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## **Improving library services to people with print disabilities: the role of technology in public libraries**

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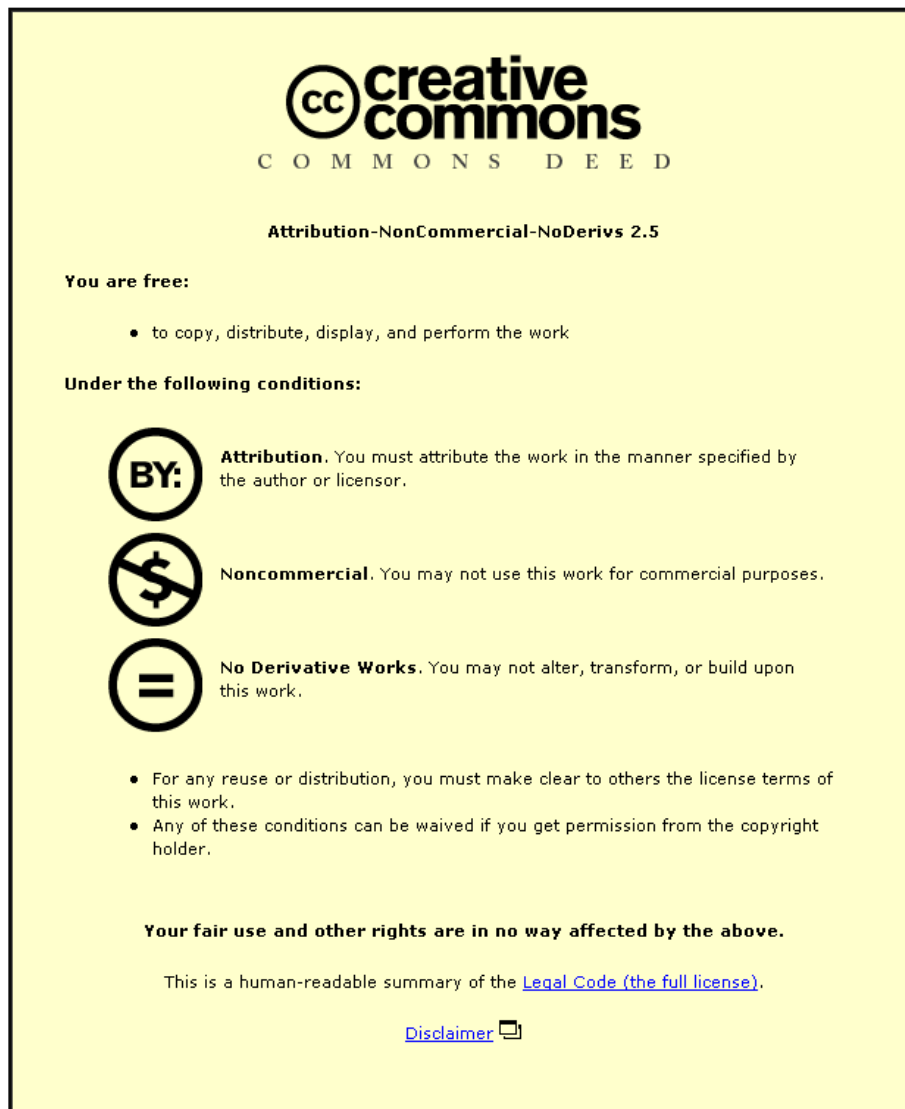
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# Improving Library Services to People with Print Disabilities – The Role of Technology in Public Libraries

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## **Introduction**

Traditionally, the term “library” refers to a collection of books and journals. However the ready availability of books, journals, papers, maps, artwork and other formats in libraries today allows the user to access a vast amount of information. This is further increased by electronic technologies that enable information to be stored in a range of formats. In this respect, the library is a tremendous source of information. Public libraries are the primary source for information queries from users with disabilities. To ensure that they can continue to provide this function, librarians must constantly address both the barriers that people with disabilities face when accessing information and the tools available to help people overcome these barriers.

