2. ICT FOR DEVELOPMENT: ILLUSIONS, PROMISES, CHALLENGES, AND REALIZATIONS

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In this chapter we will critically examining some of the illusions, promises, challenges, and realizations of the Information Society. Handed down from the past are specific myths that may create illusions in the present and promises for the future that in effect will hamper the realization of the Information Society in its most promising forms.

In the first section the standard definition of the Information Society and the related issues of digital divide, development, and democracy are scrutinized. We will show that often the usage of these concepts and related policies implicitly draws on technologically determinist assumptions. We identify three myths as constituting this set of assumptions: the myth of technology as *not* human-made, the myth of the technical fix, and the myth of technology's neutrality. When these myths are not adequately deconstructed, the ideological character of the discourses around the Information Society and the digital divide will remain hidden. This would hamper the adequately addressing of the underlying socio-economic dimensions of the digital divide.

The second section follows suit by adding a socio-economic analysis to the socio-cultural and political analysis of the first section. We ask the question how the capacities are currently distributed in this globalized world, and how this distribution is related to hardware and software development. The negative effects of lock-in are identified, and we conclude that a targeted effort to stimulate local socio-technical development would be important to help in bridging the digital divide.

In the third and fourth sections we move to the promises and challenges of the Information Society, especially relating to the large amounts of information that people have to deal with. In the third section a software solution is described that builds on an analysis of the structure of digital information as well as its content and context. In the fourth section a series of conferences is described, aimed at offering a solution for the specific challenge of integrating the huge amounts of environmental data that now exist globally.

In the final section some of the effects of realizing the Information Society are addressed. We wonder what the effects are of foreign graduate education on the Internet use by Philippine researchers. As we will show, such questions can only be answered by analyzing the local context of these researchers. The meaning of 'personal computer', for example, is quite different in the Philippines as compared to countries in the north.

We thus hope to demonstrate in this chapter that the Information Society and the bridging of the Digital Gap can only be realized when supported by a comprehensive research program that includes science, technology, and society (STS) studies. This heterogeneous set of approaches comprises, as we demonstrate in this chapter, a broad range of humanities, social sciences, and engineering disciplines. For bridging the digital divide, a deconstruction of its ideological character is as much needed as a software solution to the information overload; a socio-economic analysis of lock-in processes is as much necessary as a sociological analysis of Internet use in developing countries.

2.1 Technological Determinism and Ideology: Questioning the 'Information Society' and the 'Digital Divide'[3]

The 27 September 2004 issue of *Business Week* featured a cover story entitled 'Tech's Future'. Both the cover and the story were illustrated with pictures of dark skinned women. The one on the cover was of an inhabitant of Recife in the poor North East of Brazil described as a 'prospective PC buyer'. The main story was illustrated by a full page photograph depicting an Indian woman, Neelamma, dressed in a traditional sari decorated with a garland of flowers holding a Hewlett Packard digital camera. The message in the story was driven home by a large font, bolded, subtitle stating: "With affluent markets maturing, tech's next 1 billion customers will be Chinese, Indian, Brazilian, Thai..." This message was illustrated by the case story of Neelamma, a 26 year old village woman from Andhra Pradesh, who, as part

of an experiment organized by Hewlett Packard, was charging local villagers "70 cents apiece for photos of newborns, weddings and other proud moments of village life" taken with a digital camera and printed with a portable printer powered by solar charged batteries which had been rented from Hewlett Packard for $9 a month.

Both in the pictorial metaphors and in the textual message Business Week was presenting a particular strategy for bridging what has become known as the 'digital divide'. The poor and those marginalized from the 'Information Society', particularly women and black people, need to be brought into it as potential customers rather than as human beings with needs. This, it is suggested, will simultaneously eradicate poverty and create the conditions whereby basic needs are satisfied.

The strategy promoted by Business Week had been advocated in December 2003 at the 'World Summit on the Information Society' (WSIS) in Geneva. To justify the summit, the WSIS web site cited the existence of the 'digital revolution' which has been "fired by the engines of the of Information and Communications Technologies" and which has "fundamentally changed the way that people think, behave, communicate, work and earn their livelihood... forged new ways to create knowledge, educate people and disseminate information ... provided for the speedy delivery of humanitarian aid and healthcare, and a new vision for environmental protection". Further, "access to information... has the capacity to improve living standards for millions of people around the world" and "better communication between peoples helps resolve conflicts and attain world peace".

