

# Enhancing the Applicability and Impact of Recommendations and Tools for Accessibility of Internet Services

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**Abstract:** Accessibility is usually conceived as an add-on feature at the user interface of Internet services, which is considered to require 'extra' design and development effort. The paper claims that this is a limited approach to a wider issue: that of good user-based design, if possible for all end users. However, in order to alter this approach for Internet service design, a number of steps need to be followed. These steps are related to the a) explanation of the rationale of the design of current recommendations; b) purposeful synthesis and elaboration of the large amount of existing work into a set of design requirements that can address all end-users; and c) incorporation into Web development tools of both the rationale of design of recommendations and the elaborated design requirements. These issues are dealt by IST project IRIS that aims to encapsulate into a design aid environment work on design-for-all recommendations, tools and methods, and use this environment to redesign and enhance existing services in the areas of teleworking and electronic commerce, guided by rigorous user testing and evaluation.

**Keywords:** Design for all, support environment, Internet services, accessibility, usability, recommendations

## 1 Introduction

There is a large amount of work on accessibility recommendations of Internet-based services that is progressing in a number of directions. The W3C WAI (World Wide Web Consortium - Web Accessibility Initiative) is working on guidelines for accessible web content (Chisholm, et al, 1999), authoring tools (Treviranus et al, 2001), user agent (Jacobs, et al, 2001) and XML (Dardailler and Paimer, 2001) addressing key aspects and technologies of Internet services design and development. Major IT vendors (such as Microsoft, IBM, Sun and Apple), have also introduced accessibility guidelines that address issues considering different commercial platforms (i.e. Windows, Java, and the MacOS). Furthermore, at a national level, a number of countries like USA, Canada and Australia have developed legal frameworks for accessibility of Internet services, while other countries like those in the European

Union and Japan are fast moving towards establishing such measures.

Besides establishing legal actions for Internet accessibility, it is important that other purposeful activities are undertaken by the research and academic community so that accessibility is not perceived as a 'add-on' feature to Internet service design. These activities are related to the exploitation of existing work on accessibility guidelines and recommendations in terms of developments of both Web development tools and electronic services and also to the evaluation of these electronic services by varied user groups.

The IRIS project is moving towards the elaboration, synthesis and exploitation of existing work on 'Design for all' (DfA), including accessibility guidelines, into the design and development of a DfA Support Environment that will be used by designers towards enhancements of Internet services in the areas of electronic commerce and teleworking. These services will be evaluated by diverse user groups including people with special needs.

IRIS does not take as a starting point any specific set of guidelines, recommendations, or standards in order to achieve its objectives, but instead it attempts to elaborate on the major strands of work in 'Design for all'. During this tedious task, it has been realised that the purposeful synthesis of this large amount of work on 'Design for all' requires a number of activities. More specifically, in terms of accessibility guidelines we have seen that a number of steps need to be pursued so that existing work can be meaningfully incorporated into the IRIS DfA support environment. These steps are related to the:

- a) Explanation of the rationale of the design of current recommendations;
- b) Purposeful synthesis and elaboration of the large amount of existing work into a set of design requirements that can address all end-users; and
- c) Incorporation into Web development tools of both the rationale of the design of recommendations and (at a very minimum) a set of widely accepted design requirements.

In this paper we provide a discussion on the above issues highlighting the need for more work towards these directions and we present the approach taken in terms of the IRIS project.

## **2 Rationale of Accessibility Recommendations**

Rationale is an important part of any type of recommendation because it provides important explanatory information, which can be used for various purposes, including evaluation and take up. More specifically, for the case of Internet accessibility guidelines, Internet service designers may not be in a position to estimate whether a set of guidelines is appropriate for a particular design, unless the rationale of the guidelines is well explained. For example, despite the fact that most of the work on W3C.WAI recommendations for accessibility can be taken up at the development and evaluation / validation phases of a design process or methodology, there are aspects of these guidelines that cannot be automatically implemented by a software compliance test program, but are left to the designer to decide how they are implemented. These aspects may be ignored by designers and by software programs that attempt to apply the guidelines.

This problem may be more intense if we add that in some cases the rationale seems to derive from existing technology limitations, rather than from general principles of accessible and usable design. In such situations, guidelines simply cannot be

followed, unless the technology to which they refer to is adopted.