## **Background**

Public libraries have a long tradition of providing services to disabled people. In 1857, one of the first organisations to provide books for blind users was Liverpool’s public library. Two decades later, alternative embossed formats including Braille were made available in public libraries. As a counterpoint, services to housebound individuals became available only after the Second World War. Hence, it can be suggested that different formats were available for disabled users well before accessibility to the material became a mainstream issue.

## **Print Disability Defined**

*Disability: (n) A disadvantage or deficiency, especially a physical or mental impairment that interferes with or prevents normal achievement in a particular area.*

To understand the concept of disability it is of prime importance to first define the terminology used. Generally people are confused by the terms impairment, disability and handicap and often use them interchangeably. The World Health Organisation (WHO) originally produced a classification of the terms in the form of the International Classification of Impairments, Disabilities and Handicaps (ICIDH) (the three key words in the name have since been replaced by the less politically charged “functioning, disability and health”).

- “Impairment” is a deviation from the generally accepted norm of the body function and structure as a result of a loss or abnormality. The “body function” defines the physiological and psychological functions of the body. The “body structure” includes the limbs and organs.
- “Disability” describes the inability to perform daily tasks and activities as a result of impairment.

- “Handicap” defines the social disadvantages to a person as a result of an impairment or disability. The term "handicap" stems from the ‘hostile social environment’ suffered by a person with a disability. Because of numerous negative historical connotations, the term handicap is not readily used, however.

Thus, persons with a print disability are those who are unable to perform the daily task or activity of reading standard print materials. These people would have an impairment preventing the use of standard print.

It can be argued that to identify one particular type of disability and to discuss the common requirements may lead to pigeonholing and negating other important factors. However, print disability focuses on resolving issues related to the disability, and as such does not make assumptions about underlying impairments. In literature, users with sensory impairments (i.e. visual impairments), other physical impairments, and cognitive impairments such as dyslexia are identified as users who have difficulty with traditional print. Their numbers are significant—for example, in the United Kingdom dyslexia affects between 4% and 10% of the population [1].

## **International Survey Of The Number And Type Of People Who Cannot Use Traditional Print Because Of A Disability**

As people get older, they are more likely to have a disability. Visual impairments represent the greatest disability group and the group that as a whole most needs alternatives to traditional print. WHO estimates that in 2002 there were 161 million people with visual impairments, of whom 37 million were blind. The organization projects that by 2020 this number will have increased to 76 million. That amounts to a possible 76 million people who will not be able to use traditional print—excluding people who cannot use standard print for reasons other than visual impairment. For this reason, it is essential to make information available in different formats and to ensure that both current and potential library users are included.

## ***Alternative Formats***

Libraries were originally places that stored physical materials, mainly books and journals. Now most libraries, especially public libraries, provide a one-stop shop for information contained in a multitude of formats ranging from traditional print books to CD-ROMs, printed journals, online journals, and others.

People who could not use traditional print can use many of the electronic resources now available, and alternative formats have been developed to facilitate access to print materials. The following sections describe three of the main alternatives to standard print.

## **Braille**

Braille [2] is a form of tactile communication used mainly by people who are blind or have very low vision. Today, Braille has two different meanings. It can either refer to a Braille alphabet, a set of characters or cells designed for reading by touch or to one of the many Braille codes. Sixty-four unique dot combinations are possible with a six-dot Braille cell, where one particular combination is blank and is used as a space. Braille symbols are a Braille cell or a sequence of Braille cells that have a single meaning. An

example of a Braille symbol is two cells that create an uppercase letter. Braille dot

patterns are the arrangements of dots that make up a particular cell. The most commonly used method of describing a dot pattern is to list the position numbers of the dots. Extended Braille character sets frequently use 8 dots. A single 8 dot cell can be used to replace a standard 2 cell symbol. Another example of an extended Braille character set is the Dot Plus that uses either 6 or 8 dot cells as well as other tactile symbols.