But the site also points to the paradox that while the "digital revolution has extended the frontiers of the global village, the vast majority of the world remains unhooked from this unfolding phenomenon" and "the development gap between the rich and the poor among and within countries has also increased". The purpose of the World Summit was therefore to discuss ways to bridge the digital divide and "place the Millennium Development Goals on the ICT-accelerated speedway to achievement".

In its "Declaration of Principles" the WSIS declared that its purpose was: "to harness the potential of information and communication technology to promote the development goals of the Millennium Declaration, namely the eradication of extreme poverty and hunger; achievement of universal primary education; promotion of gender equality and empowerment of women; reduction of child mortality; improvement of maternal health; to combat HIV/AIDS, malaria and other diseases; ensuring environmental sustainability; and development of global partnerships for development for the attainment of a more peaceful, just and prosperous world."

But the general tone for the Summit was set by the UN Secretary-General in his keynote speech: "The future of the IT industry lays 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. E-health, e-school and other applications can offer the new dynamic of growth for which the industry has been looking."

This example is typical of the way the relationship between technology and social change is often portrayed by the media and by policymakers. There are a number of different aspects to this representation. The first is that it ignores the fundamental fact that technology is created by human society. Instead it reifies technology, which in this representation acquires a 'phantom objectivity' as an agent of social change, 'an autonomy that seems so strictly rational and all-embracing as to conceal every trace of its fundamental nature: the relation between people' (Lukacs 1971:83).

The second and inter-related representation involves the myth of the 'technical fix', the implicit assumption that technology provides the best or the only feasible solution to complex social problems. Thus the World Summit on the Information Society, in its Declaration of Principles, implies that information and communication technologies possess quasi-magical powers to provide solutions to the world's greatest social and economic problems such as poverty, disease, illiteracy, race and gender discrimination, and environmental pollution.

The third is the use of myths about technology in order to promote particular policies and help create particular ideologies. The reification of technology, by creating the impression that the technological change is a rational, objective and inevitable quasi-natural process which is driving social change, hides the social forces and social interests behind the change and the fact that there are winners and losers in the process. In this case the new technologies are associated with the neo-liberal 'free-market' ideology and the combination is presented as creating a process in which everybody wins: the transnational corporations find new markets and the poor find new ways to improve their conditions- by making money from other poor people.

De Miranda (2005) traces the way that the concepts of the 'Information Society' in Europe, and of the 'Information Age' in the United States have moved from their origins in academic social science to acquire an important normative role in determining the policies of countries and of international organizations. It shows that these concepts are inherently technologically determinist and argues that their widespread adoption as a normative policy tool is due to their ideological usefulness to the dominant interest groups, which include the ICT corporations. It also demonstrates that the concept of the 'digital divide' plays a similar ideological role. The concept developed

during the same period as social and economic inequalities within countries and between countries increased greatly. It reduces the problem of lessening socio-economic inequalities 'bridging the technological divide'. The physical and intellectual development of human beings is thus reduced to the ability to access and use the latest technologies. However some studies have shown that the spread of ICTs have been a contributory factor to increasing these inequalities (cf., *inter alia, Economic Report of the President*: 1994). It is therefore difficult to understand how 'bridging the digital divide' can be seen as the main means to improve socio-economic inequalities. The appeal of this approach to those in power resides in the fact that it enables the creation of new markets for the ICT corporations and justifies like-minded policies and public investments under the guise of 'building the Information Society for all'. The need to accelerate the 'bridging of the digital divide' becomes all the more urgent as IT markets become saturated in the developed countries.

It can be concluded that whilst the 'digital divide' is undoubtedly real and dealing with it is important because access to ICTs can now be considered a basic human need, it can only be 'bridged' within the broader context of tackling the socio-economic divide through effective actions by governments using redistributive policies. But to prepare for such redistributive policies, we need to have insight in the existing distribution of capacities and the possibilities for, and barriers to, their further development. It is to this issues that we turn in the next section.

