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The challenges of Web accessibility: The technical and social aspects of a truly universal Web

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The challenges of Web accessibility: The technical and social aspects of a truly universal Web

by Justin Brown and Scott Hollier

Abstract

This paper explores the concept of Web accessibility and how technologies, guidelines and policies have evolved since the turn of the twenty-first century in order to address the ideals of equitable access to online content for all people. The paper discusses the high availability of assistive technologies built into consumer devices and the associated accessibility guidelines for Web sites and content. Through examination of the literature, this paper shows that the accessible design and assessment of Web sites can be complicated, and that social media, corporate and government Web sites are yet to fully realise the goals of an accessible Web. The paper concludes with the view that disability awareness, more than technology and policy, is perhaps the primary obstacle to a more universally accessible Web.

Contents

Introduction

In little more than two decades the Web has evolved into an essential service for many of us in our daily lives, moving beyond the sum of its parts as an information, communication and collaborative resource. This is particularly true for people with disabilities for whom the Web offers the promise of independent participation. However, for people with disabilities to enjoy the benefits that the Web can provide, two key access issues need to be addressed: the provision of assistive technologies to enable the use of particular devices, and the need for Web sites and applications to adhere to Web accessibility standards. This literature-driven research posits that whilst advances in accessibility technology in the last decade has been significant, with some ever more promising cloud technologies on the horizon, widespread adoption of accessibility principles have not.

Traditionally, assistive technologies were expensive, bolt-on software and hardware products designed to assist people with disabilities in using computers and the Internet, but in recent years the operating systems (OSs) of mainstream computers and mobile devices have incorporated accessibility features into their products, partly due to policy and legislative requirements and partly due to the need for all uses to engage with popular products. As a result, people with disabilities are not only able to more readily use popular technologies such as smartphones and tablets, but they also have the same choice of device as available to the mainstream population. While the consumer space continues to largely revolve around the provision of accessibility options in the form of assistive technologies, the availability of Web content and services continues to struggle in the developer space despite established support through established Web and ISO standards.

However, the key question currently faced by people with disabilities is not just a matter of addressing specific accessibility issues, but whether such issues are preventing effective

participation in society, or more concerning, leading to a reliance on inaccessible online information which in turn leads to choices being made that are different to the original intent. This paper explores this question, looking at the rise of the accessible consumer device and accessibility standards, the challenges around it and questions if people with disabilities are able to effectively participate as digital citizens.

Policy and the goal of an accessible Web

The inclusion of assistive technology into mainstream OSs and devices is largely credited to the introduction of the United States' Rehabilitation Act of 1973, Section 508 (U.S. General Services Administration, 2014), arguably the first time that a country had specifically legislated the need for accessible Web content (Takagi, *et al.*, 2003). While Section 508 primarily focuses on public procurement policies, it also created a requirement for federal government information to meet basic accessibility requirements which in turn meant that both people with disabilities accessing government information, and people with disabilities seeking employment within the U.S. government, had the opportunity for significantly improved access to information and provided a framework which was widely adopted by other countries.

Prior to Section 508, assistive technology was primarily developed by third-party assistive technology specialist companies and was considered expensive, often costing thousands of dollars, comparable to the purchase of the Windows-based computer on which the software was installed. With a clear goal for mainstream companies to sell product to the U.S. government, accessibility features began to be included shortly after the arrival of Section 508 (Jaeger, 2008). The success of Section 508 was largely due to the draft WCAG 1.0 recommendations created by the World Wide Web Consortium (W3C)'s Web Accessibility Initiative (WAI). This initiative included the development of guidelines, tools, educational research and developmental research (Goldstein, *et al.*, 2011; World Wide Web Consortium, 2014a) aimed at providing testable guidelines and educational resources for the development of accessible systems and content. The standard created by WAI was the Web Content Accessibility Guidelines (WCAG) 1.0 (World Wide Web Consortium, 1999) which was designed as the practical implementation of accessibility on the Web, ensuring that assistive technology products would function effectively when viewing information via a Web browser. WCAG 1.0 consisted of 65 checkpoints across three priority levels and, while Section 508 in 1998 was one year prior to WCAG 1.0 becoming a recommendation, much of Section 508 was based on the WCAG 1.0 draft.