Braille cells have no universal meaning. The meaning depends upon the particular Braille code and the local context in which it is being used. Braille codes are described as ‘elegant, concise and very human systems’ used for transcribing printed material using a Braille alphabet. Braille

codes are similar to computer codes as they are “a system of symbols given certain arbitrary meanings and used for transmitting messages requiring brevity.”

Louis Braille, a young Frenchman, developed Braille in 1829 at the age of 20 [3]. Braille had been accidentally blinded at the age of three and attended a school for blind children in Paris. At the age of 11 he was introduced to a tactile code developed to allow soldiers to communicate in dark or smoky conditions. The code was based on a twelve-dot cell, 2 dots wide by 6 dots high. A combination of dots stood for a letter or a sound. Braille adapted the code and, by reducing cell size from 12 to six, enabled the fingertip to completely encompass the cell. This allowed the reader to gain an impression of one cell and then quickly move to the next. Braille continued to refine his writing system until his death



Figure: Letters in Standard Braille are formed by a combination of six raised dots [4].

Historically, Braille has been written using a stylus and slate or on a typewriter-like machine called a Brailler, which has six keys representing each dot in the cell. This in itself can be restricting as it cannot produce 8-cell or extended Braille. Today, people also can use computers to produce Braille.

Barriers to Braille use include the time needed to learn the code; age-related decreases in fingertip sensitivity that can make it hard for older people to read Braille; and a lack of available Braille materials, especially in developing nations. Hence, not all people who are blind or have serious visual impairments use Braille. Instead, they rely on a range of assistive technologies, from talking books and screen readers to screen magnification.

## Talking Books

Audio outputs in the form of recorded or synthesized speech have made it easier for people with print disabilities of all kinds to access information. Prior to the invention of synthesized speech, audio recordings, large print and Braille books were the only method for the visually-impaired to access reading materials. Producing each translation was time-consuming and impractical for many ephemeral or special-interest materials.

However this changed with the development of synthesized speech. While synthetic speech has been available for some time, the transition to digital information gives it even more promise. The Digital Accessible Information System (DAISY), is a standard format that breaks down text into chunks and uses screen reading software to read the words on the computer screen.

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A DAISY book can be explained as a set of digital files that includes:

- One or more digital audio files containing a human narration of part or all of the source text;
- A marked-up file containing some or all of the text (strictly speaking, this marked-up text file is optional);
- A synchronization file to relate markings in the text file with time points in the audio file; and
- A navigation control file which enables the user to move smoothly between files while synchronization between text and audio is maintained.

The DAISY standard allows the producing agency full flexibility regarding the mix of text and audio ranging from audio-only, to full text and audio, to text-only.

There are 14 Full Members of the DAISY Consortium, more than 55 Associate Members, and more than 20 Friends.

- Full and Associate Members are nonprofit organizations, typically national talking book libraries or national consortia of such libraries.
- Friends are for-profit organizations including developers of production and/or playback hardware or software;<sup>1</sup>

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When incorporated into computer software, DAISY enables users to scan books and have them read back to them by a synthesised or recorded human voice. The user is able to adjust the speed at which the text is read out, to place bookmarks and to move forwards or backwards through chapters at a touch of a button.

## **Electronic Materials**

The digital age has seen a transition from traditional print, large print and embossed formats to electronic methods of accessing information. Electronic access ranges from access to the Internet, CD-ROMs, online journals and e-Books, e-Music and other online services. Many public libraries are now offering portals which users can search for e-

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<sup>1</sup> [http://www.daisy.org/about\\_us/default.asp](http://www.daisy.org/about_us/default.asp)

Books. They can download the results and read them using a screen reader, output them to a refreshable Braille display, or have them read at leisure.

