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Delivering Together for Inclusive Development:

Digital Access to Information and Knowledge for Persons with Disabilities

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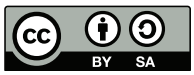

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Delivering Together for Inclusive Development:

Digital Access to Information and Knowledge for Persons with Disabilities

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Executive summary

This report focuses on digital inclusion as it relates to four of the 17 Goals for the 2030 Sustainable Development Agenda:

SDG 9 - Innovation, Industry, and Infrastructure,

SDG 16 - Peace, Justice, and Strong Institutions,

SDG 17 - Partnerships for the Goals,

SDG 4 - Quality Education.

For each of the goals, a number of major challenges and key recommendations are defined.

Finally, general recommendations are given for improving global digital inclusion overall.

Introduction

According to the United Nations, persons with disabilities (PWDs) form the world's largest minority. It is estimated that more than one billion people worldwide – 15 percent of the global population – are living with a disability, 80 percent of whom live in developing countries (World Bank & WHO, 2011).

'Disability' is a broad term which can refer to many different varieties and degrees of impairment, whether they relate to vision, hearing, speech, mobility, cognition, or psychosocial factors. They may be congenital or acquired through illness or injury. Disabilities may also arise with the onset of age, a factor which will become increasingly significant over time as the global population ages. In 2010, an estimated 8 percent of the global population was aged 65 or older; this number is expected to double by 2050, primarily due to declining fertility rates and increased longevity.

Around the world, PWDs face challenges that prevent them from participating in social or economic life equally. They may face inaccessible physical environments, barriers to vital services and information, a lack of basic assistive technologies, and negative societal attitudes towards disability, to name a few. The consequences of such barriers can be severe. Individuals with disabilities face higher poverty rates (Mitra, Posarac, and Vick 2013) and drastically higher unemployment rates – as high as 80-90 percent in some countries, including both developed and developing nations (Mizunoya and Mitra 2012). Disabilities can place heavy financial demands on individuals as well as their families, often contributing to a cycle of poverty as resources and time are strained. Children with disabilities are less likely to receive primary or secondary education (UNICEF 2013), further limiting their opportunities for employment when they reach adulthood. Such disparities tend to be even greater for women, ethnic and racial minorities, citizens in rural or isolated areas, and other marginalized populations.

All this effectively means that PWDs are regularly denied human rights and fundamental freedoms. Accessibility – defined, within the context of this report, as measures that enable equal access for PWDs – must thus be considered a necessary instrument for achieving equal fundamental human rights and freedoms. Duty bearers have an obligation to uphold the rights of all citizens, including citizens with disabilities.

In recent years, a great deal of progress has been made in the area of accessibility. Internationally, one of the most important factors in this shift was the United Nations Convention on the Rights of Persons with Disabilities (CRPD), which took place in 2006. The CRPD highlights the importance of accessibility overall, and also makes specific references to accessibility in information and communication technologies (ICTs). The CRPD addresses the importance of "enabling persons with disabilities to fully enjoy all human rights and fundamental freedoms." Article 9 of the CRPD specifically obliges Member States to take appropriate measures to ensure access to ICTs, including the Internet. However, despite the progress being made, the potential of – and urgent need for – ICTs and assistive technologies (ATs) to assist PWDs often remains overlooked.

In today's digital age, information and communication technologies (ICTs[1]) play a central role in nearly all aspects of life. ICT affects how we work, play, vote, and interact. As a result, digital inclusion will be critical to achieving the 2030 Sustainable Development Agenda. "Digital inclusion" refers to the ability of all persons to access and use information and communication technologies. There are many populations worldwide who have lower access to ICTs: individuals with lower incomes, ethnic minorities, women and girls, senior citizens, persons with lower education, and persons with disabilities. This paper will focus on digital inclusion as it relates to persons with disabilities. Digital inclusion for PWDs is also referred to as "ICT accessibility" or "eAccessibility."

1 The general term 'ICT' widely refers to any information and communication device or application. For the purposes of this report, the term will refer to modern digital technologies, such as computers, mobile phones, network hardware and software, computerized assistive devices, radio, and television.

For PWDs in particular, ICTs can represent a powerful opportunity to improve quality of life. There is a famous quote from Mary Pat Radabaugh, former Director of the IBM National Support Centre for Persons with Disabilities: "For most people, technology makes things easier. For persons with disabilities, technology makes things possible." Professor Stephen Hawking, author of *A Brief History of Time*, also spoke to the importance of ICTs in a video message to the 2014 UNESCO International Conference on the Role of ICTs for Persons with Disabilities, stating: "Without technology, I would not be able to ask for a cup of tea, let alone describe my theory of how the universe began. We need to make sure this technology becomes available to those who need it so that no one lives in silence. Please listen to me; I speak for the people you can't hear."

ICTs have vast potential to improve the independence and inclusion of persons with disabilities. They can offer opportunities for work, leisure, and social interaction, as well as act as sources of information. Increasingly, ICT accessibility must be seen not only as right in itself, but also as a critical element for ensuring equal access to other rights, such as the right to education, political participation, social engagement, and so on.

In recent decades, Internet and computer technologies have broadly overtaken earlier forms of ICT in terms of importance. For a report issued for the 2013 UN High Level Meeting on Disability and Development, a team of experts ranked the importance of different ICTs for the inclusion of persons with disabilities as follows:

Table 1. Ranking of various ICTs for persons with disabilities. Scale: 5 = Most important,1 = Least important. The highest score for each life category is highlighted in blue. Scores lower than 3 are greyed out. (Source: UNESCO et al., 2013.)

	Websites	Mobiles	TV sets	Radio	Other
Healthcare	**3.3**	3.1	2.9	2.5	2.7
Primary education	**3.0**	2.6	2.8	2.3	2.9
Secondary education	**3.4**	3.0	2.7	2.3	2.8
Tertiary, prof., lifelong education	**3.7**	3.4	2.9	2.4	2.8
Employment	**3.7**	3.3	2.5	2.2	2.7
Independent living	**3.4**	**4.6**	2.8	2.4	2.8
Government services	**3.5**	3.0	3.0	2.3	2.6
Participation: Political/public life	**3.3**	3.1	2.7	2.5	2.6

The rankings listed in Table 1 highlight websites as the most crucial tool overall, while mobiles phones have the highest individual ranking in the category of independent living. Other ICTs, such as TV and radio, are ranked as having comparatively low to moderate importance. The rankings reflect the increasingly central role of Internet-based technologies in modern life compared to earlier media forms.

This paper provides an overview of relevant facts, figures, and good practices in terms of enhancing ICT accessibility, within the context of four selected SDGs:

SDG 9 (Innovation, Industry, and Infrastructure)
SDG 16 (Peace, Justice, and Strong Institutions)
SDG 17 (Partnerships for the Goals)
SDG 4 (Quality Education)

Because of its importance and relevance for all of the SDGs, Goal 9 is addressed first. Each chapter also identifies major challenges and presents recommendations for achieving each of the selected SDGs. Finally, this paper summarizes the key recommendations for improving ICT accessibility overall.

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Sustainable development goal 9

(Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation)

1.1 Relevance of SDG 9 for digital inclusion

SDG 9 covers a broad array of aspects related to infrastructure, innovation, and industry. While PWDs are not explicitly addressed in this Goal, its reference to Internet access represents a crucial factor in the development of digital inclusion. Internet access plays an increasingly central role in societal participation, and can be an especially powerful tool for PWDs, providing greater opportunities for work, study, and leisure. Another key technological, social and economic trend in recent years is the inclusion of accessibility features in mainstream technologies, which reduces the need for more costly specialized assistive technologies. The relevant targets of SDG 9 are presented in Table 2.

Table 2. Relevant targets for digital inclusion `

Target	
9.C	Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020

The reach and power of ICTs has grown tremendously in recent decades. The Internet age has transformed the way people interact across the globe, and has revolutionized the fields of business, politics, and information. It has become a catalyst of economic and social change. During the 71st session of the UN General Assembly in 2016, members of the Broadband Commission stated that the Sustainable Development Goals "cannot be achieved without affordable and universal access to ICTs and broadband connectivity." The fact that SDG target 9.C is set for the year 2020 (rather than 2030 like most other targets) underlines its urgency as a critical factor for sustainable development.

This chapter will address SDG Target 9.C (access to ICTs and the Internet) as it relates to PWDs. An overview of global Internet access and usage is presented below. This chapter also presents the state of the art in ICT innovations for PWDs, including the tools and services that are available via the Internet, as well as technologies that allow PWDs to access and use the Internet.

1.2 Facts and figures

1.2.1 Internet access and use by PWDs

Considering the vast potential of Internet technology to improve the lives of persons with disabilities, wider Internet access should be considered imperative to achieving the SDGs in terms of digital accessibility. Global access to fixed-broadband services have increased sharply in the past decade; however, according to the recent SDG progress report of the Secretary-General, the digital divide between developed and developing regions remains wide (United Nations, 2016). In 2015, fixed-broadband penetration was only 7.1 percent in developing regions, compared to 29 percent in developed regions. Among the least developed nations, penetration was as low as 0.5 percent. This disparity between nations is also observed in terms of Internet usage: only 1 in 10 people are online in the least developed countries, versus 1 in 3 people in other developing regions. Clear disparities exist between different populations as well; for example, in 2015, the global Internet user penetration rate was about 11 percent lower for women than for men. The gender gap is even higher in developing regions (15 percent lower for women) and highest in the least developed countries (29 percent lower).

