

6.0 THE PROVISION OF OPERATING SYSTEMS, SOFTWARE APPLICATIONS AND HARDWARE

6.1 *Introduction*

As outlined in previous chapters, the existence and severity of the disability divide is determined by the changes in society, policy and the effectiveness of computing and Internet tools and resources. As with changes in society and policy, few would argue that there are a number of products and services available to people with vision disabilities. However, the historical development of computing and IT suggests that these products are not always effectively addressing the challenges faced by blind and vision impaired individuals.

The purpose of this chapter is to identify the benefits and detriments of current and emerging technologies in relation to the welfare of people with vision disabilities. The corporations that are responsible for the provision of these products and services play a vital part in determining what products are available and how those products can be used to address the disability divide effectively. Much of mainstream technology is determined by a handful of multinational corporations. As such, the decision-making processes of these corporations are crucial in determining how people with vision disabilities can interact directly with both mainstream tools and disability-specific applications.

The identification of the corporate role in the disability divide is achieved through interviews with key multinational IT corporations, disability-specific AT providers and an examination into the types of products currently available and the impact of these products on people with vision disabilities. Such an investigation not only identifies the current issues but determines if the severity of the disability divide would be affected with the emergence of new mainstream computing and Internet technologies.

6.2 Mainstream corporate implementation of accessibility policy

Ultimately, responsibility for the development of accessible technologies lies with the designers and manufacturers of the IT products and services that sustain users' daily interactions with technology. The corporations which provide accessible technology can be separated into two categories: producers of mainstream technologies with accessibility features and manufacturers who develop AT-specific products and services. One of the major difficulties in determining the role of corporations is the phenomenal amount of information and misinformation about the various products and services available. There is also a significant amount of corporate marketing designed to portray a positive self image which does not necessarily accurately describe all benefits and weaknesses of their technologies. In order to determine effectively how the corporations perceive their role in the community, interviews were organised with the accessibility divisions of each major international corporation relevant to this study. Although it was anticipated that the interview responses would endeavour to emphasise their products and services in the best possible light, the interview process provided the best opportunity to ask questions that would allow for a new insight into issues surrounding the disability divide.

The six multinational corporations selected for this study were Apple, Cisco Systems, Hewlett-Packard (HP), International Business Machines (IBM), Microsoft and Sun Microsystems. Most of these companies are household names in the provision of home and business technology: Microsoft and Apple provide the dominant operating systems for computers worldwide and Sun significantly contributes to the UNIX GUI GNOME system. Cisco and HP were selected to permit the examination of network infrastructure and PC hardware design respectively. The selection of IBM was due to both its renown in the field of accessibility and because IBM was a leader in early accessibility development. These six companies also dominate the IT market. Microsoft and Apple, for instance, are often regarded as a duopoly in the commercially available Operating System (OS) market for the home user while Sun contributes significantly to UNIX-based development and is more relevant to business systems. Cisco dominates the

networking infrastructure market, while HP is the largest PC manufacturer in the world and IBM was one of the founders of the IT industry. These six companies are all listed on the US NASDAQ technology stock index and as outlined in Figure 6.1, represent a combined market value (NASDAQ, 2004) of a staggering \$US678,325,800,000 or approximately \$A900,000,000,000. As such it is fair to say that these companies have significant input in the provision of technology and their role in regards to people with disabilities is highly significant.

COMPANY	\$US VALUE
Apple	21,401,800,000
Cisco	128,535,900,000
HP	60,839,600,000
IBM	158,221,900,000
Microsoft	292,040,000,000
Sun	17,285,700,000
TOTAL	678,325,800,000

Figure 6.1 Market Value of Interviewed Companies in \$US (NASDAQ, 2004)

Representatives from these corporations viewed computing and the Internet as highly beneficial to the able-bodied population, but potentially even more so for people with disabilities. For example, the Microsoft representative indicated that he viewed the Internet as being highly beneficial in allowing people to pursue a wide variety of interests. The representative indicated that one of the specific advantages of Internet-related technologies from Microsoft's viewpoint to a person with a disability, is that once an individual is online, and has access to the correct AT equipment, having a disability is no longer an issue due to the equity of online interaction. Representatives from Apple had a similar viewpoint, believing that in addition to the provision of information, the communication aspect is rapidly becoming vital to people with disabilities. The Apple representative indicated that currently web access and e-mail access are the primary information and communication tools, but real-time chat is rapidly becoming a 'close number two' for people with disabilities, especially in the provision of disability-related support.

The representative from Sun took the view that vast quantities of information are "...available to massive amounts of people at the speed of light", significantly changing the way in which people with disabilities locate information. The view of Internet-related technologies from hardware developers HP was similar, with the representative indicating that the Internet is now affecting "every area of life" in its social, cultural and economic significance by adopting the e-inclusion philosophy of technology. The representatives from IBM also believed that the Internet is vital to people with disabilities, primarily as an information resource and, as indicated by Microsoft, it has the potential to be a great equalizer. The IBM representatives also suggested that the Internet is significant in allowing services to come to the user, highly useful to people with disabilities as they do not need to be concerned with difficult travel logistics due to the benefits of online communication and e-commerce resources. The consistency in responses confirmed that all of the multinational corporations that provide mainstream technologies genuinely believed that such technologies can support people with disabilities due to substantial benefits in the areas of information and communication.

When asked about which physical disability group the corporate entities perceived to have the most difficulty accessing computing and Internet-related technologies, all of the representatives agreed that blind and vision impaired people were significantly disadvantaged. Many of the corporations also indicated that they believed blind and vision impaired individuals currently face the greatest difficulty in accessing Internet-related technologies. To illustrate the point, the representative from Microsoft indicated that there were three significant barriers specific to people who are blind and vision impaired. Firstly there is an assumption that people can see the GUI. Secondly, the GUI is designed specifically for visual interpretation and it is difficult to convey its information in an alternative manner. Thirdly, the current computing emphasis is on multimedia, introducing technologies that are highly inaccessible to such people. The representative from HP shared this view, indicating that there are visual cues in virtually all computing and Internet-related products, some of which are minor whilst others are vital to the achievement of IT-related tasks. The representatives from IBM said that, unlike other disabilities, people who are blind or vision impaired face a situation where "...either the technology is accessible or it isn't." However, the IBM representatives also believed that if the

Internet were accessible, it could provide the most benefit to people with vision disabilities. This indicated that there was a belief that the Internet had the potential to be the best tool ever invented for blind individuals.

When asked about the need for improved access to computing and Internet technologies for people with vision disabilities, all of the representatives interviewed stated that their corporations had significantly contributed to the provision of accessible technologies. The Microsoft representative explained that the company's role was more about providing solid Application Programming Interface (API) modules which could then provide the framework for third-party manufacturers to develop fully-featured AT products. The nature of these products is discussed later in this chapter. The policy of Microsoft in this case is that the AT manufacturers are experts in the field and should be the ones creating the technology. However, Microsoft strongly believed in ensuring that people with vision disabilities should still be able to access information in environments where installation of appropriate AT devices may not be possible, such as when a computer is in a shared resource area such as a library. The Microsoft representative indicated that the provision of basic tools, in conjunction with API support for the creation of AT products, was an effective policy in ensuring that people who are blind or vision impaired gain access to mainstream technologies.

