

## Assessing Web Content Accessibility of E-Commerce Websites for People with Disabilities

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### Abstract

In recent years online shopping has grown significantly. Due to the rapid growth of technology, companies also continuing to extend the functionality and design of their Business-to-Consumer (B2C) e-business websites. However, it is also important to adopt web accessibility such as the Web Content Accessibility Guidelines in B2C websites to increase the consumer's satisfaction of all ages and with disabilities. This study analyses 30 Australian B2C websites in accordance to Web Content Accessibility Guidelines (WCAG 2.0) using an automated web service. The result shows that B2C websites in Australia are not paying attention to web accessibility for people with disabilities. However, e-commerce will succeed in meeting WCAG 2.0 by making B2C e-commerce websites accessible to consumer of all ages and with disabilities. Recommendations are proposed in order to improve web accessibility for people with sensory (hearing and vision), motor (limited use of hands) and cognition (language and learning) disabilities in B2C e-commerce websites.

**Keywords:** Business-to-consumer, e-commerce, web accessibility, people with disabilities, Australia

### 1. Introduction

An e-commerce website is the central way an e-retailer communicates with their online consumers. E-retailer seeks to provide positive online purchasing experiences for online consumers of all ages. A website features encourages or discourages a consumer's online purchasing intentions [9]. In the context of business-to-consumer (B2C) e-commerce, website features have different effects on forming consumers' trust and distrust [36]. In particular, B2C websites those are accessible content, information and easy to navigate influences consumer trust to buy online and must appeal to consumers [8, 11]. Websites need to be accessible to all consumers, including those with disabilities. People with disabilities have limitations for going shopping, which put them at inconvenience because of their physical handicap. However, disabled people can gain a sense of emotional stability by online shopping. Though, if e-commerce websites are inaccessible, consumers with disabilities do not have the equal access they are guaranteed by law. Many online consumers may have various types of disabilities, such as sensory (hearing and vision), motor (limited use of hands) and cognitive (language and learning disabilities) impairments. An accessible web site can utilize all of assistive technologies such as screen readers, voice recognition, alternative pointing devices, alternate keyboards, and the website displays [23]. Web accessibility is an important element in the design of e-commerce websites [24, 43]. Therefore, there is a need of web accessibility in B2C e-commerce websites.

The combination of technology and people in human computer interaction is a vital part of modern society that enables a wide range of economic benefits. In particular, the emerging

growth of business-to-consumer (B2C) e-commerce allows everyone to put up his or her own business online, locally or globally. For-example, online shopping in Australia has become the new norm where more than 50% shop online [31]. According to 2012 digital media research, 75% of Australian made purchases from overseas online shops [39]. The web accessibility is an important factor that needs to be considered in Australian e-commerce [44]. Lazar and Sears [24], the authors discussed that web accessibility should receive attention in e-commerce websites. The B2C website provides the consumers with instant online access to products without physical barriers. In order to get the most out of revenue from online trade, businesses must focus on an accessible B2C e-commerce website, which should also give a real and convenient shopping experience for consumers of all ages. In particular, people with disabilities, such as colour blindness. Because of the Internet availability, online shops provide consumer the ease of buying and selling products. However, the required web technological infrastructure is either insufficient or does not exist in terms of web accessibility guidelines. For that reason, the Web Content Accessibility Guidelines (WCAG 2.0) developed by the World Wide Web Consortium (W3C) help to make the website accessible for users of all ages and with disabilities such as colour blindness, deaf users, and age related vision problems.

Therefore, the purpose of this study is to evaluate Australian B2C e-commerce website accessibility for consumers with disabilities in particular. According to Australian Bureau of Statistics (ABS) Survey of Disability, Ageing and Carers (ABS 2012), in 2009 18.5% of Australians had a disability (Sight 30%, Hearing 10%). The research will be used as a guide for future improvement in e-commerce website accessibility. By assessing the web accessibility of online stores now, e-retailers may avoid legal problems in the future and possibly design accessible website. For that reason, this study analyses the Web Content Accessibility Guidelines (WCAG 2.0) in Australian B2C e-commerce websites using an online accessibility self-evaluation web service called "A-Checker" [1], to determine to what extent they meet the requirements of the web content accessibility guidelines (WCAG 2.0).