2.2 Globalization and ICT: Lock-in barriers for capacity building in developing countries?[4]

The last decades ICTs have seen an enormous growth in both homes and businesses especially in industrialized countries. More than any other technology ICTs drive economic and financial globalization as they facilitate rapid transactions and global market transparency. Moreover, the Internet is the means of transport for a rapidly growing service economy. However, globalization and the formation of dominant technologies in the ICT sector pose problems for capacity building, using ICT in developing countries.

Globalization leads to a more rapid spread of products and services than we have ever seen before. Locally a wider variety of products will (has) become available. On a global scale product diversity will decrease as the larger (global) suppliers have a large cost advantage. Understandably this has an effect on local cultures both in the developing world as in industrialized countries.

This applies even stronger for software. Fixed costs of developing software are high, but the marginal costs of selling an additional software

package are almost zero. Transport costs are negligible. The current dominant technologies on the hardware market and on the software market of operating systems for home and office computers appear to be in a *lock-in* situation, despite the rapid technology development in the ICT sector. From statistics of several websites, where both the operating system and the browser are detected, we see that about 90 % of the PCs has a *Microsoft Windows* operating system (see for example the website of W3 Schools). With a market share of 90 % it is obvious that there is a lock-in situation in the global software market for operating systems in homes and offices. There is also a dominant technology for the hardware market of PCs. Intel and AMD are the most important players in the market for chips and ICs, with Intel having a market share of about 70 to 80 % for Central Processing Units (CPUs). From the path of technology development of ICT, starting with the separation of software and hardware, the invention of the IC and the use of the chip, via the alliance of IBM and Microsoft's *MS-DOS*, ending with the standards set for communicating between computers via the Internet, it is clear that this sector is locked-in in a regime of hardware and software development (Ceruse, 2003). Lock-ins are formed through a process of positive feedback (Arthur, 1989) and are characterized by a dominant technology as is the case for hardware and software for PCs in homes and offices. The deep entrenchment of a technology makes it virtually impossible to change.

If we consider that ICTs, amongst which PCs in homes, offices, schools and hospitals can give people information to increase their ability to contribute to capacity building in developing countries, we should analyze both the quantity and quality of connected PCs in those countries. Both the number of PCs in different regions in the world, and also the speed with which they are connected with the Internet must be considered.

PCs have become available to a large number of people, first mostly in office locations, but later more and more in homes as well. In 2004 to every 100 people in The Netherlands, there were almost 70 PCs and the situation in most Western countries is not very different, indicating that PCs have seen a tremendous diffusion in the Western world (ITU Yearbook of Statistics, 2005). ICTs and especially PCs with an Internet connection can help to increase development both in Western countries and developing countries, as is the assumption of the World Summit on the Information Society. The amount of PCs in use and sold in developing countries in Asia, Africa and Latin America is a fraction of that, especially in Africa. The number of internet users in Asia is strongly increasing and will probably surpass the number in Europe and North America (eTForecasts, 2005).

Not only the amount of PCs and Internet connections is important to consider, when discussing the potential of ICTs for development, but also their quality (in this case the speed of the connection). From figures of the International Telecommunications Union (ITU) we can see that the countries with the highest penetration of broadband are all European or North American, except for South Korea, Taiwan and Singapore. Those three are among the most modern or industrialized Asian countries (eTForecasts, 2005).

There is not only a difference in the number of PCs in use , number of internet users and connection speed, but also in the number of registered domains per capita of industrialized and developing countries (see for example the website of Zooknic, 2005). This means that the countries with the highest number of country code Top Level Domain (ccTLD) registrations (registrations of domains with TLDs such as .nl, .bj, or .th), also have the most information in the local languages. Those countries are also the countries of which the languages are the ones in which software is available, creating another division. In order for people in developing countries to find information that is useful, there should also be web pages in languages they can read. Connectivity alone should therefore not be a priority, but useful local content in local languages should have the highest priority.

