UNITED NATIONS
APCICT - ESCAP

ICT Trends

Digital Healthcare | Mobile Payment | Assistive Technologies | Internet of Things (IoT)

5th Generation Mobile Networks (5G) | Artificial Intelligence and Machine Learning

Blockchain and Shared Ledgers | 3D Printing

ICT Trends Assistive Technologies

APCICT ASIAN AND PACIFIC TRAINING CENTRE FOR INFORMATION AND COMMUNICATION TECHNOLOGY FOR DEVELOPMENT

Correspondence concerning this publication should be addressed to the email: apcict@un.org

Contact:
Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT/ESCAP)
5th Floor G-Tower
175 Art Center Daero
Yeonsu-gu, Incheon
Republic of Korea
Tel +82 32 458 6650
Fax +82 32 458 6691/2
Email: apcict@un.org
http://www.unapcict.org

ISBN: 979-11-88931-01-9

ABOUT

The 2030 Agenda for Sustainable Development provides a plan of action for achieving an economically, socially and environmentally sustainable future. Information and communication technologies (ICTs) are recognized as enablers of the 2030 Agenda for Sustainable Development. Their diffusion and application in all sectors of society provide new solutions to persistent development challenges.

As new technologies, along with increased connectivity, spread rapidly and transform the ICT landscape around the world, it is important for policymakers and government officials to understand the current trends in order to fully leverage the potential benefits of ICT.

This publication aims to provide timely and relevant information on the major ICT trends and the implications of these trends. It serves as a knowledge resource for policymakers and government officials in Asia and the Pacific to increase their awareness and appreciation for the continuously evolving ICT landscape. It intends to present a broad understanding of how new and emerging ICT trends could be utilized to support sustainable and inclusive development.

This publication is a collection of brief write-ups on the following eight ICT trends:

1. Digital Healthcare
2. Mobile Payments
3. Assistive Technologies
4. Internet of Things
5. 5th Generation Mobile Networks
6. Artificial Intelligence and Machine Learning
7. Blockchain and Shared Ledgers
8. 3D Printing

This set of topics was selected based on their relevance to achieving the Sustainable Development Goals (SDGs). The topics selected also aim to provide a broadly representative sample covering a wide range of technology areas spanning hardware, networking, software and data, as well as application domains (i.e., healthcare, finance and disability).

Each write-up introduces the topic by first describing the technology features and components, and then proceeds to highlight potential application areas and use cases, with examples from the Asia-Pacific region and beyond. This is followed by a discussion on the policy implications involving regulatory aspects, standards and linkages to the SDGs. Each write-up may vary slightly to highlight relevant aspects.

The write-ups can be read independent of the other. Although the topics have been presented in a certain sequence, readers may start with any topic of interest and move on to any other topic that they find of relevance or interest. While going through the write-ups, readers may find multiple connections across application domains and technology areas. This has been intentional to foster

a better appreciation of the potential use of the new and emerging technologies for sustainable development. As these are brief descriptions, interested readers are advised to go through the references provided at the end of the write-ups for a more comprehensive understanding of the topics.

ACKNOWLEDGEMENTS

ICT Trends was prepared by the Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT) of the Economic and Social Commission for Asia and the Pacific (ESCAP) under the overall guidance of Tiziana Bonapace, Director of the Information and Communications Technology and Disaster Risk Reduction Division and Officer-in-Charge of APCICT. Amit Prakash, Angel Jeena, Apoorva Bhalla, Rajesh Hanbal, Sanjay V.P., Supriya Dey and Vidhya Y. from the Centre for Information Technology and Public Policy, International Institute of Information Technology Bangalore were part of the core team as external experts.

This publication benefited greatly from internal reviews by Atsuko Okuda, Eric Roeder, Yungman Jun, Nuankae Wongthawatchai and Robert de Jesus, and external reviews by Usha Vyasulu Reddy, Nag Yeon Lee, Kamolrat Intaratat, Shahid Uddin Akbar, Sholpan Yessimova, Almaz Bakenov, Asomudin Atoev, Yudho Giri Sucahyo, Chi Kim Y and Bolorchimeg Ganbold. Editing support was provided by Christine Apikul.

Kyoung-Tae Kim, Hyunji Lee and Kevin Drouin provided research assistance. Joo-Eun Chung and Hyeseon Do undertook administrative support and other necessary assistance for the issuance of the publication.

TABLE OF CONTENTS

III. Assistive Technologies

Disability, Accessibility and Assistive Technologies

Contents

List of Figures

1. Introduction

1.1 Disability

The International Classification of Functioning, Disability and Health[1] defines disability as an umbrella term for impairments, activity limitations and participation restrictions. Impairment is a problem in body function or structure; an activity limitation is a difficulty encountered by an individual in executing a task or action; while a participation restriction is a problem experienced by an individual in involvement in life situations. The World Health Organization divides the type of disabilities into nine broad categories: (1) behavioural disabilities; (2) communication disabilities; (3) personal care disabilities; (4) locomotor disabilities; (5) body disposition disabilities; (6) dexterity disabilities; (7) situational disabilities; (8) particular skill disabilities; and (9) and other activity restrictions.

According to the World Health Organization,[2] over a billion people are estimated to live with some form of disability. This corresponds to about 15 per cent of the world's population. Between 110 million (2.2 per cent) and 190 million (3.8 per cent) people 15 years and older have significant difficulties in functioning. Disability is on the rise, due to ageing populations and a higher risk of disability in older people, as well as the global increase in chronic health conditions such as diabetes, cardiovascular disease, cancer and mental health disorders.[3]

Disability is not just a health problem. It is a complex phenomenon, reflecting the interaction between features of a person's body and features of the society in which he or she lives. Society disables people with impairments by failing to take into account their rights and needs, as groups or individuals. Overcoming the difficulties faced by persons with disabilities requires interventions to remove environmental and social barriers.[4] The United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) recognizes disability as a human rights issue and a development issue. Addressing the importance of disability inclusion for development, the 2030 Agenda for Sustainable Development includes several development targets for persons with disabilities and for accessible environments for them.[5]

1 World Health Organization, *Towards a Common Language for Functioning, Disability and Health: ICF – The International Classification of Functioning, Disability and Health* (Geneva, 2002). Available from http://www.who.int/classifications/icf/training/icfbeginnersguide.pdf.