It has been seen that there is much room left to designers for interpretation in some aspects of this work. This is natural, but there is a need to aid the designer towards aspects such as summarising and deciding upon which recommendations and tools to select and apply. The quality of the final design can be affected in various ways, when such support is not provided by the set of guidelines or design and development tools. Stephanidis and Akoumianakis (1999) demonstrate that different engineering perspectives in the implementation of guidelines can lead to different interpretations and can influence the quality of the final products.

The task of placing guidelines that are general in scope, into a particular context is not easy and may result into nearly exhaustive enumerations of properties and characteristics. An example of an elaboration of ISO 9241 for the evaluation of user interfaces is that of Gappa et al (1997) who have developed a guideline oriented expert-based evaluation method that prepares the requirements of the standard to be tested in about 450 test items. However, such tasks, related to the interpretation of general in scope recommendations, may discourage designers to consider the use of such recommendations into their design processes (Koutsabasis et al, 2001).

In terms of the IRIS project, we have seen that work towards conceptualisation and adding context to recommendations is important not only for providing a more holistic view of the textual description of a set of design guidelines, but also for incorporating guidelines into a design support environment, presented in section 5.

## **3 Accessibility Recommendations: The Need for Elaboration to a set of Design Requirements**

### **3.1 Accessibility recommendations have started to converge into W3C work**

When the WAI was formed in March 1997, there were over 40 documents that had been written to address web accessibility. Since then, the W3C Web Accessibility Initiative (WAI) has gained acceptance worldwide. Various fora, which have published Web accessibility guidelines in the past, have now adopted WAI Web Content Accessibility Guidelines (WCAG) (Chisholm et al, 1999) and propose their implementation. Furthermore, other sets of highly useful guidelines for Internet services design include the Authoring Tool Accessibility Guidelines

(ATAG) (Treviranus, et al 2001), and XML Accessibility Guidelines (XMLGL) (Dardailler and Palmer, 2001).

The WAI initiative includes many independent organisations and large IT vendors. It issues guidelines in the form of recommendations aiming to be taken up and used by designers and developers. WAI also issues other documents such as sets of notes, techniques and curricula. WAI guidelines have practical (as opposed to theoretical) aspects and refer many technological issues, which minimises the complexity of the problem of issuing and evaluating guidelines. With the release of checkpoints for each guideline, WAI also provides specific items for validation, which also eases the application of legal conformance.

### 3.2 Other areas of Design for All work

However, accessibility seems to be only the starting point for good, user-based design for all users. The 'Design for all' concept attempts to cover a wide range of requirements for user-based design, access and use of computer-based applications. This

general perspective requires that a wide range of methodologies, methods, recommendations, techniques and tools that can provide aid to various phases of the design process should be taken into account in an approach towards aiding designers to design for all.

An empirical enumeration that represents the broad and disparate nature of work in the area of Internet-based services, that is relevant to 'Design for all' concepts, includes work and tools relevant to: accessibility, usability, user profiling, semantics / metadata of content and media, cognitive / reactive models of perception and action, and models of interaction. These strands of work, although not constrained only to Internet-based systems and services, can provide useful references to Internet designers at various phases of the design process, such as requirements, design, development, valuation – not necessarily in this order, as shown in Figure 1.