ICT applications can contribute to development and improved education, health care, and governance in developing countries. However, within the current system of hardware and software development this poses some problems. The current lock-in situation and other aspects of globalization in the ICT sector, such as a limited amount of suppliers on the global software and hardware market, form barriers for people to benefit from ICTs. There is little possibility to compete by developing countries because of globalization effects in both the hardware and software market. Next to that there is a large difference in both the quality and the quantity of PCs and internet infrastructure between industrialized and developing countries. A third major issue is the availability of information in local languages. Overriding priority should be given to both developing local content and connectivity in order to prevent frustration and offence by the content of western oriented websites. The number of websites in local languages, but also the languages in which operating systems and software are available form an important, but not unconquerable barrier. These issues should be taken into account when discussing the use of ICTs for capacity building.

Let us now assume, for a moment, that a large part of the world is connected to the Internet and is enjoying the benefits of access to many sources of information. How then to manage the huge information load that is the result? The next two sections address this issue.

2.3 Integrating Digital Information into Knowledge for the 'Information Commons'[5]

Access to digital information has become effectively infinite and instantaneous with nearly 20,000 petabytes of information produced and stored on print, optical and magnetic media each year; microprocessor speeds that have increased 5 orders of magnitude since 1972; existence of the Internet; increasing global capacity to collect and transmit information via satellites; and availability of powerful search engines. The problem is in recognizing that information is more than a commodity with access speed and volume driving global consumption.

The paradigm shift created by digital technologies is the opportunity to utilize the inherent structure of information as well as its content and context. A printed book or record can be managed based on its content and context (as in libraries and archives), but it is not possible to break a printed book or record into smaller units that can be managed dynamically. It is this ability to manipulate the structure of information in an automated manner that distinguishes information management with digital technologies from all of the hardcopy media that have ever been applied in our civilization (Figure 1).

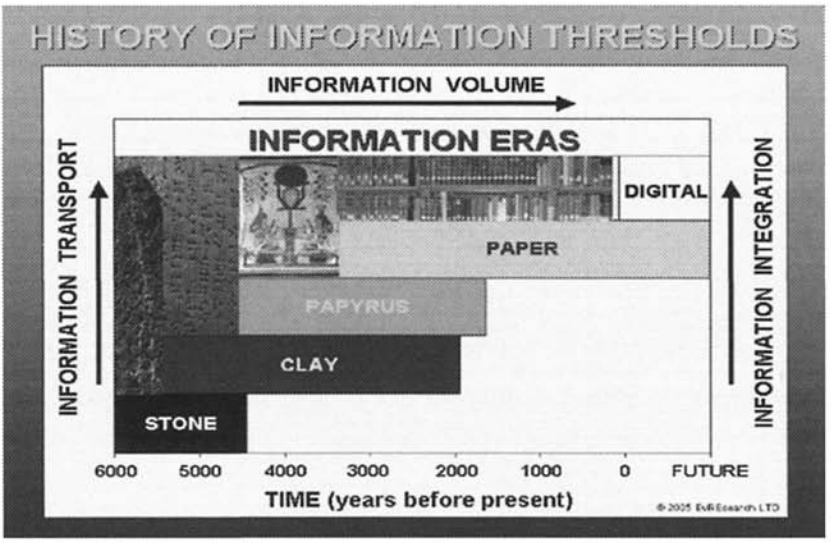

Figure 1: Technology thresholds that have influenced information management in our civilization. Each of the media prior to digital had been used for millennia. Adapted from Berkman et al. 2006.

By utilizing the inherent structure of information as well as its content and context, it becomes possible to comprehensively discover objective relationships within and between digital resources independent of their scale and formats (i.e., "structured" as well as "unstructured" information). An example of the automated granularity technology to leverage the inherent structure of digital information is the patented *Digital Integration System* (DigIn®) from EvREsearch LTD, which has been used to integrate digital collections such as the *Antarctic Treaty Searchable Database* (http://aspire.nvi.net) that is now in its 6th edition (Berkman et al. 2005, 2006).

We have reached the threshold in our 'world Information Society' when access to information is necessary, but not sufficient. The sufficiency comes from generating knowledge. Knowledge (which emerges from understanding information relationships) derives from the process of integration. Such distinctions between the processes of information access and integration underlie the technological solutions for the future when *"knowledge is the common wealth of humanity"* (as expressed by His Excellency Adama Samassekou at the 2004 Committee on Data for Science and Technology, CODATA, meeting in Berlin).