Apple has taken a significant step forward in the provision of accessibility. The Apple representatives indicated that unlike Windows, the APIs in Mac OS 10.x are completely accessible and therefore all applications developed on the Mac OS platform will automatically incorporate accessibility features if programmers choose to develop in the recommended manner. Apple considers its biggest contribution to people with disabilities as being the stability with which multimedia content can be viewed via accessibility tools. The Apple representatives explained that in many OS platforms, the use of a screen magnification program or text-to-speech engine often causes conflicts with multimedia presentations. For example, if a movie file is being run under Windows XP and a screen magnification program is launched, the AT product would not be able to magnify the movie. Under Apple's Mac OS 10.x, the Quartz graphics engine allows the internal zooming feature to magnify a movie without any disruption to the movie or the magnification program. Another example

of Apple's commitment to accessibility policy is its ability to update products, especially its ability to integrate new features. On the Windows platform, the accessibility features have remained virtually untouched for a number of years. On the Mac OS platform, the tools are constantly revised. The last two revisions of Mac OS 10.3 have seen on-screen alerts added to the screen magnification tool and the latest version to date, Mac OS 10.4, has introduced a text-to-speech application designed to provide access to Macintosh computers for blind computer users. The specifics of the accessibility tools included on the Mac OS platform are discussed later in this chapter.

Sun primarily sees its role as providing the programming tools in the Java programming language to ensure that any code developed results in accessible interface modules. According to the representative, Sun ultimately "...don't want the application developer to think deeply about accessibility" as it should occur automatically. The other area on which Sun is focusing is the development of accessibility tools in the GNOME GUI under UNIX-based Operating Systems. Unlike many other commercial entities, Sun liaises closely with the open-source development community to work collaboratively in the development of accessibility tools.

These responses indicated that the corporations were committed to producing tools and products which are beneficial to people with vision disabilities. It also indicated that there are many differing approaches between the corporations in how best to cater for the needs of people who are blind or vision impaired. However, as discussed earlier, such responses were anticipated as it demonstrates and actively promotes the success of corporations in assisting people with disabilities.

When asked about how each corporation determines the needs of people with vision disabilities, each corporation gave a slightly different answer. The Microsoft representative indicated that determining the needs of people with disabilities was primarily left up to the AT vendors as they are the experts in the area. The representatives at Apple discussed a number of resources including internal discussions with developers and communication with high-end users of their products. IBM had a similar approach in terms of online user groups, but also used

developer conferences as a good way to gather information. In terms of hardware-specific design, HP gathers most of its information through internal committees and ongoing human factor research. HP also consults with AT developers for similar reasons to Microsoft and looks at existing technologies which may be applied to people with disabilities. The HP representative used the analogy of how the Personal Digital Assistant (PDA) was initially designed for women as they did not want to carry around a big laptop, yet the technology had appealed to both sexes. The same 'accidental' applications can be applied to people with disabilities, particularly people with vision disabilities. Sun generally finds out what people need by speaking with open-source product users and with vendors at conferences.

It is this kind of response which indicates the biggest flaw in corporate policy. As discussed in section 3.4, with the development of travel aids and AT products, it is extremely difficult to produce products that will benefit people with disabilities unless there is some sort of formal consultation process. The responses from these corporations indicate that the corporations seem to have very little or no communication with people who are blind or vision impaired, effectively preventing them from determining exactly what it is that people with vision disabilities need from technology. Essentially, deciding what people need is done either internally or with users who are already dedicated product users. This results in companies guessing what people with vision disabilities need or running the risk of 'preaching to the converted' by only talking with blind or vision people who are already comfortable with the technology.

When asked about the difficulties in trying to communicate with people with disabilities directly about what they need from technology, all the interviewed corporate representatives conceded that it was a difficult process. The Microsoft representative indicated it was simply not their role to actively communicate with people with disabilities as this was left to the providers of AT who were experts in the field. The Microsoft representative also added that he believed enough was being done at an OS level to cater for people with disabilities, but agreed there was always room for improvement. The representatives at IBM acknowledged that they were deeply sensitive to the types of OS-based tools and AT technologies that were around to help determine gaps, but also conceded that they rarely had the opportunity to talk

directly with end users. The representative from HP explained that it was often a difficult process for companies to become motivated as people do not generally think about technologies for people with disabilities until they need them. This can extend to a corporate level. Furthermore, Reddy (2004) believed that there were other factors which prevented large corporations from exploring what people with disabilities actually need from technology. Reddy argued that it was costly to perform large amounts of testing in the marketplace and therefore little was done. In fairness, many of the large corporations have extensive beta testing programs but very few implement large disability-related product trails. Apple is one notable exception. It recently conducted worldwide testing of its VoiceOver module now integrated into Mac OS 10.4.

Another issue faced by multinational corporations is the employment of people who do not have any knowledge of the needs of people with disabilities but who are expected to create relevant products. When asked if people hired who had recently achieved tertiary qualifications had a good understanding of accessibility issues, all of the interviewees stated that they had no knowledge at all of the needs of people with disabilities. One representative from IBM expressed this by stating “I don’t think they have a clue.” It is therefore left to the corporations themselves to ensure that the programmer has a thorough understanding of issues faced by people with disabilities.

This lack of corporate policy regarding the need to directly communicate with people who are blind or vision impaired is a current major contributor to the disability divide on two levels. Firstly, it indicates that this lack of consultation is stopping people who know little about computing or the Internet from learning about the possibilities that mainstream computing products can provide. Secondly, the AT products created contain barriers which prevent those who are aware of computing and Internet benefits from effectively accessing information and communication resources.

6.3 Disability-specific product vendors' accessibility policy

As indicated by the multinational corporations, much of the AT development for people with vision disabilities was primarily left up to disability-specific AT vendors. The Microsoft representative, for example, stated that Microsoft worked with approximately 75 vendors to ensure that the APIs in Windows work well with the development of approximately 200 AT products. The HP representative also cited the importance of working closely with AT vendors, quoting the example of the PACMate by Freedom Scientific which was designed in collaboration with HP. Given that both Microsoft and HP perceived the developers of AT products and services as being the experts in the field of AT, it is important to understand if company perspective is different from the multinationals and if corporate policies are helping or hindering the disability divide process.

The AT company which was interviewed for the purpose of this study was Humanware, formerly PulseData, one of Australia's leading manufacturers and distributors of AT products and services. Humanware is an international company with its headquarters in New Zealand and its products include scanners, speaking dictionaries, Closed Circuit Television (CCTV) systems, magnification software, text-to-speech software and Braille displays. Humanware is renowned in Australia primarily for its development of CCTVs, the BrailleNote and VoiceNote organizations and the distribution of the ZoomText screen magnifier and the WindowEyes text-to-speech program within Australasia.

