# Horizon Scanning Series

# The Effective and Ethical Development of Artificial Intelligence: An Opportunity to Improve Our Wellbeing

*Disability*

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# Submission paper on AI in relation to disability

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## Introduction

The statistics on the number of disabled people in the world varies depending on the source. The World Health organisation (WHO) 2011 reported the world had 15% (1 billion) People with disabilities (PWD). 2015 Australia had 18% PWDs reported by Australian bureau of Statistics (ABS) Disability, Ageing and Carers 2015 report. The variance between the percentages of PWD depends on self-disclosure, countries classification of a disable person and methods used in collecting stats on PWD's. General consensus, PWD statistics is increasing due to age, new diseases and conflicts in countries.

The use of Artificial Intelligence (AI) in our everyday homes has seen rapid growth in recent years due to the popularity of the Internet of Things (IoT) and associated digital assistants.

The commercial sector is heavily investing into AI with the introduction of new services to the consumer and commercial sectors. IoT is one example of heavy adoption by the commercial sector. Other examples are facial recognition, big data manipulation, security technology, networking technology, Application performance improvement, et cetera. Cisco exemplifies this type of investment and innovation with solutions such as: Encrypted traffic analytics (ETA) which allows organizations to find threats and malicious activity in encrypted traffic. Webex Assistant, an artificial intelligence-powered solution for meeting management. It can be used with voice commands to get calls started, to find people in the directory, and control volume levels (Cisco has the edge with artificial intelligence – July 2018)

The general community's concern in relation to inherent bias from artificial intelligence (AI); management of data; privacy concerns and usage of AI technology also apply to PWD. Generally, PWD are concerned about: The human interaction of the AI technology; Impact to employment and education, access to information, using automation tools like Kiosks and, social activities, are just a few areas.

Lisa Annese CEO of diversity Council of Australia (DCA) at the May 2018 workshop on the Future of work: automation, robotics and what it all means for diversity & inclusion highlighted to have an inclusive workforce you require 4 components: connection, respect, contribution to the organisation and opportunity to progress. The two groups identified which do not feel they are included were disability and Indigenous identity for Aboriginal people and Torres Strait Islander people. The comment was based upon DCA recent research into the State of Inclusion.

Other disability peak bodies have a similar view that a digital divide still exists for the disabled community. PWD, and in particular people who are blind or vision impaired, are not embracing computing and Internet-related technologies at the same rate as the able-bodied population (The Disability Divide, Dr Scott Hollier 2007).

The introduction of AI in some areas has started to close this gap by introducing technology specifically designed for PWD and using mainstream technology to expand their level of independence.

However, for PWD, such evolution represents far more than the sum of its parts. There is little doubt that the future of AI over the next 10 years will provide significant benefits for engagement and independence, particularly in the areas of mobility, home automation and information access. Yet despite these benefits, it is also critical that support is provided in our policy and legislative frameworks so that both benefits and protections are delivered in a pro-active, rather than re-active, manner across all the technology sectors. Some of the benefits from this approach are: Decrease the current unemployment rate for PWD; developing a more inclusive education system for PWD; promoting access to existing and new media content, information and print publications; increasing accessibility in consumer goods, computer and telecommunication technologies for all, resulting in a more inclusive society.

# Technology now and the future.

In order to answer the question “In the next decade, what opportunities and challenges does AI pose to communities traditionally disadvantaged by new technologies like the disabled?”. It is important to provide some current and historical information in relation to accessibility for PWD as it stands, provide information on benefits of current usage of AI and, finally to discuss challenges in relation to artificial intelligence.

There is a variance between each disability group on their requirements and needs in relation to information and technology in the area of accessibility. Some generalised examples:

- A low vision person will require the colour contrast to be in a specific range between the foreground and background texts.
- Someone who has hearing impairments, will require caption (text of the spoken word) on video content or a full text transcript of the auditory content.
- Someone who has physical disabilities, will require alternative methods of accessing the technology. As simple as ensuring the user interface is accessible via a keyboard and alternative input devices like switch, puff devices or voice recognition.
- Someone who has learning or cognitive disability, might require simplified text, graphics to demonstrate concepts, and less amount of information on the screen at one time.