Knowledge is inherently social, in addition to the substantive dimensions than were discussed in this section. In the next section this social dimension is added to the issue of managing the information load that the new Information Society may imply.

2.4 Twenty Years of Conferences Structuring Environmental Knowledge[6]

The debate on sustainable development involves an overwhelming amount of information from various disciplines. In 1986 a group of scientists in German speaking countries collectively built a common intellectual platform combining informatics tools such as databases and information systems with environmental applications. Thus the emerging field of environmental informatics was enriched with some of the first hybrid scientific content involving both fields, and the series of EnviroInfo conferences began.[7]

Data from ever expanding networks of sensors and monitoring activities have since then yielded increasingly detailed environmental information. Informatics brought all this data together, and by the same token it can serve as a tool to manage the flood of information. Indicators derived from this data have provided a structured view of environmental conditions and the dynamics of ecosystems. Products resulting from such structuring with

informatics tools show the "State of the Environment" from regional, country-wide and continental perspectives. Global examples of results from such activities are the European Environment Agency's (EEA) "Europe's environment: the third assessment" (2003) and EEA Signals 2004, the Worldwatch Institute's "State of the World" reports, UNEP's GEO Report Series and yearbooks, and the global syntheses prepared during the Millennium Ecosystem Assessment (World Resources Institute 2005).

In recent years EnviroInfo conferences with such themes as "Environmental Communication", "Sustainability in the Information Society" and "The Information Society and Enlargement of the European Union" have promoted network building and the scientific exchange of knowledge and featured unifying visions in their keynote speeches by renowned scientists. One innovative example of a significant EnviroInfo result is the German Environmental Information Network GEIN, which was later showcased at the "Expo" World Fair in 2000. It is a network containing detailed environmental information from nine German "Länder" which takes up over 400,000 Web pages.

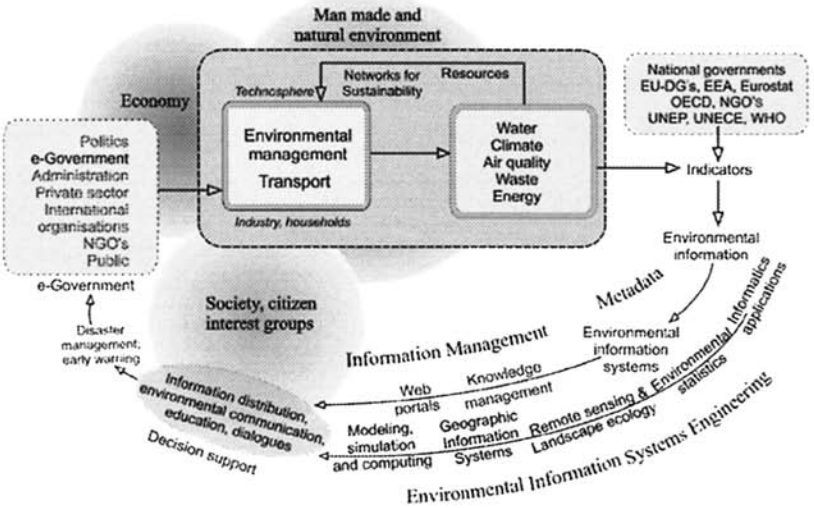

Figure 2: Section headings used at EnviroInfo conferences are shown around the lower part of the figure

Environmental studies are multidisciplinary by nature, and sustainable development is inherently international. Participants at Enviroinfo conferences are given unique opportunities to transcend traditional

disciplinary borders. Each session covers at least one environmental application and one informatics tool such as Geographic Information Systems GIS, environmental information systems, Web portals, remote sensing, modeling and simulation.

Figure 2 represents an attempt to describe EnviroInfo topics thought to promote "sustainable development". It is a systems structure in an input/output model representation. The arrows running along the outside represent communication links between the natural and man-made environments (the technosphere), society and the private sector - the economy.