Reference materials also are available in electronic format. The importance of having dictionaries, thesauri, encyclopedias and other materials available online is highlighted by James and Litterick [1]. They believe that by conducting computer-based searches, users will not have to worry about the spelling of words (which is a problem faced by some users with dyslexia) and will be able to traverse many documents and media sources with a single search, retrieving more and more relevant information.

## ***Technology Adoption - The Accessibility Cycle***

Many mainstream technologies are developed for the “average” person. Being mostly usable by most people can go a long way to ensuring success in the market place. Unfortunately, the needs of people with disabilities often are not average—and there are inevitably some technologies they cannot access.

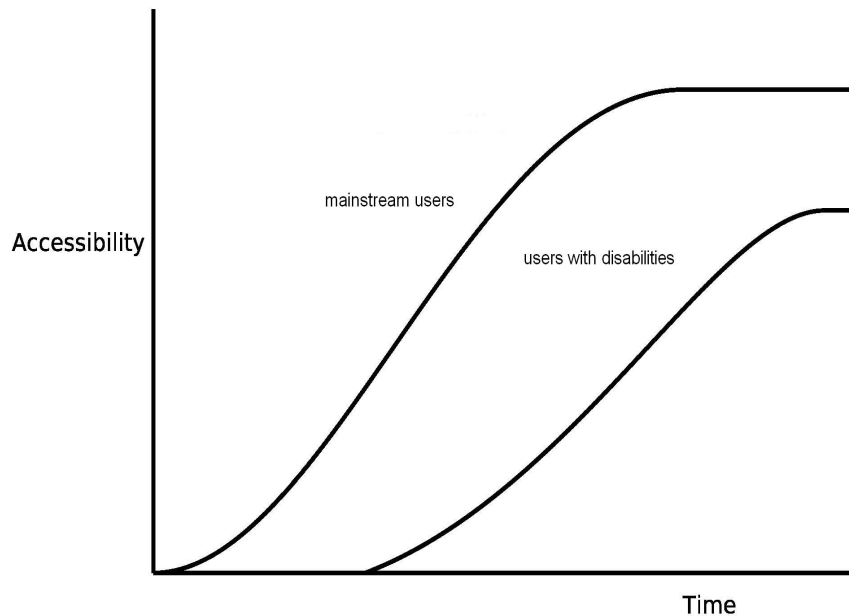
There are two common ways to get around this problem. They are retrofitting technology and using adaptive technologies to make otherwise inaccessible information available.

### **Retrofitting**

The most common approach is retrofitting some form of accessibility system on top of the mainstream technology. This often exposes most of the essential functions of the underlying technology but frequently limits the scope of what the disabled person can achieve due to assumptions made during its design (for example the “accessible” Digital Radio, whose buttons can be easily used, but is unable to read out text sent from the radio station to a blind user).

By retrofitting an existing mainstream technology, it can be kept current and made accessible to a wider audience of users. Though there are some significant disadvantages to this method (which will be discussed later), it can be the most effective and easy-to-implement approach in some situations. In many countries and jurisdictions there is a legal requirement for some technologies to be made accessible [5,6], so retrofitting is a common practice. Large organisations favour it because it enables them to continue using the toolset and processes they currently employ. Development of accessibility improvements is usually considered when the user base of a given technology, such as the print book, personal computer or World Wide Web, reaches a critical mass. The effect of this is that there can be a significant time lag before a system is rendered accessible to users with disabilities. As the technology eventually becomes obsolete and is replaced by newer versions, most users can move on, but people with disabilities often have to wait because the new technology is not yet accessible.

Figure: Moore's graph of technology adoption demonstrates the lags involved for people with disabilities.



### ***Using Adaptive Technologies for Print Materials***

There are alternative physical media to standard print. These include large print, Braille and talking/audio books. Their advantage is that no extra equipment is necessary to adapt them to their target users. Their disadvantage is that they can be expensive to produce.

