Accessibility

Universal Design

BENEFICIAL FOR
EVERYONE.

GERMAN **UPA**
Association of German Usability and
User Experience Professionals

German UPA

The German UPA is the professional association of the German Usability and User Experience Professionals that operates under the umbrella of the international UXPA (User Experience Professionals Association). The association is a network of and for usability experts who are committed to sharing knowledge and shaping public opinion on issues associated with usability and user experience.

The goal of each local UXPA Chapter is to offer people with the same interests the opportunity to come together regularly to share their experience and encourage each other in the usability profession.

Within the German UPA, the members are involved in working groups that cover a range of different topics. This is where they exchange their expert knowledge and collaborate with others throughout the country.

One of the working groups is dedicated to the topic of accessibility. Its members are experts on the subject and represent the interface between usability and accessibility within the German UPA. In addition to public relations, the group generates a lively exchange of knowledge and experience. You will find further information on the German UPA's website under "Aktivitäten/Arbeitskreise".

http://ak-barrierefreiheit.germanupa.de

Authors' note:
The first edition of this publication was created in 2010 in German language. The slightly adapted content of the current English edition considers the international audience.

Contents

I. Universal design for a world without barriers

As usability professionals, we emphasize the importance of Human-Centred Design (HCD), making sure the focus is on the user when developing products and information systems. We carry out user research, collect usage profiles, perform task analyses and consider contexts of use. Ultimately we attempt to adapt the product design to the individual requirements as closely as possible. Agile development processes support our work by enabling iterative design.

However, there is one group of users, people with disabilities, who are rarely the central focus of our research. In fact, we often forget about them altogether. This might be because they are not usually included in the client's business requirements, or because we usability professionals are not yet aware of the significance of this user group. Social equality considerations are not the only reason for us to consider accessibility for people with disabilities in all our projects. Disabled people are also customers and colleagues, and ultimately an economic factor. They add a significant dimension to our professional efforts to create the best possible product. User-oriented design that applies to the widest diversity of users also includes accessibility and is universal design in the best sense of the word.

Accessibility and universal design are already in use in several areas of life, such as house construction and public transportation. This brochure is focused on accessibility in the field of information technology, the key technology of our contemporary information society.

People with disabilities use the Internet

There are people with disabilities everywhere, spread across all age groups, professional groups and walks of life. Not all disabilities are obvious, and some of these people do not actually regard themselves as disabled.

- A 33-year-old office equipment buyer uses several online shops as part of his job. He is colour-blind and often finds it difficult to pick out details on product photos. He prefers to make his purchases from sites that include detailed product descriptions. He also has problems noticing special offers if they are marked red. Eight per cent of men suffer from colour blindness; many of them are not even aware of their disability.

- A 48-year-old journalist has developed a long-term repetitive strain injury through excessive computer use. She has to learn to activate the computer functions with the keyboard and is given voice input to dictate texts. She is relieved every time she encounters a website or a computer program that does not rely solely on using a mouse.

- A young man with Down's syndrome finds it difficult to find what he needs in a supermarket, especially if the layout is often changed. A friend shows him a particularly well-thought-out website for ordering goods. There is a search function with predictive text, which means he only has to type in the first couple of letters in order to find the right product. As well as this, he can use his previous orders as a template. Despite his learning difficulties, the young man is now able to order his groceries online.

These examples illustrate the use of universal design on the internet. They come from the Web Accessibility Initiative (WAI) of the World Wide Web Consortium (W3C). Similarly, usability professionals use the persona method to describe realistic requirements of different user groups. When products are to be developed for a wide range of users, it is particularly important to consider the possibility of functional impairments right from the beginning.

Including people with disabilities – the UN Convention

The "UN Convention on the Rights of Persons with Disabilities" came into effect in May 2008 and has since been ratified by numerous countries. According to this agreement, people with disabilities should be able to exercise their fundamental right to participate in society on an equal basis without restrictions. Society has an obligation to remove barriers in all areas of life, be it employment, education, politics or culture. The goal is an inclusive society in which people with disabilities are taken into account from the outset rather than being excluded.

Accessibility – access for people with disabilities

Disabled people should be able to use all facilities in the normal way, without any special access or isolated applications having to be created for them. No distinction should be made between different types of disability. The laws apply equally to physically disabled people, such as people with impaired vision or spasticity, and to people with learning difficulties or mental disabilities. What is required is a universal design that can be used equally by all people.

Universal Design – Usability for All

Universal Design, or Design for All, is accessibility seen from the viewpoint of product developers. The term includes all findings and procedures that can be used as a basis for developing accessible products, environments and information.

There are three stages to universal design:

1. Universal usability

The rules for accessible design are combined with the rules for good usability. Products can then be developed that are suitable for all users without restricting the target group in any way. This is the ideal goal; in practice, it will always be necessary to draw the line somewhere, even when every effort has been made to find a solution. This is because there are always limits to what is technically and financially feasible. In such cases, the two options below should be considered.

2. Adaptability

If the basic version of a product cannot be made accessible to all target groups, an option should be provided for individual adaptation. A typical example is the option of adjusting font sizes and colour contrasts to help people with visual impairment.

3. Interfaces for technical aids / assistive devices
There are target groups that are only able to use a product with the help of assistive technologies. Examples include a Braille display for blind people or a special keyboard for people with spastic paralysis of the hand. An accessible product contains interfaces to these devices and ensures that the overall usability does not suffer as a result.