There is no globally comparable data on Internet access or usage for PWDs. Nevertheless, there is good reason to expect that PWDs have lower overall access to the Internet than the general population. One reason for this is that PWDs have lower employment rates and lower incomes on average (Mitra, Posarac, & Vick, 2013; Mizunoya & Mitra, 2012), making it more likely that the costs of Internet subscriptions and electronic devices will be prohibitive for them. Persons with disabilities are also less likely to be educated [source], and are thus likely to have lower levels of digital literacy. Additionally, even where digital education, ICTs, and Internet connections are all available, they often remain inaccessible unless special assistive technologies (ATs) are also provided. For example, persons with physical disabilities may not be able to operate the standard devices used for navigating

the Internet (mouse, keyboard, screen), and may need alternate devices suited to their needs. Persons with visual, reading, cognitive, or other disabilities may encounter barriers with inaccessible digital content (e.g. webpages and documents), and may require more accessible formatting or assistive software.

Several studies have clearly demonstrated a disparity in Internet use between those with disabilities and those without. One recent study in Great Britain (UK Office for National Statistics, 2013) found that PWDs were more than 20 per cent less likely to have ever used the internet than those without a disability (Figure 1). An American study on disability and Internet use (File, 2014) found a similar disparity in the US.

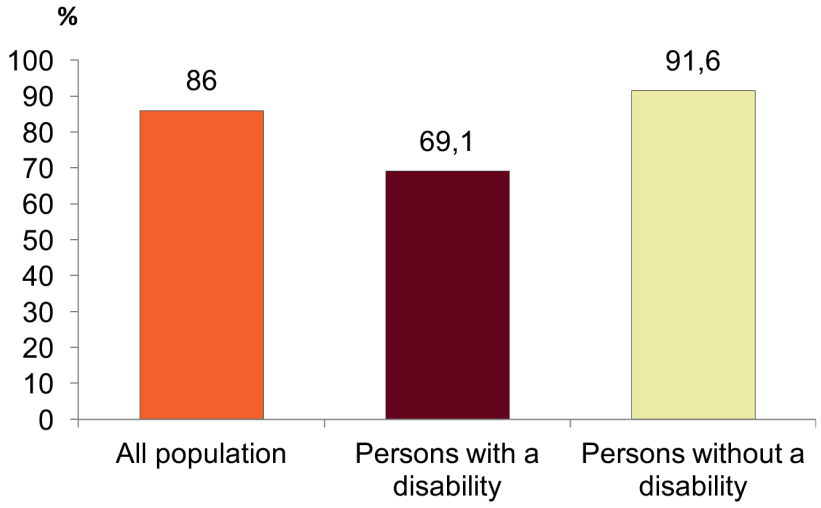

Figure 1. Percentage of population that has ever used the Internet in the UK, 2013. All persons surveyed were aged 16 and over. (Source: UK Office for National Statistics, *Internet Access Quarterly Update*, Q2 2013, Table 1A.)

It is likely that such disparities are disproportionately detrimental for PWDs in less developed countries, where disability rates tend to be higher and incomes lower. Figure 2 shows the relationship between gross national income with both disability prevalence and Internet use, with more developed nations tending to feature lower rates of disability as well as higher Internet use.

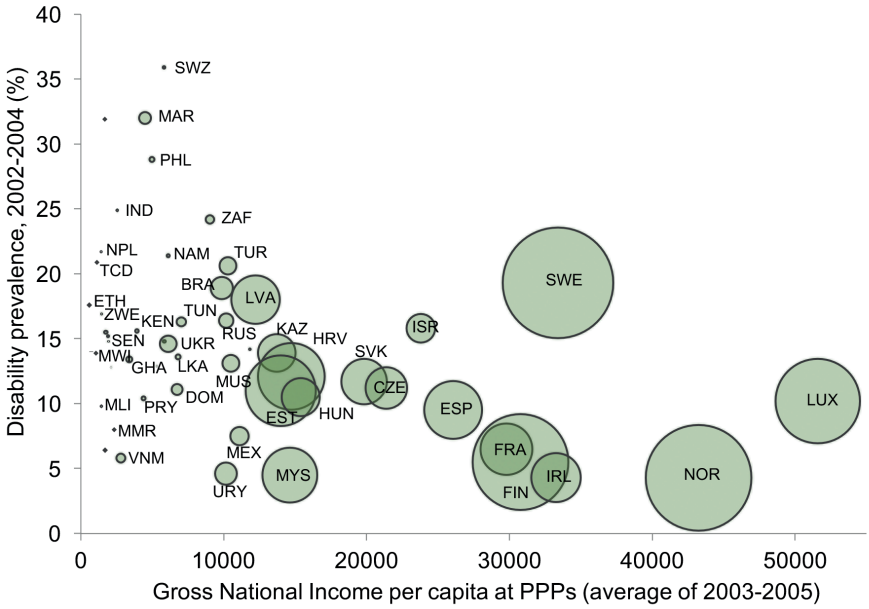

Figure 2. Per capita income, disability prevalence and Internet use, early 2000s. The diameter of the circles is proportionate to the % of individuals using Internet (average 2003-2005).

Mobile Internet is has overtaken fixed-broadband as the preferred type of connection in recent years, according to ITU figures. Overall, figures for mobile-cellular network coverage, including 3G coverage, are considerably higher than for fixed-broadband Internet. As shown in Table 3, the global average for 3G connection is 66

percent, while the least developed countries are not far behind, with 50 percent coverage. Overall cellular network coverage (regardless of speed) is even higher, with 95.7 percent coverage globally, and 85 percent coverage in the least developed countries.

Table 3. Percentage of population covered by a mobile network, by technology, in 2014. (Source: United Nations 2016)

	Covered by a mobile-cellular network	Covered by at least a 3G mobile network
World	95.7	66.0
Developing regions	94.9	56.6
Northern Africa	99.2	74.8
Sub-Saharan Africa	87.8	53.2
Latin America & Caribbean	98.5	87.0
Eastern Asia	99.5	46.7
Southern Asia	92.5	46.8
South-Eastern Asia	96.3	83.8
Western Asia	95.9	73.6
Oceania	95.7	39.3
Caucasus and Central Asia	95.6	51.5
Developed regions	99.7	94.6
Least developed countries	85.0	50.1
Landlocked developing countries	88.0	48.7
Small island developing States	87.4	48.8

Table 3 shows that both mobile network coverage and mobile 3G+ coverage are highest in developed regions, while 3G+ coverage is lowest in Eastern Asia and Southern Asia. It should be noted that, while mobile and 3G+ coverage tend to be higher in more developed regions, the correlation between national income and internet availability is not perfect. For example, even though Eastern Asia is known to have a higher per-capita income than Sub-Saharan Africa, Table 3 shows that Eastern Asia has the lower 3G mobile network coverage of the two. It may be interesting to explore such discrepancies in further detail; however, such an investigation goes beyond the scope of this report.

The availability of high-speed Internet (3G and faster) is expected to increase over time. High-speed Internet has the advantage of supporting more data-heavy assistive technologies, such as apps involving live video feed, or tools that require downloading. As such, faster connections can generally be considered preferable to slower connections. However, even a slow connection can still be hugely beneficial, offering access to websites, tools, and information that would otherwise be out of reach.

1.3 State of the art and good practices

1.3.1 Increasing Internet access for PWDs

Many countries are beginning to catch on to the potential of Internet access to improve social and economic development. In 2010, Colombia developed the Plan Vive Digital, which ran until 2014. Prior to the implementation of this program, Colombia had been lagging significantly behind other countries in terms of Internet connectivity. The Plan aimed to increase both availability and usage of the Internet and ICTs, particularly for vulnerable and low-income populations. It also paid special attention to persons with disabilities, drawing a clear link between access to ICT and important success factors such as education and employability. The results of the Plan were promising: The program succeeded in increasing the number of Internet connections from 2 million in 2010 to 14.4 million in 2016. The Alliance For Affordable Internet (2017) now ranks Colombia at number 1 in Latin America in terms of affordable Internet access. Other Latin American nations, including Peru and Mexico, are now following suit with similar programs aimed at increasing Internet access.

1.3.2 Universal Design and built-in accessibility in mainstream ICT

Assistive technologies are often needed for individuals with certain disabilities to interact with the Internet and other ICTs. For example, a person with a visual impairment may need a screen reader to read out the content of a website. In the past, such technologies were usually acquired in the form of specialised software or hardware that needed to be purchased individually. Today however, many ATs are already embedded into mainstream products. Modern computers and smartphones now include several built-in assistive technologies.

The iPhone, for example, has built-in accessibility features which allow users to customize its interface and settings. These features include voice recognition, a screen reader, adjustable colour displays, screen magnification, and other features for various types of disabilities. Android phones and other smartphones offer similar features. Another example of built-in accessibility features can be seen in smart TVs; for example, Samsung televisions offer adjustable contrast settings and text-to-speech voice guidance to allow users with vision impairments to operate their televisions more easily.

Both of the above examples demonstrate key principles of "Universal Design." Universal Design is a concept in which mainstream products, buildings, and services are designed so as to be accessible to all people – regardless of age, size, ability or disability. This means that accessibility is considered in the design process from the very beginning. The resulting designs will thus not require any special modifications or accommodations to benefit PWDs, but will be inherently accessible to different needs. In many cases, products designed under the principles of Universal Design are not only more accessible to people with special needs, but are more pleasant and easy to use for all people. A good resource on Universal Design and the 7 principles it incorporates is the Centre for Excellence in Universal Design, which offers information and recommendations on accessible design in a variety of different settings, whether for products, built environments, institutions or services.