The rise of mainstream consumer accessibility

For consumers, the catalyst of Section 508 in the U.S. was a driver for multinational companies to include accessibility features in their OSs if they intended to sell products to the U.S. government. As Jaeger (2002) states: "Without the requirements of Section 508, much EIT, from Web sites to computer terminals, would remain inaccessible to individuals with many types of disabilities" [1]. The requirements of Section 508 might have directly contributed to Microsoft including Narrator in Windows 2000, the first screen reader to be bundled into a popular mainstream OS. While Narrator itself was not generally considered a particularly good screen reader for people who are legally blind or partially-sighted, for developers it did mark the need to take accessibility considerations seriously as the underpinnings of the whole OS had to be optimised for the screen reader application to provide text-to-speech interaction with the OS and Web browsers. This primarily focused on the importance of labelling graphical elements correctly. A variety of other accessibility features were also added, with particular focus on people with vision, hearing and mobility-based accessibility issues.

While the introduction of the Narrator screen reader in 2000 (Lazzaro, 2001; Microsoft Corporation, 2014) was a significant development, the inclusion of cutting-edge mainstream accessibility features by Apple in its Mac OS X platform was considered to be of even greater significance (Hollier, 2013) due to the quality of the tools. With the inclusion of the first full-screen magnifier into a commercially available mainstream OS, Apple went on to introduce the advanced VoiceOver screen reader in Mac OS 10.4 Tiger in 2005. For consumers this was significant in several ways; firstly, people who were legally blind or vision impaired were able to effectively use a mainstream computer for the first time. While Narrator was helpful in Windows, it was not effective enough to replace a commercial screen reader VoiceOver, however, was a viable alternative to a commercial product. The second highly significant benefit of the screen reader's inclusion is that it meant for the first time consumers with disabilities did not just have accessibility, but also had choice as to which mainstream OS they wished to use. Prior to this it was generally accepted that Windows with a third-party screen reader was the only viable choice. Finally, the release of VoiceOver had a similar impact to the Apple developer community as Narrator did for Windows, leading to Mac OS developers to also focus on labelling graphical elements in the graphical environment. Mac OS also continued to improve its other accessibility tools such as speech-to-text dictation functions.

As consumer devices began to shift from the traditional desktop model to more portable devices such as smartphones and tablets, Apple again led the charge. Prior to the iPhone 3GS, it was largely believed that touchscreens and accessibility were mutually exclusive (Hollier, 2013). While this release may have been initially challenging for application developers in terms of accessibility requirements during Apple's iPhone development, the inclusion of touchscreen accessibility features including a screen reader and zoom functionality (Burton, 2009) were the result. For people with disabilities, the ability to have an accessible and portable device opened up an extraordinarily range of possibilities with disability-specific applications developed which used the built-in accessibility features to allow support for reading books, personal navigation, engagement with accessible media and accessible (somewhat) social media. With the inclusion of the same accessibility features on the iPad, the need to purchase a high-end PC to support expensive assistive technologies was essentially no longer required.

With Apple's accessibility advancements now being viewed as a competitive advantage, Google updated its Android mobile platform in 2011 to ensure that it was able to also effectively support people with disabilities. Google's Android 4.0 release improved its accessibility offerings to be suitable for daily use and more recent updates have included a full screen magnifier and device-wide captioned video playback support.

The importance of Android becoming accessible is that Android devices are significantly cheaper than their Apple counterparts and, as such, the inclusion of effective accessibility options in Android devices (Adam, 2014) marked a turning point where accessible devices are not just less expensive, but can actually be considered affordable, with sub-$100 tablets and smartphones containing the required accessibility features now available in the market. Once again, the increase of accessibility features in mainstream off-the-shelf products has resulted in people with disabilities not just having access, but having choice as to which device they wish to use and, now for the first time, significant choice regarding affordability between the same products as able bodied consumers.

