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USING CONTEXT TO SUPPORT EFFECTIVE APPLICATION OF WEB CONTENT ACCESSIBILITY GUIDELINES

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The World Wide Web Consortium (W3C) has developed guidelines to support the creating of Web content that is accessible to the widest possible audience, regardless of disability. Yet without considering the context in which a Web site will be used, a purely guideline-based approach may leave levels of accessibility and usability to disabled people disappointingly low. A reliance on end-user adoption of appropriate browsing technology and author adoption of appropriate authoring tools may also prevent effective accessible design, while inappropriate reference to guidelines in policy and legislation may also lead to problems. This paper promotes a framework for a holistic application of the W3C's Web Content Accessibility Guidelines in designing Web content, by supporting consideration of the target audience, the intended outcome or experience the resource will provide its users, the usage environment, and the existence of alternative delivery mechanisms. Examples are given of how the framework might be applied to support more effective implementation of accessible Web design techniques.

Key words: Web Accessibility, Web Content Accessibility Guidelines, Inclusive Design, Methodology, Evaluation.

1 Introduction

The importance of ensuring that Web sites are designed with accessibility to disabled people in mind has reached unprecedented levels of acknowledgment amongst Web site providers and Web technology developers. This has been sparked in many countries by the emergence of anti-discriminatory legislation protecting the rights of disabled people, and the extension of this legislation to the 'virtual' as well as physical world. At the same time, compelling arguments exist outlining the commercial benefits that may be gained by designing a Web site to maximise accessibility to the greatest possible audience. As awareness grows, so too does the number, quality and prominence of resources available to support Web content authors in designing with accessibility in mind, yet surveys consistently show that while awareness of accessibility is increasing, progress in improving Web content accessibility remains disappointing. The upshot is that the potential of the Web, to enable independent living and enhance quality of life for millions of disabled people, remains frustratingly unrealised.

We suggest that the reasons behind this have changed over recent years - from an overwhelming. lack of awareness amongst Web content authors of disability accessibility, and, in particular, a lack of knowledge of accessible Web design techniques, to a number of diverse factors that may singly or together combine to adversely affect Web site accessibility. These include:

- Level of understanding of Web accessibility issues by owners and commissioners of Web sites;
- Capability of the Web authoring environment in generating or encouraging generation of accessible Web content;
- The Web content author's interpretation and use of accessibility guidelines;
- Involvement of third-party authored content and non-HTML formats;
- Capability of browsing and access technology amongst end users;
- End-user awareness of the availability and capability of their browsing and access technology.

In each case, the impact of these factors on accessibility of a particular site may be exacerbated by inappropriate consideration of the context and intended use of the Web content in question.

As legal pressures mount, organisations with a Web presence should define and implement an effective policy for optimising the accessibility of their Web content [31]. In addition to education of staff, provision of appropriate tools and methodologies for developing and evaluating Web content, there is a need for organisations to specify to their staff (or to third parties contracted to develop or author Web content) a baseline level of accessibility that all resources must reach. In parallel, legislators and policy makers will also seek to find a comparison between lawful practice and a technical baseline definition of accessibility.

Any such baseline should, of course, look to best practice in accessible Web design, and in particular relevant standards and guidelines. What makes this job difficult, though, is the difficulty in equating 'accessible' with a technically testable level of conformance. The very 'human' factor of accessibility makes it difficult to specify a single, transferable standard against which performance can be measured. Even so, a number of different sets of guidelines on Web site accessibility do exist, most

notably the World Wide Web Consortium (W3C) Web Content Accessibility Guidelines (WCAG) and on which a Web accessibility policy, or even legislation, could potentially be based.

Unfortunately, given the varying factors in determining an optimal approach to Web accessibility a blanket application of such guidelines, whether specified by organisational policy or by legislation, may lead to two undesirable scenarios, neither of which have a positive benefit on Web accessibility. On the one hand, a rigid application of guidelines may discourage a consideration of the contextual aspects surrounding the Web site in question identified as being so important to effective design [2]. This may lead to potentially inappropriate accessibility solutions being applied, which in turn results in reduced value of the resource to disabled people and to the audience in general – and also likely frustration of Web content authors. On the other hand, a resource may be falsely considered as being 'inaccessible' when, while it may technically fail to reach a pre-specified standard, people with a wide range of sensory, physical and cognitive impairments can nevertheless use the resource successfully for its intended purpose.

We argue that while there is an important role for guidelines to support accessible Web site authoring, there is also a pressing need for a support mechanism that allows authors to apply these guidelines most effectively given contextual factors such as the nature of the site in question, its target audience and usage environment. We propose such a framework later in this paper, but first consider the Web Content Accessibility Guidelines and their relationship to existing legislation in more detail.

2 Guidelines for Web Accessibility

2.1 Non-W3C Guidelines

Before discussing the WCAG in detail, we must also acknowledge that beyond WCAG, other guidelines exist that focus partially or completely on the issue of Web accessibility. Some of these may be similar to, or even based on, the WCAG, yet may be more prominent to specific communities. Examples include the Section 508 Electronic and Information Technology Standards [25] (discussed further in *Section 3*) and the IMS Accessibility Guidelines specifically designed for e-learning resources [12].

Unlike the WCAG, Section 508 and other similar sets of guidelines, where the strength of the evidence supporting the validity of each guideline is not explicitly stated and must be assumed by the user, more explicitly research-based guidelines do exist. In some cases, these have been developed from studies involving disabled people, such as the usability guidelines for disabled people developed by Coyne and Nielsen [7], and guidelines for Web design for screen reader users [30]. Such studies tend, however, to focus on specific groups rather than a cross section of impairments, with a corresponding bias in advice given which may conflict with the needs of other users.