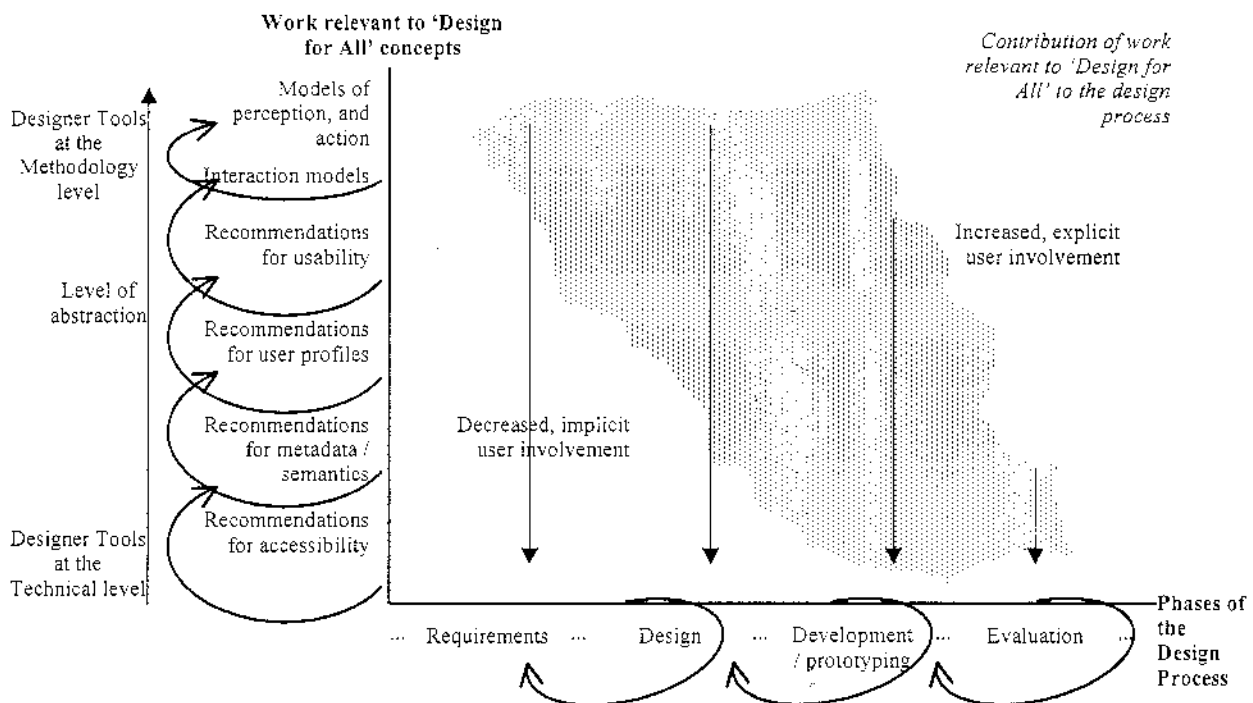


Figure 1: Contributions of work relevant to 'Design for All' to major phases of the design process.

The effect of this existing, relevant to 'Design for all' concepts, work cannot be strictly bound to specific phases of a particular methodology or design process (thus, in Figure 1 we use small dots to reflect this vagueness). Generally, whenever these tools cannot provide formal solutions, which can assist

designer in an automatic manner, user involvement is usually more explicit and increased.

The elaboration of work relevant to the 'Design for all' concepts, methodologies, methods, recommendations, techniques and tools is a major objective of the IRIS project. This task is the starting point for the development of a framework for aiding

designers to incorporate this work into their methodologies and design processes.

Unfortunately designers rarely take into account the breadth of issues regarding the incorporation of work related to 'Design for All' concepts. Most often, designers focus on work that contributes directly to the development and prototyping phases of the design process (Velasco and Verelst, 1999; Velasco, 2001).

## 4 Incorporation of DfA Design Requirements into Web development tools

A large number of development tools exist that can aid designers towards incorporating and testing design for all, currently focusing on accessibility. These tools aim to assist designers to reduce the large number of design options into those that follow accessibility and usability principles (Nicolle C. and Abascal J., 2001). These tools fall under the following, broad categories:

- *Authoring tools*: these tools address the main issues of Web development such as Web site organisation, WYSIWYG or source editing of HTML, etc. In general, these tools include limited design for all support, however they have recently started to incorporate accessibility aids.
- *Server-side tools*: these tools assist the designer to automatically translate content into alternative formats and also validate content conformance according to specifications.
- *Accessibility checks*: they automatically check the validity of a Web page according to a set of guidelines and are very specific to accessibility requirements.
- *Other tools*: they are useful for various operations such as content transformation, colour management, removers of non-standard elements from content, etc.

An indicative list of such tools and a brief description of their accessibility features is shown at Table 1.