2 World Health Organization, "Disability and Health Fact Sheet", November 2017. Available from http://www.who.int/mediacentre/factsheets/fs352/en/.

3 Ibid.

4 World Health Organization, *World Report on Disability* (Geneva, 2011). Available from http://www.who.int/disabilities/world_report/2011/report/en/.

5 United Nations Department of Economic and Social Affairs, *Global Status Report on Disability and Development Prototype 2015* (New York, 2015). Available from http://www.un.org/esa/socdev/documents/disability/2016/GlobalStatusReportonDisabilityandDevelopment.pdf.

1.2 Accessibility and Existing Institutional Frameworks

The Decent Work Agenda from the International Labour Organization defines "decent work" as work that, "sums up the aspirations of people in their working lives". This means that enforcing right to work would imply, "promotion of full, productive and freely-chosen employment".. The International Labour Organization Convention No. 159 requires that members provide equality of opportunity in the labour market to disabled persons through rehabilitation measures that will ensure retention and advancement of the jobs that they are in.[6]

Similarly, the United Nations envisages treating persons with disabilities as, "beneficiaries and agents of change in society and development". It calls for, "urgent action towards creating policies and development initiatives intended to lead to an inclusive, accessible and sustainable society". The UNCRPD, adopted in 2006, requires that parties to the treaty recognize the right to work of disabled persons. Particularly, Article 9 of the convention covers accessibility and the right for people with a disability to participate fully in all aspects of life, including the aim to, "promote access for persons with disabilities to new information and communications technologies and systems, including the Internet", and to, "promote the design, development, production and distribution of accessible information and communications technologies and systems at an early stage, so that these technologies and systems become accessible at minimum cost".[7]

In response, frameworks and models have been developed to incorporate issues faced by persons with disabilities into policymaking. The Sustainable Livelihoods Framework was developed by the United Kingdom Department for International Development mainly as a poverty reduction tool for development programmes. This framework helps us understand the access to resources and entitlements by disabled persons, so that relevant policies can be formulated. The community-based rehabilitation model of the World Health Organization covers health, education, livelihood, social and empowerment issues to improve the equalization of opportunities for persons with disabilities. The livelihood component includes guidelines to promote skills development, self-employment and wage-employment opportunities, as well as social security measures and financial inclusion. A United Nations report[8] pointed out that being cognizant of accessibility during the planning, designing and developing stages of any virtual or physical environment will lead to a higher chance that the final products and services will be accessible to all. This will avoid retrofitting, which can be more costly.

6 International Labour Organization, "C159 – Vocational Rehabilitation and Employment (Disabled Persons) Convention, 1983 (No. 159)". Available from http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_INSTRUMENT_ID:312304.

7 United Nations, "Convention on the Rights of Persons with Disabilities: Article 9 - Accessibility". Available from https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities/article-9-accessibility.html.

8 United Nations Department of Economic and Social Affairs, *Global Status Report on Disability and Development Prototype 2015* (New York, 2015). Available from http://www.un.org/esa/socdev/documents/disability/2016/GlobalStatusReportonDisabilityandDevelopment.pdf.

In a study of access to assistive technology in the European Union in 2003, Deloitte and Touche estimated the existence of more than 20,000 assistive-technology-related products, which represent a market volume of over EUR 30 billion.[9] Yet, disability has rarely been included in national policies or programmes until very recently. The recent United Nations 2030 Sustainable Development Agenda specifically targets, "areas related to education, growth and employment, inequality, accessibility of human settlements and means of implementation".[10] In response to the Agenda, governments across the world have begun to focus on the promotion of inclusion, participation and development of persons with disabilities through provision of accessible services.

Accessibility generally refers to the provision of special needs of persons with disabilities. However, the 2015 United Nations report on mainstreaming disability in the 2030 Sustainable Development Agenda treats accessibility as, "a precondition for an inclusive society for all, and may be defined as the provision of flexibility to accommodate each user's needs and preferences".[11] Accessibility is, therefore, not only a means and a goal of inclusive development, but also considered an enabler of, "an improved, participative economic and social environment for all members of society". The UNCRPD[12] links the provision of accessibility to empowering persons with disabilities to live independently, be included in the community, and exercise personal mobility, freedom of expression and opinion, and access to information. The United Nations identifies accessibility as, "a global public good and not a defined benefit for a particular group".[13]

9 European Commission, *Access to Assistive Technology in the European Union* (2003). Available from http://www.acessibilidade.net/at/access_AT_EU.pdf.

10 United Nations General Assembly, Seventieth Session, 70/1. Transforming our world: the 2030 Agenda for Sustainable Development (A/RES/70/1), 21 October 2015. Available from http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E.

11 United Nations, *Accessibility and Development: Mainstreaming Disability in the Post-2015 Development Agenda* (New York, 2015). Available from http://www.un.org/disabilities/documents/accessibility_and_development.pdf.

12 United Nations, "Convention on the Rights of Persons with Disabilities". Available from https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities.html.

13 United Nations, *Accessibility and Development: Mainstreaming Disability in the Post-2015 Development Agenda* (New York, 2015). Available from http://www.un.org/disabilities/documents/accessibility_and_development.pdf.

2. Need for Assistive Technologies

The World Report on Disability[14] defines assistive technology as, "any item, piece of equipment, or product, whether it is acquired commercially, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of individuals with disabilities". Whether a technology is assistive or otherwise may affect how people acquire the technology.[15] According to the Assistive Technology Industry Association,[16] assistive technologies are essential for disabled persons to navigate their daily environment, participate in society and contribute to different kinds of livelihood opportunities. With the spread and near ubiquity of smart devices there have been efforts to develop life-enhancing applications for disabled users. New access technologies that involve the use of microelectronics, robotic mechanics and biotechnology to create assistive and adaptive technologies for the disabled becomes relevant. For example, a special keyboard that takes into account certain functional disabilities of people is a new access technology. Through the use of such technologies, persons with disabilities can expand the avenues of employment that are available to them in today's age.[17] The development of accessible information and communication technologies (ICTs) has been a major policy objective in international frameworks concerning the advancement of persons with disabilities and sustainable development since the 1990s.[18]

Persons with disabilities have to grapple with issues such as inaccessibility, exclusion and inability to participate fully in daily living. Poverty, deeply held attitudes about the disabled, and lack of awareness of policies and laws debilitate persons with disabilities.[19] Multiple factors in the environment and the physical condition of persons with disabilities create barriers in performing normal routine tasks. This discourages many employers from hiring persons with disabilities, and self-employment options are infeasible without adequate support.