- A blind person will require the information being presented to be in a auditory or tactual form. Such as the output of the information being sent via a refreshable Braille display or synthetic speech.

There are challenges for designers and developers ensuring the user experience works for all users. The user interface must support the relevant assistive technology (AT) used by PWD.

## Current state of mainstream technology

Since 1998, vendor's who sold products to the USA Federal government and affiliated organisations were mandated by the USA Section 508 Rehabilitation Act to have accessibility included in the product. This ACT uses a self-certified process for accessibility via the voluntary product accessibility template (VPAT) v2.1 published by the ITU which has been adopted by vendor's like Cisco Systems to show the level of accessibility in their products. Introduction of this act has encouraged vendors to include accessibility in their products in the USA market. In 2016, similar standards have been introduced by the Australian Federal government which will promote accessibility being included in vendor products.

Lack of accessibility in technology is one barrier in relation to employment. This was reinforced at the DCA May 2016 workshop on: Willing to Work Report with Susan Ryan AO: Disability and Age Discrimination in Employment. A question asked to the panellist: Why the statistics for the unemployed disabled have not improved. The reason is technology.

In the consumer sector, touch screen technology can be a major barrier for a disabled person. The mobile technology is one example where inclusive design behaviour has been achieved across the different disabilities. Where Apple, Microsoft and Google have included accessibility and assistive technology into the core of the OS. On the other hand, household products which do not provide IoT and have touch screen are a major barrier to specific disabled people such as the Vision Impaired.

Automatic check-out systems, FPoS, ATM's, automatic check-in and ticket systems, and Information Kiosks are another area where accessibility greatly varies from no accessibility to poor design. For example, the bank new touch screen FPoS devices have accessibility barriers and usability issues due to PCI international standards preventing the banks from creating a fully inclusive product. Self-Check-out machines in stores is another example not able to be used by all disabled individuals.

The variety of different content available to consumers today by the different media outlets, such as social media; online papers; interactive magazines; electronic books et cetera is another area where access for PWDs varies greatly. Kindle books for example are very accessible for PWD. On the other hand, television content within Australia is behind the UK. In the UK it is regulated that 10% of television content must be audio described. However, the UK television sector voluntarily describes 20% of its content. (Blind Citizen of Australia and Media Access).

Broadly speaking, technology by vendors have placed unintentional barriers in front of the disability community due to lack awareness, following best practice in user experience research and design, and treating accessibility as a feature enhancement and unnecessary additional costs. There are some vendors who are making an effort to improve accessibility in their products.

## AI benefits and challenges

The emergence of AI in IoT and big data within the consumer and commercial space has been receiving a significant amount of attention, but importantly it is not an entirely new concept. While its popularity has been relatively recent, products have been available for the past two decades. For example, in 2000 LG launched the Digital DIOS smart refrigerator (Appliance Design, 2000). The refrigerator was heavily marketed as featuring AI as it could potentially detect when grocery items needed replacing and order new ones based on sensors and AI algorithms. The product was a failure due to its primitive AI implementation, lack of connectivity and high price (Hollier, et. al, 2017).

By contrast, modern IoT products are being rapidly embraced by consumers, private and public organisations, and in turn allow for the potential of IoT benefits to be received by people with disability.

Connectivity is one reason for the improvement of IoT. As devices can be permanently connected to provide and receive data in our homes, cars, and even clothing (G3ICT, 2015).

A second factor is the ability to receive and process highly specific information. While the original refrigerator could only determine whether a product was available, modern sensors and actuators can combine with AI to provide specific data and output in real-time to meet individual needs (Hollier and Abou-Zahra, 2018).