The US Department of Health and Human Service's National Cancer Institute produced a set of research-based Web design and usability guidelines [18], including a section specifically devoted to accessibility, based on an expert review of the strength of existing evidence supporting each guideline. The transparency of the methodology and the listing of evidence sources for each guideline support those seeking a confidence in the guidelines' validity and usefulness. Even so, when analysed by researchers from a highly evidence-driven discipline such as medicine, these guidelines have come in

for criticism [4], the authors noting that none of the 60 guidelines were backed by the highest category of supporting evidence, and that 12 (20%) guidelines were based "entirely on opinion".

In all cases, though, in comparison to the WCAG, knowledge of these alternative guidelines appears to be comparatively limited amongst Web developers.

2.2 The Web Content Accessibility Guidelines: Scope and Nature

The W3C's Web Content Accessibility Guidelines (WCAG), Version 1.0 of which was published by the World Wide Web Consortium in 1999 [39], are widely acknowledged as the *de facto* standard against which Web accessibility is measured. The WCAG is one of three sets of guidelines addressing the issue of accessibility of Web content to disabled people which have been developed by the W3C's Web Accessibility Initiative (WAI), the other two guidelines being the User Agent Accessibility Guidelines (UAAG) [36] and the Authoring Tools Accessibility Guidelines (ATAG) [37].

The approach taken by WAI acknowledges that responsibility for Web content accessibility lies not just with content authors, but also with the tools needed to access and process that content (the User Agents) and the tools used to create that content (the Authoring Tools) [3]. Through this approach, WAI indicates that universal Web accessibility can be achieved through full conformance against the relevant set of guidelines by each of these components, as illustrated in *Figure 1*.

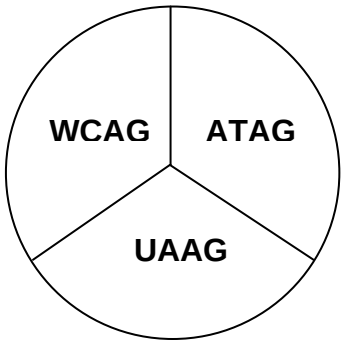

Figure 1: The WAI Approach to Accessibility

The simplicity of this approach has helped WAI in successfully raising the profile of Web accessibility, to the extent that the WCAG is generally acknowledged as the pre-eminent reference to providing accessible Web resources. Indeed, the success in which accessibility has been embraced as a crucial part of the increasingly popular "Web standards" movement [42] has been noted by a number of commentators [5] [24], where the prime motivator for working towards WCAG conformance amongst many Web professionals is that of technical quality of their work.

However, as this paper argues, there are limitations with this three component approach. In particular, the WAI model does not truly reflect the diverse uses made of Web technologies and the diversity of the end user environment. The model is also reliant on developments in the capabilities of user agents (browsers and assistive technologies) and authoring tools, something beyond the control of Web authors. The limitations of the model in general are further affected by implementation issues relating to the WCAG themselves, discussed in the next section.

2.3 Surveys of levels of Web accessibility

Many surveys have been carried out which seek to measure WCAG conformance of Web sites across a number of communities, and overwhelmingly find that conformance levels are lower than desired [9] [10] [14] [22]. While a full evaluation against WCAG by its nature requires human analysis of the subject Web site – both by experts in accessible design and ideally by disabled site users [9] [27], this inevitably impacts adversely on the resources required to complete the evaluation – in terms of time required to carry out the evaluation as well as the need to recruit disabled evaluators. As such, surveys have typically made use of automated accessibility auditing tools to rapidly measure conformance of multiple sites with WCAG features which can be checked automatically. This approach cannot measure full conformance, but it can be used to give an upper bound on WCAG conformance (for example, a tool can report on resources which appear to comply with WCAG through the presence, say, of alternative text (an HTML 'alt' 'attribute) for images but will not be able to say if appropriate alternative text for images are provided, which is needed for WCAG conformance). Despite the inevitable limitations of an evaluation procedure that does not involve manual inspection of the site, such surveys can prove useful as they can help to give a broad picture across communities, help to spot common problems and inform the development of appropriate strategies for developing solutions.

The experience of the authors is such that awareness in Web accessibility has improved enormously in recent years, and continues to grow, yet even amongst resources developed by highly competent Web authors, accessibility issues remain. While time, financial and other factors undoubtedly influence the quality of work, we suggest that the resources available to authors, in particular the WCAG, may not effectively support them in achieving their goals in terms of accessibility. In 1999, Colwell and Petrie [6] evaluated the usability of the WCAG with Web site designers, and this study revealed a number of issues, such as the navigability of the guidelines, and presentation of content and examples. Since then, as more and more Web authors and content developers become exposed to the WCAG, voluntarily or involuntarily, the authors have noted a number of additional reservations concerning applicability of the WCAG in specific circumstances, raised informally through personal discussion, mailing lists, Web forums and events, which appear to provide at least a partial explanation as to why levels of Web accessibility are lower than desirable.