One representative at Humanware indicated that the company serves a niche market. As such, it is obligated to ensure that they operate professionally and ethically as most of their clients are people with disabilities. The representatives acknowledged that there is a need for a balance between providing the best possible service and remaining profitable. This view was evidence of the economic model-based perspectives showing that people with disabilities and the distributors of disability-specific products and services can come to a mutually beneficial and profitable arrangement. In relation to the benefits of computing and Internet for people with disabilities, the representatives of Humanware agreed with those from the mainstream multinational corporations that information and communication were

the two most important aspects of modern computing and Internet use. The representatives believed that the Internet will be particularly beneficial to the next generation who have tools such as the Internet integrated into learning systems, allowing the tools to be readily available in a way that is perhaps not so to the older generation. This response again confirmed that corporate policies which involve the production of new technologies are generally endeavouring to support people with disabilities.

The disability which was perceived as causing the most difficulties in using technology was vision impairment. One of the representatives indicated that the reason behind this view was due to the difficulties in converting data whilst retaining the original information. Such examples included the ability of computers to convert print into an electronic format and the conversion of Internet information into speech. Such benefits ultimately assist in providing more independence to people with vision disabilities, confirming the discussion earlier in section 2.5 about the importance of electronic-based information. This response highlights the importance of having effective AT products which easily provide accessible information to the user and allow for the conversion of inaccessible information to an accessible format.

One of the most important aspects of Humanware's development of AT products is its partnership with multinational corporations. The representatives talked primarily about the relationship with Microsoft who partners with them in the development of the BrailleNote and VoiceNote products. They believed that if a company like Microsoft has made a product that already reaches 95% of the population, Humanware should not have to dedicate time, money and extra resources just to cater for the remaining 5% who have a disability. This view confirms the Microsoft representative's earlier statements that accessibility products should be handled by AT specialists. The representatives indicated that it makes more sense for a professional organization that works specifically in the AT area, such as Humanware, to cater for that 5% and that it should be the responsibility of people who actually need those additional services to purchase them as required. The concern is that large multinationals could easily afford to develop AT tools but this would be an issue for two reasons. Firstly, large multinational corporations do not have the expertise to develop such tools. Secondly, there is a danger in having one

company which tries to do everything for everyone. This might stifle innovation, a critical element in the ever-evolving AT requirements.

One area where Humanware differed from the non-AT corporations was its way of finding out the needs of people with vision disabilities. The Humanware representatives indicated that employees talk directly with the various disability associations and the users of the products. Although the users are deemed to be the 'upper-echelon' of computer users, the feedback is valuable in the development of AT products. Conferences and internal discussions are also useful in determining the requirements of AT devices. On this basis, it would seem that Humanware is successful in ensuring that there is a consultation process with its clients in an endeavour to understand the needs. However, the corporate representative acknowledged that, like the mainstream multinational corporations, it struggles to communicate with those who have a disability and are not currently using company products. There is a reliance on various blind and vision impaired organisations to guide potential customers in Humanware's direction.

One of the greatest criticisms levelled at the policy of AT providers is the high purchase costs of their products. As discussed earlier in section 1.7, people with vision disabilities do not have access to much in the way of funding yet they are expected to pay a high price for AT products. Products such as text-to-speech programs and screen readers retail at approximately \$A1000-2000 for the home user, meaning that an individual with a visual disability will effectively need to pay the price of two computers to have access to one.

Essentially, the policies of the AT product vendor Humanware focused on the economic model-based social categorisation in both the relationship between different corporations and the relationship between the AT provider and people with disabilities. The products and services available to people with vision disabilities provide improved, independent access to computing and the Internet whilst making profits for the company. The Humanware representatives perceive the role of the company as providing specialist expertise in a niche market and that larger corporations are only required to provide the framework in their products for such developments.

6.4 Corporate policies based on legal requirements

The development of products for people with disabilities is shaped in part by the legislative frameworks discussed in the previous chapter. All of the interviewed representatives of the corporations agreed that the current US legislative framework was extremely important to the development of accessible technologies for people with vision disabilities. The examination of corporate policy and US legislation was necessary to verify whether the effects of legislative implementation were supporting or hindering development for people who are blind or vision impaired.

In terms of complying with Section 508, the six corporations acknowledged that it was imperative to ensure compliance in order to obtain government contracts. Apple, for example, acknowledged that the Section 508 legislation motivated it to ensure that its APIs were accessible, yet representatives reported that the presence of Section 508 inspired them to go further than the legislative requirement, particularly in the multimedia development area. The representative from Sun further explained the importance of Section 508 by indicating that such policies ensured a certain level of accessibility. However, it is still up to the individual companies to fill in the missing pieces and go further than is required. Microsoft representatives also shared this view, explaining that it was often invited to consult with the US government on the creation of policy to assist in refining IT-related policy for people with disabilities. Cisco representatives believed that the legislation assisted in providing an e-commerce framework within the US Federal government which allowed for greater accessibility with the wider community as the company commenced branching into the home market.

One of the most crucial points regarding the impact of Section 508 was made by an IBM representative. The representative explained that Section 508 was very useful for development but even better as a policing mechanism as “people will do what you inspect, not what you expect” in terms of developing technologies for people with disabilities. Such legislation ensured that, at least in part, the ‘right thing’ was done by the corporations. The IBM representative also pointed out that the legislative framework was very broad, covering everything from the personal

user through to large networks and telecommunications. As such there was a certain degree of interpretation by the companies as to how to comply with the legislation. On this basis the responses confirmed that the US Rehabilitation Act of 1973, of which Section 508 is an element, has indeed had an impact in ensuring that corporations provide accessible functionality within products. However, the acknowledgement that much of the accessibility work was implemented as a result of Section 508, indicated that this was done more from an economic model point of view, ensuring that lucrative contracts with the US government could be maintained.

Therefore the next important issue was to confirm whether only the minimum has been implemented or whether the corporations had future plans to ensure improved accessibility beyond the Section 508 requirements. The examination of this issue revealed significant differences between the corporations in terms of future plans for the improvement of accessibility features for people with vision disabilities.

6.5 Products designed to assist people who are blind or vision impaired

6.5.1 Accessibility tools in mainstream operating systems

When addressing the needs of blind and vision impaired people in corporate policy and government legislation, it is important that an awareness of products and services are taken into account during the decision-making process. There are currently three major operating systems used regularly in the home and workplace. The most popular is Microsoft Windows, the current version of which is Windows XP. The second is Mac OS on the Macintosh platform, of which the most current version is Mac OS 10.4. The third is the UNIX-based platform Linux which features two major GUI environments, GNOME and KDE.

The Microsoft Windows-based OS platforms were notably lacking in accessibility features for the home user until the release of Windows 95 in 1995. Windows 95 introduced four key accessibility features. The first was the use of visual alerts for the hearing impaired, designed to appear in conjunction with standard audio alerts. The second accessibility feature was the ability to adjust the

mouse pointer. The mouse pointer could be adjusted in size, colour and shape. Windows 95 also introduced the MouseKeys option, allowing the use of navigation of the mouse arrow with the keys of the numeric keypad. The adjustment of the mouse size and shape was designed to assist people with vision disabilities whilst the MouseKeys feature was designed to assist people with mobility difficulties who find the use of a traditional desktop mouse difficult to manipulate. The third accessibility feature was the implementation of keyboard-specific accessibility tools. These included keyboard shortcuts for program access and Filter keys which allowed for adjustment of the length of time between when a key was pressed and when the OS acknowledged the key press. In addition, the speed in which keys could be held and repeated on screen could also be adjusted and the Sticky Keys feature allowed for multiple-key commands to be selected with one key at a time.