Technological breakthroughs in productivity have helped businesses get the most from employees of all backgrounds and capabilities. However, according to the World Health Organization, only 5-15 per cent of persons with disabilities have access to assistive devices and technologies for accessibility in low and middle-income countries. In tandem with technologies that enable better management of day-to-day lives, there is an urgent need for developing technologies that enhance the skills and capabilities of persons with disabilities for employment and livelihood, especially as increased accessibility in workplaces leads to more participation of persons with disabilities in the labour market and, consequently, more diversity in society, capturing persons of all talents and abilities.[20]

---

14 World Health Organization, *World Report on Disability* (Geneva, 2011). Available from http://www.who.int/disabilities/world_report/2011/report/en/.

15 Marilyn J. Field and Alan M. Jette, eds., "Assistive and Mainstream Technologies for People with Disabilities", in *The Future of Disability in America* (Washington D.C., National Academies Press, 2007). Available from https://www.ncbi.nlm.nih.gov/books/NBK11418/.

16 Assistive Technology Industry Association, "What is AT?" Available from https://www.atia.org/at-resources/what-is-at/.

17 H. Allan Hunt and Monroe Berkowitz, *New technologies and the employment of disabled persons* (Geneva, International Labour Office, 1992).

18 United Nations Department of Economic and Social Affairs, *Global Status Report on Disability and Development Prototype 2015* (New York, 2015). Available from http://www.un.org/esa/socdev/documents/disability/2016/GlobalStatusReportonDisabilityandDevelopment.pdf.

19 Ajit Mondal and Jayanta Mete, "Education of Children with Disabilities in India: Policy Perspective and Concerns", *Indian Journal of Educational Research,* vol. 2 (2013), pp. 56-67.

20 Adolf Ratzka, "The case for accessibility legislation in a market economy", Report of the CIB Expert Seminar on Building Non-Handicapping Environments, 1991. Available from http://www.independentliving.org/cib/cibbudapest28.html.

3. Types of Assistive Technologies

Assistive technologies can be classified into the following three types—personal assistive devices, adaptive assistive devices and cognitive assistive devices.

1. Personal assistive devices act as extensions of a person's physical capacities. These include canes, scooters, hearing aids and magnifying glasses.

2. Adaptive assistive devices make an inaccessible mainstream or general use device usable by a person with a disability, although usually at additional cost. The computer screen reader (Figure 1), which allows blind or visually-impaired people to hear text displayed on a computer screen, is one such device.

Figure 1: Screen Reader

Source: Freedom Scientific, "Blindness Solutions: JAWS®". Available from http://www.freedomscientific.com/Products/Blindness/JAWS.

The screen reader software takes the standard output from a computing or mobile device and presents it to a user in an audio form or tactile output such as a braille display—although the audio form is the more popular option for blind and low-vision users.[21] The screen reader software can either be installed on computers and mobile devices, or hosted as applications on the cloud on a pay-per-use basis.

21 Ted McCarthy, Joyojeet Pal and Edward Cutrell, "The "voice" has it: Screen reader adoption and switching behavior among vision impaired persons in India", *Assistive Technology*, vol. 25, no. 4 (Winter 2013), pp. 222-229. Available from https://www.ncbi.nlm.nih.gov/pubmed/24620705.

There are also a number of mobile applications for the visually-impaired that can be readily available on one's mobile device. For example, colour identification applications help people who are blind decide what to wear, and currency identifiers help users distinguish between currency notes. Waving a phone camera over the piece of clothing or the currency enables it to identify the item. These applications can be downloaded on mobile devices at low or no cost.[22]

Another example for the visually-impaired is glasses with technology-enabled cameras that can help the visually-impaired hear any text appearing on any surface, and recognize the faces of people they know (Figure 2).

Figure 2: Glasses with Technology-enabled Cameras

Source: OrCam, "My Eye". Available from https://www.orcam.com/myeye/.

Examples of adaptive assistive devices for people with hearing impairments are speech recognition software and real-time captioning on phones that display every word the caller says throughout the conversation.

3. Cognitive assistive technologies include visual or auditory prompting devices or schedule reminders that provide simple cues to help people perform a task or remember things that they need to do.

22 Dave Zielinski, "New assistive technologies aid employees with disabilities", *Society for Human Resource Management*, 20 December 2016. Available from https://www.shrm.org/resourcesandtools/hr-topics/technology/pages/new-assistive-technologies-aid-employees-with-disabilities.aspx.

Figure 3: Cognitive Assistive Devices

Source: Priscilla Goy, "More people with disabilities tapping enhanced tech fund", *The Straits Times*, 21 July 2016. Available from http://www.straitstimes.com/singapore/more-people-with-disabilities-tapping-enhanced-tech-fund.

Examples include simplified versions of email applications or alarm devices for warning caregivers that a disabled person may be in danger, by tracking devices that use Global Positioning System technology to determine the location of an individual. Other examples of such technologies are predictive texting, speech recognition, text-to-speech, built-in calculator and large and simple display screens.