1.3.3 Internet-based assistive technologies

Basic Internet access already opens many advantages for PWDs in itself; however, there are also a number of specialised tools based on mainstream Internet technologies developed specifically for PWDs. In many cases, these tools are either free or are available for a low cost, and can be accessed from anywhere. This section presents an overview of some of the most current Internet-based tools, looking at four common types:

- Mobile apps
- Webtools and online platforms
- Cloud-based assistive technologies
- The Internet of Things

Mobile apps in particular provide convenient, affordable, user-friendly assistance. The number of assistive mobile apps or "accessibility apps" has sharply increased in recent years. For example, navigation apps such as WheelMap, AccessibleMap, Wayfindr, and ViaOpta allow users with mobility and vision impairments to safely reach their destinations. Apps such as these might use GPS information to analyse the user's location and recommend safe routes, or they may rely on crowdsourcing to identify and rate accessibility in various establishments, such as restaurants, shops, or public buildings. Remote person-to-person apps, such as Be My Eyes, Convo, VEASYT, and VerbaVoice, connect users with visual or hearing impairments to a volunteer or interpreter, who receives a live camera and microphone feed from the user's device and can then assist the user with a given task. There are a host of other internet-based mobile apps that offer a range of assistive tools. Many of these accessibility apps are free to use, receiving funding from governments, non-profits, advertisement revenue, or the sale of premium versions.

Webtools and online platforms also offer many services for PWDs, particularly services which are more complex, as these would be less well-suited to the simpler formats of mobile apps. Examples of webtools for PWDs include Amovil, a tool which helps users identify the best-fitted accessible mobile device for them, PAVE, which assists content creators in making accessible PDFs, and Robobraille, an online service which automatically translates text into Braille. All of these examples are free of charge to users.

Cloud-based assistive technologies, as their name implies, are stored in the Cloud and can be used as needed, independent of location. A European Commission-funded project, "Cloud4All," has launched an initiative called the Global Public Inclusive Infrastructure (GPII), which aims to build a cloud-based system where users can store customized AT software. This initiative would allow users with disabilities to access their preferred ATs from any device and location. For example, a user with low vision could use online AT software to adjust their screen settings on their personal tablet to display larger letters and higher contrast. The software, including the user's personal settings, would be saved in the cloud, and the user could later access them from other devices, such as a library computer or work device, for example. The GPII initiative is still under development, but it could have great potential to make ICTs more accessible for PWDs.

The so-called "*Internet of Things*" (IoT), is also gaining increasing importance in terms of the assistive opportunities it offers. The IoT allows any "smart" device to operate autonomously by transmitting data through the Internet, as well as communicating remotely with other devices and systems. For example, this could allow a user to control the lighting in their home using their smartphone. The IoT can be applied to anything from transportation (such as Google's self-driving car), remote health care monitoring, sensors, and security systems, to everyday household objects, such as refrigerators, air conditioners and even egg timers. The IoT thus has great potential for enabling elderly persons and PWDs to live more independently and safely. There are currently many projects looking into the use of IoT for PWDs in so-called "smart homes," in which comfort and safety features are accessible at the touch of a button. Another emerging concept is that of "smart cities," in which urban infrastructure is connected to the Internet. In this scenario, a PWD could use an app to find a free parking spot, for example, or could use a virtual city guide to find accessible building entrances. These days IoT devices and systems are often highly expensive, both to purchase as well as to produce and install; however, costs are expected to drop over time as the technology becomes more mainstream.

1.3.4 Specialised assistive technologies

Some assistive technologies require specialised external software or hardware. NVDA provides free, open-source software for advanced screen-reading as well as text-to-Braille conversion for Braille display devices. Other examples include Blitab, a tablet with a screen that can display Braille, or Tobii, a provider of eye-tracking hardware and software for people with physical and/or communication impairments. Unlike assistive apps or built-in assistive software, however, such external technologies are often provided by private or semi-private companies, and may sometimes be prohibitively expensive.

1.3.5 3D printing

The development of 3D printing technology has offered exciting opportunities for accessibility in many different areas. It can allow for complete customization of 3D objects, giving users total control over what is produced. One recent development is the use of 3D printing to create customized prosthetic devices; this method has the advantage of being much cheaper than traditional methods of prosthetic production. An increased interest in 3D printed prosthetics recently led to the formation of Enabling the Future, an international network of 7,000 volunteers with access to 2,000 3D printers worldwide, dedicated to creating prosthetics arms and hands for those in need. 3D printing can also be used to create cheap and customized adaptive devices for persons with physical impairments; such devices could include customized utensil holders, bottle openers, joysticks, and so on.

For people with vision impairments, 3D printing offers boundless possibilities for translating visual information into tactile information. Another potential use for 3D printing is in increasing access to art and creative pursuits. For example, the UK SHIVA project (Sculpture for Health-care: Interaction and Virtual Art in 3D), which ran from 2010 to 2014, allowed schoolchildren with physical and cognitive disabilities to design their own 3D-printed sculptures. The children could create their design on a computer screen, and then print it out in physical form. The project used specialized software that allowed the computer interface to be customized to each child, whether this meant using eye-tracking software to control the cursor, or adjusting the colour and size of the symbols on the screen.

3D printing could also offer people with visual impairments increased access to fine art and historical artefacts. 2D paintings could be rendered in 3D form, with raised edges and shapes, giving those with

vision impairments tactile access to the artwork. Precious artefacts in museums, such as those enclosed in glass cases or displayed as images, could likewise be replicated through 3D printing, providing a sensory experience of important culture and history.

1.3.6 Accessible television and radio

Television and radio continue to serve as important sources of news and entertainment for PWDs around the world. For both of these technologies, there are two aspects where accessibility considerations arise: equipment, and programme content. Equipment refers to hardware (buttons, cables, remote controls) and software (menus, programme guides). These can sometimes be difficult to PWDs to operate, particularly those with physical, vision, or cognitive impairments. Equipment can be made more accessible by ensuring that buttons on the devices and remote controls are simple, clearly labelled, and distinguishable by touch. On-screen menus and text should feature adjustable colour and size, as well as a text-to-speech option. Programme content also frequently presents barriers to PWDs. Users with hearing impairments may miss out on dialogue, while those with vision impairments may not have access to video. These issues can be addressed with the use of closed captioning, sign language interpretation, radio transcripts, and described video.

A good example of best practices in accessible television is the Canadian organisation Accessible Media Inc (AMI). AMI is a non-profit which provides broadcasting services for PWDs, particularly for those with visual, print, or hearing disabilities. Their major services for PWDs: AMI-tv, which broadcasts popular television programming with described video and closed captioning, and AMI-audio, the world's largest broadcast reading service, for which volunteers read and record current articles from magazines and newspapers. AMI broadcasts its content in both English and French. Its website is also fully accessible, complying with the highest level of WCAG 2.0 standards.

Another Canadian organisation making waves in accessible media is the Broadcasting Accessibility Fund, an independent and impartial funding body supporting accessibility of broadcasting content in Canada. It is the first such funding body in the world. The fund has supported projects such as an accessible emergency broadcasting toolkit, and sign language interpretation videos of popular national radio programming.

1.3.7 Guidelines and standards for accessible ICTs

Digital content is frequently inaccessible to persons with disabilities – particularly to those with vision, hearing, or cognitive impairments. For example, a user with a vision impairment may not have access to an image on a website, while a user with a hearing impairment may miss out on spoken narration in movies or television. A person with a cognitive impairment may have difficulty navigating through overly complex website menus or layouts. These are just some examples of the barriers encountered by ICT users with disabilities.

To address such issues, standards and guidelines have been created for accessible websites, documents, and other digital media. They may cover things like enlargeable text, adjustable colours and contrast, closed captioning for video content, or simple and clear website layouts, to name a few. Standards and guidelines are similar in that both are intended to promote the needs of users with disabilities, and provide a foundation for implementing accessible solutions. Guidelines are intended to provide optional instructions and advice, whereas standards represent an acceptable level of quality, acting as quantifiable, low-level mandatory controls.

Web content guidelines specifically address accessibility in websites. The most universally recognized and widely used are WCAG (Web Content Accessibility Guidelines), which are currently in their second generation, called version 2.0. Published by the World Wide Web Consortium in 2008, WCAG 2.0 have gone on to become an ISO/IEC standard (called "ISO/IEC 40500:2012"). They are open-access and have been officially translated into 22 languages, along with several unofficial translations in other languages. Prior to the development of the WCAG, there were a number of different sets of web guidelines used by various nations and institutions. In recent years, however, most individual guidelines have been set aside in favour of WCAG 2.0. Many national governments have adopted WCAG into their basic web accessibility standards. In some cases, the WCAG have even been written into the law: The United States, for example, recently updated its Section 508 – a law enacted in 1998 to enforce accessibility in ICT procurement – to

align with the WCAG guidelines. The European Standard on Accessibility also draws on the WCAG in its ICT procurement requirements.

The aim of the WCAG is to promote accessible web content. This has significant implications for PWDs, as websites have been ranked among the most important ICT platforms for fostering inclusion (see Table 1). There is also reason to believe that adopting such guidelines is beneficial to everyone: "empirical evidence shows that the adoption of these guidelines improves user experience and accessibility for all persons, regardless of disability. This fact – that investments in accessibility also introduce benefits for wider groups of the population – is a common and hugely significant finding" (UNESCO et al., 2013).

