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Introduction

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Earliest Libraries

Clay tablets have been used to keep records from the earliest times. However, they were used for archives rather than libraries and consisted mainly of administrative records. Private and personal libraries containing books first appeared in Greece in the 5th century BC. The Royal Library of Alexandria was founded in the 3rd century BC and was reputedly the largest library in the world. It was linked to a museum, or research centre, and appeared to be primarily devoted to editing Greek texts on papyrus scrolls. The library was initially organised by Demetrius Phalereus who wrote about history, rhetoric, and literary criticism, and was a student of Aristotle.

One of the most important libraries in Persia established in the 7th century was that associated with the Academy of Gundisaphur, which offered training in medicine, philosophy, theology and science. It was the most important medical centre of the ancient world during the 6th and 7th centuries. In the 8th century Iranians and Arabs imported the skill of paper-making from China, and by the 9th century, public libraries started to appear in many Islamic cities, although they were later destroyed by invaders. However, the contents of the texts were copied by Christian monks and were added to texts from Roman, Greek, and Byzantine works. Library design at the time reflected the labour intensive process of hand-copying of texts and the need to keep them secure. Thus librarians chained books to lecterns or shelves. Today Radio Frequency Identification (RFID) can be used if we wish to know where a book is located.

The first public libraries in the west were established under the Roman Empire and readers could access scrolls and works in Latin and Greek. Between AD500 and 1000, starting with Monte Cassino in AD529, monasteries became the focus for projects involving the writing and copying of books. They were centres of intellectual discussion and education and welcomed priests who came to study and learn. Some of these eventually developed into Universities.

Printing Press

In 1455, Johann Gutenberg used movable type, oil-based ink, and a wooden printing press to produce the first printed book. It was instrumental in the developing Renaissance, and later assisted in the scientific revolution a hundred years later. The printing press led on to the mass production of books, broadsheets, newspapers, and media in general. A book provided an irreducible deposit of information that could be read, reviewed, criticised, as well as providing the basis for the development of its ideas into further volumes. A book also carried with it the idea of context – the set of historical circumstances giving rise to its production, as well as the knowledge to which its author had gained access.

Computers

The first computers can be traced back to the late 1940s and were very successful in automating numerical calculations on data. It was this automation which started the information revolution. However, it wasn't until the development of the early consumer computers in the late 1970s and early 1980s that sufficient processing power became generally available and, more importantly, the software to allow the easy manipulation of text. Decreasing costs of memory soon enabled large amounts of text to be stored and processed, and also the inclusion of pictures with equal facility. This provided the environment for the first electronic book. It was also significant that because the text was held electronically, it could be searched electronically. This facilitated the automatic creation of indexes as well as allowing the reader to search the text for any words or phrases they wanted.

The Internet

Although the foundations of the Internet can be traced back to the development of networking concepts at the Defense Advanced Research Projects Agency (DARPA) in 1962, the implications of networked connections for mass use did not come to the fore until the development in 1989 of the World Wide Web - an Internet-based hypermedia

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initiative for global information sharing. It was the linking of information via the Internet that provided the opportunity for direct access from any point on the network to any other point. This was the key development that initiated the information revolution because it enabled any information placed on the world-wide-web to be accessed by anyone else. It therefore allowed documents to include embedded hyperlinks, digital pictures, and digital videos which transformed linear documents into a hierarchy of information of different types in different physical locations. Using the search tools referred to earlier allowed particular pieces of information in documents to be located from a user anywhere on the Internet. This process has been automated to a high level of sophistication by search engines. Further developments in this area are taking place both to provide more digitised content and to increase the sophistication of the search techniques.

Digital Futures

The development of the Internet provided the framework for linking information and people. Asia has the largest number of Internet users (400m) compared to Europe (300m) and North America (200m) as at the start of 2007. However, in Asia this is only 10% of the population of 3.7bn, whereas in Europe it is 40% of 800m, and in North America it is 70% of 300m. The greatest potential for further growth is in Asia. The total number of global users is 1bn which represents 17% of the total world population of 6.5bn.