One of the drawbacks with recent developments is that consumers with disabilities generally had to choose their devices based on the type of input they wished to have. For traditional desktop computer users, input was basically a keyboard or a third-party specialist input device. For mobile devices, input was generally optimised for touch and, while keyboards were available, they were generally cumbersome to use for accessibility in such a touch-heavy environment. The most recent step forward in providing consumers with effective input choices on the one device is the development of Windows 8.x which has optimised its accessibility features to be equally effective on a touch-enabled tablet or the more traditional keyboard input method (Sinofsky, 2012). With Narrator being updated for the first time in 12 years to provide touch-screen support and other accessibility features also touch-optimised without losing their keyboard functionality, the new Windows 8.x interface has again significantly improved the effectiveness and choice for people with disabilities in using computer and mobile devices.

The most recent innovation in consumer accessibility is also credited to Windows 8.x, with the first inclusion of disability-specific cloud accessibility features. Users of Windows 8.x can set up their accessibility preferences and then store those preferences in the cloud, meaning that if the same user logs onto another Windows 8.x device its accessibility features will already be set up with their preferences. The availability of this is highly significant as conceptually it presents the genuine possibility of an anywhere, any device accessible interface. However, the applicability and effectiveness of these tools only represents one part of the equation as in order for these tools to work effectively, it is necessary that Web sites implement the current version of WCAG and its associated WAI standards and techniques.

WCAG 2.0 and the shift back to a content focus

With WCAG 1.0 and its influence on the U.S. Section 508 being a strong catalyst for the inclusion of accessibility features in mainstream products, the standard itself became outdated due to rapid evolution of Web technologies and content in the early 2000s. As a result, the W3C released WCAG 2.0 in December 2008 (World Wide Web Consortium, 2008). The focus on WCAG 2.0 was to ensure that the guidelines were more technology-neutral and based on the four POUR design principles of perceivable, operable, understandable and robust within which are contained twelve guidelines. A simplified version of the guidelines (World Wide Web Consortium, 2011) listed the twelve guidelines as

Perceivable

- Provide text alternatives for non-text content.
- Provide text alternatives for non-text content.
- Provide captions and other alternatives for multimedia.
- Create content that can be presented in different ways, including by assistive technologies, without losing meaning.
- Make it easier for users to see and hear content.

Operable

- Make all functionality available from a keyboard.
- Give users enough time to read and use content.
- Do not use content that causes seizures.
- Help users navigate and find content.

Understandable

- Make text readable and understandable.
- Make content appear and operate in predictable ways.
- Help users avoid and correct mistakes.

Robust

- Maximise compatibility with current and future user tools.

Whilst it is beyond the scope of this paper to launch into a deep analysis of each of the above, one salient example of accessibility at its most basic is that of alternative text for non-text content, primarily images. As most Web pages make heavy use of images for both informative and decorative reasons, poorly implemented or non-use of alternative text descriptions can significantly impact on the meaning that special needs users can draw from the content of a given page (Bigham, 2007). As an example, Figure 1 below shows a picture of traffic taken in Seoul, South Korea in April 2014. Below the figure are a number of possible representations of how this image could be inserted into the html code of a Web page.

```
1. <img src="SAM_0056.JPG" />
2. <img src="SAM_0056.JPG" alt="" />
3. <img src="SAM_0056.JPG" alt="SAM_0056.JPG" />
4. <img src="SAM_0056.JPG" alt="heavy traffic in Seoul, Korea April 2014" />
```

Figure 1: Alternate text example.

