

1. Background

Information and Communication Technologies (ICT's) are enabling a global audience to share knowledge and ideas with one another by the click of a button. One of the key tools of this revolution is the Internet, which is replacing CD ROM's with online databases, traditional hard copy books and journals with digital libraries and atlases with interactive geo-spatial data. The success of these services is maximised if end users are well supported to easily accomplish their desired tasks.

1.1 The Joint Information Systems Committee

The Joint Information Systems Committee (JISC) was established as an advisory committee, working on behalf of funding councils to provide and support the implementation of ICT's in further and higher education. They have already achieved many of their goals by providing expertise, independent advice, guidance and key resources to help institutions throughout the country deliver a high level of service.

The disciplines that JISC services cover range from science and technology to art and the humanities, and are represented via a broad spectrum of digital media:

- Journals
- Textbooks
- Theses
- Abstracts
- Manuscripts
- Music scores
- Still images
- Moving picture and sound files
- Geo-spatial images and maps

(Grout and Ingram, 2001)

Over the past few years JISC's work has also aided the wider implementation of the Joint Academic Network (JANET) which links schools, colleges, universities, research establishments and small and medium size enterprises (SME's). Following on from this has been the

development and rollout of Super JANET 4, an international high-speed backbone enabling the fast transmission of information across the globe (JISC, 2001). The establishment of this infrastructure has enabled JISC to move forward and develop an Information Environment (IE) which allows users to find, access, use and disseminate quality information resources.

1.2 Information Environment

JISC announced their 5-year Information Environment Development Strategy (IEDS) in 2001. The aim of IEDS is to ‘...build an on-line information environment providing secure and convenient access to a comprehensive collection of scholarly and educational material’ (JISC, 2002a). With this aim it is essential that all resources are successfully managed and presented in the most coherent way. The IEDS is a vital process in the *global* networked environment and therefore a successful and sustainable implementation must involve all stakeholders:

- Publishers and suppliers of digital content to the DNER.
- International standards development bodies.
- Library, museum and archival professionals and allied strategic and funding agencies.
- Policy makers, information mediators, and creators and users of digital content in the further and higher education communities.

(JISC, 2002b)

A key concern for JISC is the wide variety of users’ needs and the usability of services for users:

[U]sers do not all want to access information in the same way but will require a diverse range of views of resources in order to satisfy their needs (JISC, 2002a).

JISC is fully aware that the material they provide is intended to serve a wide variety of end-users. For example, post 16 learning requirements are not only different from those in higher education and research environments, but differ between individuals within different institutions and environments. This complex problem is being tackled by discovering what users require, how best it should be presented to them and what support mechanisms need to be in place to assist their learning experience. All of these groups need to be able to access information resources in the manner that most suits their needs, and thus utilise it to its full potential. JISC is investing in many different avenues of research, the findings of which can be used to further develop the IE

strategy. The team from City University is one body involved in such research and analysis, leading to the formulation of a sustainable usability and accessibility framework. The IE strategy Presentation Programme clearly establishes JISC's aims regarding issues of usability and accessibility:

1. To significantly improve the usability of JISC Services and resources offered through the Information Environment.
2. To establish the most effective means of embedding the presentation of resources within institutional, departmental, local and personal environments.
3. To establish and disseminate best practice wherever possible in the design of interfaces to support the requirements of access to diverse types of digital resources.

1.3 Usability and accessibility

The International Organisation of Standardisation (ISO) (ISO 9241-11, 1994) identifies three key factors to assess the usability of an interface:

Usability is measured by the extent to which the intended goals of use of the overall system are achieved (effectiveness); the resources that have to be expended to achieve the intended goals (efficiency); and the extent to which the user finds the overall system acceptable (satisfaction) (John and Marks, 1997).

The usability of a system is also related to issues surrounding its accessibility. There is a broad range of users to whom web-based services are directed, and the services provided ought to be accessible to them:

- People who are visually impaired
- People who are hearing impaired
- People who are physically impaired
- People who are cognitively impaired
- People with different experience of and attitudes towards technology

Other factors that may also affect the way an individual accesses web-based services include:

- Stress

- Fatigue
- Temporary disability – e.g. having a broken arm, forgetting one's glasses
- Environmental setting – e.g. noisy work/study place, poor lighting

Interface design should therefore be governed by the requirements of all stakeholders of the system. Thus a variety of issues have to be taken into account throughout by using a highly user-centred design process.