Other guidelines and standards exist for a variety of different technologies. The ICT4IAL project has developed general Guidelines for Accessible Information which cover many forms of digital media, including video, audio, text, and images. The International Organisation for Standardization (ISO) has also published accessibility standards for a variety of ICTs, including standards for hardware devices like keyboards and screens (ISO 9241-20:2008), standards for software (ISO 9241-171:2008), and standards for accessible PDF documents (ISO 14289-1:2014). For eBooks, there are the EPUB3 accessibility guidelines, published by the International Digital Publishing Forum.

Many regions also have standards for closed captioning in television and digital video broadcasting: these include the European standard ETSI EN 301 775, the ATSC A/343:2016 standard in North America, the ISDB standard in Japan and much of South America, and the CMMB standard in China. In terms of communication services, the International Telecommunication Union (ITU) published a 2007 series on "Non-Telephone Telecommunication Services" (called ITU-T F.790), which provides accessibility guidelines for services such as telegraph and facsimile.

1.4 Major challenges and gaps

- **Low Internet availability.** In isolated areas, there may be limited availability of the Internet. Encouraging and meeting the needs of persons with disabilities may be a relatively low priority under such conditions.
- **Low awareness of ICTs and ATs.** Many people, across all multi-stakeholder levels, are not aware of the potential and importance of ICT accessibility and ATs. This might apply for public stakeholders as well as for the ICT industry, where there is often inadequate awareness of (and information on) the market potential that can be created by higher demand for ICTs by PWDs under appropriate incentive and support schemes.
- **Affordability concerns.** Many PWDs have low incomes and limited educational opportunities. This applies in developed countries and even more so in developing countries. Using the Internet is expensive especially in developing countries. When assistive technologies are required, the barrier can be even higher due to lack of financial resources.
- **Lack of standard conformance/Lack of nationally binding policies.** The majority of online content is not created with accessibility in mind, and is not presented in an accessible format. Web accessibility standard exist, but are not followed by the majority of nations. Even where national policies do exist, they are often not conformed to.
- **Lack of ICT Accessibility competencies among providers and content creators.** Very often, content creators, web designers and other people involved in the creation of ICTs have no skills or knowledge in terms of implementing accessible websites, applications, devices or content.

1.5 Recommendations

- **Enhance the development and dissemination of open-source software.** Open-source software allows developers to adapt and localize existing programs to suit the needs of PWDs in certain areas or populations, requiring less time and expense than the development of entirely new software.
- **Subsidize Internet access for people with disabilities.** Focus should be placed on enhancing high-speed Internet access to PWDs, particularly in lower-income regions.
- **Emphasize mobile Internet access.** Globally, mobile networks with at least 3G-speed Internet are already much more widely available than fixed-broadband infrastructure; this is especially pronounced in the least developed countries, which have 0.5 percent broadband coverage, as compared to 50.1 percent 3G mobile coverage. The importance of mobile networks is also expected to rise over time. The growth of mobile Internet access will provide important benefits to PWDs, in that it will increase access to information and tools such as mobile apps and websites, which are often relatively cost-effective to produce and disseminate.
- **Develop/publish statistics on Internet access at the sub-national level.** Although national data on Internet access is available, collecting data at the sub-national level would allow for a better understanding of regional and territorial aspects of ICT access. These statistics could include:
    - Percentage of individuals (or households) with Internet access (or using the Internet) in rural areas.
    - Percentage of individuals (or households) with Internet access (or using the Internet) in regions where per-capita incomes are below the national average.
- **Provide statistical data to investigate the link between disability,** Internet access, and personal income. Introduce questions in household expenditure surveys that would allow measuring and analysing the link between disability status/prevalence, Internet access, and income. This data should be regularly collected and published, and should ideally include monthly (or annual) average cost of household Internet access
    - as a % of average disposable income,
    - as a % of average disposable income at the bottom (or middle) quintile of income distribution, and
    - as a % of average disposable income of population with disabilities.

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2.

Sustainable development goal 16

(Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels)

2.1 Relevance of SDG 16 for digital inclusion

On many fronts, persons with disabilities are often denied a chance to participate in civic life. Public institutions may not have accessible infrastructure, government and legal information is frequently not available in accessible formats, and the electoral process may present several barriers to potential voters with disabilities.

The Internet is a critical source of news and information on political campaigns and events. Governments are already moving towards digital formats, making public information, services, records, and forums increasingly available online. This shift intensifies both the potential and the need for the public sector to be made more accessible to PWDs electronically (eGovernment).

Target
16.7 Ensure responsive, inclusive, participatory and representative decision-making at all levels
16.10 Ensure public access to information and protect fundamental freedoms, in accordance with national legislation and international agreements
16.B Promote and enforce non-discriminatory laws and policies for sustainable development

2.2 Facts and figures

2.2.1 Inclusive decision-making

Accessible voting remains a pressing issue in nearly all nations. SDG target 16.7, which addresses inclusive decision-making, specifically mentions persons with disabilities in both of its indicators.

One potential ICT-based solution is electronic voting (eVoting), which could eliminate many of the barriers inherent in traditional voting systems, such as paper ballots (which are often inaccessible to voters with visual impairments and light to moderate intellectual impairments) and inaccessible polling stations. Many countries are already looking into ways to digitize the voting process. Research conducted by the International Institute for Democracy and Electoral Assistance found that 43 percent of countries have used, are using or are testing eVoting. In some instances this has led to the use of electronic voting machines (EVMs) at polling stations. While many different EVM models have existed, modern versions may feature Braille lettering, voice output, adjustable height, and touch screens (Davies, 2012). In other instances nations have introduced ballot casting via the Internet (sometimes referred to as iVoting), allowing citizens to vote remotely from their personal computers or smartphones.

2.2.2 Access to public information

Access to public information and public services is another major issue in many places, as addressed in SDG target 16.10. Citizens with disabilities face barriers where public information is presented in inaccessible digital formats. Government websites, services, and public media outlets are frequently designed without regard for accessibility. As a result, PWDs may be denied access to important news and information regarding campaigns and political candidates, public services, emergencies and natural disasters, legal matters, tax forms, and so on. Currently, 55 percent of nations lack any laws or regulations to ensure that government communications to the public using ICTs are provided in accessible formats, such as sign language, Braille, or simplified wording, while remaining nations address this issue only partially (Gould et al., 2017). People with disabilities may also be unable to access digital cultural content from libraries, museums, or art galleries.

2.2.3 Non-discriminatory laws and policies

Policies and laws are beginning to catch up with the need for accessible Internet and ICT. Internationally, one of the most significant catalysts of this change was the United Nations Convention on the Rights of Persons

with Disabilities (CRPD), which took place in 2006. The CRPD set a record for the highest number of same-day signatories to a UN convention – with 82 nations signing on the first day alone. It has since been ratified by 172 countries, as of this writing.

The CRPD highlights ICT accessibility as critical to creating inclusive societies; its preamble notes "the importance of accessibility to the physical, social, economic and cultural environment, to health and education and to information and communication, in enabling persons with disabilities to fully enjoy all human rights and fundamental freedoms." Article 9 specifically obliges Member States to take appropriate measures to ensure access for persons with disabilities to ICTs, including the Internet. The inclusion of Article 9 in the CRPD marked the first time in the history of disability law that ICT accessibility measures were specifically highlighted as an obligation of Member States. Another section, Article 4, calls for the promotion of universal design in the development of standards and guidelines, as well as accessible and assistive technologies, with an emphasis on low-cost technologies.

The reach of the CRPD may be limited, however, by the fact that it does not define access to ICTs as a right, but rather frames it as an obligation. And although the majority of Member States have ratified the law, it appears that many of the CRPD's requirements are going unmet. For example, despite the CRPD's rules regarding the direct participation of DPOs, a recent report found that only 7 percent of States Parties to the CRPD have any systematic mechanism to involve DPOs in laws and policies (G3ict, 2016).

The number of nations with ICT accessibility laws or regulations in general, however, paints a somewhat more optimistic picture. In a survey of 104 countries, a strong majority have laws defining the rights of PWDs, with nearly half of countries having a definition of accessibility that specifically includes ICTs. These numbers are even higher in the Global North (G3ict, 2016).

Another important legal landmark was the 2013 Marrakesh VIP Treaty (formally called the Marrakesh Treaty to Facilitate Access to Published Works by Visually Impaired Persons and Persons with Print Disabilities). The treaty introduced provisions for copyright exceptions for visually impaired persons. Copyright laws have been a common barrier to the creation of accessible versions of books and other works; this treaty addresses this hurdle by allowing creators of accessible content to bypass copyright laws. The treaty has been signed by 84 countries, and came into force in 2016 after its 20th ratification was received.

2.3 State of the art and good practices

2.3.1 Electronic voting (eVoting) for PWDs

A number of countries have successfully introduced eVoting to the benefit of PWDs. Switzerland introduced online voting for citizens with disabilities in one of its cantons (the city of Basel) in 2016, and there are plans to expand the program nationally. Australia introduced online Voting in 2011, allowing citizens with disabilities (as well as any citizen living in isolated areas) to vote remotely. The system recorded 46,864 "iVotes" in that year (Holmes, 2012) (it should be noted, however, that this represents only about 1 percent of the total number of PWDs in Australia).

One of the earliest adopters of eVoting was Estonia, which implemented nationwide Internet voting in 2005; the system is now widely used by Estonian voters; however, the system was not specifically designed for PWD. Brazil, India, and Kazakhstan have made similarly broad shifts towards eVoting.