The final accessibility feature proved highly beneficial, permitting the adjustment of the Windows desktop itself. The desktop appearance could be highly customised either individually or with the supplied High Contrast colour schemes. The High Contrast colour schemes are designed to provide the maximum contrast through the use of white text on a black background as indicated in Figure 6.2, or black text on a white background. Font size adjustments can also be selected.

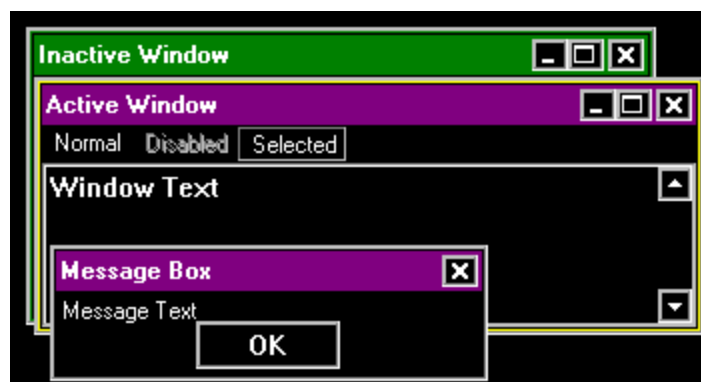


Figure 6.2 Sample of the High Contrast Black colour scheme available in the Windows OS since 1995

The Windows 98 OS platform, released in 1998, added some additional accessibility features. A wizard was provided to assist users in determining which accessibility features best suited the user. The most significant addition for people

with low vision was the addition of Magnifier, a tool which provided a magnification area at the top of the Windows screen. As indicated in Figure 6.3, this magnification bar followed the mouse arrow and would magnify the surrounding area.

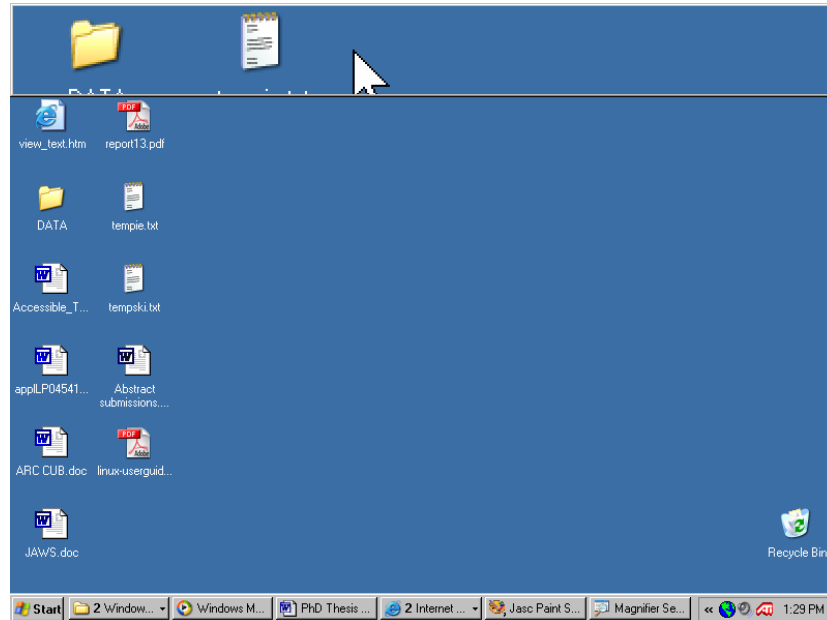


Figure 6.3 Magnifier program available in the Windows OS since 1998

Although the introduction of Windows 2000 to the business community in 2000 provided some additional accessibility features, they were not readily available to the home user until the release of Windows XP in 2001. Features included an on-screen keyboard for people with mobility difficulties and Narrator, a simple text-to-speech program with limited functionality.

The development of accessibility tools within the Mac OS platform was greatly limited until the release of Mac OS X, also known as Mac OS 10, in 2001. The traditional OS for the Apple Macintosh computer was completely revamped, becoming a UNIX-based OS. The evolution of this process heralded a significant step forward in terms of the provision of accessibility tools on the Macintosh platform. The first major change in Mac OS 10 was the provision of keyboard shortcuts to enable users who are unable to use a mouse effectively to achieve full access to the features of the OS. These shortcuts were also integrated into the application development routines of the OS to ensure that future applications could also be accessed by keyboard shortcuts.

Like the accessibility features in Windows-based platforms, the Macintosh products can be broken up into four categories: seeing, hearing, keyboard and mouse accessibility features. The initial release of Mac OS 10 featured similar keyboard options to Windows including Sticky keys and other keyboard customisation options. The mouse options were also similar to Windows, providing a variety of options for presenting the mouse arrow and MouseKeys to provide alternate access. Visual alerts were also included in the Mac OS 10 platform for the hearing impaired. The similarity between Mac OS and Windows demonstrated that, until recently, the accessibility of mainstream GUI platforms has been similar.

The main features that separated the Mac OS 10 platform from products such as Windows was the implementation of the magnification and speech facilities. Since the original release of Mac OS 10, there have been four major refinements resulting in vastly improved accessibility. Mac OS 10.2 provided a full-screen zoom feature, similar to the third-party products discussed earlier in the chapter. Additional keyboard shortcuts were also provided to adjust the desktop instantly, such as the ability to change to a high contrast colour scheme. The zoom feature has been further refined and in the current version of Mac OS, 10.4, it provides a stable fully-featured product incorporated into the operating system.

The other standout accessibility feature on the Mac OS 10.4 platform was the use of voice recognition and text-to-speech. The original release of Mac OS 10 featured benefits such as speech recognition for GUI navigation and talking alerts for speech output. The initial talking alerts and text-to-speech functionality was limited until 10.4 where the new fully integrated VoiceOver program was implemented. This endeavoured to provide full text-to-speech functionality into the OS. VoiceOver was similar to other third-party text-to-speech applications discussed earlier in the chapter but with the added benefit of being included in the operating system. Given the limited market share of the Apple Macintosh, it is expected that these additional accessibility products in the OS will increase the awareness of the Macintosh computer users and make it a more affordable and competitive choice on the PC market.

The UNIX platform has faced a difficult road in the path of accessibility for the home user. The nature of the UNIX OS, and in particular the PC-based Linux variant, relied heavily on the input of volunteers to develop accessibility programs. The other difficulty was that there were two primary GUI environments in the Linux OS: GNOME and KDE. Whilst there was some limited commercial support for GNOME from Sun Microsystems, development still lies primarily with the product's own user base. Both the GNOME and KDE interfaces provide limited accessibility functionality in the form of keyboard and mouse tools. There are also limited magnification programs and desktop modifications. In addition, several UNIX-specific applications, such as Dasher, have been developed to provide greater text input facilities to people with mobility disabilities. However, despite the attractiveness of using a freeware OS in an expensive AT environment, neither GNOME nor KDE at the time of writing provide the effectiveness or stability of accessible tools that are currently available for the Windows or Mac OS platforms.

