Information and Communication Technologies and Disability in Developing Countries

A technical note

by
Jim S. Sandhu, Ilkka Saarnio, and Ronald Wiman

October 2001

The views expressed in this report are those of the authors and do not necessarily reflect the official position of the World Bank.

Table of Contents

This note has been prepared by Dr. Jim S. Sandhu of Inclusive Design Research Associates/ United Kingdom (INDRA), Mr. Ilkka Saarnio of PARCONEC ltd/Finland, and Mr. Ronald Wiman of STAKES, National Research and Development Center for Welfare and Health/Finland.

1. Introduction

Disability and poverty are intertwined. Many studies highlight that people with disabilities are among the poorest people in the world. Conversely, poor people have a higher incidence of disability due to issues such as malnutrition, poor health, the lack of early diagnosis, and access to health services, and the effects of pollution and unsafe working conditions. In many countries disabilities are the result of social unrest and military conflicts. Other studies show that most people with disabilities in developing countries have no access to rehabilitation or training and end up being fully dependent on their extended families or engaged in begging as the only source of income. Environmental, technical, and attitudinal barriers and consequent social exclusion reduce the opportunities for disabled people to contribute productively to the household and the community and further increase the risk of falling into poverty.

However, a recent technological phenomenon can play a significant role in alleviating the cycle of poverty faced by people with disabilities in developing countries. Specifically, information and communication technologies (ICTs) are tools that have the potential to improve the access to and delivery of basic services, such as health and education, and increase the effectiveness of government and business institutions in addressing human development issues.

1.1 Perspective

This technical note addresses the promises and barriers information and communication technologies potentially create for people with disabilities. There are two issues to be addressed—accessibility of life environments and access to opportunities and participation. The application of universal design principles in mainstream contexts and the specific advances in mainstream ICTs, as well as in assistive devices, have a major role in improving the accessibility of living environments for people with disabilities. However, the problem of access to opportunities requires additional measures as people with disabilities have, as a rule, fewer resources at their command.

Aside from developments in medical care, which have had a significant impact on the quality of life around the world, developments in ICTs offer tremendous opportunities to do the same. These technologies can assist people with disabilities in undertaking activities for daily living (ADL) to compensate and even substitute for mental, sensory, and physical impairments and consequently to realize their potential for independent, meaningful, and productive living. Developments in basic and applied technologies—such as microelectronics, opto-electronics, material technologies, mechanical and production engineering, and rehabilitation and biomedical engineering—are relevant to disability. In the context of disability, low, medium, and high technologies all have a role to play in creating products and services that can enhance the quality of life.[1]

[1] E. Ballabio and I.Placencia-Porrero, eds., *Improving the Quality of Life for the European Citizen: Technology for Inclusive Design and Equality* (IOS Press, 1998).

A number of goal-conscious measures need to be taken to maximize the impact of ICTs and ensure that technologies serve the needs of disabled users in different economic, cultural, and geographical situations. User involvement throughout the developmental process will necessarily incorporate all the key user requirements.[2] In new and emerging areas of potential application of ICTs, such as enhancing the inclusion of disabled people in developing countries, understanding user requirements becomes critical. The specific challenges to doing so are the limited economic resources, the often low degree of literacy, limited technology assimilation, and understanding the capacity of local users, in general, and disabled people in particular.

This paper intends to provide a basic framework for reference and links to more specific sources and serve as a springboard for action for those concerned with inclusive policies, inclusive planning, and design for all.

1.2 Disablement as a Function of Barriers in the Environment

The social model of disability suggests that disability is not entirely an attribute of an individual, but rather a complex social and environmental construct largely imposed by societal attitudes and the limitations of the humanmade environment. Consequently, any process of increasing access and inclusion requires social action, and it is the collective responsibility of society at large to make the environmental and attitudinal changes necessary for the full participation of all citizens in every area of life.

The World Health Organization's (WHO) new standard, *The International Classification of Functioning, Disability and Health*[3] *(ICF)* describes the application of the above-mentioned social model on disabilities. It is a radical departure from earlier versions, which focused substantially on the medical and individual aspects of disability. The present version emphasizes that disabled people's functioning in a specific domain is an interactive process between their activities, health condition, and contextual factors. Within this framework, technology, in general, and ICTs, in particular, are a key interface between persons with disabilities and their environment.

However, the potential of ICTs in reducing the handicaps of disabled people has largely only benefited disabled people in industrial countries and some limited groups in developing countries who have had an opportunity to participate in donor-funded rehabilitation programs.

Introducing appropriate ICT technology to enhance the inclusion of disabled people in low-income countries is not only an issue of resources, but also one of priorities. Inclusion requires social change and policy revision. International cooperation can be helpful in bringing about the change, however a demographic dimension must be considered. In the world there are

[2] J.S. Sandhu et al., "Usability Issues for People with Special Needs. A Report for the European Commission," Project RACE R1088 TUDOR, Special Needs Research Unit, University of Northumbria (1992).

[3] See http://www3.who.int/icf/icftemplate.cfm.

about 400 million people with moderate to severe disabilities and 200 million with milder disabilities who require support, rehabilitation, and particularly vocational training and employment. Of the total, around two-thirds live in the developing or "the majority world."

The prime target group for introducing ICT-intervention strategies may be about 200 million people, of which 133 million are from developing countries.[4] Strategies based on disability-specific solutions alone are not the way forward. The disability dimension needs to be taken into account in mainstream policies, plans, and product design.

1.3 Barriers

The major advances in ICT usage, as well as the major new barriers imposed by ICTs on disabled people, are predicated on accessibility. ICTs determine accessibility in the sense that the user of the technology has to adapt to a norm, which is set through the design and operation of the technology. Until recently special individual needs for technology access in developed countries were often neglected. Users were forced to learn strange commands or computer languages to handle non-ergonomic input and output devices or to buy specific adaptive devices just to operate equipment designed for a standard user. Affordability is another barrier especially among the poor. This techno-economic view has resulted in an unbalanced situation and divided society into people who have access and those who have not.

Aside from technology accessibility, disabled users are doubly disadvantaged because of their functional limitations, lack of skills required to operate the system, and, particularly in developing countries, lack of literacy to facilitate interaction. Some times it is not lack of potential or lower intellect, but total lack of opportunities. For a poor person in these countries even minor functional limitations, such as low vision or difficulties in hearing can be limiting because they cannot afford eyeglasses or the cheapest hearing aid. Functional barriers to ICTs are, therefore, contingent on the following[5]:

Mobility. People who have reduced function of legs and feet depend on a wheelchair or other aid for mobility. In addition to people who are born with a disability, this group includes a very large number of people whose condition is caused by age or accidents including illnesses caused by polio (although it has almost been eradicated).

Vision. Blindness implies a total or nearly total loss of the ability to perceive form. Low vision implies an ability to use some aspects of visual perception, but with a greater dependency on information received from other sources.

---

[4] James Sandhu and John Wood, "Demographic and Market Sector Analysis of People with Special Needs in Thirteen European Countries: A Report for the European Commission," *The World Disabililty Report* (1999).

[5] The COST 219 and COST 219 bis projects confirm results of European Commission studies on the functional barriers to information and communication technologies. For more information, see James S. Sandhu et al. "Usability Issues for People with Special Needs."

Hearing. Hearing impairment can affect the whole range or only a part of the auditory spectrum. The term "deaf" is used to describe people with profound hearing loss, whereas "hard-of-hearing" is used for those with mild or severe hearing loss.

Speech and language. Speech impairment may influence speech in a general way or only certain aspects of it, such as fluency or voice volume. Language impairment may be associated with an intellectual impairment.

Dexterity. Reduced function of arms and hands makes activities related to moving, turning, or pressing objects difficult or impossible. This disability does not influence speech communication itself, but makes it hard to make a telephone call or use a range of other telecommunications equipment.

COST, a platform for European cooperation on scientific and technical research, stimulates activities in the disability field to provide practical assistance and evaluate future uses of ICTs. The COST 219 bis Web site contains a classification of barriers according to disability and gives more detailed guidelines for the alleviation of these barriers.[6]

The Internet and the World Wide Web introduce additional barriers for disabled people unless the structure and the content of Web sites are designed in conformity with the principles of universal design or the Web design guidelines of the World Wide Web Consortium (W3C). For example, images that are not appropriately labelled cannot be understood by the screen readers used by blind computer users. Deaf users cannot understand the sound tracks of multimedia files unless transcripts are provided. Users with dexterity or mobility disabilities may not be able to use a mouse or keyboard to access a site (table 2.1).

