

# Accessibility of Public Web Services: A Distant Dream?

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**Abstract.** Today, many public services are available online through Web sites. The accessibility of the sites, also to people with disabilities, is important because the accessibility concerns equality of citizens, a cornerstone of democracy. In the current study we carried out a meta-analysis of 17 studies concerning the accessibility of the Web sites of public administration. Furthermore, we assessed the accessibility of Web pages of 12 ministries of the Finnish government. The assessments were based on the Web Content Accessibility Guidelines (WCAG). The results showed that in terms of the WCAG guidelines, the average accessibility of public Web sites is poor. Moreover, there was no improvement in the accessibility in the 2000's and many of the accessibility failures were so simple that they could have been easily avoided. This may indicate that the building of information society is driven by technology, rather than principles of democracy and well-being.

**Keywords:** Accessibility, public administration, WCAG

## 1 Introduction

Building the so-called information society is usually conceptualised primarily as a technological task [1]. This can be seen, for instance, in the national information society programmes. Finland was among the first ones to prepare one, in the mid-1990s [2]. That report contained a technically oriented futuristic vision. More recently, the official objectives have been more human-centric. The [Finnish] National Knowledge Society Strategy for 2007-2015 is entitled “A renewing, human-centric and competitive Finland” [3]. The objective for developing the society is expressed as “A good life in the information society” [3]. However, the approach of this document is still very techno-optimistic. Like in many other countries, high expectations have been set concerning the opportunities of networked society for democracy [see e.g. 4]. This kind of enthusiastic visions should be taken dubiously, if they don't include critical analysis.

Public Web services are meant, at least in principle, for all citizens. They should be in a form which is accessible for everyone. For instance, people with disabilities should be taken into account in the design of the services.

We wanted to find out to what extent the accessibility has been taken into account in the design of public Web sites. Well-known criteria for Web content accessibility have been defined in the guidelines of the World Wide Web Consortium (W3C), called Web Content Accessibility Guidelines (WCAG). Our study was carried out in two steps. First we accomplished a meta-analysis of 17 studies concerning the accessibility of the Web sites of public administration. Then we assessed the accessibility of Web pages of 12 ministries of the Finnish government. The assessments were based on the WCAG guidelines. Before describing the two parts of the study and their results, we first discuss the core concepts of our study: disability, accessibility, and evaluation of accessibility.

## 1.1 Perspectives on Disability

The concept of disability (along with related concepts like impairment and handicap) has been a topic of lively debate for decades, at least from the early 1960s [5, 6]. Analysis of all the nuances of the debate is out of focus of the current study. We content ourselves with the introduction of two, clearly distinctive main approaches: the medical and the social approach to disability.

*The medical model of disability* is probably the most mundane approach in conceptualising what disability is all about. In it, people are classified on the basis of medical criteria to those who are disabled and those who are not. In the approach, disability is seen primarily as individual's problem which should be overcome. Due to the complex relationship between an individual and the society, individual's problem obviously concerns society as well.

In the traditional medical definition of disability, the stumbling block, causing strong arguments is obvious:

*"In the context of health experience, a disability is any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner or within the range considered normal for a human being"* [7]

As can be seen, this definition goes "out of the frying pan into the fire": while defining disability, it introduces another, similarly disputable and even ethically questionable concept of *normality* of a human being. Even though the expression has been smoothed in the updated version of the same document [8], the individual's perspective is still present.

The contradictory approach is commonly called as *social model of disability*. In this perspective, the relationship between an individual and the society is approached from the opposite direction: disability is seen to result from the structures which prevent some individuals from participating in the function of the society. In other words, no one is disabled as such; the disability appears in the discordance between the individual and the environment.

The contradiction between the social and medical views of disability is nicely compromised in the Convention on the Rights of Persons with Disabilities by United Nations [9]. In its Article 2, the concept of *universal design* is defined to mean:

*“... the design of products, environments, programmes and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. “Universal design” shall not exclude assistive devices for particular groups of persons with disabilities where this is needed.”*

In other words, the priority is to design for all, yet admitting that in some cases, special arrangements are necessary.

Even though practical implications for the design of public services may be in many cases the same regardless of the perspective, the distinction between the medical and social approaches is important in the long run.