If a product cannot be made accessible, even with assistive devices, people with disabilities will not be able to use it, or will only be able to use it with the help of another person.

Universal design is the process of developing products for the widest possible target group while reducing as far as possible the need for assistance of any kind.

II. All of us are the users

Accessibility legislation protects people with disabilities, but the benefits to society of universal design go far beyond that.

People with disabilities…

Reported disability prevalence rates from around the world vary dramatically, from under 1% in some developing countries to 20% or more in some industrialized countries. Several factors cause this variation, including differing definitions of disability, huge varieties in the severity of disabilities, different methodologies and purposes of data collection, and variation in the quality of study design.
The World Health Organization (WHO) estimates about 15% of the world's population live with some form of disability. This global estimate for disability is on the rise due to population ageing and the rapid spread of chronic diseases, as well as improvements in the methodologies used to measure disability.[1]

The international guide to defining what is meant by disability is the International Classification of Functioning, Disability and Health, known more commonly as ICF, by the World Health Organization. ICF is the WHO framework for measuring health and disability at both individual and population levels and encompasses the complex multifaceted interaction between health conditions and personal and environmental factors that determine the extent of disablement in any given situation.

Disability is caused by a wide range of interacting aspects, for example communicable diseases, genetic factors, injuries, aging, etc. Not all types of disabilities impact on the use of information and communication technology (ICT). People directly affected include those with visual impairments (blind and low vision), with dexterity impairments (e.g. reduced strength, reduced co-ordination, not being able to use fingers or arm), with cognitive impairments (e.g. dyslexia and intellectual impairments), and hearing impairments (deaf and hard of hearing).
It is also worth highlighting that the prevalence of disability rises with age, for example:

- European Union (EU28): Limitation in work caused by a health condition or difficulty in a basic activity by age group: Age 15–24: 3.5%; age 25–34: 5.4%; age 35–44: 8.3%; age 45–54: 14.2%; age 55–64: 23.1%.[2]

- Canada: Among children aged 0 to 14, 3.7% reported a disability, with this rate rising to nearly 11.5% among adults aged 15 to 64 and to 43.4% among persons aged 65 and over. In fact, more than half (56.3%) of persons aged 75 and over reported having an activity limitation.

- USA: Adults reporting disability:
18–44 years: Males 10.3%, Females 11.7%;
45–64 years: Males 21.8%, Females 25.9%;
65+ years: Males 45.3%, Females 56.5%.

...and other people

In German law for instance, disability is seen as a person's individual impairment. However, the UN Convention stipulates that disability arises from the relationship between a person and their environment. In an accessible environment, people with a functional impairment are not prevented from participating in society. On the other hand, it is not uncommon for people who are mentally and physically fit to be restricted by their environment.

- Environmental conditions can hamper people's ability to perceive information. Frequently, light reflection or glare make it difficult to read monitors on public terminals, such as on cash dispensers. When there is a lot of environmental noise, passengers in a bus are unable to hear the bus stop announcements.

- Protective clothing restricts the operation of devices. Doctors in operating theatres wear gloves, making it more difficult for them to use input devices, or, for reasons of hygiene, there are some situations in which they cannot use their hands to operate information technology.

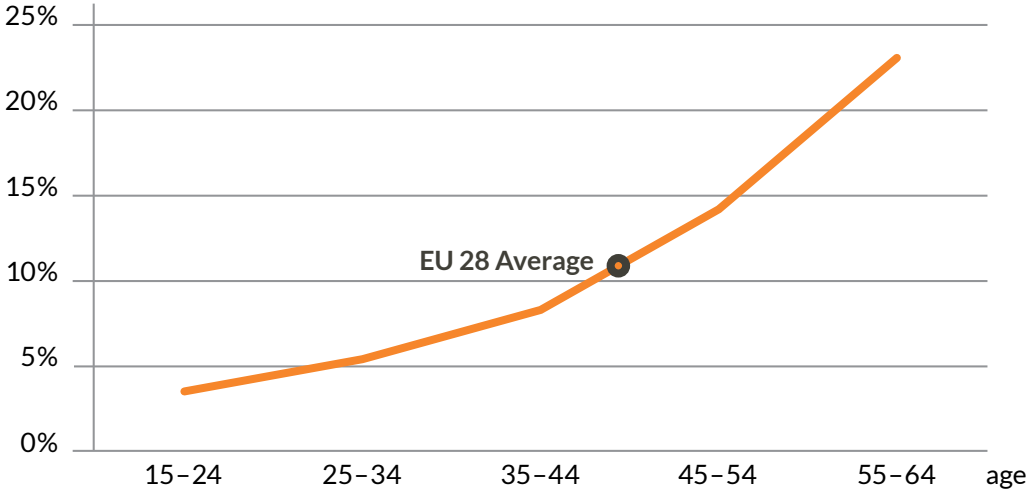
- People may be immersed in another, more important activity, for example, while driving. Using telephones and navigation devices while driving is a safety risk and is therefore strictly regulated.

- When tired or in a hurry, even well-educated people find it difficult to understand a complicated sentence structure.

The above are examples of areas of application that benefit from the findings and solutions that come from universal design. Products that can be used by people with disabilities are usually less physically demanding, less subject to error and more efficient for other users, too.