From the perspective of accessible design, code snippets 1 and 3 offer little to the user of assistive technologies as they know it is an image, and/or the name of the image file, but nothing of the context. In terms of accessibility best practice, if the image serves no purpose (such as being a part of a clickable link) then snippet 2 would be acceptable, generally indicating to the user that the image is largely decorative in nature (WebAIM, 2014). In the context of this explanation, snippet 4 would provide the most relevant information to the user without adding undue cognitive load (Olsen, *et al.*, 2010) in terms of excessive explanation of the image content.

Since the introduction of WCAG 2.0 an exhaustive amount of exemplar, tutorial and implementation resources have developed around the application of the POUR guidelines and the accessibility techniques available within each (Aizpurua, *et al.*, 2009). As well as the materials available via the W3C, WAI and WebAIM Web sites, there are numerous blogs and meetup groups dedicated to the ongoing implementation and advocacy for the use of WCAG across all aspects, of the Web, from small business, to large governments and multinational corporations. In terms of

research, there are a number of high profile international conference series and journals which focus on accessibility technologies as well as assessment methodologies.

Assessment and conformance

Assessment methodology is a field of research which sees a constant stream of publications matched to robust debate, particularly in terms of automated versus human centred assessment (Hong, *et al.*, 2008). Whilst WCAG 2.0 was designed to be more testable than WCAG 1.0, the literature is alive with both consensus and contradiction when it comes to value of assessment methods and the results they present. There are a large number of automated assessment tools available for Web site and content assessment ranging from free, page at a time tools to enterprise level whole of site suites which can costs thousands of dollars a month to subscribe to. Many of these tools originated in the era of WCAG 1.0 (Web Accessibility Initiative, 2006), though some have transitioned to WCAG 2.0 and are designed to assess content as well as site design, including PDF documents, colour, audio and video flicker rates. In terms of automated tools and assessment against WCAG 2.0, research consensus is that whilst automated tools can take on some of the heavy lifting of large scale Web site checking, the results should be considered indicative rather than definitive (Brajnik, 2008; Vigo, *et al.*, 2013). Automated assessment is particularly problematic from the perspective of false positives and false negatives, where a false positive is an identified error where none exists and a false negative is an actual error that has gone unreported. As an example, automated tools can readily search through a page or an entire Web site and identify any instances of the html <img> tag that have no associated ALT attribute, or where the value of the ALT attribute is the same as the image file name (see snippet 3 in Figure 1). However, what the automated tool cannot do is indicate if an ALT attribute value is actually relevant, including whether the description of the image is accurate, or if the ALT value is blank (ALT="") that this correctly implies a decorative image or not. To ascertain if the site is fully conformant with WCAG 2.0 human intervention and inspection is still required, with verification of automated results normally the starting point (Al-Khalifa, 2012).

Manual assessment of Web sites against a set of guidelines, also referred to as conformance reviews (Brajnik, 2008), provides a far more accurate picture of the real-world accessibility of the Web site design, but it also far more time-consuming and labour-intensive than automated assessment. It requires one or more 'expert' users to work through a number of pages in a Web site, using a variety of tools in order to diagnose usability issues and incorrect application of accessibility guidelines. Whilst the literature defines an 'expert' in a variety of ways, typically the term refers to a person who has technical knowledge of html, css and other Web coding languages, as well as in-depth knowledge of accessibility guidelines, techniques and how they should be applied (Brajnik, 2008; Bailey and Pearson, 2011; Vigo, *et al.*, 2013; Bailey, *et al.*, 2014). Along with the conformance check assessment approach other testing methods include structured and barrier walkthroughs, where the Web site assessor attempts to complete a set process within a site, such as purchasing a product through an online store, recording any accessibility or usability barriers which may prevent a user from completing that task (Brajnik, 2008; Bailey and Pearson, 2011; Bailey, *et al.*, 2014). Unlike automated assessments, manual assessments performed by experts and/or special need users are considered to give a more holistic view of a Web site and its level of accessibility, though the number of pages that can be realistically checked is far smaller. Whilst an automated assessment tool may be able to check a Web site of 10,000 pages or more in a couple of hours, realistically an expert assessor or group of assessors might spend hours testing a single content heavy page. Whilst the literature is replete with accessibility auditing methodologies, with a focus on the balance between automated and manual assessment, the W3C's Web site accessibility conformance evaluation methodology (World Wide Web Consortium, 2014b) outlines a five step evaluation procedure consisting of defining the evaluation scope, exploring the target Web site, selecting a representative example of pages, auditing those pages and reporting the findings.