To augment these alternatives, a range of solutions is available to enable access to print material. Most of them can be effective, especially when a library has a large number of patrons who could make use of such technology and/or access is sought for general reading material. If, however, more specialist access is required, less traditional methods may need to be used.

Many users may be able to access traditional print material through the use of extra equipment. A large range of such support equipment exists, with great variation in terms of technology level, cost and effectiveness for given groups of people. Examples include:

- Coloured films placed over the printed page may enable some dyslexic patrons to read the text.
- Simple lens magnifiers can help moderately vision-impaired people decipher text.
- CCTV-based magnification devices are suited for stronger vision-impairments due to the range of magnification and image manipulation options on offer.
- Scan-to-Speech systems—either dedicated hardware devices or a combination of Optical Character Recognition (OCR), Text-To-Speech (TTS) and/or screen magnification software—provide multiple options and are suitable for people with a broad range of print disabilities.



- Electronic file delivery in a flat ASCII (or Unicode) format allow users who have their own adaptive computer systems to use the output method they prefer.

An important trend to note, which also applies in other areas of accessibility, is that as we move down the list of devices above, their cost and complexity increase, they target users who are further from being able to access printed material and their effectiveness in specialist situations can fall.

Though these limitations may not be a problem in some general areas and the cost of high-technology solutions could be justified by numbers of patrons willing to use them, they may still not be appropriate. In the case of specialist publications, particularly scientific or mathematical ones that contain formulae, the Scan-To-Speech solution is almost useless due to the lack of technology to convert mathematical equations into an accessible form.

#### Example -- Reading a Newspaper

Consider low-vision readers, familiar with the page-layout concepts used by newspapers, who want to read a newspaper that is not available electronically. We can surmise that some form of magnification would enable these patrons to access the material almost as effectively as their sighted counterparts. They are familiar with the flow of text on the page and most will be able to benefit from the inclusion of images. However, a user who must convert the printed articles to Braille text or speech could have great problems, even with the newest technologies. OCR software is improving at recognising the layout of pages, particularly when only two or three columns are used and the input material is of high quality. Unfortunately, the bridging of OCR and Text-To-Speech technology is not currently as successful and often results in errors being introduced. It is quite common for such systems to read across columns and captions for figures, rather than down columns. It is also important to note that figures, illustrations, and advertisements are almost certainly inaccessible to the reader and, as the medium is aimed at sighted people, no alternative textual description is provided.

It is important to bear in mind that this area is an example of a very common trend: the more “bridging” a retrofitted access technology has to do, the more likely it is to be complex, costly and effective only in general areas. It is quite possible it could be of great use, but this depends upon the size and nature of the intended user-base.

## ***Adapting Electronic Information***

Many people assume that electronic information, by its inherent nature, will be universally accessible. There are good reasons why this should be the case, but all too often it is not. In this section, we have selected three popular formats and explain how their usability, accessibility and potential legal issues interact. The important thing to note is that though these are specific technological examples, the situations they typify are common and can be more broadly applied.

### **PDF**

The Portable Document Format, used extensively by the publishing industry, is a close electronic match to printed material. As an electronic format, it can be magnified and manipulated to a certain extent. However, problems inherent in how PDF is designed prevent most print-disabled people from using it effectively [7]:

- Vision-impaired users who already use screen magnification to view the computer must cope with two independent levels of zooming and panning on the screen. The access software shows only a portion of the entire screen on the monitor; panning is used to view the rest of the image. In a PDF-viewing application, zooming may be used to show a given area of the page at once, with scrolling

features to move about the (virtual) page. A screen magnifier user would have to accommodate both of these levels of zooming and panning – a cumbersome and somewhat tiring activity.

- As PDFs use what are essentially line and curve drawing instructions to render the text and many graphical elements, they are not recognisable as text by screen readers. This means that people who rely on Text-To-Speech will not be able to access most PDFs. A large number of PDFs are created by scanning in a printed work as a series of images. Naturally, these suffer from similar accessibility problems as well as a general loss in quality compared to documents initially created electronically.
- Due to Digital Rights Management (DRM) and other edit and copy-protection measures incorporated into many PDFs, there are few workarounds (such as “copy and pasting” into a Text-To-Speech system) that could be used to extract textual content and increase accessibility of these documents, even when the material is coded as text.