Disability can also be defined like this: "Disability is the inability to accommodate poor design." In other words, poor design that is insufficiently adapted to the requirements of the person, the situation and the task to be completed, represents a barrier and must serve as the starting point for making changes.

> ***„Disability is the inability to accommodate poor design."***
> **Prof. Gregg Vanderheiden, University of Wisconsin**

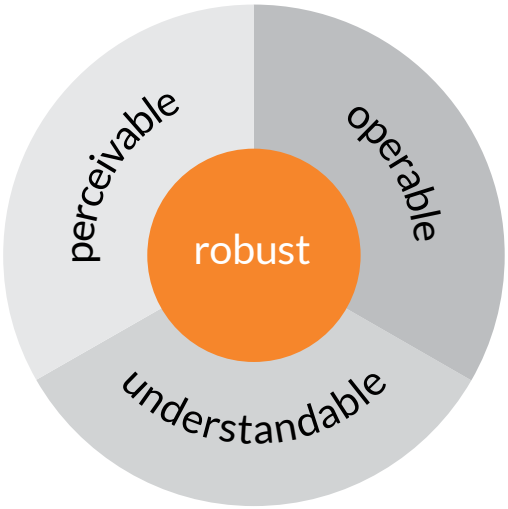


Percentage of people in the European Union (EU28) in 2011 facing limitations in work caused by a health condition or difficulty in a basic activity, by age group.[2]

1. **World Health Organization (2011):** World report on disability 2011. Available online at: *http://www.who.int/disabilities/world_report/2011/report/en/*

2. **EUROSTAT (2014):** Population by type of disability, sex, age and marital status (hlth_dp060). Data from 2011. Available online at: *http://ec.europa.eu/eurostat/product?code=hlth_dp060&language=en&mode=view*

What constitutes universal design? Which rules and procedures need to be considered? The design principles for the design of internet content have been succinctly formulated: internet pages should always be perceivable, operable and understandable, and need to be technically robust enough to allow their use with older machines or with assistive technologies for people with disabilities.



The four design principles: perceivable, operable, understandable, robust.

Several examples of requirements are presented below. The complete set of guidelines can be viewed under "Web Content Accessibility Guidelines (WCAG) 2.0".

Perceivable

Surfing the internet or using information technology primarily involves viewing graphically processed visual information on an output device. People with impaired vision are limited in what they can view; in some cases, they are not able to see anything at all. As broadband data access becomes more pervasive, more information will become available in a multimedia version, including aural information. This, in turn, creates problems for people with impaired hearing. Universal design guidelines help to guarantee the perceptibility of information for people with visual and hearing impairments.

Sufficient contrast

Sufficient contrast is essential for perceiving information. There are guidelines for the brightness of lettering in contrast to the background and for the volume of speech in contrast to background noise. The use of certain colours to highlight information can also be a problem. Red-green contrast or glaring colours mean that some people are unable to see the information. Visually impaired computer users often adjust the colours to meet their individual needs. To allow this, it is important that highlighting is not only coded as colour, but that additional features such as graphic symbols or semantic mark-up are available.

Not clearly legible: pieces of text are superimposed on each other when the font size is increased. Errors of this kind do not occur with a fluid layout.

Subtitles in films are beneficial for deaf people, but also help people to learn a foreign language.

Scalability

Clearly legible text requires an adequate font size. However, there is no general mandatory standard for font size as several additional factors, such as font style and contrast, also influence legibility. The visual acuity of each user is so different that all font sizes ranging from tiny to one word per screen may be requested. This is why it is better if the users can adjust the font size themselves. The situation is made more complicated by the large variety of browsers, monitors and assistive devices with which users view websites. In order to guarantee the scalability of internet pages, the technique of fluid layout is used in web design, which allows the flexible adjustment of all font sizes and monitor widths.

Alternative text

Text is the medium that makes information available to all users. When pictures are labelled, even blind people know what is in them. When videos have subtitles, deaf people are able to understand their content. Alternative text is the fall-back solution for information of all kinds, to make up for problems in perception. It is also important when optimising image and film media for search engines.

Clearly visible stop announcements in a tram

The navigation device is easy to use due to its large symbols. It is important that the menu levels are clearly structured.

Two channel principle

One rule of thumb for universal design is the two channel principle or multimodality: information needs to be accessible in several different ways and it must be possible to carry out an action in several different ways so the system will still work under difficult usage conditions. One example is stop announcements in modern buses, which are spoken and displayed in fluorescent letters at the same time. Likewise, alarms should never only be audible, but should also attract attention with a visual signal, such as a flashing symbol.

Operable

Information technology is interactive. As a rule, it is necessary to call up information from menus or to type it in with a keyboard. The classic pointing device is the mouse, which lately has been supplemented by touch screens and multi-touch devices such as tablet computers. The use of these input devices requires functioning limbs with both gross and fine motor skills such as steadiness, accuracy, speed, strength and a certain operating range. For users with restricted abilities, there is a wide variety of alternatives to the mouse, such as trackballs, keyboards with large keys, or head, eye and voice controls.

