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BACKGROUND PAPER

Digital Dividends

Bridging the Disability Divide through Digital Technologies

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Bridging the disability divide through digital technologies

Background Paper for the 2016 World Development Report: *Digital Dividends*[1]

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[1] The 2016 World Development Report (WDR) will explore the impact internet and digital technologies have on development. As the World Bank's flagship annual publication, the WDR is an influential guide to the economic, social, and environmental state of the world today. Learn more at http://www.worldbank.org/en/publication/wdr2016.

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Abstract

The exclusion and marginalization of persons with disabilities is a human rights issue as well as an economic issue for countries. Digital technologies break traditional barriers to communication, interaction, and access to information for persons with disabilities. The confluence of increasing public and private service provision through Information and Communication Technology (ICT) and the growing number of mainstream, everyday ICTs that can be used as accessible devices is changing the paradigm of technology-enabled development for persons with disabilities. This paper provides an overview of the opportunities presented by the internet and ICT for the full participation of persons with disabilities. Accessible ICT can level the playing field for persons with disabilities across life domains including education, employment, e-governance and civic participation, financial inclusion, and disaster management. However, earlier divides may persist and new divides may be created when ICT-enabled development is not accessible to persons with disabilities, leading to an uneven distribution of benefits. This paper reviews the main challenges to the realization of ICT-enabled inclusive development and presents cost-beneficial policy and practice recommendations for governments and development practitioners.

Introduction

There is an often-cited quote by Mary Pat Radabaugh, formerly with the IBM National Support Center for Persons with Disabilities, that sums up the importance of technology in the empowerment of persons with disabilities (National Council on Disability 1993),

> For most people, technology makes things easier. For people with disabilities, technology makes things possible.

The exclusion and marginalization of persons with disabilities is a human rights issue as well as an economic issue for countries. When a significant section of society, estimated at 15 percent of the world's population, faces obstacles in receiving an education, transitioning into the labor market, and becoming economically self-sufficient, it not only undermines their rights and dignity but adds significantly to a country's welfare burden (WHO and World Bank 2011).

Information and Communication Technology (ICT) is increasingly enabling persons with disabilities to level the playing field in access to lifelong education, skills development, and employment (Broadband Commission for Digital Development et al. 2013). The confluence of two major trends is reshaping the paradigm on using technology to promote inclusion and full participation of persons with disabilities.

The first is that the Internet and Information and Communication Technology (ICT) are becoming common and popular channels for the delivery and implementation of governance, welfare, socioeconomic development, and human rights programming (Samant, Matter, and Harniss 2012). They are transforming pathways to poverty reduction by enabling direct interactions between producers and markets globally, new methods of delivering personalized public and social services quickly, different channels for income generation, and innovations in asset accumulation and

access to finance (Omole 2013; Spence and Smith 2010). The internet also enables multiple channels to access and contribute information, with a global reach, which can improve transparency, accountability, and monitoring of development programs and services. Multiple delivery channels are being used for communication and service delivery including email, text messaging, voice communications, and video.

The second is that a growing number of mainstream, everyday ICT such as mobile devices and desktop computers increasingly offer functionalities that facilitate communication and information access for persons with disabilities. Features such as text-to-speech and voice recognition, ability to change contrast and color schemes, touch and gesture input, and screen magnification which in the past required specialized standalone software and hardware are embedded within off-the-shelf ICT devices. Digital technologies enable persons with disabilities to receive information and content in the format that they can perceive and prefer. For example, a person with visual impairments can use speech-to-text functionality or software to read a website, a person with hearing impairments can use SMS or instant text messaging to communicate, and a person with mobility impairments can use voice recognition to operate and navigate their digital device.

This presents an important opportunity to break the traditional barriers of communication and interaction that persons with disabilities face and which hinder their full participation in society. A recent survey of 150 experts from over 55 countries ranked websites and mobile devices and services as the technologies that can contribute the most to the social and economic inclusion of persons with disabilities (Broadband Commission for Digital Development et al. 2013). The experts also perceived the highest impact of ICT for individuals with disabilities to be on independent living, employment, education, and access to government services.

However, the advancements in technology are insufficient by themselves to bridge the gaps in the socioeconomic inclusion of persons with disabilities. The adaptation, operationalization, and implementation of ICT for inclusive development remains dependent on others factors within the ecosystem (Samant, Matter, and Harniss 2012). Existing evidence shows that the success of using the internet and ICT for the inclusion of persons with disabilities is heavily impacted by stakeholders' knowledge and awareness of the ICT solutions available, laws and policies, and the capacity of various stakeholders to support accessible ICT services (Samant, Matter, and Harniss 2012). In fact, the use of the internet and ICT can widen the disparities between persons with and without disabilities if they are not designed to be accessible and inclusive.

This paper provides an overview of the opportunities presented by the internet and ICT for the full participation of persons with disabilities. Accessible ICT can level the playing field for persons with disabilities across life domains including education, employment, e-governance and civic participation, financial inclusion, and disaster management. However, earlier divides may persist and new divides may be created when ICT-enabled development is not accessible to persons with disabilities, leading to an uneven distribution of benefits. The paper also reviews the main

challenges to the realization of ICT-enabled inclusive development and presents cost-beneficial policy and practice recommendations for governments and development practitioners.

Understanding the disability divide

Over a billion people globally, approximately 15 percent of the world's population, have disabilities and 80 percent of them live in developing countries (WHO and World Bank 2011). Individuals can experience different types of disabilities including visual, hearing, speech, mobility, cognitive, and psychosocial. Individuals also experience the onset of disabilities as they age. Almost 12 percent of the world's population is over the age of 60; that figure will be over 20 percent by 2050 (UN Department of Social and Economic Affairs 2013).

Children with disabilities attend and complete primary and secondary education at lower rates than children without disabilities (UNICEF 2013), and the gaps are as high as 40 to 60 percent in low and middle income countries such as Cambodia, Bolivia, and Indonesia (WHO and World Bank 2011). Estimates suggest that almost a third of the children who do not receive a primary education have disabilities (Human Rights Watch 2012). This further limits their opportunities for employment as they transition to adulthood.

The employment rates of persons with disabilities are a third to half of the rates for persons without disabilities, with unemployment rates as high as 80 to 90 percent in some countries (including developed and developing economies) (Mizunoya and Mitra 2012; UN Enable, n.d.). Individuals with disabilities also face higher rates of multidimensional poverty as compared to persons without disabilities (Mitra, Posarac, and Vick 2013). The relationship between income and disability can be complex, and gaps in the economic well-being of persons with and without disabilities can be significantly higher in middle income countries than low income countries (Mitra, Posarac, and Vick 2013). Lower educational attainment and lower productivity in a workplace that is not adapted to be accessible impacts the earning potential of an individual with a disability and results in wage disparity as compared to individuals without disabilities (Longhi, Nicoletti, and Platt 2010).

A high unemployment rate for persons with disabilities increases a country's expenditure on welfare which is in fact counter-productive to their social inclusion and economic self-sufficiency (Burkhauser and Daly 2011; Etherington and Ingold 2012; OECD 2010). Ripple effects can also impact the earning capacity of other household members, mostly women, who serve as primary caregivers for children and youth that are unable to go to school. Studies on vulnerability risks show that factors of low education and economic well-being, dependence on social and welfare services, and low civic and political capital raise the risks of marginalization in receiving other important services including disaster and emergency management, healthcare, and asset accumulation (Hoogeveen et al. 2005; Samant Raja and Narasimhan 2013).

The physical inaccessibility of "brick and mortar" and "pen and paper" based educational, employment, information, and social environments has been one of the primary factors for the

marginalization of persons with disabilities. Everything from being able to travel to and enter a school or work site, perceiving and understanding what is written on the blackboard, hearing, understanding, and communicating with teachers, managers, clients, and peers, accessing paper and print based content, and recreation and socialization can become a barrier.