These tools are very useful for Internet service development. They have been developed by major IT vendors, independent consortia and organisations as well as from the open source community and address specific accessibility needs for Internet technologies. However they do not provide assistance to designers at the methodology level, or in parts of other design phases besides implementation and testing. For example there are only a few tools that can aid the design process in phases such as identification of methodologies for HCI design, elicitation and organisation of user requirements and conduction of

user centred evaluation of user interfaces (Koutsabasis et al, 2001). Furthermore, there are notably fewer tools that consider usability requirements along with accessibility (Koutsabasis et al, 2001b).

In order to provide a holistic aid to designers of Internet-based services at the level of design and development, there is a need to meaningfully categorise this large number of recommendations and tools. The development of an environment that can purposefully synthesise the aforementioned work in terms of a tool that can aid the designer to design for all is an objective of the IRIS project.

## 5 The work of IST project IRIS

### 5.1 The project concept

The objectives of the IRIS project are to:

- Encapsulate into a design aid environment, work on design-for-all tools and methods; user modelling theories and methods, including users with special needs; guidelines, recommendations and results from work about hypermedia, enrolment and accessibility; and
- Use this environment to redesign and enhance existing services in the areas of teleworking and electronic commerce, guided by rigorous user testing and evaluation.

The basic elements of the IRIS project approach and tasks are shown diagrammatically in Figure 2.

Designing for all implies a user centred approach in design starting from the identification, modelling, specification and automated utilisation of user characteristics. User characteristics may include a variety of information such as: preferences, attitudes, sensory capabilities or impairments, user access features (related to both software and hardware).

The IRIS design support environment takes into account existing work in areas related to design for all such as usability, accessibility, content metadata and user modeling and profiles. IRIS will identify the suitability of a range of tools and methods, such as metadata for delivering media and alternating content formats. By identifying the suitability of such methods and tools, IRIS will have formed a broad design space, where the aforementioned user models can be translated to a range of possible selections regarding the design of accessible services.

Preliminary evaluations, carried out within the scope of the IRIS project based on WAI Authoring Tools Accessibility Guidelines (Treviranus et al, 2000), of several of the most known commercial tools show a very limited implementation of accessibility features within their design environment.