## **1.2 Perspectives on Accessibility**

Regardless of the perspective on disability, accessibility is a fundamental issue and criterion in the development of public services. This is based on wide agreement about the rights of the disabled people, formalised in the Convention on the Rights of Persons with Disabilities [9], in Article 9:

*“States Parties shall also take appropriate measures:*

*...*

- (f) To promote other appropriate forms of assistance and support to persons with disabilities to ensure their access to information;*
- (g) To promote access for persons with disabilities to new information and communications technologies and systems, including the Internet;*
- (h) To promote the design, development, production and distribution of accessible information and communications technologies and systems at an early stage, so that these technologies and systems become accessible at minimum cost.”*

In other words, importance of information access has been seen such a central right, that it is stressed by expressing the issue from the points-of-view of information, related technology and even the development of technology.

Sir Timothy Barnes-Lee himself, the director of the World Wide Web Consortium (W3C), has been one of the key persons behind recent accessibility efforts e.g. in the UK [10]. Indeed, the Internet and the World Wide Web are the technologies which have become essentials for citizens. It is therefore quite natural, that much of the accessibility efforts concern the World Wide Web.

## **1.3 Evaluation of Accessibility**

Web accessibility is usually bind to the accessibility guidelines of W3C, called Web Content Accessibility Guidelines (WCAG), version 1.0 from 1999 [11] and 2.0 from 2008 [12]. The two versions have a lot in common; the later one, however, is applicable in a wider range of devices. For instance, version 2.0 contains four general accessibility principles hierarchically above the detailed guidelines; the principles are thus applicable even when the technology specific, detailed guidelines appear irrelevant.

The WCAG guidelines provide a number of checkpoints that can be used to check the accessibility of Web content. Each checkpoint is associated with one of three priority levels. Level 1 criteria or checkpoints define the basic and most critical features that accessible content *must* satisfy, level 2 checkpoints refer to the criteria that the content *should* satisfy, and level 3 to the criteria that *may* be satisfied. The checkpoints in guidelines are constructed in a hierarchical manner so that the requirements concerning the same feature get higher when proceeding from level 1 to level 2, and further to level 3. For the content to be tested, for example, a Web page or a Web site, the guidelines define three conformity levels: A, AA, and AAA. In order to be on level A, all level 1 criteria have to be satisfied. On level AA, all the criteria of levels 1 and 2 have to be satisfied. Finally, on level AAA, all criteria of all levels have to be satisfied.

There are several other guidelines and criteria for accessibility, but in this study, we focus on WCAG.

WCAG can be applied both in the design of accessible Web content as well as in the evaluation of accessibility of existing content. The evaluation methods can be divided into automated, semi-automated, and manual. Since in the definition of WCAG it is stated that the criteria has to be testable [12], the success criteria are concrete and many of the criteria can be tested automatically.

## **2 Meta-Analysis of Previous Public Administration Accessibility Studies**

In order to get an overall view of the current state of accessibility in public administration Web sites, we carried out a meta-analysis of existing relevant accessibility studies which have been reported in scientific forums.

### **2.1 The Data**

The criteria and method for the article sample was as follows: They had to be published in the proceedings of international conferences, journals, or in the final reports of large research projects. The reports were searched from the databases of ACM, SpringerLink, and Elsevier. Google Scholar was also utilised, as well as the reference lists of relevant articles. The keywords used in the searches were "WCAG 1.0", "WCAG 2.0", "accessibility", "Web sites", "public government" and "public administration". Since WCAG 1.0 was released in 1999, only articles which have been published after that were included.

We found 23 studies in total. In a closer inspection, it was found out that four of them did not report the application of WCAG detailed enough for the needs of this analysis. In addition, one report was excluded because of quality problems (did not actually use WCAG 2.0 criteria even if it was argued in the report that it did). The final list of 17 included studies is provided in Table 1.