Keyboard accessibility

Internet pages and other software should be set up in such a way that allows them to be used with a keyboard only. This operating method is used by blind people and people with impaired motor skills; it is also the interface for voice input based on keyboard control. However, precision control of the keyboard is restricted in internet browsers; in most cases, people move from one link to another with the tab key. This causes a problem, particularly in large theme portals, when a page contains hundreds of links. Large conglomerations of links like these are made clearer by grouping the links and assigning them jump labels for direct access with the keyboard.

Error tolerance

People with disabilities often need more time to operate interactive systems. This is why it is important that a generous amount of time is allowed for completing online forms and, if the system ends the session, the data that has already been entered should not be lost. Clear instructions for use should also be supplied in order to avoid laborious error correction.

Understandable

According to a study conducted by the German charity "Aktion Mensch", the greatest barrier on the internet is created when content and navigation structures are not comprehensible. Understanding is a quality that greatly depends on the user's personal experience. The general design principles for software ergonomics, such as suitability for the task and conformity to user expectation, are an important basis for the creation of comprehensible websites. In addition to this, content can be made more easily understandable by the use of **plain, easy to read language.** Content should be written as clearly and simply as possible. The required reading ability should not be more advanced than the lower secondary education level.

The most important rules are that sentences must be simple, and should not contain more than one statement at a time. Also foreign words should be avoided. Necessary technical terms need to be explained, either the first time they appear or in the form of a glossary. Even for websites providing specific technical information, it is advisable to include, as much as possible, plain language for the general public.

Plain language

Clear and succinct writing helps to make language more understandable. All subject-specific information benefits from an introduction in plain language that is understandable by the wider audience. Plain language rules include using simple sentences with each sentence dealing with a single thought or subject. Technical terms should be avoided or, if essential and cannot be avoided, they should be explained the first time they are used or they should be included in a glossary. Unfortunately, there is no

standardized set of rules or specifications for plain text that can be used as an assessment tool.

Easy-to-read language

In specific contexts, in particular where people with learning difficulties are addressed, plain language is not sufficient. Easy-to-read language uses simplified grammar and content making reading and comprehension easier. Easy-to-read guidelines or instructions are available for many languages, such as, Inclusion Europe (16 European languages), People First (worldwide) and Leicht Lesen (German). Specialized translation bureaus offer easy-to-read texts as a service.

Sign language

In contrast to easy-to-read language, sign language aims at preserving the complexity of the information and at conveying it accordingly. Sign language acts as a foreign language; in fact it is the “mother tongue” of many deaf. Deaf people who have not learned a spoken language as children can also struggle with written information, as sign language has a completely different grammar. As a consequence, deaf people may require sign language for full comprehension of information. In some countries, sign language is an officially recognized language next to the community language(s) of the country.

Alternative versions of content

Using alternative language versions of a website, for example, for easy-to-read or for sign language information, is a borderline case of Universal Design.
As different versions are prone to inconsistencies or delays in information provision, their use requires careful consideration. In Germany, authority bodies are obliged to offer some basic easy-to-read and sign language information on their websites.

Technically robust

In the context of internet pages, technical robustness means that the pages can be used in all the users’ browsers and display devices. This includes older browsers, Braille devices and speech output as well, all of which should be able to reproduce a usable version of the content, even if precise graphic representations are not possible for technical reasons.

Standard-compliant programming

The standards for web pages are HTML for structured content and CSS for style sheets. The correct use of these standards is an essential foundation for the availability of the content on all devices. Likewise, it has advantages for the efficiency and cost-effectiveness of web development and is therefore already widely established on the internet.

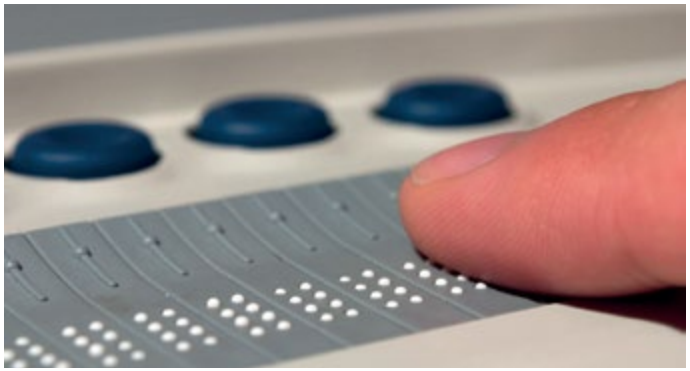
Semantic tagging

There are HTML elements for tagging the structural meaning of content elements: headings, paragraphs, accentuations, lists, tables, form fields. If these semantic tags are used correctly, the content is comprehensible even without graphics. Spoken versions can, for example, include an acoustic signal to indicate the start of a new chapter. The functional areas of a page, such as navigation, main content, and content in the margins, also have to be made accessible.

Support of assistive technology

Web pages programmed in semantically-correct HTML can be used with technical aids such as voice synthesis and voice control. Other internet technologies that are not standardised by W3C – PDF, JavaScript and Flash® – require this, too. In order to make PDF accessible, semantic tags are used in a similar way to their use in HTML. A mandatory standard for this is available in the ISO standard PDF/UA (Universal Accessibility).

As in programming technology, display units are also undergoing a swift technical development, which includes several innovative approaches for the implementation of accessibility. On the other hand, the assistive devices market that mainly consists of small and medium sized enterprises only reacts to innovations when they have become established as market standards. The iPhone® shows how this gap can be closed: it has its own integrated speech output and can therefore be used by blind people without the need for additional assistive devices.



