

A Preliminary Study to Understand How Mainstream Accessibility and Digital Assistive Technologies Reaches People in Lower- and Middle-Income Countries

Tigmanshu Bhatnagar^{1,2}, George Torrens⁵, Ben Oldfrey^{2,3}, Priya Morjaria^{2,4}, Felipe Ramos Barajas^{1,2}, Katherine Perry^{1,2} and Catherine Holloway^{1,2}

¹UCL Interaction Centre, ²Global Disability Innovation Hub, ³UCL Institute of Making, ⁴London School of Hygiene and Tropical Medicine and ⁵Loughborough University

INTRODUCTION

Access to information on digital platforms not only facilitates education, employment, entertainment, social interaction but also facilitates critical governmental services, ecommerce, healthcare services and entrepreneurship [1]. Article 9 of United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) enforces its signatories to commit to provide full accessibility to every citizen of the nation [2]. This has helped to spearhead accessibility directives such as the European Accessibility Act [3] that aims to improve the functioning of markets for accessible products and services. Such directives contribute to ensure that mainstream digital technologies (smartphones, computers etc.) are accessible for everyone and without being socially remarkable, they are able to assist in daily living. Additionally, there is evidence that improving access in mainstream technologies improves product experience and usability for everyone [4]. However, mainstream access has not been fully realized, leading to inferior opportunities for people with disabilities, a disparity which is more prominent in lower and middle-income countries [5].

Furthermore, it is important to note that there is a practical limitation to the amount of access and assistance that mainstream digital devices can facilitate. Specialist Digital Assistive Technologies (Digital AT) are therefore required such as Refreshable Braille Displays, Augmentative and Alternate Communication devices, and specialist applications/software. With Digital AT, people with disabilities can access information on digital platforms and communicate through them independently. However, Digital AT can put an additional burden of purchasing and learning them on the person with disability [6] and their use in social situations may attract curiosity which can lead to stigmatization of the user and even abandonment [7]. There is also a need to build capacity to train people with disabilities and raise awareness about the number of affordable and inexpensive Digital AT solutions that are already available [8].

Amidst these challenges, there is little that we know about how mainstream accessibility and Digital AT in practice reaches people in lower and middle-income countries (LMICs). In this study, eight experts were interviewed who are established in the domain of training people with disabilities, advising on policy and facilitating access and Digital AT, and shared their diverse experiences. The insights we assimilate from these conversations should help developers of accessibility and Digital AT solutions to more effectively deliver products and services to those in need. The same insights should also provide a better understanding of the market to business strategists to deliver pathways to accessibility and Digital AT.

BARRIERS	STRATEGIES
Awareness	Increasing Accessibility and Digital AT in mainstream devices
Availability	
Training	Open Source Digital AT
Accessible and Interoperable AT	Championing and Particular Product Service System
Updated and Maintained	

Figure 1: Overview of the five identified barriers and three provisioning strategies

METHODS

5 of the 8 experts work in LMICs and together, they shared experiences from working in seven different countries. We briefly describe each participant in Table 1. Semi-structured interviews were conducted with the 8 experts and each interview lasted for approximately 60 minutes and consisted of questions regarding their product or service, its inception, its need, financing models, provisioning strategies and innovation in their domain. These were conducted as part of the five Product Narratives developed by the Clinton Health Access Initiative (CHAI) under the AT2030 program in support of the AT Scale Strategy [9]. Informed consent was taken from each participant along with their permission to record the conversation. All interviews were transcribed, identifying details were omitted and all participants were given pseudonyms to ensure anonymity and confidentiality. The data were analyzed thematically using an inductive approach [10] to draw themes for provision strategies from an experiential orientation, investigating only from practical experiences shared by the experts. From the interview data, we were able to code key challenges and the strategies used to overcome them. We found that certain codes repeated across socio-economic contexts which were then clustered to develop the core themes of Digital AT provisioning strategies.