Regardless of the evaluation and assessment methodology employed, the assessment aspect of Web accessibility can be as difficult as or even more so than the actual implementation of the accessible coding and design. Assessment requires individuals with multiple skillsets as well as a mature understanding of the different types of special needs faced by Web users and the subsequent implications of these needs in terms of accessible design. Whilst the literature and associated evidence is currently underdeveloped, it is the view of these authors that perceived issues in conformance assessment, including cost, availability of expertise and lack of a standardised assessment reporting approach is a significant contributor to low levels of accessibility uptake.

Accessibility and government

While the 12 WCAG 2.0 guidelines were widely adopted into policy and legislative frameworks, the implementation of WCAG 2.0 was generally considered slow in its implementation. In

Australia, for example, the Federal government established a National Transition Strategy (NTS) to ensure that the implementation of WCAG 2.0 was achieved across all Australian government Web sites to the minimum Level A standard by the end of 2012 and then Level AA standard by the end of 2014. However, the release of the first report in December 2013 outlining the success of the Level A 2012 target indicated that only 26 percent of Federal government Web sites had in fact reached this target (Australian Government Information Management Office, 2013) As a result, people with disabilities requiring information from Australia's Federal government are largely unable to do so (Australian Government Information Management Office, 2009) despite effective access to mainstream devices with accessibility features. The reasons for this failure of government, certainly in terms of the Australian experience, is largely attributable to a lack of resourcing and the need for a greater focus on consistent methods and toolsets (Brown, *et al.*, 2013; Wood and Hollier, 2014). Outside of the Australian context, a number of studies have examined government Web sites (Hyun, *et al.*, 2008; Luján-Mora, *et al.*, 2014; Nizar, *et al.*, 2013; Evans-Cowley, 2006; Jaeger, 2006; Paris, 2006; Kopackova, *et al.*, 2010; Isa, *et al.*, 2011; Basel Al Mourad and Kamoun, 2013; Easton, 2013) of a number of nations and, in most cases, whilst faring better than non-governmental sites, still present accessibility problems on a large scale (Lee, *et al.*, 2007; Kuzma, 2009; Lundy, 2009). Unlike corporate Web sites, government sites have received more attention in terms of accessibility assessment in recent times, most likely due to governments actually having policy or legal requirements outlining specific targets for the accessibility of their sites and content (Sloan and Horton, 2014). Accessibility of government information and services can be critical to special needs users as government services have, over the period of least the last decade (Wintour, 2010; Hermana and Silfianti, 2011; Ghazal, 2012; Song, 2014), progressively been moving to the Web as a source of information, policy, forms and inquiry. Along with core service provision to citizens, governments have also embraced both asynchronous and synchronous online platforms to communicate policy (Tsimonis and Dimitriadis, 2014), platform (Chen, 2008; Church, 2010; Cury, 2011; Gibson and McAllister, 2011) and electoral messages to a national audience (Naim, 2009; Cury, 2011; Lev-On, 2012; Cheng and Chen, 2014). Whilst YouTube is a primary example of an asynchronous media channel whereby government can present a controlled and managed message for citizens and the media to consume after the fact, other environments offer a more synchronous, two way modality where communication is in response to queries and events emanating from with the community. In order for citizens to participate in such discourse, they need to have equitable access to the most commonly used social media tools.