**Table 1. The included studies**

Authors & Countries	Method: A=automatic M=manual	No. of analysed pages	A-level AA- WCAG level	
			1.0/ 2.0	1.0/ 2.0
Abanumy et al. [13], Saudi-Arabia & Oman	A (Bobby <sup>1</sup> )	27	0	*
Al-Khalifa [14], Saudi-Arabia	A, M	36	* / 0	* / 0
Basdekis et al. [15], Greece	A, M (Bobby)	256	14	1
CabinetOffice [16], EU	A, M	436	3	0
Choudrie et al. [17], Singapore, Australia, Canada, Hong Kong & Finland	A (WebXACT <sup>2</sup> )	5	40	0
EU [18], EU & USA	A, M (TAW <sup>3</sup> )	102	0/0	0
Goette et al. [19], USA	A (Bobby)	51	70	2
Kuzma et al. [20], USA	A (Truwex)	50	12/0	*
Lazar et al. [21], USA	A, M (A- Prompt <sup>4</sup> )	50	2	*
Loiacono et al. [22], USA	A (Bobby)	221	28	*
MeAC [23], 25 EU-countries, Australia, Canada & USA	A, M	336	5.3	0
Paris [24], Ireland	A (Bobby)	26	14	0
Potter [25], USA	A (Bobby)	63	19	2
Shah et al. [26], Nepal	A (Bobby)	27	11.1	*
Shi [27], China & Australia	A (Bobby)	CN 30 AU 8	CN 3 AU 87.5	*
Shi [28], China	A (Bobby)	339	0	*
Yu et al. [29], USA	A (Kelvin[29])	272778	0	0

<sup>1</sup> <http://www.erigami.com/truwex/>

<sup>2</sup> <http://oa.mo.gov/itsd/cio/architecture/domains/interface/PC-Accessibility-MOITAccessibilityStds-WatchfireWebxact060606.pdf>

<sup>3</sup> <http://www.tawdis.net/>

<sup>4</sup> [http://www.aprompt.co.uk/45/Website\\_Accessibility\\_Testing/](http://www.aprompt.co.uk/45/Website_Accessibility_Testing/)

The names in the third column refer to the automated tool used. The figures in the 4<sup>th</sup> and 5<sup>th</sup> column indicate the percentages. “\*” stands for N/A.

## 2.2 The level of accessibility

As can be seen in Table 1, in four of the included studies none of the analysed pages met even the WCAG level A. In three studies, less than ten per cent of the pages reached level A. In six studies, the percentage of level A pages was between 10 and 25. In four studies only the percentage of pages that satisfied level A criteria, was above 25.

In 10 of the included studies the conformance to level AA was assessed. In them, the percentage of the level AA pages was 2 at its best. In six studies the conformance to level AAA criteria was assessed as well, but not a single page met that level.

It has to be kept in mind that for reaching the compliance level A the page cannot fail in a single level 1 criterion. For reaching the compliance level AA, the page has to satisfy all level 1 and 2 criteria. And only pages satisfying all of the criteria, on all three levels, reach level AAA compliance. This means that one failure on level 1 is enough to prevent calling a page WCAG compliant, on any level, even though all other criteria were satisfied. Therefore it is important to take a look at the results concerning individual success criteria and the most typical failures concerning them.

## 2.3 Typical accessibility failures

### WCAG 1.0 Priority 1 Checkpoints

- Checkpoint 1.1: “*Provide a text equivalent for every non-text element.*” This is essential e.g. for blind users applying screen readers. All of the included 17 studies mentioned this as one of the main accessibility problems.
- Checkpoint 12.1: “*Title each frame to facilitate frame identification and navigation.*” Even though the use of frames is not as usual as previously, they remain one of the most common accessibility challenges. Screen readers, for example, do not necessarily read the contents of frames. The titling of frames was found as a problem in 7 studies.
- Checkpoint 6.3: “*Ensure that pages are usable when scripts, applets, or other programmatic objects are turned off or not supported. If this is not possible, provide equivalent information on an alternative accessible page.*” Often, scripts are disabled, so if the use of a Web site requires the functioning of scripts, they are an accessibility problem for anyone. Six of the studies found problems in the use of scripts.