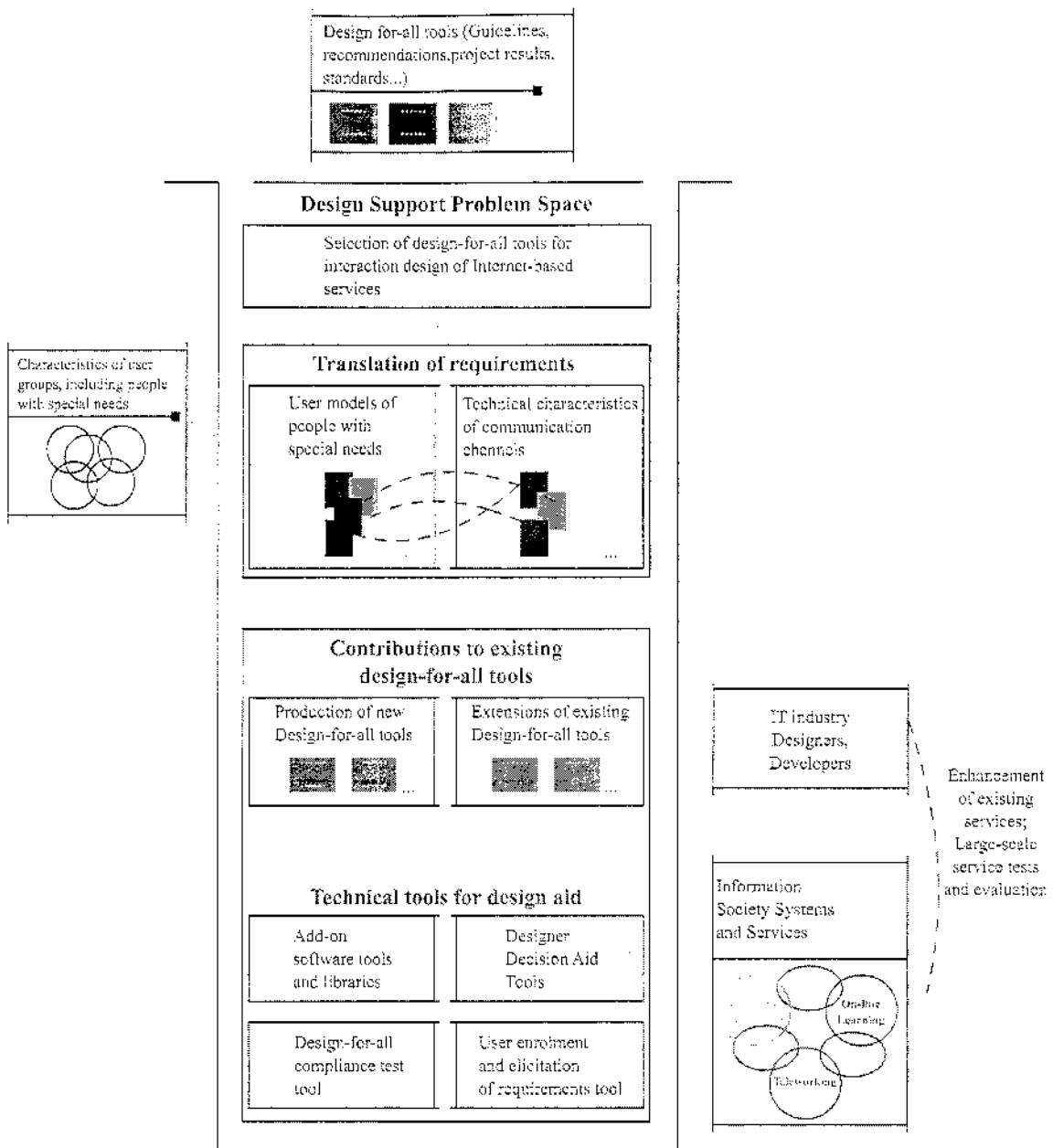


Figure 2: The IRIS project concept.

