

4. Study of Current Practices

4.1 Digital Libraries

In recent years, the information superhighway, the Internet, has become a global gateway for information dissemination. With the ability to share worldwide collections of information, DL's have become one of the common mediums to store and disseminate information by individuals or groups that select, organise and catalogue large numbers of documents.

DL's, generally referred to as 'collections of information that are both digitised and organised' (Lesk, 1997) give us opportunities we never had with traditional libraries or even with the web. DL's are emerging and the digital computer is the technology that has enabled Bush's 'memex' to be finally realised. Bush (1945).

According to JISC, a DL may be defined as an organised collection of digital resources accessible by means of an electronic catalogue or other form of finding aid. It includes conventional library catalogues such as the Online Public Access Catalogue (OPAC) as well as newer resources such as e-journals, records from special and archival collections and multimedia resources. A DL system is the software environment that underpins the library catalogue and other resources. The system may be wholly or partly accessible via an Intranet or the Internet. It may often integrate access to virtual versions of library services, such as reservations, registration and reference enquiries offered, particularly to distance learners. The term DL resource refers to a resource that is associated with or part of a DL. The linking to local DL systems is defined as systems that are available within the local institution.

JISC currently funds a number of projects and programmes to develop a national infrastructure for access to DL resources in the UK. JISC is supporting the management and preservation of institutional and community records and digital materials. Preservation of digital resources will be of increasing importance for a wide range of activities and materials within UK further and higher education. The sector invests substantial sums in subscriptions to e-journals and in addition is investing heavily in digitisation and in arts and scientific data in digital form. The organisation aims to provide a strategy and a range of information and advice sources that assist in the wider process of digital preservation.

DL's consist of four main components:

1. Information referring to the content of a DL
2. Structure referring to the metadata of objects described in the DL collection.
3. Interaction elements referring to the dynamics of searching and browsing, screen design, dialogue between end-users and the DL's
4. Propriety referring to security, ethical, copyright issues, etc.

Studies have shown that users have great difficulty using relatively basic OPACs. These difficulties are mainly caused by issues such as difficulties in learning to use any new piece of software, difficulties in getting to know the structure of where information lies in a library and difficulties of using Boolean search operators.

Current design of DL's contains complex facilities including text search, functionality relating to hypertext, multimedia, the Internet and highly interactive interfaces.

As a DL is more complex than simply a web page, it is reasonable to assume that a lot more work has to be focused on usability in order to ensure having a more usable DL than conventional web pages. DL's are just more than web-sites or a place for information storage. In order to design usable and accessible DL's, it is essential to have knowledge about who the users are, what they will use DL's for, their context of work and the environment in which the DL's will be used, as well as the technical aspects of the DL's and the feasibility of that in logistical terms. When designing usable DL's, it is important to be aware that special usability issues such as knowing the tasks and populations of users as well as the cultural diversity issues of users should be taken into account as these are all important aspects in producing truly usable DL's.

Dix et al (1998) suggested that even if the best methodologies and models are adopted in the design of a usable interactive system, it is still necessary to assess the design and test the system to ensure that it behaves as expected and meets the user's requirements. Therefore, there is a need for a usability and accessibility framework that supports the development of effective solutions for DL's in order to produce truly usable and accessible DL's.

When designing and building DL's, it is important to take account of existing usability research in the area of traditional libraries as well as research in the area of information management. To ensure a good, usable DL is produced with high performance and users' satisfaction, it is

important that not only the advantages of digital information are embraced, but also to retain the advantages of print, drawing upon expertise, and knowledge from both the DL as well as the information and library science communities.

Current research (Theng et al., 1999) evaluated DL's which provide similar services to some of the DL's services funded by JISC. These libraries are:

- The Networked Computer Science Technical Reference Library (NCSTRL)
- The New Zealand Digital Library (NZDL)
- The ACM Digital Library (ACMDL)

These services are all available to the general public and are good examples of DL's found on the web in terms of their information and coverage according to the evaluators.

NCSTRL is an international collection of computer science research reports and papers made available for non-commercial use from more than 100 participating institutions and archives. (<http://www.ncstrl.org>). NZDL comprises several demonstration collections such as computer science technical reports, literary works, Internet FAQs, and the Computists Communique magazine (<http://www.nzdl.org>). And for ACMDL, it consists of a vast resource of bibliographic information, citation and full-text articles (<http://www.acm.org>).