Table 1: Brief description of the participants

P1	The general secretary of a national charity to train and educate BPSP and an accessibility consultant for the Daisy Consortium	P5	An independent AT consultant with over thirty years of experience in the domain of AT
P2	Director of an international charity focused on helping children to have access to Braille education and devices	P6	Manager of an educational accessibility initiative of an international organization
P3	A sales manager for an AAC company for 11 years and in the domain for 16 years	P7	Founder of a multinational AT assessment and advisory online platform that has been in existence for 2 years
P4	Coordinator of ICT policy development at an international forum of Disabled People's Organization	P8	Founder of a charity that provides digital literacy to people with disabilities in a developing country.

BARRIERS TO MAINSTREAM ACCESS AND DIGITAL AT IN LMICs

Provisioning strategies aim to overcome five key steps or barriers to accessibility uptake and use of Digital AT. The first step is to create awareness among people with disabilities and their families about accessibility features and Digital AT in LMICs, as a majority of them do not have the basic awareness that there are digital tools which are easily available out there that can help them.

"I think the biggest battle we face globally is awareness. There is huge amount of people who don't know what AAC is. For the average person on the street, AAC is irrelevant, it's not something you will come across in day-to-day life. Only when somebody themselves is impacted with an event which later requires an AAC or someone within their family is either born or acquires disability is when it starts to get on people's radar. It's the same for a lot of professionals. The amount of training speech therapists get in the course of their training is miniscule." – P3

Once people are aware of a potential solution, the second step is to ensure the availability of affordable Digital AT in the vicinity of the user.

"The biggest challenge is the economics of providing digital assistive devices of any kind. We are trying to work with two big banks in (our city) to see how they can support visually impaired university students, teachers or professors to acquire a payment plan that the bank can provide as a part of their corporate social responsibility." – P2

The third challenge after owning Digital AT is to appropriately train people to be able to use the Digital AT products and services available. Without training, people may not know how to effectively operate devices or about features that exists to facilitate access and make their life easier.

"When you train young blind people with ICT, they have a lot of potential and learn very quickly. When they learn well; they can become role models for others and help them overcome the fear of using ICTs." – P8

The fourth step is to ensure that the information, content and services on mainstream digital devices are accessible and that specialist Digital AT devices are maintained and are interoperable within the mainstream digital ecosystem. Accessibility of mainstream websites and mobile applications is measured against international guidelines like the Web Content Accessibility Guidelines (WCAG) 2.0 [11]. They set up the requirements for web-based content and services if they are to be accessed by people with disabilities. However, these guidelines are ensured by the national legislation on accessibility which is depended on national policy. In LMICs, legislation around accessibility is rarely enforced. As a result, developers have little incentive to make even important websites and applications like banking and e-commerce inclusive and accessible. A lack of awareness that people with disabilities will use website and other online platforms or that they will be a new customer segment is a significant aspect of the problem. It then comes down to retrofitting accessibility, which becomes challenging as it requires significant investment to iterate and maintain an accessible service, that people tend to avoid.

"Legal obligation is not there, awareness is not there so the developers do not test their sites for accessibility and do not comply to the guidelines. Even when the disabled person has the confidence and the device, they are not able to make use of it. The same thing is with mobile apps." – P1

The fifth challenge with Digital AT is that its ecosystem needs to be constantly updated and maintained to keep pace with evolving needs and new technologies. This requires targeted coordination of stakeholders within the supply chain, from product and service providers, to governments. Each provisioning strategy therefore aims to address these five challenges within its regional context.

STRATEGY 1 – INCREASING ACCESSIBILITY AND DIGITAL AT IN MAINSTREAM DIGITAL DEVICES

Essential services such as banking, education, governance, healthcare etc. along with entertainment and lifestyle activities are increasingly becoming more popular and common on digital devices, typically the smartphone [12].

People with disabilities are able to participate and use such services for which, accessibility features are crucial. For instance, a person with visual impairment can choose to listen to the displayed text through inbuilt text to speech programs in smartphones and computers. A person with hearing loss instead uses text messaging and closed captioning to understand and communicate with others while people with mobility impairments have the option to interact with devices through voice commands. Accessibility on such devices enhances the economic and social participation of people with disabilities [5].