**Table 1: An indicative list of Web development tools and a brief description of their accessibility features.**

TOOLS	BRIEF DESCRIPTION OF ACCESSIBILITY AIDS
<b>Authoring tools</b>	
Allaire Homesite - <a href="http://www.alaire.com">http://www.alaire.com</a>	Maintain Pure HTML; sport of a wide range of technologies (CSS, SMIL, WML, HDML); Support of a range of tools; (Tag Insight, Tag Editors, Tag Inspector, Tag Completion, Tag Snippets, Thumbnail-Image Preview, Code Sweeper, colour coding support);
lotmetal Pro - <a href="http://www.hotmetalpro.com">http://www.hotmetalpro.com</a>	HTML Source Editing; WYSIWYG Editing; Tags On Editing; CSS Support;
Macromedia Dreamweaver - <a href="http://www.macromedia.com">http://www.macromedia.com</a>	"Check Page for Accessibility" Tool for Accessibility, based on W3C.WAI WCAG; Support for Cascading Style Sheets (CSS), Image Maps, Alternative text for images and frames and customisation of tables; Voice Browsing Support; Control Over Source Code; Valid HTML Markup;
Microsoft Frontpage - <a href="http://www.microsoft.com">http://www.microsoft.com</a>	The accessibility of Microsoft Frontpage is dealt homogeneously with other MSOffice products, in terms of Microsoft Accessibility.
Opera - <a href="http://www.operasoftware.com">http://www.operasoftware.com</a>	Analysis of a text-only view of an HTML document (utilising the <ALT> tags); Checking the speed of the browsing by viewing only images already downloaded and cached; Switching between using the document (author) style sheet and the user style sheet; Turning off tables and frames; validation of any web page according to the HTML standard; displaying the size of windows (to assist with monitors' analyses); zoom function;
W3C Amaya - <a href="http://www.w3.org/amaya">http://www.w3.org/amaya</a>	Lets users both browse and author Web pages; maintains a consistent internal document model adhering to the DTD; works on several documents at a time; helps authors create hypertext links; includes a collaborative annotation application; it is easily extended (according to several APIs and mechanisms with the least modification to the source code)
<b>Server-side Tools</b>	
IBM Websphere Transcoding Publisher - <a href="http://www-4.ibm.com/software">http://www-4.ibm.com/software</a>	Extend existing Web content to new devices (HTML to HDML; HTML to i-mode; XML to XML variants using XSL stylesheets; HTML to WML; JPEG images to GIF and wireless bitmap; GIF images to JPEG and wireless bitmap); Streamline delivery so that content is provided efficiently (fragmentation of Web pages for HDML, i-mode and WML; elimination or reduction of images for faster delivery to constrained devices); Customization of content presentation for the end user (it is possible to tailor source content without programming through an XML-compliant annotation language, Java programming, XSL stylesheets and device profiles);
NIST WebMetrics Tool Suite - <a href="http://zing.ncsl.nist.gov/webmet">http://zing.ncsl.nist.gov/webmet</a>	It is a set of four tools used to test the usability and accessibility of a site. <b>WebSAT</b> : The Web Static Analyzer Tool uses a subset of usability guidelines to analyze a page for accessibility, form use, performance, maintainability, navigation, and readability. <b>WebCAT</b> : The Web Category Analysis Tool allows a web designer/usability engineer to test a proposed or existing categorization scheme of a web site to determine how well the categories and items are understood by users. <b>WebVIP</b> : The Web Visual Instrumenter Program is a tool that can be used to conduct traditional user testing on a given set of tasks but in a remotely and automatically. <b>WebVISVIP</b> : It is used to visualize the path data generated by VIP in 3D graphics.
W3C CSS Validator - <a href="http://jigsaw.w3.org/css-validator">http://jigsaw.w3.org/css-validator</a>	Tests Web pages for Cascading Style Sheets, level 2.
W3C HTML Validator - <a href="http://validator.w3.org">http://validator.w3.org</a>	Checks documents for conformance to W3C HTML, XHTML Recommendations and other HTML standards.
<b>Accessibility checks</b>	
-Prompt - <a href="http://aprompt.snow.utoronto.ca">http://aprompt.snow.utoronto.ca</a>	Validates Web accessibility of HTML documents based on W3C.WAI WCAG.
Bobby - <a href="http://www.cast.org/bobby">http://www.cast.org/bobby</a> Delorie Lynx Viewer - <a href="http://www.delorie.com">http://www.delorie.com</a>	Validates Web accessibility of HTML documents according to W3C.WAI WCAG. Shows how a page will look in Lynx, a well known text browser
NCSA Tom (Text-Only Maker) - <a href="http://lunch.ncsa.uiuc.edu/tom">http://lunch.ncsa.uiuc.edu/tom</a>	Converts graphical Web pages into text-only pages, or hybrid text and graphics web pages.
WAVE - <a href="http://www.temple.edu/inst_disabilities/piat/wave">http://www.temple.edu/inst_disabilities/piat/wave</a>	Adds icons and text to a page to help the developer judge whether it is accessible.
<b>Other tools</b>	
Adobe PDF to HTML converter - <a href="http://access.adobe.com">http://access.adobe.com</a>	Converts ADOBE Acrobat files into HTML.
Colorfield Insight - <a href="http://www.colorfield.com/insight.html">http://www.colorfield.com/insight.html</a>	Allows to model and predict image legibility for colour deficient viewers.
HTML-TIDY - <a href="http://www.w3.org/People/Raggett/tidy">http://www.w3.org/People/Raggett/tidy</a>	Assists writers of HTML code to fix mistakes automatically and tidy up editing into nicely laid out markup
MSOffice 2000 HTML Filter - <a href="http://office.pdata.microsoft.com">http://office.pdata.microsoft.com</a>	Removes Office-specific HTML markup tags embedded in Office 2000 documents saved as Hypertext Markup Language (HTML)
RFC2HTML - <a href="http://www.w3.org/Protocols/rfc2616">http://www.w3.org/Protocols/rfc2616</a>	Converts Internet Society Request for Comments into HTML.
W3C Tablin: a Table Linearizer - <a href="http://www.w3.org/WAI/Resources/Tablin">http://www.w3.org/WAI/Resources/Tablin</a>	Linearizes HTML tables and renders them accordingly to preferences set by the presentation layer

IRIS defines a generic architecture for a designer aid incorporating design for all methods and tools. The basic components of the design support architecture will be defined at the conceptual, functional and technical levels.