A third factor relates to affordability. Cheap sensors have allowed for the proliferation of AI applications aimed at providing personalised services – from location and routing to daily energy consumption (Gupta, et. al., 2015)

Yet while these three factors are vital for the collection of data and for it to be processed in a meaningful way, it is our ability to interact with the data in a conversational way that truly represents the typical AI consumer perception. Importantly, it is also this ease of interaction that highlights why AI in the IoT space provides such an important benefit to people with disability (Choudary and Narayanan, 2017).

"While IoT in higher education is still an emerging technology, particularly in relation to access for people with disabilities, universities need to seize the opportunities presented and develop plans to both engage with, and develop, these technologies in a learning and teaching environment. They also need to ensure that these technologies are interoperable with student's own technology, particularly AT and to address the challenges to the privacy and security for both students and staff presented by IoT technologies." (Hollier, et. al, 2017)

4 ways machine learning is improving web accessibility (Simone Sporle, 2017), demonstrates how AI technology helps with managing costs and improving the learning experience for disability learners. Automated captions for the Hearing Impaired; Automated image descriptions helping vision impaired and adaptive learning delivery capabilities that use facial recognition capability to identify how learners are responding to e-learning experiences; Simplification software which helps with restructuring text helping learners with learning and cognitive disabilities; Automated learning intervention helping to identify learning difficulties, by detecting language or learning disorders and prompting early intervention.

To focus specifically on the needs of people with disability, it is important to note that the impact of AI in devices equates to more than the sum of its parts. Given that IoT has the capacity to provide aid based on human limitations, it can be argued that IoT devices with the ability of AI to deliver data and interact with commands is, in principle, a form of Assistive Technology (AT), providing support to

information in a similar way to how popular AT software such as a screen reader provides content to a person who is blind (Hennig, 2016).

However, it is the AI aspect of IoT devices which sets it apart from other AT solutions due to its always-on real-time connectivity, which can ensure that people can quickly and easily obtain assistance and support. This can result in another avenue to achieving a good quality of life and facilitating participation, both socially and economically (Domingo, M. 2011). As such, it can be argued that the potential benefits of connected things are limitless, especially for persons with disabilities providing there is AI support to effectively meet user needs and seamless engagement between the user's requests and the processing of such requests.

This concept is illustrated by JORDAN BAKER, The Sunday Telegraph Oct 2014 and Amit Malewar from Tech Explorist April 2013 by the use of eye tracking and brain's electrical activity sensor technology with using self-driving car technology to develop self-driving wheelchairs.

Researchers from different universities have undertaken AI research and have developed software to dynamically simplify the user interface to improve the user experience of software. The research benefits people with learning, cognitive, visual impairments and mobility disabilities (Guardian 2011 and Technology Networks, May 2018 ).

IBM research published an What's next for AI by Chieko Asakawa on AI technology assisting Vision Impaired users in assisting with seeing what is around them in context via the Cognitive Assistance Project for Visual Impairment. This type of technology will benefit all users.

Another common benefit for AI processing can be highlighted in relation to mobility. An illustration where all benefits of AI converge is the ability for a blind person to navigate in an unfamiliar environment. If a blind person was hungry but did not know the location of the nearest food outlet, it is currently possible for that person to use an app to identify food places nearby, then have various mapping apps, AI assistants and real-time GPS tracking to guide the person to that location.

Microsoft article Using AI to empower people with disabilities via their AI for Accessibility program, have developed a range of technology specifically helping the disabled. Ranging from Microsoft Translator used for captions, Helpicto turns voice commands into pictures helping autism users, Seeing AI and auto alt text helping the vision impaired with reading text and facial detection.