Access issues in social media

While accessibility barriers in terms of online government services may be a significant issue in its own right, people with disabilities face even greater challenges in their endeavours to achieve online participation. Research into social media and accessibility (Borrino, *et al.*, 2009; Dale, *et al.*, 2012; Fuglerud, *et al.*, 2012; Hollier, 2012; Holone, 2012) found that people with disabilities often struggled to access popular social media Web sites such as Facebook, YouTube, Twitter and LinkedIn due to Web accessibility issues, preventing their opportunity for participation, despite social media offering some disability-specific benefits such as assisting a hearing impaired person explain the nature of the disability via Facebook prior to attending a social event, a legally blind person seeking employment via LinkedIn and the ability to overcome transportation issues in getting food by finding local pizza delivery vouchers on Facebook. As social media has become the norm for many people in terms of their social and professional communication, so have corporate and government entities around the world embraced tools such as Facebook and Twitter as tertiary communication channels with their clients and citizens (Hilts and Yu, 2011; Mousavi and Pimenidis, 2014; Kim, *et al.*, 2008; Harris and Dennis, 2011; Lassen and Brown, 2011; Waters and Williams, 2011; Bertot, *et al.*, 2012; Joseph, 2012; Illia and Balmer, 2012; Magro, 2012; Piotrowski, 2012; Unsworth and Townes, 2012; Bonsón and Ratkai, 2013; Haigh, *et al.*, 2013; Pérez Dasilva, *et al.*, 2013; Kwok and Yu, 2013; Lieberman, *et al.*, 2013; Linke and Zerfass, 2013; Thomas and Akdere, 2013; Nwagbara and Reid, 2013; Khan, Yoon, Kim and Park, 2014;, Khan, Yoon and Park, 2014; Lillqvist and Louhiala-Salminen, 2014; Mendez, *et al.*, 2014; Soon and Soh, 2014). This communication can extend beyond marketing and casual information, but as the primary communication between a client or constituent and the corporate or government agency from which they require service or assistance. Emergency services and police agencies are starting to move to the social media channel in terms of community awareness, alerts and assistance with crime solving and emergency management (Carter, *et al.*, 2014; Merchant, *et al.*, 2011; Yin, *et al.*, 2012). In these latter examples, where social media is used a communication channel between government agencies and a nations citizens, a lack of accessibility in these tools can hinder a section of the community from expressing their democratic rights (in nations where they exist) or readily seeking assistance in times of emergency (Kent and Ellis, 2015). The role of social media, in terms of both the research literature and popular media is one of collaboration and engagement, not exclusion.

Potential of the cloud

While Web accessibility is the primary accessibility issue in terms of access to Web pages and content, there is great potential with the promise of cloud accessibility as a potential solution. The cloud and the Web are often defined as the same entity, and in some contexts they may be, though for the most part the cloud is less about content and more about platform. The cloud represents data, interconnectivity and on-the-fly delivery and scalability of digital services, where services can be pulled down and utilised on demand and in context of user need. The Global Public Inclusive Infrastructure (GPII) (Global Public Inclusive Infrastructure, 2014) is an example of the cloud as a delivery platform for a user contextualised service, with the concept of GPII being based around the idea that a person with a disability could approach a device, such as a ticket machine and, once the user is identified, their accessibility preferences and associated technology requirements are downloaded from the cloud and the device is set up to the user's needs in real-time (Vanderheiden and Treviranus, 2011; Lewis and Treviranus, 2013; Global Public Inclusive Infrastructure, 2014) If, for example, a person with a vision impairment approached the machine, the interface could change to include a high contrast colour scheme, large print and text-to-speech output (Madrid and Bailey, 2014). Alternatively, if a person who used a wheelchair approached the same machine, their preferences would lead to the interface putting the touchscreen buttons towards the bottom of the screen within easy reach of the user. Essentially, the digital device and working environment would adapt to the context of the user and their specialised requirements (Raman, 2008; Hoehl, 2012; Miñón, *et al.*, 2013; Hubbell, 2014).