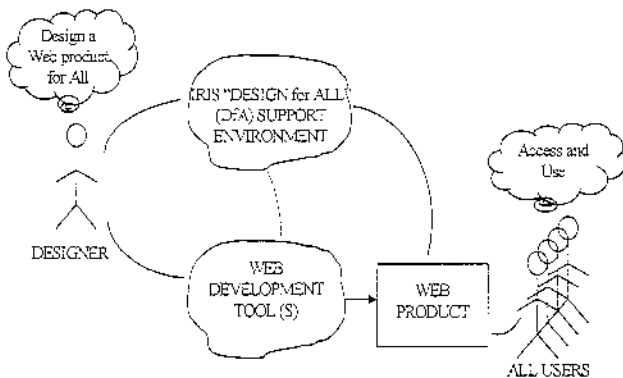
The IRIS design support environment will be used by designers in order to enhance existing Internet services and applications in the selected areas of electronic commerce and telework. This will be achieved by further developing existing Internet services in these areas.

During the enhancement of existing services, IT designers will assess the support of the design aid environment and the extensibility and customisability of design for all tools. Designers will use those tools to assess the re-engineering effort for adding 'design for all' principles to their software products, and to employ them directly to their developments.

The evaluation of enhanced Internet services will be user-centred, involving international associations of people with special needs, who are familiar with ICT and who will provide insight to various usability and accessibility issues.

## 5.2 The context of the IRIS DfA support environment

The IRIS design support environment aims at supporting all designers to design web applications / services for all users based on user modelling. A first abstract view of the IRIS design support environment situated within its environment is shown in Figure 3.



**Figure 3: The context of the IRIS design support environment.**

The IRIS design support environment is a new element in a typical design process, where a designer aims to produce a Web product with the use of a (set of) Web development tool(s). The need for the design support environment is created from

the observation that the designer is engaged to solve a design problem that requires a 'DfA' approach, which is not readily offered by existing Web development tools. Work currently in progress has surveyed designer preferences regarding how they would like to receive design aid. The replies range from static references, e.g. good book, succinct presentations, video materials, educational materials, such as courses and training materials; to interactive web based materials in form of public Q&A fora, or help desks [DASDA project, 2001]. The IRIS design support environment will attempt to provide some of the range of help including pointers to static materials; educational materials, to support for technical evaluation tools.

As can be seen from this conceptual level of analysis, the IRIS design support environment can act synergistically with existing Web development tools with the purpose of supporting the designer in a generic manner and scope, covering the full lifecycle of the design process from problem understanding until development and testing, to apply 'DfA' concepts to the analysis, design and development of Internet services. Thus, the IRIS design aid environment is not just another Web development tool, but instead allows self-produced interfaces and/or elements relevant to 'DfA' to existing development tools.

From the perspective of the designer, the IRIS design aid environment could be used either via their preferred Web development tool or via its own interaction module in order to support the designer in phases of the design process. In the first case the link between the IRIS design support environment with Web development tool(s) can enable the IRIS design support environment to monitor the design process proactively and possibly act in this manner in order to provide assistance to the designer. In the second case the design problem may be communicated to the IRIS design support environment (via suitable mechanisms and rules) and/or the Web development tools according to the communication language(s) used.

The ultimate aim of the designer is to produce a Web product, e.g. an Internet service. For the purposes of the IRIS project there will be developments and demonstrators in Internet services in the selected areas of teleworking and electronic commerce. However, the scope of the IRIS design support environment is to provide assistance to