If we move closer to the technosphere/environment part of the model in order to focus on the impacts humans have on the environment, the system structure includes multiple control loops. Environmental goals (e.g. pollution reduction, national environmental action plans, Local Agenda 21, Integrated Product Policy (IPP), the Eco Management and Auditing Scheme (EMAS)) influence politics, government administrations, industry, services and households. Appropriate legislation and political measures such as taxes fostering environmentally friendly technologies along with information, research and environmental communication limit the impact of enterprises, services and citizens on the environment. The combinations of these various fields are topics of Enviroinfo conferences. The information gathering, analysis and communication of environmental information and the embedding of results in decision processes are depicted in the lower part of the figure.

The group of pioneers from 1986 has now grown into an established constituency, and is open to new submissions from qualified participants from all over the world.[8] The conferences have made the transition from being an exchange for environmental information to one for sustainability knowledge, and thus are intended to counteract some of the negative effects of globalization by considering social and economic factors along with the environmental ones.

We now have reviewed the cultural, political, and socio-economic illusions, promises and challenges of the Information Society (in the first two sections), and the resulting promises and challenges of the huge increase of information (in the third and fourth sections). In the next and final section we turn to some of the questions relating to the realization of these promises, especially pertaining to the issue of bridging the digital divide.

2.5 Does Mickey Mouse Matter? International Training, Professional Networks, And Productivity of Philippine Scientists[9]

In the aftermath of the 9/11 attacks, the presence of international students who entered the U.S. for graduate training was highlighted as a matter of policy significance. Recently imposed new requirements, laborious screening procedures, stricter visa restrictions, and budgetary cuts in educational and cultural exchange programs all work to reduce the influx of international students into the U.S. (Ante 2004). If the long-term result is diminished numbers of foreign graduate students trained in the U.S., this could have a significant impact on scientific knowledge production in developing areas.

Few studies have examined the specific consequences on scientific careers as a function of graduate education at the scientific core, even when most scientists in developing areas receive advanced training there. In the Philippine case, scientists are typically trained in Australia, Japan, and the U.S. through sponsored programs (e.g. assistantship, exchange programs, fellowships, grants, and scholarships). Hence, it is reasonable to forward the hypothesis that having been educated and trained at the core influences peripheral scientists' careers and productivity. Partial support for this hypothesis is found in Ynalvez et al. (2005) where they found that receiving graduate training in a developed country enhances self-reported productivity among Ghanaian scientists, but not for Indian and Kenyan scientists. Another support comes from the socio-cultural practice, and the extended translation model of science (Callon 1995). Explicit to these models is the process of enculturation wherein knowledge producers are assumed to be capable of learning so that on-site visit and face-to-face interaction with core scientists enable peripheral scientists not only to learn and understand explicit (or codified) knowledge, but also acquire tacit (or hard-to-transfer) skills. Tacit knowledge or skills is deemed essential to the effective transmission of techniques and practices crucial to knowledge production (MacKenzie and Spinardi 1995).

To date, there is a paucity of studies that have focused on the professional activities of scientists in peripheral areas. Of those who have investigated these activities (Ehikhamenor 2003 a & b), none have ventured into exploring the effects of graduate training at the scientific core on the adoption of technical innovations like the Internet, and the career trajectories of scientists in developing areas. While the effect of level of graduate education has been the subject of much research attention, place of education, which provides a potent mechanism for the acquisition and

transmission of tacit knowledge has not yet been systematically studied. Specifically, its role in scientists' adoption of the Internet, their professional network, and productivity has not yet been studied.

In this section, place of graduate education is treated as a causally prior dimension that may determine the configuration of scientists' network characteristics and their productivity patterns and rates. In other words, place of graduate education is taken as independent dimension and then focus is on the population of Filipino agricultural scientists in answering the following questions: First, to what degree has the Philippine research system adopted the Internet? In contrast to Ynalvez et al (2005), here Internet adoption is conceptualized in five dimensions: current use, ready access, extent (years of use), intensity (hours of use in a typical week), and diversity of use. Second, how can disparities in Internet adoption in the Philippine research system be characterized? And third, does place of graduate education play an important role in scientists' professional network and research productivity? In answering these questions, results from face-to-face interviews of 315 agricultural scientists in two knowledge production sectors (state universities and government research institutes) in two Philippine locations are discussed: Los Baños, Laguna (home of the green revolution in rice), and Muñoz, Nueva Ecija (the second largest agricultural research site).