2.3.2 Accessible eGovernment

Qatar is an example of a nation taking steps to present government information and services in an accessible form; their comprehensive eAccessibility policy, developed as a joint public-private effort, emphasizes the need for digital accessibility in the public sector. The policy includes provisions for accessible government websites and mobile applications, banking institutions, ATMs, and public service kiosks, and aims to improve accessibility for users with visual, hearing, physical and reading impairments.

The EU has similarly introduced a directive on "the accessibility of the websites and mobile applications of public sector bodies," which entered into force in December 2016. The directive aims to improve the

accessibility of public sector websites and mobile applications, particularly for those with vision or hearing impairments. It also requires Member States to monitor and report on their progress. Member States are required to transpose the text into their national legislation by September 2018.

Other nations have created laws specifically requiring government websites to comply with W3C's Web Content Accessibility Guidelines (WCAG). As of April 2016, at least 12 nations had passed specific legislation in this regard. In addition, the European Commission has adopted WCAG 2.0 as a European government standard. The US has similar legislation, called Section 508, which also aims to align itself with WCAG 2.0.

2.3.3 Accessible public broadcasting

Public broadcasting remains an important source of news and information for many PWDS. Many nations have provisions for accessibility measures in public audio-visual content. An example of good practices in accessible broadcasting legislation is the US 21st Century Communications and Video Accessibility Act (CVAA), which was signed into law in 2010, and which covers a broad and progressive range of provisions for accessible audio-visual content. Aside from providing important news and entertainment, public broadcasting also serves as a platform for critical public services, such as early emergency or disaster warnings. For example, anecdotes relate that broadcasters in Japan, Chili, Haiti, New Zealand, Australia, and the US critically included sign language interpreters during live televised emergency broadcasts before a major natural disaster.

2.3.4 Web accessibility legislation

Some nations have built upon the measures of the CRPD to apply to public as well as private agencies. For example, in 2010 Argentina introduced Law No. 26,653, requiring that both State-run and privately run institution provide information in accessible formats on their web pages. The province of Ontario in Canada also recently introduced progressive legislation requiring any large private sector and non-profit organization with more than 50 employees to make their websites compliant with WGAC 2.0 (Level AA) by the year 2021. In the United States, Title III of the Americans with Disabilities Act prohibits discrimination in any privately-run place of "public accommodation," a term which, according to recent court rulings, includes websites.

2.4 Major challenges and gaps

- **Inaccessible eVoting formats.** Unfortunately, eVoting itself is not a guarantee of accessibility. Neither Internet-based platforms nor EVMs are necessarily made available in accessible formats. For example, in India, many voters with visual impairments need to ask an assistant to press the button on the EVM for their selected candidate; Braille options have only been made available sporadically, and only in certain districts (Ashok, 2017).
- **Security concerns related to eVoting.** While South America and Asia are showing increasing interest in using eVoting technology, North America and Europe now appear to be moving away from it. Ireland experimented with eVoting until 2012, when it was found that its voting machines were unreliable. New Zealand was set up to trial internet voting in 2016, but cancelled those plans due to security concerns.
- **Web accessibility legislation is difficult to enforce.** A lack of monitoring mechanisms, knowledge and resources prevent the implementation of existing ICT-accessibility-related laws and policies.

2.5 Recommendations

- **Provide accessible eGovernment solutions.** Government information and services should be made available in accessible formats for a variety of disabilities. This should apply to public websites, constitutions, laws, tax forms, public announcements, campaigns, national television and radio,

telephone services, emergency services, and referendums. Citizens should also be given a variety of options for interacting with government. Services and information should be available in multiple accessible formats, which may include mobile apps, SMS, web portals, accessible websites, accessible PDFs, sign language video, subtitling, the use of simple and concise language, etc. Governments should work in close collaboration with DPOs during every phase of development in this area.

- **Develop eVoting options for voters with disabilities.** eVoting has vast potential for citizens with visual and physical disabilities. Internet voting platforms must include alternative formats such as tactile keys, audio, and customizable displays to accommodate voters with a wide range of abilities.
- **Create national legislation for digital accessibility.** Nations should develop laws to meet the ICT accessibility requirements outlined by the CRPD. This legislation should include provisions for involving of PWDs and DPOs in developing new accessibility-related laws.
- **Offer public broadcasting in accessible formats.** Audio-visual broadcasting should be made available in accessible formats for citizens with disabilities. Public audio-visual content should include options for closed captioning, sign language interpretation, described video, and text transcripts for radio content. This recommendation is especially directed at public broadcasters, but governments could also encourage commercial broadcasters to offer accessible audio-visual content.
- **Address ICT accessibility criteria in public procurement regulations.** For example, when government buys software for its employees, the software must be accessible to employees with disabilities.
- **Create a mechanism of accountability.** Provide legal mechanisms to enforce ICT accessibility provisions, such as lawsuits against stakeholders if accessibility provisions are not fulfilled.

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3.

Sustainable development goal 17

(Strengthen the means of implementation and revitalize the global partnership for sustainable development)

3.1 Relevance of SDG 17 for digital inclusion

Global partnerships in the field of accessibility appear to be on the rise, as globalisation creates both a greater supply of and a greater demand for international partnerships. The importance of partnerships is reflected not only the in SDGs, but also in Article 32 of the CRPD, which states that countries should strive to share technology and information, cooperate in research, offer financial and technical assistance where needed, and ensure that PWDs are actively included in development programs.

The field of ICT accessibility tends to attract engaged and passionate advocates and stakeholders around the world. As a result, it is a highly collaborative field, with strong international networks and a high degree of knowledge sharing. These networks include governments, academic institutions, corporations, non-profits and networks of accessibility professionals.

Target	
17.6	Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the United Nations level, and through a global technology facilitation mechanism
17.7	Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed
17.8	Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries by 2017 and enhance the use of enabling technology, in particular information and communications technology
17.9	Enhance international support for implementing effective and targeted capacity-building in developing countries to support national plans to implement all the sustainable development goals, including through North-South, South-South and triangular cooperation

3.2 State of the art and good practices

3.2.1 Knowledge sharing

The field of ICT accessibility has seen a boom in regional and international networks, programs, and conferences in recent decades. These networks promote knowledge-sharing and collaboration between professionals from different fields. Some of the largest and most productive international networks in the area of ICT accessibility are GAATES and G3ict, ENTELIS, the Nippon Foundation. These various networks also regularly collaborate among one another. For example, GAATES, G3ict, and the Nippon Foundation (along with dozens of other DPOs and some corporations) are all partners of The Zero Project, an initiative that works with a network of over 3,000 disability experts in over 150 countries to gather information on policies and practices in accessibility, and which publishes its findings in an annual report (and although ICT accessibility is not a specific focus of the publications, it is often featured prominently.)

International conferences dedicated to the topic of ICT Accessibility are another way of promoting knowledge sharing among researchers and stakeholders. Some of the major conferences addressing the topic of ICT accessibility include ICCHP, M-Enabling Summit, DSAI, and ICTA.

For a more complete list and detailed descriptions of the major international networks and conferences related to digital accessibility, see Appendix A.

3.2.2 Technology sharing

Qatar's current focus on digital accessibility has given rise to an international partnership between Mada (Qatar's assistive technology centre) and the US-based organisation Bookshare – the world's largest online

accessible library for people with print disabilities. As a result of this collaboration, Bookshare now offers hundreds of accessible e-books in Arabic.

3.2.3 International recognition

One way to share news and bring stakeholders in ICT accessibility together is to offer international recognition for innovators in this field. Prizes and competitions encourage individuals and organisations to come forward and present their achievements in the field, while also setting an example that can inspire others. One such competition is UNESCO's Emir Jaber al-Ahmad al-Jaber al-Sabah Prize for Digital Empowerment of Persons with Disabilities. Another example is the ICCHP Roland Wagner Award, which awards a cash prize of roughly €3000 to outstanding individuals, organisations, and projects in the area of ICT which have a positive impact on the lives of people with disabilities.

3.2.4 Development aid for ICT accessibility

While the level of collaboration and knowledge-sharing is increasing, development aid for ICT accessibility remains sorely lacking. Despite rising Official Development Assistance (ODA) numbers – member countries of the Development Assistance Committee of OECD committed $131.6 billion in 2015, representing the highest level ever reached (United Nations, 2016) – few countries have mainstreamed disability into their development programs, and even fewer have addressed ICT accessibility. Australia provided 5.5 million USD to support disabled people's organisations globally between 2009-2014, but the program did not place any emphasis on ICTs or digital inclusion. At the same time, much of the ODA that does benefit PWDs, including in the area of ICT accessibility, may remain "hidden" or unreported as such, as this was not a high priority policy issue until recently.

3.3 Major challenges and gaps

- **Language barriers.** While many open-source resources and assistive ICTs have been developed in recent years, they overwhelmingly tend to be available in English or other major European languages, in terms of content and user interface. This limits the reach of many open-source or open-access resources, making it difficult for other nations or linguistic minority populations to use or adapt them. Language barriers may also limit knowledge exchange, for example, by hindering participation in international conferences, which often use English as the central language for their programs and proceedings.

- **Lack of Internet infrastructure**
  Sonations lack the technological infrastructure to fully benefit from shared knowledge or technology. For example, even where an open-access resource is accessible and available in a variety of languages, it will remain unusable to those without Internet access. This is particularly true for rural and isolated areas.