In particular, this study intends to focus on the following research questions. (1) What accessibility issues do Australian B2C e-commerce websites currently face? (2) What recommendations can be proposed in order to improve web accessibility in Australian B2C e-commerce websites? This study is organized as. The next section provides background and literature review. Then, research method is presented, followed by results and discussion. Finally, the study provides recommendations and concludes.

## 2. Background and Related Studies

### Issues for Consumer with Disabilities in E-Commerce

The following examples may help to explain the types of barriers that can be encountered by an online consumer with a disability.

**Visual objects.** Product images are placed on the e-commerce website. Websites that use flashing images could trigger symptoms for those with seizure disorders [15]. These images are an example of a barrier for consumers who are visually impaired. They are unable to see the product image and therefore unable to buy it. Such as the use of screen readers cannot read images, animations, navigational buttons, as well as some difficulties with reading layout tables and charts [51]. In addition, a color-blind consumer making online purchase will not differentiate the red font highlighting the discounted prices.

**Audio objects.** An e-retailer has recorded product information available to consumer on the website as an audio clip. Also, other products such as digitized audio. Then consumer who has difficulty in hearing or deaf cannot hear to buy the product.

**Language difficulty.** If the product information displayed on the website page is written in unnecessarily complicated language, such as the use of technical terms in specifications of electronics products. Then it may present serious difficulty for consumers with language, learning or cognitive disabilities (for-example, reading disabilities, thinking, remembering, sequencing disabilities). In addition, all consumers can face language comprehension barriers.

**Objects Interaction.** When an e-retailer focuses on more advanced image interactivity technology, such as three-dimensional (3D) virtual models, 360-degree rotation view, which allows the manipulation of product images. These will represent a barrier for a consumer who cannot grip the mouse to imitate actual experiences with the product. For-example, consumers with various forms of motor impairments may have increased difficulty using a mouse or keyboard. Such as, rollovers and drop- down menus are difficult to use without a mouse.

## 2.2 Web Accessibility

The World Wide Web Consortium (W3C) [49] defines web accessibility as “people with disabilities can perceive, understand, navigate, and interact with the web”. People with disabilities include visual, speech, physical and neurological disabilities. There are varieties of web accessibility guidelines, but the most relevant are ISO 9241-151, Section 508 of the US rehabilitation Act and Web Content Accessibility Guidelines (WCAG) developed by the W3C. ISO 9241-151 and Section 508 comply with W3C. Web Content Accessibility Guidelines (WCAG) version 1.0 was developed in 1999, and then in 2008 more recommendations were made in WCAG 2.0 [50]. WCAG 2.0 is not limited to HTML but support various technologies [26].

The guidelines covered by WCAG 2.0 are: Perceivable, Operable, Understandable and Robust. The aim of “Perceivable” is to direct the user to perceive the user interface components. The “Operable” guides the users that how the interface should be operated and how to navigate. The “Understandable” means the web contents should be understandable by all users. The “Robust” describes that the information should be interpreted by the variety of users in the same way. WCAG 2.0 provided a testable success criterion for each accessibility guideline to determine whether a web page has met or failed the level of conformance. Three levels of conformance for web content accessibility guidelines (WCAG) are: Level A, Level AA and Level AAA. Web developers must satisfy the Priority 1 (Level A) minimum level of conformance, Priority 2 is the Level AA includes all Levels of A and AA success criteria that the developer should satisfy. Priority 3 (Level AAA) is the highest level, the developer may satisfy the requirements for the webpage to help make accessible. These guidelines make web access easy for old age people and to people with disabilities. People who have cognitive and/or sensory, physical disabilities benefit from using accessible websites. The most common disabilities affecting the use of the website are hearing and visual impairment. In addition, people with difficulty gripping object, such as the use of a mouse requires additional access to web.

Methods for appraising web accessibility include automatic and expert evaluation. A number of researchers used automatic evaluation tools in their studies, such as in e-government, internet banking, schools, universities and company’s website etc., for example [19, 20, 22, 25, 27, 35, 46, 47]. Other studies used a group of web accessibility experts for measurements, such as [3, 28, 37]. In addition, a number of researchers assessed web accessibility using both automatic and expert evaluation methods, such as [17, 18, 26, 34, 38, 41]. There are a various free web accessibility online tools examining web pages and automatically evaluating their compliance with Web Contents Accessibility Guidelines (WCAG), such as LIFT, Truwex, A-Prompt, WebXACT (also referred Bobby), WAET, K-WHA, A-Checker, etc. These techniques has the advantage of providing useful evaluations of web accessibility as well as quantitative results [6]. In [23] the authors found that 78.9% of the webmasters were aware that there are automatic tools to check web accessibility. This means that the missing knowledge is not the main reason for the absence of development of accessible websites. The web accessibility evaluation in e-commerce has been limited, in particular in the context of business-to-consumer (B2C) consumer. The following section discusses web accessibility in e-commerce.

