G3ict

Knowbility

The Impact of Digital Accessibility Innovations on Users' Experience

A Survey Conducted by
G3ict and Knowbility
For Participants of the
8th M-Enabling Summit

Washington, D.C.
June 17-19, 2019

The Impact of Digital Accessibility Innovations on Users' Experience

A Survey Conducted by G3ict and Knowbility
in the Occasion of the 8th M-Enabling Summit
Washington, D.C.
June 17-19, 2019

Contents

Background

People with disabilities want what all digital users want – opportunities to learn, to work, and to participate in consumer, social, and civic activities online.   Digital users interact through many channels. They interact with governments, retailers, banks, health care providers, travel services, Organizations of persons with disabilities, and many other mainstream providers through a growing range of channels and devices (physical and electronic) web and social media platforms. All these affect user experience. They use new sources to seek out information. They gain knowledge about products and services through interactions with multiple electronic channels and related information sources. Users increasingly prefer to use peer recommendations found on social networks than those of experts. And they value simplicity. Users are continually striving for simplicity. To achieve simplicity and to sustain user engagement, leaders across all sectors of global society are working to transform their interactions through technology innovations toward effective digital accessibility.

Accessiblity innovation is not driven by the necessity to implement new, cost cutting technologies. It is driven by the need to provide clear content and easy interaction, and to create new products and services which align to user behaviors and meet their needs. The surge of technology innovations over the past 10 years such as mobility, artificial intelligence and machine learning, data analytics, cloud and social media are not necessarily the key drivers of innovation (e.g., U.S. Patent and Trademark Office). Technology is the enabler, but value and desired outcomes are first and foremost generated by responding to user behavior.

Digital innovation is defined as the process of combining digital and physical components to create novel devices, services or product models; bundling them to constitute and enable valued offerings; and embedding them in wider sociotechnical environments to enable their diffusion, operation and use (See, for example: Yoo Y, Boland RJ, Lyytinen K, Majchrzak A (2012) Organizing for innovation in the digitized world. Organ Sci 23(5):1398–1408; Fichman RG, Dos Santos BL, Zheng ZE (2014) Digital innovation as a fundamental and powerful concept in the information systems curriculum. MIS Q 38(2):329–343; Nambisan S, Lyytinen K, Majchrzak A, Song M (2017) Digital innovation management: reinventing innovation management research in a digital world. MIS Q 41(1):223–238; Kohli, R. and Melville, N.P. (2019), Digital innovation: A review and synthesis. Information Systems Journal. ISJ Volume29, Issue1 January 2019, 200-223).

Motivating Factors for Digital Accessibility Innovation

Business and industry digitally innovate to enter new markets, differentiate themselves, be competitive and remain relevant to customers. In the 'corporate world' innovation is a common business strategy. Other motivating factors include: Market Competition, Market Expansion - W3C/WAI ; Product and Service Improvement - Google, CISCO, Facebook, Adobe, MIcrosoft ; Corporate Social Responsibility – IISD, Global Reporting Initiative, WIPRO, Microsoft Stakeholder Engagement; Legal and Regulatory Compliance – https://medium.com/@lsnrae/the-state-of-accessibility-in-e-commerce-fc97b9bad3a2; Employee Engagement - PEAT; User Experience Enhancement – Gartner, dotCMS, Interaction Design Foundation, SAS , ACQUIA; and, Organizational Enhancement - IBM; IBM2.

Governments and public-sector entities also digitally innovate because of various motivating factors, including: Civic Tech – OECD Observatory of Public Sector Innovation, Consul/Jamaica, Canada 2019 Accessibility Tech Program and FAQs, Digital Leaders, and Digital Agenda; Governance Instruments and Strategic Action Plans – UNCTAD, and 2030 Agenda-SDG9; Multi-Stakeholder Collaborations – Internet

Governance Forum, World Economic Forum; International Partnerships and Agendas– Global Partnership for Assistive Technology AT2030. Environmental Redesign and Integration – Livable Communities, Smart Cities, and Intelligent Communities; Community Social Inclusion – a2i, NESTA/DSI; and Citizen Engagement – Techsoup/Europe, and Consul.

People drive digitally accessible innovations through demand for tech-enabled products and experiences. They embrace digital platforms for eCommerce and entertainment, and to access healthcare, education and government services and information. And they develop and apply the skills that fuel digital innovation. As a result, the degree to which we grow digital innovation across the globe will largely be dictated by the people who use it (See, for example, Financial Times). Technology companies recognize the increasing need to recruit and infuse user experiences into digital innovation initiatives (see, for example, Google - Become a Trusted Tester, Microsoft – Accessibility Customer Feedback, Adobe – Accessibility Feedback, IBM - Accessibility User Experience

Digital Accessibility Innovation and User Experience

To better understand the extent of some recent trends we conducted a survey of digital accessibility experts involved in innovation. The survey sought to explore both what areas and types of innovation experts were involved with, the role(S) they played in that regard, how they assess the utility of those innovations, and what they perceive to be innovation gaps in digital accessibility. This survey was conducted as part of a collaboration between Knowbility and G3ict. In addition, the collaborators reviewed the extant literature and scanned the environment to identify effective digital innovation practices.

We designed our research to ensure that it was independent and not prematurely aligned to any industry or business models, commercial perspectives, or specific sets of technologies. Results are expected to help both industry and advocacy organizations assess how recent technology innovations have impacted the user experience of persons with disabilities. It is G3ict's understanding that there is no recent data publicly available on this topic. However, there has been a sea change over the past ten years in the availability of accessibility features and the emergence of new types of digital information, products and services.

Areas of interest for this work involved:

- Accessibility innovations that have had over the past few years the most positive impact on users with disabilities and for which types of applications.
- The type of virtual/remote customer services most appreciated by persons with disabilities with examples.
- New digital products, services and contents that create the most accessibility challenges for users with disabilities and why.
- Specific organizations/companies perceived as most effective at implementing accessibility policies, products and services from a user's perspective.
- The degree to which accessibility features of mainstream products are used by persons with disabilities and the reasons why they may not use them.
- Identification of most desired functionalities to be further developed by industry to improve the experience of users with disabilities.

Methodology

Our research approach relied on several steps. First, a review of the recent and extant literature on digital inclusion, digital innovation, and accessibility. Second, an environmental scan of digital innovation across public, non-public and private domains was carried out. Third, an online questionnaire was initially designed and field-tested, and revised based on feedback from a field test. The revised survey was placed online and an invitation to participate was sent to the Knowbility tester panel participants. The panel is predominantly located throughout North America and represents different user segments by type of disability and by selected interested industry participants.

For the survey question, "What disability do you have/are you most familiar with?" respondents were asked to select all that apply. Possible responses involved 56 disability choices which included: visual, hearing, neurological, motoric, cognitive, physical, educational, medical, and none. Of the 159 survey participants, only one (1) respondent selected a single disability choice as the response (i.e., neuro-congenital). The other 158 survey participants identified as few as two (2) or as many as thirty-three (33) disability choices as their response. Survey questions generally fall within the following areas:

- Demographics;
- Types of virtual/remote customer services most appreciated by persons with disabilities;
- Accessibility innovations that have had over the past few years the most positive impact on users with disabilities and for which types of applications;
- Accessibility innovation features deemed effective and why;
- Customer services most appreciated by persons with disabilities, with examples;
- New digital products, services and contents that create the most accessibility challenges for users with disabilities and why;
- Specific organizations/companies perceived as most effective at implementing accessibility policies, products and services from a user's perspective.
- Degree to which accessibility features of mainstream products are used by persons with disabilities and the reasons why they may not use them; and
- Identification of most desired functionalities to be further developed by industry to improve the experience of users with disabilities.

Survey Findings and Analysis

This survey collected information from 159 digital accessibility expert users (also referred to as "power users") who participate in user testing for Knowbility. on innovations and innovation activities during 2013 to 2018. For this survey, an innovation was defined as the introduction of a new or significantly improved product, process, or service. Furthermore, an innovation must have characteristics or intended uses that are new or which provide a significant improvement over what was previously used or available to users.

Findings from survey respondents are now presented along five major themes: (1) assistive technologies and accommodations they used to interact in digital space; (2) innovations that respondents were involved with over the past five years, type or level of involvement, and opinions of those innovations, including challenges and possible solutions; (3) availability and effectiveness of a range of accessibility features; (4) opinions about value-added and perceived levels of user satisfaction with "new" technologies, including mobile and desktop features and apps; and (5) if any respondents were web

developers, including changes and challenges and solutions. Findings presented for open-ended questions are not all-inclusive but are meant to depict the range and texture of respondents' answers.