1.4 Usability requirements

The vast array of services provided by JISC means that not all usability requirement gathering and evaluation techniques are applicable to all of the services in the same manner. In addition, the goals and actions that users wish to achieve vary according to the nature of the service. Therefore, it is imperative that the specific usability issues that apply to each service are clearly identified, along with the corresponding stakeholder requirements for each resource.

For example, the usability issues surrounding virtual map libraries differ in some aspects from those of other digital libraries (DL's) due to the specific type of information they preserve and display. The technical nature of the information means that the interface must provide visualisation tools that all users can utilise. Hence the system's usability, especially in terms of interface design, must be strongly correlated with the end-users' productivity. Methodologies that gather user requirements and evaluate usability must also be adapted to suit individual services in some instances. Query techniques like questionnaires need to be designed to specifically extract users' requirements in relation to that service.

The requirements of the different types of users also differ between, and within a service. Some users require a service to offer an abundance of advanced tools, thus providing greater versatility when interacting with the application. Other users however want clearly structured and formulated steps to help them accomplish their tasks, although perhaps at the expense of flexibility.

1.5 Current usability practices within JISC

Our research indicates that JISC's previous application of usability and accessibility techniques have been directed towards specific projects; thus no framework has been established that can be applied to a variety of services.

A usability study of the JISC 'general' web-site was conducted by the Internet Development Group at the Institute for Learning and Research Technology in 1999 (Belcher et al, 1999). The aim was to assess the usability of the web-site at that time, and form part of the JISC web-site 'Consultation Exercise' that was carried out before the re-design of the site in 2000 (JISC, 2000). The standard techniques of questionnaires and interview were used to establish usability requirements. It should be noted that both of these techniques were used to gather information relating to the site's content and layout, as much as to uncovering usability issues. Another part of the 'Consultation Exercise' was an accessibility audit carried out by the Digital Media Access Group from the Department of Applied Computing at the University of Dundee (Gregor et al., 1999). Both of these studies identified problems and delivered recommendations to ensure that the new design was more usable. However, neither provided a detailed methodology or framework that could be applied to other services, so JISC service staff have been unable to use these evaluations as templates for their own studies.

In terms of current JISC usability practices, we distributed an informal questionnaire to the delegates whom attended the JISC conferences in October 2002. We asked their initial views on how usability was currently being practised in their JISC services. This was then followed by a formal questionnaire sent to these delegates via email with these questions:

- 1) Have you previously applied usability testing to your services?
- 2) What techniques were selected?
- 3) Did you find these techniques to be successful in achieving your objectives?
- 4) Were modifications made as a result of the evaluations?

From their feedback, most of the services were aware about usability but not much of it was implemented when designing their services. Most of the services have not conducted formal usability evaluations. Questionnaires were the most common form of usability assessment used. Data on basic usability issues, such as ease of use of their sites or services provided were collected from those questionnaires. Detailed usability issues were not the main focus of these questionnaires though.

Through our research we have identified that usability and accessibility techniques have been implemented by in-house staff with individual services. These include:

- Questionnaires
- Focus groups
- Interviews
- Check lists – World Wide Web Consortium (W3C) (2002)
- Prototyping
- User testing
- Heuristic evaluations
- Automated testing – Bobby
- Web log statistical analysis

While informal evaluations can produce some valuable data, they are regarded as ‘quick and dirty’ since they are devised out of a combination of techniques, thus failing to adhere to any formal methodology. An appropriate formal HCI technique would have been a user testing evaluation where a broad cross-section of end-users rather than staff being the participants. In user testing a participant attempts to complete a number of given tasks, perhaps whilst "thinking aloud" as they do it. The session is generally videotaped for later analysis. After the participant has attempted the tasks a short interview is held. This allows the evaluator to obtain more detailed information about features of the design that the user found particularly positive or negative, and to get suggestions about how to improve the service. The validity and the accuracy of the results are significantly improved when following established usability techniques.

Nonetheless, the findings of the evaluations previously conducted by JISC services were generally perceived as being successful in achieving the team’s goals. Many of the services were also keen to build upon the work they had done, having recognised the significant benefits of usability techniques.

One of the precursors to designing a successful, usable system is internal recognition of the advantages that increased usability and accessibility can provide. JISC appears to appreciate this and are now in the position to successfully build upon the work they have already done in this arena.