Questionnaire results in the research show that users' overall impressions of DL's are determined by how effective the DL's are in helping them to complete the tasks successfully.

In performing the 'Search' tasks, it was found that categorisation is important for a successful search result. While for the 'Browse' tasks, it was found that confusing layout of the site prevents users from browsing the site effectively.

Based on the DL study conducted by Theng et al. (1999), areas of design flaws were evident in their DL's evaluation and need improving. The main issue was to provide better navigation support mechanisms to address the 'lost in hyperspace' problem. Navigation here is used in terms of end-users' confidence in navigating within the DL. Users experienced some degree of 'lostness'. This relates to the 'lost in hyperspace' problem referring to the following phenomena:

- The problem of not knowing where they are in the DL

- How to get to some other place they know (or think) exists in the DL
- How to return to a topic left previously
- The problem of forgetting the key points covered

Soergel (2002) developed a framework for DL research. His research proposed some guiding principles for the development of DL. The principles that related to usability issues were:

- DL's need linked data structures for powerful navigation and search.
- The interface for the DL's should guide users through complex tasks
- Innovative DL design should be informed by studies of user requirements and user behaviour.

First, as much of the knowledge base and intellectual assets of institutions and staff are now in digital form, unless significant effort is put urgently into digital preservation and securing long-term access to these digital resources, uncertainties over archiving will continue to impede the growth and take-up of digital services, e-science, and new working practices. Second current investment in digitisation and digital content will also only secure short-term rather than long term benefits.

In building DL's for JISC, it is important to consider key principles so that these libraries will be easily usable, and have long-term archival value:

1. Declarative representations of documents should be used.
2. Document components should be represented using natural forms, namely objects that can be manipulated by users familiar with those objects.
3. Links should be recorded, preserved, organised and generalised.
4. There should be a separation between the DL and user interfaces to it.
5. Searching should make use of advanced retrieval methods.
6. Open systems that include the user, and where (some of) the functions of librarians are carried out by the computer, must be developed.
7. Task-oriented access to electronic archives must be supported.
8. A user-centred development approach should be adopted.
9. Users should work with objects at the right level of generality.

4.2 JISC Digital Library Services

In this usability evaluation study for JISC Information Environment four types of service were evaluated:

4.2.1 Resource Discovery Services

In order to improve resource discovery over the Internet, there is a need for better interaction between a user carrying out the search and the search system. Resource Discovery Services (RDS) improve the current search engines and offers better search accuracy for the users by using their profile information. From the European funded project GESTALT (Getting Education Systems Talk Across Leading Edge Technologies), a list of user requirements for RDS was identified. According to the list:

- the user environment should be multi-platform
- the user environment should be easy to use (technical and non-technical users) and should provide fast response times
- different actions (search, filter, retrieve) should be integrated in one consistent user interface: use-standardised interface for all searches.
- the user environment should support Internet access and a number of different access networks (e.g. ISDN, ATM)
- the user environment should keep a trace of the different actions performed by a specific customer. The system could use information generated from previous searches

And in terms of the search facility:

- the search utility should be fast and easy to use
- the search result should provide the user with all the information he/she needs about a product or services
- the search engine should confirm the authenticity and quality of the product and supplier
- the search facility should support multi-type and multi-level searches

The resource discovery service requires the development of a user profile service where users are allowed to enter and manage information about themselves together with their service requirements, and this information will then be used by the RDS to improve the search facilities.

Comparative Services

- Academic Info – The Social Science Gateway <http://www.academicinfo.net/subsoc.html> - This social science information gateway aims to improve access to online educational resources by developing an easy to use subject directory covering each academic discipline. In terms of usability, this site has a simple and basic interface design. However, the visual hierarchy is not clear enough and it has a rather limited collection of resources available. The information does not categorise according to resource type but only by alphabetical order, the search function is not obvious enough to users as well, which makes finding specific information a difficult task to complete.
- The Voice of the Shuttle <http://www.mirror.ac.uk/sites/vos.ucsb.edu/> - The Voice of the Shuttle is a web directory for academic research which provides information resources to a broad range of categories not just limited to social science resources. However, the visual hierarchy is not clear to users with poor navigation structure. The links provided are not obvious whether they are clickable or not, and the site contains a number of broken links which makes it not usable at all.
- Social Science Virtual Library <http://www.clas.ufl.edu/users/gthursby/socsci/index.htm> - The Virtual Library is the oldest catalogue of the web, started by Tim Berners-Lee, the creator of html and the web itself. It is a non-commercial service run by a group of volunteers, whom compile pages of key links for particular areas in which they are experts. This site mainly categorises the resources according to alphabetic order, the navigation is simple and easy to use but the site does not have breadcrumbs (on a Web site, a breadcrumb trail is a navigation tool that allows a user to see where the current page is in relation to the Web site's hierarchy) to tell users where they are within the site. Users might experience degrees of 'lostness' while browsing the site looking for information.
- Infoglobus – Social Sciences Gateway <http://social.narod.ru> - Infoglobus is a Russia- based online resources for social scientists. The links are not obvious whether they are clickable or not and the visual hierarchy is not clear as well. In particular, the site does not clearly tells users how to change the default language from Russian to English, which makes it non-usable for users who have no knowledge of the Russian language.