The Braille display is an assistive device for using computers by blind people.

Many providers are taking new directions in the field of accessibility. The iPhone® as a multi-touch device has a built-in speech output, making it easier for blind people to use.

For several years, most countries have had regulations about equality for people with disabilities and how they can participate in society. The concept of accessibility is of central importance here.

Below we will present the most important international, American (USA) and European regulations, limited to general issues plus information technology and telecommunications.

International

On 3 May 2008, the "UN Convention on the Rights of Persons with Disabilities" came into effect. Since then, it has been systematically implemented by its signatories, which include most EU states, the Council of Europe and the European Commission. This agreement sets down in detail the rights of people with disabilities and the states' obligation to implement them in different areas of life. The signatories have to file regular reports on the stage of implementation they have reached.

A further internationally recognised document is "International Classification of Functioning, Disability and Health" (ICF), published in May 2001.

The international standards and guidelines also include:

- "Principles of Universal Design" (2.0), Center for Universal Design, North Carolina State University, USA, 1997
- "Web Content Accessibility Guidelines" (WCAG) 2.0, World Wide Web Consortium (W3C), 2008, published as ISO/IEC 40500:2012
- ISO 9241-171:2008 "Ergonomics of human-system interaction; Part 171: Guidance on software accessibility"
- ISO 9241-20:2008 "Ergonomics of human-system interaction; Part 20: Accessibility guidelines for information/communication technology (ICT) equipment and services"
- ISO 14289-1:2012 "Document management applications -- Electronic document file format enhancement for accessibility -- Part 1: Use of ISO 32000-1 (PDF/UA-1)"
- ISO/IEC Guide 71:2014 "Guide for addressing accessibility in standards", freely available at http://www.iso.org/guide71
  CEN/CENELEC Guide 6 is the European equivalent to Guide 71.

- ISO TR 22411:2008 “Ergonomics data and guidelines for the application of ISO/IEC Guide 71 to products and services to address the needs of older persons and persons with disabilities”
  This technical report is currently undergoing revision.

Despite their titles, Guide 71 and TR22411 are not only important for standards writers, but also for designers.

USA

In the USA, there are laws regulating the subject of accessibility. The Access Board, a government body, develops appropriate standards for accessibility and is responsible for ensuring these are made known and applied. Among the most important accessibility standards are the Section 255 guidelines regulating the accessibility of telecommunications products and services, plus the Section 508 standards regulating the accessibility of products and technologies acquired by government bodies, including computer hardware and software, internet pages, telephone systems, fax machines and photocopiers.

On the internet, a “Buy Accessible Wizard” is available as an additional mechanism for checking that Section 508 standards are being adhered to; businesses use a Voluntary Product Accessibility Template (VPAT) for the self-declaration of the accessibility features of their products.

The Section 508 and Section 255 accessibility standards are currently being reworked. The new version will be a combination of both Sections and will also be harmonized with the European norm EN 301 549 (see below).

Europe

Since 1999, there has been a systematic drive to create an “information society for all” through a progressive series of programmes on the theme of “e-inclusion”. The measures taken by the European Commission and the Council of Europe for the advancement of accessible solutions include the issue of directives that have to be integrated into national law within certain deadlines, and funded mandates to the European standardisation boards.

One of the most important projects was Mandate 376, completed at the end of February 2014, entitled “Standardisation mandate to CEN, CENELEC and ETSI in support of European accessibility requirements for public procurement of products and services in the ICT domain”. Its aim was to develop a coordinated mechanism throughout Europe, based on the US model, which makes accessibility a criterion for the awarding of contracts in public invitations to tender.

The results of Mandate 376 are the European norm EN 301 549: “Accessibility requirements suitable for public procurement of ICT products and services in Europe”, along with three technical reports listing applicable standards (TR 101 550), guidelines for the assessment of accessibility (TR 101 551) and materials providing instructions and support for public invitations to tender (TR 101 552).

In November 2013, work started on the new EU Mandate 473: “Standardisation mandate to CEN, CENELEC and ETSI to include “Design for All” in relevant standardisation initiatives”. The project is scheduled to take four years and is intended to establish the “design for all” approach in European standardisation procedures. For this purpose, suitable recommendations will be developed, topic areas prioritised and selected standardisation projects supported and observed. In addition to this, a document is to be developed that will support businesses in integrating “design for all” during the product development process.

The above-mentioned mandates are connected to the European strategy, which started in 2010, for the benefit of people with disabilities 2020: “Renewed commitment to an accessible Europe”.

In March 2014, the EU directive 2014/24 was published, which newly regulates public procurement law and now includes accessibility as a procurement criterion.

Before the end of 2016, a European directive on accessibility of internet pages is expected. Regardless of the provider, this will apply to websites that are of particular interest to citizens (e.g. health insurance or tax returns). Two drafts are already available.

A proposal of a “European Accessibility Act” has been published in December 2015. It sets down wide-reaching standardisations in disability law.

V. Practical ways to implement accessibility

More often than not, when it comes to developing an accessible project, accessibility experts are not called in until it is too late. Accessibility cannot be implemented successfully on every platform so it needs to be considered when the software architects make the initial system design decisions. As a rule of thumb, accessibility becomes expensive and inadequate when it is to be "tested into" a finished product. If, however, the requirements of people with disabilities are taken into consideration right from the start, accessibility does not incur any additional costs.