### **WCAG 1.0 Priority 2 Checkpoints**

Ten of the included studies assessed level AA conformity. The most common failures concerned:

- Checkpoint 3.4: *“Use relative rather than absolute units in mark-up language attribute values and style sheet property values.”* From the point of view of accessibility, it is important that the user-interface elements are scalable to different needs and terminals. Eight studies mentioned this as an issue.
- Checkpoint 9.3: *“For scripts, specify logical event handlers rather than device-dependent event handlers.”* Device dependent technology is problematic since especially disabled people may be unable to use standard devices and have to use customised technology instead. The violation of this guideline was detected in five studies.
- Checkpoint 13.1: *“Clearly identify the target of each link.”* Important for users with cognitive disabilities and users with visual impairments in particular. Classified as a problem in four studies.
- Checkpoint 3.2: *“Create documents that validate to published formal grammars.”* Valid code ensures that it works in different platforms, including assistive technologies. Either HTML or CSS code was found invalid in four studies.
- Checkpoint 12.4: *“Associate labels explicitly with their controls.”* This is important especially for the visually impaired users, who are unable to utilise visual cues in associating e.g. a form field and its help text.

### **WCAG 1.0 Priority 3 Checkpoints**

In the six studies assessing level AAA conformance the priority 3 failures mostly concerned

- Checkpoint 4.3: *“Identify the primary natural language of a document.”*
- Checkpoint 5.5: *“Provide summaries for tables.”*
- Checkpoint 10.5: *“Until user agents (including assistive technologies) render adjacent links distinctly, include non-link, printable characters (surrounded by spaces) between adjacent links.”*

### **WCAG 2.0**

Surprisingly, only one of the studies contained analysis of the accessibility problems on the basis of version 2.0 of WCAG. Therefore, it was not possible to make any comparisons or generalisations about them.

## **2.4 Summary of the meta-analysis**

Table 1 shows that in average the level of accessibility in terms of WCAG is low. It also shows major differences in the results, especially concerning the level A compliance of public sector Web pages of the case countries or areas. Based on this meta-analysis we cannot, however, make any kind of ranking of the countries or areas in

respect to their WCAG level A compliance. Likewise, any other kind of direct comparisons among the included studies is problematic due to their evident differences; without going into details in the differences in the data and analysis methods of the included studies, it is easy to see that already in the number of pages assessed in the studies there is a huge range: from 5 to 272778. The earliest of the studies has been published in 2002, the latest in 2011. Our expectation was that some improvement might be visible during the time frame from 2002 to 2011. To our surprise no such improvement could be seen. In other words, there is no sign in this sample that accessibility had improved over recent years. Another surprise was related to the individual failures and their types. Most of the violations of WCAG checkpoints were plain and apparent. Since the form of WCAG is extremely pragmatic and concrete, most of the identified accessibility violations would have been easy to avoid. This may indicate an attitude problem rather than lack of resources. The issue is further discussed in the last section of this paper.

### **3 Accessibility of the Web Sites of Finnish Ministries**

After the meta-analysis indicating major accessibility problems of the Web sites of the public administration in the USA and many other countries we wanted to assess the accessibility level of the Finnish public administration.

#### **3.1 The Data and the Analysis**

We chose the Web sites of the Finnish ministries for the assessment because the Finnish Government has emphasized for several years the importance of building the Finnish Information Society. In the Finnish Government there are 12 ministries. From the ministry Web sites we analysed 108 pages altogether. The chosen pages included the front page of each of the ministries, and the second-level pages which were linked from the main navigation bar of the front page.

In order to gain commensurability with analysis of previous studies, we used a similar kind of approach: We analysed the WCAG compliance and searched for typical accessibility failures. Most of the analysis was carried out with the help of automated accessibility tool, called Worldspace [30]. We ended up to an automated tool since this strategy is usually high in reliability. Automatic analysis is prone to validity problems [31], though, which has to be taken into account in the interpretation of results. In addition to the application of Worldspace, the validity of the HTML code was checked with the markup validator of W3C. From the available automated tools Worldspace was chosen since it is free, covers both versions of WCAG, is included in the listing of W3C and is easy-to-use. It covers all conformity levels of WCAG 1.0 and levels A and AA of version 2.0.

Since automated analysis is purely based on the HTML code, ideally all the results would be manually checked. In the current study, in terms of the resources available, full scale manual inspection was not an option.



### 3.2 Detected accessibility failures

#### Criteria: WCAG 1.0

Our analysis shows that out of the 108 Web pages, only 9 reached the level A conformance of WCAG 1.0. Of these 9, 8 were pages of the Ministry of Transport and Communications, which is a positive indication – at least the Ministry which is responsible for the domestic Internet policy has applied the accessibility guidelines. Unfortunately, even this ministry's expertise has not yielded above level A: no single page in the whole sample reached the AA conformance, not to speak about AAA.