2.4 The Web Content Accessibility Guidelines: Challenges in Implementation

2.4.1 Theoretical and closed nature of the guidelines

There is a feeling that the guidelines are too theoretical and are based on a W3C perspective rather than real world experiences. In particular, WCAG supporting documentation makes no obvious mention of widely used Web formats such as PDF and Flash, yet concentrates on open W3C technologies such as such as RDF, PNG and SVG, the use of which is extremely limited, and for which comparatively few practical experiences are available. In mitigation, the WCAG's age means the guidelines predate some Web technologies now in widespread use; the guidelines were also developed under the W3C's remit to promote open standards and technologies rather than provide guidelines for proprietary technologies. Nevertheless there is a danger that the WCAG's role as the pre-eminent resource supporting the creation of accessible Web content is blurred by the separate goal of promoting use of W3C technologies, some of which have had little practical use beyond academia, and which does not acknowledge real world use of proprietary, yet widely used Web technologies such

as Portable Document Format (PDF), Shockwave and Flash from Adobe/Macromedia. The giant steps taken by the vendors of such technologies towards improving the accessibility of their products likewise has gone unacknowledged, although there are encouraging signs that Version 2 of WCAG will allow for a wider application of the guidelines across open and proprietary Web technologies alike.

2.4.2 Dependencies on other WAI guidelines

The WAI model shown in *Figure 1* of complementary accessibility guidelines rightly presents accessibility as a collective responsibility of Web users, developers of browsing and assistive technology, developers of Web content authoring and publishing tools, and Web content providers. In practice, this model is inappropriate for Web authors, since improvements to accessibility support of Web browsers and HTML authoring tools are outside their control. Similarly, the WAI model assumes that as and when they become available, UAAG-conformant browsers, assistive technologies, media players and other applications will readily be adopted and used by the Web browsing population.

For example, a 2004 survey by the Disability Rights Commission (DRC) of the accessibility of UK Web sites and the implications of the survey findings on the WCAG [9] indicated that some access barriers found could not be directly attributed to non-conformance with a specific WCAG checkpoint. WAI responded [33] to say that many barriers were due to non-conformance of browsing technology used with the UAAG, suggesting that were Web users to access Web content with UAAG-conformant browsing technology, levels of access problems would be reduced. This may be true, but does assume that users can and will change their browsing technology. In practice, while newer browsers may achieve high levels of UAAG conformance and will be adopted by more capable and experienced Web users, many Web users will continue to use a browser with a lower conformance level, and this is particularly so for Web surfers who may have no interest in even knowing the name of their browser, let alone be motivated to (or know how to) upgrade it to a more conformant browser.

The widespread adoption of UAAG-conformant browsers is a desirable scenario, and one that is frequently expressed by frustrated Web developers who strive to develop using Web standards. Until this happens, however, a model that depends on user agents (and users) taking responsibility for accessibility appears to be fatally flawed. Thus, knowledgeable Web authors may find themselves obliged to extend browser functionality in terms of accessibility support by adding features within page content – for example by providing features such as style sheet switchers to enable customization of page appearance, or access to audio versions of the Web page's content. This bespoke encroaching of the user-interface into the Web page may have immediate accessibility gains, but without standardisation will inevitably vary from site to site in implementation style, with clear implications on usability.

2.4.3 Ambiguity of the guidelines

The guidelines themselves have been widely acknowledged as in some cases being very ambiguous. Phrases such as 'until user agents' and 'if appropriate' are used, with no formal guidance on when the condition in question has been met. In other cases, exception conditions may not clearly be stated, leading to common misconceptions such as accessibility being equivalent to 'text-only'. This can then lead to wildly varying interpretations of what the WCAG requires, and its impact on Web developers.

In an attempt to clarify the diversity of interpretations of WCAG a brief questionnaire was distributed at an annual UK Web management conference in 2003. The responses, from an audience with what was regarded as an above-average knowledge of Web accessibility issues, presented a diverse set of answers to questions such as "Testing of accessibility can be fully achieved through the use of automated accessibility checking tools" and "Fully accessible Web sites should contain no pictures or multimedia features" [15].

2.4.4 Complexity of the guidelines

Not only are the WCAG guidelines ambiguous but they are also complex. This has led to many documents being written which seek to explain and interpret the guidelines (e.g. [19]); from these inevitably are spawned other sets of guidelines or standards. Simplification and generalisation may result; misconceptions may be propagated, with a resultant confusion amongst Web authors looking for definitive, yet comprehensible guidance in Web accessibility.

2.4.5 Logical flaws within the guidelines

The wording of specific WCAG checkpoints could be seen to lead to a number of logical absurdities. As an example, a strict interpretation of Checkpoint 11.1 "... use the latest versions (of W3C technologies) when supported" would mean that a WCAG AA conformant HTML 4.01 Web site would be degraded to WCAG A conformance overnight when XHTML 1.0 was officially released! A similar scenario might arise when the proprietary GIF format is used as a graphics format in favour of the W3C Portable Network Graphics (PNG) format. Given this strict interpretation, a policy or law that required all Web content to be WCAG-AA conformant may thus require removal of any site using GIF images or written in conformant HTML 4.01 Strict.

2.4.6 Level of understanding required of accessibility issues

One of the most appealing aspects of the Web, and one of the key factors behind its success as a publishing medium is the relative ease with which authors can publish online content, without requiring significant technical knowledge. There is a profusion of tools easing the task of Web content authoring; there are many ways in which content not directly authored for the Web can nevertheless become potentially valuable online resources – for example the published archive of an email discussion list. This means that the vast majority of Web content providers, on whom is placed a responsibility for making Web sites accessible, are not experts in Web authoring, let alone accessibility or access technologies, and many never will be. Despite the existence of supporting documentation provided by WAI, and the many other very useful and valuable materials available on the subject, evidence suggests that there is still a demand amongst Web developers for clear, straightforward guidance on how to produce accessible Web sites [9].