1. Assistive technologies and accommodations respondents use in digital space

Types of Assistive Technologies or disability accommodations respondents most familiar with.
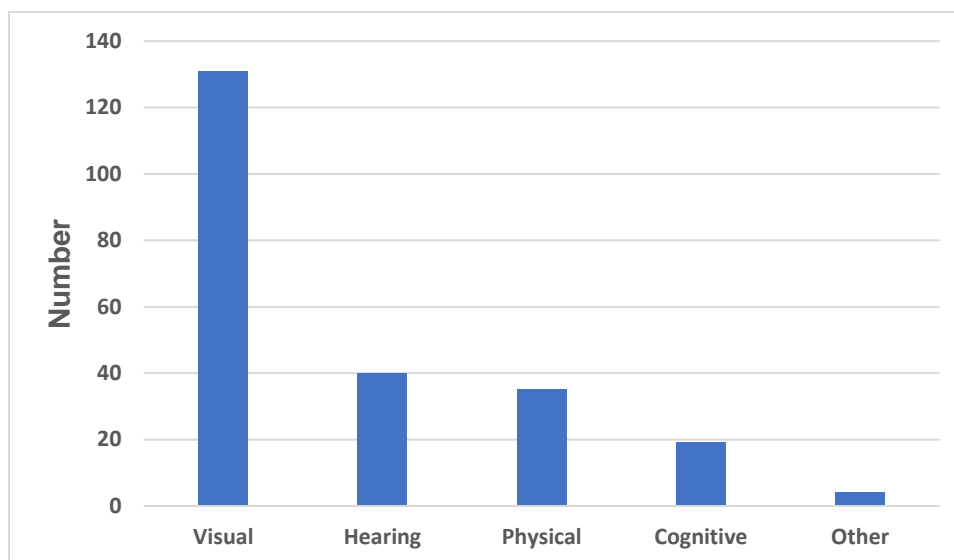
Figure 1 - Which types of assistive technology or disability accommodations are you most familiar with?

Technologies used by respondents to read and understand output from their computer

ANSWER CHOICES	RESPONSES
Screen reader or voice reader	120
Mobile device such as a phone, small tablet, or book reader	124
Laptop computer or combination tablet with keyboard	117
Audio descriptions of video content	87
Braille output device	72
Normal computer screen, up to approximately 30 inches	27
Operating system accessibility option settings for output	45
Extra-large monitor such as a 50-inch wide-screen television	9
Custom browser settings	24
Transcripts for time-based media	21
Screen magnifier software such as ZoomText	21
Text enlargement with browser controls (control/command-plus)	20
Captions for audio content	18
Color independent content	8
Custom style sheets	6
None of these	1

Table 1 - What technologies do you use to read and understand output from the computer?

Types of screen or voice readers used by respondents
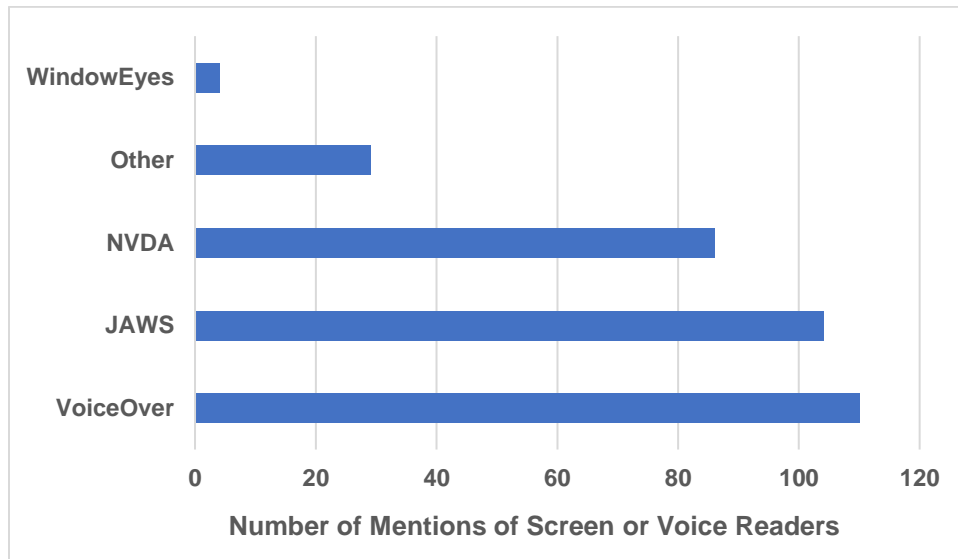
Figure 2 - If you use a screen or voice reader, please check which one or ones you use.
Others include:
Zoomtext, TalkBack for Android, Narrator, Voice Assistant, Text-to-Speech Magnifier,
Orca on Linux, Gnome-Orca, Alexa and Voiceview,Read & Write, ClaroRead Pro

Technologies used by respondents to control and send input to the computer

ANSWER CHOICES	RESPONSES
Keyboard plus mouse, trackpad, or touchpad/screen	71
Keyboard only, no use of mouse or touch device	81
Trackball or touchpad only, with no keyboard	1
Alternative or customized keyboard	3
Braille input device	58
Mouth stick or head wand	1
Single switch control	1
Operating system accessibility option settings for input	25
Eye tracking device	3
Writing and self-editing support	8
Word prediction software	16
Voice input	55

Table 2 - What technologies do you use to control and send input to the computer?

2. Innovations that respondents were involved with over the past five years

Involvement of respondents with product or service innovations of any kind
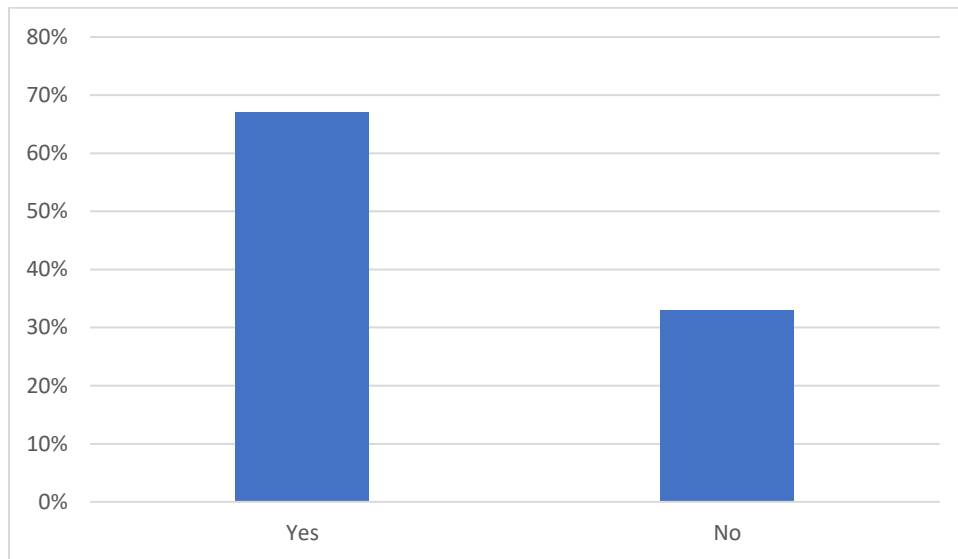
Figure 3 - During the period 2013 to 2018, were you involved at all (e.g., development, testing, marketing, direct usage, general awareness) with product or service innovations of any kind (new or significantly improved products or services)?

Products and services innovations and companies with which respondents are familiar with.

Survey responses included:
- Accessibility testing of Microsoft's Seeing AI application;
- En-Vision AmericaOmni3 Barcode scanner;
- Braille Note Touch Plus by Humanware; Horizon by AIRA Tech.
- Google-TalkBack, Chase Bank Screen Reader-support on website, you Describe - YouTube
- Voting machines (HART);
- Apple iPhone with VoiceOver. Beta tester for Apple and app developers. Microsoft Windows 10 Beta tester;
- Orbit Reader 20, APH and Orbit Research, Graphiti from APH, AIRA, Kanute;
- Accessibility menu for Facebook;
- Tested a Walabot by Vayyar, Inc as an assistive input device;
- Talkback by Google; Narrator by Microsoft;
- Updates in Jaws by Freedom Scientific, NVDA by NV access;
- Tested software to make PowerPoint presentations more accessible. Software manufactured by Markido Inc.;
- As an Android user, I worked with Mozilla on on internet browsers to improve their accessibility;
- Accessible Remote Services: NVDA Remote, NV-Access, Remote Incident Manager, Serotek Corporation, JAWS Tandem, Freedom Scientific LLC;
- I worked with Knowbility to test Porter Airlines website, a digital media/multimedia curriculum platform through the use of VoiceOver;

- Equatio math accessibility for TextHelp EPub accessibility standards - Bookshare, Learning Ally and George Kercher;
- Gnome Orca screen reader; Fenrir, screen reader on GITHUB open source; JAWS, by Vispero.; Vinux, vinuxproject.org manager;
- PC, Microsoft products, iPhone, tested websites with Knowbility; and
- Target website, Septa website, Septa Chi court usage.

