

# Web Evolution and its Importance for Supporting Research Arguments in Web Accessibility

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## ABSTRACT

The World Wide Web (Web) is in constant evolutionary change. This evolution occurs along many fronts and is led by infrastructure developers, Web designers, technologists, and users. These multiple stake-holders ensure that the Web is a heterogeneous entity, not just in the nature of the content, but in the technology and agents used to deliver and render that content. It is precisely this heterogeneity which gives the Web its strength and its weakness. A weakness in technology adoption leading to an increasing disconnect between the actual user experience and the expected experience of the technology stakeholders. We are interested in the human factors surrounding the evolution of the Web interface; and believe that the wait is always too long for new recommendations, guidelines, and technology to be adopted. We are therefore, currently focusing on technological interventions for the client-side experience as opposed to waiting for guidelines or core technology adoption. But our beliefs are nothing more than anecdotal, to accurately target our work we need to understand the way the Web evolves. In this paper we do not present any solid research evidence but wish to explain our rationale and methodology (our position), and expose this to comment and criticism from the research community. Therefore this paper presents the ‘*why* and *how*’, as opposed to the ‘*what*’.

## Categories and Subject Descriptors

H.5.4 [Hypertext/Hypermedia]: Theory; I.7.2 [Document Preparation]: Hypertext/hypermedia; H.1.2 [User/Machine Systems]: Human factors

## General Terms

Measurement, Theory, Design, Human Factors

## Keywords

Web Accessibility, Web Evolution, Technology Adoption

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## 1. INTRODUCTION

The World Wide Web (Web) is a heterogeneous set of technologies, recommendations, and guidelines which are in constant, and combinatorial, evolutionary change. The Web is seemingly self regulatory in that there are so many stakeholders that their combined interaction makes Web evolution somewhat unpredictable. While the heterogeneity of the Web is one of its major strengths, in that it is adaptable and flexible, it also one of its major failings in that there is no control of the predicted outcome. With homogenous technologies (such as C, Java, SQL, and Eclipse etc) there is a degree of developer led conformance, and this conformance is useful for consistency across the user experience. However, the Web cannot guarantee this conformance and therefore the interactive experience cannot be assured.

We are interested in the human factors surrounding the evolution of the Web interface and the Human Computer Interaction (HCI<sup>1</sup>) aspects that exist in large scale heterogeneous systems. We believe that the wait is always too long for new recommendations, guidelines, and technology to be adopted, and that even core technology changes take time to be widely adopted. Waiting for User Agent adoption and then Web designer use, means that it can take considerable time for the user experience to become as originally intended. Further, it also takes significant time for the failings of the initial technology, recommendation, or guideline design to become apparent when released into a domain with so much scope for use other than as was intended.

However, our beliefs are anecdotal<sup>2</sup> assertions, but our work demands empirical evidence to guide future research effort. Therefore, we have a need to understand the rate of: technology, recommendation, and guideline adoption as rationale for further developments; and are in the process of creating an experiment utilising the Internet Archive<sup>3</sup> to understand these factors. By performing this study we hope to answer questions such as: ‘Do we rely on technology or guideline adoption?’, ‘Do we need technical intervention?’, ‘Will technical interventions be adopted into User Agents?’, and ‘Should we be led by users, by engineers, or by past history?’ In this way we hope to either support or refute our anecdotal assumptions and thereby better guide our future work giving us a clear rationale and domain to place our

<sup>1</sup>Or Computer Human Interaction (CHI).

<sup>2</sup>... and not empirical...

<sup>3</sup><http://www.archive.org/>: Founded to build an Internet library, with the purpose of offering permanent access for researchers, historians, and scholars to historical collections that exist in digital format.

new and continuing work.

In this paper we first look at Web Interaction and Accessibility (see § 2), describe our Rationale (see § 3), and methodology (see § 4); then Discuss (see § 5) our expected outcomes. We are at the cusp of this new work and so do not present any new research evidence, but rather, wish to explain our position (also see § 5) and expose this to comment and criticism from the research community. We therefore forego any mention of conclusions of future work and instead present the ‘*why and how*’, as opposed to the ‘*what*’.