2. Policy Context

As markets often fail to provide for the inclusion of people with disabilities, legislation and public intervention have had a critical impact on the opportunities of disabled people. Comprehensive legislation models are available, mainly from industrial countries, and appropriate application of similar principles and standards would likely improve accessibility of and access to ICTs by poor and disabled people in developing countries.

In the United States, accessibility is a standard feature or soon will be thanks to the implementation of Section 508 of the U.S. Rehabilitation Act. The same type of legislation exists in the United Kingdom under Section 21 of the Disability Discrimination Act of 1999. Furthermore, additional European legislation will likely be enforced through Section 13 of the Amsterdam Treaty of 1999. Examples of good practices resulting from these policy changes could provide impetus to developments in poorer countries.

Table 2.1 Overview of Identified Barriers[6]

More details =>	Vision	Hearing	Speech	Intellect	Mobility	Coordination & Strength	Height
Locate, Access & Identify equipment or commands	Difficult	-	-	Limited problem	Limited problem	Limited problem	Limited problem
Lift, hold or use devices & switches	-	-	-	Limited Problem	Very Difficult	Very difficult	Limited problem
Use dial, numeric keypad or keyboard	Limited problem	-	-	Difficult	Very Difficult	Limited problem	-
Read & write Braille (bar & keyboard)	-	-	-	Very Difficult	Very Difficult	Very difficult	Limited problem
Use, touch & read screen	Very difficult	-	-	Difficult	Limited problem	Limited problem	Limited problem
Receive & understand visual info	Very difficult	-	-	Difficult	-	-	-
Receive & understand audio info	-	Impossible	-	Limited problem	-	-	-
Receive & understand tactile info	-	-	-	-	-	-	-
Use spoken info	-	Difficult	Very difficult	Limited problem	-	-	-
Handle cards, coins, media & books	Very difficult	-	-	-	Very difficult	Very difficult	Difficult

2.1 The International Policy Standard

The *United Nations Standard Rules on the Equalization of Opportunities for Persons with Disabilities* constitute the foundation for a standardized, rights-based disability policy for all countries. The rules provide holistic guidelines on the enhancement of participation opportunities for people with disabilities in culture, transport, education, employment, information, recreation, social security, accessibility to the built environment.[7]

The *Standard Rules* form an appropriate basis for a disability-related approach to the information and communication technologies. The document interprets equalization of opportunities as "the process through which the various systems of society and the environment, such as services, activities, information, and documentation, are made available to all, particularly to persons with disabilities." The extracts from the *Standard Rules* can be used as guidelines for designing national policies and plans for ICT development (box 2.1).

[6] See http://www.stakes.fi/cost219/cosB220.html.
[7] See http://www.un.org/documents/ga/res/48/a48r096.htm.

Box 2.1 Extracts from *United Nations Standard Rules on the Equalization of Opportunities for Persons with Disabilities*

I. Preconditions For Equal Participation

Rule 4. Support services: States should ensure the development and supply of support services, including assistive devices for persons with disabilities, to assist them to increase their level of independence in their daily living and to exercise their rights.

II. Target Areas For Equal Participation

Rule 5. Accessibility: States should recognize the overall importance of accessibility in the process of the equalization of opportunities in all spheres of society. For persons with disabilities of any kind, States should (a) introduce programmes of action to make the physical environment accessible; and (b) undertake measures to provide access to information and communication.

(a) Access to the physical environment
(b) Access to information and communication

6. States should develop strategies to make information services and documentation accessible for different groups of persons with disabilities. Braille, tape services, large print and other appropriate technologies should be used to provide access to written information and documentation for persons with visual impairments. Similarly, appropriate technologies should be used to provide access to spoken information for persons with auditory impairments or comprehension difficulties.

9. States should encourage the media, especially television, radio and newspapers, to make their services accessible.

10. States should ensure that new computerized information and service systems offered to the general public are either made initially accessible or are adapted to be made accessible to persons with disabilities.

11. Organizations of persons with disabilities should be consulted when measures to make information services accessible are being developed.

III. Implementation Measures

Rule 14. Policy-making and planning: States will ensure that disability aspects are included in all relevant policy-making and national planning.

3. The needs and concerns of persons with disabilities should be incorporated into general development plans and not be treated separately.

5. States should facilitate the development by local communities of programmes and measures for persons with disabilities. One way of doing this could be to develop manuals or check-lists and provide training programmes for local staff.

Rule 15. Legislation: States have a responsibility to create the legal bases for measures to achieve the objectives of full participation and equality for persons with disabilities.

Rule 16. Economic policies: States have the financial responsibility for national programmes and measures to create equal opportunities for persons with disabilities.

> 3. States should consider the use of economic measures (loans, tax exemptions, earmarked grants, special funds, and so on) to stimulate and support equal participation by persons with disabilities in society.
>
> 4. In many States it may be advisable to establish a disability development fund, which could support various pilot projects and self-help programmes at the grass-roots level.

Rule 21. Technical and economic cooperation: States, both industrial and developing, have the responsibility to cooperate in and take measures for the improvement of the living conditions of persons with disabilities in developing countries.

> 3. When planning and reviewing programmes of technical and economic cooperation, special attention should be given to the effects of such programmes on the situation of persons with disabilities. It is of the utmost importance that persons with disabilities and their organizations are consulted on any development projects designed for persons with disabilities. They should be directly involved in the development, implementation and evaluation of such projects.
>
> 4. Priority areas for technical and economic cooperation should include:
> (b) The development and dissemination of appropriate disability-related technologies and know-how.

Source: See http://www.un.org/documents/ga/res/48/a48r096.htm.

2.2 The Digital Divide

The digital domain expands opportunities for those who are included and makes it harder for those who are excluded, also known as the gap between the "information rich" and the "information poor." ICTs could become a main dividing line between individuals, as well as nations globally. The Organisation for Economic Co-operation and Development (OECD) addresses the digital divide in *Understanding the Digital Divide*:

> the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regards both to their opportunities to access information and communication technologies (ICTs) and to their use of the Internet for a wide variety of activities. The digital divide reflects various differences among and within countries. The ability of individuals and businesses to take advantage of the Internet varies significantly across the OECD area as well as between OECD and non-member countries. Access to basic telecommunications infrastructures is fundamental to any consideration of the issue, as it precedes and is more widely available than access to and use of the Internet.

> The digital divide among households appears to depend primarily on two variables, income and education. Other variables, such as household size and type, age, gender, racial and linguistic backgrounds and location also play an important role. The differences in PC and Internet access by household income are very large and increasing, but access in lower income groups is rising. Largely through its effects on income, the higher the level of education, the more likely that individuals would have access to ICTs.
>
> Other important indicators concern differences in the profiles of countries, individuals and businesses that make the most use of the possibilities offered by the new information technologies and the Internet.[8]

If the description above can be called the "horizontal" divide, a "vertical" divide can be described as the difference between people who are able to use the existing technologies and people with disabilities with little or only partial access to these resources. As stressed earlier, this difference exists because the specific functional requirements of people with disabilities are not considered.

3. Opportunities

Strategies for empowering poor people with disabilities should be based on the objective of ensuring equality of opportunity for all and independent living and active participation in society without discrimination based on an individual's physical characteristics. Such strategies will require taking active steps to bridge the gap between gender, age, caste, education, disability status, and income differences.[9] Meaningful strategies must also recognize that the problems of disabled individuals are always multidimensional, whereas government attempts to alleviate the problems are unidimensional. An understanding of cultures, local politics, and local groups working in the field, especially those made up of disabled representatives, is essential to evolving a strategy for action.

Lessons from developing countries corroborate that social inclusion, equal opportunities, and mainstreaming are key to maximizing the gradual incorporation of ICT in developing countries. In 1998 the Danish Government and local activists initiated the Advocacy and Action for Africa (AAA) program in six African countries. The program aims to bring together representatives of disability organizations and external experts to discuss action on U.N. Standard Rules. The AAA workshops identified six major barriers to exercising full human rights by marginalized groups:

- Hostile attitudes by officials and members of the public who lack a clear understanding of the problem.

[8] See http://www.oecd.org/dsti/sti/prod/Digital_divide.pdf.
[9] *Eurobarometer*, November 2000, NTIA Aug 2000.