In terms of the modern Web, initiatives such as GPII offer great hope to an ever-evolving inclusive environment. The idea that any device could be set up in real-time (Alvar and Atan, 2012) to ensure its accessibility means that people with disabilities would only have to learn one interface and one set of assistive technology tools. The automated process would also allow for instant participation and avoid potential barriers such as Web accessibility issues and the ever-present need for people with disabilities to 'plan ahead' before undertaking interactions with others, digital or otherwise. However, there are some important reasons as to why such a system is yet to gain mainstream appeal. One significant factor is a lack of high speed broadband infrastructure which would be required to set up accessibility preferences and features in real-time, and there would need to be significant communication between the key stakeholders of government, industry and the end user in order for the system to be used (White, 2011). As with most cloud initiatives, there is also the ever-present issue of privacy and security (Joseph, 2012) and whether people with disabilities would be comfortable storing their personal information online and having it instantly retrievable in public circumstances. There is great potential for the evolution of cloud technologies and the capability they offer to the accessibility community, as witnessed in small scale by Microsoft's could-based accessibility preferences on their Windows 8.x platform. In the wider scale, special needs users could one day consume accessibility technologies at the point of need at the same time they consume the information content or services that these assistive technologies enable. Ultimately, with the recent push by organisations towards placing terminal interfaces on mobile devices as apps (such as ATM teller machines) it may be that the need for cloud based services like GPII are superseded before they even move beyond the concept stage.

Awareness more than technology?

Whilst this paper has examined a number of technology options and environments impacted by accessibility concerns, along with guidelines for best practice and evidence of a great deal of work being done at the research and development level of Web accessibility, the issue still remains that accessibility has yet to reach the mainstream of corporate and community consciousness. A study conducted by Gonçalves, Martins, Pereira, Oliveira and Ferreira in 2009 across WCAG 1.0, WCAG 2.0 and U.S. Section 508 guidelines on the Web sites of Forbes 250 largest enterprises found that nearly all the sites were riddled with accessibility errors, and that the sites did not conform to even minimal accessibility requirements (Gonçalves, *et al.*, 2013) for most types of institutions. The literature describing the accessibility of various government, commercial and education organisations around the world is quite interesting in that a bulk of such literature exists in the pre WCAG 2.0 period, mainly from 2001 through to around 2007/8, with an excellent summary of such literature presented in the work of Bradbard, Peters and Caneva (2010). Bradbard, *et al.* summarise a number of large scale studies similar in intent to that of Gonçalves, *et al.* (2013), whereby most types of intuitions studied fared poorly in terms of Web site accessibility. In more recent times, the literature indicates that tastes in the field of accessibility research have moved away from the 'assess and report' style study (aside from government-based Web sites it would seem) and more towards assessment methodologies, policy development, attitudes towards and understanding of accessibility.

It may be awareness of Web accessibility, brought about through legal and policy mechanisms, will have a greater impact on the uptake of accessible design than will the ongoing improvement of accessible technologies. For many people without a disability, explaining the concept of accessibility and its importance to all users, not just those with specialised needs, can be