Respondents description of the product or service innovation they were involved with
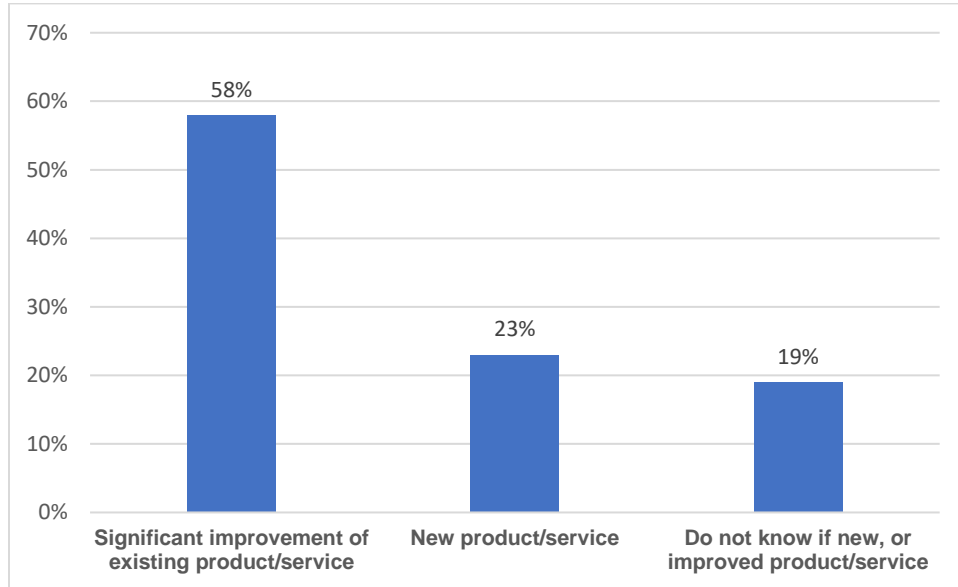
Figure 4 - Which phrase best describes the product/service innovation?

ANSWER CHOICES	RESPONSES
This product/service innovation demonstrates a significant improvement of a product/service that already existed	**58%**
This is a new product/service	**23%**
I do not know if this product/service was new, or if improvements were made to existing products/services.	**19%**

Table 3 - Which phrase best describes the product/service innovation?

Level of involvement of respondents with products or services innovations described
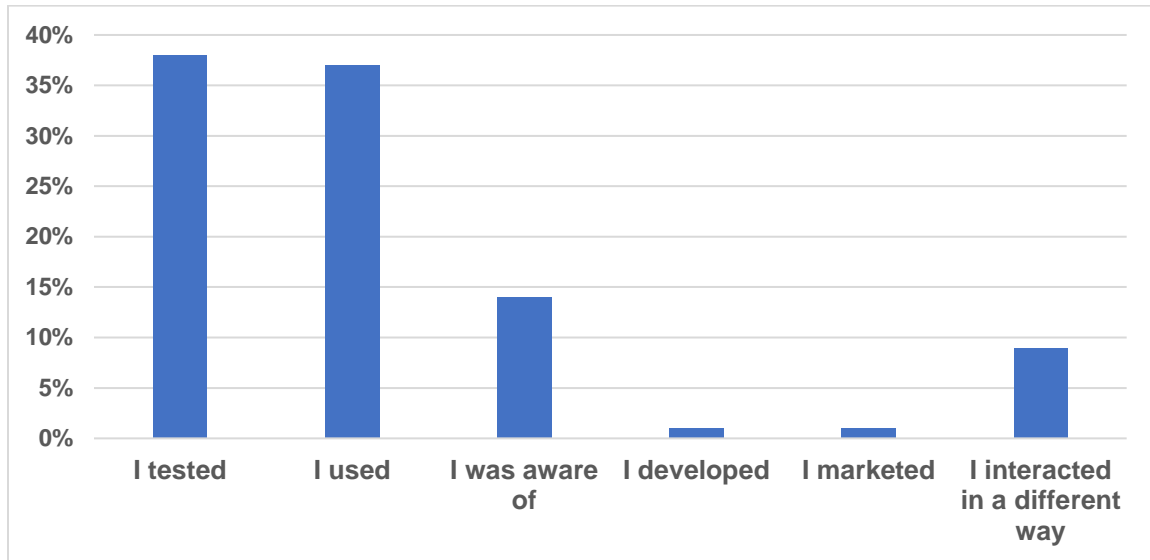
Figure 5 - Please describe your level of involvement with the products and services innovations you described.

ANSWER CHOICES	RESPONSES
I developed these product/service innovations	1%
I tested these product/service innovations	38%
I marketed these product/service innovations	1%
I used these product/service innovations	37%
I was aware of these product/service innovations	14%
I interacted with these product/service innovations is a different way	9%

Table 4 - Please describe your level of involvement with the products and services innovations you described.

"I INTERACTED WITH THESE PRODUCT/SERVICE INNOVATIONS IN A DIFFERENT WAY"
Survey responses included:

- I provided technical support as my full-time job to people using the Braille Note Touch plus. I also provide tech support to people using Aira.
- I customized many of these innovations for my own needs.
- Subject matter expert
- I was a retailer and user of assistive technology and am currently using several.
- I project manage the Vinux project.
- OSU explored as AIRA as a staff accommodation
- I played multiple roles with multiple companies
- I now use Narrator when in need to set up computers

3. Availability and effectiveness of accessibility innovations

Innovations with the most positive impact on users with disabilities by types of application

In your opinion, what innovations have had the most positive impact on users with disabilities and for which types of applications?

Survey responses included:

- In my opinion, Seeing AI application have had the most wonderful impact in the lives of a differently abled user, as it was the first to introduce real-time text recognition, which earlier was a pain to do.

- The mainstreaming of use cases formerly only for disability (such as mobile interfaces not relying on hover states, or automobile interfaces requiring hands-free input and spoken output).

- I believe both the horizon glasses as well as the Braille Note taker I just described has the most positive impact on users who are blind or visually impaired. These products provide users with independence and the note taker provides students greater proximity and independence in the classroom.

- I think the iPhone and VoiceOver have had the biggest impact on users with disabilities since VoiceOver was built into the Apple devices.

- Artificial Intelligence and visual interpretation services (i.e. AIRA, Seeing AI and other artificial intelligence identification systems, etc)

- AIRA for visual assistance for people who are blind, Orbit Reader 20 for braille readers who need access to electronic braille.

- EyeGaze control for Computer and Tablet operation

- Voice assistance, such as Amazon Alexa or Google home for interacting with one's surroundings

- The innovations with the most positive impact are the google and amazon speakers, updates to vice over and jaws.

- YouTube captions were revolutionary. The ability to watch and understand the whole video revolution has been great.

- iPad for larger keys and overall ease of use

- AI-Voice Recognition, AI-Based Text Processing, and AI-Automatic Alt-Text

Types of types of virtual/remote customer services appreciated by persons with disabilities
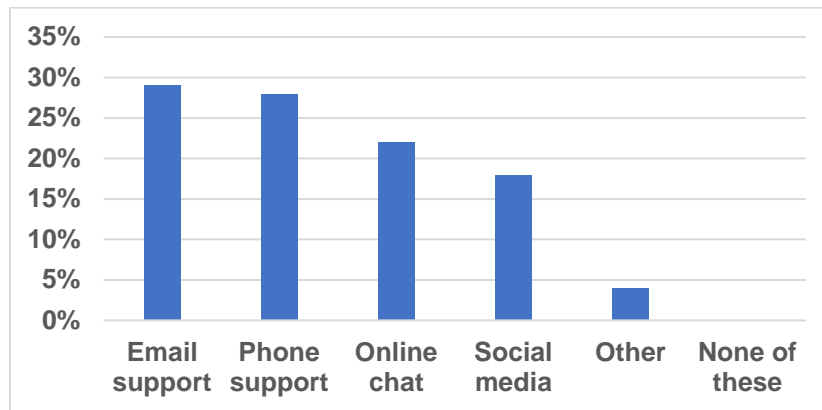

Figure 6 - Which of the following types of virtual/remote customer services are appreciated by persons with disabilities?

Other types of virtual/remote customer services appreciated by persons with disabilities (please specify).

Survey responses included:

- Obviously, there are disabled people who appreciate each of these! Speaking for myself I want email or phone support.
- When they can get on your computer to correct technical issues
- VRS-Video Relay Service
- Be my eyes
- Remote tandem sessions
- Online chat is often easiest for mobility impaired people because it allows the user to consult with technical support in real time without the need for holding a telephone.
- Remove support i.e. NVDA remote, JAWS tandem, Vinux project's CFH Cry for help service.
- The AIRA visual interpretation service and Be-My-Eyes
- I want email and phone support

Changes in the digital space that make it harder to access recent innovations

Respondents were asked, "Have you encountered changes in the digital space that make it harder to access recent innovations?" Responses to this open-ended question included:

- I don't like that companies are starting to move more towards automatic captioning;

- Single page apps written in React or Node usually have very bad accessibility, but the absolute *worst* is when companies release so-called desktop applications that are just Electron (Chromium + Node.js); wrappers around their (usually terrible and inaccessible) website, so they don't talk to the accessibility APIs. Then AT can't talk to the application, and the app only works with AT if the programmers basically rewrite an entire accessibility and keyboard layer from scratch. Think the Slack desktop app;

- Second step security checks to get into accounts using text or email, passwords, visual puzzles (I am not a robot);

- Browsers and screen readers often have compatibility issues. My screen reader manufacturer says it's because the browser manufacturers makes so many changes at such a fast pace;

- Windows, Apps and other technology is changing so frequently these days and screen reader products are lagging behind. Sometimes, App developers make changes in their apps without taking into consideration the accessibility or they break existing accessibility in place;

- Ribbon based applications. Such as Windows 10 file explorer and Start menu are difficult to navigate;

- Social media is often not conducive to using Dragon NaturallySpeaking. Facebook does not like direct input with the software. I must 1st type to a notepad then transfer by copy & paste to the proper field for input;

- The increased utilization of touchscreen products where the developers do not think of those with disabilities (kiosk's, vending machines etc.);

- Chat room support can be difficult to use with a screen reader and is not always accessible;

- Pop-ups for online chat have made it more difficult to use websites in general, and companies that defer to email or online chat instead of phone support;

- Lack of data and Wi-Fi available. Heavily relies on data and Wi-Fi. Visual information. Provide captions and subtitles of all media - videos and images. Voice my concerns about ASL interpreters and providing captioning. unable to provide means diminishing my voices;

- As touch screens become more prevalent in daily life, devices that lack a way to relay information via audio or a braille display will pose significant barriers to access. From tablets in restaurants and cafes, to touch screens to unlock a restroom, continued development of this technology without considering people with disabilities is a negative trend. A customer should not need an employee at a coffee shop to independently make a purchase or open a restroom; and

- Mobile apps which are not always accessible with my screen reader.