Fortunately, some of these drawbacks are being worked on. One driving force is that some governments are searching for an open standard format for information dissemination to the general public and PDF currently seems to be the de facto standard. Developments such as “tagging” (where textual content is included in such a way that screen readers may access it) are improving accessibility somewhat, but they still suffer from layout issues and the fact that awareness about such problems is very low.

This example goes to further demonstrate the points made above in relation to how some seemingly new technologies' adoption can cause accessibility barriers to increase, especially when it stems from a former use in areas where accessibility was not a concern—in this example, the use of PostScript technology (upon which PDF is based) in the publishing and printing industries.

PDF is an example of an electronic format that poses as many accessibility challenges as its physical counterpart. By forcing the use of traditional metaphors (such as the breaking of documents into pages), we negate the potential of computer systems to help us locate and present information in the way that is most suited to each individual patron.

## **Plain Text**

Something that could be seen as an opposite of PDF in terms of accessibility is the plain text document. This is a format that lacks almost all methods for providing formatting, graphics, pagination, predictable or fixed wrapping of lines and other contemporary design techniques. All of these qualities make it an excellent format for presenting information accessibly to vision-impaired and particularly blind patrons. Users can choose which font, colours, and/or Braille translation method is most appropriate to them. They can search for text and reformat the document to ensure lines are of an acceptable width if they so desire.

Many of these same qualities, however, are the well-established reasons for plain text not being a mainstream format for disseminating information. The lack of images, security

and authenticity of information, and concerns about illegal distributions are the principal issues for most authors.

## Web-Based Formats – HTML and XML

Unlike other formats for dissemination, information provided on the Internet (in this example we discuss formats such as HTML and XML) is often freely available and in many cases does not attempt to remain analogous to paper-based material. Key implications of this are that text size and layout are more fluid, and documents can easily encompass many different modalities (including text, sound, video, images, and interactive elements). Further, information from disparate sources is easily searchable; documents in related areas are often densely linked and information is often changing and being updated.

There are many tools on offer—a significant number of these being free and open for everyone to use—to assess the accessibility of websites and give feedback on how this can be improved. A discussion of the particulars is out of the scope of this work, but the fact that web accessibility does not have to be a large burden to the competent web designer is an important one to make.

Based on the discussion above, most of these qualities may seem ideal for both “average” users and people with print disabilities. However, while there is great potential for improvement in future, there are currently two especially serious barriers to accessibility.

- Many sites are designed poorly, using deprecated design techniques, platform-specific conventions and complicated or inconsistent layout and navigation schemes. These issues affect everyone but significantly increase the time it takes for people using adaptive technologies to find the information that they are looking for.
- A growing number of sites now require the use of “plug-ins” to view content – content that in most cases could have been easily created using techniques compliant with web development standards. When non-standard methods of presenting content are used, the chance that a presentation is accessible decreases significantly. The use of animations, video and some types of “applet” technology almost ensure that a person using adaptive technologies will be excluded from using a given site.

These main issues also cause problems for “average” users of sites, especially those who are accessing the site by means other than a standard computer (such as via a mobile telephone or PDA). A recent UK Disability Rights Commission Report [8] shows that websites are 35% easier to use for everyone if they are accessible to people who have disabilities (i.e. compliant with accessibility [9] and other web standards). This tells us that accessibility is a valid metric by which we can estimate the usability of websites for all people.

By extension, through compliance with web development standards, libraries should be able to improve the productivity of all people wishing to access their website and web-based documents—documents created in a format that can be displayed readily by web browsers (i.e. HTML, XML, but not PDF as this requires a “plug-in”). A large number of software manuals, lecture notes, product leaflets, government information packs and so on fall under this category.