The use of technology in the empowerment of persons with disabilities is not new. Specialized assistive and adaptive technologies such as screen reading software, magnification devices, augmentative and alternative communication (AAC) devices that aid persons with difficulties in verbal communications, and telecommunication relay devices have been used to promote independence and participation. However, persons with disabilities in low and middle income countries face significant challenges in acquiring assistive devices such as the cost and availability of standalone, specialized equipment (WHO and World Bank 2011). The cost of assistive technologies can be a barrier to their use in promoting the independent living, education, and employment of persons with disabilities in low and middle income countries which have lower state funding to facilitate the acquisition of assistive technology (Broadband Commission for Digital Development et al. 2013).

The ICT opportunity for persons with disabilities

ICT enables the use of multiple means of communication - voice, text, and gestures - to access information and engage with others, and hence can help to address longstanding barriers of communication and interaction. ICT is clearly identified as an enabler in the Convention on the Rights of Persons with Disabilities (2006) (hereafter the CRPD), the first human rights treaty specifically addressing the rights and needs of persons with disabilities (Lord, Samant Raja and Blanck, 2012). The CRPD which came into force in 2007, has been ratified by 152 countries as of March 12, 2015 (UN Enable 2015).

The Convention (2006) consistently brings up the role of ICT in promoting the independence and full participation of persons with disabilities across life domains, and requires States Parties to make concerted efforts and investments to advance access to ICT. ICT is an important enabler of accessibility to systems and services (Article 9), access information and uphold freedom of expression and opinion (Article 21), and meaningful habilitation and rehabilitation (Article 26). Articles on access to justice, rights to political participation, education, health, and employment all raise the need of affordable and accessible technology to realize the rights of persons with disabilities.

ICT is a disruptive force in enabling the inclusion of persons with disabilities due to a number of characteristics and benefits as discussed below.

Multiple channels to access content and communicate

Major barrier to inclusion: When traditional written or verbal communications are the only forms of communication available, they can be completely inaccessible to persons depending on type of disability.

How ICT can help: Individuals can use the form of communication that works for them—voice, text, video—to understand and contribute information in face to face or remote interactions.

ICT enables content creation and delivery in multiple formats through multiple media. Public and private service providers are using multiple communication channels simultaneously to connect with consumers including SMS, voice, websites with multimedia, social media, and mobile apps (Andes and Castro 2010; Broadband Commission for Digital Development et al. 2013). Persons with disabilities are accessing content through television and radio, landline telephones, cellular and mobile audio telephony, text messaging/SMS, websites, email, instant messaging over the internet, Voice over Internet Protocol services, web conferencing, and social media. The growing demand for services through multiple communication channels by consumers with and without disabilities is resulting in greater readiness and effort on the part of service providers to facilitate the use of a number of channels for communication.

When multiple modes of communication are available, an individual with a disability can choose the one most suited for their functionality without additional financial burden on the demand or supply side. The most prominent example of this is how SMS and online text formats were adopted for communication by persons with hearing disabilities (Andes and Castro 2010; Pilling and Barrett 2007; Power and Power 2004). The popularity of SMS in addition to voice services over mobile networks radically changed how persons with hearing and speech disabilities could communicate over mainstream communication channels. Many cellular service providers around the world now offer text-only plans for persons with hearing impairments. The adoption of online instant messaging at work and in social communications served a similar role in leveling the playing field for persons with hearing and speech disabilities.

Table 1 offers a snapshot of how the main barriers that persons with different disabilities face and examples of ICT solutions that address those barriers.

Table 1: Barriers to participation by disability type and relevant ICT solutions

Disability Category	Examples of barriers in social, economic, and community participation	Examples of accessible technology solutions
Visual Disability **Includes total blindness or low vision**	• Reading print (e.g., textbooks, instructions, documents) and writing (e.g., signing checks, legal documents) • Accessing visual information in print or audiovisual media (for example, warnings and information in text scrolls on television). • Navigating new surroundings when all signage is in text.	• Text-to-speech rendition and speech/voice output • Braille displays • Screen and text magnification • Voice recognition • Audio description of graphic and visual media • Electronic audio signage • GPS-facilitated navigation • Optical character or image recognition • Changing screen brightness, color contrast
Hearing disability **Total or partial hearing loss**	• Hearing lessons, warnings, and other auditory information in person or over audio media such as the radio or television. • Communicating with others including educators, peers and colleagues, clients, first responders, government personnel, and others.	• Closed and open captioning, subtitles for videos, TV programming • SMS, text messaging • Text Telephone or Telecommunication Device for the Deaf (TTY/TDD) which allow text messaging over the phone line • Telecommunications Relay Services which allow text to speck conversions through an operator • Use of vibrations/text alerts instead of audio alerts
Speech impairments	• Communicating with others including educators, peers and colleagues, clients, first responders, government personnel, and others.	• SMS, text messaging • Synthesized voice output, text to speech functionality • Use of virtual picture board and communication solutions
Physical Disability **Loss of mobility, dexterity, and control over some body functions.**	• Entering, navigating, and using buildings, classrooms, and other physical spaces. • Using writing tools such as pens and pencils, keyboards, mouse.	• Voice recognition systems • Adapted and virtual keyboards • Joysticks and adapted mouse • Use of eye-gaze and gestures to control devices • Remote and online access to work, education, and other services
Cognitive Disability **Includes a range of conditions which may impact a person's memory, thinking and problem-solving, visual, math,**	• Difficulty understanding, remembering, or following instructions. • Difficult in comprehending textual information.	• Text-to-speech rendition and speech/voice output • Touch screen devices • Mobile apps and online resources that mimic Augmentative and Alternative

Disability Category	Examples of barriers in social, economic, and community participation	Examples of accessible technology solutions
reading and language comprehension, ability to pay attention or follow instructions. Examples of underlying conditions are traumatic brain injury, learning disabilities, down syndrome, autism, cerebral palsy.	• May occur together with other limitations such as speech impairments or trouble with hand grip and movements. • Difficulty in communicating or expressing thoughts and ideas.	Communication (AAC) devices, electronic picture boards for communication • Organization and memory aid tools such as online calendars, note taking, alerts • GPS-facilitated navigation • Use of multimedia to aid comprehension e.g., videos, graphics
Psychosocial Disability	• Need for flexible schedules • Difficulty understanding, remembering, or following instructions. • Inability to react and make appropriate decisions following information or instructions. • Difficulty in communicating or expressing thoughts and ideas.	• Use of online communication, documentation, work tools to aid with flexible scheduling • Organization and memory aid tools such as online calendars, note taking, alerts

Availability and Affordability

Major barrier to inclusion: Specialized, standalone, assistive technology used to increase, maintain, or improve the functional capabilities of individuals with disabilities can be cost-prohibitive for persons with disabilities without external financial supports or subsidies.

How ICT can help: Accessible functionalities in mainstream, off-the-shelf, ICT are rapidly reducing the cost barriers to technology solutions for persons with disabilities, while becoming attractive features for all users irrespective of disability.

The rapid developments in digital technologies have been a disruptive force in the field of assistive and adaptive technology because they have brought many of these specialized functionalities within the domain of general consumer and personal technology. The most important impact of this development has been on the cost and availability of accessible technology for persons with disabilities.

Take the example of specialized augmentative and alternative communication (AAC) devices that aid persons who have difficulty with verbal communication such as those with intellectual or cognitive disabilities. AAC devices can cost in the range of US$6,000 in developed economies. When sold at similar price tags in low and middle income countries, they remain out of reach for a large number of persons with disabilities. Smart devices such as the iPad and Android based tablets can be configured to offer similar functionality with the combination of in-built

accessibility features and free or paid mobile applications. Even with the use of costly, high-end apps on a smart device, the total cost could come down by over US$5,000 (Foley and Ferri 2012).[2]

Both Microsoft Windows and Mac OS come with in-built accessibility settings that a user can activate including text-to-speech, voice recognition, preferences for mouse and keyboard navigation, contrast settings, and magnification. These are at no extra cost beyond the cost of the operating system. Since 2014, individuals with a license for Microsoft Office 2010 and higher or a subscription of Office 365 can download Window-Eyes, a leading screen reader, for free (GW Micro 2014).