The work we have conducted in the Centre for HCI Design at City University will enable JISC to evaluate their services with a unique DL framework that incorporates a variety of established and specifically modified techniques.

2. Usability and Accessibility

2.1 Definition of usability

Usability is a concept that relates to the quality of a service or resource: According to the definition of ISO 9241 (1994), usability is the effectiveness, efficiency, and satisfaction with which specified users achieve specified goals in particular environments. It is the measure of the quality of a user's experience when interacting with a service or resource, which could be a web-site, a software application, mobile technology, or any user-operated device (Usability.gov, 2002).

2.2 Web usability

In term of web services and resources, usability is important because according to recent research (User Interface Engineering, 2001) people cannot find the information they seek on Web-sites about 60% of the time. Similarly, research by Manning et al. (1998) revealed that the consequence of bad site design is that the site will lose repeat visits from 40% of the users. This can lead to wasted time, reduced productivity, increased frustration, and loss of repeat visits and revenue, increased training and increased support costs.

Nielsen (1993) points out that usability is not a one-dimensional concept, but includes a number of components:

Learnability: ease of learning to use the system so that the user can get started rapidly.

Efficiency: once the system has been learned, a high level of productivity should be possible.

Memorability: casual users should be able to return to the system after some period of not having used it without having to relearn everything.

Errors: it should be easy to recover from errors. Also catastrophic errors should never occur.

Satisfaction: the system should be satisfying to use.

2.3 Web accessibility

The power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect. (Berners-Lee, W3C Director and inventor of the World Wide Web)

“Universal Access” is the concept that promotes designing products and services so that they are usable by the widest range of people operating in the widest range of situations as is practical. It involves understanding how users attempt to accomplish tasks using a variety of technologies in different organisational and social contexts (Shneiderman, 2000), Universal Access applies as much to web-based services and resources as it does to any other new technology and is explicitly part of the philosophy of the World Wide Web, as the quote from Berners-Lee indicates.

Universal Access needs to be considered in the development of services and resources in an integral matter, not as an ad hoc manner. This is both the cost effective approach and treats users with disabilities on an equal basis with other non-disabled users. According to Travis (2002), when carrying out usability tests with disabled people, the one comment that they often hear is that disabled people do not want to be treated as "special"; they want to be treated with the same respect as anyone else. Therefore, we should aim to achieve this goal by making sure that a website is *accessible* to disabled users and *usable* by everyone. Throughout this report we will emphasise the close relationship between usability and accessibility, both theoretically and practically.

2.4 Disability Discrimination Act

The Disability Discrimination Act (DDA) began to come into effect in December 1996 and brought in measures to prevent discrimination against people on the basis of disability. Part III of the Act aims to ensure that disabled people have equal access to products and services. Under Part III of the Act, businesses that provide goods, facilities and services to the general public (whether paid for or free) need to make reasonable adjustments for disabled people to ensure they do not discriminate by:

- Refusing to provide a service;
- Providing a service of a lower standard or in a worse manner;

- Providing a service on less favourable terms than they would to users without the disability.

It is a legal obligation on service providers to ensure that disabled people have equal access to web-based products and services. Section 19(1) (c) of the Act makes it unlawful for a service provider to discriminate against a disabled person "in the standard of service which it provides to the disabled person or the manner in which it provides it".

While no web-sites in the UK have so far been pursued under the Act, it does appear that courts will use the W3C WAI guidelines as the accepted standard required for compliance with the DDA (Sloan, 2001). Interestingly, in April 2003 the Disability Rights Commission (DRC) launched a formal investigation (to be carried out by the Centre for HCI Design at City University) into the accessibility of public and private web-sites (for more information refer to <http://www.drc-gb.org/newsroom/newsdetails.asp?id=393§ion=1>). Additionally, under the eEurope Initiative launched in December 1999, the European Commission has committed the Member States to "make all public web-sites and their content accessible to people with disabilities" through the adoption of WAI Guidelines. Although this is a non-legal requirement and only applies to public sector Web-sites, there is also a commitment to review legislation and standards — which could see the initiative extended outside the public sector.

A web-site, however, could comply with all of the W3C WAI guidelines yet still not be usable. Conversely, with the recent research on E-government usability (Ma & Zaphiris, 2003), a usable web-site does not mean it is also accessible.