- The Pinakes <http://www.hw.ac.uk/libWWW/irn/pinakes/pinakes.html> - Pinakes is a web page that provides Internet resources by linking to other major subject gateways. The image icon associated with each link enables users to easily spot the subject gateway that relates to the subject area or specific information that they are looking for. The categorisation of the site is a bit ambiguous though, as some of the links were categorised as 'multi-subject gateways' while the rest of the links have no category at all.

4.2.2 Bibliographic services

Bibliographic services contain databases in a form of ‘an organised collection of information’. The database contains descriptive information (citation and subject headings) for publications, such as books, periodical articles, videotapes or government documents. According to Aalberg (2002), when users have vaguely defined information needs and prefer to explore which publication is available by browsing the catalogue, it is important to have a meaningful navigation path to assist their search.

The structure of the database generally consists of the following information:

Index- includes citation and subject headings, also known as descriptors, for each publication.

Abstracted Index - includes the citation, subject headings (descriptors) and a summary of the content of the publication.

Comparative Services

Most publishers offer table of contents alerting for their own journals. For example:

- Elsevier <http://www.elsevier.nl/homepage/alert/?mode=direct> (Alerting service) and Springer <http://link.springer.de/cs/service.htm> (Alerting service) - Elsevier’s includes books in its table of contents and the site has a clear visual hierarchy and clickable items are obvious to users. However, some of the links in the navigation bar split into two lines which makes it difficult for users to identify each individual link. For Springer, the visual hierarchy of Springer’s site is also clear to users and the site is divided into sections with primary navigation and secondary navigation in its hierarchy, which makes it easy to navigate. Clickable links and buttons in part of the Springer site (e.g. the Alert services) are not obvious enough though, which needs improvements in these areas.
- There are also specific products such as ISI's Current Contents Connect (<http://www.isinet.com/isi/products/alerting/>) that provides alerting services to users.
- MedFetch <http://www.medfetch.com/> uses Medline to provide subject based alerting services. Users may find difficulties in navigating the site as the site does not have a clear visual hierarchy. Some terminologies are not clear to users as well and the search function is not obvious to users.

4.2.3 Virtual map libraries

Geo-spatial data resources like virtual map libraries are increasing in availability, size and complexity. However, the expected growth in numbers of users related to research in higher education has not materialised. One possible reason for this is the steep learning curve associated with effective use of spatial data (KINDS, 2003).

Research over the past decade has revealed that inappropriately designed interfaces have led to problems regarding the usability and accessibility of the services.

When paper maps were the sole tool for visualising geospatial information there were many efforts by the geospatial community to provide tactile or tactual maps for the visually impaired... so as to not exclude certain members of the community. Similarly, research has produced guidelines for use of colour on maps (and other displays) that minimises interpretation problems for those with colour vision impairment... The same needs to be done for contemporary visualisation products. Access to geospatial information, and the interfaces that provide the “gateways” to this information, need to be designed in sympathy to all users, so as to ensure equality of access and use (Cartwright et al., 2001).

Davies and Medyckyj-Scott’s (1994; 1996) (research in the mid 90’s identified key usability problems that effect Geographical Information Systems (GIS) user interfaces. Issues that also need to be addressed with regards to web-based virtual map libraries:

- Non technical end-users are often unable to adapt the interface to their preferences and comfort.
- User interfaces should comply more thoroughly with national, international and proprietary interface standards, to enable users to transfer existing computing knowledge and skills to the GIS and thus increase learnability.
- Extra functionality should not be brought in at the expense of usability.
- Problems of ease of use can only be solved through better design. Longer training courses have not compensated for poor usability.
- The system usability, especially in interface display is strongly correlated with users’ productivity.