3.4 Recommendations

- **Promote ICT accessibility in development aid programs.** Though there are numerous development aid programs in the area of disability, as well as many in the area of ICT, there are very few which support ICT accessibility. Greater resources should be invested worldwide for the development of ICT and Internet infrastructure for PWDs, specifically. Where possible, emphasis should be placed on fostering local expertise and local resources for ICT-based solutions for PWDs.

- **Track and report on ODA dispensed for ICT accessibility.** Conducting surveys of aid agencies and programs may be helpful for developing a better picture of official aid in this area. Another option may be to add some disability-related codes to the Creditor Reporting System's list of "Purpose Codes" in order to track Official Development Assistance targeted at populations with disabilities.

- **Develop microfinance programs for local entrepreneurs working on AT and ICT accessibility in developing countries.** This could be a private project or a private-public partnership. Multinational enterprises with corporate responsibility programs should include ICT accessibility and AT support in their microfinance programs.
- **Promote open-source solutions (technology sharing).** Where new software is created for improving accessibility, developers and providers should be encouraged to share their source code where possible, either by making it available to the general public, or by offering it to governments, NGOs, or other stakeholders.
- **Create a pool of experts in ICT accessibility.** A recognized pool of experts in the area of AT ICT accessibility could help Member States by providing their expertise in different areas.
- **Organise a recurring, high-level international conference on AT and ICT accessibility.** Develop a recurring conference to monitor and discuss progress in ICT accessibility, to define action plans for achieving the SDGs, to promote assistive technologies worldwide, and to accelerate partnerships between different stakeholders through networking. This conference should additionally highlight the need for comparable statistics on PWDs and ICTs, and encourage improved collection and analysis of data for monitoring progress. The event should ideally be held in partnership with the UN, and should involve governments, DPOs and industries from different nations. The 2014 UNESCO International Conference on the Role of ICTs for Persons with Disabilities serves as a good model for such an event. Given the speed with which technology changes, a regularly recurring format, e.g. annual or biennial, is essential.

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4.

Sustainable development goal 4

(Ensure inclusive and quality education for all and promote lifelong learning)

4.1 Relevance of SDG 4 for digital inclusion

ICTs play an increasingly important role in accessible education. Many studies have demonstrated that ICTs can be used to improve learning and teaching as well as literacy for students with disabilities (Starcic and Bagon 2014; Trucano 2005). As information becomes more widely available online, the Internet will likely be one of the most important factors in making education more inclusive at all levels. Many of the services and assistive devices discussed in Chapter 1 above could be used in an educational context, particularly those that offer accessible ICT platforms. As such, Internet access can be considered a key element of the "adapted infrastructure and materials for students with disabilities," as mentioned in SDG indicator 4.A.1(d).

Targets

4.4	By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship
4.5	By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations
4.A	Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all
4.B	By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries
4.C	By 2030, substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and small island developing States

4.2 Facts and figures

4.2.1 Education disparity

Education disparity remains rampant throughout the world. A recent survey of 1.4 million children in 30 countries in the Global South found that children with disabilities were 10 times less likely to attend school than children without disabilities (Plan, 2013). Disparities also occur in the Global North; for example Eurostat data show that PWDs across Europe are more than twice as likely to stop their education early[1], with 31.5 % of students with disabilities leaving early, compared to just 12.3 % of students without a disability (Eurostat, 2014). Disparity may be compounded by other factors such as gender. For example, girls have lower rates of public education around the world (UNESCO, 2013a). Girls with disabilities may thus have a disproportionate disadvantage with regards to education levels. One national literacy study in Turkey illustrates a stark difference in this regard; it found that illiteracy was significantly higher among people with a disability, and was particularly high for girls with disabilities (Figure 3).

1 "leaving early" refers here to when an individual aged 18 to 24 has completed at most lower secondary education, and is not involved in further education or training (Eurostat, 2014).

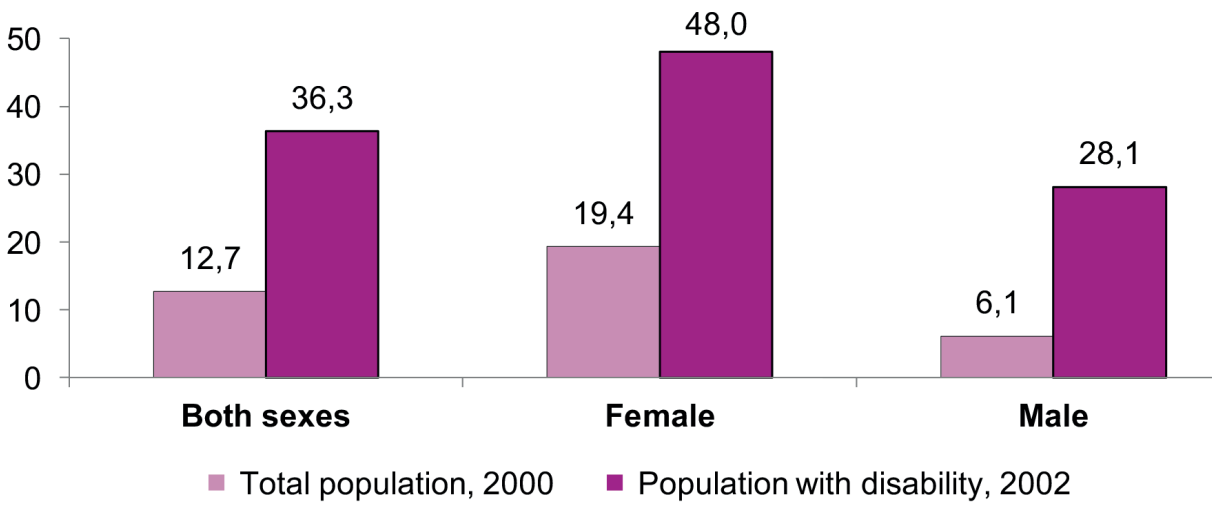

Figure 3. Illiteracy rate (in percent) in Turkey according to disability status, early 2000s. Surveyed persons were aged 6 and up.

Disparity between PWDs and the mainstream population can also be observed at the post-secondary level. Research in Kenya (Kochung, 2011) and Zimbabwe (Mutswanga, 2013) found that PWDs were unable to access higher education due to a number of internal and external barriers, such as inaccessible infrastructure and negative attitudes towards disability. In the United States, despite the legal provisions for non-discrimination laid out in the Americans with Disabilities Act, many universities lack any specific policies on ICT accessibility. As a result, students with disabilities have been forced to file lawsuits against their institutions before reasonable accommodations were provided.

Schools are beginning to universities are beginning to include web and ICT accessibility in their policies, but overall change is progressing at a slow rate. In the developing world, the issue of disparity is twofold: A general lack of accommodations for students with disabilities is often paired with a lack of digital infrastructure or Internet access, which can be considered a prerequisite to fully accessible education.

4.2.2 Accessible ICT infrastructure in education

Digital accessibility often appears to be left out of educational infrastructure, despite its importance for inclusive education. A survey of 104 countries by G3ict revealed that the majority of nations do not offer accessible infrastructure like digital libraries or assistive technologies (G3ict, 2016).

A US study found that, depending on the type of disability, 55 to 64 per cent of American schools that had students with disabilities provided assistive or adaptive hardware, and 39 to 56 per cent provided assistive or adaptive software (Kleiner & Ferris, 2002). This number is likely to have increased since that time, as technology has advanced and Internet access has become more widely available. The same study also found that the lack of assistive hardware and software is compounded by other factors: For example, schools with higher minority enrolment, higher poverty concentration, and smaller size were all found to be less likely to offer such assistive tools.

In order to assist states in updating their educational policies to address the need for accessible ICTs, UNESCO (2014) offers a model policy covering a broad range of actions to improve the use of inclusive ICTs in all levels of education.

4.3 State of the art and good practices

4.3.1 Accessible digital infrastructure

Several nations have been successfully introducing ICTs into their educational infrastructure to help bridge the learning gap. Tunisia, in collaboration with the World Bank, developed the eDisabled Project, which used ICT to improve literacy and social inclusion of students with various disabilities. The project provided assistive and accessible software to schools, and funded 24 resource centres throughout the country that offered a range of accessible ICTs, including magnification software, text-to-speech, touch screen devices, and sign language translation software (Raja, 2016). In 2014, Macedonia and Serbia piloted the eAccessible Education Project. The project introduces assistive ICTs, such as digital textbooks, into mainstream primary education. Vietnam's Nhat Hong Centre teaches visually impaired students to use various assistive ICTs, as well as offering a higher education program, and vocational and career training.

At the post-secondary education level, Karlsruhe Institute of Technology takes an exemplary approach to accessible infrastructure, providing state-of-the-art accessible education materials – such as accessible graphics and mathematic formulas – for students with visual impairments in engineering fields. In Japan, there is one university – the National University Corporation Tsukuba University of Technology (NTUT) – attended entirely by students with visual and hearing impairments.

4.3.2 Teaching ICT accessibility

Open and distance learning is an especially useful educational tool for many PWDs, providing access to courses and material that may otherwise be out of reach. UNESCO's "Guidelines on the Inclusion of Learners with Disabilities in Open and Distance Learning" present good practices in ensuring that distance education is provided in accessible formats for all (UNESCO, 2016).

The availability of academic curriculums on digital accessibility is increasing. Some universities now provide undergraduate and graduate programs in digital inclusion and related topics. In the US there are at least 14 different certificate programmes in assistive technologies. The University of Linz (Austria), Middlesex University (UK), and the Karlsruhe Institute of Technology (Germany) also cover digital accessibility in their curricula.