The term 'Information Superhighway' conveys the picture of millions of bits/sec being transported around global networks. However, the key concepts are connectivity and access, not just for business and commercial reasons, but also for social and recreational activities.

Convergence

The convergence of IT, telecommunications and media is bringing about a revolution in the way information is collected, stored and accessed. There are three principal reasons why this is happening – reducing cost, increasing quality, and increasing

bandwidth. Moore's Law results in ever-decreasing costs of processing, storage, and transmission. Digital information preserves content accuracy (e.g. digital television) in a way other systems do not. High bandwidth transmission from one place to another on the planet is now possible. Information is ubiquitous and globally accessible, and can be held and accessed just as easily on a global network as on a local personal computer or in a local library. Distinctions between local and global are fading as the centre of function and access moves from the physical location to the virtual address.

Net Generation

The net generation has come of age and their influence is more pervasive in shaping the design of learning spaces and the provision of current and future information and IT services in many schools, colleges, and Universities. Learning spaces in some institutions have been redesigned to meet these new needs and requirements. The concept of a Third Place has been developed that is neither work nor play but is a combination of the two. A Joint Information Systems Committee (JISC) study on "Designing Spaces for Effective Learning"¹ sets out some of the possibilities.

Location

There is now more location-independent working with mobile devices. There is probably more of this to come as it is in principle more eco-friendly, since it usually involves less travelling to places to obtain information. Location independence also implies greater flexibility for the user, and normally access to digital information is 24 hours a day 7 days a week, and is therefore not limited to the opening times of a traditional library.

Intelligence

Devices are increasingly intelligent and network-ready. User interfaces are becoming more adaptable and flexible, and can be tailored to particular application domains.

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Digital intelligence is becoming seamless and invisible, enabling more attention to be paid to the content and the user's interaction with it. This revolution is having effects on the development and organisation of information and artefact repositories such as libraries, museums, and exhibitions, and the way in which physical and digital aspects are mediated to users. Service providers are in an increasingly competitive market place where the interface to the user is increasingly important.

Environments

Improved toolkits with online audio and video assistance enable the digital environment to be a productive place for the user to study and access information. However, it is generally acknowledged that the readability of information on display screens is usually less than that of printed books or journals, at least for extended periods. It is not a matter of a simple comparison of text on a screen with that on a printed page. Developments in the area of hypertext have enabled electronic documents to refer directly to others in situ, thus a document viewed on a screen is more likely to be a hierarchy of documents. Where the computer has a network connection, this is from a global database of information. Books are linear, not hierarchical.

Digitisation

Mass digitisation projects are bringing traditional library materials online, with consequent changes to the infrastructure of libraries and the role of librarians. One such project is being led by Google and is digitising older printed books with no copyright restrictions. Currently the company has ten agreements in place, including the libraries of Harvard University, Stanford University, New York Public, and the University of Oxford.

The Open Content Alliance, sponsored by the Internet Archive and Yahoo!, is digitising works after seeking permission of the copyright holder, in contrast to Google who assume fair use unless explicitly told not to copy by the copyright holder.

A large number of digital libraries now exist, alongside traditional libraries.

Push versus Pull

Pull services are gaining market share because they are centred on the user and deliver added value; push services may decline. Books and libraries have been typically push services, and publishers are primarily interested in the economics of book production if they are a company with shareholders. With the rise of the Internet, users decide which information they wish to look at and then drill down if an area is of particular interest. Thus service providers seek to provide information which pulls users in. Attractive pull services are often quickly acquired by larger commercial organisations because of their content and existing user base. The open access approach implies a shift from supply-led to demand-led information provision.

Follett Report

A review of library and related provision in higher education in the UK was commissioned in 1992 and reported on at the end of 1993. It was chaired by Sir Brian Follett and the primary aim of the group that was set up was to review:

- the implications of the growth in undergraduate student numbers for library services
- the role of libraries in support of research, given the increasing number of periodicals and specialist books, and their increase in price
- the developments in information technology and the implications for libraries.