2.5 The Human Aspect of Accessibility

The existence of a set of guidelines may lead Web developers to assume that some acceptable goal of 'accessibility', or the avoidance of unjustified discrimination, can be reached by self-validation against each and every checkpoint. Indeed, this can be extended to the reliance of automated checking tools for reporting levels of accessibility, when these tools can only check against those guidelines that

directly refer to easily machine-testable conditions, such as the presence or absence of specific HTML code (or strings of text). As discussed in *Section 2.3*, this is clearly inappropriate, yet for many, both from a technical and policymaking perspective, there seems to be a strong desire for an automatically and unambiguous testing mechanism for accessibility.

While accessibility may be perceived as conformance to WCAG 1.0, WAI provides a definition of accessibility that makes it much closer to usability: "content is accessible when it may be **used** by someone with a disability" [38] (emphasis added). This definition seems much more consistent with current legislative obligations in many countries (discussed further in *Section 3*). Therefore it follows that an appropriate test for accessibility is whether disabled people can use it for the intended purpose, not whether it conforms to WCAG or other guidelines. Clearly, a high correlation between user performance and usability measures on the one hand and conformance to WCAG on the other hand is desirable, but as yet there are few studies that have produced the evidence base for this relationship. In the UK, the DRC formal investigation into Web site accessibility revealed Web sites that rated very well on user performance and acceptance measures yet did not conform to WCAG [9]. Conversely an investigation of museum Web sites in England [23] showed that Web sites evaluated to reach a high level of conformance to WCAG were found during evaluations to be virtually unusable by disabled people, and thus rated as "accessibility catastrophes".

User evaluation throughout the design lifecycle is widely recommended as a crucial aspect of inclusive and usable design. User evaluation does, though, require organization and time, in particular in the identification and recruitment of appropriate subjects, in carrying out evaluations and in synthesising and analysing results into a set of design recommendations. Coyne and Nielsen noted the difficulties in recruiting a suitable number of disabled subjects when they carried out their investigation of Web site accessibility [7].

The tension between calls for a truly human-centred approach to accessibility and the desire for a technically testable baseline definition has led to conflict [13] [26]. Indeed, the findings of the DRC's Investigation into Web site accessibility [9] caused uproar when it emerged that those sites found to perform very well when used by disabled people did not conform with all WCAG checkpoints, and the curious situation emerged of the research being called into question [41] because disabled people were found to be able to use 'inaccessible' Web sites.

This scenario may lead Web developers to conclude that either:

- The WCAG is flawed and should not be relied upon, or
- The use of automated tools testing against WCAG is a more reliable and robust way of identifying accessibility barriers than involving disabled people in evaluation- a particularly illogical scenario, given the intended beneficiaries of accessible Web design.

Both these scenarios are undesirable and unhelpful in a drive towards an optimally accessible - and usable -Web.

2.6 WCAG 2.0

It is important to note that while this paper focuses on WCAG 1.0, at the time of writing, development continues on Version 2.0 of the WCAG [32]. WCAG 2.0 has been in development for a long time, with versions being released initially in January 2001, and numerous updates released since.

The WCAG 2.0 guidelines apply to all Web content, and are not specific to any one Web technology. The new guidelines are organised around four design principles for Web accessibility:

1. Content must be perceivable;
2. Interface elements in the content must be operable;
3. Content and controls must be understandable;
4. Content must be robust enough to work with current and future Web technologies;

The first point that should be noted is that WCAG 2.0 covers all Web content, and does not mandate use of W3C technologies. This approach does reflect our user-centred approach to Web accessibility, which should be neutral to the provider of the technology. However, although the authors welcome this development, it does lead to the question of backwards compatibility with WCAG 1.0 guidelines and how ensuring content must be perceivable, operable, understandable and robust will be applied across a much more diverse environment than was required for WCAG 1.0 compliance.

There are likely to be difficulties in interpreting these guidelines and such difficulties are likely to result in differences in interpretation. Such confusion is likely to be compounded given that a requirement of the WCAG 2.0 guidelines is to "Ensure that the revision is 'backwards compatible'". The background to this requirement is that "A number of other materials and tools reference WCAG 1.0, such as specifications, evaluation tools, authoring tools, and government and organizational policies." [35].

This paper does not seek to criticise the W3C, WAI or the validity of the guidelines it produces; nevertheless it is hoped, and indeed anticipated that the issues outlined in *Section 2.4* will be addressed in WCAG 2.0. However, we fear that, with a continued reliance on the tripartite model of Web accessibility [3], the lethargy of browser and authoring tool manufacturers in meeting their responsibilities towards accessibility, and limited take-up by end users of these tools, accessibility will continue to fall short without advice on contextual application of these guidelines, as good as the guidelines themselves can be.

3 Legislation and Web site accessibility

3.1 Relevant legislation around the world

Given the *de facto* authoritative nature of the WCAG, many have looked to the role of the guidelines in anti-discriminatory legislation. In this section, we briefly examine legislation from around the world that either explicitly apply to Web site accessibility for disabled people, or are widely regarded as applying to Web sites. We also consider the relationship of each piece of legislation to the content of the WCAG.

In **Australia**, the Disability Discrimination Act 1992 (DDA) was demonstrated in a court of law to apply to discrimination resulting from a Web site being inaccessible to someone on account of their disability, in the ruling of Sydney Organising Committee of the Olympic Games (SOCOG) versus Maguire [11]. The terms of the legislation of the DDA do not specifically mention acceptable levels of Web accessibility – or even Web sites themselves, although in delivering the verdict on SOCOG v Maguire, Australia's Human Rights and Equal Opportunities Commission considered that had the WCAG been followed by the site developers, unlawful discrimination would not have occurred [28].