(Davies & Medyckyj-Scott 1994 and 1996)

Fabrikant (2001) therefore notes that to help overcome these issues, the geo-visualisation community needs to focus upon two specific goals:

1. The need to develop task-centric visualisation tools.
2. The need for sound usability evaluation procedures.

Current usability practice

Usability evaluations of web-based geo-spatial information providers have developed on the back of this previous research, and have begun to be carried out in recent years.

- Researchers at Oregon State University reviewed several large clearinghouses including the National Geospatial Data Clearinghouse (Walsh et al., 2002). The established usability assessment methods that were applied to their study included a user expectation survey and user testing evaluations.
- Associate professor Moller-Jensen from the University of Copenhagen has recently conducted query based evaluations and low fidelity prototyping to ‘...monitor the interaction between a group of relatively inexperienced GIS-users and a standard internet map server (IMS) application’ (Moller-Jensen, 1999).
- Researchers at Manchester University have also noted that ‘accessibility and usability of spatial data sets are major bottlenecks to increasing the number of users and applications’ (Li et al, 1999). Thus they have applied HCI principles in the development of the Knowledge-based Interface to National Data Sets (KINDS). KINDS provides a virtual map library that comprises of a full UK national coverage directory and sub directories named after the corresponding tile of the National Grid. Its key aim is to ‘...increase awareness, accessibility and usability of spatial data sets’ (KINDS, 2003). A user survey including semi-structured interviews and a technical questionnaire were conducted to assess the users' requirements.

The key findings from these studies indicate that ‘new users face a significant learning curve when adopting spatial data... The combination of high level technical skills required often result in spatial data handling being the preserve of the highly technically competent’. To overcome these issues, the evaluators note that user friendly, easy to access and flexible interfaces need to

be developed, thus enabling all users to browse and handle spatial data effectively (Li et al, 1999).

Comparative services

JISC offers a variety of geo-spatial services including:

- Landmap <http://www.landmap.ac.uk> - Orthorectified satellite image mosaics of Landsat, SPOT and ERS radar data and a high resolution Digital Elevation Model for the whole of the British Isles. These data are in a form that can easily be merged with other data, such as road networks, in order that any user can quickly produce a precise map of their area of interest (JISC, 2003a).
- Digimap <http://edina.ac.uk/digimap> - Comprehensive selection of Ordnance Survey® (OS) digital map data and high-quality cartographic products, including: Land-Line.Plus, Meridian, 1:50,000 Scale Colour Raster, Strategi, Land-Form PANORAMA Contours, Land-Form PANORAMA DTM, Gazetteer and Codepoint with Polygons (JISC, 2003b).

Some of the services these resources provide are unique. However the interaction and design of services like the Basic Mapping interface on Digimap can be compared to that of other services, especially since the user interface is one of the most important aspects of a geo-spatial information system. The sites below all offer web-based mapping services that follow established web design guidelines, such as providing icons to navigate their way around the site and manipulate the data. Li et al note that ‘potential spatial data users can gain information about the data set far more easily by browsing its contents than by reading a textual description’ (Li et al, 1999). Factors such as this can enable a comparative assessment of the usability and accessibility of these services, and those provided by JISC to be carried out.

- The British Geological Survey <http://www.bgs.ac.uk/geoindex/index.htm> - Geoscience Data Index mapping facility that allows users to generate OS maps that identify key areas of geological interest i.e. boreholes in a region.
- GeoWeb North Van GIS <http://www.geoweb.dnv.org/maps/index.html> - Grid maps that divide the District down into small sections, or grids, that show small areas in great detail. The site additionally offers maps displaying one theme across the entire District.

- MultiMap <http://www.multimap.com> - A commercial mapping service that allows users to view the retrieved data in twelve different scales. Panning options assist the user in their tasks.

4.2.4 Digital image libraries

The number of images available on the Web was estimated in 1997 to be between 10 and 30 million (Eakins & Graham, 1999), a figure that we can assume has vastly increased in the past five years. Digital image libraries are now a key resource in retrieving such images over the Internet, but users often find it hard to access the information they want for:

- Interfaces are non intuitive.
- Users do not know what information is available.

One reason for this, as proposed by Bird (1999) is that ‘...little attention has been paid to the user requirements and expectations associated with content-based image retrieval’ (a technique for retrieving images on the basis of automatically-derived features such as colour, texture and shape).