Suggested solutions that could be offered to address challenges

As a follow-up to the previous question, respondents were asked, "Do you have ideas for solutions that could be offered to address such challenges?" to which they said:

- In my opinion, a product can become completely accessible only when the accessibility would be implemented right from the designing phase rather than implementing it after development phase.

- It would be good to see major companies offering products directly to the disabled in exchange for continued feedback, perhaps these kinds of programs are available, and I am just not aware.

- Don't do that! But since that's a lost battle, we need to pressure the Electron and Chromium people. The accessibility APIs are there for a reason, and it's unacceptable for a major and widely used framework not to talk to them. I quote from the Electron docs: "Electron

applications keep accessibility disabled by default for performance reasons but there are multiple ways to enable it." We need to pressure these development teams to change this attitude.

- Yes - screen reader technology that scans pages for key content could be used to help persons with cognitive challenges, especially sites with too much content today. I also wish every web site had a PDF or JPEG file to save of key site and contact info.

- Multiple columns of merchandise on one line are so confusing. If companies could just list everything line by line, not row by row

- Web CAPTCHAS are making things difficult. I know of a few automated CAPTCHA solutions, but they seem to be falling behind or once developed, seem to be fading out of existence.

- The Firefox Web Visum extension project was the most reliable of Captcha solving solutions I found. It is frustrating that such tools have gone away.

- Double check the webpages are optimized for both mobile and desktop

- I think all developers and companies should hire people with disabilities to invent the most

- Ensure more developers are familiar with WCAG 2.1.

- Zoom must be enabled in apps. All apps should have a dark mode. All photos should retain normal coloring when text color is inverted.

- More people with severe vision loss Must be included on design teams. Accessibility should be intrinsic, and not farmed out to a special department, or outsourced. Also, a program that would visually show what VoiceOver actually says in an app. Having a mode on a smartphone, that visually shows what the speech would say, and the limitations of the functionality for speech output implementation. People who use their eyes to read the screen need a visual indicator and are usually unable, due to brain restrictions, to process audible information, especially with synthetic speech. Seeing a screen, that is showing something different than what they are hearing is extremely confusing.

- Labeling buttons and not using to make screen shots. I do when possible save screen shots or photos to my iPhone then use seeing AI to turn in to a text format.

- The ability to plug in headphones and choose nonvisual access or to attach an adaptive device to the kiosk or other touchscreen device would be useful. ATM's allow insertion of a headphone jack therefore allowing spoken feedback along with the option to blacken the screen. This can be universally applied

Top performing companies most effective at implementing digital accessiblity

According to survey respondents, the top three performing organizations/companies that have been demonstrated as most effective at implementing digital accessibility innovations are Apple, Microsoft, and Google. The specific names of the three organizations' products or services are as follows:

- Apple - Seeing AI, iPhone, iOS, VoiceOver, dictation, macIOS
- Microsoft - Echo Bluetooth Microsoft, MS Windows, Seeing AI, Office 365, W10 and W10 on-board activation, Xbox Abilities controller, SoundScape, Narrator

- Google - Accessibility Suite, Search engine, Gmail, Maps, android assistant, home VFO fusion, G Suite productivity software.

Survey respondents also listed the following organizations/companies and their products and services as valued digital innovations:

- Facebook – website and app;
- Vispero/Freedom Scientific – JAWS, ZoomText screen reader/magnifier;
- AIRA Tech Corp – Horizon Kit, AIRA;
- Zoom – Zoom Cloud;
- Nuance - Dragon NaturallySpeaking;
- Amazon - Voice-Over;
- Humanware - Braille note touch plus;
- YouTube – captions;
- NVAccess – NVDA;
- Be-My-Eyes – Be my eyes;
- Motorola – android smart phone;
- Amazon – VoiceView;
- Serotek - with its suite of remote tools; and
- Cascadia Deaf Nation- WeSynergy and captioning services.

Descriptions of company innovations were occasionally provided, as well, for example:

- "MS Windows. Microsoft is still the best, by a long shot. Windows is the best at desktop accessibility out of the box. They don't innovate, but they also don't regress much, either, and that's important. Although it's certainly true that Windows 10 UIs are less accessible (physically, visually, and cognitively) than older versions.
- iOS. Apple does an excellent job on mobile and innovates well for IOS, but on desktop they still don't have full hands-free control, and it's 2019, for goodness' sake. Also, they often seem to think disability means blindness and accessibility means VoiceOver.
- Facebook (website and app) Increased usability with assistive software by addition of navigation keys, labeling improvements and increased help guides for users of assistive technology."

Respondents were asked, "What is the most significant innovation-related issue or challenge that users face?" Responses to this targeted question included:

- "Facebook personalities" who are heavy into video not using captioning, therefore leaving out a wide audience. Certain pages (US Army being one) not using captioning for their videos.

- It is hard for the blind, who always have mobility issues, to get to a place or business where the products could be demonstrated, a hands-on touch. It would be nice to be able to be sent products and be able to send them back so that the products could be tried out and evaluated by the individual.

- The modern reality that the best innovations for a11y are coming at the expense of privacy choices. Think hands-free spoken control: Siri, Alexa, Hey Google. It's impossible to use any of these without sacrificing privacy in a major way. Many of the recent innovations so good for accessibility (dictation, health apps, mapping, smart homes etc.) require the user give up a huge

measure of privacy. When able bodied people make the same choices, they don't have the same cost benefit analysis.

- Cognitive accessibility/usability of web sites and apps. These challenges are why many once thought "capable" users avoid tech. At any given time, at least 50% of tech users are struggling with this, and this failure to innovate cognitive/usability is WHY most people aren't using tech more regularly. And no one wants to say it!

- Having websites that you must figure how to use because either it is mouse friendly only, need to use a virtual cursor, or apps that are easy for sighted people to use but for some reason do not read anything when a VO is being used.

- Mobility impaired users often face speech recognition software that is monetarily out of reach. The software needs to be priced more in line with the finances of the people using it. Social media needs to be more accessible thru this type software in order to encourage more mobility impaired users.

- I'm really not sure. I think the speed of innovation vs necessity. There are many apps that are produced for iOS and not for more financially accessible Android OS. There are apps and hardware developed that exist in some form or another, and rather than recreating that project perhaps improving upon it would be better. Example: Humanware released a standalone handheld scanner with limited onboard storage that could be used to OCR print media and then allow users to enlarge or use text-to-speech. This happened right after Phillips released their own Kurzweil- based device. One was much smaller than the other, one was much more expensive. They did the same thing but neither caught on because mobile devices were easier to carry around and folks want All-in-one devices. I personally loved the Humanware device, but it wasn't cool enough looking for my students to want it, compared to an app on their mobile device (not that that camera was as good)

- The best AT is still very expensive for people earning a low income. For example, the Focus 40 Blue braille display, which I consider to be the best in the field, costs around $3,000 US. Unless it is procured by a vocational rehabilitation agency, students and job seekers will find it difficult to obtain one. Thanks to technology that allows braille displays to be connected to computers and smartphones via USB or Bluetooth, braille is thriving in the digital age. Research shows that blind people who know braille are more likely to be employed than those who do not. Unfortunately, the more featured-packed devices are remain out of financial reach for many.