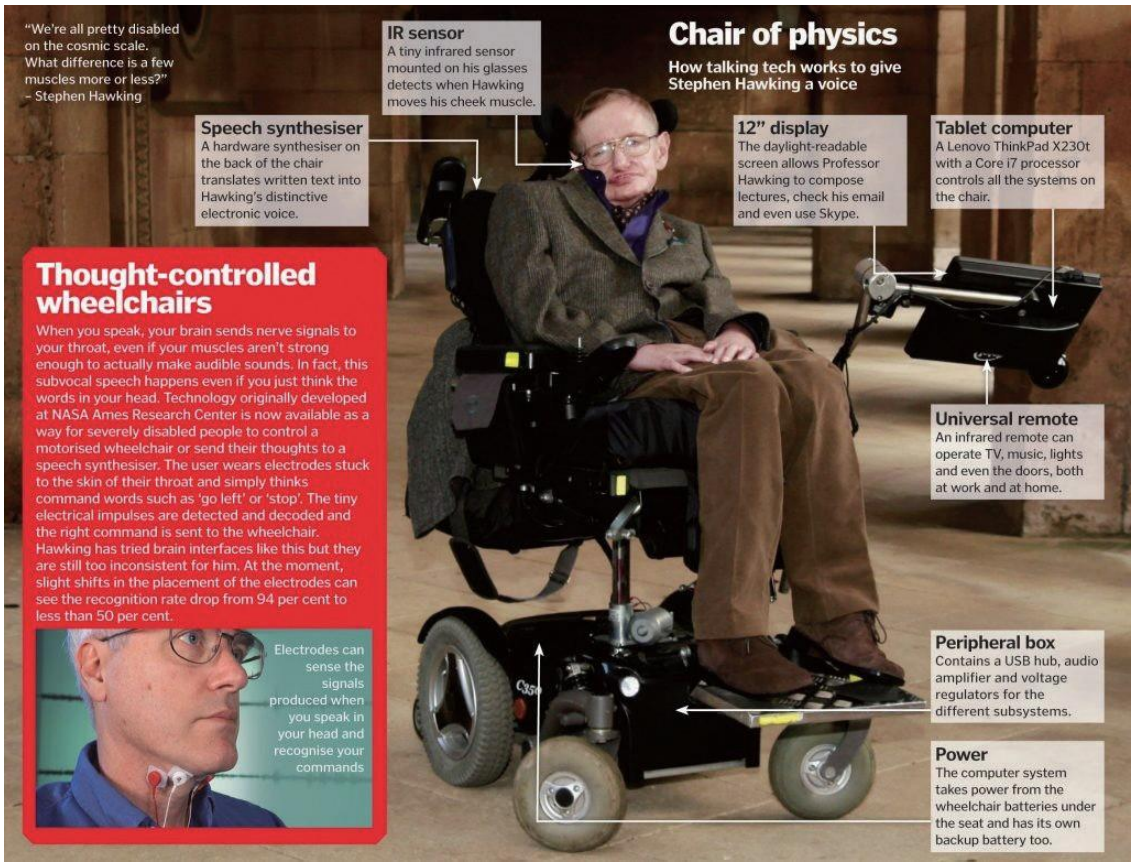
A range of new assistive technologies are being developed to take advantage of advances in electronics and computing power, such as communications devices based on the tracking of individual eye movement (e.g., for people with severe speech and movement impairments because of a stroke), and complex prosthetic devices that respond to neural impulses and are, therefore, controlled by the mind (Figure 4).

Figure 4: Complex Prosthetic Devices

Source: Freethink cited in Maddie Stone, "How a Hillbilly Delivery Man Is Trailblazing Our Cyborg Future", *Gizmodo*, 31 August 2016. Available from https://gizmodo.com/how-a-hillbilly-delivery-man-is-trailblazing-our-cyborg-1785993977.

The renowned scientist, Stephen Hawking for example, has been using various assistive technologies to communicate since he lost his ability to speak in 1985. Since 2008, Hawking has also lost the ability to move his fingers to click. Yet, he writes emails, browses the Internet, writes books and speaks, using only one cheek muscle. A switching device called the "cheek switch", is attached to his glasses and detects when Hawking tenses his cheek muscle via a low infrared beam.

Figure 5: Stephen Hawking's Wheelchair



Source: How It Works, "How Stephen Hawking's wheelchair works", 2015. Available from https://www.howitworksdaily.com/how-stephen-hawkings-wheelchair-works/.

Text-to-speech readers are now available from many vendors and as open source software products. Technology for the blind has generally been based on audio cues. Latest technologies, however, use vibrations to guide people around. They do this through wearables (e.g., the Wayband™ wristband – Figure 6) that connect to a mobile device and can guide users to where they wish to go. The device buzzes when the user faces the wrong way and stays silent when the person is on the right track.

Figure 6: Wayband™

Source: Wear Works, "Wayband". Available from https://www.wear.works/wayband-product.

Innovations in assistive technologies are emerging in the Asia-Pacific region. For example, the SmartCane™ (Figure 7), an electronic travel aid that detects hanging obstacles above the knee, is designed by Assistech at the Indian Institute of Technology Delhi.

Figure 7: SmartCane™

Source: Assistech, "SmartCane™ Device: About". Available from http://assistech.iitd.ernet.in/smartcane.php.

In India, a biennial conference, Techshare India,[23] brings together creators of assistive technology. It offers assistive and accessible product demos as well as a space for policymakers to have seminars. The 2016 seminar saw the launch of the Newz Hook app and website—the first ever news portal for persons with disabilities.[24]

In Pakistan, the Pakistan Telecommunications Authority led a Mobile App Awards initiative in 2016 that focused on addressing the needs of persons with disabilities.[25]

In Bangladesh, the Prime Minister Office's Service Innovation Fund offers grants to initiatives that promote economic and social development. Currently, about 10 per cent of the projects are targeted at meeting the needs of persons with disabilities. Additionally, a Disability Innovation Lab has been established under this scheme to support the creation, testing and commercialization of disability-inclusive products and services.[26]

23 Techshare India 2016, "Exhibition at Techshare India". Available from http://techshare.barrierbreak.com/exhibition-at-techshare-india/.

24 Newz Hook, "About Us". Available from https://newzhook.com/about.

25 Pakistan Mobile App Awards. Available from http://mobileawards.pta.gov.pk/. View a video about the winners of the awards at https://isoc.box.com/s/h8fktk0qagph5r21d5ltqanhg682ez3a.

26 A2I Prime Minister's Office Bangladesh, "Exhibition and Discussion Forum on 14 Disability related Innovations held". Available from http://a2i.pmo.gov.bd/exhibition-and-discussion-forum-on-14-disability-related-innovations-held/; and A2I Prime Minister's Office Bangladesh, "Disability Innovation Lab". Available from http://a2i.pmo.gov.bd/innovation-lab/lab/disability/.