"In the latest version of ePub standard, ePub 3, they have incorporated WCAG inside ePub3 which is very good because now industry standard for eBook is incorporating the accessibility guidelines. All the ebooks that will be placed globally now benefit everybody as people will be able to change the font size, change format to enable different ways of reading, which is good for people with dyslexia, who are blind or have learning disabilities." – P4

At the same time, devices like the smartphone are increasingly being able to provide applications and features for assistance, which in the past required standalone devices. This has significant cost benefits as assistance can be provided through a single widely available, serviceable and portable device, which reduces the need for specialist devices. Furthermore, such devices eventually become nodes to control other interoperable smart devices such as smart glasses and smart appliances making independent living easier. Therefore, free or low cost assistive technology applications on mainstream digital devices are popular among disabled users [9]. These software options offer choices to the users as they have an opportunity to evaluate multiple applications providing the same assistance and judge which one suits them the best on a variety of personal parameters. This opens up the market of choice for the user and therefore, motivates developers to continuously improve their services, creating growth and innovation.

"A visually impaired person can download 3 different magnification apps from the Appstore instead of procuring a magnifier and make a choice for himself, as to which apps suits him and his needs the best." – P5

STRATEGY 2 – OPEN-SOURCE DIGITAL AT

Open assistive technology software on mainstream devices can also see a higher adoption in comparison to proprietary software as it is free to download. The value system of open source that anyone can use the developed solutions and improve it, forms a community of people who adapt the software as per their needs, giving rise to new context specific services and business models.

"One of the (country's) organization, they are making use of the (open-source software) code, they have enhanced it for the local languages, and they are now selling a customized (open-source software) package with several local language text to speech voices. It is called (company). The price is also very nominal. Now people have a choice to buy this one instead of downloading the free version, so they get more languages and also have a company to go back to for support. Similar thing has been done in a few other countries." – P1

Groups on social media serve as a platform for support and advice. Self-organizing social media groups of users using a particular Digital AT also spreads awareness, raise common issues and extends community support to people who are new to the service. In this way people can become aware about a device or service, download or purchase it online and without formal training and start using it and troubleshoot problems using the online support groups. Furthermore, they are also used to as a medium to research trends in user's needs and therefore, advises product developers to provide new and relevant services with their offerings.

"There is stuff that people say that I want it to do this. But then there is also that you start to see people using workarounds and using their own techniques to achieve difference, so you see more people using the tool to access social media for example...we don't have tools for that, so why don't we build it. So that informs part of the product development" – P3

Evidence shows that open-source platforms eventually become more popular, accessible and contextually relevant as they are facilitated by new business models and self-organized support groups on social media platforms [9]. The quality and features of open-source systems may still be not as proficient than proprietary services, but people seem to be willing to adopt the open version. Their viewpoint is that some assistance is better than none, even if it isn't perfect.

"Let's move from the patron perspective of I as a healthcare professional knows what is best for you, I will restrict you from the open market, you just need to use the so-called device that I have been working with and I know this is reliable...No...We need to work with consumers, and we need to change this market." – P7

STRATEGY 3 – CHAMPIONING A PARTICULAR PRODUCT SERVICE SYSTEM

When a Digital AT shows evidence of success, but cannot be free or open source, *coordination* is required between the entire ecosystem for the product development, its financing, provision, service, training and maintenance. This strategy operates in an organized Product-Service System (PSS) as the lead organization (which could be a charity, university, government or a private company) creates a contextually appropriate mix of

products and services for people. It is important to note that this is different to a traditional charitable distribution model of assistive technologies that focuses solely on products [13]. Typically, a good Digital AT for this strategy is required by the masses, affordable, does not have high infrastructural requirements but a high functional utility, reliable, interoperable within the existing digital ecosystem and offers a clear advantage to people over existing solutions.

"All of these (organizations) have to be linked together because if they do it together then, our plan falls apart. A lot of work and effort goes in managing the relationship with government institutions... We work with the hope that as we include them, they see the benefits, as they see how things change, it's kind of an advocacy for them to take it up in the future." - P2

The service infrastructure around the Digital AT can involve coordination to develop financing models, partnerships with private organizations to develop content, coordination between government departments to manage funding and outreach, service delivery partnerships, and institutions to build capacity and sensitivity about disability and assistive technologies. The major issue in managing and coordinating is the time and energy it takes to push things through important stakeholders, who do not have the assistive technologies as a mandate.