The common violations of WCAG 1.0 are quite in accordance with the previous studies. We now list the ones which came up in more than half of the pages, or at least three most common problems in each level.

The foremost violation of the first level checkpoints concerned the checkpoint 1.1: *“Provide a text equivalent for every non-text element.”* The failure to meet this criterion was detected in 80 per cent of the pages. The second most common issue on the first level was about the checkpoint 12.1: *“Title each frame to facilitate frame identification and navigation.”* The difference between the frequency of 1.1 problems and 12.1 problems was huge: only 10% of the pages violated guideline 12.1. The third most common violation was about 6.1: *“Organize documents so they may be read without style sheets”*, which was violated in 8% of the pages. In other words, just by providing text equivalents for all non-text elements, the accessibility rating of these pages would have been hugely higher.

On the second priority level the problems were more evenly distributed among checkpoints:

- 13.1: 91% of the pages violating (*“Clearly identify the target of each link”*)
- 3.2: 91% (*“Create documents that validate to published formal grammars”*)
- 12.4: 85% (*“Associate labels explicitly with their controls”*)
- 3.5: 68% (*“Use header elements to convey document structure and use them according to specification”*)
- 3.4: 63% (*“Use relative rather than absolute units in markup language attribute values and style sheet property values”*)
- 10.1: 62% (*“Until user agents allow users to turn off spawned windows, do not cause pop-ups or other windows to appear and do not change the current window without informing the user”*)

Of these, only 3.5 and 10.1 did not come up in the list of most common accessibility issues in the review of previous studies. This shows that the types of accessibility problems are quite similar on the Web sites of public administration in different countries.

On the third priority level, the number of problems was huge, the most common ones distributed as follows:

- 10.5: 95% (“Until user agents (including assistive technologies) render adjacent links distinctly, include non-link, printable characters (surrounded by spaces) between adjacent links”)
- 9.5: 88% (“Provide keyboard shortcuts to important links (including those in client-side image maps), form controls, and groups of form controls”)
- 13.6: 88% (“Group related links, identify the group (for user agents), and, until user agents do so, provide a way to bypass the group”)
- 2.2: 81% (“Ensure that foreground and background color combinations provide sufficient contrast when viewed by someone having color deficits or when viewed on a black and white screen”)
- 4.3: 71% (“Identify the primary natural language of a document”)

A good example is the most common of the level 3 failures. Guideline 10.5 had been very simple to follow. Whether it is a question of negligence, ignorance or something else, obviously cannot be answered on the basis of this study.

#### **Criteria: WCAG 2.0**

In terms of the WCAG version 2.0, none of the pages of our sample reached even the lowest level of conformance (A). In the review of previous studies, the conclusions were similar; only very few pages of public administration reached the A level.

According to the results of the automated analysis, the most common accessibility problems concerned criteria on the first priority level, in particular, the following criteria:

- 1.3.1: 93% (“Information, structure, and relationships conveyed through presentation can be programmatically determined or are available in text”)
- 3.3.1, 89% (“If an input error is automatically detected, the item that is in error is identified and the error is described to the user in text”)
- 1.1.1, 77% (“All non-text content that is presented to the user has a text alternative that serves the equivalent purpose, except for the situations listed below”)
- 3.1.1, 71% (“The default human language of each Web page can be programmatically determined”)
- 4.1.2, 67% (“For all user interface components..., the name and role can be programmatically determined; states, properties, and values that can be set by the user can be programmatically set; and notification of changes to these items is available to user agents, including assistive technologies”)
- 2.4.4, 61% (“The purpose of each link can be determined from the link text alone or from the link text together with its programmatically determined link context, except where the purpose of the link would be ambiguous to users in general”)

Surprisingly, only one problem was detected by Worldspace concerning the second level success criteria. The failure concerned the criterion 1.4.3: “The visual presentation of text and images of text has a contrast ratio of at least 4.5:1” (... plus some UI-element specific refinements). From the tested pages 49% failed to meet the criterion.