The examination of these accessibility tools highlights the similarities and differences in the provision of corporate policy. The similarities between all three operating systems are the use of the GUI. As previously discussed, the GUI has a wide variety of advantages for the mainstream user but has disadvantages for people with vision disabilities. One of the most notable issues regarding the GUI is lack of experimental design. Most GUI environments have not undergone any fundamental changes in recent years. Microsoft Windows, for example, is similar today to how it looked in 1995 and the Mac OS interface resembles its original incarnation in 1984. It may be the case that the significant step forward that the GUI brought is now holding development back from further technological advance because new innovative designs could potentially remove the benefits that the GUI currently provides. In relation to the disability divide, a change in thinking would be highly beneficial in providing a more accessible computing environment. Yet it is unlikely that the implementation of a non-GUI OS will emerge in the near future. The tools which are automatically included in the OS of a computer system are examined with great interest in the hope that they will deliver the required technologies without having such a high price tag for additional AT products.

When providing accessibility tools, all of the corporations' representatives indicated that products go above and beyond the legal requirement for accessibility. The representative from Microsoft indicated that the corporation has a policy regarding accessibility development. The policy states that "...as our operating system and applications evolve, (they) will become more accessible. Every Microsoft employer must deliver on that commitment." The Apple representative indicated that the company only took six months to two years into the future for accessibility development, but believes its recent accessibility efforts with Mac OS 10.x reflect the effectiveness of this method of development.

However, the reality is that some corporations only provide minimal accessibility to comply with Section 508. Microsoft, which provides the world's leading OS, acknowledges that it has only put in minimal support so that the AT vendors can provide a fully-fledged product. The Magnifier program built into Windows XP, for example, provides a message:

Magnifier is intended to provide a minimum level of functionality for users with slight visual impairments. Most users with visual impairments will need a magnification utility program with higher functionality for daily use.

The Narrator program contains a similar message. The Microsoft representative indicated that this is necessary due to its close relationship with the AT providers. Sapey (2000) views this type of collusion between the manufacturers, the assistive technology providers and welfare agencies who distribute the technology as a significant part of the problem. This chain allows for organisations at every level to maintain control and profit from people with disabilities. In addition, the provision of comprehensive accessibility tools is extremely important when computers are being used in public places, such as libraries, where there are no opportunities to install custom AT products.

Microsoft in particular has been in some legal difficulties in recent times over its perceived inaction in delivering effective accessibility tools in its OS. Microsoft was widely criticised in 1998 by welfare agencies for releasing Internet Explore 4.0 which was inaccessible with most AT products. This was rectified shortly after with the introduction of version 4.01 (Barrett & LeDuc, 1998). Furthermore, at the time

of writing, Microsoft is being sued by US lobby groups because of fundamental accessibility flaws in its OS which are believed to be not Section 508 compliant. Microsoft accessibility director Madelyn Bryant acknowledged the oversight, which is particularly significant to people with vision disabilities and has vowed to rectify the problem (Royal National Institute of the Blind, 2003a).

On occasions when accessibility tools are effectively provided in operating systems, such as the change in mouse arrow size or colour scheme in most GUI environments, they provide a significant level of functionality to people with disabilities. As such it is interesting to note that there have been some significant movements in recent times in improving the accessibility tools within operating systems. Apple, for example, has introduced many new accessibility tools to its OS. Its fully featured screen magnification and recent text-to-speech programs have stirred much interest amongst blind and vision impaired people because it removes the need to purchase expensive AT equipment.

Although Microsoft's accessibility tools have remained unchanged for a number of years, the development team for the next version of Windows, to be known as Windows Vista, has mentioned that there has been a recent move to improve the accessibility of the API modules which is a promising sign for people with disabilities. In terms of the UNIX-style OS, the text-based interface can be made easily accessible, but the lack of support for the GUI interface, on which the OS is becoming increasingly dependent, means that UNIX could potentially become largely inaccessible.

As a result it can be observed that the OS development process itself also has a bearing on the level of accessibility. The policy of Microsoft Windows is very restrictive in allowing programmers access to the source code of the OS. The policy of Linux, on the other hand, has very few restrictions on access to the source code. The policy of Apple is a combination of the two approaches. It maintains propriety control on certain elements of the OS but allows open source development for much of the OS because of the UNIX-based nature of the product.

These different developmental processes appear to impact on accessibility in that the control of the source code in Windows makes complete integration of accessibility tools by third-party manufacturers difficult. The other end of the spectrum, complete open source, has also proved restrictive by making it difficult to maintain uniform and cohesive developments for AT products. The development approach by Apple appears to be providing an effective framework for ensuring that AT products and built-in accessibility tools can effectively support people with vision disabilities, although the limited user base of Apple products can prove restrictive. On this basis it can be argued that a mixture of open source and propriety development is the most beneficial development method as it provides more of an opportunity for consultation with people who are blind or vision impaired.

In essence, the lack of consultation with people who are blind or vision impaired, the desire to comply only with the minimal legal requirements and the economic model-based policy decisions have led to the world's most popular OS from being effectively accessible unless expensive AT products are purchased. Although it is encouraging to see developments in other OS products, there is still a need for fundamental GUI issues to be addressed to prevent continuing disability divide issues in mainstream products.

6.5.2 Hardware products

Generally, the only hardware input device used by a blind or vision impaired individual is a keyboard. The main reason for this situation is that the use of other devices, such as a mouse or a joystick, relies on visual cues to inform the user of a movement or action. The keyboard allows for both the input of text and the ability to navigate in a GUI environment through the use of keyboard shortcuts.

AT tools are available to assist those who are unfamiliar with the standard QWERTY keyboard layout, or prefer the use of a Braille keyboard. The Braille keyboard primarily relies on the use of six keys, each representing one of the six Braille cells contained within a character. Unlike standard text entry, keys on a Braille keyboard need to be pressed in synchronous combinations to generate characters. For example, pressing keys one and four will generate one Braille

character containing two dots. Braille keyboards generally consist of either an overlay placed on a standard keyboard, such as the Sixin, or are offered as a replacement to the standard keyboard. An example of this product is the Bach Braille Keyboard, produced by Wagner Technologies, as shown in Figure 6.4. It contains the standard six keys plus some additional control keys.



Figure 6.4 Bach Braille Keyboard (Abledata, 2004a)

For people with low vision, a number of large print keyboards are available. Large print keyboards generally maintain the standard QWERTY layout but may have larger keys or a large print lettering overlay. One example, featured in Figure 6.5, shows the Hooleon large print overlay on a standard keyboard.



Figure 6.5 Hooleon Large Print Keyboard overlay (Abledata, 2004b)

Braille printers, referred to as embossers, allow a computer user to print electronic information as a Braille document. Computer users generally have the choice of printing either directly from a Braille-based editing package or they can opt

to convert standard text into Braille. Although some embossers are able to print both text and Braille, most embossers will only print Braille, thus reducing the purchase cost of the item. Many embossers are able to print single- and double-sided by printing between the indents on the alternate side of the paper. Models of embossers include the ViewPlus Tigercub, the Enabling Brailleplace and, as featured in Figure 6.6, the Everest produced by Index Braille.