extremely challenging. The wider community can understand issues of physical disability, particularly in terms of ramps into buildings, elevators and accessible toilet facilities. These are typically physical, relatable concepts, unlike accessibility which is linked to a far wider set of special needs outside just the physical and observable (Whitaker, 2004; Charles, 2005; Ryan, 2007; Columna, *et al.*, 2009; Adcock and Baillie, 2011; Sanderson, 2011). Accessibility is also associated with Web technologies and how they interact with assistive technologies, which when aligned still further with multiple assessment and analysis methods, can create a cognitive barrier to the target audience and place accessibility in the 'too hard basket'. All too often the social argument of 'it is the right thing to do' takes a back seat to the carrot and stick approach which uses examples of litigation, or promises of increased profits as the motivator for adopting accessible practices (Keates and Clarkson, 2003; Williams and Rattray, 2005; Fulton, 2011; Roig-Vila, *et al.*, 2014). Krach and Jelenic (2009) refer to three of the most common drivers in equality of online content in terms of 'litigation, regulation and legislation.' Looking beyond accessible design as the antidote to risk and reputational damage, an evolving school of thought in the accessibility community is that accessible design principles lead to more useable sites and content for all users. An interesting body of literature exists describing the 'curb-cut phenomenon' (Elin, 1996; O'Hara, 2004; Westin, 2005; Clarke, *et al.*, 2008; Ben-Moshe, *et al.*, 2005; Connolly, 2009; Creamer, 2012; Treviranus, 2014) whereby roadside curbs have been made accessible for people with mobility issues, which in turn are used by non-disabled people. Examples of phenomenon are extended to include ramps into buildings, widespread use of elevators, spacious disabled toilet facilities and automatic opening doors, all of which are commonly used by all members of society, not just those that specifically rely on them (Treviranus, 2014). By extension, if corporate and government Web site owners can see that accessibility and usability and inherently linked, by building with accessibility in mind the site can essential have 'usability' for free, with a view to benefitting all users, not just those defined as have a special need.

Conclusion

The interaction of the Web, consumer technology, policies and legislative frameworks along with associated Web accessibility standards and techniques have all contributed to a profound impact on the ability of people with disabilities to independently access information and communication technologies. The interweaving of policy initiatives such as Section 508, the creation of WCAG and the evolution of consumer technologies such as built-in screen readers and accessible touch screen devices have all contributed to ensuring that digital citizens can effectively gain access to affordable mainstream tools that allow online engagement.

However, despite this rapid evolution of accessible consumer technologies, Web accessibility issues remain prevalent despite the well-established WCAG 2.0 and associated W3C WAI standards and techniques. While initiatives such as Australia's NTS and the U.S. Section 508 requirements provide broad guidance as to how key public resources can be made accessible, analysis and assessment of corporate and governmental Web sites on an international scale demonstrates that there is still a clear gap between the policies designed to improve accessibility and their practical implementation due to the high degree of technical skill required to conformance test a Web site, the costs involved in such a process, effective resourcing to address this issue and a lack of awareness as to how people with disabilities are likely to engage with such content. While awareness of Web accessibility issues may have increased through the delivery of key policy and legislative frameworks, the practical reality is that the assessment and implementation of Web accessibility issues currently remains a highly specialised area of expertise and more training is required to support ICT professionals to incorporate Web accessibility principles into their work practices. While cloud-based initiatives such as GPII offer some hope for the future that an always-on, always-accessible environment is possible, the underpinnings of existing technologies must have their accessibility issues addressed in order for such a future to become a day to day reality for those with special needs. Whilst this paper has only been able to address accessibility issues in the broadest sense, the authors feel that accessibility is impacted by social drivers, not technical ones, and include limited awareness, disability stigma and a lack of empathy as presenting the greatest hurdles to universal accessibility and acceptability.

About the authors

Dr. **Justin Brown** is a Senior Lecturer in the School of Computer and Security Science at Edith Cowan University in Perth, Western Australia. Dr. Brown has been teaching Web-based technologies for nearly 20 years, with a focus on Web applications and markup languages. He is heavily involved in course design and quality teaching practice, particularly in his roles of course coordination and chair of his school's teaching and learning committee. Justin also manages his school's work integrated learning program and works closely with industry partners to provide students with internships and industry experience prior to graduation.

Whilst Dr. Brown's doctoral work was in the field of e-learning, over the last five years his research interests have moved towards the field of Web accessibility and accessibility issues in general. Having required the use of a wheelchair since childhood, Justin has an affinity for the issues faced by all people with special needs, whatever form those needs may take. Dr. Brown is an invited expert on the World Wide Web Consortium's Research and Development Working Group and is currently supervising a number of Master's and doctoral candidates working in the field of accessibility. Dr. Brown's current research interests include the role of ATAG in Web CMS tools and the difficulties in spreading the accessibility message in languages other than English.
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Note

1. Jaeger, 2002, paragraph 4.

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