Open source assistive technology software packages are also available which offer quality alternatives to high prices assistive software, such as the open source software such as the NVDA open source screen reader which is also available in 43 languages in addition to English (NV Access, 2015). There are several initiatives exploring the use of cloud computing to deliver assistive technology, and accessible content and services at low costs to persons with disabilities. For example, LucyTech (2011) offers assistive technology (AT) on the cloud to help lower the cost of purchasing a license by distributing ownership over a larger user base. AT on the cloud also removes the constraint of requiring assistive software on every personal computer, and allowing its use on any public access computer that can connect to the internet. The Global Public Inclusive Infrastructure (GPII, 2011) is another initiative to use the cloud to store user interface preferences, such that any ICT device connected to the cloud can "change to fit users rather than requiring users to figure out how to adapt, configure or install access features they need."

When commonly used digital technologies such as the smartphone offer accessible features, they also help to lower the "othering" of employees or students with disabilities (Foley and Ferri 2012). In fact, persons without disabilities are demanding accessible functionality on their devices at home, school, and work (Kemp and Macsata 2014). Accessible ICT features also benefit many persons who may not identify as having a disability, including senior citizens, people with low literacy, and people who may not know the dominant language.

There is an app for everything

Barrier to inclusion: Many persons with disabilities will need more than one type of assistive technology solution to enhance their independent living and socioeconomic participation.

How ICT can help: The growing number of apps and web-enabled services make it possible to bundle and access multiple assistive features within a single or limited number of devices thus increasing affordability, efficiency, and portability.

There is also growing consumer choice in the app market at all price points. There are apps to aid with memory and organization, control smart devices in the home, note taking, object recognition

[2] It is important to note that new ICT cannot replace assistive and adaptive technology for every single user and some will continue to need specialized equipment.

including currency, recording personal information to use in case of an emergency, and reaching for assistance in case of need. Apps such as TapTapSee assist users with visual disabilities in recognizing objects by taking a photo and identifying it through a database of crowdsourced images. There are apps to scan barcodes and identify the product, read aloud menus through optical character recognition, and pull up Braille keyboards.

There are apps to aid individuals that are non-verbal to use icons, images, and storyboards to communicate. Apps can assist individuals with hearing disabilities by providing instant captions for audio content including phone calls, voice amplification, video calling, and converting audio alerts into text. There are educational apps that focus on assisting students with learning disabilities in learning and working on math, composition, and reading.

Innovations are not limited to mobile apps. For example, many web-enabled services offer targeted assistance for individuals with disabilities such as remote live captioning for meetings and webinars, remote sign language interpretation, and video relay where a sign language interpreter assists in the communication between individuals with and without hearing disabilities. Crowdsourcing platforms offer new opportunities for persons with disabilities to learn and inform others about accessibility of restaurants, hotels, tourist destinations, and other public sites.

This continues the role of ICT as disruptive technology in the field of assistive and adaptive ICT as it not only changes the form in which people can access this technology, but it also serves as a catalyst for innovative and multi-functional apps that would have been difficult to offer previously.

ICT for inclusive development

This section offers an overview of how ICT can facilitate disability inclusion in some of the most crucial areas in development programming: education, employment, access to governance and civic participation, financial inclusion, and disaster management. These serve as examples of the wide application of ICT in driving the inclusion of persons with disabilities.

Education and Literacy

Education is a precursor to economic empowerment. E-learning and online education are now viewed as a mature market, having moved beyond experimentation and gaining credibility among consumers (Gallagher and LaBrie 2012). Web 2.0 tools for learning benefit students with and without disabilities. ICT is being used to offer differentiated instructions and learning by adapting content and process to meet a student’s readiness level (Bender 2012). This is exactly what is required to offer a rich learning experience for students with disabilities. Figure 1 depicts the different ways in which ICT can support the educational participation of students with disabilities.

There are numerous examples in literature of ICTs driving learning and literacy for students with disabilities (Starcic and Bagon 2014; Trucano 2005). The World Bank and the Republic of Tunisia's Ministry of Social Affairs, Solidarity and Tunisians Abroad collaborated on the e-Disabled Project which used ICT to improve literacy and social inclusion of students with

disabilities in Tunisia. The project facilitated the provision of assistive and accessible software in school computer labs, and funded 24 centers throughout the country that offered a range of accessible ICTs including touch screen devices, magnification software, text-to-speech, and sign language translation software (World Bank 2008).

Several special educators and assistive technology specialists that work with students with disabilities see a tremendous overlap between *assistive* solutions and general educational tools and software designed (Bocconi and Ott, n.d.; Marino 2009; O'Connell, Freed, and Rothberg 2010; Puckett 2011). Some of the most renowned conferences in the field of assistive technology nowadays dedicate many sessions to the effective and efficient use of computers, tablets, apps, smartphones, and web services as aids for students with disabilities in the classroom.

Educators are using a range of ICT to enhance learning for students with disabilities including electronic whiteboards, recording and uploading lectures, task organization and categorization, memory tools and aids, (O'Connell, Freed, and Rothberg 2010). If a classroom has access to regular ICT tools, a platform for inclusion is already there. Both Windows and Mac OS have in-built accessibility features such as text-to-speech, using voice commands, non-use or improved use of a mouse or external keyboard, magnification, text alerts instead of voice alerts. Electronic interactive whiteboards can be used effectively as a means to engage students with different learning needs, actively include students with disabilities in sessions where students are called upon for an exercise on the board, and facilitate collaboration and group learning between peers with and without disabilities (Allsopp et al. 2012; Gioia and Daniels, n.d.; Mead 2012).

Accessible learning content is now easier to create and disseminate. Web-based bulletin boards and knowledge management platforms, electronic documents, e-books, and audio books offer important alternatives to the rigidity imposed by traditional print-based and handwritten forms of learning and expression. E-publishing formats such as the DAISY format have been specifically developed to ensure that e-books are accessible by users' assistive technology (Watkins 2014). Learning is also aided by presenting materials in various formats including video and graphics and this again facilitates the principle of differentiated instruction that benefits students with and without disabilities.

Smart devices such as tablets are also important tools for inclusive education (Shah 2011; O'Connell, Freed, and Rothberg 2010). Beyond their embedded accessibility features, a large number of apps are available, and growing in number, to assist students with disabilities in accessing and understanding complex subjects such as math and science , aiding them in following lessons through audio recording, electronic note taking, and apps that work as memory tools and help with organization (Watkins 2014). The growing number of rigorous and accredited distance education programs is another avenue to promote greater access to educational opportunities for students with disabilities (Myhill et al. 2007).

Figure 1: How ICT addresses barriers to participation in education for persons with disabilities

Employment and Income Generation

ICT is becoming a key driver for the successful employment of persons with disabilities due to its permeation and proliferation of ICT in the world of work. ICT has changed how people build their skills, how they search for work, how they do their work, how they interact with coworkers and clients, and how they receive and use benefits in the workplace (Raja et al. 2013). Email, websites, social media, and web-enabled multimedia content and communication are mainstays in the workplace. Work processes are increasingly shifting online with the adoption of cloud-based content management and document sharing, software applications, internet-based audio and video communications, and remote collaboration platforms.