4. Design Considerations for Assistive Technologies

In the 1990s, the universal design philosophy was introduced by architect Ronald L. Mace to describe the concept of designing all products and the built environment to be aesthetic and usable to the greatest extent possible by everyone, regardless of their age, ability or status in life.[27] It is defined as a framework for the design of places, objects, information, communication and policy to be usable by the widest range of people operating in the widest range of situations without special or separate design or adaptation.[28] Other common terms for this process are "design for all", "inclusive design" and "accessible design". The concept of accessible design ensures both "direct access" (i.e., unassisted) and "indirect access" meaning compatibility with a person's assistive technology (e.g., computer screen readers). Although coming from quite different histories, the purpose of universal design and assistive technology is similar—to reduce the physical and attitudinal barriers between people with and without disabilities. However, the specificity of the environment in which persons with disabilities live, impacts their level of participation in everyday life. Hence, a proper understanding of the medical, legal, economic and socio-cultural phenomena driving the disabled populations is pertinent while designing and developing technology solutions. The United States National Task Force on Technology and Disability advocates this approach for the designers and users of assistive technology.[29]

Accessible design of technologies can benefit all persons in a given population, not only persons with disabilities. For instance, the mobile phone vibration mode and short message service are not only useful for persons with hearing loss but to a larger population who may benefit from sensory alteration. Similarly, magnifying application in smartphones that increases the size of text can enhance usability for older persons, as well as for those with visual impairments, who find it difficult to read small text fonts.[30]

27 Centre for Universal Design, "About the Center: Ronald L. Mace". Available from https://projects.ncsu.edu/ncsu/design/cud/about_us/usronmace.htm.

28 Marilyn J. Field and Alan M. Jette, eds., "Assistive and Mainstream Technologies for People with Disabilities", in *The Future of Disability in America* (Washington D.C., National Academies Press, 2007). Available from https://www.ncbi.nlm.nih.gov/books/NBK11418/.

29 National Taskforce on Technology and Disability, "About Us". Available from http://ntftd.com/.

30 United Nations Department of Economic and Social Affairs, *Global Status Report on Disability and Development Prototype 2015* (New York, 2015). Available from http://www.un.org/esa/socdev/documents/disability/2016/GlobalStatusReportonDisabilityandDevelopment.pdf.

Another path to safer and more useful products is human factors engineering, which considers how people use products and how human capacities and expectations interact with the characteristics of products in different environments. As is also true of universal design, one focus of human factors engineering is the design of products and processes to reduce the opportunity for human error. Human factors engineering was not intended to consider the capacities of people with visual, hearing, mobility or other impairments. Nonetheless, its principles and methods can be applied to the design of mainstream and assistive technologies to take into account how people with different kinds of impairments interact with such technologies. Although the application of human factors standards appears to have made some medical equipment more accessible, "a disturbing proportion of new devices still have significant shortcomings".[31]

31 Michael E. Wiklund, "Human Factors Standards for Medical Devices Promote Accessibility", in *Medical Instrumentation: Accessibility and Usability Considerations*, Jack M. Winters and Molly Follette Story, eds. (Boca Raton, CRC Press, 2006).

5. Policies and Regulations on Accessibility and the Use of Assistive Technologies

5.1 Challenges

Despite these design principles and the growth of the digital economy with increasing digital inclusion, persons with disabilities still tend to be excluded from mainstream activities and workspaces. Accessibility is a major concern as technologies are not designed according to standards and guidelines devised to benefit the disabled.

While the potential for ICTs and other technologies to be drivers of change has been well documented, technologies have also been known to widen economic and social disparities. Furthermore, a limiting factor affecting the usage of accessibility features and applications is language, as these applications are not always available in local languages. This is accentuated in countries with many local languages such as India and African countries.

Most of the assistive technologies today are designed in the industrialized world, for people living in those countries. This is especially true in the case of assistive technologies for people with vision impairments—market-prevalent technologies are both very expensive and are built to support the language and infrastructure typical in the industrialized world.[32] Although there are a growing number of accessibility applications for smartphones, many of which are available free of charge, the affordability of smartphones, screen readers and text-to-speech applications remains a major issue in developing countries.

Further, the lack of access to higher education among persons with disabilities reduces awareness of the advantages of access to ICTs.

More broadly, the provision of accessibility requires active government intervention, and the implementation of measures to reduce barriers and provide means to ensure equal access and participation.

32 Joyojeet Pal and others, "Assistive technology for vision-impairments: An agenda for the ICTD community", *Proceedings of the 20th International Conference Companion on World Wide Web* (March 2011), pp. 513-522.

5.2 Standards and Global Good Practices

Employment opportunities for the disabled are scarce due to inaccessible work places and information, discrimination, negative attitudes towards persons with disabilities, and misconceptions about their capacity to work.[33] In most countries, persons with disabilities are more likely to be self-employed than non-disabled people, and are also more likely to be in low-paid jobs with poor career prospects and working conditions.

Frameworks from international bodies[34] encourage governments and other organizations to provide equal opportunities for all by taking appropriate measures to ensure accessibility in the physical and digital environments. In response, governments of many developing countries have created anti-discrimination legislation in employment. To enhance the employability of persons with disabilities, some countries such as Bangladesh have mainstreamed disability in technical and vocational education and training, and reserved a percentage of seats in polytechnics, technical schools and colleges for persons with disabilities. The Hunan Disabled Persons' Federation in China chose 10 non-governmental organizations and vocational training centres as pilot organizations to train and create opportunities for employing the disabled. Subsequently, work opportunities were identified and matched to the interests of persons with disabilities.

Based on the principles of universal design, performance standards and technical requirements for accessibility are expected to produce results for persons with disabilities and non-disabled persons alike. The European Committee for Standardization, for example, has developed Europe-wide standards on accessible built environments. Similarly, various countries such as Australia, Cambodia, Canada, France, South Africa, Sri Lanka and the United States of America have passed national legislations on accessibility of any public space for any person with disability.[35]

Accessibility is a major concern as various kinds of technologies, such as electronic goods, websites and mobile phone applications, are not designed according to standards and guidelines devised to benefit the disabled. As ICTs are increasingly becoming an integral part of our environment, ensuring their accessibility to disabled persons should gain greater priority. ICTs and particularly web access, is a priority accessibility requirement of most national policies.