## Challenges of AI

However, just as the benefits of AI and IoT are amplified for people with disability, so are the potential risks of exclusion. These issues (Hollier and About-Zahra, 2018) include:

- Interoperability – currently consumer systems with AI interaction systems tend to be closed with proprietary standards and APIs, making it harder for customized assistive technologies to provide access for people with disability
- Accessibility Support – devices, sensors, and other IoT objects need to ensure accessibility on the data and protocol level to allow IoT applications to provide accessible interfaces and associated AI services.
- Identification and Configuration – of accessibility features need to be available transparently and consistently through platform APIs, as they are commonly available on operating systems.

- Privacy – AI devices systems may expose information that is more sensitive to people with disability and may also need to address privacy concerns more specifically.
- Security and Safety – also security and safety concerns may be higher for people with disability, particularly in areas of healthcare and commerce where highly sensitive interactions occur.

Bruce Maguire from Vision Australia was interviewed to provide his input on AI from the Vision Impaired point of view. He stated: AI technology "appears to be happening without any reference to the needs of people who are blind or have low vision." There are good examples of some AI technology specifically design for the Vision Impaired users. "But mainstream applications that will have an impact on us are largely being developed separately." Take into account the self-driving cars: Are they going to be accessible to vision impaired users and how to ensure the driverless vehicles do not discriminate against people with a disability when making decisions about possible pedestrian collisions? How do we ensure that facial recognition and related biometric algorithms such used in airports do not exclude people who are blind, whose eyes are either not visible or not able to focus on facial technology?

One area which has not been fully explored is the development environments used to build AI, robotic, virtual and augmented reality, standard development environments, and administration tools for these technologies. Possible implications of inaccessible tools: The PWD is unable to use these tools locking them out of this employment opportunity. Development environments which do not include accessibility as part of their library set will introduced inherently inaccessible products.

## What is Accessibility

Accessibility crosses all market sectors and social demographic groups. The formal definition of accessibility is the removal of barriers for PWD in the use of products, goods and services. Within this paper the term accessibility is focusing on the human interaction of technology.

If the different market sectors do not address accessibility within their technologies before release, the full potential of the market is not reached. In turn excluding the largest minority group from inclusive technology. Historically, accessibility is an after-thought in mainstream technology. There are exceptions to this methodology such as: Apples iWatch which has leveraged prior work done on the iOS platform. Cisco's 8800 IP Phone self-speaking using Text-to-speech (TTS) providing independence for Vision Impaired users.

## Whom does Accessibility Benefit

The broader community view is accessibility benefits only PWD. This current view is not correct as accessibility benefits everyone. Some examples:

- The ability of increasing text on web pages up to 400% (WCAG 2.1 success criteria) benefits individuals who have difficulty with small text and are not legally blind.
- Pram ramps in gutters originally introduced for people in wheelchairs with the side benefit of helping people using bikes, prams, trolleys, et cetera.
- Providing best practice for colour contrast for text helps people who are colour blind or in environments where there is glare.
- Caption in multimedia assisting English as a second language individuals who find easier to understand the written word. Also search engines can use captions in their search algorithms.

This only scratches the surface of improvements in technology that benefit society as a whole via accessibility.

## Where accessibility fits into the product life-cycle

Accessibility must be performed at each stage of the product life-cycle and not performed at the end.

> The planning and design phase must include PWD users, and use accessibility best practises at this phase. At the user experience (UX) stage, the product team must seek input from the PWD. Before the actual development starts, correct research and design for the user interface (UI) must be undertaken.

- Once the actual design of the product has been completed, the development team must ensure that the user interface components follows recognised international guidelines on accessibility and validate the product by prototyping with PWD users to ensure the features of the product work as designed.
- Formal testing and user base testing by PWD is another component to ensure the product is usable. As this group of users have the specialised knowledge and experience to be able to provide the required feedback to ensure the product becomes fully inclusive. Formal accessibility auditing is another process to ensure the technology fulfils the minimal international standards.