The **US** has two key pieces of legislation relevant to Web site accessibility. In the amended Section 508 of the Rehabilitation Act [1], legislation places obligations on federal agencies to ensure that the technology they procure and provide for the use of employees and for provision of information and services to members of the public, reaches an acceptable level of accessibility to disabled people. This level is defined in the Section 508 Standards [25], a set of technical requirements. The legislation requires conformance with the Standards, but the content of the Standards themselves are not part of the legislation itself, allowing the Standards to change to reflect developments in technology without rendering the legislation itself obsolete. Some of these requirements specifically relate to Web accessibility, and are similar to - but not identical to, and not as extensive as - the WCAG.

The Americans with Disabilities Act (ADA) is the primary legislation in the US that deals with the rights of disabled US citizens not to encounter unjustified discrimination on account of their disability. The terms of the ADA concentrate on an individual's rights, and do not contain any direct reference to the Web or Internet, to the WCAG. This lack of concrete technological requirement has led to a number of seemingly contradictory rulings in several cases that have come to a court of law concerning the application of the ADA to a case concerning Web accessibility [40].

In **Italy**, legislation setting out requirements for accessibility to disabled people of computer systems was introduced in January 2004, with specific provision for Web sites [21]. This legislation, as with the US's Section 508, provides for the establishment of a technical standard of accessibility which - while not part of the legislation - will require to be adhered to by Web site developers in order to ensure legal compliance. While anecdotal evidence has suggested this legislation will closely reference the WCAG; at the time of writing, it does not appear that this standard has been formalised.

Like Australia, the **UK**'s Disability Discrimination Act sets out the legal rights of disabled people not to encounter unjustified discrimination, as employees, when accessing "goods, facilities and services", and when receiving education. No reference to Web sites or any other technology is made in the text of the legislation itself, although mention of Web sites is made in Codes of Practice that accompany the legislation – Codes of Practice while not themselves law do advise on how the law might be applied in particular situations. Most commentators agree that the UK's DDA would likely apply to a Web site which could not be used by a disabled person on account of its accessibility barriers [28]. The legislation places a responsibility on the need for service providers to take "reasonable steps" to make services accessible to - and usable by - disabled people. Most commentators agree that the WCAG would be influential in determining whether a web site's level of accessibility is lawful, but as yet no consensus exists in terms of what might be deemed a "reasonable step" under the legislation in terms of WCAG conformance.

3.2 WCAG, Law and Policymaking

The above examples of legislation show the diversity of approaches around the world to protecting the rights of disabled people not to encounter unjustified discrimination when accessing online information and services. What seems clear is that, as a stable and referencable document, WCAG is widely seen as a standard to which legislation and policy can refer, directly or indirectly. The case of Maguire v SOCOG has shown that WCAG would play an influential role in any case that came to court.

Yet, given the challenges outlined in *Section 2.4* in applying the WCAG in today's diverse Web browsing environment, establishing WCAG conformance as a legislative obligation or enforceable policy requirement may lead to serious problems for many Web developers. A scenario may arise whereby a failure to meet one WCAG checkpoint will see a breach of legislation, or force them to remove or dilute potentially very valuable and useful Web content – a checkpoint that may in reality have a relatively minor impact on accessibility for the affected user group, and where more damage may be done by removing the resource when it significantly enhanced information accessibility for some groups of disabled people. The presence of a separate standard referred to in the Section 508 legislation discussed in *Section 3.1* indicates that direct reference to WCAG conformance in legislation has already been rejected.

However, while the lack of clear guidance of legislation in terms of strict technical requirements that can be implemented by developers and incorporated in benchmarking exercises, we suggest that legislation or policy that does not directly dictate a specific, non-negotiable WCAG conformance level is unlikely to be applicable in the real world, and may have the impact of curtailing and discouraging the online publication of potentially very valuable Web resources. On the contrary, legislation and policy that supports contextual application of the WCAG, for example through providing no direct reference to technical requirements (as, for example the UK's DDA) is arguably most backwards- and forwards-compatible in terms of how it can adapt to the flexible nature of the Web and the way it is used.

4. Supporting Diversity in Context – An Alternative Approach to Web Accessibility

4.1 The Need for a Framework

The authors acknowledge the hard work undertaken by WAI in creating WCAG 1.0 and the in-progress WCAG 2.0, and the resultant success of these guidelines in raising the profile of accessibility of Web content to disabled people. However, so long as Web developers, authors, site commissioners and policymakers are aware of and/or consider WCAG 1.0 as the pre-eminent *de facto* standard against which Web accessibility is measured, and so long as WCAG 2.0 remains in a draft and un-referencable form, we consider that there is a need to address **now** the concerns over the nature of existing guidelines and the potential problems that may arise from an uninformed application of the guidelines by content providers and policymakers alike.

We therefore propose a framework to allow organisations and individuals to apply the WCAG effectively, taking into account contextual issues surrounding the subject site in question, and at the same time urge policymakers to consider the contextual nature of accessibility when setting out obligations to be fulfilled for optimal accessibility of Web content.

4.2 A Holistic Approach to Accessibility – UK e-learning

The shortcomings of the rigid approach to the concept of accessibility that may be inferred by many from the existence of guidelines such as the WCAG have been identified as potentially being particularly damaging to the effectiveness of e-learning resource design. Given the role of e-learning resources in supporting, complementing and enhancing traditional teaching delivery, there is enormous potential to make the learning environment accessible to the widest possible audience. Yet the authors

are aware of examples of where a misinterpretation of accessibility guidelines by resource providers has resulted in an unnecessary and unjustified rejection or removal or potentially useful e-learning materials, particularly where the resources have a significant amount of multimedia.