- Lack of resources and institutional capacity.
- Lack of enforcement. Although laws and regulations exist, funds and the will to ensure enforcement are often absent.
- Urban activities that leave large tracts of the countryside uncovered.
- Environmental barriers that make it extremely difficult for citizens, especially those with disabilities, to access services in both urban and rural areas.
- Inadequate services in health care, education, training, and rehabilitation.

Any viable strategy that uses ICTs must take into consideration the barriers noted above to maximize impact. Bringing ICT facilities into the reach of poor people would also bring possibilities to poor people with disabilities, provided the agenda addressed specific disability needs, such as education, communications, telecommuting, call centers, distance learning, assistive devices, and alternative and augmentative communication. The primary disabilities to consider are related to vision, hearing, mobility, motor skills, and communication abilities. For instance, certain output devices and software enable access for visually impaired people, an accessible environment and different control devices assist people with limited mobility or motor skills, and some computer programs aid communication.

Accessibility to public access points, also called telecenters, by people with disabilities is essential. To be accessible, such centers must choose and purchase software, technology, assistive facilities, and operational systems. The accessibility approach must begin with the physical environment and cover all levels of the operation of the center. (See "The Starfish Project," which is discussed later in this paper.)

Education has a particularly important role in empowering poor people with disabilities. Disabled people have, on average, lower enrollment and educational attainment levels than the rest of the population. Even standard ICTs can enable disabled people to use mainstream educational opportunities, provided that standard ICTs are designed to be more accessible to people with functional limitations. Furthermore, assistive devices can revolutionize the learning opportunities for people with visual or hearing impairments, as well as of those who have dexterity problems.

The increasing potential of the Internet and intranets for localized training and education programs holds great promise for ICT usage and dissemination in developing countries. For instance, the Infocentros Association in El Salvador is a network of franchised telecenters that provides both the infrastructure (Internet connectivity) and the "infostructure" (locally produced and relevant contents) to the public.[10] (For more examples, see the Annex.)

[10] "Creating a Development Dynamic: Final Report of the Digital Opportunity Initiative," Accenture, Markle Foundation, and U.N. Development Programme. See http://www.opt-init.org/framework/pages/appendix2Case3.html.

4. Strategies

A range of recent technological developments could prove to be beneficial in implementing the dissemination of ICTs in developing countries. As emphasised earlier, these technologies are not unidimensional and therefore must work across professional and administrative boundaries to be effective.

4.1 Universal Access

The main challenges of extending universal access to information resources at a reasonable price have been noted by Christian Maxwell in the paper, "Global Trends That Will Impact on Universal Access to Information Resources"[11]:

- General affordability of worldwide access.
- Accessibility of hardware and software.
- Accessibility features of the Internet.
- Availability of accessible Internet access devices.
- Availability of accessible Web sites.
- Managing multiple languages.
- Program design of software for users.

Maxwell points out that none of these items exists extensively enough to provide the required level of access for people with disabilities. Access should be provided to all and the solutions should be tailored to meet the needs of disabled people within a larger solution. Solving these issues is essential to providing global affordable access.

The PROMISE project has distilled the prerequisites for universal access into availability, awareness, accessibility, affordability, appropriateness, and acceptability.:[12]

Availability. Wide availability of equipment and online services is a fundamental prerequisite to assisting people with disabilities. Initiatives must, therefore, define ways to ensure that individuals have access to equipment and connections, and that service providers are encouraged to provide useful and desirable services.

---

[11] Christian Maxwell, "Global Trends That Will Impact on Universal Access to Information Resources," submitted to UNESCO, June 15th, 2000. See http://www.isoc.org/isoc/unesco-paper.html.

[12] The PROMISE project, a European joint venture, was established to raise awareness about the ways in which technology can benefit the disabled and the elderly. The project collected case studies and analyzed best practices in the disability area. Although PROMISE looked at the problems and solutions in the European context, several guidelines and practical solutions can be applied to developing countries if they are adapted to local circumstances and prerequisites. See http://www.stakes.fi/promise.

Awareness. One major barrier to inclusive approaches is the lack of awareness in public policy, in industry, and in other sectors, such as education, of the needs of disabled people and the ways by which these needs can be provided. Potential users must also be aware of possibilities and opportunities.

Accessibility. Disability initiatives must give the highest priority to the promotion and implementation of design for all to ensure that everyone can have access.

Affordability. Public funding is important because disabled people often have low incomes and many older people are still at risk of poverty. Therefore, initiatives must actively address the financial dimension and ensure that lack of income does not exclude the participation of those who could benefit the most.

Appropriateness. The appropriateness (or usefulness) of applications in particular circumstances is important. One way to assess appropriateness is with the involvement of end-users. Initiatives must include social assessment as a central dimension.

Acceptability. Finally, a key ingredient of usage is whether the user accepts the product for what it is.

4.2 The Role of Universal Design

There are two primary means of ensuring that people with disabilities benefit from ICTs. The first of these is based on the principle of *Universal Design* (American) or *Design for All* (European).[13] This principle represents generic guidelines for designing mainstream products and services that will accommodate a broader range of users, such as the elderly and the disabled.

However, designing for the "broader average" will not always accommodate the needs of those with severe disabilities or very particular user requirements. Access to technologies for such users can best be achieved in another way—by designing special products and services or in many cases adapting or interfacing existing products or technologies to meet the user's specific requirements. The technology based on universal design and on special products and services for older people and people with disabilities is called *assistive technology*.

Universal design is also based on the recognition that design and modifications needed to accommodate people with disabilities actually benefit everyone and create solutions that are attractive, marketable, user-focused, and less expensive.

A working group of architects, engineers, product designers, and environmental design researchers has collaborated to establish *The Principles of Universal Design* to guide a wide range of design disciplines including products, environments, and communications (Box 4.21).[14] These seven principles may be used to evaluate existing designs to guide the design process and

[13] See http://europa.eu.int/comm/information_society/eeurope/pdf/actionplan_en.pdf.
[14] See http://www.design.ncsu.edu/cud/univ_design/princ_overview.htm

to educate both designers and consumers on the characteristics of more usable products and environments.[15]

Box 4.21 Principles of Universal Design

1. Equitable use—the design is useful and marketable to people with diverse abilities.
2. Flexibility in use—the design accommodates a wide range of individual preferences and abilities.
3. Simple and intuitive use—use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or concentration level.
4. Perceptible information—the design communicates necessary information effectively to the user, regardless of ambient conditions or of the user's sensory abilities.
5. Tolerance of error—the design minimizes hazards and adverse consequences of accidental or unintended actions.
6. Low physical effort—the design can be used efficiently and comfortably and with minimal fatigue.
7. Size and space for approach and use—appropriate size and space are provided for approach, reach, manipulation, and use regardless of user's size, posture, or mobility.

The INCLUDE project Web site provides holistic information and tools for marketing and telematics designers.[16] The site contains information about standards, universal design, market considerations, case studies, design guidelines, tools and methodologies, users and their requirements, legislation and regulations, and assistive technology services. The paper, "Telecommunications: Guidelines for Accessibility," is one of the many publications by the COST 219 bis project that addresses accessibility features of some common telecommunications equipment.[17]

The project has also provided structured and detailed guidelines for potential remedies to many identified barriers that are met by people with various disabilities (box 4.22).[18]

4.3 Accessibility of the Internet

Access to the Internet is central in industrial countries and is gaining increasing importance in developing countries as global organizations try to bridge the digital divide between the two groups. The W3C is the de facto standardization body on Internet-related issues. Since 1996 a special working group, Web Access Initiative (WAI), has addressed the needs of Internet users with disabilities. [19]

[15] See http://www.design.ncsu.edu/cud/.
[16] See http://www.stakes.fi/include/index.html .
[17] See http://www.tiresias.org/telecoms/index.htm.
[18] See http://www.stakes.fi/cost219/cosb229.html.
[19] See http://www.w3c.org/WAI.

Box 4.22 Alleviating Barriers to Information and Communication Technologies

Locating Equipment

Blind—Directional signs also printed in Braille. Use audio recorded information. Place public equipment in logical places. Use Smart Cards and Global Positioning System.

Partially sighted—Directional signs printed in large letters. Directional signs in contrasted and standardized colors. Place public equipment in logical places.