## 2. ACCESSIBILITY & INTERACTION

Web Accessibility aims to help people with disabilities to perceive, understand, navigate, interact, and contribute to the Web [1, 2]. There are millions of people who have disabilities that affect their use of the Web. Currently most Web sites have accessibility barriers that make it difficult or impossible for many people with disabilities to use the sites. Web accessibility depends on several different components of Web development and interaction working together, including Web software (tools), Web developers (people) and content (e.g., type, size, complexity, etc.). The W3C Web Accessibility Initiative (WAI) recognises these difficulties and provides guidelines for each of these interdependent components: (i) Authoring Tool Accessibility Guidelines (ATAG) which address software used to create Web sites [3]; (ii) Web Content Accessibility Guidelines (WCAG) which address the information in a Web site, including text, images, forms, sounds, and so on [4]; (iii) User Agent Accessibility Guidelines (UAAG) which address Web browsers and media players, and relate to assistive technologies [5]. There are also other organisations that have produced guidelines (e.g., IBM, RNIB, AFB, Macromedia, etc.) but the WAI guidelines are more complete and cover the key points of all the others. There is however, no homogeneous set of guidelines that designers can easily follow. Moreover, some guidelines are tailored to address the limitations of existing assistive technologies<sup>4</sup> and devices. For instance, there is a guideline which says that extra white space needs to be added between link menu elements as some screen readers cannot handle link menu items properly. This means that some of these guidelines are more concerned with temporary technical fixes than with designer good practice.

Web Interaction focuses on improving technologies that provide interaction with the Web. This is led by the W3C’s Interaction Domain, which is responsible for developing technologies that shape the Web’s user interface [7]. These technologies mainly include (X)HTML, which is the markup language that started the Web, Cascading Style Sheets (CSS), which provides a mechanism for adding presentation style to Web pages, Scalable Vector Graphics (SVG), which can be used to create two-dimensional graphics in XML, etc. Development in these technologies effect how people browse the Web, and how they author Web content [8]. Therefore in any effort to support Web accessibility it is crucial that features and limitations of these technologies are clearly stated. As part of the W3C’s Interaction Domain, the Multimodal Interaction Working Group seeks to extend the Web to allow users to choose an effective means to interact with Web

<sup>4</sup>Assistive technology refers to hardware and software designed to facilitate the use of computers by people with disabilities [6].

applications through the modes of interaction best suited to their needs and device (visual, aural and tactile). This activity is focused on providing use cases and requirements analyses which are important resources for future Web design. In the Web accessibility field there are also best practice efforts which mainly include developing tools to ensure accessibility, such as validation, transformation and repair tools. Validation tools analyse pages against accessibility guidelines and return a report or a rating [9]. Repair tools, in addition to validation, try to repair the identified problems. Although there has been extensive work in the degree and development of validation, repair and transformation tools, automation is still limited [10]. While it is likely that there are certain accessibility issues that cannot be fully automated (e.g., checking the quality of alternative text provided for images), these tools still provide incomplete automation and complex outputs.

Into this mix of infrastructure; guidelines; and technology recommendations come Web designers all using this very complicated set of tools in very non-standard, often unintended, and heterogeneous ways. In this case the only point where we can truly understand how the Web page will be rendered, presented, and interacted with is at the moment it is displayed on the specific client-side user agent (or assistive technology) chosen by the user.

## 3. RATIONALE

Creating an accessible Web is a difficult goal mainly due to the complex interplay of the Web’s: infrastructure; guidelines; technology; and content. Indeed, it is this final point of Web content design, along with the view of the designer, which often creates the most difficulty when we wish to understand Web evolution in the context of Web accessibility. It is often the case that technology or guidelines are created to address perceived problems with access to the Web, however there is often little thought as to the time-scale that these solutions will take, or how these solutions may evolve in the future especially when we consider their non-standard use.

Our work looks at understanding the way users, specifically visually disabled users, interact with the Web and from this understanding create technological solutions which are inserted between the user and delivered Web content. These solutions are normally situated on the client interface or as part of a proxy system. These technical platforms, or prototypical experiments, are useful in two ways. Firstly, by encoding our hypotheses into these platforms we make a statement about the predicted outcome of the user experience, by testing users with these technologies our predicted experiences should be ratified, thus they enabling our research findings to be tested. But secondly, and in the ‘real-world’ at least, more importantly, they enable a better user experience than the one which would have been available if the user agent alone provided the interaction.