Inclusive design is the essence of including the full user base into the product life-cycle. The concepts outlined apply to all technologies including AI. Including accessibility as an afterthought increases the cost of the product. This is supported by the presentation Accessibility Myths for the Mobile Generation slide 34 (Jonathan Hassell, Accessibility Director at Open Inclusion 2015). The slide shows the gradual increase of the cost of fixing accessibility bugs through the different testing phases.

# International policy and legislative implications

For PWD to enjoy the benefits provided by AI devices along with protections relating to privacy and security, it is necessary to have effective legislative support and technical standards.

## Accessibility Technical Standards

The definitive world standard in the relation to accessible digital content is the World Wide Web Consortium (W3C) Web Content Accessibility Guidelines (WCAG) 2.1, published June 2018 (W3C, 2018). Due to the relatively new release of the standard, most countries that have a digital access policy adhere to the former WCAG 2.0 standard (W3C, 2017). Other W3C accessibility standards are: WAI-ARIA the Accessible Rich Internet Applications 1.1, accessibility technical Authors guide (ATAG) and, usability Agent accessibility guide (UAAG). Yet despite little international guidance being currently available, W3C have commenced a project referred to a Silver, or Accessibility Guidelines 3.0 (W3C, 2016). The purpose of Silver is to create an all-encompassing standard that provides definitive support for PWD regardless of the type of technology in use. This would include existing standards such as WCAG plus cater for upcoming technologies such as IoT and AI. Accessibility will play an important part in the development of this standard. Encouragement for vendors to be pro-

active in creating technologies that keep accessibility in mind, leading to a pro-active approach to digital access rather than the current reactionary approach.

The ISO 9241-171 2008, Ergonomics of human-system interaction, Guidance on software accessibility and ISO ISO 9241-210 2010, Human-centred design for interactive systems both focuses on accessibility beyond web technology.

USA Section 508 Rehabilitation act refresh from 18 January 2018 has harmonise with the web content accessibility guidelines 2.0 for Web, Mobile, Desktop, documentation and hardware technology.

The EU 301-549 accessibility IC Procurement standard utilises the Web Content Accessibility Guidelines for web technology and provides accessibility guidelines for other technologies. Australia's AS EN 301 549: 2016 - Accessibility requirements suitable for public procurement of ICT products and services is based upon this standard.

Mobile and desktop operating systems (OS) provide their own accessibility framework to support application developers to introduce accessibility into the product. These frameworks are unique to each vendor OS using similar principles. AI and other technology must utilise the accessibility framework to ensure that the user interface is accessible. All graphical user interface (GUI) proprietary vendor's OS's are encouraged to follow the existing accessibility frameworks developed by Apple, Microsoft, Google to name a few.

## Existing regulations and treaties

To highlight the significance of digital access for people with disability, Article 9 of the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) (United Nationals 2017) states that:

To enable persons with disabilities to live independently and participate fully in all aspects of life, States Parties shall take appropriate measures to ensure to persons with disabilities access, on an equal basis with others, to the physical environment, to transportation, to information and communications, including information and communications technologies and systems, and to other facilities and services open or provided to the public, both in urban and in rural areas.

As a signatory to the UNCRPD, Australia has some policies in this area but there is no specific disability-based legislation designed to cater for the needs of ICT for people with disability. The Australian Human Rights Commission (AHRC) highlighted in its World Wide Web Access: Disability Discrimination Act (DDA) Advisory Notes revision. 4.1 (2014) (Australian Human Rights Commission, 2014) that Section 24 of the Disability Discrimination Act of 1992 can apply if there is a denial of service due to digital access issues. However, it is the complainant that must demonstrate this to be the case and that the content in question fails compliance to the WCAG 2.0 standard.