Figure 6.6 Everest Braille Embosser (Index Braille, 2004)

Another output device gaining in popularity is the refreshable Braille display. The Braille display works by moving pins up and down to create Braille characters. These characters represent on-screen text information. Although many Braille displays are limited in the number of characters they can represent, newer models are able to translate the text into recognised Braille characters which can represent multiple letters. Models of refreshable Braille displays include the Braille Voyager, the Alva BrailleTerminal 320 and the Vario 80 produced by Baum Retec AG as demonstrated in Figure 6.7.



Figure 6.7 Vario 80 Refreshable Braille Display (Abledata, 2004c)

Hardware voice synthesizers are another output AT device, once the only source of text-to-speech output available to blind and vision impaired computer users. Improvements in speed and processing power of modern computers have now led to most users opting for a software-based solution. However, many people with vision disabilities still prefer hardware-based synthesizers because of the clarity of voice and the reliability of the product. Such products work by converting a graphical data stream into a text stream and outputting it to the hardware device. The user then hears the text equivalent of the graphical information that would normally be viewed on the screen. Popular models include the DECTalk and the Artic Transport as featured in Figure 6.8.



Figure 6.8 Artic Transport Voice Synthesizer (Artic Technologies, 2004)

The hardware devices available for blind and vision impaired users are generally separated into two categories: input devices, such as the Braille keyboard and output devices such as the Braille printers. The difficulty with this type of AT is that the interaction between the input and output devices is not simultaneous. People without vision disabilities rely heavily on simultaneous feedback to grasp the significance of their actions and movements, such as the relationship between the movements of a mouse being output of that moment to a screen.

In order to provide equivalent functionality to blind and vision impaired computer users, a variety of haptic devices have been created, some of which are still in the experimental stage of development. Haptic devices, or tactile devices as they

are also known, rely on the sense of touch to provide instant feedback when a task is performed by a computer user. The common computer mouse is one tool that has been examined as a possible haptic enhanced method of interaction for blind and vision impaired individuals. Models range from a vibrating mouse which reflects sounds in multimedia applications to devices which attempt to represent a screen display in tactile form. Haptic mice can be divided into two categories: mice with mounted tactile displays and force-feedback mice that simulate objects and textures.

Force-feedback mice are similar to the commercially available force-feedback joysticks in that they use a vibration or pressured feedback system to inform the user of an action. The tactile haptic mouse, such as the VTPlayer from VirTouch as noted in Figure 6.9, has two 16-pin displays, similar to those on a refreshable Braille display. These pins are mounted where the user's first two fingers sit on top of the mouse. The feedback from these pins provides a tactile representation of the screen environment under the cursor.



Figure 6.9 VTPlayer VirTouch Haptic Mouse (VirTouch Solutions, 2004)

Another type of haptic device that has recently gained support in the marketplace is the Omni Phantom produced by SensAble Technologies, as featured in Figure 6.10. The flexibility provided through the spatial and orientation exploration with six degrees of freedom has proven to be of interest to researchers. In particular, these devices can present the perception of virtual haptic environments. The Phantom is a commonly used device in this category. An example of the potential use of such a device was presented in the format of making mathematical graphs accessible to people who are blind or vision impaired. Although potentially beneficial, all haptic devices providing spatial and orientation degrees of freedom are expensive and not currently available for mainstream use.



Figure 6.10 Omni Phantom (SensAble Technologies, 2004)

Tactile graphics tablets have also received much attention as a method of conveying information from a visual monitor in a non-visual form. They usually consist of a large rectangular set of pins which can be raised and lowered like those in a refreshable Braille display. However, other approaches have used vibrating pins or plastic bumps. Shaped memory alloys have also been used in the construction of tactile graphics displays. An important benefit of tactile tablets is that they often support multipoint interaction like that in the real world. That is, objects can be felt with all fingers of both hands, rather than with the point of one stylus or by the movement of a mouse. It is also highly useful in conveying spatial concepts such as the height of graphs and the measurement of distances. This allows maximum use of the restricted bandwidth available to the sense of touch. Tactile graphics tablets are still experimental and are not currently available in the commercial marketplace.

Portable note-taking devices are also useful in providing portable computing technology to blind and vision impaired users. Similar in functionality to a PDA and in many cases running the same Operating Systems, portable note takers provide office productivity tools such as word processing, contact management and Internet facilities. The input is generally via either a standard or Braille keyboard. As the device is for blind or low vision users, the output is audio speech rather than a screen display. Examples of electronic note takers include the PACMate by Freedom Scientific and the BrailleNote as seen in Figure 6.11. The BrailleNote also incorporates a refreshable Braille display, wireless and GPS technologies.



Figure 6.11 The BrailleNote PK (Humanware, 2004)

6.5.3 Software products

Software products are vital in ensuring that people who are blind and vision impaired can access mainstream technology. Software applications play an important role in supporting hardware AT devices because they provide an effective method of translation which ensures that visual information is correctly entered into a computer. Software applications also ensure that information is effectively directed to the user. The main categories of products are Optical Character Recognition (OCR) software and voice recognition software.

OCR is the method in which scanned pages of text are converted into electronic text documents (San Diego State University, 2004). The OCR process is not in itself considered AT due to its mainstream applications but there are several software applications available which can directly translate a scanned document into a text stream thus making it available for text or voice output. The software focuses on obtaining audio-friendly elements of the document to ensure clarity for voice output options. Examples of AT-specific OCR software include OpenBook produced by Freedom Scientific and Kurzweil produced by Kurzweil Educational Systems.

Voice recognition software is another mainstream product that has been adapted to assist people with disabilities, particularly those with spinal cord injuries or vision disabilities. The software is designed to interpret the spoken word and translate it directly into text. Although this technology is still being refined due to variances in pronunciation and the inconsistencies found within many languages, many specialist products are now available. These products include Dragon Naturally Speaking by ScanSoft, ViaVoice by IBM and I-Say by T&T Consultancy. In

addition there are other input-based software applications that respond to voice including voice-activated web browsers and voice-activated calculators

Software output-based products are often deemed to be the most essential of all the AT products available for blind and vision impaired computer users. The reason for such importance is the visual nature of the GUI. The inability to observe a graphical environment on a computer screen display with ease means that alternative output methods need to be developed. There are an assortment of output products available with the most popular being either screen magnification software for low vision users or text-to-speech systems for those who are blind or have severe low vision.

Screen magnification software is designed to enlarge the GUI by ‘zooming in’ into a particular section of the graphical environment. There are a variety of different magnification techniques offered by magnification programs depending on the needs of the user. Most magnification programs focus on providing a full screen zoom, as outlined as shown in Figure 6.12. A full screen zoom enlarges a small area of the screen and allows the user to scroll around the other areas. Most programs provide magnification ranges from slightly above non-zoom levels through to 16x magnification.

Other magnifiers may split the screen, keeping part of the GUI environment the same size and another part of the GUI magnified. Others operate by providing a magnifying ‘ruler’ or ‘glass’ as indicated in Figure 6.13, which can be moved over different areas of the screen to provide minor magnification. Popular screen magnification programs include ZoomText produced by AiSquared, MAGic produced by Freedom Scientific and Magnus produced by Sensory Software.