## 4 Discussion

There are today a great number of different public services available through Web sites. The limitations in the accessibility of the content of a site may fully prevent using the main functionalities of the site. Our study reveals that the level of Web content accessibility of public administration is in low level. Since accessibility of public Web services is essential in terms of the principles of democracy, improving the accessibility is a necessity.

We used WCAG as a criterion for accessibility in this study. Those guidelines have their strength in being concrete and measurable. They do not, however, take a stand on more ambiguous qualities like attitudes or ethical values. Therefore, there may be a risk that the usage of guidelines is mechanical fixing of errors. In other words, application is first designed and only after the initial design accessibility guidelines are utilised. An analogous problem has already been handled in human-computer studies for quite a while ago: When personal computers became common, user-interface was seen as a means to make the complicated computer technology usable for everyone. It was found soon, however, that a nice user-interface cannot compensate fundamental usability problems. The solution was to change the process: rather than creating unusable technology and only after that try to make it usable with a fancy user-interface, we should include the user's point-of-view in all stages in design.

We argue that the approach described above should be applied to the design of Web content. Rather than creating inaccessible content and later try to fix it with the help of guidelines, the content should be designed accessible in the first place. The form of technology should not be the primary criterion for the development of public services – accessible service may not always be the fanciest looking and not even the cheapest option.

It can be concluded that the construction of accessible services is not a huge technological challenge. The biggest challenge is in the attitudes. Designers of public services should see their role as constructors of democratic society rather than only as application designers [32].

## References

1. Halttunen, V., Maksimainen, J., Pirhonen, A. Less, Slower, Better. Do Information Society Visions Have Healthy Alternatives? In: Suomi, R., Ilveskoski, I. (eds.) Navigating the Fragmented Innovation Landscape. Proceedings of the Third International Conference on Well-Being in the Information Society (WIS 2010). TUCS General Publication no. 56, University of Turku, 77–88 (2010)
2. Finland's Way to the Information Society, Ministry of Finance, Edita, Helsinki (1995)
3. A Renewing, Human-Centric and Competitive Finland. The National Knowledge Society Strategy 2007-2015. Government Policy Programmes, Prime Minister's Office (2006). <http://vnk.fi/julkaisukansio/2006/tietoyhteiskuntaneuvosto/tietoyhteiskuntastrategia/en.pdf>
4. La Porte, T. M., Demchak, C. C., de Jong, M.: Democracy And Bureaucracy In The Age Of The Web: Empirical Findings and Theoretical Speculations. *Administration & Society* 34(4), 411--446 (2002)