An important proviso here is that education is not covered by the DDA, but by separate legislation, the Special Educational Needs and Disability Act 2001 (SENDA, 2001). This Act introduces the right for disabled students not to be discriminated against in education, training and any services provided wholly or mainly for students, and for those enrolled on courses provided by 'responsible bodies', including further and higher education institutions and sixth form colleges. Student services covered by the Act can include a wide range of educational and non-educational services, such as field trips, examinations and assessments, short courses, arrangements for work placements and libraries and learning resources. In a similar wording to the DDA, SENDA requires responsible bodies to make reasonable adjustments so that people with disabilities are not at a substantial disadvantage.

So if JISC services and resources are used by people with disabilities as part of their work or personal development, they will be subject to the DDA (as providers of goods and services to employees of educational or research institutions or members of the public); if they are used by students or prospective students, they will be subject to SENDA.

2.5 Benefits of and Return On Investment (ROI) for usability and accessibility

Usability evaluations are effective at all stages of the service or resource development cycle. By applying usability methods in the initial design stage of services such as Digital Libraries (DL's), one can greatly reduce the need for extensive redesign, maintenance, and customer support. Thus, although there is a definite cost to incorporate usability design and usability evaluation within the development cycle, there is a clear return on investment (ROI) to be recouped.

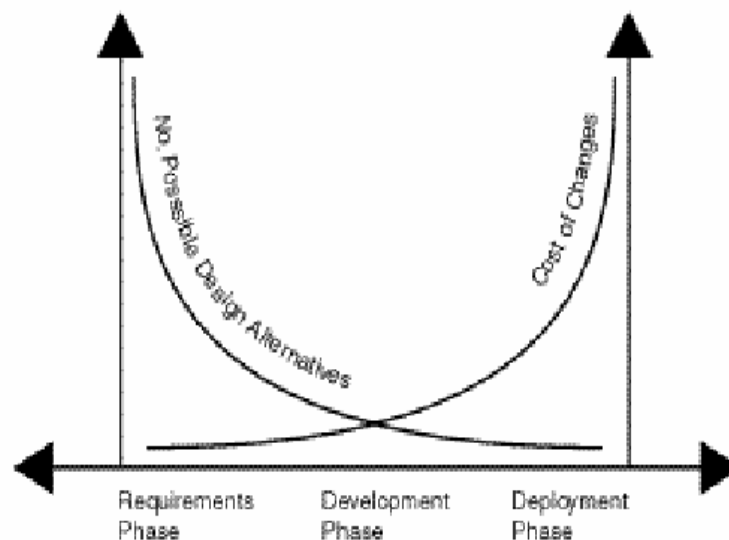


Figure 1: Number of design alternatives and cost of changes at different phases of the design process (from Bias & Mayhew, 1994)

Figure 1, above, shows the fundamental relationship between the stage at which changes might be implemented and the cost of those changes. The earlier in the design process the need for change is identified, the easier and cheaper it is to implement those changes. Thus use of evaluation methods to identify the need for changes early in the design process will yield the greatest ROI,

although identifying the need for change at any stage of the design process will reduce long term cost of user support.

Users of JISC services can directly benefit by usability and accessibility improvements through increases in effectiveness, efficiency, ease of use, ease of learning, and overall user satisfaction and experience. Providers of JISC services can benefit by reductions in the needs for and costs of user training and support as well as maintenance. Taking proactive measures in usability and quality during the initial development stages can thus produce a cost saving rippling effect.

As usability increases user satisfaction and productivity, this leads to greater trust and loyalty from users, and this also results in tangible cost savings. In the first 10% of the design process, when key system design decisions are made, it can determine 90% of a product's cost and performance (Smith & Reinertsen, 1991).

Usability also plays an important role in the users' overall perception of an organisation, in addition to their specific perception of its services or resources (Marcus, 2002).

The following are some of the key benefits that JISC could receive by investing in usability and accessibility work on services and resources:

Savings on redevelopment costs:

Once a system is in development, correcting a problem costs 10 times as much as fixing the same problem in design. If the system has been released, it costs 100 times as much relative to fixing [it] in design (Gilb, 1998).

Increase user satisfaction:

In a Gartner Group study, usability methods raised user satisfaction ratings for a system by 40%; when systems match user needs, satisfaction often improves dramatically (Bias & Mayhew, 1994).

Increase ease of use of services and resources:

Incorporating ease of use into your products actually saves money. Reports have shown that it is far more economical to consider user needs in the early stages of design, than it is to solve them later (IBM, 2001).