The internet and digital technologies are also changing how entrepreneurs, people who are self-employed, and free-lancers are raising capital, finding clients, and selling services. This also means that if persons with disabilities are unable to access these technologies, they will be further disadvantaged in the digital workplace (Partnership on Employment & Accessible Technology 2014). Empowering persons with disabilities to compete in the increasingly digital work environment will thus require that they have access to accessible ICTs as well as opportunities to learn and build ICT skills (Samant Raja et al. 2014). Figure 2 depicts the different ways in which ICT can address barriers to labor market participation for persons with disabilities.

ICT can help to level the playing field for persons with disabilities at all stages of the employment life cycle—hiring, retention, and promotion. People may acquire disabilities at later stages in their employment life. People are also staying in the workforce for longer, and may experience age-related onset of disabilities. Ensuring their continued employment is a matter of economic benefit to the employer as well as the employee.

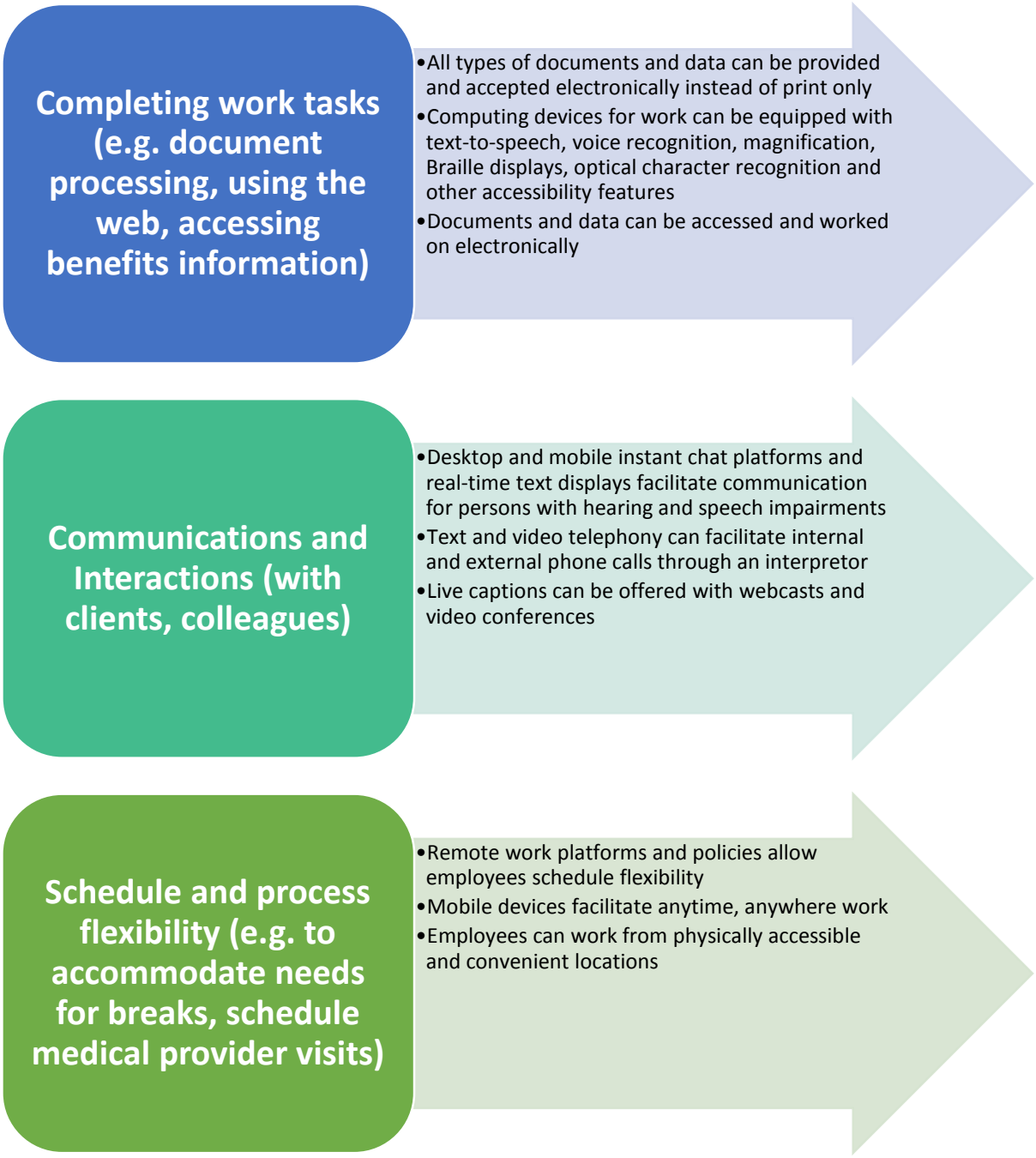
Many persons with disabilities pursue self-employment due to the barriers of getting jobs in the competitive labor market. The internet and digital technologies are changing the field of self-employment and entrepreneurship through online work and micro-work sites such as oDesk, Elance, and Amazon Mechanical Turk. Individuals with disabilities now have a wider opportunity to find and interact with clients, and sell their goods and services across physical and infrastructural obstacles. The growing recognition of telework and remote distributed work through the internet as feasible and productive ways to work can facilitate a more inclusive work environment for employees with disabilities requiring schedule flexibility and alternative work arrangements.

Persons with disabilities, especially those with intellectual disabilities, also work in sheltered workshops that pay below minimum wages. The work involved usually is only at the apprenticeship level with few to no opportunities to play a management, sales, or other executive roles within the workshop or transition to the open labor market (ARUNIM 2014). Sheltered workshops grew out of the perception that persons with certain types or severity of disability could not work independently or meet the demands of competitive jobs but could be engaged and permanently placed in less demanding vocational activities. The advancements in ICT and the

number of apps and solutions that support persons with cognitive and intellectual disabilities challenge these notions and offer a pathway out of such sheltered settings.

Technology and work skillsets to participate in an ICT-enabled economy will change over time. Hence persons with disabilities should be able to participate in continuing education and ongoing reskilling opportunities in equality with their peers without disabilities (Samant Raja et al. 2014).

Figure 2: How ICT addresses barriers to labor market participation for persons with disabilities



E-governance and civic participation

The realization and exercise of human rights and citizenship is deeply intertwined with one's ability to participate in elections, engage in civic discourse, access governance, and obtain information on political and civic processes. Persons with disabilities have been deeply disenfranchised due to infrastructural barriers which impact their ability to engage in civic and electoral processes independently or privately (Lord, Stein, and Fiala-Butora 2014).

Electronic voting machines and processes can enable persons with disabilities to cast their votes, and do so in private and independently. Electronic voting machines can have Braille lettering, voice output to navigate instructions and candidate names, and touch screens (Davies 2012; Wildermuth 2006). The internet is also a prominent channel for dissemination of information on political campaigning and messaging. Persons with disabilities make use of new media to access information on political campaigns and processes.

Accessible e-governance is also important to ensure civic and social inclusion of persons with disabilities. Increasing transition of government services, records, and paperwork to digital formats can promote independent and autonomous interface with government services and offices. Government websites, social media, and crowdsourcing platforms have become important sources of information for persons with disabilities and need to be designed using accessibility principles (Bricout and Baker 2012; Infocomm Development Authority of Singapore 2013; Suomi and Krebs 2012). Greater use of digital technologies to offer government services including SMS, mobile apps, accessible web-based forms, and web portals can address varying communication needs and preferences while enabling interaction between the government and citizens with disabilities.

Financial Inclusion

The use of technology in the delivery of financial services through traditional banking and alternative services such as microfinance is heralded for its potential to reach out to many marginalized groups that remain unbanked and outside the consumer finance market. A majority of persons with disabilities have been unable to bank autonomously and independently because of a combination of physical constraints in accessing financial institutions and services and misperceptions about their inability to handle personal finances (G3ict 2015). The delivery of financial services was also predominantly paper based before the growing adoption of technology-enabled banking. Now it is easier to offer services to persons across the spectrum of disabilities using internet banking, phone banking, mobile banking, and ATMs and kiosks.