Figure 6.12 (left) Example of full screen 2x screen magnification in Windows XP

Figure 6.13 (right) Example of 'ruler' 2x screen magnification in Windows XP

Screen reader software is designed for people with severe vision disabilities. The software performs a two-part process, firstly converting the GUI environment into text and then secondly outputting the text as audible information. Most screen reader software is programmed to take an intuitive snapshot of the GUI and output the most relevant information. To achieve this result, screen reader programs generally have different software scripts for different applications so that the software can immediately determine the information most relevant to the user. Unlike other AT software programs, screen readers assume that the user cannot see a mouse point and therefore all input will come from keyboard shortcuts. The voice used to convey the information can generally be altered in pitch, tone and speed to ensure comfort for the user. Popular screen reader programs include JAWS produced by Freedom Scientific, WindowEyes produced by GW Micro and Lookout produced by Sensory Software.

In addition to specific input and output software applications used to provide accessibility and functionality for blind and vision impaired computer users, accessible versions of general applications such as word processors, calculators and web browsers have also been released. One example of the products available is the Braille translating software package from Duxbury Systems, a Braille equivalent of a Word Processing application. Another popular product is a program called Home Page Reader, produced by IBM, which converts the output of a web page into speech. There are also numerous large-print versions of fonts which can be used in standard word processors and calculators featuring large print buttons.

HP, Cisco and IBM have all contributed to the development of AT products. The HP representative sees the company's role as going for "the sweet spot of the market...people with disabilities are not 'one size fits all'..." so it is imperative that the technology matches the individual needs of users. HP have spent much time ensuring that its hardware devices can be accessed by people with disabilities, such as ensuring that all HP laptops can be opened with one hand. The HP representative used the analogy that HP builds an accessible house so that others can put individual AT needs inside it.

Cisco has primarily contributed to the needs of accessibility through the provision of its educational program. The Cisco Certified Network Administrator (CCNA) course, used by students worldwide, has a trial course at Curtin University of Technology. It is called the Cisco Access for Vision Impaired (CAVI) project and it is designed specifically for blind and vision impaired users. The Interface for Cisco networking and routing equipment uses a text-based Command Line Interface (CLI) OS, allowing for easy translation into a text-to-speech engine or allowing the modification of text and colour size. This makes the course a good opportunity for people with vision disabilities (Murray & Armstrong, 2004).

IBM has produced significant contributions in the field of accessibility. As one of the pioneers of the IT industry, the representatives explained that IBM has endeavoured to include accessible APIs for many years exemplified by the design of OS/2. In recent times, IBM has stepped away from focusing on in-house AT development for the mainstream marketplace but continues to focus on the development tools in niche areas where such are not currently available. For example, the development of Home Page Reader allows text-to-speech functionality when navigating the World Wide Web on a UNIX platform where accessibility tools are still limited. The representatives summed up IBM's position by indicating that it is also aiming to fill in the gaps in AT and to provide tools at affordable prices.

For the most part though, the AT products listed are manufactured by AT-specific companies. Even AT devices themselves can pose problems which contribute to the disability divide. There is often a perception that once a person with a disability has received an AT product, all problems are immediately solved.

AT often fails when there is not enough time dedicated to ensuring that the AT device receives the correct support. There are three areas which are vital in ensuring that an AT device is going to be effective.

Firstly, there are the factors related to the people who are supporting the use of the AT product. This includes the evaluation and testing of the product, providing support and training, determining the practicalities such as funding, service and delivery and cultural factors. The second group of factors relate to the AT user. The device needs to match perfectly the user, the age of the person, literacy skills, gender and ability to use. The third group of factors revolves around the device itself. This includes the attention to essential human factors, design, mechanical safety, durability, power consumption and reparability (King, 1999).

Ironically, it is also possible to give too much support to the use of AT devices. Dorman (1998) suggests that in order for AT to be truly effective in an educational environment, an evaluation team must be assembled for each student. This team must consist of the student, teachers and appropriate design professionals. Input must be considered by the user, a focus of the AT functions must be determined, the advantages and disadvantages must be carefully considered and after an analysis of all products, a device can be obtained. Unfortunately, personal observation and conversations with many other students with disabilities suggest that by the time the meeting has been coordinated and evaluation completed on the appropriate product, too much time has passed in the course for the eventual choice to be useful. It is important to strive for a balance between the analytical approach to AT and real-world time constraints.

In addition to cost and the time for implementation, AT devices are also criticised for their design. For example, the PACMate, developed between HP and Freedom Scientific, runs the same OS as other PDA systems but it is very large in comparison to the equivalent pocket-sized devices. When the HP representative was asked about this issue it was suggested that it is significantly cheaper to keep AT products large. Given that they are already so expensive, it is important that costs are cut wherever possible. When the issue of the cost of AT was discussed with employees of Humanware, the representatives confirmed that it is likely that only the

‘upper-echelons’ of users would fully understand the process and cost faced by people with disabilities but denied that there was any conspiracy indicating that such a small market resulted in high prices.

Essentially, the provision of AT products is often successful in providing access to mainstream technologies for people with vision disabilities. However, the complexity in using the products, combined with the cost, often makes these products prohibitive to most blind and vision impaired computer users.

6.5.4 Internet tools

There are a number of online services and resources available to assist in the creation of accessible web sites. There are also a number of support services in the form of online information, chat rooms and mailing lists which provide people who are blind or vision impaired with the opportunity to share experiences and seek advice about their disability. There are many online tools and services available to assist people who are blind or vision impaired. One of the major uses of the Internet is locating information about related medical conditions and accessing other web sites and information relating to AT products, training, employment, books, magazines and medical resources. Yet the benefits of the Internet extend further than just disability-specific information. The availability of mainstream information on the Internet has provided unprecedented opportunities for people who are blind or vision impaired. As indicated earlier in sections 2.3 and 2.5, people with vision disabilities were greatly restricted in gaining access to information due to the inability to access material in libraries and other printed medium. Through the use of AT, such as screen magnification or text-to-speech software, Internet pages provide a wealth of information to people who were previously unable to access this information.

In order to check web sites for W3C compliance, there are a number of validation tools available either for download or via validation web pages. Examples of these tools include WebXact, formerly known as Bobby from Watchfire and ADesigner from IBM. The WebXact web site, located at <http://webxact.watchfire.com/> provides a limited free portal to test web pages. Once

a web page has been tested, a report is issued outlining the three W3C accessibility guideline Priority levels and any issues that need to be repaired to ensure compliance. ADesigner, recently released by IBM, incorporates a number of tools into one validation package. In addition to testing a page for W3C compliance, it also allows for a variety of visual simulators so that people with good vision can experience a web page in a similar fashion to a vision impaired individual. ADesigner also examines how successfully the page could be read by a text-to-speech program and how easy the site would be to navigate. Figure 6.12 demonstrates the use of ADesigner on the Curtin University home page.