To what degree has the Philippine scientific community adopted the Internet? From the Philippine research locations and sectors that were sampled and studied, it immediately became obvious that the PC (or personal computer) is a far cry from the usual notions of access and use scientists in developed areas have, where they are typically assigned a desktop in their personal offices. In most cases, they will also have laptops. Indeed, for scientists in developed areas the PC, more than fits the definition of a "personal computer" in that it is assigned to a single user and located in the personal office. In contrast, our findings indicate that PCs, as construed in the context of the Philippine research system, rarely translates to personal computers. These technical artifacts are more accurately described as "public computers" which are shared and typically located in communal workstations.

Despite the practice of computer sharing in communal workstations, and with the PC as a prerequisite for connectivity, almost all of our respondents consider themselves current users with ready access. In a way, it can be claimed that Internet adoption in terms of simple access and use is no longer an issue among Filipino knowledge producers. In terms of software-user interaction, those who report current usage use email for a very limited time in terms of intensity of use. Current users may have extensive experience as indicated by years of exposure, but it is also important to take note that extensive exposure is meaningless, especially if intensity of use is extremely

low, and even more so if the technical item continually and rapidly evolves. With the low intensities of use that were observed, it is doubtful if Philippine knowledge producers are really able to gain Internet skills and competency that can only result from continuous and intensive practice, and prolonged and extensive exposure. Diversity of use is another important dimension of Internet adoption where Philippine scientists register low. It is indeed doubtful whether Filipino scientists, with minimal experience (both in terms of extent and intensity) on the Internet can master skills that will permit them to do a variety of things with it.

Hence, it was observed that Philippine knowledge producers tend to have achieved high levels of ready access and current usage. But, in more advanced dimensions of Internet adoption like experience and diversity of use, they are obviously registering low. In other words, areas of concern are no longer within the domain of simple access and use, but have already shifted into more advanced areas of extent and intensity of experience, and diversity of use. These new areas of concern seem to have shifted from simple access and user skills to more complex hardware-software-user interaction skills.

How can the disparities in Internet adoption in the Philippine research system be characterized? It is not surprising that location and sector play a role in the "digital divide" observed in the Philippine research system where scientists in Los Baños, and in government research institutes tend to have ready access and extensive experience. With the limited financial and material resources dedicated to knowledge production, it seems practical and efficient for national policy makers and government officials to allocate resources to the premier research community (Los Baños) and to invest on applied rather than on academic research.

With respect to scientists' personal characteristics, the "digital divide" among Philippine knowledge producers predominantly runs across categories of age. Younger scientists are more likely to be extensive and diverse users, a result that is consistent not only with findings in developing, but also in developed areas. However, it is surprising to note, especially in traditional societies like the Philippines where gender is one source of durable inequality that it is only with respect to diversity of use that males dominate. Males and females tend to be on "equal footing" with respect to other aspects of Internet adoption except that of diversity. Because our measure of diversity includes activities pertaining to interaction outside of scientists' immediate work environment, it could be that in Philippine societies, although women have achieved considerable parity with men, women are still only comfortable to interact with men (and women) whom they know through face-to-face interaction or by way of a third party

introduction. Hence, there may still be much inertia for women to initiate or start a technology-mediated social interaction, especially if it is a total stranger who is at the other computer terminal.