An upcoming report from the Global Initiative for Inclusive ICTs (G3ict 2015) on the use of technology for financial inclusion for seniors and persons with disabilities catalogues how all forms of ICT-enabled banking can be made accessible and inclusive of users with varying needs and preferences. Some effective practices from the report are shared below:

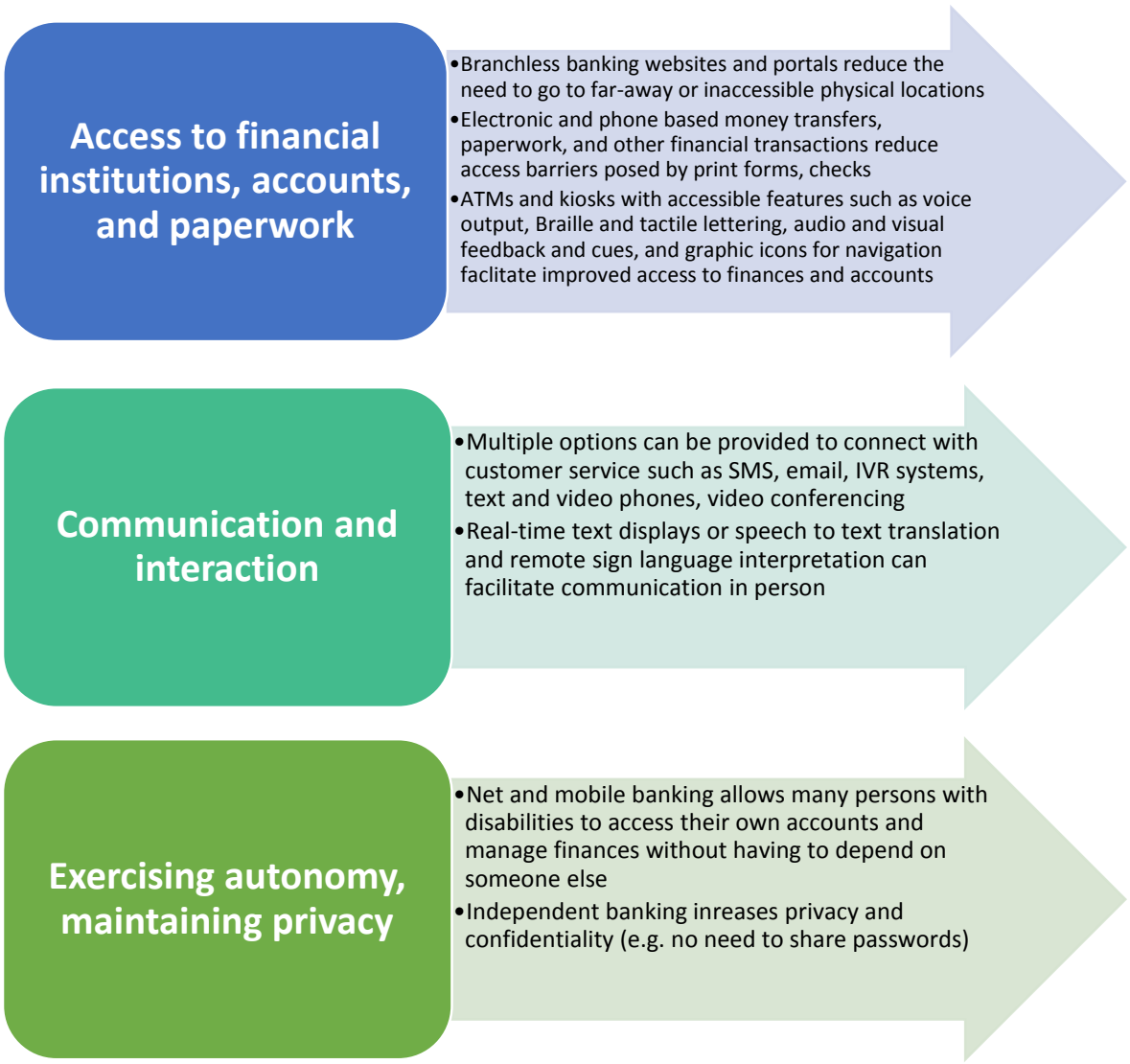
- ATMs can be equipped with voice output, touch screen navigation, Braille and tactile lettering, audio and visual feedback and cues, and graphic icons for navigation can benefit

persons with varying disabilities, as well as individuals with low literacy and language limitations.

- Accessible internet banking through websites and web portals allow persons with disabilities and others to operate their finances when a physical visit to a Bank branch is difficult.
- Financial institutions can offer multiple ways to contact customer service including email, IVR systems, SMS, telephone relay, and video conferencing.

Figure 3 depicts the different ways in which ICT can support the financial inclusion of persons with disabilities.

Figure 3 How ICT addresses barriers to financial inclusion for persons with disabilities



A survey of 13 international financial institutions by G3ict and Scotiabank in different countries revealed that banks are undertaking efforts to make their services accessible to persons with

difference disabilities such as visual and print disabilities (59 percent), hearing disabilities (51 percent), physical disabilities (49 percent), and speech disabilities (47 percent) (G3ict 2015). The survey revealed a gap in addressing the needs of persons with cognitive or learning disabilities. Table 2 depicts the extent of accessibility across services for different types of disabilities.

Table 2 Results from G3ict Financial Services Survey on the accessibility of different ICT services in multiple countries (Source: G3ict Financial Inclusion Survey, G3ict 2015)

Technology-enabled banking service	Visual or print disability	Hearing disability	Speech disability	Physical disability	Cognitive or learning disability	Other
Branch banking	50%	25%	25%	67%	33%	17%
Online (web) banking	80%	40%	50%	50%	20%	20%
Kiosks and payment terminals	60%	50%	40%	40%	20%	20%
Phone banking	80%	40%	20%	60%	20%	20%
Mobile banking	60%	60%	60%	30%	20%	20%
Digital wallet	33%	33%	33%	33%	33%	50%
Loans	50%	50%	50%	50%	38%	25%
Debit or credit cards	63%	63%	50%	50%	25%	25%
Statements	89%	56%	56%	56%	22%	11%
Investing/trades	44%	56%	44%	33%	22%	22%
Insurance	67%	83%	83%	83%	33%	17%