Reduced vision/ no speech/ reduced intelligibility/low speech volume—Directional signs made easy to spot. Place public equipment in logical places.

Deaf (without/with speech) and hard of hearing—Place public equipment in logical places.

Dyslexia and language comprehension—Use standardized icons or words. Place public equipment in logical places.

Intellectual impairment—Directional signs made easy to spot. Use standardized icons or words. Place public equipment in logical places.

Accessing Equipment

All—Egonomic environmental design of area where equipment is located.

Blind and partially sighted—Provide speech synthesis.

Wheelchair—Use standardized dimensions for public booths to allow easy access. Use automatic doors. Provide space under the equipment for wheelchair users. Provide a hands-off facility. Provide a tilting keypad. Use cordless or mobile phones.

Cannot use arms, one arm, or fingers/cannot lift or push/reduced strength/lack of coordination/ reduced coordination—Use automatic doors. Design insertion slots in pay phones in such a way that cards and coins can be inserted with a special tool. Make it possible to pre-feed coins.

Height—Use standardized dimensions for public booths to allow easy access. Allow height of equipment to be adjusted.

Source: COST 219 bis

The WAI Web site lists comprehensive guidelines for the characteristics of an accessible site:

- **Web Content Accessibility Guidelines** explain how to make a Web site accessible for people with a variety of disabilities.
- **Authoring Tool Accessibility Guidelines** for software developers explain how to make a variety of authoring tools that support the production of accessible Web content and how to make the software itself accessible.

- **User Agent Accessibility Guidelines** for software developers explain how to make accessible browsers, multimedia players, and assistive technologies that interface with the following:

  Images and animation—Use the *alt* key to describe the function of each visual.
  Image maps—Use the client-side *map* and text for hotspots.
  Multimedia—Provide captioning and transcripts of audio and descriptions of video.
  Hypertext links—Use text that makes sense when read out of context. For example, avoid the term "click here."
  Page organization—Use lists, headings, and consistent structure. Use *CSS* for layout and style where possible.
  Graphs and charts—Summarize or use the *longdesc* attribute.
  Scripts, applets, and plug-ins—Provide alternative content if case-active features are inaccessible or unsupported.
  Frames—Use the *no frames* element and meaningful titles.
  Tables—Make contents of each table cell clear. Summarize.
  Check your work—Validate. Use tools, checklist, and guidelines.

The WAI Web site also provides guidelines for creating accessible Web design and alternatives to manual Web browsing. There are several detailed guidelines for accessible web design based on the WAI guidelines.[20]

People with disabilities—whether temporary or permanent—use a wide range of alternative approaches that are different from traditional mouse-and-screen-based browsers. People with visual impairment or reading difficulties rely on speech output, Braille displays, or screen magnification and in many cases use the keyboard instead of the mouse. Voice output devices would also serve people who are illiterate. People who cannot use a keyboard rely either on voice recognition for spoken commands or on switch devices, which can be controlled by head, mouth, or eye movements. People whose eyes are busy with another task may need Web access using voice-driven systems. Some may need assistive technologies, such as screen magnifiers, screen readers, or Braille interfaces to create, access, or use information goods owing to a physical or sensorial disability. Others may need text-based or low-density graphical content since they have limited communications capacity (bandwidth) or a low level of information technology to support robust graphics, streaming audio, and video clips.

In summary, the application of WAI standards offers multiple benefits to people in low-income countries. These standards not only make Web sites accessible to people with disabilities, but also to people who only have access to slow connections, old browsers, or computers with limited capacity.

[20] "The European Guidebook" was published by the COST 219 bis project (See www.stakes.fi/cost219/webdesign.htm.) The Trace Research and Development Center at the University of Wisconsin-Madison also maintains a list of resources covering several issues, including tools, projects, organizations, and accessibility. See http://trace.wisc.edu/world/web/.

4.4 Adaptive and Assistive Technologies

Adaptive technology is a prerequisite for many people with disabilities to using computer technology. These are devices, modifications, or upgrades to a computer's hardware and software to enable alternative methods of input and output. Some modifications can be as simple as a mouthstick and a raising mechanism on the computer desk or as challenging as an eye-coordinated input device or a speaking screen reader

Several databases and information services offer adaptive and assistive solutions for people with disabilities (box 4.4). The Center for I.T. Accomodation handbook notes such services and gives examples of a variety of products available.[21] The handbook states that:

> Individual consultation is necessary to identify appropriate accommodation solutions. There is no single "best" solution for all people who are blind, or have low vision, or impaired mobility. The functional requirements of an accommodation are determined by the nature of the job and how the individual will be using information resources.[22]

Although there have been attempts to create international databases for assistive technology, the operating databases are still largely national (with some international characteristics). The two biggest ones are ABLEDATA in the United States and REHADAT in Germany.[23]

Box 4.4 Examples of Adaptations and Assistive Devices

Visual Impairments

Low Vision—Glare protection screens, large monitors with high resolution, magnified displays of computer screens, magnified displays of hardcopy materials, large print production, color and contrast selection, and keyboard orientation aids.

Blindness—Speech synthesizers, screen reader software, Braille printers, Braille translation software, Braille dispalys, Braille notetakers, Braille input devices, optical character recognition (OCR), and speech recognition.

Hearing Impairment—Visual redundancy on computers, interpreters, hearing aid- compatible phones, speech amplification telephone, speech amplification meeting or conversation, text telephony, text telephone relay services, signaling systems, captioned videos, electronic mail and fax, and videoconferencing.

Mobility Impairment—Sequential keystroke input, key repeat rate control, keyboard macros, alternative keyboards, non-keyboard-dependent input devices, word prediction software, speech recognition, robotic devices, mouse alternatives, keyguard, speaker phone, gooseneck receiver holder, telephone headset, speed-dialing.

[21] See http://www.itpolicy.gsa.gov/cita/front.htm.
[22] See http://www.itpolicy.gsa.gov/cita/sect_3.htm.
[23] See http://www.abledata.comand www.rehadat.de/English.htm.

4.5 Standards and Legislation

Many countries have adopted inclusive policies and enforced them with standards and legislation. While most of these are largely found in high–income countries, the general principles are applicable in any context where ICTs are used. However, more specific legislation on accessibility is necessary. Most poor signatory countries view the U.N. Standard Rules being irrelevant to their populations. Oftentimes specific legislation is ignored because of conflicting demands and priorities. For instance, the Indian Disability Act 1997, which has tremendous potential, has resulted in little action for an estimated 80 million disabled citizens.

The scope of possible legislative initiatives related to disability could include:

- Accessibility of public information and services based on ICTs.
- Accessibility obligations for the private sector in relation to ICTs.
- Availability of assistive technology for those who need it to make use of public information and services.

The basis for such legislation could be to ensure equality of opportunities for the mobility of all citizens and workers, including those who are disabled. Harmonized consumer legislation might also provide a basis for change.

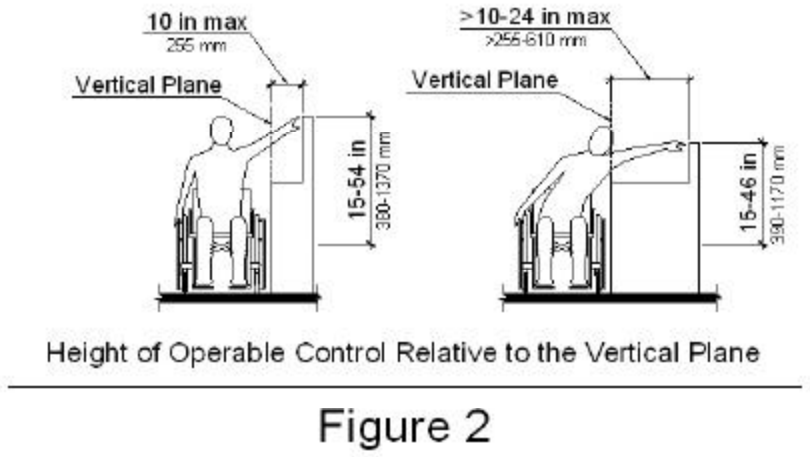
The "Americans with Disabilities Act" requires that covered entities furnish appropriate auxiliary aids and services where necessary to ensure effective communication for individuals with disabilities, unless doing so would result in a fundamental alteration to the program or service or cause an undue burden. Auxiliary aids include taped texts, Brailled materials, large print materials, captioning, and other methods of making audio and visual media available to people with disabilities.