Other institutions have labs dedicated to researching and advancing ICT accessibility. Examples include the Research Laboratory of Technologies and Information and Communication & Electrical Engineering (University of Tunisia), the ICT Accessibility Lab (Zurich University for Applied Sciences), the Study Centre for the Visually Impaired (Karlsruhe Institute of Technology), the CHArt Lab (University of Paris), the Institute for Accessible Science (Purdue University), and the AMAC Accessibility Solutions and Research Centre (Georgia Institute of Technology).

There are also a number of academic journals dedicated to digital accessibility, including the Journal of Enabling Technologies, Disability and Rehabilitation: Assistive Technology, Technology and Disability, and ACM Transactions on Accessible Computing.

4.3.3 Massive open online courses (MOOCs)

MOOCs are gaining traction as a mainstream educational technology. A MOOC is any online course which is openly available via the web, and may include both traditional course materials (readings, video lectures, exercises and activities) and interactive elements (online quizzes and assignments, open comment sections, live chats). Some of the major MOOC platforms today are EdX, Coursera, and Moodle; these platforms are not yet fully accessible, but user tests indicate that they could be capable of offering content supporting users with different types of disabilities (UNESCO, 2013b). MOOCs offer a unique opportunity for many PWDs to access higher education. Students who have limited mobility, for example, may find that MOOCs are a practical alternative to physical classrooms. MOOCs may also offer an affordable alternative to more an expensive classical education. However, accessibility features must be kept in mind if MOOCs are to become truly open to all. As a web-based technology, it is necessary for providers to keep web standards and guidelines such as WCAG 2.0 in mind when designing online educational content.

Currently, it is difficult to report on the accessibility status of MOOC content on major platforms, because courses can be created by anyone at any time, and no major platform currently enforces accessibility standards in content creation. Recently, the EdX platform committed to full WCAG 2.0 conformance in its basic infrastructure (website, platform and mobile application design), after reaching a settlement with the US Department of Justice in 2015. However, this commitment does not extend to accessible content.

4.3.4 Accessible electronic documents

Digital textbooks and other digital learning materials offer a relatively low-cost, easily shareable alternative to traditional printed documents. They also offer a unique opportunity for inclusion of students (and others) with print disabilities, as they have the potential of being read using screen-reading software. The increasing popularity of digital books (or "eBooks") has been beneficial in this regard. There are many different formats for eBooks, but not all are equal in terms of accessibility. The EPUB 3 format is by far the most highly amenable to accessibility requirements, and was in fact developed with accessibility in mind. EPUB books use HTML format, meaning that they can be easily read by screen-readers on any device.

PDF is another well-known digital format. It can be used to create eBooks or other educational documents, such as exercises, readings, etc. On their own, PDFs are not generally accessible to users with print disabilities; in order to be fully accessible, PDFs require special modifications called "tags." Tagging provides background-level information on the document's structure (titles, figures, lists, etc.), allowing screen-reading software to read the document correctly, hence making it accessible for visually impaired users.

4.3.5 Digital libraries

Digital libraries are holdings of electronic books, and are growing in popularity as eBooks become more mainstream. Two such libraries, both based in the US, were explicitly created for students with disabilities: AMAC has a holding of over 300,000 textbooks in accessible digital formats, offered to students at a relatively low cost, while Bookshare is the world's largest accessible online library, offering its books to students largely for free. Mainstream digital libraries, including ACM and IEEE, have recently implemented policies to make their online content (including PDF, web, and video content) accessible and compliant with WCAG 2.0 guidelines.

4.3.6 Scholarships

There are few widely known scholarships specifically offered for the study of ICT accessibility. An online search reveals a lone result: An e-Accessibility scholarship offered jointly by the annual European Disability Forum (EDF) and Oracle (a private software and ICT service company).

4.4 Major challenges and gaps

- **Education disparity is compounded by other factors.** Poverty has an influence on availability of ICTs in both developed and developing countries. Factors such as minority status and gender also compound the issue.
- **Low awareness of ICT accessibility among stakeholders.** Publishers, teachers, instructors, administrators are often not aware of the common barriers presented by mainstream ICTs, nor of the potential of ICTs to enhance education for students with disabilities.
- **Low prioritization of ICT accessibility among decision-makers.** ICT accessibility is often considered superfluous within education systems.
- **Lack of experts in the field of ICT accessible education.** There are few people who have the specialized knowledge to teach about ICT accessibility at education institutions.

- **Few ICT accessibility programs/curricula in higher education.** Where courses are available on the topic of ICT accessibility, they are generally not mandatory. This is likely because accessibility continues to be perceived as a superfluous topic in ICT, rather than a critical priority. Most educators and students in the field of ICT have no knowledge of the principles of universal design or digital accessibility, nor of the importance of including these topics in supporting the fundamental rights of PWDs.

4.5 Recommendations

- **Leverage accessible ICT-enabled schools as resource hubs.** This can be an especially effective approach in regions where resources are low, making it more efficient to concentrate accessible ICT and AT resources in one central location.
- **Promote accessible open-access educational resources.** Open-access online resources, such as massive open online courses (MOOCs), are growing in popularity and availability as knowledge-sharing platforms. These resources provide a huge potential for the education of PWDs, and as such should be provided in accessible formats. Wherever possible, open-access resources should also be made available at low or no cost. This will be particularly advantageous for areas where educational resources are more scarce.
- **Make ICT accessibility a mandatory component of related study programs.** The issue of accessibility should be built in to the curriculum of higher education programs in the fields of technology, information processing, ICT, and computer engineering, as well as general teacher education programs. This could ideally involve the creation of dedicated modules or courses on ICT accessibility for students in the abovementioned programs, but could also simply mean including ICT accessibility as a topic in other related modules.
- **Promote ICT and AT research centres at the post-secondary level.** Research programs could explore and develop emerging technologies and possible applications for different types of disability.
- **Establish scholarships in the area of ICT accessibility.** These should prioritize students with disabilities as beneficiaries, but could also be made available to any student interested in ICT accessibility, particularly those in the fields of computer engineering and internet technologies.
- **Develop and use accreditation systems in ICT Accessibility.** Existing examples of certification and accreditation program are those offered by IAAP and G3ict.
- **Include ICT accessibility as criteria in university ranking schemes.** ICT accessibility should be included as a criterion in the ranking of world universities; ICT accessibility in this case could refer to accessibility in different areas such as website, online learning materials, or other ICT-based infrastructures.
- **Provide statistics to measure the scale of the challenge.** The data should include the number and proportion of students with special needs from a disability point of view, such as:
    - Disability prevalence in population aged 6 to 18, and 19 to 24.
    - Educational enrolment ratios of the population aged 6 to 18, and 19 to 24.

5.

Key recommendations

1. Promote the visibility and understanding of disabilities.

Although this recommendation is not specific to ICT accessibility, it is an essential first step to ensuring that the needs of PWD – including the need for AT and ICT accessibility – are considered a global priority. The topic of disability in general remains a taboo in many contexts, and is often met with silence, discomfort, or patronizing responses. This perpetuates the stigma, negative stereotypes, and misinformation surrounding disability, and results in an absence of the open discussions necessary for progress to be made. It is imperative to amplify the voices of persons with disabilities, and to openly discuss the topic of disability and the needs of PWD in public settings. Actions for raising awareness could include public campaigns, films festivals, events marking the International Day of Disabled Persons (December 3rd), and school curriculums.

2. Raise awareness and knowledge of ICT accessibility.

Improving public awareness of the barriers and solutions presented by ICTs for PWD will be crucial to successfully addressing this issue within the parameters of the SDGs. In particular, key stakeholders such as governments and decision makers, educators, statisticians, NGOs, DPOs, and ICT industries must be alerted to the vast potential of, and urgent need for, accessible ICTs to improve quality of life and inclusion among PWD. Some methods to achieve this could include the development of academic programs and training programs highlighting ICT accessibility and universal design.

3. Involve PWDs directly.

This recommendation is specifically defined in CRPD and appears across many publications in the area of accessibility. In order to properly understand the variety of needs and abilities that ICTs can address, persons with disabilities must be involved at every stage of development. One of the most effective ways to do this is to work together with DPOs, particularly those which have expertise in the field of ICT accessibility. Article 33 of the CRPD instructs Member states to “develop and enact systematic formal processes to involve DPOs in policy making and monitoring.”

4. Develop/publish comparable data on disability prevalence at the national level.

With the current lack of comparable statistics on disability, it will be impossible to know to what extent the related SGD targets are being met. There is an urgent need for reliable and comparable data and analysis in order to ensure accountability among Member States. The key elements required to achieve this include:

- A core set of international indicators (with additional optional indicators that different countries can use as desired)
- A common methodology for collection and analysis, which will enable international comparisons
- Centralized collection and publication by a recognized statistical body (some possibilities include the UNESCO Institute for Statistics, the World Bank, the UNDP Human Development Report database, and the ITU).

Ideally, the responsible statistical body could provide an open-access, online platform where data from participating nations could be accessed and compared. Another helpful option would be for the same statistical body to provide coaching/training to Member States on how to provide and collect this relevant data.

5. Provide affordable Internet access for PWDs.

Introduce programs, policies or regulations that facilitate free or reduced-rate Internet access for PWDs, particularly those in lower income brackets. This could be in the form of either a monetary social benefit

for PWDs, or non-monetary benefits such as free or subsidized mobile devices and Internet subscriptions. Mobile Internet access, in particular, should be prioritized, given that mobile network coverage is globally higher than broadband penetration, and is expected to increase further, especially in developing countries. Alternatively, community resource centres could be established where PWDs can have facilitated access to Internet and ATs. Affordable Internet access is arguably the most important element of digital inclusion, as it can provide job opportunities, access to information and education materials, access to services, and social participation.