Degree to which accessibility features of customer interfaces are available and effective
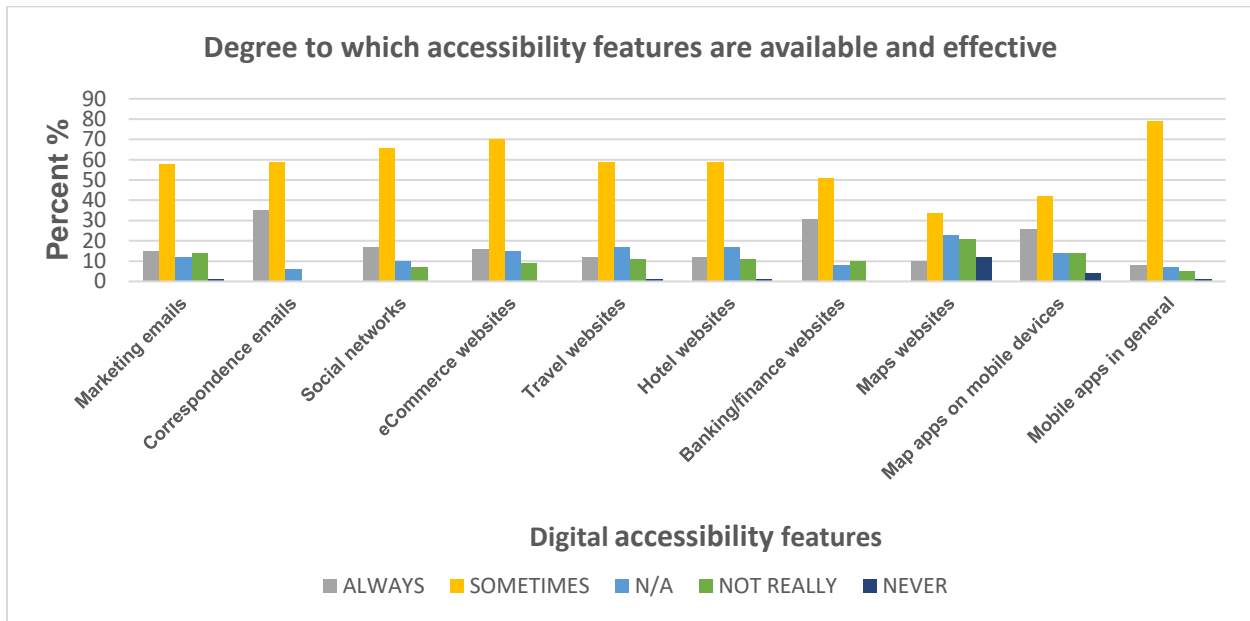

Figure 7 – To which degree accessibility features are available and effective for the following customer interfaces?

Accessibility Features of:	ALWAYS	SOME TIMES	N/A	NOT REALLY	NEVER
Marketing emails	15	58	12	14	1
Correspondence emails	35	59	6	0	0
Social networks	17	66	10	7	0
eCommerce websites	16	70	15	9	0
Travel websites	12	59	17	11	1
Hotel websites	12	59	17	11	1
Banking/finance websites	31	51	8	10	0
Maps websites	10	34	23	21	12
Map apps on mobile devices	26	42	14	14	4
Mobile apps in general	8	79	7	5	1

Table 5 - To which degree accessibility features are available and effective for the following customer interfaces?

When asked to describe their ability to interact with marketing emails, including any accessibility issues they have encountered, respondents noted:

- Sometimes, I had a really hard time in understanding that what is the product/promotion all about, as most of the information is provided in the form of graphics that too without any alternative text/description.
- I haven't really had issues, unless it links to a video. I'd rather read.

- I don't interact with marketing emails, because it's 2019 and I can't tell the difference between marketing emails and phishing emails.
- The graphics which is where most of the information is located are rarely labeled.
- Too many spam, fake mail, can't "unsubscribe" the ones I want I can't get to, too exhausted from sorting
- Poorly formatted, unlabeled graphics and or links, embedded pictures and attached product sheets that are just images and not tagged for assistive technology.
- I have no problems with emails.
- If I am signed up for one and have chosen plain text, then it's much easier. For cold-call style emails, it depends on if their app (like constant contact) settings allow me to change it in email. Otherwise I often end up with unlabeled images, headers, and custom fonts/colors that are inaccessible.

Please describe your ability to interact with correspondence emails, including any accessibility issues you have encountered.

- Most emails I received are accessible, however some correspondence emails have attachments that are not accessible and need some other program to open. This is very frustrating.
- Checkboxes are still an issue as well as reading some attachments, which might be included.
- I use Microsoft Outlook. So, it offers a number of accessibility and other features often not available in web-based email.
- Most correspondence are done well unless the contain a table then a person is better turning off table navigation.
- I manage pretty well with the help of dictation software like Dragon
- I am able to correspond all the time. I have not encountered issues
- It seems to me this is a function of the email service provider. I use Gmail, and it is extremely accessible thru my speech recognition software.
- I prefer using my iPad for faster responses and sorting

Please describe your ability to use social networks, including any accessibility issues you have encountered

- Have not encountered any such issues.
- Lack of captioning on videos, and lack of resources for people to learn to add captioning.
- The accessibility features in social media are largely dependent on their sites/app UI design. Sometimes these are more intuitive or user friendly like Facebook or Twitter, whereas Instagram and portions of Google are unintuitive. And when these sites do major OS updates and changes to the UI, this often render web/app portions and features much less accessible.
- Most social networks are difficult to navigate and not very descriptive.
- I primarily use Facebook and LinkedIn. These applications are usually accessible, though the Facebook app in my iPhone is more hit-and-miss. Currently, I can't listen to the text of web pages whose links are shared in the Facebook iPhone app.
- Most networks are improving, even Pinterest and Instagram that are visual in nature.
- As I've mentioned previously, social media is not as accessible as it needs to be for its mobility impaired users.

Please describe your ability to use eCommerce websites, including any accessibility issues you have encountered.

- I haven't really had any issues.
- Difficulty I have is Captchas and inactionable links as well as images.
- Bank would be the most common, and most banking websites are quite accessible. However, some of the banking phone apps are not so accessible.
- eCommerce websites are generally accessible, though poor design for smaller vendors can sometimes pose challenges. For example, my screen reader sometimes has trouble reading text, or the page design makes it hard to navigate when my screen magnifier is turned on.
- Paypal's website is simply terrible with a screen-reader. Venmo's site is pretty good, so it depends on the site.
- Many main ones like Amazon, Ebay, and WalMart work fine; others are problematic.
- It's all about labeled images, alt text, consistent coding of buttons/labels/headers/site navigation/and content placement. Wal-Mart is a great example of what not to do. The website is difficult to figure out visually (the image logo takes me to the main page, where is the site nav?) and filters, etc. aren't easy. Target, oddly enough is fairly easy to use, including choosing a local store and ordering in advance.
- Most accessibility problems have been fed back and fixed by the financial institution.

Please describe your ability to use travel websites, including any accessibility issues you have encountered.

- I mostly have trouble when booking flights on airline websites when choosing seats. This is because images are not labeled correctly. I also have issues with Captchas.
- I would have to say the most accessible one are Air Canada and West Jet. Most websites I have visited for Canada and the US have been easy to navigate with a screen reader.
- About the only travel sites and apps I use are for airlines. I recently decided to use an airline app while flying on a trip and found the app to have more features and accessibility than their web page. Still, their app posed accessibility challenges when it failed to store critical information.
- Some airline sites like Southwest are real good with JAWS. other sites like Kayak completely fall short of even being usable!
- Often, seeing what seats are available is a challenge, and if I need to select a seat, this can be a problem. Again, airlines are trying, but their accessibility solutions aren't consistent, and so each new travel Web site is a learning experience.
- The main sites I've used have been Travelocity, Orbitz, Carnival, TripAdvisor, & Expedia. They have all been very good about accessibility.
- I have a better chance of getting hit in the head by a satellite rock from outer space then using my assistive technology on these web-sites.

Please describe your ability to use hotel websites, including any accessibility issues you have encountered.

- Hotel websites are generally accessible, though poor design can sometimes pose challenges. For example, my screen reader sometimes has trouble reading text, or the page design makes it hard to navigate when my screen magnifier is turned on.

- Most have inaccessible date pickers/calendars.
- Don't use many, however, the few I have used had serious unlabled graphics and links, dynamic text my screen reader was not able to read and unlabled form fields and date pickers.
- The only website I use for hotels has been Hotels.com & it is extremely accessible.
- Here again, is where forms must work and usually don't.
- I have never been able to book Disability accommodations online. Either the tools don't work, or they don't have the options that I need

Please describe your ability to use banking and finance websites, including any accessibility issues you have encountered.

- I have no problem using my bank's web site but find the app on my iPhone much more convenient and easier to use.
- Banking and financial web sites have improved, but some still pose cognitive usability challenges. One common challenge is with their dependence on security questions, which can have various formats of their answers. It has resulted in my being locked out of these sites. I have complained about this more than once.
- Most of these work well; these sites are ahead of the curve.
- I am able to use banking apps and sites. Some apps have inaccessible check scanning features.
- I use banking and finance websites all the time for my bills & credit cards. I know that I've made workarounds for several of them, but I can't remember which ones those are. I've been using them for many yrs. and it's just become a habit to have these workarounds. The websites they use are Digital Credit Union, Chase.com, Barclaycardus.com, Synchrony Bank.
- In reading statements and negotiating transaction pages, what the screen access technology speaks is not always where you actually are on the form or table.
- A variety of banking and mobile finance tracking apps are accessible such as Mint and various financial institution apps.

Please describe your ability to use maps websites, including any accessibility issues you have encountered.