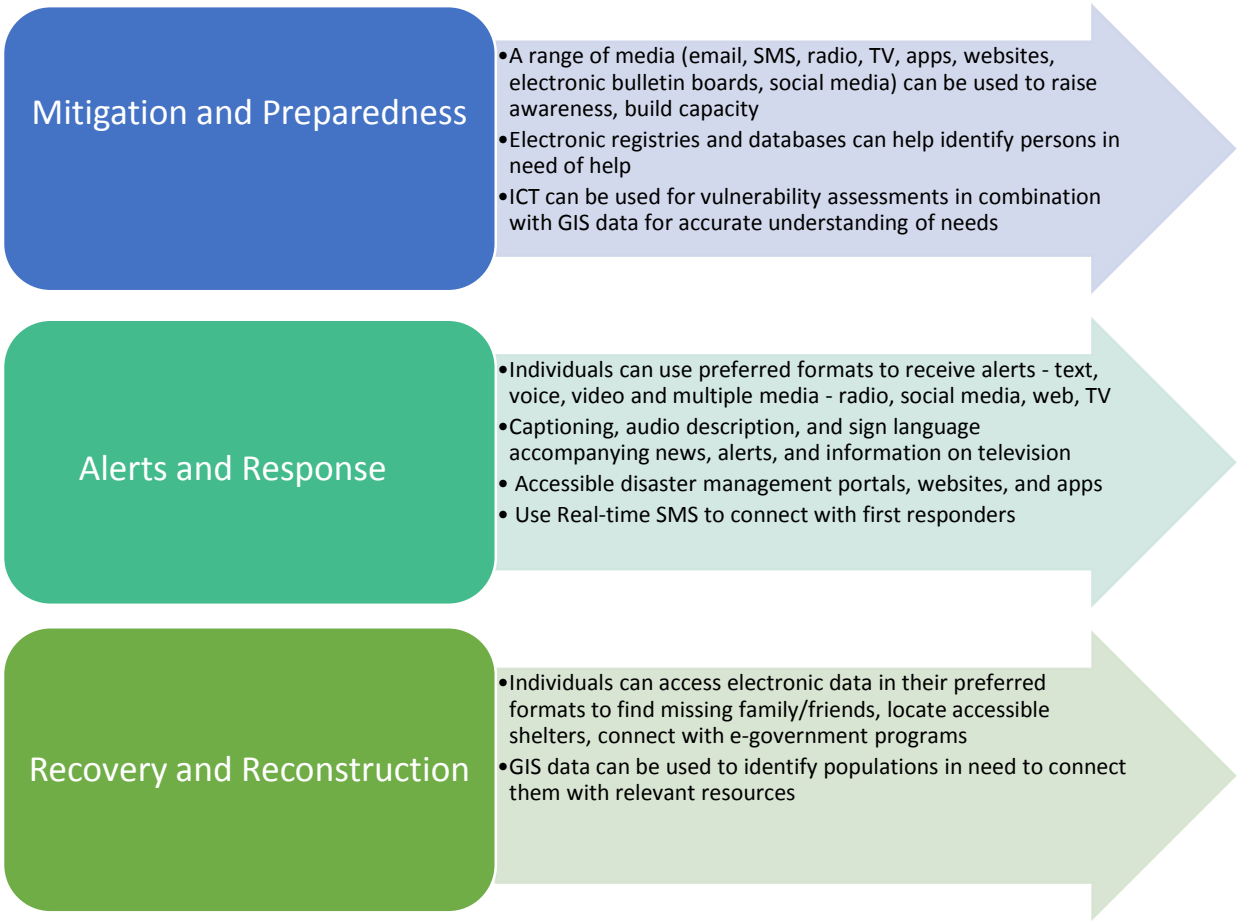
The most important resources to offer accessible services highlighted by the respondents included accessible customer feedback mechanisms (84 percent), published, accessible accommodation processes and services (77 percent), alternative formats for financial statements (for example, Braille, large print, accessible PDFs on request) (77 percent), alternative formats for marketing materials (77 percent), and accessibility requirement in procurement processes (77 percent). Respondents also offered insight into the tools they would invest in to offer more accessible and inclusive services: Communication tools (chat, remote interpreters, captioning) (83 percent), online/web banking (75 percent), Mobile security and authentication (including biometrics) (73 percent), and mobile customer service (73 percent). Other areas included debit and credit cards (64 percent), statements and alternative print materials (64 percent), and accessible employee accommodations (64 percent).

Disaster Management

Access to instant, current, reliable, and relevant information and communication before, during, and after an emergency or disaster situation saves lives and reduces injuries and damage to property. ICTs can improve the capacity of persons with disabilities and their families as well as response personnel, community workers, and disaster management authorities to prepare better, respond quickly, and access disaster relief services more easily.

Figure 4 depicts the different ways in which ICT enhances access to emergency and disaster management services for persons with disabilities.

Figure 4 How ICT facilitates access to emergency and disaster management for persons with disabilities



Electronic registries and databases are being used at local government and community levels to assist responders in identifying individuals who need additional assistance due to disability during a disaster and allocating accessible evacuation and response resources (IFRC 2007; Smith, Jolley and Schmidt 2011). Such registries have to be governed by strong ethical codes to ensure that individuals' privacy is not violated and their confidential data is appropriately used (Samant Raja and Narasimhan 2013). "Big data" practices can analyze passively generated and crowdsourced

internet content in combination with environmental data and social vulnerability assessments to improve targeted and accessible disaster response (IFRC 2013; Georgia Institute of Technology 2014).

Disaster alerts and information can be delivered through multiple media and formats to ensure that persons across the spectrum of disabilities are able to access them: Audio and visual alerts on television accompanied with captions and sign language interpretation, cell broadcasts that generate audio and visual alerts, email and desktop alerts, web based portals and multimedia content, dedicated mobile apps, and social media (Samant Raja and Narasimhan 2013).

Contacting emergency personnel through SMS is one of the most important emerging practices in accessible and inclusive disaster management. This is not only important for people with hearing and speech disabilities, but serves a wider population. In situations of threat to personal security, it may be safer to send a text message than make a vocal call (Samant Raja and Narasimhan 2013). The National Relay Service (2015) in Australia can be used to send a SMS to emergency services. In 2014, the Federal Communications Commission (FCC) in the United States adopted a rule to facilitate the deployment of Text-to-911 services, and while the service is currently available only in locations where the Public Safety Answering Points (PSAPs) are enabled to receive and respond to texts it is expected to be widely available in the near future (FCC 2015).

Challenges in the widespread use of accessible ICTs

There is a visible disconnect between what we know ICT can achieve for persons with disabilities and real life examples of widespread adoption and delivery of accessible ICT. The latest G3ict CRPD 2013 ICT Accessibility Progress Report, which assesses progress towards realizing the ICT dispositions of the Convention, found that a majority of the 76 participating countries did not have accessible government websites (55 percent), accessible public electronic kiosks or ATMs deployed in the country (61 percent), or programs in place to facilitate the usage of telephony by persons with disabilities (74 percent) (G3ict & Disabled Peoples' International 2013). The study assessed the degree of implementation of the ICT accessibility provisions in the CRPD to be 50 percent for specific ICT products and services, 47 percent for accessible features for computers, and 37 percent for accessible telecom and media services.

Technology does not exist in a vacuum, but is influenced by the societal, legislative, personal, and infrastructural factors that surround it. An ecosystem approach helps to analyze how ICT and the other actors, systems, and processes impact each other and how these can be shaped to facilitate accessibility and inclusion for persons with disabilities (Dikter 2011; Samant, Matter and Harniss 2012). This section presents some of the main challenges to the realization of ICT-enabled inclusive development.

Lack of enabling legal and regulatory frameworks

Legislation, regulations, and policies play a very important role in advancing availability, acquisition, and use of accessible ICT. G3ict's survey of 150 experts identified the lack of policy

implementation and/or lack of effective implementation mechanisms and the lack of policies which foster widespread availability of accessible ICTs as two of the three primary challenges to the use of ICT in inclusive education and employment (Broadband Commission for Digital Development et al. 2013).

As discussed above in this paper, the Convention on the Rights of Persons with Disabilities clearly mentions the provision of accessible ICTs to promote the full participation of persons with disabilities. Disability rights and anti-discrimination legislation in most countries will include accessibility requirements, but depending on when these were passed may not specifically include ICT and virtual and digital environments within their purview.

There is a need for supporting governments to undertake measures to improve legislation and policy on ICT accessibility and develop mechanisms to promote and enforce implementation. G3ict's ICT Accessibility Progress Report which surveyed experts in 76 countries captures the use of laws, policies, and regulation to promote ICT accessibility across countries with varying per capita income, as depicted in Table 3 below.

Table 3 Use of laws, policies, and regulation to promote ICT accessibility across countries with varying per capita income

Legal and Regulatory Initiatives	Very High	High	Medium	Low
Define public procurement rules policy promoting accessible ICTs	63%	40%	27%	5%
Definition of accessibility which includes ICTs in the laws	76%	53%	50%	26%
Ensure that government communications to public using ICTs are provided in accessible formats, sign language or Braille	81%	67%	40%	42%
Promote access for persons with disabilities to ICTs and systems	100%	87%	53%	7%

Sources: G3ict CRPD 2013; ICT Accessibility Progress Report, G3ict & DPI, 2014.