---

33 United Nations Department of Economic and Social Affairs, *Global Status Report on Disability and Development Prototype 2015* (New York, 2015). Available from http://www.un.org/esa/socdev/documents/disability/2016/GlobalStatusReportonDisabilityandDevelopment.pdf.

34 United Nations, "World Programme of Action Concerning Disabled Persons". Available from https://www.un.org/development/desa/disabilities/resources/world-programme-of-action-concerning-disabled-persons.html; United Nations, "Standard Rules on the Equalization of Opportunities for Persons with Disabilities". Available from https://www.un.org/development/desa/disabilities/standard-rules-on-the-equalization-of-opportunities-for-persons-with-disabilities.html; and United Nations, "Convention on the Rights of Persons with Disabilities". Available from https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities.html.

35 United Nations Department of Economic and Social Affairs, *Global Status Report on Disability and Development Prototype 2015* (New York, 2015). Available from http://www.un.org/esa/socdev/documents/disability/2016/GlobalStatusReportonDisabilityandDevelopment.pdf.

The Web Content Accessibility Guidelines (WCAG) 2.0[36] and e-accessibility checker software has been developed to assist those who wish to verify if their websites satisfy the ISO accessibility criteria.

Figure 8: WCAG 2.0

Source: ACRL TechConnect, "Making Your Website Accessible Part 1: understanding WCAG", 15 October 2012. Available from http://acrl.ala.org/techconnect/post/making-your-website-accessible-part-1-understanding-wcag.

The WCAG 2.0 forms the basis of national guidance documents and legislation on developing accessible websites in many countries, including countries of the European Union, Australia, Hong Kong (SAR, China), Japan, New Zealand and the United States of America. In line with WCAG 2.0, the United Nations assesses websites using criteria such as, the availability of options to configure font size and colour, and read content aloud (useful for visual disabilities), and view videos with sign language or captions (useful for hearing disabilities). Other criteria include making all functionalities available from a keyboard (so an alternate keyboard can be used for those with mobility disabilities), and providing text alternatives for non-text content, such as the addition of descriptions to images (so that those using a screen reader can understand the content and functionality of the image).

36 International Organization for Standardization, "ISO/IEC 40500:2012 (W3C)". Available from http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=58625.

6. National Policies/Projects Using ICTs to Make Workplaces/Public Spaces Inclusive

The Model ICT Accessibility Policy Report[37] offers a comprehensive framework for national policymakers and regulators creating their own ICT accessibility policies and programmes, in consultation with persons with disabilities and ICT stakeholders. The report is targeted at ICT policymakers, regulators and other stakeholders active in ICT and/or disability issues, including non-governmental organizations, organizations working with persons with disabilities and parliamentarians.

While countries across the world have in principle adopted equal opportunity provision for the disabled, specific schemes adopted by governments across the world can be representative of existing global best practices in the field. Examples of such schemes from Brazil, the European Union, South Africa, Japan and the United States of America are presented below.

Case: Brazil

According to Brazil's 2010 census, there are 45 million persons with disabilities in the country, which is about 23.9 per cent of its population.[38] In Brazil, the UNCRPD and its Optional Protocol was ratified in 2008 and has the same legal status as a constitutional amendment. All companies may obtain a voluntary accessibility certification issued by the Brazilian Association of Technical Norms. One of the accessibility initiatives by the federal government called the Accessible Tourism Guide is a website that compiles accessibility ratings of tourist destinations. The collaborative website allows Internet users to rate the accessibility features of hotels, restaurants and various attractions. The website's database currently provides accessibility information on approximately 530,000 establishments in the country.

Case: European Union

The European Disability Strategy 2010-2020 has been framing actions in the European Union as the main instrument to support implementation of the UNCRPD. Actions include, among many others, adoption of the first European ICT accessibility standard in 2014, revision and adoption of legislation related to rail, maritime, air and road transport, to enhance the accessibility for and assistance to persons with disabilities, and compulsory accessibility requirements in actions financed by the European Structural and Investment Funds Regulations. In 2016, the web and mobile accessibility directive for public sector bodies was adopted. The rules include the following:[39]

37 International Telecommunication Union, *Model ICT Accessibility Policy Report* (2014). Available from http://www.itu.int/en/ITU-D/Digital-Inclusion/Persons-with-Disabilities/Documents/ICT%20Accessibility%20Policy%20Report.pdf.

38 James Thurston, "Public Policy & Digital Inclusion in Brazil", *Global Initiative for Inclusive ICTs*, 20 September 2017. Available from http://buyict4all.org/blog/public-policy-digital-inclusion-in-brazil.

39 Emily Griffin, "EU Commits to Web Accessibility Rules", *3Play Media*, 4 May 2016. Available from http://www.3playmedia.com/2016/05/04/eu-commits-to-web-accessibility-rules/.

- All websites or web applications owned by the European Union member governments must be fully accessible to people with disabilities. New websites must be accessible and existing content must be updated.
- Archival content and documents will be available on demand in accessible form.
- Government videos must be closed captioned. Live video has a window of 14 days since first broadcast to get captions.
- Online services, like paying fines or fees, will have to be accessible.
- The European Union government websites must indicate if (and why) parts of their website are inaccessible.
- The European Union member states must regularly monitor and report to both the public and the European Commission on the accessible status of their web services.

Case: South Africa

The disability rights movement in South Africa emerged in the 1980s as part of the broader liberation struggle against apartheid. Disabled People South Africa spearheaded the strategy to mobilize and organize persons with disabilities to resist oppression on the bases of both race and disability.[40] One of their demands was that, "disabled people shall have the right to mainstream education with personal assistance where necessary, appropriate assistive technology and specialized teaching".[41]

Subsequently, South Africa ratified the UNCRPD and its Optional Protocol, established the Ministry of Women, Children and Persons with Disabilities, and developed an Integrated National Disability Strategy. South Africa's Parliament introduced policies that contain extensive support measures for Members of Parliament and employees with disabilities. South Africa's Department of Public Works developed a Disability Policy Guideline to move from policy to practice, while adhering to the principles of universal design.[42] The guideline advocates the design of products, environments, programmes and services that are usable by all people to the greatest possible extent, without the need for adaptation or specialized design. This includes assistive devices for particular groups of persons with disabilities.