In the United States the Architectural and Transportation Barriers Compliance Board (Access Board) issues accessibility standards for electronic and information technology, which is covered by Section 508 of the Rehabilitation Act Amendments of 1998. This section requires the Access Board to publish standards that define electronic and information technology and the technical and functional performance criteria necessary for such technology to comply with the Section.[24] The section also requires that when federal agencies develop, procure, maintain, or use electronic and information technology, they must also ensure that the technology facilitates access by disabled federal employees unless an undue burden would be imposed on the agency (figure 4.4). Furthermore, individuals with disabilities who seek information or services from a federal agency have access to and use of information that is comparable to that provided to the public who are not individuals with disabilities, unless an undue burden would be imposed on the agency.[25]

[24] See http://www.access-board.gov/sec508/508standards.htm.

[25] "From Architectural and Transportation Barriers Compliance Board," 36 CFR, Part 1194, Docket No. 2000-01, RIN 3014-AA25.

Figure 4.4 Position of Operable Controls



Source: Section 508 of the "Rehabilitation Act Amendments of 1998."

As part of its "e-Europe" initiative the Commission of the European Union has recommended that all European institutions and member states endorse the existing WAI guidelines, thereby making the design and content of all public Web sites accessible to people with disabilities. The Commission will also examine how it can use its procurement activities to promote accessible goods, services, and systems. Following consultation with disability and elderly organizations, the Commission has asked European bodies to ensure accessibility for as many European Union citizens as possible.

At the global level, standardization in the ICT field is carried out by the International Organisation for Standardisation and International Electrotechnical Commission through the Joint Technical Committee and the International Telecommunications Union.

4.6 Universal Service Obligation

The Universal Service Obligation is a central and essential factor for including elderly people and people with disabilities in society. It states that all services and devices must be made in a way that elderly and disabled people can use them. An example of its application can be found in the Republic of South Africa, where regional disparities have been exceptionally wide, in the 1996 Telecommunications Act, which aims to promote universal services and affordable provision of telecommunication services throughout the country and across ethnic groups.[26]

A universal service provision is intended to make telecommunications services available to the minority of potential users who do not have access to the service and for whom not having access to the service would constitute a social or an economic disadvantage (table 4.7).

[26] See http://www.opt-init.org/framework/pages/2.3.2.html.

4.7 Public Interventions

In the knowledge field, market failures are common. Thus, even in high-income countries public sector intervention has often been necessary to prevent exclusion and to create a true public good that is considered necessary for overall economic and social development. Governments support, subsidize, regulate, create incentives, and even substitute for market-based solutions in such fields as education, training, dissemination, management, and knowledge production. However, at times entry restrictions, monopolistic pricing, and barriers to innovative solutions have hampered these measures.

Analysis of African Internet service providers suggests that countries with highly liberalized telecommunications networks had Internet access costs that were eight times lower than those countries with completely closed markets. Countries with more open telecommunications sectors also had more host sites, lower monthly Internet charges, a greater number of providers, and higher rates of Internet penetration.[27]

Experiences in industrial countries reveal that the regulatory environment of a communications industry must be conducive to a competitive market for citizens to fully benefit from private sector participation and liberalization. The ideal environment will allow for legal and regulatory mechanisms that:

- Promote fair interconnection and revenue-sharing arrangements between telecommunications operators.

- Promote cost-orientated tariffs and the elimination of internal cross-subsidies, with the limited exception of carefully designed subsidies to ensure access and use for the poor and the disabled.

- Support a strong and truly independent regulatory agency capable of enforcing rules.[28]

Finally, as with any global human development approach, the differences between those who have access to the Internet and other technologies (as in the urban industrial countries) and those who remain on the technology periphery (as in developing countries) must be considered to attain successful results. The poor (often disabled) of developing countries, who must spend hours collecting water, wood, or food, are unable to command the processes and benefits of globalization, including information and communication technologies. For them, globalization and the ICT revolution is still a distant, slow-moving process. Therefore, any approach must consider how to include poor, disabled people in local, regional, and international information flows.

[27] Africa Internet Forum.

[28] One far reaching impact of regulations resulting from the United States "Workforce Investment Act of 1998" Section 508 legislation is that all public information Web sites were to have been fully accessible to people with disabilities by the end of 2001.

Table 4.7 Outline of Universal Service Obligations that Aim to Make Telecommunications Services Available to the Elderly and People with Disabilities

Universal Dimensions	Universal Service Goals
Universal availability	• Full range of identical services available irrespective of location. • Universal provision of payphones.
Universal accessibility	• Provision of equipment to ensure functionality for all users. • Nondiscriminatory access to all facilities.
Universal affordability	• Removal as far as possible of all financial barriers to telecommunications access and usage. • Efforts to redress socioeconomic inequality through explicit targeted programs.
Universal technological standard	• Policies concerning the spread of communications technologies so that certain innovations are made universal on the basis of need, social expectations, and social desirability. • Uniform quality of service for all users. • Periodic upgrading of the standard telecommunications service.
Universal telecommunications and participation in society	• Policies of telecommunications use that enable full participation in society. • Protecting freedom of speech and freedom of information through policies of common carriage and content-neutrality. • Protecting privacy.

Source: Gerard Goggin and Ian Wilson, "Reforming Universal Services: The Future of Consumer Access and Equity in Australian Telecommunications," Consumers Telecommunications Network, Sydney, Australia (1993).

The most appropriate ICTs should be used in any given initiative. Evaluation should be based on a comprehensive understanding of access, media use, and the content preferences of the stakeholders. In this sense the Internet cannot be viewed as a panacea for overcoming institutional difficulties in service delivery. However, targeted use of ICTs can directly benefit organizations that work with the Internet, making them stronger and more efficient to serve their clients.

5. Good Practices and Recommendations

The technological and economic changes, which underlie the rapid transformation of global communications networks and the spread of the Internet, offer great opportunities for developing economies and poverty reduction. Information and communication technologies have an ever-increasing role in propagating sustainable economic growth through the promotion of exports

(especially in services), the improved functioning of markets, and the increasing quality and efficiency of government services. ICTs can also have an immense direct impact on the lives of poor and disabled people. Information technologies can help generate a new, dynamic sector in the economy, which in turn may increase productivity and create opportunities for innovation. A carefully considered program of ICTs would enable the poor and the disabled to better access market information, to demand better services, to receive education, and to learn new skills that can enhance employability.

5.1 Benefits of ICTs—Good Practices in Developing Countries

ICTs can give a voice to the disadvantaged—a voice that enables the poor and those with disabilities to use their own knowledge and skills to escape poverty traps. For instance, in 1994, a relatively inexpensive and simple microwave radio-telephone system and community access points were installed in the remote region of Tumaco, Columbia. Within three years, residents of the region reported that services had resulted in better trade and market opportunities as agricultural cooperatives used the phones to learn about market prices in neighboring areas and to coordinate transport. Within a few years these opportunities also reduced unemployment, enhanced new business opportunities, improved health care delivery and information access, improved public safety and security, and improved the level and quality of government services.[29]

Farmers in Harayana, India, have benefited from Internet information on the current prices of crops and on various Indian and African businesses, thereby establishing viable and profitable global outlets for local crafts.[30]

In Bangladesh, Grameen Phone, which works with a Norwegian telecommunications operator, offers traditional cellular services in urban areas and gives loans to low-income women entrepreneurs in rural areas to provide payphone services based on cellular technology. The Grameen Bank has over a decade of experience providing microcredit to the rural poor and over 1,300 telephones to poor rural women through loans averaging US$350 to cover equipment and start-up costs. The operators have made a profit by reselling airtime to others in the village. The service has allowed rural farmers to check livestock prices and coordinate medical needs. The phones have become an important new business sector in the villages, generating jobs and income where none previously existed.[31]

In addition to the measures described in the Annex, one of the best examples of good practices that benefit disabled people is “Starfish,” a project that is operating in Malawi, Nagpur, and Assam in India. The Starfish Initiative is targeted at teaching new skills to young, illiterate prostitutes in standard shipping containers that double as classrooms. One powerful computer in a secure unit at the end of the container serves up to six personal computer monitors that are plugged into a main power source. This US$7,200 classroom can be shipped anywhere in the world.

---

[29] ITU (1998).
[30] *International Herald Tribune*, June 11, 2001.
[31] See www.rdc.com.au/grameen/impact.html.