Accessibility in Human-Centred Design

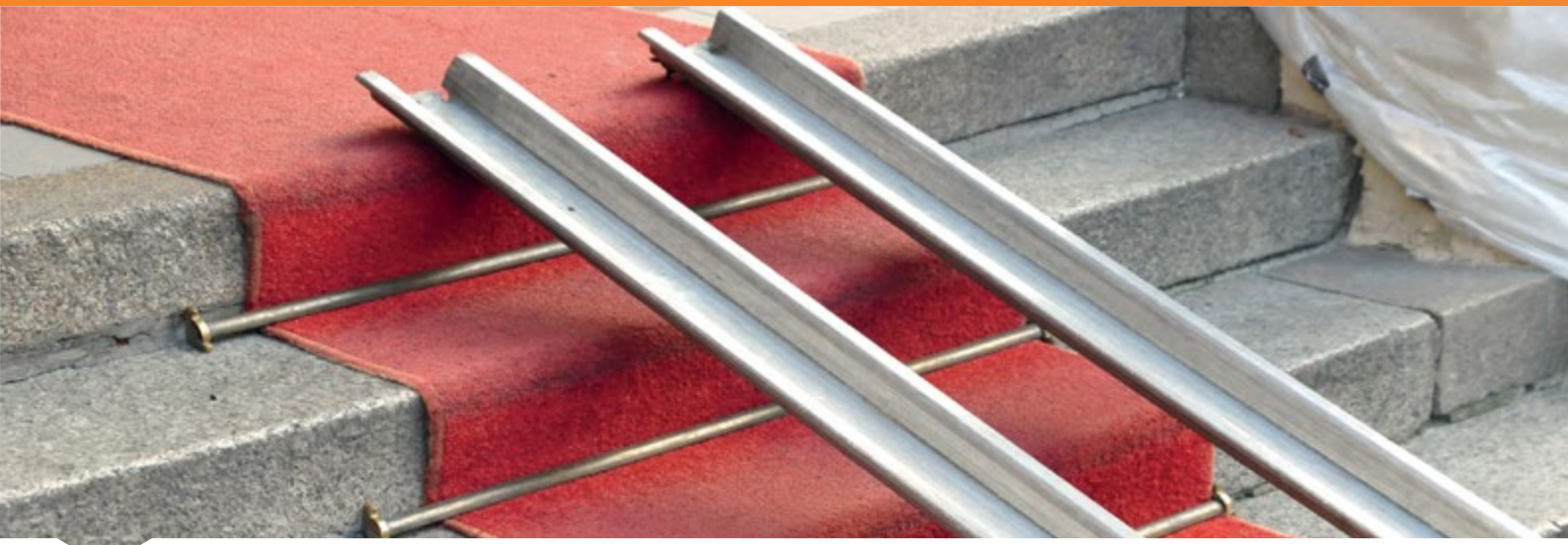
The goal of Human-Centred Design (HCD) is to develop usable products. To achieve this, the potential users are closely involved in the development process. User requirements are determined in an iterative process, implemented in product designs and honed after a user test until the solution fulfils all the requirements. This process is described in the ISO Norm 9241-210.

Accessibility is part of the user requirements. Integrating accessibility into an HCD process means taking into account the largest possible user group and an extended context of use. The extent to which users with disabilities should be included in the development process needs to be evaluated for each case.

Understanding requirements

At the start of the HCD process, the user requirements collected relate primarily to the detailed technical concept. The subject of disability constitutes an extension of the context of use. It is important to identify which functional restrictions are relevant for the use of the application.
In the case of a public information system, all user groups have to be considered, whereas graphics software can seldom be used by people who are severely visually blind or impaired. An accessibility expert can help answer these questions.

A detailed specification of accessibility requirements is not normally necessary, or can be covered by referring to the various guidelines. In some situations it does make sense to involve disabled users even at this phase of the development process. For many projects, a project group with no experience of universal design can rely on personal viewpoints in order to gain a better understanding of how people with disabilities work with a product. One exception is pilot applications in which the techniques of accessible design have not yet been explored, like currently dynamic web applications. In this case, the participation of disabled users is important to obtain best practices.



Creating accessible design solutions

Web designers and software developers need expertise in the practices of accessible design, most of which they can learn from published tutorials and sample solutions.

During the iterative development process, interim solutions are often verified in user tests. The inclusion of people with disabilities during this phase only makes sense if the interim solutions are also accessible. This is usually not true for initial drafts, such as diagrams and prototypes.

Testing goal attainment

Two classes of evaluation methods can be used to evaluate any design solution: expert-based procedures and procedures with user participation. Accessibility is also tested with comparable methods. In the case of web pages, a large part of the requirements can be covered by applying WCAG 2.0 techniques, e.g. the German BITV test which consists of detailed instructions for the expert test. If people with disabilities are used as testers in usability tests, special provisions have to be made. It is important to ensure that assistive technology is installed at the test work stations and that the testers are familiar with the respective aids.

Experience has shown that evaluation approaches that are only expert-based or based on a simulation of disability deliver poorer results than approaches that include people with disabilities throughout the whole HCD process.