## 2.3 Web Accessibility in E-commerce

The significance of web accessibility standards in e-commerce has been known around the world [2, 45]. Noonan [32] investigated accessible e-commerce in Australia and recommends

that e-commerce developers should consider accessibility in their web design. “As public organizations and private businesses rely more on web based technologies for online shopping, information, and service delivery they must implement strategies to ensure all users can fully access web content” [36], and proposes a web accessibility model to benefit all public organizations and private businesses. As noted in [37], “e-commerce sites lose up to 50% of potential online sales because users cannot find what they want”. An accessible website provides a satisfying experience to end-users, hence increasing sales and revenue for seller [5]. In [29] the authors analysed usability and accessibility errors of African e-commerce websites compared to Europe using an automated tools. In [30] the authors recommends putting their own accessibility guidelines for African countries to ensure accessibility for all users.

According to Dolson [10], “The physical disabilities of a merchant’s visitors are a factor that he or she should consider”. In [40] the author believes that getting more loyal customers and avoid legal challenges are the other two reasons to design for accessibility. If the consumer gets the relevant information, then the trustworthiness of the website is increased and hence leads to higher purchase intention [14]. Faulkner [12] developed a Web Accessibility Toolbar (WAT) for Internet Explorer in collaboration with Vision Australia, the Paciello Group (Europe) and of the Web accessibility tools consortium, to assist in evaluating a web page for compliance to the Web Content Accessibility Guidelines (WCAG 2.0). It is well recognized that information on the e-commerce websites varies in quality. To the extent that consumer perceive that e-commerce website presents quality information, they are more expected to have confidence and will perceive the merchant as trustworthy [21]. Therefore, there is a need of quality measurement criteria accessibility for e-commerce [16].

### 3. Method

The most practical method for measuring website accessibility is content analysis. Therefore, content analysis approach is used to investigate web accessibility in e-commerce websites. In particular, the unit of measure for this study is Australian Business-to-Consumer (B2C) e-commerce websites. The sample for this study was generated by region from Alexa, a provider of global web metrics. In (www.alexa.com) website, by clicking the link “Browse Top Sites” and selecting country Australia, 500 website were provided. After deletion of irrelevant links (such as, non B2C e-commerce websites), remaining top 30 B2C e-commerce websites was finalized for further analysis.

#### 3.1 Instrument

Automated analyses were performed using an open source web accessibility evaluation tool called “A-Checker” version 0.8.6 [1] to test all the web pages of selected websites for conformance to web content accessibility guidelines version 2.0 (WCAG 2.0). The online web service “A-Checker” is developed by a research group at the University of Toronto [48] that tests single web page for accessibility conformance. “A-Checker” identifies three types of problems.

- **Known Problems (KP):** These are problems that must be fixed and have been identified as accessibility barriers.
- **Likely Problems (LP):** These are problems that are likely to be fixed and have been identified as probable barriers.
- **Potential Problems (PP):** These are problems that require a human decision for modifying or not to modify your webpage.

#### 3.2 Procedure

Data analysis took place in November 2015. The homepages of the selected B2C websites were tested in order to gain insight into what issues web pages might contain. The URL for each web page was entered into a required field and checked for accessibility. Options such as ‘HTML validator’ and ‘CSS validator’ were enabled and ‘view by guideline’ report format was selected. All three types of problems (known problems, likely problems and potential problems) were

checked and recorded for each level of web content accessibility (WCAG 2.0) compliance of each website. Such as, each webpage was tested for Level A, Level AA and Level AAA of WCAG 2.0. Data (errors) were placed into an Excel sheet and descriptive statistics was conducted using SPSS v.22. If the webpage had the minimum level of conformance error (Level A), it failed the test. If no error were recorded, the webpage passed the test.