First the initiative will teach five basic subjects—water, childcare, nutrition, self-esteem, and disease control—through a series of short videos that run simultaneously on different monitors. A graphic rendering of a starfish is used for navigation in place of a mouse. Touching any of the starfish's legs gives a different option, for instance, the red leg for information on water, the blue leg for information on childcare, and so on. No written commands are used on the screen, instead only voice commands are used through video in the local language.[32]

The potential of the Starfish initiative can be seen in a similar initiative from the 1980s in the United Kingdom. As part of this project, a Concept Keyboard (a flat, touch-sensitive panel) was used to assist physically and learning disabled people. Areas of the keyboard were programmed to produce different results. The keyboard could be covered by a range of paper overlays that illustrated the programmed areas with words, symbols, numbers, colors, and pictures. The Concept Keyboard can be used as a communication device to teach concepts, word recognition, and other literary and numerical skills.

Studies from industrial countries have shown that the Internet can be a valuable tool for learning. Hong Kong, Mexico, Singapore, Taiwan, and Brazil have open universities based on the Internet. In some African countries a virtual university is offering courses on language, economics, computer technology, and remedial subjects.[33] However, none of these courses is accessible to students with disabilities. Pressure and financial support from international organisations could ensure that courses are made accessible.

Though advances in digital telecommunications systems and Internet connectivity are occurring rapidly in certain contexts in Botswana, Mauritius, Rwanda, and The Gambia, many countries with large rural populations, such as Chad, Cambodia, and the Democratic Republic of Congo, have yet to significantly modernize their communications infrastructures.[34]

Between 1997 and 2000 Internet connectivity in Mali rose from just 800 to 4,500, mostly in the capital of Bamako. A commitment to linking all of Mali's 701 communes has been made by the government, which recognizes the potential benefits of e-learning and e-commerce to the public. Such a network can provide opportunities for nongovernmental organizations and other key intermediaries in-country to access information that is relevant to their work.

5.2 Recommendations

The following observations provide a platform for building strategies that use information and communication technologies to enhance opportunities for people with disabilities.

[32] *The Guardian*, April 19, 2001.
[33] See www.avu.org.

[34] Sida, "I.T. in Swedish Development Co-operation: Suggestions for Ways of Including the Low-Income Countries," (1999).

Policy framework

- Inclusion and full participation by all in the knowledge-based economy is both a fundamental right and a prerequisite for economic advancement both at the individual and national level. Thus, policies should be geared toward the new opportunities ICTs and global information-sharing networks have made available. The disability dimension should be specifically taken into account while designing policy frameworks. The U.N. Standard Rules provide a basic policy standard.

- The closing of the digital divide will require concentrated action by intergovernmental organizations as well as bilateral donor agencies. The disability dimension needs specific attention in mainstream programs and projects.

- A regulatory framework that enables and stimulates everyone to reap the full economic and social benefits of ICTs should be a priority. It is important to encourage market forces to lead the way and at the same time recognize that market failures and their unintended effects are a common risk. Among other things regulations must strengthen competition, pluralism, and democracy, preserve and promote local cultures, including minority cultures, avoid monopolistic positions, guarantee consumers' rights and open access to networks for content provider.

- Universal service must be affordable and ensure accessibility for people with disabilities so that when they are confronted with costs of equipment, connection, service subscription, and other usage costs they can participate. Universal service must also ensure that adequate infrastructures for accessibility are available.

Accessibility

- Basic accessibility standards and guidelines should be followed at the global level to avoid exporting bad practices.

- International organizations should audit their Web sites for accessibility and follow appropriate accessibility standards while designing and developing their the sites.

Infrastructure

- The status of the existing infrastructure should be examined for accessibility. Eventual structures and practices that may imply disincentives to accessibility and improved access to ICTs by the disabled should be avoided. Particular attention should be given to the accessibility of public access points. Specific components that support the participation of disabled people may be needed to ensure equal opportunities. Industrial countries (with technical assistance they receive from donor organizations) can be a major provider of these components.

Financing

- Accessibility of facilities and critical quality factor must be budgeted for in operations. Improving access to information and ICTs for disabled people can be made economically viable through microfinancing, social funds, and community involvement.

- Public subsidies are often necessary to support the participation of people with disabilities. Subsidies can be targeted at customers themselves to empower them and ensure the customer's influence on services provided on the market. These subsidies should be considered an investment with high social return because they would lead to a more productive, integrated, and independent segment of the population.

- Cooperation and integration within the public sector and between local, national, and regional administrations must increase if the full potential of ICTs is to be realized. Interoperability between information systems must be assured. ICT standardization could help to meet this challenge and reduce costs.

Human resources development

- Inclusionary and exclusionary practices begin at school. Therefore, the primary focus for long-term development is to raise the enrollment levels of children with disabilities. Investments in appropriate, quality ICTs and support for children with disabilities would be viable components of education sector projects. Such practices would enable all children to understand the problems of others and see themselves as part of a diverse society.

- Community-based rehabilitation and vocational training for people with disabilities should include teaching skills that could lead to modern employment options with high incomes instead of traditional job choices that keep people with disabilities in poverty.

- Pilot projects should make use of the Internet and other ICTs to provide "e-consultation" options for early detection and rehabilitation planning.

- People with disabilities, their families, and disability organizations must have access to information during the project planning phase.

- Investigations must be launched to identify concrete sources for job creation for disabled people in developing countries in the ICT and content production sector. Such investigations must be part of ongoing policies and practices at the national level rather than isolated actions.

Participation

- The design of programs, projects, and products must use information on user requirements from people with disabilities, in part by supporting the work of representative grassroots organizations.

- People with disabilities should be consulted on matters related to disability to build credible structures and to help build their capacity, knowledge, and involvement. Local disability organizations should develop their own research, planning, and outreach capabilities to ensure sustainability in the long run.

- Women and children with disabilities (and their parents) should be included in the program consultation process.

- Public and private partnerships, particularly those that involve communities and disabled people directly and focus on incentives and economic opportunities, should be studied as alternatives to charity and public welfare-driven initiatives.

Pilot projects and good practices

- Indicators and monitoring mechanisms would be crucial to measuring the effects and results of differing strategies, especially mainstreaming strategies. The LFA planning tool, used by all major agencies, should be used to introduce the disability dimension in formulating objectives, indicators, and outputs. Concrete guidelines for planning inclusive development activities should be used.[35]

- In-depth studies of specific countries—selected according to the degree of social exclusion of disabled people, the potential benefit of ICTs, and education initiatives—would inform future projects.

- Innovative pilot projects that transcend traditional attitudes and practices—such as using an intensive ICT training component for people with disabilities from disadvantaged communities—should be launched.

- Platforms for the exchange of expertise should be fostered and coordinated between various agencies to make such information more easily accessible.

International collaboration

- A platform for cooperation and coordination among international initiatives on closing the digital divide should be established to share experiences, to promote synergy, to focus some activities on "the poorest of the poor," and to avoid duplication of efforts.

6. Conclusion

This report has endeavored to provide an outline of the uses and specifications of information and communication technologies in improving access and opportunity for full participation of people with disabilities in mainstream society.

[35] R. Wiman, "The Disability Dimension in Development Action, Manual on Inclusive Planning" (1996).

The examples from developing countries highlighted in this report—both mainstream and disability-specific—indicate the potential of these technologies to benefit disabled users. The benefits are multilayered, ranging from enhancing the functional limitations of individuals to providing a means of communication or to enabling the acquisition of skills and education. ICTs are tools that can change the lives of many citizens around the world. Indeed, these technologies can provide a platform and a process for the integration of entire societies by enhancing choice and the exercise of citizenship. Information and communication technology initiatives will require synergy, concerted action, wide consultation, adequate funding, and the direct involvement of people with disabilities and disability organizations to be successful.

The design and construction of new infrastructures and the adaptation of existing ones will require human and financial investments that are not readily available in developing countries. However, good practices show that investments in narrowing the digital divide within countries can be profitable, sustainable, and economically sound. Furthermore, sensitivity to user requirements for people with disabilities as well as awareness of the benefits that can be derived from decreased economic dependency and improved use of human capacities is not always readily available.

While there are no instant solutions there is a need for marketing knowledge and good practice examples of the feasibility of a development path toward access and opportunity for people with disabilities to have wider and more functional access to ICTs and information. The concept of an appropriate model of an inclusive information society for all is the long-term policy direction necessary for effective participation in the mainstream world economy.