To justify our research findings and our pragmatic approach of encapsulating those findings into client-side technology we need to support the hypotheses that the adoption of guidelines and recommendations is both slow and in some cases non-existent, and suggest that user agents should also adopt the techniques that we have developed for better user interaction. However, we are often faced with the comment that these solutions are temporary fixes and once new technology and guidelines are adopted these problems will be

solved. This argument also completely ignores the fact that our understanding of human behaviour in the context of Web interactions may go beyond the knowledge of the technologists or guideline designers. It is our assertion that our ‘temporary technology’ is vital as a demonstrator of leading edge user agent technology, and more than this, that our technology is not temporary but permanent, or at least as temporary as any other aspect of the Web.

The reality is that we have two, often opposing, viewpoints on Web accessibility issues: (1) There is the viewpoint which suggests technological recommendations and guidelines will enable Web accessibility, and that these will render Client-side assistive technology superfluous or even harmful; and (2) there is the opposing view that technological interventions must be created because recommendations and guidelines are often too slow to be adapted, and in some cases are not adopted at all. Our intention then, is to understand the way that the Web has evolved over the last ten years in an attempt to support our arguments: that (1) Based on past trends technological interventions, encapsulating leading edge research, must be created and allowed to evolve as new findings are discovered; and that (2) Our technology is useful for a similar amount of time as a user agent version, after all we do not consider the most up-to-date version of Mozilla Firefox to be a ‘temporary fix’.

By understanding the way that the Web *has* evolved we can understand the way that the Web *will* evolve.

#### 4. ARCHIVE & ARCHAEOLOGY

For our purposes an understanding of Web evolution can be based along two tracks: Web Archives<sup>5</sup>, and Web Archaeology<sup>6</sup>. We can define these twin concepts in two complementary ways:

**Archive:** An archive is a set of Web pages placed into a protected, or ring fenced, store at or near the time they were created, with the intention of using them at a later day for some unspecified process or purpose. The archive however, suffers from some sociological aspects because there needs to be a methodology for placing the Web pages into the archive and this normally means there is an associated perceived importance; and

**Archaeology:** Web pages outside of a defined archive, in the wild – if you will, which happened to be preserved in a much older state than the rest of the current Web. These pages are often found in the so-called long-tail and are in many cases not linked to a large number of other ‘current’ pages. The pages tend to be forgotten remnants created in bespoke and individual cases as opposed to parts of large corporate Websites or Web sites that are currently maintained. They are therefore useful in contextualising an archive view and maybe thought of as a kind of social history.

Both are important however the archive is far more ‘available’ as a tool and therefore we will be looking at archival material. Only if time permits will we look into the archaeological record. For our work, we intend to build a Web

<sup>5</sup>An archive refers to a collection of historical records, and also refers to the location in which these records are kept.

<sup>6</sup>The recovery, documentation, analysis and interpretation of material remains and environmental data.

robot which uses the ‘Internet Archive’ as its page corpse. Web robots, also known as Internet bots, WWW robots or simply bots, are software applications that run automated tasks over the Internet. Typically, bots perform tasks that are both simple and structurally repetitive, at a much higher rate than would be possible for a human editor alone. The largest use of bots is in web spidering, in which an automated script fetches, analyses and files information from web servers at many times the speed of a human. We then use site rankings from ‘Netcraft’ to pick the top twenty sites that have been valid over the last ten years. Next we build a randomised corpse of five-hundred sites, and finally allow third parties to add their own site. We then take snapshots in time between 1998 and 2008 and analyse each home-page for each site against the following criteria (contained within simple regular expressions):

**HTML Version:** By capturing the HTML version built into the header of each Web page we can understand how version adoption has evolved when compared to recommendations release date. This will enable us to answer the question ‘What is the uptake of core technology with regard to the Web evolution scenario?’

**Image Technology:** Images are yet another infrastructure technology, however, they are disjoint from the basic Web page and so are not classed as core technology. However, by understanding the uptake of GIF, JPG, and PNG formats we can understand how Web images have evolved and how possible non-core, but important, technologies would also evolve in the future.

**Script Technology:** Script technology is a more recent development, however, JavaScript has been available for some time. In this case what are the uptake patterns of JavaScript and for other less well known scripting languages. Has JavaScript now become the de-facto standard or are other languages ‘bubbling under’?