In an attempt to counter this, a holistic approach to e-learning accessibility has been developed by Kelly, Phipps and Swift [17]. This framework (illustrated in *Figure 2*) has been developed to focus on the learning outcomes provided by the e-learning resource, rather than the resource or the technologies used to create the resource. It accommodates a blended learning approach, whereby a rich learning environment is created to support multiple learning styles amongst students, combining e-learning technologies and traditional approaches to learning.

This approach is based on current consensus approaches to learning within the UK tertiary educational communities in which there is a recognition of the need to support a diversity of learning styles through the provision of a diversity of learning approaches. Importantly, supporting diverse learning styles is a core aspect of an inclusive learning environment, one that supports students with the widest range of sensory, physical and mobility impairments. Electronic resources have an important part to play in aiding learning, communication and collaboration with peers, and in assessment.

Figure 2: TechDis/UKOLN Approach For Holistic E-Learning Accessibility

4.3 Extending the Approach

The holistic approach to e-learning discussed in Section 4.1 shows that accessibility cannot be treated in isolation from other factors that combine to determine the success or otherwise of an e-learning resource in the wider context of the learning environment. In this section we outline a more general holistic approach to accessibility.

We argue that the WCAG cannot be applied to a specific resource in isolation, without taking into account a number of factors. Only when these factors have been considered, and a definition of the context of use of the subject resource exists, can an effective strategy for applying the WCAG be implemented:

- **The intended purpose of the Web site or resource.** (To help establish this, one might ask: what are the typical tasks that user groups might be expected to perform when using the site? What is the intended user experience? What outcomes might a user expect to achieve from using the site?)
- **The intended audience.** Can any assumptions be made about their level of knowledge of the subject(s) addressed by the resource? Or their knowledge of and attitudes towards Web browsing? Their awareness and capability of assistive technology usage?
- **The intended usage environment.** Can any assumptions be made about the capability and range of browsers and assistive technologies that the target audience is likely to be using?
- **The role of the subject site in the overall delivery of services, experiences and information.** Are there pre-existing non-Web means of delivering the same outcomes identified as being the purpose of the site?
- **The intended lifecycle of resource**. When will it be upgraded or redesigned? Is it expected to be evolvable?

Once these parameters have been established, the following must be defined, each definition being provided with a justification:

- The nature and extent of bespoke accessibility features to be provided within the site (for example an accessibility information page, custom style sheets providing alternative text and background colour schemes or a large text option, the provision of a means to hear the spoken content of each page)
- Acceptable (X)HTML validation targets;
- Acceptable use of proprietary technologies;
- Level of involvement of disabled users in evaluation, including an indication of the degree to which they represent the target audience in terms of available technology and subject knowledge.

Any instance of a WCAG checkpoint found not to be implementable or applicable given the defined context of the resource in question given must also be documented and justified. This is a crucial aspect of the process – any assumption made must be documented, in order to implicitly define the limitations of usage of the resource. Consideration of how those who may remain affected by the barrier can access the information or functionality in another way should, of course, also be documented, even though the process described above should ensure that a failure to meet a guideline has a minimal impact on the target audience's ability to use the resource as required.

This process should create a framework for effective application of the WCAG without fear that conformance with specific checkpoints may be unachievable or inappropriate. In providing a reason to apply all of those WCAG checkpoints relevant to the resource and its context of usage, the proposed framework may also help to reduce or avoid the current dilemma, whereby the presence of three rigid priority levels may discourage Web authors going beyond a specific conformance level only to grind to a halt at a seemingly unrewarded point short of the next conformance level, despite the obvious accessibility benefits making these 'extra steps' would offer users.

This approach also addresses a fundamental flaw in the 'priority' approach of WCAG version 1. A checkpoint's WCAG priority is related to the impact of not meeting that checkpoint on the accessibility to a specific group of users. Yet, WCAG priority may not necessarily be a true indicator of its impact on disabled users – as evidenced in the findings of the DRC formal investigation [9]. Consider the impact of a frequent and high-profile Priority Three checkpoint failure –the failure to provide a way of bypassing groups of links. The effect of this failure may mean that for a screen reader user, or someone with a severe physical disability who uses a switch device, navigation through a site that contains a large number of links on each page may be so tiresome and physically demanding as to render the site unusable to those users. This apparent low priority failure may therefore be more serious in terms of true accessibility than a failure to provide alternative text for a spacer image somewhere towards the bottom of a rarely-visited page –classified as a Priority One failure.

In such a case WCAG conformance levels are no longer an effective way of assessing accessibility for disabled people – and therefore cannot be reliably used as the basis for setting minimum accessibility levels both by design teams and by policymakers. We argue that moving emphasis away from designing and assessing accessibility according to priority of checkpoints, towards making accessible the *purpose* of the site to the *target audience*, is a more user-centred and more effective way of ensuring optimal accessibility. This underlines the often quoted description of accessibility as a process rather than a product.

5. Applying Our Holistic Approach

5.1 Some Examples

We present here some fictitious examples of how a contextual approach to Web site accessibility may result in a more effective application of the WCAG. In each case, a particular WCAG checkpoint may have been deemed not to be met. Yet, because context is considered, a case can be made for this non-conformance.