In the context of disability a number of pilot projects must be established across a range of typical public and commercial services, each focusing on one particular issue and shedding light on some of the practical organizational and local problems associated with the introduction of new ICTs. Pilot projects should identify the many organizational bottlenecks involved and enable diversity at the local administration level. The report has also voiced concerns about strategies that focus purely on the implementation of new technologies and ignore their organizational contexts. Such strategies are not only ineffective, but can also be costly.

The lessons of experience suggest that ICTs must be introduced within the context of a broader reform program. These technologies cannot act as a substitute for reform. For example, the impact of improved ICT access on farm earnings through increased knowledge of market prices will be muted if there are no roads to carry crops to markets or no markets because of an unreformed agricultural sector.

Information and communication technologies can have an immense direct impact on the lives of people with disabilities. Provision of ICTs in the lives of disabled people can enhance their daily lives by enabling them to demand and use services, to receive education, to learn new skills, to access markets, and to become economically productive and independent. These technologies can give voice to a marginalized group and enable them to use their own knowledge and strengths to acquire a better quality of life.

Although the multiple benefits of information and communication technologies to people with disabilities have been analyzed and examined over time, their benefits are perhaps most clearly illustrated in the following quote from around the time ICTs first appeared in developing countries.

> Two years ago I was introduced to the most exciting technological development for disabled people I have ever seen—synthetic speech. If, when I was a little boy, someone told me that I would grow up and make speeches to large groups, I would have called him either a fool or a madman. Yet here I am—I can only say this: modern technology has allowed me to release my creative spirit where it can soar, free, high above the clouds. Without the fruits of modern technology, I would probably be stuck counting the hours until my death. To some people, this synthesiser may be an ugly box with cables. To me, however, it is an analogue of freedom. Let freedom ring.[36]

[36] S. Richardson and James S. Sandhu, *Concerned Technology: Electronic Aids for People with Special Needs* (1984).

Annex

This annex provides summaries of two disability projects—the Technical Education Project and the Simputer Project—as case studies, both based in India. The first, a World Bank project, established two polytechnic institutions that are designed for students with disabilities.[37] The second project resulted in a handheld tool that is designed to make the Internet more accessible to illiterate people.

Technical Education Project

Project objectives

This project supports India's Ten-Year Technical Education Investment Program (1990–99) with three major objectives:

- Capacity expansion.
- Quality improvement.
- Efficiency improvement.

Borrower: Government of India

Implementing agencies: Bureau of Technical Education, Ministry of Human Resources Development

Beneficiaries: States of Bihar, Goa, Gujarat, Karnataka, Kerala, Madhya Pradesh, Orissa, Rajasthan, and Uttar Pradesh

Cost: US$275 million

Partner agencies: Special Needs Research Unit, University of Northumbria, United Kingdom

World Bank funding: International Development Association, US$230 million (The International Bank for Reconstruction and Development loan component was cancelled at borrower's request.)

Duration: 1990–98

The India Technical Education Project (TEP) supported the government's ten-year Technical Education Investment Program (1990–99) as part of its National Policy on Education. The program aimed to provide India's industrial sector with technicians of suitable quality in the areas of civil, mechanical, and electrical engineering, computer and electronics technology, and

[37] World Bank. *Including Persons with Disabilities: A Directory of World Bank Projects* (Washington: World Bank, 1999).

other required new and emerging areas. TEP had three components that supported institutional development processes to facilitate the ability of the polytechnic system to respond to a rapidly changing environment:

- Capacity expansion—expanding and diversifying programs in the polytechnic system especially in new and emerging technologies, conventional and advanced technician engineering, and continuing education diploma courses. Special attention was also given to expanding and improving training opportunities for women, rural populations, and persons with disabilities.

- Quality improvement—modernizing the facilities of polytechnics, expanding teacher training and introducing career development, and undertaking curriculum development activities.

- Efficiency improvement—granting academic autonomy to selected polytechnics, encouraging internal revenue generation, establishing equipment and facility maintenance systems, and strengthening the Bureau of Technical Education, the State Directorates, and Boards of Technical Education.

Support for persons with disabilities

According to a late-1980s estimate, there are over 85 million persons in India with disabilities. Of these, there are 15 million who are blind or visually impaired, 25 million with physical disabilities, 20 million with mental disabilities, 10 million with speech and hearing disabilities, and 15 million have cerebral palsy or leprosy. A nationwide central government initiative on integration of persons with physical disabilities with the mainstream in technical education has begun. Many voluntary organizations and government agencies have been engaged in the rehabilitation of persons with physical disabilities. However, no facility was built for formal professional education and training of this large group of the population.

Under TEP, two polytechnic institutions have been established exclusively for persons with disabilities at Mysore (Karnataka) and Kanpur (Uttar Pradesh). These institutions admit students who are physically disabled or deaf. They offer courses on computer science and engineering, architecture, and commercial practice, and plan to offer more courses in future. In both institutions, the physical structure of buildings allows easy mobility between classrooms, laboratories, and hostels, and laboratory equipment is designed for operation by persons with disabilities with minimum difficulty. Both institutions have a complete teaching faculty, most of them specially trained in India or abroad. They act as resource institutions for teacher training and learning-resource development.

The objectives of the institutions over the longer term are to:

- Provide formal professional education to the persons with physical disabilities and provide training and placement facilities for students with disabilities after the completion of their course.

- Provide research and development assistance in rehabilitation sciences, such as solar audio caps, myoelectric hands, hearing aid testers, the Jaipur foot, laser canes, and speech trainers.

- Conduct certificate courses for students with disabilities who are not enrolled in the polytechnic institution but seek employment, short-term and refresher courses, and seminars on education of persons with disabilities, and increase public awareness of the program.

- Provide training for teachers and instructors on physiotherapy, occupational therapy, spinal manipulative therapy, and peripheral manipulative therapy.

The institutions have been established at a cost of about US$3.5 million each.

The J.S.S. Polytechnic for Physically Handicapped, Mysore

This polytechnic institution was established by the J.S.S. Mahavidyapeetha, a nongovernmental education society that supports 220 educational institutions in India.[38] With financial aid from the government of Karnataka, the polytechnic institution is linked to a network of institutions, one of which is the Science and Technology Entrepreneurs Park located on the same campus. Through this organization, students with physical disabilities will be assisted to start small businesses. Other established organizations in the city of Mysore that work with the rehabilitation of persons with disabilities include:

Government

All India Institute of Speech and Hearing
District Rehabilitation Center
School for Deaf and Dumb

Voluntary organizations

Destitute Home for Children of the Physically Handicapped
School for the Mentally Handicapped
School for Diploma in Integrated Education
Association for the Welfare of the Handicapped
Helen Keller School for Deaf Preschool Children
United Friends Association School for the Mentally Retarded
Residential School for Mentally Handicapped
Rangarao Memorial School for Blind Girls
Industrial Training Center for the Blind

[38] Jim Sandhu, one author of this report, and Mr Shivkumar, a staff member from the J.S.S. Polytechnic, helped establish a World Bank-funded resource center in Mysore for people with disabilities that included videos, reports, compendiums, and CD-based world databases.

Dr. Ambedkar Institute for Physically Handicapped, Kanpur

This institute, established by the government of Uttar Pradesh, is located in Kanpur, an industrial city in Northern India. It has links with major organizations in the region, including the Indian Institute of Technology, Kanpur.

The Simputer Project

In an effort to bring the Internet to the masses in India and other developing countries, several academics and engineers have used their spare time to design an inexpensive handheld Internet appliance. The Simputer, for SIMple ComPUTER, makes the Internet accessible to illiterate populations. The device was designed by professors and students at the Indian Institute of Science (IISc) at Bangalore and engineers from Encore Software, a Bangalore-based design company.

The Simputer is built around Intel's StrongARM CPU, with Linux as the operating system. It has 16 MB of flash memory, a monochrome liquid crystal display (LCD) with a touch panel overlay for pen-based computing, and a local-language interface. The appliance has Infrared Data Association and Universal Serial Bus interfaces and features Internet access and e-mail software. The designers expect the Simputer to be used not only by individuals as an Internet access device, but also by communities of users at kiosks. A smart-card interface to the device enables the use of the device for applications such as microbanking. “We expect to change the model for the proliferation of information technology in India," says Professor Swami Manohar, professor in the computer science and automation department of the IISc. "The current PC-centric model is not sustainable because of the high cost of the PC, and also because we expect that most of the users will not be literate.”