**Animation:** Animation is also a more recent, seemingly Web 2.0, technology. However, Flash is in its ninth version so then and what is the uptake of animation technologies and how long does it take for these technologies to become commonplace?

**Guidelines:** Guidelines are important and in this case we look at the WAI (AAA, AA, A), ADA-508, and Mobile OK guidelines. We can see these by an analysis of: (1) The hyper-links to validation sites; (2) The various image accreditation badges; (3) Combination of AAA, AA, A, and 508 characters; or the (4) Words (terms) Mobile OK, MobileOK, or accessibility – present but not used in sentences or as links to intra-site pages describing policy. Remember we are not interested in whether the guidelines have actually been followed as opposed to the perception that the designers think them important enough to list on their Web pages.

By analysing these key areas we expect to be able to understand, and plot, the uptake of technology both in leading edge sites, in general over the Web, and for interested parties.

## 5. DISCUSSION & POSITION

Work already exists which looks at other forms of Web evolution from the perspective of communities and social groupings [11] or from the viewpoint of information retrieval with regard, specifically, to the lifespan of individual pages [12, 13]. However there has been little work of the kind proposed here and there are no sources which specifically would enable us to support our anecdotal assertions.

While we have no concrete experimental data just yet, we do have some idea of the kind of output we expect to generate. While our figures may be inaccurate and the timelines invalid in this example we do expect the kind of output shown in Figure 1. This graph is an example of one possible scenario for core Web technology where by we have two series of data: one denoting the top 20 sites and one denoting a random 500 site sampling; both plotted over 15 years. We can see that our top 20 sites have core technology adoption before the random 500. We would expect this to be the case because by their nature the top 20 sites have to be up-to-date to maintain their competitive advantage. If we also plot on this graph the location of the core technology release, for instance HTML 4.01 and show this at year two then we can see that 50 percent adoption within the top 20 sites takes five years, as it is placed at year seven, and for the random 500 sites it takes six years as this is placed a year later in the scenario.

By understanding that core technology exhibits a five-year lead on average we can defend our position that interim technology is required. More than this, as five-year time lag is easily the length of time required for a new full browser version to be released and so this interim technology is no more temporary than any other piece of Web technology. Therefore, after completion of this study we would expect to be able to offer some concrete evidence to support our arguments above and in addition answer questions such as:

- Is the technology maintained or are there peaks and troughs;
- When, and how, does one technology overcome another;
- Is there a difference in adoption rates between core technology and recommendations as opposed to none core aspects;
- Do recommendations and guidelines have the same status with regard to designer uptake and evolution time (elapse time);
- Do validation and repair tools make a difference to the take-up of guidelines and recommendations; and
- Can we see any socio-technological aspects which effect infrastructure, recommendations, or guidelines?

*Our position is therefore simple, we do not expect to directly contribute to the Web Evolution effort for its own sake, but rather, need to understand the evolution of infrastructure, guidelines, and recommendations to support our Human Factors work. By understanding the way the Web has evolved we can attempt to predict how it will evolve, and as such guide our future efforts in supporting Web Accessibility, and understanding human behaviour in the context of Web interaction.*

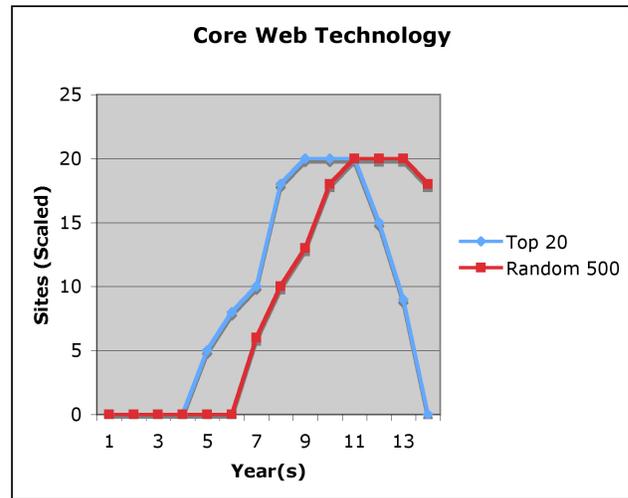


Figure 1: Core Graph Example

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