Commonwealth Anti-Discrimination Law Reforms of 2012 was one initiative undertaken to examine the current discrimination laws. Vision Australia's submission outlines the challenges in relation to technology as it currently exists in the DDA:

"37) The DDA also does not explicitly deal with the accessibility of internet resources such as websites. While the AHRC has advised that in its view the definition of "service" in the DDA includes websites provided by companies and organisation, we are not aware that such coverage has been tested in the courts. There is, in theory at least, some doubt about the extent to which the DDA can

be construed to cover new and emerging areas of public life that result from technological and other developments. “The Blind Citizens of Australia also had a similar comment in their submission to the same review.

The complainant approach illustrates a reactive approach in making technology accessible for the PWD. Additionally, technology such as the web is classified as soft law compared to the Education, Employment and Building Standards which are referenced in the DDA.

The Australian Federal Digital Service Standard criteria 9 says "make it accessible". Commonwealth procurement rules Clause 10.10 & 10.38 state any applicable Australian standard applies. The introduction of AS EN 301-549 (Accessibility requirements suitable for public procurement of ICT products and services) standard was introduced in 2016. All Federal agencies are mandated to adopt this standard. The Digital Transformation Agency (DTA) is taking the lead in how this is being adopted. NSW State Government and DTA aligning with a national approach based on feedback from disability peak bodies, governments and vendors alike. July 1st, 2018 the NSW mandates AS EN 301 549:2016 into ICT services scheme (SCM0020) rules. To date Tasmania and South Australia are in the process of completing this task.

One missing initiative in Australia is mandatory education for accessibility within our tertiary and high school education bodies. Accessibility must be integrated into the subjects related with product management, design, and development, marketing and legal requirements as examples and not as a stand-alone subject. The benefit of having accessibility in multiple subjects within a course is for re-enforcement of importance of accessibility concepts in products, goods and services.

Furthermore, there are genuine concerns that no current Australian policy or legislative framework provides guidance in relation to the privacy, security or interoperability aspects relating to AI or associated devices such as IoT, and this reality is also reflected globally. While there is some work in W3C relating to the security implications of CAPTCHA and how the malicious use of AI can be thwarted without preventing access exclusions for people with disability (W3C, 2018b) and some broader investigations relating to accessibility and the Web of Things there is little guidance offered to support or protect in relation to the use of AI in consumer devices or data. This is supported by Emma Bennison CEO of Blind Citizen of Australia outlining certain technologies like Aira where the human agent who supporting the blind individual could obtain information on the individual without their knowledge. Such as obtaining financial information, personal habits, and other information which the user accidentally revealed. As AI is going to impact the consumer and commercial sectors, the laws as they stand are not inclusive enough and provides a high risk to exclude a large percentage of the population from accessing current and future technologies.

# Conclusion

In specific reference to AI, there is little in Australia’s current policies and legislative framework which is currently providing support in this area. The WCAG standard, while effective in providing guidance for digital access issues broadly, does not specifically discuss AI or the relevance of AI to accessible data or devices. In addition, the ad-hoc nature of the DDA 1992 in its interpretation on the ICT needs of PWD render this legislative framework ineffective as well. While the procurement policies are arguably the most applicable policy that could specifically address accessibility for devices that may contain AI functionality, there is little guidance on this issue.

It is recommended therefore that an update to the DDA be considered so that there is ICT-specific guidance that can both support and protect PWD as such technologies evolve.

The AS EN 301-549 should follow the self-certification methodology which USA vendors use for the Section 508 rehabilitation act of 1998. The USA Federal government has Section 508 coordinators, whose purpose is to ensure the information contained in a voluntary product accessibility template (VPAT) provided by the vendor is valid and to highlight any potential errors.

Additionally, governments at the federal and state levels providing incentives programs targeted at private organizations who develop or provide goods and services to the consumer and commercial sector who include accessibility in their product at release. This approach could encourage small organizations who otherwise would not include accessibility in the product or services to start doing so.

Accessibility experts, vendors, policymakers, and advocates must not take the view that disability is completely separate from the general discussion and that the disability will deal with all the relevant issues. The approach must be fully inclusive and to ensure technology is accessible by the whole community.