How accessibility can be integrated into Human-Centred Design:

- **The existing usability guidelines are expanded to include accessibility requirements.**
- **User research incorporates all groups of users, including users with disabilities.**
- **Work processes also incorporate the use of assistive technologies, e.g. screen magnifiers.**
- **Various usage strategies are incorporated, e.g. computer operation with the keyboard only.**
- **Usability tests are also carried out by people with disabilities.**

Methods and tools

Methods and tools for the accessible design of information technology are at different stages of development. While there is a large range of resources for the design of accessible websites, resources for dynamic web applications are still at an early stage. Likewise, there is still a long way to go when it comes to the accessibility of classic, non-web-based computer programs.

Accessible internet

The World Wide Web Consortium (W3C) compiles standards and guidelines for the internet. The Web Accessibility Initiative (WAI) is the group responsible for accessibility and includes additional subgroups. Among other things, the WAI compiles the Web Content Accessibility Guidelines (WCAG), which deal with the content of a website, and the Accessible Rich Internet Applications Suite (WAI-ARIA), which addresses dynamic web content.

An extensive range of open source tools makes it easier for web designers to integrate accessibility during production. Browser add-ons that can be used easily are recommended.

Recommended tools for testing:

- Web Accessibility Toolbar for Internet Explorer – *http://www.visionaustralia.org/digital-access-wat*
- Web Developer Toolbar – *https://addons.mozilla.org/en-US/firefox/addon/web-developer/*
- Juicy Studio Accessibility Toolbar – *https://addons.mozilla.org/en-US/firefox/addon/juicy-studio-accessibility-too/*
- Firebug – *https://addons.mozilla.org/en-US/firefox/addon/firebug/*
- W3C-Validator – *http://validator.w3.org*
- Colour Contrast Analyser – *http://www.visionaustralia.org/digital-access-cca*
- PDF Accessibility Checker (PAC 2) – *http://www.access-for-all.ch/en/pdf-lab/pdf-accessibility-checker-pac.html*

Dynamic web applications

While procedures for the accessible design of information websites are already relatively advanced, dynamic web applications are currently just starting out. Applications such as online editors or route planners on the internet present several challenges for the development of an accessible user interface.

Dynamic web applications have the task of transferring the complexity and comfort of use of classic computer programs to the generally available platform of the internet browser. Conversion processes that would otherwise be delivered by the server are performed directly in the browser through JavaScript and AJAX. This results in several weak points that can become critical when assistive devices are used.

New control elements

Control elements such as scroll bars, which are not included in the HTML form set, have to make their function recognisable to assistive devices.

Complexity

Frequently, the only way to clearly structure a wide range of interactive elements is by showing and hiding them at different layers. Devices that only display a small section of the screen require additional aids to orientation.

Reloading information

The static concept of the web page creates restrictions for dynamic content, e.g. the browsers' back navigation does not work for dynamic changes. Screen readers have to observe changes in the screen content and notify the user, either immediately or upon request.

Keyboard operation

Internet browsers offer only a limited set of keyboard commands. However, complex applications require fine control that has to be realised with JavaScript.

WAI-ARIA supplies solutions for these specific challenges that come with dynamic web applications. Accessible Rich Internet Applications (WAI-ARIA) 1.0 is a W3C standard with add-ons for HTML/XML and JavaScript for adapting web applications to assistive technology devices such as screen readers. Some JavaScript frameworks, especially jQuery and the Yahoo User Interface Library (YUI), are working to make accessible JavaScript routines available.

There are also applications in Flash® and Silverlight® named Rich Internet Applications (RIA) that offer an easier-to-operate alternative to HTML and JavaScript. These platforms claim to be suitable for accessible design but are not accepted to the same extent as the W3C standards by the "accessibility community", i.e. the community of dedicated developers. These "web standards" are being further developed. There are solutions for many dynamic functions in HTML5, CSS3 and JavaScript already available that could previously only be realised in Flash®.

Accessible computer programs

It does not take a huge amount of additional effort to design accessible desktop applications, as long as provisions are made early in the development process. The most important preliminary decision is the choice of a platform that is suitable for use with assistive devices. In the past, the manufacturers of such aids have concentrated on Microsoft Windows® and have delivered scripts for all applications in that operating system. The support for other platforms is less developed.

The guidelines for accessible computer programs are set down in the ISO Norm 9241-171. The IBM checklist for accessible software provides practical assistance, being based on the older US guideline section 508. As a general rule, the same requirements apply as those described for web applications in the WCAG guidelines.

Each manufacturer of platforms and programming languages provides instructions for the integration of the accessibility regulations in its products.

Basic requirements for accessible computer programs:

- adherence to the operating system standards for user interface elements, and disclosure of the user interface elements to be recognizable by assistive technologies
- compliance with the accessibility options of the operating system (font enlargement, contrast mode)
- operation of all functions using only the keyboard
- accessible documentation

Very little support is available through automatic tools for testing the accessibility of desktop software. The test basically consists of operating the software with the keyboard, with the operating system's accessibility options and with assistive devices. An efficient, reliable test procedure is based on task oriented usage scenarios. Experts should be called at the test phase at the very latest. These can be external accessibility experts, supported by disabled users, particularly blind and visually impaired people, who can test the software with their technical aids.