40 South African Human Rights Commission, "Towards a barrier-free society: A report on accessibility and built environments", November 2002. Available from https://www.sahrc.org.za/home/21/files/Reports/towards_barrier_free_society.pdf2002.pdf.

41 Disability Rights Charter of South Africa, 2008. Available from https://www.safmh.org.za/documents/policies-and-legislations/Disability%20Rights%20Charter.pdf.

42 Department of Public Works, South Africa, *Disability Policy Guideline* (no date). Available from http://www.publicworks.gov.za/PDFs/documents/WhitePapers/Disability_Policy_Guideline.pdf.

Figure 9: Sign Language Interpretation Service at the Parliament of South Africa

Source: Zero Project, "South Africa's equal access for Members of Parliament". Available from https://zeroproject.org/policy/south-africa/.

Case: Japan

In 1995, the Japanese government adopted the "Government Action Plan for Persons with Disabilities: A Seven-Year Strategy to Achieve Normalization". Subsequently, a legislation promoting barrier-free access in transportation was passed in May 2002. This law has through multiple amendments assisted in enabling access to public buildings, and in developing a policy to reduce access-to-information disparities by improving ICT systems.

Since 2010, Japan has launched an ICT policy of Ubiquitous-Net-Japan (U-Japan).[43] It aims to connect everyone and everything using unique, user-friendly and universal principles of design. It adopts the universal as well as individualized design approach to address accessibility issues and remove barriers that impede persons with disabilities.

The main measures taken include: providing subsidies[44] for research and development to improve communications and broadcast services for elderly and persons with disabilities; enforcement of laws such as, "the promotion of project for facilitation of use of telecommunications by people with disabilities contributing to improved convenience of people with disabilities"; ensuring information accessibility through operational models for local government websites; and enforcing national[45] and international[46] standards for accessibility of telecommunications equipment and services.

43 Yokota Kazuma, "Policy for the Information and Communication Accessibility in Japan", presentation made at the International Conference for Information Society and the Elderly: Global Perspectives, no date. Available from http://www.soumu.go.jp/main_sosiki/joho_tsusin/eng/presentation/pdf/080227_2.pdf.

44 These subsidies are provided by the National Institute of Information and Communications Technology.

45 National standardization (JIS X8341-4).

46 International standardization (ITU-T recommendation F.790).

Case: United States of America (USA)

USA passed the Americans with Disabilities Act (ADA) in 1990 as a comprehensive law that covers most issues of accessibility for persons with disabilities.[47] It applies to all state and local government offices and buildings and other spaces that are available to the general public. ADA guarantees both physical accessibility and non-discrimination in employment and the delivery of goods, services, programmes and education.

Based on ADA, the United States government offers tax incentives for money spent on equipment, materials and labour leading to increased access for persons with disabilities. Since 1993, all TV sets sold in the USA are required to be equipped with closed-captioning receivers that can be turned on through an on-screen menu or a remote. When turned on, closed captioning displays a text version of what is being said on the screen, enabling deaf or hearing-impaired viewers to experience any show with captions.

According to Section 508 of the Rehabilitation Act, the United States government is required by law to make government websites and those of any organizations or institutions that are federally funded accessible and WCAG 2.0 compliant. This includes ensuring compatibility with software and hardware devices that make it possible for people with visual or hearing difficulties, or for those who cannot use a mouse or keyboard, to have full access to the content of a website. The Access Board provides training on its accessibility guidelines and standards to various organizations and groups across the country. Most training sessions focus on the ADA Accessibility Guidelines that cover the built environment and transportation vehicles. The Department of Education mandates that when schools use technology to provide educational benefits, services or opportunities, the technology must be fully accessible to students with disabilities.

47 Community Tool Box, “Section 4. Ensuring Access for People with Disabilities”. Available from http://ctb.ku.edu/en/table-of-contents/implement/physical-social-environment/housing-accessibility-disabilities/main.

7. References

ACRL TechConnect. Making Your Website Accessible Part 1: understanding WCAG. 15 October 2012. Available from http://acrl.ala.org/techconnect/post/making-your-website-accessible-part-1-understanding-wcag.

Assistech. SmartCaneTM Device: About. Available from http://assistech.iitd.ernet.in/smartcane.php.

Assistive Technology Industry Association. What is AT?. Available from https://www.atia.org/at-resources/what-is-at/.

Centre for Universal Design. About the Center: Ronald L. Mace. Available from https://projects.ncsu.edu/ncsu/design/cud/about_us/usronmace.htm.

Community Tool Box. Section 4. Ensuring Access for People with Disabilities. Available from http://ctb.ku.edu/en/table-of-contents/implement/physical-social-environment/housing-accessibility-disabilities/main.

Disability Rights Charter of South Africa. 2008. Available from https://www.safmh.org.za/documents/policies-and-legislations/Disability%20Rights%20Charter.pdf.

European Commission. *Access to Assistive Technology in the European Union*. 2003. Available from http://www.acessibilidade.net/at/access_AT_EU.pdf.

Field, Marilyn J., and Alan M. Jette, eds. Assistive and Mainstream Technologies for People with Disabilities. In *The Future of Disability in America*. Washington D.C.: National Academies Press, 2007. Available from https://www.ncbi.nlm.nih.gov/books/NBK11418/.

Freedom Scientific. Blindness Solutions: JAWS®. Available from http://www.freedomscientific.com/Products/Blindness/JAWS.

Goy, Priscilla. More people with disabilities tapping enhanced tech fund. *The Straits Times*, 21 July 2016. Available from http://www.straitstimes.com/singapore/more-people-with-disabilities-tapping-enhanced-tech-fund.

Griffin, Emily. EU Commits to Web Accessibility Rules. *3Play Media*, 4 May 2016. Available from http://www.3playmedia.com/2016/05/04/eu-commits-to-web-accessibility-rules/.

How It Works. How Stephen Hawking's wheelchair works. 2015. Available from https://www.howitworksdaily.com/how-stephen-hawkings-wheelchair-works/.