- Whenever I've used maps on a website they are just images and are inaccessible.
- On the IPhone map sites such as Google maps are very accessible. Maps on the computer are not accessible.
- I never use map web sites but do use map features on my iPhone.
- Google Maps has changed how we use maps and related accessibility. Google Maps mobile app works much better than its web site counterpart. Still I have complained to Google maps about how it displays search results, and maps that include tools which I rarely take.
- Very few of the have directions in text format.
- Do not use these often unless it is to retrieve text directions
- I cannot remember any map websites that are truly accessible. The maps used to track an arrival of meals, cabs or deliveries have a pictorial pin on the map that tracks the location of the vehicle. There is no textual information giving the name of the intersection, or how far away the vehicle is. When trying to get directions to a location, for example, with Apple or Google maps, one has to expand the screen to obtain step-by-step directions, but that quickly disappears.

There are no indications of what intersections have traffic lights, or specific walking directions when going from a street to a path or trail. They all assume that everyone can see.

Please describe your ability to use maps apps on mobile devices, including any accessibility issues you have encountered.

- I use Google Maps all the time to get directions. It is extremely accessible with IOS.
- I have been able to use Google maps well on the IPhone
- Google Maps on mobile device is much improved over the same on their web site. However, the web site and Google Earth site allow the user the option to print a paper map.
- We get the driving directions quite a bit on the iphone and have never been disappointed!
- I use Google maps, and I love it. The app is very accessible on Android.
- Only use to the extent of accessing text directions or turn by turn navigation with speech output, do not access maps at all
- TomTom is pretty good. Navigation is somewhat good; Nearby Explorer is quite good. Apple Maps is also good.
- I am able to use maps successfully. Updating location and reading real time location is hard with screen readers
- Unlabled buttons and maps, not many directions. Kudos to Apple iPhones which gives us the ability to follow maps on-screen with fingers.
- Very difficult to zoom on mobile devices.

Please describe your ability to use mobile apps in general, including any accessibility issues you have encountered.

- It depends on how the app is coded. There are many apps that are accessible for people who use assistive technology. For instance, uber is one, and Bookshare is another. I've also found Direct Tv Now to be extremely accessible as well.
- Most of the time, I can navigate apps on my iPhone with no problems. But sometimes, there are accessibility issues when they update the apps and change the interface. I have had this problem with the Lyft app a lot lately.
- This really depends on the app and on the user's degree of experience with the app (and versions of the app). I am quite adept at mobile apps and use my address book, calendar, photo, tasks, and utility apps in very innovative ways esp as cognitive accessibility tools.
- I can use all of the Google apps on my Android phone. There are a lot of helpful blindness apps that I also use. Mainstream apps can be very easy to use and accessible, but some/many are inaccessible and don't work with a mobile screen reader.
- Generally, no issues if apps are fully VoiceOver compatible, however some apps are not fully accessible or do not have buttons labelled, occasionally may have inaccessible buttons to VoiceOver, etc.
- On Apple iPhones and iDevices, many apps that are very useable with the ability to offer feedback to developers in the hopes the app will get fixed on an accessibility level. With Android, we have the same issues, though the feedback is sometimes hit or miss, also not as many accessible offerings in terms of apps on Android.
- Unlabeled or ambiguous labeling of elements. Eye candy, with little textual information. Inconsistency in same app. Often updated for the worse. Apathy of support staff or company owners to fix accessibility problems. Too busy, with extraneous information or fields. Forms are

unusable: edit fields that won't open, combo boxes that won't open, popups that won't open, color used exclusively to indicate preference selection, CAPTCHAs. "Prove that you are not a robot." Very insulting. No audio choices for reading image. Incorrectly labeled tabs. No contact information for tech support. Apathetic responses to written communication, though get better response if negatives are left in a review.

- I am unable to use mobile apps because there isn't a good speech recognition app to be used on mobile devices. The Dragon software has progressed to include a mobile app but it's not up to the ability I needed to be to use my phone.
- This is increasing rapidly. Many developers are becoming aware of the needs of users with various disabilities and are striving to increase their usability to increase who can use their apps.

4. Respondents' opinions about value-added and perceived levels of user satisfaction

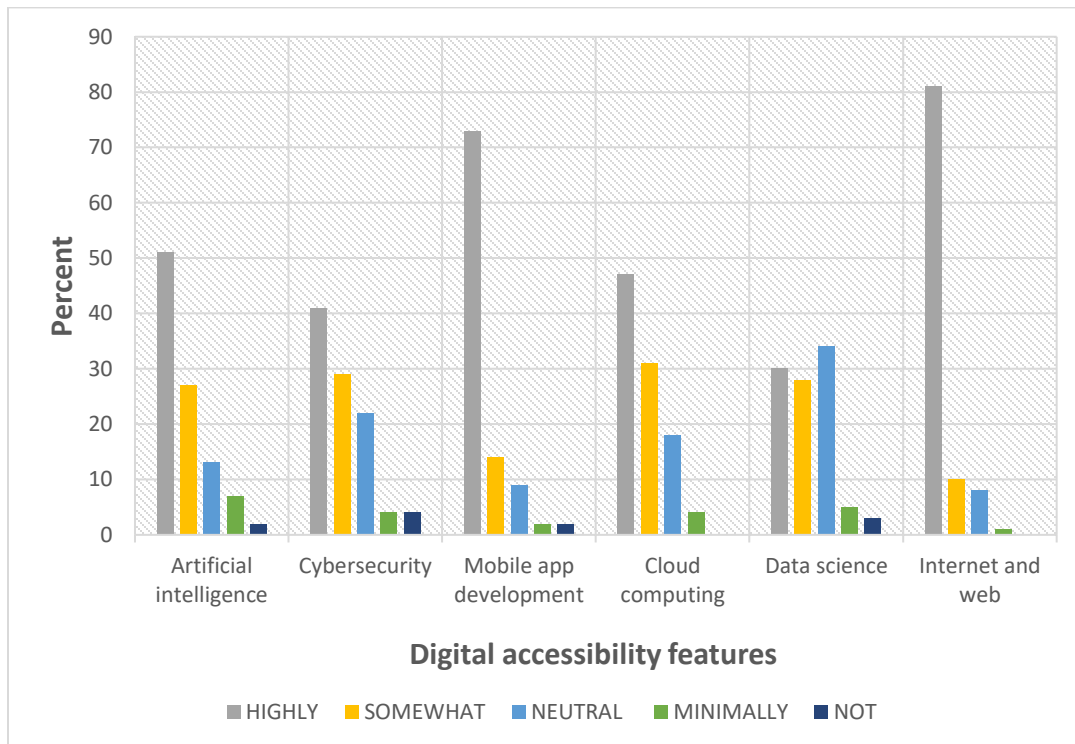**Degree that digital accessibility features are valued by users**

Figure 8 - To which degree are the following digital accessibility features valued by users?

Digital Accessibility Features	HIGHLY	SOMEWHAT	NEUTRAL	MINIMALLY	NOT
Artificial intelligence	51	27	13	7	2
Cybersecurity	41	29	22	4	4
Mobile app development	73	14	9	2	2
Cloud computing	47	31	18	4	0
Data science	30	28	34	5	3
Internet and web	81	10	8	1	0

Table 6 - To which degree are the following digital accessibility features valued by users?

What are the most desired functionalities to be further developed by industry to improve the experience of users with disabilities?

- Accessibility features need to take security and privacy into account. I need a website where I can view my password as I type it, without it being scraped by page add-on. I need to be able to dictate without the cloud. I need to be able to use AT securely. I need apps to stop blocking paste into password fields.
- Improved GPS and object recognition as well as further development and improvement of print recognition would be amazing for the visually impaired.
- The cognitive engagement of all sites & apps is the biggest hurdle in my opinion, and this transcends not only UI designs & interfaces, but use of colors, figures & icons, new interface hardware, and reproducibility of designs across multiple web pages, apps, and OS updates. AI with voice feedback and Voice Control of mobile devices, also PCs.
- Solution to solve CAPTCHAS. --- Not only coming up with , but actually enforcing that web and mobile accessibility standards are met!
- I can't get ease of access voice controls flexibility! (ability to change features, visually, interjectionally, auditorily, etc)
- Screen sharing, better social media accessibility, games; Theme settings within apps; Increased A.I., more tactile feedback.
- Dragon NaturallySpeaking is top- of-the-line when it comes to speech recognition. However, I believe because of that it is very highly priced. There needs to be more competition, so users have a choice about prices and companies. It would also be a huge innovation for 1 of the major mobile phone companies to include speech recognition capabilities on their devices.
- Adding a multichannel experience in audio queues to screen readers would go a long way in helping the spacial aspect of the digital world.
- Accuracy of dictation, screen reader and OCR support for all languages, audio and video description for things around us, AI, describing accurately people and environment around us.
- Better user experience (navigation, color contrast, plan language content, descriptive on buttons, use accessible images/diagrams, use audio and video, linear logical layout, subtitles, break up content) and let users ask for their desired functionalities.

Please list some of the most well-known products and innovations that have appeared over the past 5 years, in your opinion.