Callon's (1995) socio-cultural practice model and his extended translation model of science views science actors as capable of learning, and Collins (2001) and MacKenzie and Spinardi (1995) argue that explicit and tacit skills are important in knowledge production. The results reported here support these claims in that it could be observed that scientist education enhances Internet adoption. For simple access and use, explicit knowledge is the main discriminating dimension where higher levels of graduate education translate to current usage and having ready access. Explicit knowledge or the credentials symbolic of explicit knowledge (like having a Ph.D.) are held with deference and prestige in Philippine research systems in a way that scientists who hold credentials and titles symbolic of explicit knowledge tend to be awarded access to resources like PCs and Internet connectivity. As one of our informants in the Philippines mentioned, those who have PCs and connectivity are usually those who have doctorates. For extent and intensity of experience, the place of graduate education is an influential factor. For example, the training culture in Australian scientific communities emphasizes a research practice that demands both extensive and intensive use of the Internet, while the training culture in Japan and in the U.S. emphasizes a research practice that demands extensive use. This result suggests that tacit skills acquired by having Filipino scientists trained abroad seem to result to significant changes in Internet use behavior. It should be noted too that sophisticated and diverse use of the Internet is also influenced by level and place of graduate education, which suggests that advance hardware-software-user skills maybe be greatly enhanced not only by higher levels of graduate education, but also by graduate training at the scientific core.

Does place of graduate education play an important role in Philippine scientists' professional network and productivity? In general, scientist education does not determine network size, but it does matter in configuring network quality. Level and place of graduate education somehow enhances network quality by having a direct positive effect on the proportion of foreign contacts. The effect of graduate education is indeed suggestive of the important role of codified and tacit knowledge in scientific network structure. Codified knowledge provides the necessary credentials fundamental for structuring the interaction among scientists, while tacit knowledge offers the rituals and courtesies necessary for harmonious socialization. Between level and place of graduate education, the latter has a stronger influence on the quality of networks. Among the digital dimensions, diversity of use is an important positive determinant of both size and quality.

In other words, education directly and indirectly affects quality of network mainly through hardware-software-user interaction skills. Meaning the both explicit and tacit knowledge already on its own and can also be enhance through digital use and skills.

Output in domestic journals is influenced by level of graduate education and diversity of use, where doctorates and diverse users are associated with higher productivity. Like for current use, ready access, intensity and extent of use, we significant effect was observed for place of graduate education on domestic output. It can also be seen that traditional bases of social inequality like age, gender, marital status, and number of children do not influence domestic output. Level and place of graduate education, availability of computers in personal offices, extent of experience, and diversity of use mainly influence visibility in foreign outlets. These results suggest that education, privacy, and hardware-software-human interaction skills are crucial for visibility in international science outlets.

While the inequality in foreign output with respect to level of graduate education is straightforward and intuitive in that doctorates have higher productivity than non-doctorates, this is certainly not the case for place of graduate education. Normally one would expect foreign training to be associated with visibility in foreign journals. However, our results show that this is not the case. The inequality is structured in such a way that scientists trained in either Japan or the U.S. tends to have higher levels of output than those trained in either Australia or the Philippines.

Given that Japanese and U.S. training seem to matter compared to other training structures raises the question why this is so. It is still difficult to completely understand this phenomenon, but what can be observed is that Japanese and U.S. training structures somehow influence the careers of Filipino scientists. Maybe the effect of these two training structures can be traced to the larger socio-economic and cultural ties that exist between Japan and U.S. on the one hand, and the Philippines on the other hand. These two core countries, Japan and the U.S., are very similar in the sense that Japan is considered to be the most "Americanized" Asian nation, and that it seems natural for Filipinos to develop high affinity with both Japan and the U.S. given that much of the Philippines' social, economic, and cultural arrangements is influenced by America through previous colonial engagements. Indeed, much of this affinity can be observed among Filipino children who always yearn to meet *Mickey Mouse*, wherever he might be – in Florida, in California, in Tokyo...maybe *Mickey Mouse* does really matter!

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2.7 Notes

1 Authors in order of the section they contributed. The chapter was compiled and edited by Bijker.
3 This section was contributed by De Miranda.
4 This section was contributed by Peet and Mulder
5 This section was contributed by Berkman.
6 This section was contributed by Ruddy and Pillmann.
7 Further details on Enviroinfo conferences can be found in the article by Pillmann, W.; Geiger, W.; Voigt, K.: A Survey of Environmental Informatics in Europe. Environmental Impact Assessment Review, forthcoming in 2006.
8 In 2006 twenty years of EnviroInfo conferences will be celebrated in Graz, Austria; see www.enviroinfo.net
9 This section was contributed by Ynalvez

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