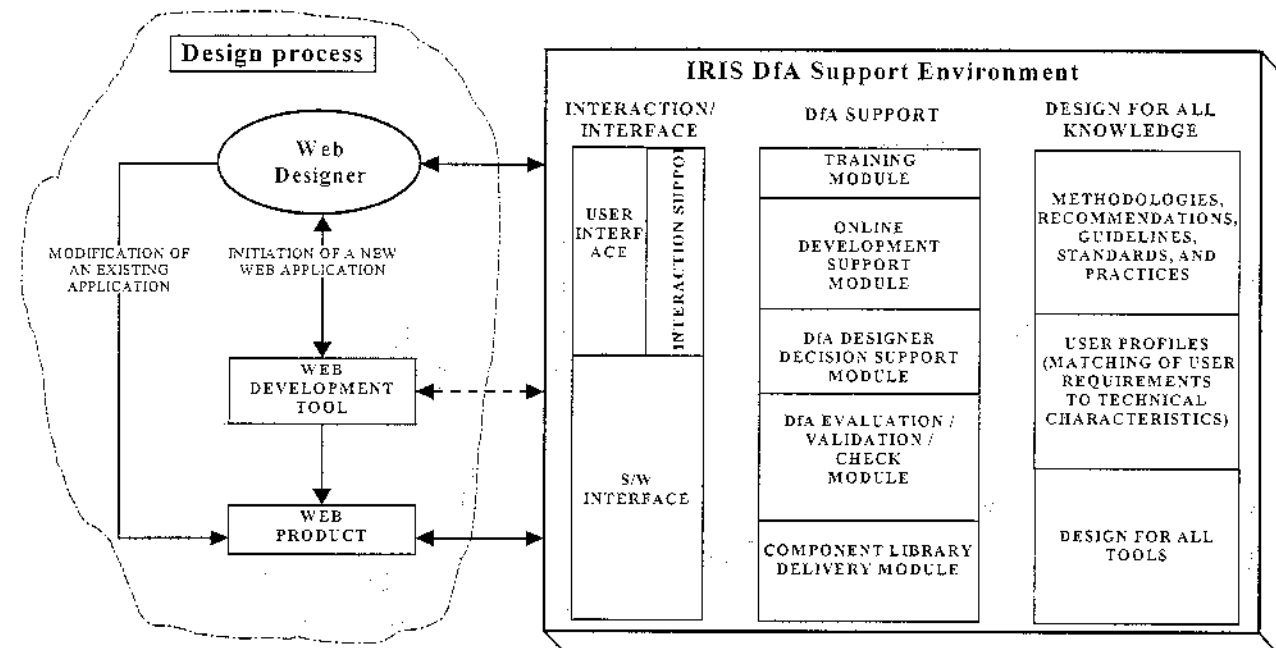
designers at a generic level and support the design process beyond these domains of application.

### 5.3 The functional architecture of the IRIS DfA support environment

The IRIS DfA support environment will support Internet designers / developers (including people with disabilities) to implement Internet applications

for all. They will be provided with supporting modules that will assist online and offline the designer to accommodate accessibility issues on his web design.

The basic functional modules of the IRIS DfA support environment are:



DfA: Design for All

Figure 4: A first view of the IRIS design support environment functional architecture.

- Interaction: This module consists of the IRIS DfA support environment user interface, the interface to other software, which will be mainly designed in the form of APIs (Application Program Interfaces) and interaction support, which will employ mechanisms for interactive dialogue with the designer (user) based on user modeling approaches.
- DfA support: This module consists of components that can aid the designer (user) both online and offline: Online aids include the online development support, validation / check and component (i.e. software components and objects) delivery, while instruction, evaluation and decision support can be either online or offline aids.
- DfA Knowledge: The IRIS DfA support environment will require a large amount of DfA knowledge which can be either encoded inside the environment or externally available. This knowledge includes existing

methodologies, user requirements and their translation to technical characteristics, recommendations guidelines, standards, case studies and possibly other types of knowledge.

This multifarious work will also enable IRIS to provide generic recommendations for enhancements of Internet-based services, addressing the IT community, based on the above findings and experience.

## 6 Conclusions

Despite the fact that the principles of universal design and accessibility are well accepted, putting principles into practice is still problematic.

The paper presented a number of issues that place obstacles to designers of Internet-based systems and services to design for all. These issues are related to:

- Explanation of the rationale of the design of current recommendations;



b) Purposeful synthesis and elaboration of the large amount of existing work into a set of design requirements that can address all end-users; and

c) Incorporation into Web development tools of both the rationale of the design of recommendations and the elaborated design requirements.

For the efficient take up of this research it is important that work on design - for - all methods and tools is accommodated into a format that can be easily presented to and evaluated by the designers of electronic services.

The paper argued in favour of the need for an environment that can support designers to design for all. It illustrated aspects of 'DfA' work that need to be elaborated into this environment and outlines its form at a conceptual and functional level.

The work described in the paper is work in progress. The IRIS consortium actively seeks collaborators in the area of design for all in order to achieve better developments in the area and ensure that IRIS results are validated by experts external to the project.

## 7 Acknowledgements

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