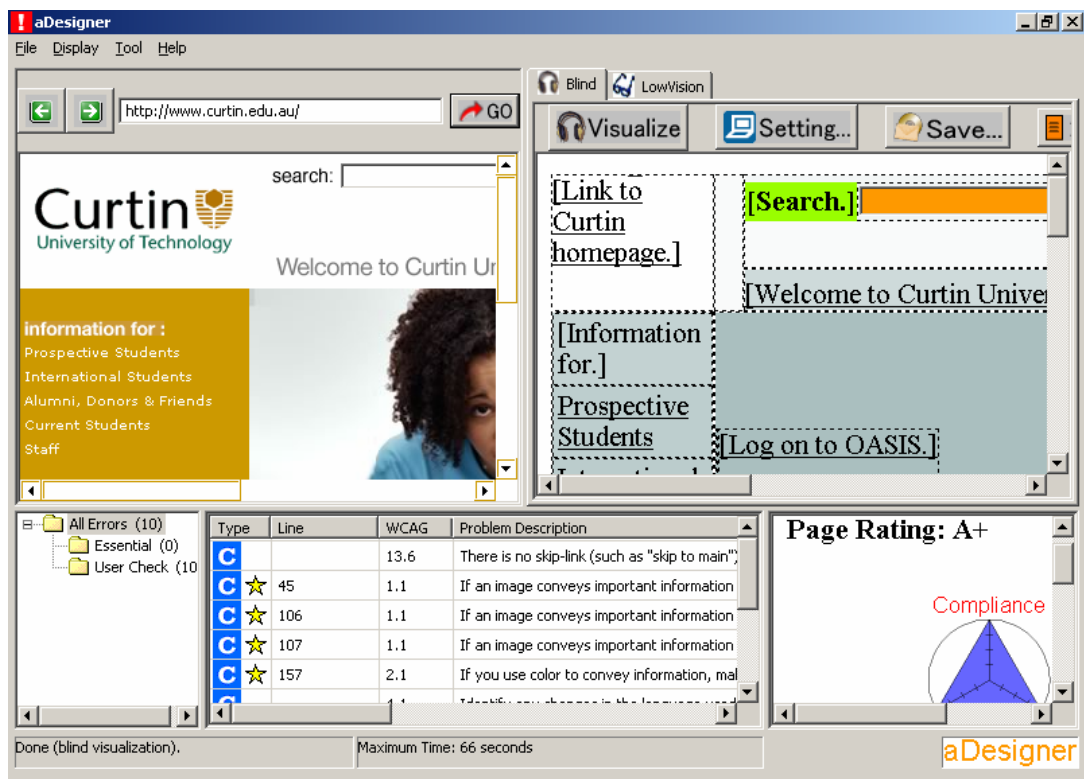


Figure 6.12 IBM ADesigner validating the Curtin University home page

As discussed earlier in section 2.5, the other significant benefit of the Internet to people with disabilities is the ability to gain support from other people with similar medical conditions. These support services can come in several forms including mailing lists, chat rooms and messenger services. Web portals are also commonly used to provide information and communication to people who have been recently diagnosed with a visual disability. In Australia there are a variety of services available. General information and further links to resources can be found at sites

such as Vision Australia located at <http://www.visionaustralia.org.au>, Retina Australia <http://www.retinaaustralia.com.au>, and other various blind and low vision associations. In terms of communication, the VIP-L mailing list is for Australians who are blind or vision impaired. <http://www.hicom.net/~oedipus/blist.html#vip-l>. Organisations such as Blind Citizens Australia have an online presence and can be located at <http://www.bca.org.au>. Real-time chat can be found for a variety of different vision disabilities. One of the most popular web sites featuring information for online chat is the Dee's Wonky Window web site, available at <http://www.netserv.net.au/doonbank/dee.html>.

The examination of Internet tools and resources indicates that there are a number of products available to assist blind and vision impaired people. It also demonstrates that there are a lot of resources available to government and corporations to ensure accessibility of their own online information. Yet despite these resources, corporations acknowledge that it is very difficult for people with vision disabilities to access resources on the Internet.

The Microsoft representative acknowledged that it is much harder for a person with a disability to get online, especially someone who is blind or vision impaired. He indicated that finding information online can be "...like a swamp" at times, a concept confirmed by the Sun and IBM representatives who indicated that one of the biggest difficulties is determining the reliability of information. The Sun representative also felt that the inaccessibility of web site and cost were big factors and the Apple representatives believed that the GUI was still one of the major stumbling blocks. However, all of the representatives denied that the companies are in any way contributing to this difficulty. Instead, they indicated that the companies are providing products and help in solving accessibility difficulties.

In order to understand further the importance of providing access to people with vision disabilities by the mainstream technology providers, checks were done prior to the interviews regarding the accessibility of their own corporate web sites. The checks were personally performed in June 2003 for W3C Single-A compliance. The sites have also been checked regularly since this date. The web sites of Microsoft and Apple both failed to meet even the minimal guidelines. When

interviewed about the W3C guidelines, all the representatives indicated that it was important but most agreed that it was no more or less important than other policies. When Microsoft and Apple representatives were confronted about the inaccessibility of their own sites, both vowed to rectify the problem. Apple rectified it almost immediately and Microsoft rectified their home page after six months. However, a vast number of web pages are still not meeting the minimal W3C standards. All other companies are currently meeting the W3C minimal accessibility standards. This result again strengthens the argument that the disability divide is caused by issues which are largely preventable. The creation of accessible web sites would greatly assist access to the Internet and it should be a standard requirement for corporate web sites to meet even the minimal WC2 Single-A compliance.

Interestingly, none of the representatives who were interviewed perceived their own actions as being a contributor to the disability divide. Given the difficulties faced by people with disabilities in accessing computer and Internet-related technologies, it is interesting to note that all of the interviewed representatives either did not perceive the disability divide to be substantial or did not believe that it was an issue. All representatives cited examples of people with disabilities who were able to use their products or people who worked for the company who were able to use their products effectively.

6.6 Conclusion

This chapter demonstrates that multinational corporations play a major part in shaping the way in which computing and Internet technologies are presented to the mainstream population. In relation to people with disabilities, there are two main factors which control the accessibility of a product: the level of dedication in corporate policy to helping people with vision disabilities and the design of the product itself.

The data collected for this chapter suggests that there is a level of dedication in trying to provide products and services to people with disabilities effectively. There is an acknowledgement that people with vision disabilities face particular hardship in gaining access to current computing and Internet technologies and

internal policies reflect the need to provide this technology. Generally speaking, there is a corporate aim towards a 'level playing field' and the belief that in the future, people who are blind and vision impaired will have equal access to products and services.

However, the formation of internal policies and the implementation of products are not effectively catering for people with vision disabilities and as such are directly contributing to the disability divide. This is due in part to the fact that corporations only implement the minimum requirements as indicated by US law. Another factor is because the provision of particular technologies which are largely beneficial to the mainstream population, such as the GUI, have turned out to be highly detrimental to people with vision disabilities.

The greatest problem, however, is the fact that most of the mainstream corporations have little consultation with people who are blind or vision impaired at the grass-roots level. This lack of a policy which could ensure consultation is resulting in either products being developed for the small minority who have embraced a particular product, or products which do not cater for the needs of people who are blind or vision impaired. Essentially, both the policy and product elements of technological provision are contributing to the disability divide. Although there are efforts being made in some areas to address this issue, it is likely that the recurring pattern of the disability divide identified earlier in chapter 3 will continue if consultation with those affected is not effectively established.