Hunt, H. Allan, and Monroe Berkowitz. *New technologies and the employment of disabled persons*. Geneva: International Labour Office, 1992.

International Labour Organization. C159 – Vocational Rehabilitation and Employment (Disabled Persons) Convention, 1983 (No. 159). Available from http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_INSTRUMENT_ID:312304.

International Organization for Standardization. ISO/IEC 40500:2012 (W3C). Available from http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=58625.

International Telecommunication Union. *Model ICT Accessibility Policy Report*. 2014. Available from http://www.itu.int/en/ITU-D/Digital-Inclusion/Persons-with-Disabilities/Documents/ICT%20Accessibility%20Policy%20Report.pdf.

Kazuma, Yokota. Policy for the Information and Communication Accessibility in Japan. Presentation made at the International Conference for Information Society and the Elderly: Global Perspectives, no date. Available from http://www.soumu.go.jp/main_sosiki/joho_tsusin/eng/presentation/pdf/080227_2.pdf.

McCarthy, Ted, Joyojeet Pal and Edward Cutrell. The "voice" has it: Screen reader adoption and switching behavior among vision impaired persons in India. *Assistive Technology*, vol. 25, no. 4 (Winter 2013), pp. 222-229. Available from https://www.ncbi.nlm.nih.gov/pubmed/24620705.

Mondal, Ajit, and Jayanta Mete. Education of Children with Disabilities in India: Policy Perspective and Concerns. *Indian Journal of Educational Research*, vol. 2 (2013), pp. 56-67.

National Taskforce on Technology and Disability. About Us. Available from http://ntftd.com/.

Newz Hook. About Us. Available from https://newzhook.com/about.

OrCam. My Eye. Available from https://www.orcam.com/myeye/.

Pal, Joyojeet, and others. Assistive technology for vision-impairments: An agenda for the ICTD community. *Proceedings of the 20th International Conference Companion on World Wide Web* (March 2011), pp. 513-522.

Ratzka, Adolf. The case for accessibility legislation in a market economy. Report of the CIB Expert Seminar on Building Non-Handicapping Environments, 1991. Available from http://www.independentliving.org/cib/cibbudapest28.html.

South African Human Rights Commission. Towards a barrier-free society: A report on accessibility and built environments. November 2002. Available from https://www.sahrc.org.za/home/21/files/Reports/towards_barrier_free_society.pdf2002.pdf.

Techshare India 2016. Exhibition at Techshare India. Available from http://techshare.barrierbreak.com/exhibition-at-techshare-india/.

Thurston, James. Public Policy & Digital Inclusion in Brazil", *Global Initiative for Inclusive ICTs*. 20 September 2017. Available from http://buyict4all.org/blog/public-policy-digital-inclusion-in-brazil.

United Nations. *Accessibility and Development: Mainstreaming Disability in the Post-2015 Development Agenda*. New York, 2015. Available from http://www.un.org/disabilities/documents/accessibility_and_development.pdf.

United Nations. Convention on the Rights of Persons with Disabilities. Available from https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities.html.

United Nations. Standard Rules on the Equalization of Opportunities for Persons with Disabilities. Available from https://www.un.org/development/desa/disabilities/standard-rules-on-the-equalization-of-opportunities-for-persons-with-disabilities.html.

United Nations. World Programme of Action Concerning Disabled Persons. Available from https://www.un.org/development/desa/disabilities/resources/world-programme-of-action-concerning-disabled-persons.html.

United Nations Department of Economic and Social Affairs. *Global Status Report on Disability and Development Prototype 2015*. New York, 2015. Available from http://www.un.org/esa/socdev/documents/disability/2016/GlobalStatusReportonDisabilityandDevelopment.pdf.

United Nations General Assembly, Seventieth Session, 70/1. Transforming our world: the 2030 Agenda for Sustainable Development (A/RES/70/1), 21 October 2015. Available from http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E.

Wear Works. Wayband. Available from https://www.wear.works/wayband-product.

Wiklund, Michael E. Human Factors Standards for Medical Devices Promote Accessibility. In *Medical Instrumentation: Accessibility and Usability Considerations*, Jack M. Winters and Molly Follette Story, eds. Boca Raton: CRC Press, 2006.

World Health Organization. *Towards a Common Language for Functioning, Disability and Health: ICF – The International Classification of Functioning, Disability and Health*. Geneva, 2002. Available from http://www.who.int/classifications/icf/training/icfbeginnersguide.pdf.

World Health Organization. *World Report on Disability*. Geneva, 2011. Available from http://www.who.int/disabilities/world_report/2011/report/en/.

World Health Organization. Disability and Health Fact Sheet. November 2017. Available from http://www.who.int/mediacentre/factsheets/fs352/en/.

Zero Project. South Africa's equal access for Members of Parliament. Available from https://zeroproject.org/policy/south-africa/.

Zielinski, Dave. New assistive technologies aid employees with disabilities. *Society for Human Resource Management*, 20 December 2016. Available from https://www.shrm.org/resourcesandtools/hr-topics/technology/pages/new-assistive-technologies-aid-employees-with-disabilities.aspx.

Glossary

Activity limitations : A difficulty encountered by an individual in executing a task or action.

Assistive technology : Any item, piece of equipment or product, whether it is acquired commercially, modified or customized, that is used to increase, maintain or improve the functional capabilities of individuals with disabilities.

Decent work : Work that sums up the aspirations of people in their working lives.

Disability : An umbrella term for impairments, activity limitations and participation restrictions.

Impairments : A problem in body function or structure.

Participation restrictions : A problem experienced by an individual in involvement in life situations.

Prosthetic : An artificial substitute or replacement of a part of the body.

Universal design : The concept of designing all products and the built environment to be aesthetic and usable to the greatest extent possible by everyone, regardless of their age, ability or status in life.

Acronyms

ADA	Americans with Disabilities Act
ICT	Information and Communication Technology
UNCRPD	United Nations Convention on the Rights of Persons with Disabilities
WCAG	Web Content Accessibility

APCICT/ESCAP

Asian and Pacific Training Centre for Information
and Communication Technology for Development
5th Floor G-Tower, 175 Art center daero,
Yeonsu-gu, Incheon City, Republic of Korea

www.unapcict.org