Stakeholder awareness, knowledge, and capacity

There is a lack of awareness and knowledge on the full scope of accessible ICT solutions, what already exists, and their affordability and return on investment on both the demand side (persons with disabilities, disability organizations) and supply side (policy makers, designers, developers, development practitioners, service providers) (Broadband Commission for Digital Development et al. 2013; G3ict & ITU 2014).

Many persons with disabilities, their families, and disability service providers, especially in low and middle income countries, are not aware of the range of accessible ICTs available, and how these can be used (Samant, Matter, and Harniss 2012). It is also difficult to keep up with the pace of development in accessible digital tools. New and improved technologies and solutions are constantly emerging (Field and Jette 2007; Vanderheiden 2008).

Government service providers, educators, employers, development practitioners, and the ICT industry need training and sensitization to implement a barrier-free digital environment. The design of digital content is very important and if a service, website, app, or software is not designed correctly, a person with a disability may be unable to use it even with the right technology.

Studies on the use of ICT for students with and without disabilities show that the awareness and knowledge of educators and school personnel is critical for success. In a study of ICT usage by students with disabilities in Norway, Söderström (2012) found that the most important determinants of successful use of ICT for education to be "teachers', school administrations' and collaborative partners' knowledge, competence and attitudes towards technology and disability" (p. 44). A study on inclusive education by the Indian Ministry of Human Resource Development and the National Council of Educational Research and Training found that teachers' attitudes towards students with disabilities and presumptions about their capabilities due to a lack of sensitivity training and resources such as technology severely impacted the students' retention rates and successful learning outcomes (Julka et al. 2014). Even teachers who understand the value of ICT for students with disabilities, may lack sufficient knowledge and competency to design accessible content and support the use of accessible technology for learning (Mavrou 2011; Wong and Cohen 2012).

Increasing awareness about ICT accessibility and building capacity of all relevant stakeholders is hence a priority to increase the proportion of accessible digital content and acquisition of appropriate accessible solutions by persons with disabilities.

Concerns about cost and affordability

Some persons with disabilities will continue to need external assistive technology (AT) to use ICT and access the internet. The cost of specialized AT continues to be high and could limit the impact of web and mobile enabled development programs. AT is predominantly produced in western economies can be very cost-prohibitive when it is sold at western market prices with additional taxes or duties on imported technology. Many families in middle and low income countries cannot afford these technologies without any state funding mechanisms or subsidies in low and middle income countries. Governments can develop different types of financial assistance schemes to offset the cost of assistive technology such as loans and grants to support purchase of assistive and accessible technologies and reduce cost of imported AT by waiving customs duties and fees. Public-private partnerships can promote greater local manufacturing of indigenous AT (Samant, Matter and Harniss 2012).

At times, upfront research and development costs or investments may deter technology developers and providers in ensuring content and device accessibility. For example, prior to the closed captioning mandates for televised programming in the United States, broadcasters were resistant to encoding text captions with the video signal as they felt it was an expensive service of value to a small audience (Samant, Matter, and Harniss 2012). In 2011, the National Association of the Deaf together with other plaintiffs had to file and win a lawsuit to get Netflix to ensure that its

video streaming services have closed captioning (National Association of the Deaf et al. v Netflix 2012). In 2015, Netflix voluntarily agreed to provide audio descriptions on its home production Daredevil about a superhero who is blind, although only after the series became available for general viewing and viewers complained about the lack of access for viewers who are blind (Dornbush 2015). Indian disability rights advocates have had to launch multiple high profile advocacy campaigns to win small victories in making Indian televised content accessible to persons with hearing impairments. The Indian Ministry of Information and Broadcasting provided sign language interpretation of select events of national importance such as the Republic Day parades in 2013 and 2014 on three of the six national television channels ("Channels asked to cover" 2014).

Accessible ICT brings a strong return on investment (RoI) for governments, employers, and technology developers even when upfront costs are high. Accessible ICT also benefits persons with low literacy, language limitations, persons who are aging, children, and is more usable for persons without disabilities. This results in a larger customer base and greater return on investment.

Studies that have explored the return on investment of technology accommodations in the workplace overwhelmingly show that the direct and indirect benefits to the employer almost always outweigh the costs of making the accommodation (Hartnett et al. 2011; Loy 2014; Schur et al. 2014). This is because the cost of absenteeism, lowered productivity, turnover, and loss of organizational memory all affect an employer's bottom line. Studies estimate that the total cost of turnover which includes recruiting a new employee, work disruptions, organizational memory loss, and costs associated with the new employee's learning curve (Allen, Bryant, and Vardaman 2010; Silva and Toledo 2009) could be as much as 150 to 200 percent of the lost employee's salary (Cascio and Boudreau 2011). Recent studies show that most accommodations cost below US$500 (Loy 2014; Milchus, Adya, and Samant 2010).

These findings are mirrored in a recent study with over 2000 employees with and without disabilities and their managers from across the United States, out of which 480 were individuals with disabilities who had requested ICT based accommodations (Samant Raja et al. 2014). Employees with disabilities reported that receiving accessible ICT at their workplace strongly impacted their performance, productivity, efficiency, interactions, and in-turn, their workplace satisfaction. Most respondents reported a high positive impact of the ICT accommodations on their level of productivity (70 percent), level of job performance (78 percent), and likelihood of staying at their company (70 percent). A study of six European countries observed that transitioning persons with disabilities out of welfare dependency and low income sheltered workshops into the labor market with the help of accommodations is much more cost beneficial for governments (Mallender et al. 2015).

Strengthening the ecosystem for accessible ICTs

A comprehensive approach towards facilitating the widespread adoption and use of accessible ICTs requires social, economic, and legal and policy incentives and mandates. Table 4 summarizes

the main challenges to the availability and use of ICTs by persons with disabilities with recommendations for targeted policy and practice actions to operationalize and implement accessible and inclusive ICT solutions.

Table 4 Recommendations for government and development stakeholders to promote ICT accessibility

Identified Barrier	Policy, legal, or regulatory action
Lack of policies which foster widespread availability of accessible ICTs.	• Develop policies to ensure accessibility across types of ICT (i.e., TV/video programming, electronic equipment, mobile telephony, and web content). • Develop technical standards to meet accessibility requirements and promote interoperability with assistive technologies. • Incorporate accessible ICT definitions and language in existing ICT legislation. • Use regulations, including accessibility in licensing conditions and authorizations. • Incorporate ICT accessibility into disability rights and anti-discrimination legislation including education, labor, voting, and other laws.
Lack of policy implementation and/or lack of effective implementation mechanisms	• Modify public procurement rules to mandate accessibility in any ICT purchased by governments or government-funded programs. • Use voluntary measures such as codes of conducts, guidelines, setting up committees to monitor and promote implementation. • Require minimum standards of accessibility in all public ICT services as part of Quality of Service regulations.
Stakeholder awareness, knowledge, and capacity	• Develop and fund disability sensitization, training and technical assistance programs. These are especially needed for teachers and educators, employers, and technology product and content providers (see section below for examples). • Promote accessibility in both technical/engineering and educator (general and special education) training and certification curricula. • Conduct public service campaigns that depict positive images of persons with disabilities and their capability to succeed in education and employment. • Include accessibility as a requirement for licensing and authorizations.
Concerns about cost, return on investment for technology providers	• Promote research including marketing studies on real costs and RoI. • Offer tax incentives and tax credits to employers and technology providers. • Promote public-private partnerships, offer start-up funding, research and development (R&D) grants for increased local development of accessible technology.
Concerns about cost of technology for persons with disabilities and their families	• Offer loans and grants to support purchase of assistive and accessible technologies, reduce cost of imported AT by waiving customs duties and fees. • Include persons with disabilities and elderly as eligible groups for services, subsidies and programs under Universal Service and Universal

Identified Barrier	Policy, legal, or regulatory action
	Access funds. These funds can also be used to promote use of accessible ICT in rural and remote communities. • Promote the development of local, low-cost devices.
Lack of local language ICT solutions	• Promote public-private partnerships, offer start-up funding, research and development (R&D) grants for increased local development of accessible technology. • Support indigenous development of accessible ICT, such as local language text to speech and voice recognition software.
Ensuring accessibility across all development programming	• Modify internal policies to promote mainstreaming of accessibility in all development programming. • Include accessibility as a criterion in the funding, monitoring, and evaluation of all social and economic development programs using ICT solutions.