Taking into account the intended purpose or outcome of the subject site: A Web site providing a geology e-learning resource includes a number of photographic images of rock types. The aim of the resource is to test students' powers of visual observation in identifying rocks from pictures. WCAG checkpoint 1.1. requires authors to "Provide a text equivalent for every non-text element". Clearly, to provide alternative text and long *descriptions* that identify the rock present in each example would defeat the purpose of the e-learning resource, assuming a student knew how to reveal the text alternative. In such a case, a null alt attribute would then be provided for each image, while blind and visually impaired students would require an alternative means to allow them to achieve a comparable learning outcome (through listening to a description, or perhaps through tactile means) of the rock types.

Taking into account the capabilities and awareness of the intended audience: A computing magazine makes available its content online to subscribers via a Web site. The site had been designed by a third party in such a way that font sizes were expressed using pixels, and Cascading Style Sheets had not been used consistently throughout the site to control display. In this example, the work required to allow text resizing in browsers that do not support resizing of text expressed in pixels or points, such as Internet Explorer, is assumed to be significant.

Given that end users of the site would be highly knowledgeable in issues relating to browser capability, and therefore highly likely to use or be willing to use an 'alternative' browser, the first step taken by the magazine staff to address the problem was not by changing the way the site was coded, but instead by providing information, in a page where text size is specified in relative units, recommending users with reduced visual acuity to use a browser that could resize text regardless of how it was specified. The relevant WCAG checkpoints: checkpoint 3.3 "Use style sheets to control layout and presentation", and checkpoint 3.4 "Use relative rather than absolute units in mark-up language attribute values and style sheet property values" may not have been met, but the impact of this is minimised due to the action taken.

Taking into account the intended usage environment (1): An intranet developer knows that his users will have access to a specific minimum browsing set-up, which will remain homogeneous for all users in terms of operating system, browser, and necessary plug-ins. He knows that this access environment will have JavaScript enabled, and he can therefore enhance and extend functionality of his Web resources through the use of JavaScript, ensuring device-independent operation as he goes, testing output using the available screen-reading technology to ensure that the resources remain accessible and usable to people accessing the resource non-visually, even though it may be considered that WCAG checkpoint 6.3, "Ensure that pages are usable when scripts, applets, or other programmatic objects are turned off or not supported", is not met.

Taking into account the intended usage environment (2): A college lecturer is developing a Web site providing course-related information for current students. The default browser available on campus is Microsoft's Internet Explorer, running on Windows XP. The academic uses embedded Macromedia Flash content to illustrate the site pages, safe in the knowledge that the problems that may emerge in other browsers with respect to embedded Flash and keyboard and screen-reader accessibility [29] will be avoided. She knows, however, that as soon as the possibility exists that students may use the resource with alternative browsers, then this potential barrier will have to be addressed.

Taking into account the site's role in overall delivery of services and information: The manufacturer of a popular kitchen appliance would like to provide detailed advice about a food processor on their Web site. The manual for the processor is available in correctly structured HTML, but is difficult to follow, particularly the section describing how the appliance is taken apart for cleaning purposes. Therefore the manufacturer creates a Flash animation, which can be played from start to finish, or advanced frame by frame, all controlled by the keyboard, to demonstrate the order in which the processor is dis-assembled and reassembled after cleaning. The audience of this Web site is likely to be diverse in terms of awareness and knowledge of Web browsing, in terms of browsing technology available to them. Very little can therefore be assumed about the specific attributes of the audience and access environment. However, a proprietary-format animation has been chosen to support textual content (the HTML version of the manual) in preference to an open format, as the assumption has been made that far more of the target audience have the relevant Flash player than the open alternative (an SVG player or a browser that natively supports SVG). The accessibility benefit is that for those who have difficulty reading the manual made available in textual form, the animation provides a dynamic and highly visual demonstration of the concept in question, even though it may contain accessibility barriers that limit or prevent its use to some people.

Taking into account the intended lifecycle of the resource: An organisation provides through its Web sites access to a large archive of technical documents (e.g. PhD theses), originally written in Microsoft Word. In this case, the original Word documents are published online, even though many have not been designed with accessibility in mind (for example, images not supplied with text alternatives, semantic structure not applied through use of headings). Ideally, the documents would be converted to valid HTML, with appropriate alternative text for each and every image; however to withhold publication until this task was completed was considered inappropriate, as this task would be extremely time-consuming and difficult, given limitations of technical knowledge of staff available and the unavailability of the original document authors. Instead, on-demand conversion of the Word documents to HTML was offered on the Web site to those visitors unable to access the Word content.

Clearly, in looking at these fictitious examples, a site redesign will in many cases help to remove any possible debate over whether or not an accessibility barrier exists. However, we suggest these examples help to show how real world pressures and competing objectives may help to influence the decision as to the most immediate and effective accessibility solution that should be applied in a particular scenario.

5.2 Accessibility as part of a wider holistic design approach

Beyond the need for a holistic approach to Web accessibility taking into account factors such as context of use, usability, IT accessibility, proprietary solutions, resource implications and local and regional cultural factors, there is also a need for a wider framework which addresses other important issues such as selection of standards, application environments, project management, financial and funding issues.