- iPhone - apple, glide - video messages
- Braille Note Touch Plus, The Horizon product by AIRA, Seeing AI by Microsoft, Script talk, Be My Eyes
- Mobile GPS apps that accessible to the blind, in-door locations technology for navigating malls and hotels, mobile screen readers like TalkBack, VoiceAssistant, and Voiceover; AI and Voice Assistants like Alexa and Google Assistant; apps like Be My Eyes for sighted assistance on a mobile device.
- VoiceOver, TalkBack, NVDA, and VoiceView for Amazon products.
- Dragon NaturallySpeaking, Amazon Alexa, Google home, Google assistant, leap motion
- Google Suite, screen reader accessibility on televisions, OCR from my phone
- Smart phone technology and cameras, mobile apps like Envision A.I., Microsoft Seeing A.I. GPS and mobile computing and location services, public transit accessibility and awareness.
- The advent of off the shelf talking digital products with adaptive technology built in instead of bolted on such as happened with Fire OS, Google Chromebook, Apple products etc.

- Apple's dedication to accessibility over all devices is amazing. Amazon with the Fire technology and Alexa, Google with their Google assistants.

In your opinion, what are the names of the top three most useful mobile features and apps for persons with disabilities?

- For me, it's, on iOS, 1. Assistive touch 2. Turning off all haptic feedback 3. VoiceOver For pwd in general, I'd guess it's 1. voiceover (screen readers) 2. Configurable haptic feedback (the ability to use it, and to turn it off) 3. video communications eg. skype and face time, for Deaf people who sign.
- Blind Square, a GPS app, IRA which is an app where you can call on sighted help, Be My Eyes, is another one where a person can call for sighted help. Parcel Track for checking and tracking parcels, Flip for looking at flyers, for scanning, KNF reader for scanning documents, Seeing AI which has scanning capability as well as color detection, light detecter, a way to organize your pictures that are on the phone and more.
- Built-in access features - zoom, voiceover, smart contrast, etc (for blind folks, but there are other features for other disabilities); navigation apps that have smart info (such as knowing accessibility of locations); voice controls
- Voice Dictation, Main Stream devices with speech built in and touch screen Braille input.
- Built-in screen readers, braille screen input and Flicktype keyboard app.

In your opinion, what are the names of the top three most useful desktop features and applications for persons with disabilities?

- Screen readers and magnification software 2. Speech recognition 3. OS features (eg sticky keys, high contrast views, native zoom)
- JAWS for Windows, Narrator, Quortana
- Microsoft Office, Internet, and Media player, for screen reading, NVDA and JAWS.
- KnFB reader for Windows, JAWS 19 and Microsoft Windows.
- Microsoft Outlook, Google Chrome, Adobe Reader
- Voice controls built-in access features - zoom, voiceover, smart contrast, etc (for blind folks, but there are other features for other disabilities)
- JAWS, Visual Studio, Google Suite
- Text customization throughout the system. Ability for anyone to use product after minimal set up (built-in features for accessibility). Increased availability to download apps that augment existing features.
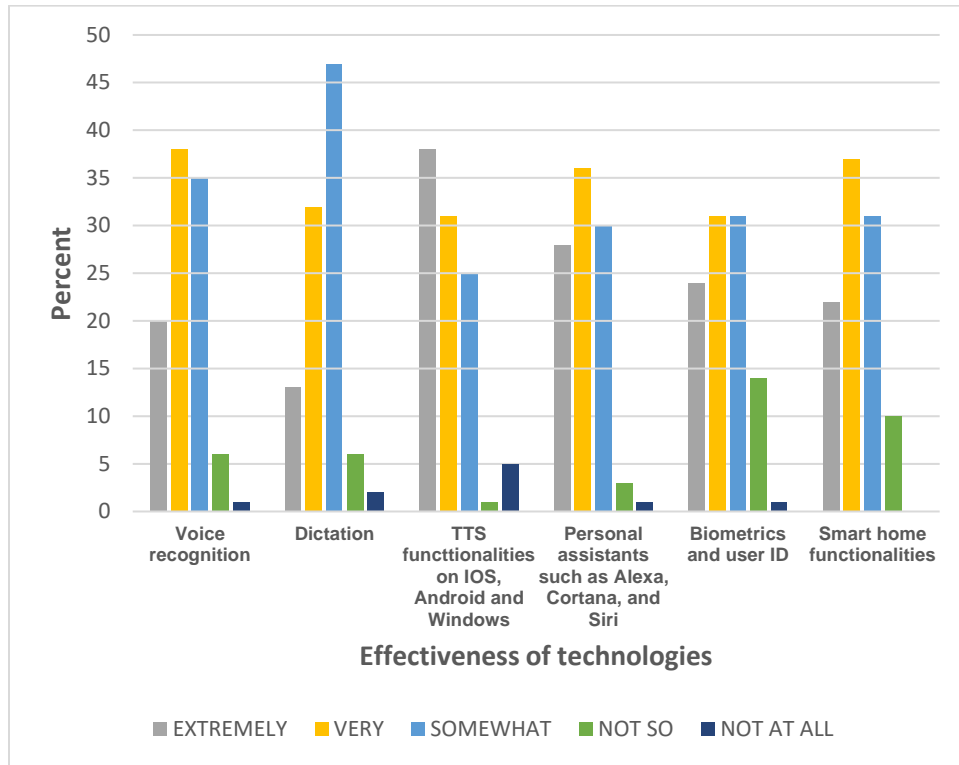
Effectiveness of accessiblity features

Figure 9 - In your opinion, how effective is?

Accessibility Features	EXTREMELY	VERY	SOMEWHAT	NOT SO	NOT AT ALL
Voice recognition	20	38	35	6	1
Dictation	13	32	47	6	2
TTS functionalities on IOS, Android and Windows	38	31	25	1	5
Personal assistants such as Alexa, Cortana, and Siri	28	36	30	3	1
Biometrics and user ID	24	31	31	14	1
Smart home functionalities	22	37	31	10	0

Table 7 - In your opinion, how effective is?

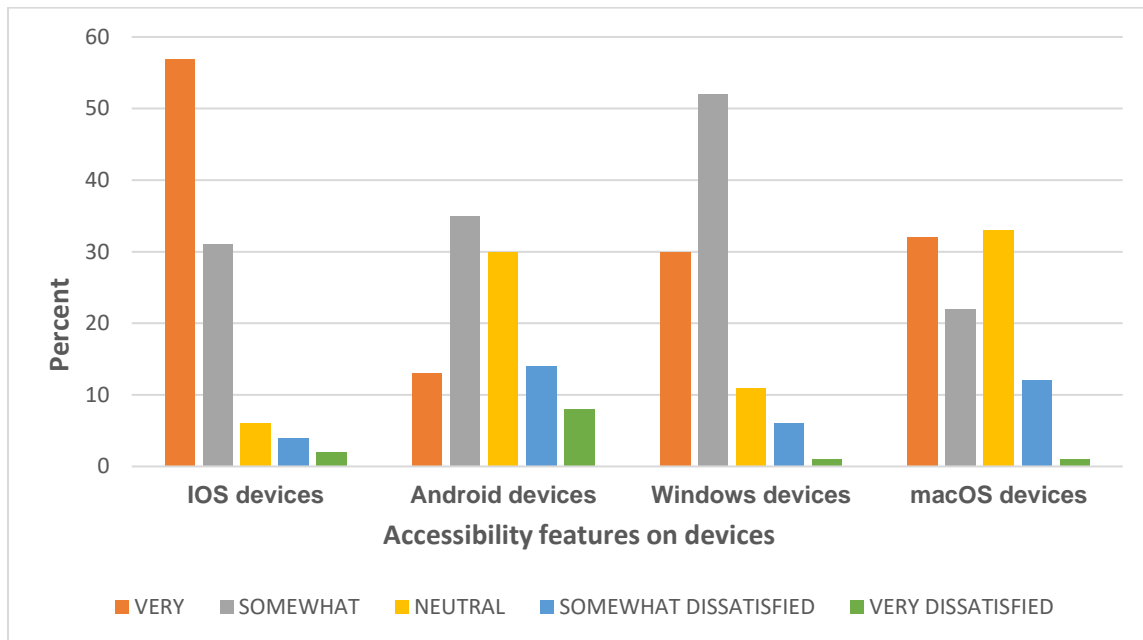**Degree of satisfaction with accessiblity features of main operating systems**

Figure 10 - How satisfied are you with accessibility features on...

OPERATING SYSTEMS	VERY	SOMEWHAT	NEUTRAL	SOMEWHAT DISSATISFIED	VERY DISSATISFIED
IOS devices	57	31	6	4	2
Android devices	13	35	30	14	8
Windows devices	30	52	11	6	1
macOS devices	32	22	33	12	1

Table 8 - How satisfied are you with accessibility features on...

5. Web Developers Perspectives

9% of respondents identified themselves as web developers.   A specific set of questions were asked for those respondents who did identify themselves as web developers.

What is changing in the developers' world, making it easier or harder for them to create new and/or significantly improved accessible digital innovations?

- Constant turnover in the trendy front-end technologies. Learn Node! No wait we mean Angular! No wait we mean React! Aaaaargh. Also, all three of those have zero culture of accessibility.
- The platforms, and it's becoming very hard to keep up. I don't do enough development to stay abreast of the rapid changes.
- More specific guidelines, and more awareness of the accessibility requirements.
- Lack of exposure to accessibility standards/guidelines and organizations purchasing inaccessible products and serveries that require a11y adaptation that can't be made.