Improving legislation and policy

Countries can use a variety of hard and soft mechanisms to develop a comprehensive policy framework that facilitate ICT accessibility such as:

- Regulation including accessibility in licensing conditions and authorizations.
- Voluntary measures such as codes of conducts, guidelines, setting up committees to monitor and promote implementation.
- Developing technical standards to meet accessibility requirements and promote interoperability with assistive technologies.
- Incorporating accessible ICT definitions and language in existing ICT legislation.
- Include persons with disabilities and elderly as eligible groups for services, subsidies and programs under Universal Service and Universal Access funds. These funds can also be used to promote use of accessible ICT in rural and remote communities.
- Requiring minimum standards of accessibility in all public ICT services as part of Quality of Service regulations (G3ict & ITU 2014).

G3ict and ITU (2014) have released a model policy framework to aid policy makers in developing policies to ensure the accessibility of TV/video programming, electronic equipment, mobile telephony, and web content.

An evidence based best practice is modifying public procurement rules to mandate accessibility in any ICT equipment, software, and applications purchased by governments or government-funded programs. Procuring accessible electronic and ICT products and services can facilitate the increased employment of persons with disabilities in the government and set a standard of practice for the larger labor market (Astbrink and Tibben 2013). Including accessibility in government purchasing policies is most effective when it is tied to specific accessibility standards that vendors have to meet such as Section 508 of the Rehabilitation Act in the United States and EN 301 549

for the European Union. The government is a large customer with significant purchasing power and demanding accessible ICT solutions from vendors has a ripple effect on the vendors' products for the larger market as well (Astbrink and Tibben 2013).

Many countries are reviewing and amending their laws with respect to the provisions of the CRPD, and the amendments should include language on ICT accessibility. Additionally, laws and policies on non-discrimination and education for all students and employment and labor laws should also include the use of accessible ICTs as reasonable accommodations to break barriers for students and workers with disabilities. Similarly, accessibility should be specifically required in all regulations and policies governing emergency and disaster communications.

Technical assistance and awareness raising

Technical assistance should be easily available to governments, educators, employers, disaster management authorities, private service providers and others.

There are many examples of technical assistance and capacity building programs that can be replicated globally. A highly regarded program is the Job Accommodation Network (JAN) (https://askjan.org/) funded by the U.S. Department of Labor's Office of Disability Employment Policy, which offers a rich knowledge base and direct assistance to employers and employees seeking ideas for accommodating an employee with a disability at the workplace. The Global Accessibility Reporting Initiative (https://www.gari.info/) set up by the Mobile Manufacturers Forum is a web based resource to help consumers learn about the accessibility features of different phones and smart devices as the compatibility of devices with different accessibility apps. The initiative was set up with the goal of assisting a consumer with a disability in finding the right accessible solution.

The Center on Effective Rehabilitation Technology service delivery (CERT) at Syracuse University is designing a web based system to assist rehabilitation service providers in identifying the right technology accommodations including ICT solutions that can assist a person with a disability in getting and retaining a desired employment position (CERT 2014). Similar web based resources can assist persons with disabilities and their families directly. It is especially important to build teacher and educator capacity to include accessible technology solutions within their classrooms and teaching methods. Teachers should have access to resources and practitioners to identify a student's needs and match them with the appropriate technology solutions.

Many developers and designers lack knowledge of accessibility standards such as Section 508 for ICT procured by the US federal government and EN 301 549 which is the first European standard for ICT accessibility, and guidelines such as the W3C's Web Content Accessibility Guidelines which cover web and mobile content and applications (Abu-Doush et al. 2011; Martínez-Normand and Pluke 2014). There are many resources that can aid designers in developing and testing digital content and ICT for accessibility such as web based accessibility checkers for websites (for example the free to use WAVE Web Accessibility Evaluation Tool by WebAIM (available at

http://wave.webaim.org/), which checks web pages for compliance with the WCAG and Section 508), inbuilt accessibility checkers for documents in Microsoft Office and Adobe Acrobat, and services and tools to check the accessibility of mobile apps such as the Accessibility Management Platform (AMP) for Mobile, an automated testing engine for native mobile applications and content (SSB BART Group 2015) and the recently announced Mobile Accessibility Checker by IBM for apps on Android and Apple devices (PR Newswire 2015).

Mainstreaming disability for inclusive development

The most effective way to ensure that development programs do not exclude persons with disabilities is by adopting disability mainstreaming as a matter of policy and practice (UN DESA 2013). Just as it is easier to construct a physical building to be accessible from the initial stages of construction rather than retrofitting, digital accessibility is also most easy and cost effective to achieve when it is considered from the very beginning of a product cycle.

ICT accessibility must be ensured in all public services offered through ICT such as disaster warnings and communications, welfare services, and financial services. Many times, development practitioners may not consider accessibility from the initial stages of providing ICT-enabled programs and initiatives. ICT products and services may be developed without attention to accessibility standards and guidelines which may further exclude many people with disabilities in need of these services.

Participatory approaches to disability-inclusive development can bring in persons with disabilities as collaborators, partners, and advisors on the design and delivery of services (Albert and Harrison, 2006; International Disability and Development Consortium 2012).

Conclusion

The internet and ICT can facilitate the social, economic, and civic participation of persons with disabilities. The use of multiple ICT channels to deliver services and multiple formats for the content delivered can allow persons with different disabilities to access information and communication in the manner in which they can comprehend and prefer. The internet and ICT are becoming a key driver of inclusive development because of their growing pervasiveness in the delivery of public and private services coupled and the increasing ability to use everyday consumer ICT devices as assistive devices.

The internet and ICT are disruptive technologies in the field of assistive and accessible technology. Accessible functionality in mainstream devices, a large market of and for mobile applications, and web enabled accessibility services are driving down costs and leading to innovative uses of ICT across life domains such as education, employment, e-governance and civic participation, financial inclusion, and disaster management.

While the potential of ICT for inclusive development is evident, its realization will require active efforts to realign and shape the societal, legislative, personal, and infrastructural factors within the

ICT ecosystem. There is a significant need to build stakeholder capacity on how ICT benefits persons with disabilities or the large number of affordable and inexpensive accessibility solutions available. This also applies to many persons with disabilities, their families, and disability service providers, especially in low and middle income countries.

The adoption and use of accessible ICT for inclusion is dependent on many actors in the ecosystem including government service providers, educators, employers, development practitioners, and the ICT industry. Efforts should focus on raising their awareness and building their capacity to successfully implement barrier-free digital environments and service provision. It is imperative that ICT enabled development programs become accessible, else the internet and ICT will become another source of marginalization and exclusion for persons with disabilities.

There is an incorrect perception that accessibility is very costly to implement when studies show that it is cost beneficial. The return on investment for governments, country economies, and employers is positive and significant.

Legislation, regulation, and policy is important to drive digital accessibility in a country. Countries can use a combination of "top-down (impose direct obligations on supply side) as well as bottom-up (rights for users/consumers)" to promote accessibility in the production, transmission, and rendering of ICT products and services (Lord, Samant Raja, and Blanck 2012). Governments can also foster innovation and local manufacturing through public-private partnerships to support the creation and delivery of locally and culturally relevant ICT accessibility tools and content. Finally, the principle of mainstreaming is crucial to ensuring that persons with disabilities are not left behind in and because of the digital revolution.

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