It is noted that more research is also required about ‘...how users can usefully be segmented into different types, the needs of these types, and the implications for retrieval systems design’ (Eakins & Graham, 1999). With their involvement in the NSF International DL’s Program JISC is helping to uncover these issues and thus increase the usability and accessibility of digital image libraries. The Visual Arts Data Service (VADS) has also spearheaded this movement by establishing standards and good practice for visual arts digital resources (Grout *et al*, 2003). The document further addresses usability issues such as consistency and navigation of the user interface.

Research into the usability of digital image interfaces, with special reference to the use of colour selection in content-based image retrieval (CBIR) systems, has been conducted by the Nijmegen Institute for Cognition and Information (Van Den Broek *et al.*, 2002). They have identified that many CBIR interfaces are difficult to use and non-intuitive. Therefore, available information concerning the users' cognitive abilities should be considered regarding all three components of CBIR-engines:

- Definition of the query by the user (i.e. in-put of content)
- The image retrieval engine, conducting intelligent image analyses (i.e. based on and adapted to the users' characteristics).

- The presentation of retrieval results (i.e. the output to the user).

Image libraries also need to be accessible to all users. One of the key requirements to enable visually impaired users who use a screen reader is for webmasters to include an alt-text whenever there's an image, thus describing an image, like "London Bridge." .

Current usability practice

Many international parties, as outlined by a few of the key studies below, have conducted usability and accessibility research into digital image libraries over the past years:

- A review of content-based image retrieval services was conducted by Venters and Cooper (http://www.jtap.ac.uk/reports/htm/jtap-054.html#_Toc482422975) from the University of Manchester in the 1990's (a study funded by JISC). The authors conducted heuristic evaluations on two web-based image services, ImageFinder and IMatch. The evaluations involved an examination of the user interface against Nielsen's ten heuristics to identify any usability problems.
- The Applied Science & Technology Group, IBM UK Laboratories have conducted a user study of CBIR as part the European Union funded Electronic Library Image Service for Europe (ELISE) project. The ELISE project is concerned with the issues that surround building a complete digital image service. The usability study was based around IBM's QBIC (Query By Image Content) technology, and consisted of images of cultural artefacts from ELISE (Day, 1999).
- The Digital Knowledge Center (the DL research and development department of the Sheridan Libraries) has worked with other library departments and groups outside the library to evaluate the usability of a variety of web-sites. They have worked with Special Collections to conduct an online survey of the prototype for the Roman de la Rose site, and are currently working with them on the digital sheet music harvester usability project (DKC, 2003).

The studies above uncovered a selection of usability problems. Venters and Cooper (http://www.jtap.ac.uk/reports/htm/jtap-054.html#_Toc482422975) noted that uncommon interface elements contributed to usability of IMatch's web-site. For example the icons used for

copy and *delete* functions did not correspond with standard Windows icons. Additionally, it was found that services such as Imatch could be improved by implementing more consistency via a Multiple Document Interface (MDI) environment, rather than presenting the user with two related, but separate interfaces. The Digital Knowledge Center in conjunction with the Roman de la Rose digital image library have also used the feedback from their usability surveys to make amendments to their original design, thus producing a more user friendly service.

Comparative Services

JISC has a variety of digital image libraries:

- Bristol Biomedical Archive <http://www.brisbio.ac.uk> - 10,300 online biomedical images, from ILRT at the University of Bristol, covering the fields of medicine, dentistry and veterinary science and intended for use in teaching (JISC, 2003c).
- St Andrews University Library Image Collection <http://www.helix.dmu.ac.uk/> - 15,000 online images delivered via the HELIX Project at De Montfort University (JISC, 2003d).
- Visual Arts Data Service <http://vads.ahds.ac.uk> - Contains ten collections from JIDI (the JISC Image Digitisation Initiative) providing online teaching and research materials which focus on image collections as well as web-sites across a range of visual arts subject areas, including student degree show material (JISC, 2003e).

The services below offer similar services to those provided by JISC, and have similarly attempted to address issues regarding the ease and effectiveness of retrieving images, thus initiating best practices for these resources.

- Picture Australia <http://www.pictureaustralia.org/index.html> - Internet based service that allows you to search many online pictorial collections at the same time. Images can be searched for via standard search box, collection or theme.
- The Metropolitan Museum of Art <http://www.metmuseum.org/home.asp> - The museum's photographic services department maintains a digital operation that supports both archival and collections-management functions throughout the institution.