6. Promote the principles of Universal Design in the mainstream ICT industry and the public sector.

Implementing Universal Design principles is more inclusive, affordable, and often simpler than developing specialized software or hardware for PWDs. There are many good examples of companies practicing universal design to the benefit of persons with special needs. The benefits of exercising Universal Design extend not only to PWDs, but also to companies by opening new market opportunities for vendors.

7. Provide funding mechanisms to support the development of open-source software.

Open-source software offers many advantages. It can be acquired free of cost, and can be adjusted according to different user needs, languages, and cultural contexts. This will be particularly important in areas where financial resources are lower and commercially available software may not be considered affordable.

8. Promote ICT-based vocational training and higher education of PWDs.

Accessible and assistive technologies play an increasingly significant role in facilitating professional training and higher education for PWDs. Online courses and educational material, especially where they are open-access, offer a unique opportunity for PWDs to develop their skills and knowledge. Given that PWDs have been found to have lower education and employment rates overall, this is a critical measure. Education and professional skills have a direct influence on financial opportunities and employment later in life. Prioritizing education and training could thus help to address the issue of higher poverty rates among PWDs.

9. Create a dedicated national government branch for ICT Accessibility.

A State-run national competence centre will enable countries to centralize activities related to ICT accessibility and AT, and to oversee the development of policies and directives. In collaboration with other national bodies, these branches could also be responsible for monitoring national progress towards ICT accessibility, organizing public campaigns, and coordinating data collection activities.

10. Create an international pool of experts in the field of ICT accessibility.

Provide a pool of internationally recognized ICT accessibility experts, who can provide consulting to member States upon request. Members of this pool could be nominated and assembled by the United Nations or other affiliated organisations.

Conclusion

In the fast-moving age of ICTs, and with information and communication moving increasingly online, digital technologies present an unprecedented opportunity for the inclusion of PWDs. At the same time, they also present a major risk of leaving PWDs further behind, in cases where these technologies, accessible products, content and services are not created with accessibility in mind.

The field of ICT accessibility has gained increasing attention in recent years. The United Nations CRPD, which has so far been ratified by 172 governments, has been instrumental in this regard. It includes specific provisions for ICT and Internet access for PWD, as well as for the direct involvement of DPOs. The 2030 Agenda defines a set of targets and indicators including some which are relevant for ICT accessibility. These are described in chapters 2-5 of this report. There are a number of initiatives, projects, and organisations worldwide which showcase innovative practices in this area, the majority of which are based in developed countries. However, many less developed countries lack basic infrastructure for PWDs, such as Internet availability.

A review of existing data was carried out to determine the state of the art in terms of reaching ICT accessibility-relevant targets and indicators. The results are disappointing. What little data on disability does exist is generally not comparable between counties and regions. Additionally, a lack of standardized methodologies and internationally recognized indicators precludes any meaningful statistical analysis. Nevertheless, based on the research carried out, it was possible to propose a number of SGD-specific recommendations as well as key indicators.

Understanding the needs of PWDs and considering them as equal counterparts is a prerequisite for the success of any disability-related activities, including those in the area ICT accessibility. Raising awareness among both public and private sectors, is critical. Involving PWDs is a must for the success of any disability-related projects, products, and services, including ICT accessibility, as they provide the best available knowledge of the needs and requirements of these groups. A systematic collection of data, a clear methodology for comparison, regular data evaluation, and a publicly available platform to showcase to interested parties are strongly recommended for a successful analysis of the state of the 2030 Agenda in terms of ICT accessibility. The Internet plays an important role for the inclusion of PWDs, and low-cost availability of Internet is crucial in this regard. Governments could provide subsidized or free Internet access for PWDs. Funding should be provided to support universal design, open-source software, and low-cost assistive technologies worldwide, as many low-income countries lack the financial resources to use specialized commercial solutions. Nationwide ICT accessibility policies and regulations build a foundation for implementing ICT accessibility in different areas. Specialized competence centres in supporting vocational training and higher education provide a sustainable strategy to reduce poverty and foster the participation of PWDs in society. International bodies such as the UN could provide a pool of ICT accessibility experts to help Member States to implement the CRPD and reach the related 2030 targets.

Many of the recommendations presented here involve multiple stakeholders – governments, corporations, and NGOs all have potential roles to play. Overall, both involvement and funding in the area of ICT accessibility should be increased. The social responsibility departments of large corporations could also be an important part of this change by dedicating more resources to the issue of digital inclusion for PWDs.

The aim of this paper was to provide an overview of existing statistics and best practices from around the world in the area of ICT accessibility, within the context of the 2030 Sustainable Development Agenda. It should be noted that this paper does not consider all aspects related to accessible ICTs and their potential use in other areas, such as employment, disaster relief, or health.

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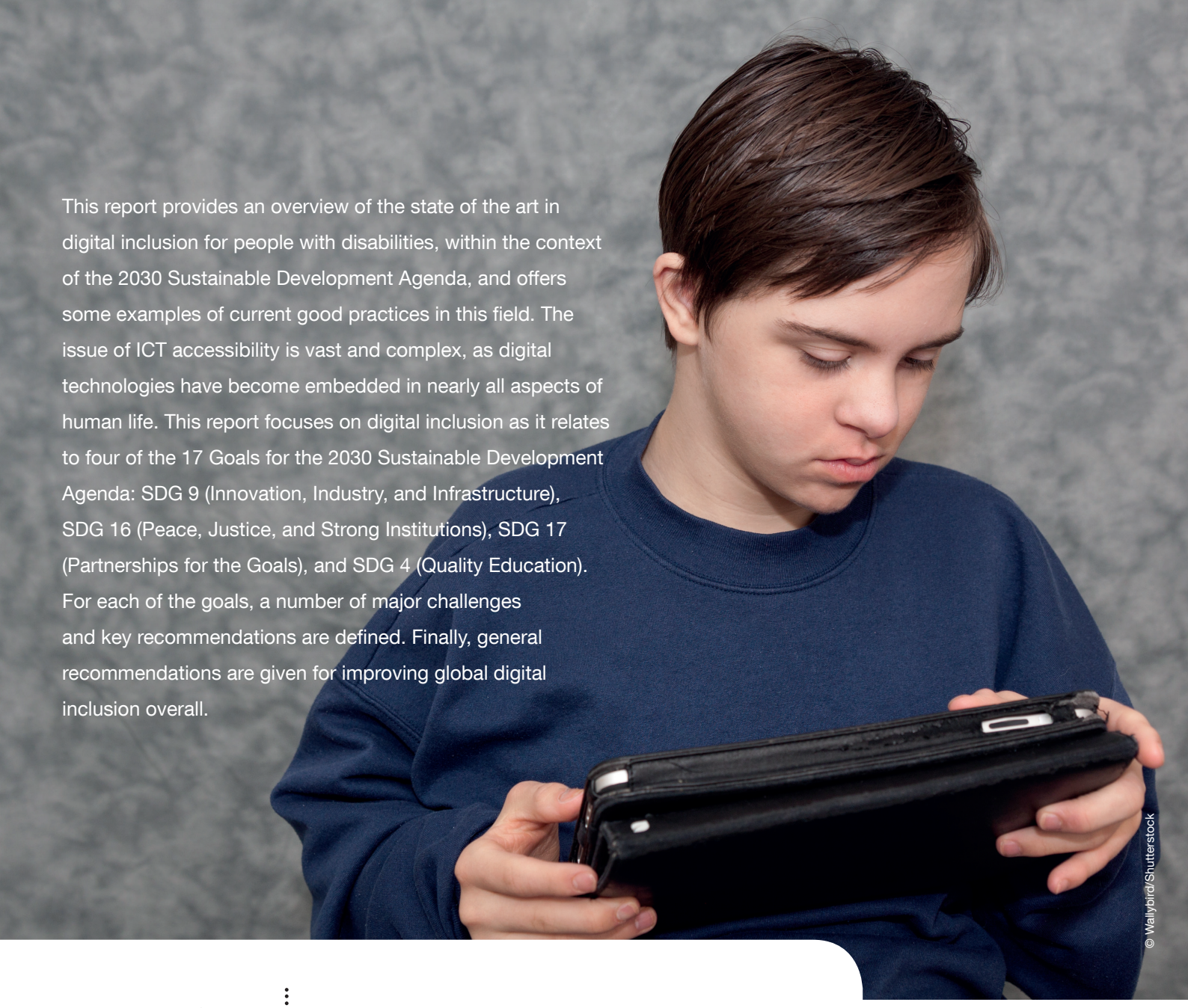

This report provides an overview of the state of the art in digital inclusion for people with disabilities, within the context of the 2030 Sustainable Development Agenda, and offers some examples of current good practices in this field. The issue of ICT accessibility is vast and complex, as digital technologies have become embedded in nearly all aspects of human life. This report focuses on digital inclusion as it relates to four of the 17 Goals for the 2030 Sustainable Development Agenda: SDG 9 (Innovation, Industry, and Infrastructure), SDG 16 (Peace, Justice, and Strong Institutions), SDG 17 (Partnerships for the Goals), and SDG 4 (Quality Education). For each of the goals, a number of major challenges and key recommendations are defined. Finally, general recommendations are given for improving global digital inclusion overall.

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