#### 4. Results

The results showed that online stores are not paying attention to at least a minimum level of conformance (Level A) of web content accessibility guidelines for their online business websites. Out of 30 Australian B2C e-commerce websites only one [asos.com.au] meets the minimum success criteria (Level A) of WCAG 2.0. Table 1 shows the descriptive statistics of the errors identified. For “Level A” conformance (the minimum level of conformance), a high number of known problems (KP) in Australian websites (mean=19.1) showed accessibility barriers that must be fixed. The results also showed quite a high number of (Level A) potential problems (PP) that requires human decision to fix. The figures are worse for ‘Level AA’ known problems (KP) are (mean=119.1) followed by ‘Level AAA’ known problems (KP) (mean=123.6).

**Table 1.** Group Statistics

Success Criteria	Mean	S.D	Std. Error Mean
<b>KP (Level A)</b>	<b>19.13</b>	<b>16.72</b>	<b>3.488</b>
LP (Level A)	5.87	12.65	2.63
PP (Level A)	782.13	476.25	99.30
<b>KP (Level AA)</b>	<b>119.17</b>	<b>281.01</b>	<b>58.59</b>
LP (Level AA)	5.74	12.69	2.64
PP (Level AA)	833.48	508.45	106.02
<b>KP (Level AAA)</b>	<b>123.65</b>	<b>281.49</b>	<b>58.69</b>
LP (Level AAA)	0.48	0.94	0.19
PP (Level AAA)	863.39	504.36	105.16
<b>Notes:</b> KP: Known Problems, LP: Likely Problems, PP: Potential Problems, S.D: Standard Deviation,			

The main problems reported in Australian B2C e-commerce websites were:

- Missing label for text element and input assistance such as “label text is empty” (65% of pages).
- In addition, problems that need to be fixed are: the contrast between the color of text and its background. The most and severe violations against web content accessibility guidelines (WCAG 2.0) were:
  - Level A 1.3. Ensure that information and structure can be separated from presentation (55% of pages).
    - Success Criteria 1.3.1 Info and Relationships (Level A)
    - “Input element, the type of “text”, missing an associated label”
  - Level A 3.3. Input Assistance: Help users avoid and correct mistakes (73% of pages).
    - Success Criteria 3.3.2 Labels or Instructions (Level A)
    - “Label text is empty”
- Level AA 1.4. Distinguishable: Make it easier for users to see and hear content including separating foreground from background (68% of pages).
  - Success Criteria 1.4.3 Contrast (Minimum) (Level AA)
  - “The contrast between the color of text and its background for the element is not sufficient to meet WCAG2.0 Level AA”.

## 5. Discussion

The analysis reveals a growing need for addressing the current problem of web accessibility in Australian B2C e-commerce. Websites are not designed with equal access for all users in mind. Table 2 presents the complexity levels of some accessibility errors, which shows how easy it is to fix the errors [13, 46]. It is highly desirable that e-commerce firms make greater efforts to ensure that the consumers with disabilities have equal access to their websites.

**Table 2.** Complexity level of some web accessibility errors

Type of accessibility errors	Priority (Level)	Ease of fixing
Alt text is not used for each region of an image map	1 (Level A)	Easy
For tables not used for layout (e.g., spreadsheet), identify headers for table rows and columns	1 (Level A)	Easy
If color is used to convey information, ensure information is also provided in another way	1 (Level A)	Moderate
Did not provide alt text for images that convey content	1 (Level A)	Easy
Did not provide label tags for form fields	1 (Level A)	Moderate
Page does not have logical heading structure	1 (Level A)	Moderate
Programmatic objects should not cause screen to flicker	1 (Level A)	Hard
Used tables to format text documents in columns	2 (Level AA)	Hard
Did not ensure that background and foreground colors contrast sufficiently	2 (Level A)	Easy
Did not provide descriptive titles for links	2 (Level AA)	Easy
Used absolute (pixels) rather than relative sizing and positioning (% values).	2 (Level AA)	Moderate
When scripts created pop-up windows or changed the active window, page did not ensure that user was aware that this was happening	2 (Level AA)	Moderate
Used deprecated language features	2 (Level AA)	Moderate
Did not identify language of text	3 (Level AAA)	Moderate
Did not specify logical tab order among form controls, links, and objects	3 (Level AAA)	Moderate
Did not provide keyboard shortcuts to frequently used links	3 (Level AAA)	Moderate
Did not provide summary and caption for tables	3 (Level AAA)	Moderate
Did not group related links	3 (Level AAA)	Moderate
Did not provide linear text alternative for tables that laid out content in parallel word-wrapped columns	3 (Level AAA)	Hard
Did not provide abbreviations for long row or column labels	3 (Level AAA)	Easy
Live regions are not specified with appropriate WAI-ARIA attributes	3 (Level AAA)	Hard