"The publishers acknowledged that there is a need but said that unless we are forced to do it, we are not going to invest in that book because the market is not big enough... the biggest win from our side is to put together in one room, the important international DPOs to agree that learning in an inclusive setting should be truly inclusive with the same book; but just that took years!" - P6

Successful coordination examples have also shown a top-down strategy where organizations in power, typically the government, mandates multiple actors to coordinate among each other to provide the products and its related services. For instance, in a LMIC, the ICT Ministry under the mandate from the President's office championed the idea of employment of people with disabilities in ICT and coordinated with companies and upskilling centers to accomplish the mission.

CONCLUSION

Through interviews with eight expert professionals in the field of Digital AT globally, five key barriers to product and service provision strategies have been identified. Through thematic analysis of the interviews, three distinct strategies have been defined from their diverse perspectives. The strengths and drawbacks of how each strategy addresses the five challenges have been discussed. Further discussion is required within the wider Digital AT community on how to effectively apply these advisory strategies back into specific Low to Middle Income Countries.

REFERENCES

- [1] United Nations Conference on Trade and Development, *Digital economy report 2019: value creation and capture : implications for developing countries*. 2019.
- [2] "Article 9 - Accessibility | United Nations Enable." <https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities/article-9-accessibility.html> (accessed Sep. 06, 2020).
- [3] baranal, "Web Accessibility," *Shaping Europe's digital future - European Commission*, Nov. 30, 2012. <https://ec.europa.eu/digital-single-market/en/web-accessibility> (accessed Sep. 16, 2020).
- [4] C. Holloway, "Disability interaction (DIX): a manifesto," *interactions*, vol. 26, no. 2, pp. 44–49, Feb. 2019, doi: 10.1145/3310322.
- [5] D. Samant, R. Matter, and M. Harniss, "Realizing the potential of accessible ICTs in developing countries," *Disabil Rehabil Assist Technol*, vol. 8, no. 1, pp. 11–20, Jan. 2013, doi: 10.3109/17483107.2012.669022.
- [6] J. O. Wobbrock, S. K. Kane, K. Z. Gajos, S. Harada, and J. Froehlich, "Ability-Based Design: Concept, Principles and Examples," *ACM Trans. Access. Comput.*, vol. 3, no. 3, p. 9:1-9:27, Apr. 2011, doi: 10.1145/1952383.1952384.
- [7] K. Shinohara and J. O. Wobbrock, "In the shadow of misperception: assistive technology use and social interactions," in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, Vancouver, BC, Canada, May 2011, pp. 705–714, doi: 10.1145/1978942.1979044.
- [8] "DS Raja - Background paper for the World Development report, 2016." Accessed: Mar. 01, 2021. [Online]. Available: <http://pubdocs.worldbank.org/en/123481461249337484/WDR16-BP-Bridging-the-Disability-Divide-through-Digital-Technology-RAJA.pdf>.
- [9] "Product Narrative: Digital Assistive Technology | AT2030 Programme." <https://at2030.org/product-narrative:-digital-assistive-technology/> (accessed Mar. 02, 2021).
- [10] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qualitative Research in Psychology*, vol. 3, no. 2, pp. 77–101, Jan. 2006, doi: 10.1191/1478088706qp063oa.
- [11] W. W. A. Initiative (WAI), "Web Content Accessibility Guidelines (WCAG) Overview," *Web Accessibility Initiative (WAI)*. <https://www.w3.org/WAI/standards-guidelines/wcag/> (accessed Sep. 06, 2020).
- [12] 1615 L. St NW, Suite 800 Washington, and D. 20036 USA 202-419-4300 | M.-857-8562 | F.-419-4372 | M. Inquiries, "Smartphone Ownership Is Growing Rapidly Around the World, but Not Always Equally," *Pew Research Center's Global Attitudes Project*, Feb. 05, 2019. <https://www.pewresearch.org/global/2019/02/05/smartphone-ownership-is-growing-rapidly-around-the-world-but-not-always-equally/> (accessed Mar. 06, 2021).
- [13] C. van Halen, C. Vezzoli, and R. Wimmer, *Methodology for product service system innovation: how to develop clean, clever and competitive strategies in companies*. Assen, the Netherlands: Koninklijke Van Gorcum, 2005.