5. Oliver, M. Defining Impairment and Disability: Issues at Stake. In Barnes, C., Mercer, G. (eds.) *Exploring the Divide: Illness and Disability*, The Disability Press, Leeds, 39–54 (1996)
6. Oliver, M. *Understanding Disability: from Theory to Practice*, MacMillan, London (1996)
7. WHO (World Health Organisation) *International Classification of Impairments, Disabilities, and Handicaps: A Manual of Classification Relating to the Consequences of Disease*. World Health Organization, Office of Publications, Geneva, Switzerland (1980)
8. WHO (World Health Organisation) *International Classification of Impairments, Disabilities, and Handicaps: A Manual of Classification Relating to the Consequences of Disease*. Final draft, WHO/EIP/GPE/CAS/ICIDH-2 FI/ 01.1 World Health Organization, Office of Publications, Geneva, Switzerland (2001)
9. United Nations. *Convention on the Rights of Persons with Disabilities* (2006). <http://www.un.org/disabilities/documents/convention/convoptprot-e.pdf>.
10. Data.gov.uk
11. W3C. *Web Content Accessibility Guidelines (WCAG) 1.0* (1999). <http://www.w3.org/TR/WCAG10/>
12. W3C. *Web Content Accessibility Guidelines (WCAG) 2.0* (2008). <http://www.w3.org/TR/WCAG20/>
13. Abanumy A., Al-Badi A., Mayhew, P.: e-Government Website Accessibility: in Depth Evaluation of Saudi Arabia and Oman. *The Electronic Journal of e-Government* 3(3), 99–106 (2005)
14. Al-Khalifa, H.: The Accessibility of Saudi Arabia Government Web Sites: An Exploratory Study. *Universal Access in the Information Society* 11(2), 201–210 (2010)
15. Basdekis, I., Klironomos, I., Metaxas, I., Stephanidis, C.: An Overview of Web Accessibility in Greece: A Comparative Study 2004–2008. *Universal Access in the Information Society* 9(2), 185–190 (2010)
16. Cabinet Office: eAccessibility of Public Sector Services in the European Union. Accessed 10/1/2013 in <http://webarchive.nationalarchives.gov.uk/+http://www.cabinetoffice.gov.uk/e-government/resources/eaccessibility/content.asp> (2005)
17. Choudrie, J., Ghinea, G., Weerakkody, V.: Evaluating Global e-government Sites: A View Using Web Diagnostic Tools. *Electronic Journal of E-government* 2(2), 105–114 (2004)
18. EU: Study on “Web Accessibility in European Countries: Level of Compliance with Latest international accessibility specifications, notably WCAG 2.0, and approaches or plans to Implement Those Specifications”. Accessed 10/1/2013 in [http://ec.europa.eu/information\\_society/activities/einclusion/library/studies/docs/access\\_comply\\_main.pdf](http://ec.europa.eu/information_society/activities/einclusion/library/studies/docs/access_comply_main.pdf) (2009)
19. Goette, T., Collier, C., White, D.: An Exploratory Study of the Accessibility of State Government Web Sites. *Universal Access in the Information Society* 5(1), 41–50 (2006)
20. Kuzma, J., Weisenborn, G., Philippe, T., Gabel, A., Dolechek, R.: Analysis of U.S. Senate Web Sites For Disability Accessibility. *International Journal of Business Research* 9(6), 174–181 (2009)
21. Lazar, J., Beere, P., Greenidge, K-D., Nagappa, Y.: Web Accessibility in the Mid-Atlantic United States: A Study of 50 Homepages. *Universal Access in the Information Society* 2(4), 331–341 (2003)
22. Loiacono, E., McCoy, S. *Website Accessibility: A Cross-Sector Comparison*. *Universal Access in the Information Society* 4(4), 393–399 (2006)
23. MeAC: Measuring Progress of eAccessibility in Europe. Assessment of the Status of eAccessibility in Europe. Accessed 10/1/2013 in

[http://ec.europa.eu/information\\_society/activities/einclusion/docs/subgroupmtg\\_jan10/meac\\_study/meac\\_report\\_06\\_11\\_final.pdf](http://ec.europa.eu/information_society/activities/einclusion/docs/subgroupmtg_jan10/meac_study/meac_report_06_11_final.pdf) (2007)

24. Paris, M.: Website accessibility: A Survey of Local e-Government Websites and Legislation in Northern Ireland. *Universal Access in the Information Society* 4(4), 292–299 (2006)
25. Potter, A.: Accessibility of Alabama Government Web sites. *Journal of Government Information* 29(5), 303–317 (2002)
26. Shah, B.P., Shakya, S.: Evaluating the Web Accessibility of Websites of the Central Government of Nepal. ICEGOV '07 Proceedings of the 1st International Conference on Theory and Practice of Electronic Governance, 447–448 (2007)
27. Shi, Y.: E-Government Web Site Accessibility in Australia and China: A Longitudinal Study. *Social Science Computer Review* 24(3), 378–386 (2006)
28. Shi, Y.: The Accessibility of Chinese Local Government Web Sites: An Exploratory Study. *Government Information Quarterly* 24(2), 377–403 (2007)
29. Yu, D.X., Parmanto, B.: U.S. State Government Websites Demonstrate Better in Terms of Accessibility Compared to Federal Government and Commercial Websites. *Government Information Quarterly* 28(4), 484–490 (2011)
30. Worldspace. <http://www.deque.com/>
31. Vigo, M., Brajnik, G.: Automatic web accessibility metrics: Where we are and where we can go. *Interacting with Computers* 23(2), 137–155 (2011)
32. Pirhonen, A., Maksimainen, J., Sillence, E. The Design of Information Technology as Design of the Information Society. In: Li, H. (ed.) *Studies on Inequalities in Information Society*. Proceedings of the Fourth International Conference on Well-Being in the Information Society (WIS 2012). TUCS Lecture Notes, No 16, August 2012, University of Turku, 125–132 (2012)