The Australian government has endorsed the Web Content Accessibility Guidelines (WCAG 2.0) and made a mandatory requirement for all e-government websites to conform Level AA by December 2014 [33]. The Australian government also needs to legitimate and strongly encourage e-businesses to develop accessible e-commerce applications for the widest audience.

In a worldwide context, web development is now growing for e-business. From a human computer interaction viewpoint, accessible websites are becoming ever more important. The web technology creates new opportunities for e-commerce firms, but as well as challenges. Companies invest in e-business since the web has become the platform to perform business efficiently and effectively. Many business models are applied to attract and engage consumers

to revisit their websites frequently. However, the presentation of B2C web design features are not conveyed through web accessibility guidelines to consumers of all ages including disabilities. Therefore, e-commerce websites must also follow web accessibility by law [42].

## 5.1 Contributions and Recommendations

It is extremely recommended to B2C e-commerce firms to ensure that their website is according to WCAG 2.0 [14], which means that consumers with disabilities can purchase online. Based on the [7, 46] recommendations, this study present the following suggestions to B2C e-commerce websites for people with disabilities such as sensory (hearing and vision), motor (limited use of hands) and cognitive (language and learning disabilities) impairments.

### 5.1.1 Consumer with vision difficulties

Web accessibility is particularly important since blind or colour blind consumer has much more difficulty browsing the web [4]. Therefore,

- Product images should be displayed denoting their purpose and not appearance. Such as the use of ALT-tags to allow screen reader to skip unimportant images.
- Use short description for images.
- “People with low vision can use screen readers such as Job Access with Speech (JAWS), available from <http://www.freedomscientific.com/products/fs/jaws-product-page.asp> or Window Eyes (i.e., a screen reader for Microsoft Windows). In order to learn how a screen reader for a person with vision loss would orally present the text of a website, developers can use a Firefox plug-ins such as Fangs Screen Reader Emulator (<https://addons.mozilla.org/en-US/firefox/addon/fangs-screen-reader-emulator/>)” [46].
- Color Oracle software can be used by designers freely (from <http://colororacle.org>) for color-blind people [21].
- Avoid text font that are difficult to read with limited resolutions. The Color Blindness Simulator is also available online (<http://www.colblindor.com/coblis-color-blindness-simulator/>) to close this gap.

### 5.1.2 Consumer with hearing difficulties

- Such consumer should be provided with text captioning (closed captioning) for all audio content.
- Variety of tools available of closed captioning such as MAGpie 2, Docsoft software and YouTube also offer closed captioning services.

### 5.1.3 Consumer with learning and language difficulties

- Avoid flashing text or images (such as displaying product deals or discount promotion) that may induce seizures.
- Text on web pages should also be resizable to improve readability.
- Allow the consumer enough time when requiring input, such as in making online transactions.

The results of this study may help online shopping managers who could use the insights analysed in this research to modify their approach. Developers and website designers can use these understandings to increase desirable outcomes by focusing the web content accessibility guidelines (WCAG 2.0), to increase the chances for an online business to succeed in countries with diverse degrees of Internet users. Practical implications extend to business firms to make changes to their online business strategies to trigger their online sale better by targeting consumers with disabilities.

## 6. Conclusion and Limitations

The results show that B2C e-commerce websites in Australia are not paying attention to meet at least the minimum success criteria (Level A) of web content accessibility guidelines (WCAG 2.0). With the widespread of mobile technology, online shopping has grown significantly in recent years. Therefore, consumers with disabilities are increasingly demanding an accessible online shopping. Web content accessibility gives the opportunity for disabled people to use websites. Web accessibility for B2C websites is also important for legal and a business reasons point of view. It is also helpful to increase serviceability of B2C to engage online consumers of all ages and to increase e-retailer reputation and revenue.

This study has limitations, the B2C websites selected, which may affect the generalization of the study to other specific B2C websites. In addition, other online accessibility evaluation tools and expert evaluation may report diverse web accessibility errors.

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