information and data.

Globalization was likened to a moving bus. Once you get onboard, you are okay and assured of reaching your destination. Most citizens in the developed countries are already in the bus. But the majority of the citizens in the developing countries are yet to board the bus. In fact, many cannot even get to the road to catch the bus.

1.8 References

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1.9 Notes

1 The Opening Plenary was chaired by Paul Mbatia, Chair of the Department of Sociology at the University of Nairobi. Dr. Mbatia has been the national coordinator of the World Science Project since 2000. The Closing Plenary was chaired by R. Sooryamoorthy of the University of KwaZulu Natal. From 2000 through 2002, Dr. Sooryamoorthy coordinated the Indian wing of the project at Loyola College of Social Sciences (Trivandrum, Kerala). Since 2003 he has led the South African branch of the project from Durban. The World Science Project is an international on-going research project that began in 1994 and is currently funded by the U.S. National Science Foundation to: (1) examine the connectivity of scientists and researchers to the ICT (such as the email and Internet), and (2) assess the impact of ICT on the productivity of scientists and researchers. Initially, the project covered three developing countries viz., Ghana, Kenya and India. Other countries that have recently been included in the project are South Africa, Chile and the Philippines. Details of the project are available at http://worldsci.net.

2 Both movies are available without charge on DVD. Please send an email request to shrum@lsu.edu or write Wesley Shrum, Dept of Sociology, Louisiana State University, Baton Rouge, Louisiana, 70803).

Before the Horse (2003) deals with the difficulties of doing development work. Internet connectivity has been a major initiative of the international aid community since the 1990s. Yet most universities and research institutes still do not have "connectivity" in the ordinary sense. Subtitled "An Essay on Paragraphs Seven, Ten, and Twenty Three of The World Summit Plan of Action," Internet connectivity is viewed as potentially useful, but subject to many of the same problems that have plagued past development initiatives in Asia and sub-Saharan Africa. Filmed in Kerala (India), Kenya, and Ghana. (Before the Horse was screened three times at the World Summit on the Information Society (Phase I, Geneva , December 2003): (1) Role of Science in the Information Society (CERN). (2) Information Society film screening (ICT4D). (3) Engineering the Knowledge Society (International Federation for Information Processing).

Story Line : The movie is built around three sequences, questioning conventional views of connectivity. In the first part, shot in Kerala , India , the Internet is described as a life-changing event. In the second, filmed in Kenya , great expectations for a connectivity project are dashed, when it is discovered that cables are missing and some of the collaborators may be mainly after money. In the third, filmed in Ghana , a university professor explains 'how things work' in the development game. *After the Fact* (2005) was made as a sequel to Before the Horse. Phase I of the World Summit on the Information Society was intended to set an agenda for action, while Phase II (Tunis , Tunisia 16-18 Nov 2005) was intended to implement and report on that agenda. But the time frame was short and the complexity of problems relating to the digital divide was immense. Filmed in Kenya and Ghana. Screened twice at the World Summit on the Information Society (Phase II, Tunis , November 2005). Story Line: Opens with a famous slave castle in Ghana , where a young African man is heard speaking to an African American tourist: he wants to go to America. Next, a reconstructed (but absolutely true!) scene from 1994, again in Ghana. A waitress near Cape Coast sees a mysterious machine—not knowing what it is supposed to do, she may understand it better than it's user! (Cut to Nairobi in 2005 leads to a montage of dishes, telecommunications gear, and signs of the flourishing ICT market.) Back again to 2000, where two administrative officers in the Vice Chancellor's office at JKUAT describe the difficulties of dialup connectivity. In the final scene ("There was a time…") two professors at a Ghanaian university talk about the connection to the Internet that they once had, but lost.

3 This presentation was delivered in two parts. The first, representing the perspective of a funding agent and project initiator, was by Wesley Shrum, who has made annual site visits to the institute in question since the late 1990s. The second, representing the perspective of the recipient and project implementer, was by George Okwach, former director of the research institute.

4 The "Acacia Tree" that serves as a backdrop for the conference web site is an original pastel on silk drawing by Susan Arnold. Editor's note: After 2005 http://worldsci.net is no longer the direct link to the "Past, Present, and Future of Research in the Information Society." The conference archive has been moved down one level and may still be found through that website.

5 As one of our more colourful Chilean informants put it, by way of praise for a sister institution, "you don't see some resources leaking around there."

6 This does not imply they should lose money. That is, they should get their expenses paid. But they should not stay in fancy hotels.

7 At present, the staff is smaller, and the number on station at any given time may not be more than 25.

8 This section was contributed by Carthage Smith.

9 This section was contributed by Qiheng Hu.

10 This section was contributed by Daniel Schaffer.

11 This section was contributed by John Dryden.

12 This section was contributed by Wayne Johnson.