Points to note when testing desktop applications:

- **Test typical usage scenarios from beginning to end, using all technical aids.**
- **Is the focus always clearly visible in dialogues?**
- **Does the tab order make sense when navigating by keyboard?**
- **Are all interactive elements perceptible?**
- **Test whether the operating system's accessibility options can be used in their entirety.**

VI. Universal design is profitable

Accessibility is an issue that concerns all of society but is frequently regarded as a matter for the authorities to deal with. Industry is rather reserved on the subject; during initial discussions, many employers tend to dispense with accessibility for financial reasons. However, this is a short-sighted way of thinking. Even small software manufacturers and online information providers profit from making their production accessible. For online shops in particular, there is significant evidence of the advantages of accessibility.

Image boost

There are now several large German companies that have chosen an accessible internet presence, such as the Postbank, the Deutsche Bahn (national railway) or Manufactum, a mail order company. They consider an accessible website a clear indicator of customer orientation and trustworthiness.

More visitors

An accessible website can tap new customer groups. The hit rates have made this simple to prove. In a recently published Austrian study, following the accessible relaunch of an online shop, there were 6% more visitors, 22% more returning visitors and 43% more page hits per visit. These figures demonstrate above all that the visitors made more thorough use of the online shop.

Increase in turnover

The Royal National Institute of the Blind in the UK (RNIB) has supported several companies in the accessible relaunch of their website and assessed the resulting commercial success. In addition to higher hit rates and an increase in search engine activity, they were also able to demonstrate a higher conversion rate, in other words greater success for the website. The turnover of one online shop was increased by about 4% through a simplified product search and optimised procedure for placing orders.

Reduction in costs

Accessible websites are programmed to comply with standards. This results in light-weight pages that load quickly and require lower storage capacities and bandwidth. The NetBank registered a reduction in data traffic by 25% due to the accessible relaunch of its website; the city portals of Hamburg and Vienna recorded similar values. For websites with heavy traffic, the savings in running costs are considerable.

Higher return on investment (ROI)

More visitors, higher turnover and lower running costs balance out the higher initial investment for an accessible website. The British supermarket chain Tesco and the insurance company Legal & General have demonstrated that the investment in accessibility pays off in the form of a higher ROI.

The accessible design of internet sites and web applications helps both users and providers to achieve their goals. A clear presentation of information, plain, comprehensible language, clearly legible information and perceivable aids increase accessibility and usability for the user. For the provider, this means more satisfied users, a positive image and, above all, a larger market for products and services. Surveys and case studies clearly show that universal design has a positive effect on the commercial success of an application.

Accessibility is beneficial for everyone.

VII. Further reading

Recommendations for further reading:

- W3C-WAI, Introduction to "How People with Disabilities Use the Web".
  http://www.w3.org/WAI/intro/people-use-web

- W3C-WAI, Easy Checks – A First Review of Web Accessibility
  http://www.w3.org/WAI/eval/preliminary
  Simple evaluation procedure in 5 steps to test websites.

- Accessible Information and Communication Technologies: Benefits to Business and Society.
  http://www.onevoiceict.org/node/101
  This report from March 2010 contains numerous case studies and success stories from Great Britain.

- "Just Ask: Integrating Accessibility Throughout Design" by Shawn Henry.
  Publisher: Lulu.com, February 2007
  http://www.uiAccess.com/JustAsk
  Basic knowledge for the integration of accessibility in the different phases of the Human-Centred Design process.

- "A Web for Everyone – Designing Accessible User Experiences" by Sarah Horton, Whitney Quesenbery
  http://rosenfeldmedia.com/books/a-web-for-everyone/

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Harald Weber is deputy director of the Research Institute of Technology and Labour (ITA) in Kaiserslautern. He also works as a project manager at the European Agency for Special Needs and Inclusive Education (Denmark). His interests include Inclusive Design and Design For All, usability and accessibility, and the use of information and communication technologies, particularly in the application areas of education and work.

Markus Erle is head of Wertewerk, an agency that has specialised in accessibility for the web and for PDF, and is a several-times winner of the BIENE AWARD. He is a member of the BIK 95plus group and a supporter of the Action Group for Accessible Information Technology. He shares his knowledge as a consultant, project manager and trainer. He is also the author of the axesPDF blog and the chapter "Implementing and testing PDF" in the standard work "Understanding and implementing accessibility" (Heidelberg 2011).

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Working group for accessibility in the German UPA

In the working group for accessibility of the German UPA, we represent the interface between accessibility and usability.

On the one hand, we are experts in accessibility who provide information about accessibility to usability professionals. This is because accessibility needs to be considered as a requirement in human-centred design from the outset, and cannot be "tested into" a software program or a website at a later stage. Accessibility means added value for everyone, not just for marginal groups.

On the other hand, we are usability professionals who represent the subject of usability, for example the human-centred processes and generally applicable usability principles, vis-á-vis the accessibility experts. After all, accessibility alone is not enough if there is no usability to go with it.

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Journals by the German UPA
Published by German UPA e.V.

Volume II – Accessibility – Universal Design
Report by the accessibility working group

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Published by:

Contact:
German UPA e.V.
Leitzstrasse 45
70469 Stuttgart, Germany

Date of publication:
First German edition September 2010.
Third revised German edition September 2014.
English edition published: April 2016

This journal is available as an accessible PDF version in compliance with WCAG 2.0 AA and PDF/UA on the accessibility working group's web page.

German UPA e.V.
Leitzstraße 45 | 70469 Stuttgart
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