A subsequent version of the Simputer may also offer speech recognition for basic navigation through the software menus. The speech dictionary can be customized to support different languages.

Later versions will also offer wireless technology

The intellectual property of the device has been transferred free of charge to the Simputer Trust, a nonprofit trust, and both the software and the hardware for the appliance have been offered as open source technology. In the open source model of development, users and developers, often unpaid, work together to update technology.[43]

Manohar says that the trust decided to put the technology in Open Source to enable third party software developers and designers to add value to the platform.

The technology for the product will be licensed to manufacturers at a nominal fee of $1150, which is to be used to finance upgrades to the Simputer.

Bibliography

Africa Internet Forum. 1999. *Economic Toolkit for African Policy Makers.* Available online at: www.worldbank.org/infodev/projects/finafcon.htm.

Analysis Ltd. 2000. *The Network Revolution and the Developing World Report.* InfoDev, Washinton, D.C.

Baldwin, S. 1985. *The Cost of Caring: Families with Disabled Children*. Routledge & Kegan Paul.

Bhatnagar, S. 2000. "Social Implications of Information and Communication Technology in Developing Countries: Lessons from Asian Success Stories." *The Electronic Journal on Information Systems in Developing Countries* (1).

Brandt, A. 1996a. "ICT Standardization and Disability in Europe." ETSI Danish Centre for Technical Aids for Rehabilitation and Education.

———. 1996b. "Mobile Telephones: The Disabled Person's Guide to Choosing a Mobile Telephone." Danish Centre for Technical Aids for Rehabilitation and Education.

Brandt, B. 1995. "Telephones for All, Nordic Design Guidelines." The Nordic Committee on Disability.

Cairncross, F. 1998. *The Death of Distance: How the Communication Revolution Will Change Our Lives.* Orion Business Books.

Caracostas, P. and Mulder, U. 1998. "Society: The Endless Frontier." European Commission.

Cullen, K. 1998. *The Promise of the Information Society, Good Practise in Using the Information Society for the Benefit of Older People and Disabled People.* STAKES.

ECOSOC (United Nations Economic and Social Council). 2000. *Development and International Co-operation in the Twenty-First Century: the Role of Information Technology in the Context of a Knowledge-Based Economy.* New York.

Ekberg, J. 1999. *A Step Forward—Design for All.* INCLUDE STAKES.

Enders, A. and Hall, M. 1990. *Assistive Technology Sourcebook*. Resnapress.

Engelen, J. and Evenpoel, P. 1999. "Producing Web Pages that Everyone Can Access, A COST 219bis Guidebook." COST 219, European Commission.

European Commission 1995. *Social Integration: Elimination of Technical and Socio-Psychological Barriers.* European Union Publications.

FORUM 1996. "Networks for People and their Communities." Information Society Forum, European Commission

Gill, J. and Shipley, T. 1997. "Disaster or Opportunity: The Impact of Telecommunications Deregulation on People with Disabilities." RNIB. COST219.

———. 1999. "Telephones—What Features Do Disabled People Need?" RNIB, PhoneAbility.

Gill, J. 1994. "The Forgotten Millions: Access to Telecommunications for People with Disabilities." The European Commission.

———. 1998. "Access Prohibited? Information for Designers of Public Access Terminals." INCLUDE, RNIB.

———. 1999. "Telecommunications—Guidelines for Accessibility." COST 219, RNIB.

———. 2000. "Tiresias: A Family of Typefaces Designed for Legibility on Screens, Signs and Labels." RNIB.

———. 2000. "Which Button? Designing User Interfaces for People with Visual Impairments." RNIB.

———. 2001. "Keeping Step? Scientific and Technological Research for Visually Impaired People." Scientific Research Unit, RNIB.

Glastonbury, B., ed. 1996. "Dreams and Realities: Information Technology in the Human Services." STAKES.

Helander, E. 1993. "Prejudice and Dignity: An Introduction to Community-Based Rehabilitation." United Nations Development Programme, New York.

Hypponen, H. 1999. "Handbook on Inclusive Design of Telematics Applications." INCLUDE, Telematics Applications Programme TIDE, European Commission.

Kenny, Charles et al. 2000. “ICTs and Poverty.” Internal Report. World Bank, Washington, D.C.

Khan, M. and Swanborough, R. 1999. “Information Management, IT and Government Transformation: Innovative Approaches in the New South Africa.” In *Information Systems for Public Sector Management*, Working Paper Series No.6. Manchester, U.K.:University of Manchester.

Lindstrom, J-I. 1999. “New Ways of Using Video Telephony, A COST 219bis Guidebook.” COST 219bis, European Commission.

Mercinelli, M. 1999. “Accessibility Requirements for New Telecommunications Equipment, A COST 219bis Guidebook.” COST 219bis. European Commission.

Negroponte, N. 1995. *Being Digital.* Hodder and Stoughton.

Nordic Disability Organisations 2000. “Inclusion of the Disability Dimension in Nordic Development Cooperation.” Danish Council for Organisation of Disabled People.

Placencia-Porrero, I. and Ballabio, E., eds. 1998. *Improving the Quality of Life for the European Citizen: Technology for Inclusive Design and Equality.* IOS Press.

Placencia-Porrero, I. and Bellacasa, R., eds. 1995. *The European Context for Assistive Technology.* IOS Press.

Roe, P., ed. 1995. “Telecommunications for All.” COST 219. Commission of the European Community, Directorate General of Telecommunications, Information Industries and Innovation.

Sandhu, James S. 1999. “Aging, Civic Rights and Universal Design.” Keynote speech at 4th International Conference on Aging. Sponsored by the International Federation on Aging. Montreal, Canada.

———. 2000a. Citizenship and Universal Design. Keynote speech at International Conference on Design for the 21st Century. Adaptive Environments and the Government of Rhode Island.

———. 2000b. “Telecommunications: Expectations and Special Needs Market Sectors.” Keynote speech at the International Telecommunications and Disability Conference. Rehabilitation International. Potsdam, Germany.

———. 2001a. “An Integrated Approach to Universal Design: Towards the Inclusion of all Ages, Cultures and Diversity.” In *Universal Design Handbook.* McGraw-Hill.

———. 2001b. “European Developments in Technology for Older People.” Keynote speech at conference on The Key Actions Technology and Aging: Quality of Life. Sponsored by the ICTA and the Government of Ontario. September.

———. 2001c. “Inclusive Design and the Sustainable Society.” Keynote speech, International Conference on Inclusion by Design. Sponsored by the Canadian Council on Rehabilitation and Work. Montreal, Canada.

Sandhu, James S. and Wood, John. 1999. “Demographic and Market Sector Analysis of People with Special Needs in Thirteen European Countries: A Report for the European Commission.” In *The World Disability Report*. International Disability Foundation, Newcastle Polytechnic, United Kingdom.

Sandhu, James S. et al. 1992. “Usability Issues for People with Special Needs.” A Report for the European Commission. Project RACE R1088, University of Northumbria.

Sida. 1999. “IT in Swedish Development Co-operation: Suggestions for Ways of Including the Low-Income Countries.” Finance and Corporate Development Department. (For more information, see http://www.sida.se.)

Price Partnership. 2000. “Study on Technology Trends and Future Perspectives within Assistive Technologies.” IRV.

Thompson, P. 1990. “Short Changed by Disability.” Disablement Income Group.

Thoren, C. 1998. “Nordic Guidelines for Computer Accessibility.” Nordic Cooperation on Disability.

Thursz, D., Nusberg, C. and Prather, J. 1995. *Empowering Older People: An International Approach.* Cassell.

United Nations General Assembly. 1993. “Standard Rules on the Equalization of Opportunities for Persons with Disabilities.” A/Res/48/96, 85th Plenary Meeting, December 20, 1993. New York.

U.S. General Services Administration. 1998. “Workforce Investment Act of 1998.” Washington, D.C.

Wiman, R. 2000. “The Disability Dimension in Development Action, Manual on Inclusive Planning.” STAKES, Saarijarvi, Finland.

Woodall, P. 1996. “A Hitchhiker’s Guide to Cybernomics: A Survey of the World Economy.” *Economist*. September 28: 43.