The authors have been involved in establishing a framework covering aspects such as standards, file formats to be used for development and service activities supporting digital library development programmes in the UK. After a period of consultation across the community, it was felt there was a need to promote an open standards culture but at the same time, stipulating the use of open standards may in some cases fail to reflect the diversity of the community in terms of disparity of skills and resources and marketplace support [16]. Thus, a layered approach to the deployment of standards and best practices was taken (illustrated in *Figure 3*), incorporating the following factors:

Context: This layer acknowledges that no “one size-fits all” solution exists, and instead projects must consider contextual factors such as the nature of the development activity (whether innovative work evaluating new technologies and methodologies, or mainstream development work enhancing existing services using mature and well-tested solutions); the remit of the work (e.g. end-user service; middleware component; closed service such as an Intranet; simple report; etc.); the developing or recipient organisation’s status (for example a well-funded research-led institution, or a small college with limited resources). Within this contextual layer, invitations to tender for new work and service level agreements for existing services will refer to the policies which are appropriate for the context.

Policies: A layered set of policies will cover areas such as technical standards, use of open source software, usability, accessibility and project management. Policies relating to technical issues may take the form of an annotated catalogue of appropriate standards and best practices, indicating level of maturity and deployment challenges.

Selection: The selection layer gives projects the ability to choose the standards and best practices which are most applicable to their particular context, subject to any requirements mandated within the Context layer.

Conformance: The conformance layer ensures that the selected standards and best practices are being implemented correctly.

External factors: A framework for digital library development cannot be developed independently of a variety of external factors. Implications of legislation are a clear example, and organisational issues that may potentially cause conflicts also need to be considered.

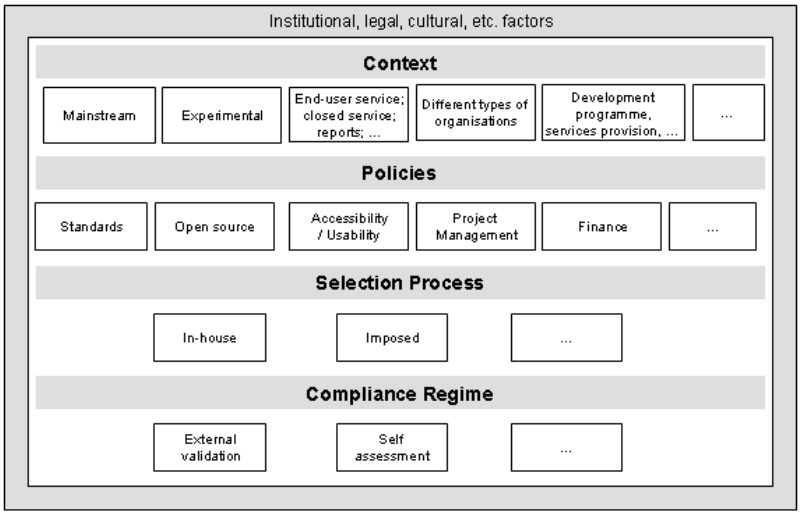

Figure 3: Wider Context For Selection Of Standards and Best Practices

An instantiation of this framework within a digital library programme could mandate use of W3C technologies only, conformance with a specific conformance level of the WCAG, and implementation of a strict conformance regime to ensure that such policies were correctly implemented. However, the framework also allows a more liberal approach to be taken.

6. Discussion

The framework we present in *Section 4* addresses the shortcomings of the ideal of universal design when applied to Web development. In their paper 'User-sensitive inclusive design', Newell and Gregor [20] outlined the almost insurmountable challenges in developing an interface that can be used by absolutely anyone, regardless of impairment or access environment, and instead should be designed to take into account *as far as possible* the needs and capabilities of the *intended target audience* – a significant difference to designing for the entire population. The presence of the WCAG has without doubt led to a similarly utopian ideal of 'access for all' amongst many Web site developers. Despite best efforts from WAI, including the introduction of the concept of baseline determination with respect to WCAG conformance claims [34], we doubt that every user of any subsequent release of the WCAG will unequivocally realise that following the Guidelines does not in itself lead to truly universal accessibility.

We suggest that a far more realistic, appropriate, and ultimately more successful approach to accessibility is to define as far as possible the parameters of the resource, who will be using it and where. Establishing context in this way allows informed decisions to be made that may allow technologies and techniques to be chosen that maximise the accessibility of the information, experience and outcomes intended to be provided by the resource to the target audience, even though some user groups may be excluded. So long as such decisions are justified, and documented on the basis that excluded users or usage situations are not part of the contextual description of the resource, then unjustified discrimination will not apply. After all, one can argue that a truly user-centred resource has been designed with the needs of as many as possible of the resource's intended audience in mind – not the needs of those who will never use it.

Of course, as illustrated in *Section 5.1*, this approach is most effective in situations where such assumptions can be made about the target audience and/or access environment. It quite clearly flies in the face of the 'any browser anywhere by anybody' philosophy. Indeed, in many Web design situations where a site may indeed need to be accessible and usable by 'anybody, anywhere', it would be impossible to make any such assumptions.

Thus, we do not propose this framework as an excuse to perpetuate blinkered one-browser design attitudes, or to encourage design approaches that do not consider best practice in Web standards. Instead, the value of this approach is in the way it seeks to reassure all those Web developers, designer and authors who find accessibility ideals apparently diametrically opposed to other objectives such as reuse of existing digital resources, usability, functionality and cost-effectiveness, that if assumptions can be made about the resource's intended usage, then they should be made in order to maximise the effectiveness of the accessibility solution implemented. This contextual information might then be incorporated into machine-readable format, for example, Evaluation and Repair Language (EARL) statements [8] about the site's evaluated accessibility.

The issue of the influence of context on approaches to accessibility should also be seriously considered by any policy or lawmakers who are tempted to incorporate the WCAG into policy or legislation without any acknowledgement of situations where WCAG conformance may not be the most effective step to achieving optimal accessibility of the resource in question.

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