What kinds of challenges are those changes creating for developers?

- No time to develop a culture of writing accessible code before the next new thing.
- There's just so many options and new platforms to consider.
- Training opportunities, need more people with specific disabilities to work in web development/design
- It costs a lot of money to use certain APIs
- Staying current on programing languages, and working with inaccessible applications

What solutions could be offered to help developers address the challenges?

- Whatwg and the HTML5 working group -- and that means the Chrome and FF and Safari and Edge devs -- need to incorporate the modern widgets directly into HTML. Think dropdowns, dialogs, accordions, etc. As long as these are implemented with JS libraries and polyfills at the developer's discretion, they'll be inaccessible. They need to be native the HTML and made functional in the browsers, styled with CSS. HTML and CSS are accessible out of the box! Javascript isn't. 2. React, Node, Jquery, GopherJS, etc, need to build a11y natively into every one of their widgets. So do all the other front end frameworks, libraries, and toolkits. If developers have to remember to add it, they won't -- and they'll do it wrong. For goodness' sake, has any developer who isn't an a11y specialist *ever* added WAI-ARIA correctly? (Answer: no. WAI-ARIA is easy to misunderstand.)
- More standardized information on the differences between them. Also incorporating plug-ins into the platform so users don't have to pick and choose.
- Colleges, private entities, and even high school must emphasize the importance of coding for inclusion. This cannot be optional, or a special course, but included in all Information Technology curricula. Blind developers must gain an understanding of visual screen design. More stringent testing and accessibility requirements need to be implemented by Apple. More people, needing accessibility, need to write reviews that expose the lack of accessibility in apps, and learn how to make coding changes that will make the elements work with screen readers. More opportunities need to exist for people who are blind to learn to write accessible code for iOS and Android. Companies trying to exploit the need for accessibility by selling high-priced evaluators need to stop it.If the code is designed and developed correctly, these accessibility evaluators should not be necessary. W3C should be the accessibility evaluator. This threat of lawsuits for lack of   compliance and exploiting private companies takes job opportunities for people who are blind.
- Education and certification

What is the most significant innovation-related issue that developers face?

- Developers are never going to be resourced to do accessibility correctly (which is to say, as a first principle, instead of tacked on remediation). And developers aren't educated about how to care about a11y or UX or empowered to push back against inaccessible design. In an Agile setting, many developers never get a chance to look at a product writ large and worry about a11y. They are handed a bucket of tiny ticket to implement, because some non-technical product people sat down and worked out a UI. There's no opportunity to say "this ticket doesn't

take into account usability" when you're handed a 2 pointer to add a drop-down menu that uses an inaccessible React widget instead of native HTML.

- Hard to say because I really don't do enough web work. It's possibly that the trend today is with hosting companies offering their own platform software, that if used to build a web site, may not be transferable to other host platforms.
- Emphasis on more animation and eye candy; form becoming more important than function; inaccessible web development tools; lack of training for inclusion in public and private educational institutions.
- Organizational ROI concerns and not having top down support

Discussion

In March and April 2019, G3ict and Knowbility conducted a first-of-its-kind survey on the state of digital accessibility innovation from a user experience perspective. The increasing attention and criticality to innovate with digital accessibility necessitated a deep look into actions across public, non-public and private sectors. We are pleased to provide our findings. These results should help all interested companies and organizations benchmark digital innovation capabilities and commitments relative to their most important stakeholder – i.e., the customer, consumer, citizen, employee, or end-user.

The primary survey goal was to understand the: (a) most recent experiences and current state of digital accessibility innovation activities, and barriers across a wide range of technologies and digital features, and (b) look ahead to user-identified priorities for new and/or improved digital accessibility innovations. The survey yielded 159 responses from a field of 800 potential participants. This survey captured feedback from a comprehensive cross-section of digital accessibility expert users, most with disabilities and using Assistive Technologies, the majority of whom are geographically located in North America.

Survey findings and go-forward digital innovation priorities

1. **Users are clear about what's working and what's not.** Digital innovation options have burst on the scene over the past 5 years, and users have developed clear opinions about which innovations work and which ones need work. The recent proliferation of digital innovations has increased the volume, velocity, and variety of options presented in digital services, products and information. Users are eager to have leaders in business, government and the private sector effectively integrate digital accessibility features throughout their "products" development, design and delivery life-cycles.

2. **Accessibly Innovation does have a positive impact:** During the period 2013 to 2018, about 70% of survey respondents indicated that they were involved - i.e., development, testing, marketing, direct usage, and/or general awareness – with product or service accessiblity innovations of any kind whether for new or significantly improved digital products or services - 58% for projects that significantly improved existing products, and 23% for new products.

3. **Barriers due to a lack of alternative modes of communication remain a leading source of concern**: A majority of respondents indicated that one of the top issues or challenges users face is the lack of alternative modes of communication: use of images, pictures, graphics without ALT text, inaccessible form controls, or lack of captioning and privacy/ cybersecurity controls. Regardless of the medium or channel – e.g., emails, social networks, websites – digital innovations

that offer rich content must ensure that accessibility fundamentals are fully incorporated across the spectrum.

4. **Among the most impactful accessibility innovations** mentioned by respondents: Seeing AI with real-time text recognition, hands free applications, iPhone, iPad and VoiceOver, visual interpretation services (i.e. AIRA, Be my Eyes), new for braille readers, EyeGaze control for Computer and Tablet operation, Voice assistance, such as Amazon Alexa or Google home for interacting with one's surroundings, YouTube captions, AI-Voice Recognition, AI-Based Text Processing, and AI-Automatic Alt-Text.

5. **Companies leading innovation in accessibility** most often mentioned are Apple, Microsoft, Google and to a lesser extent, Facebook, AIRA and Vispero. Users are clearly aware of their specific contributions to accessibility innovation.

6. **From an OS perspective**, iOS for mobile devices and Windows for personal computers are the preferred environments for persons with disabilities. Respondents said that they were most satisfied (i.e., scored as 'very satisfied' and 'somewhat satisfied') with devices' accessibility features as follows: 88% for IOS devices; 82% for Windows devices; 54% for macOS devices; and, 48% for Android devices.

7. **From a sectorial perspective,** banks web sites provide the best level of accessiblity across all sectors of activity. Map apps are well rated while map web sites are not. In general, mobile apps are seen very positively and more likely to be accessible.

8. **Perception of the value of digital accessibility features.** The degree to which digital accessibility technology features are positively valued (i.e., scored as 'highly' and 'somewhat') by users was reported as: 91% for internet and web; 87% for mobile app development; 78% for cloud computing; 78% for artificial intelligence; and 71% for cybersecurity.

9. **Cognitive accessibility/usability of web sites and apps** is an area of great opportunity for progress and innovation. A respondent says: "These challenges are why many once thought "capable" users avoid tech. At any given time, at least 50% of tech users are struggling with this, and this failure to innovate in cognitive/usability is WHY most people aren't using tech more regularly. And no one wants to say it!" Supporting this observation, the top functionalities mentioned by respondents reflect a desire for better user experience at a fundamental level. That includes better navigation, effective color contrast, plain language content, descriptive text and alt-text, linear logical layout, and manageable break-up of dense content.

10. **Developers have a limited ability to take accessiblity into consideration.** Developers must watch for accessiblity issues resulting from constantly evolving tools, platforms and technologies. In addition, as one respondent notes: "developers aren't educated about how to care about a11y or UX or empowered to push back against inaccessible design. In an Agile setting, many developers never get a chance to look at a product writ large and worry about a11y." Several respondents note that the lack of training and awareness about disability and accessiblity remains a key challenge both among developers and among management functions overseeing their work.

11. **For future accessibility innovation**, respondents see AI driving new application domains. A respondent noted that "The cognitive engagement of all sites & apps is the biggest hurdle in my

opinion, and this transcends not only UI designs & interfaces, but use of colors, figures & icons, new interface hardware, and reproducibility of designs across multiple web pages, apps, and OS updates; AI with voice feedback and Voice Control of mobile devices, also PCs."

12. **Expected steps by industry and IT vendors.** To make effective judgements in digital accessibility innovation, users believe there are some general principles that can guide leaders in business and industry decision-making as it regards inclusive product development, design and implementation. Organizations across sectors can also use these principles to figure out where they could be focusing digital accessibility innovation efforts – e.g., across business processes, citizen engagement, to name a few. Some of the general principles articulated by respondents are that business and industry should:

- Involve users with disabilities and employees with disabilities throughout the product/service life-cycle;
- Emphasize training in accessiblity among their personnel;
- Understand what changes in existing and/or new digital accessibility innovations can clearly be determined to make a difference to users;
- Enroll the support and collaboration of persons with disabilities
- Do not overclaim about the potential value-added of an accessibility innovation but, rather, seek it out as direct feedback from users and then work with the feedback to improve outcomes for all;
- Be transparent throughout the innovation life-cycle about the reasons for changes to existing products and services, as well as the creation of new ones; and
- Verify the results of business and industry assessments of outcomes experienced by people with disabilities because of their use or lack of use of digital innovations.

Acknowledgements