Fortunately, significant interest has been generated recently in ensuring that websites are made accessible for their users. Some countries have created new legislation to encourage this, as mentioned above. Given this it is interesting to note that a vast percentage of government web sites are still inaccessible [10].

With the trend towards gradually increasing accessibility of web sites, it is important to bear in mind that this area could have a dramatic impact on the accessibility of library services for patrons with print disabilities. It is imperative that existing sites be checked for accessibility problems and new sites designed to avoid such problems. Because people with print disabilities may also have impairments that make coming to the library in person more difficult, providing accessible web-based information can greatly increase library use by this community. Conversely, excluding these patrons from the website may exclude them from the library as a whole.

A number of technologies are under development that will enable users to be presented with information that is more relevant to their needs and in the formats they prefer [11,12]. These tools, if brought into the mainstream could dramatically improve the accessibility – really usability, as we are concerned with all users – of web-based documents. The ideas of “Essentiality and Proficiency” and the associated tools for users and authors of documents provide a standard to which the importance (essentiality) of information in a document can be marked-up. Subsequently the document can be displayed according to the user's preferences for essentiality of information and according to the nature of the device (telephone, PDA, computer) or disability they may have.

### ***Future Trends – A Better Way***

*“Always remember that you are unique. Just like everyone else.” –Unknown*

An ideal electronic format would exhibit similar qualities to the text file—mutability and presenting minimal accessibility issues. Such properties would be beneficial for all users. The format also would have to incorporate the ability to present images and a pleasing design for non-print-disabled users. Everyone would wish to use such a format, and it would eliminate segregating patrons with specific needs.

Sometimes, in developing a retrofit accessibility solution, a format that could be better for everyone emerges, as the DAISY example illustrates. Unfortunately, such positive (potentially for us all) developments are often overlooked or ignored. The main reasons for this are that such technologies are seen as “for disabled people” – if people are aware of them at all – and (probably the most significant reason) an industry that has already adopted one format is naturally reluctant to invest in moving to a new one. This is true even if that new format promises higher productivity than the current one. Companies also have an economic interest in promulgating proprietary formats rather than embracing open-source solutions that can be used and modified by all.

Belief that making materials accessible to people with print disabilities will benefit only a small niche audience is why retrofitting is often employed. We believe that in future, a better argument will be used more often: that designing a format that is flexible for us all to use and benefit from is desirable for the vast numbers of “average” users and is the best way. By taking advantage of both our similarities and differences, we will be much

more productive than insisting everyone adopts the average format for the average person.

Supporting this goal, there is a growing interest in the academic sector in providing interfaces to systems that can adapt to meet the requirements of their users [13,14]. The central requirement for a system to be able to achieve this is that the information processing it carries out must be separate to the way the output is rendered – so that, for example, the user could use sight, touch or sound to interact with the system.

An example from the publishing world is the DocBook XML standard for writing technical documentation (though it has been applied in much wider areas). It promotes the separation of content from style, much as accessible web standards do. Thus, once the document has been authored, it can be displayed automatically in many different formats – from PDF to HTML to plain text. This makes it highly suitable for both patrons with disabilities using adaptive technology and “average” users who may want to access the document in a variety of different situations, using a range of devices. Work is ongoing to incorporate the ideas of essentiality and proficiency into DocBook XML and to generalise them further so that essentiality can be specified based on the role that a given user has each time he or she accesses a document.

## **Conclusion**

Those providing library services will be aware of the current challenges involved in helping people who have print disabilities find information that they require, in an acceptable format. The challenges and solutions discussed here could be thought of as a generalisation of those problems. Though formats come and go, the fundamental issues are often strikingly similar. In the future, many of the now prominent challenges should be overcome, but the need for increased awareness and promotion of inclusive standards that benefit us all will remain.

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Note: All URIs last accessed in October 2006.

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