It was the first general review of library provision since a report in 1967 by the Committee on Libraries established by the University Grants Committee in 1963.

The Follett Report noted the shift that was starting from libraries as containers of information to information access. It was recognised that it was no longer possible for any single library to contain all the resources required. Shortfalls in space for libraries and materials were noted and urgent action was recommended, given the importance of libraries to the delivery of teaching and research. The Funding Councils accepted the Follett Report's findings and a sum of £10 million was made available in 1995 for

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building work in libraries related directly to student numbers. It was also recommended that the Funding Councils should jointly invest £20 million over three years in support of a series of development projects designed to further the use of IT in a number of areas. These included access and interfaces to national networks (e.g. the Joint Academic Network - JANET), navigational tools, electronic document storage and delivery, electronic journals, databases and datasets, library management systems, library automation, institutional information strategies, and training. The exploitation of IT was regarded as essential in creating the effective library of the future.

Post Follett

Have the developments recommended by the Follett been achieved? The answer is yes, to a large degree. Library space and information access assumed a new priority in University planning and resourcing. Building work extended libraries and provided new facilities for users and more space for archives. The total of £140 million funding was a relatively small amount and with institutions required to contribute two thirds of the funding, it still needed a significant commitment from the institution. However, it did pump prime the provision of expansion space and did act as a catalyst for later building projects. After the three year funding period arising out the Follett Report, the expansion programmes continued due to the new impetus from increased student numbers and the requirements of new technologies.

One key thrust of the Follett Report was to increase the support for research. This has been accomplished by a variety of initiatives including access to e-resources, the provision of datasets funded by JISC, and national access schemes via the Society of College, National and University Libraries (SCONUL). An example of the latter is SCONUL Research Extra – a passport to the libraries of over 150 participating higher education institutions.

A further successful outcome of the Follett Report was the collaboration over IT developments for the future. Key issues such as copyright, liaison with publishers, and access to electronic journals and databases have benefited from collaboration and negotiation at national level. Resources have been obtained at reduced rates and the community has benefited by working together. The Consortium of Research Libraries in the UK (CURL) has sought to increase access to distributed resources (electronic

and print) to all users. The principle of sharing resources and expertise has clearly benefited the local, national and international research community, and is a model for the academic community to follow. It is unfortunate that the current drivers at national level to greater selectivity in research funding and greater autonomy in curricula discourages collaboration on the academic content in UK Universities at a time when there is major collaboration on service infrastructures and access to quality national and global repositories. Such competition is fundamentally divisive and is not in the best interests of UK academia as a whole.

Electronic journals are available from libraries and access is usually provided to all staff and students via campus networks to their desk top or laptop using their username and password. This access is therefore location-independent and is effectively global. A number of projects have been sponsored by the Joint Information Systems Committee (JISC) to prototype IT developments and provide new user services, and in general these have had a significant impact on the development of library services. Institutions are required by the Funding Councils to have a defined Information Strategy, and the senior person for this should take a leading role in the management of the institution. The objective of this was to provide an institutional framework that would ensure proper oversight of the area and a sustainable future.

The use of electronic documents in libraries and increasing access to other libraries and resources via national networks (e.g. JANET) resulted in a degree of overlap between the traditional library and the Computer Centre. In some cases, institutions have merged these services with one overall head. It is an example of converged services and appears to work well, although historically the cultures of the staff have been different (e.g. the former with collections of materials and the latter with the development and support of systems). In recent years these services have been extended in some institutions to include learning support services in general. Some institutions have de-merged library and IT services and strengthened the link between the library and e-learning provision. Other institutions have taken the opportunity to provide new kinds of learning environments that are user-configurable to some degree (e.g. the University of Warwick Learning Grid and the Saltire Centre at Glasgow Caledonian University).

Areas where Follett recommendations have not been so successful were in staffing and the Fielden Report on Human Resource Management in Academic Libraries. However, developments have been taken forward by SCONUL. Management training

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for senior librarians was seen as a key issue and this has been addressed by the provision of the Leadership Foundation. In addition, SCONUL was successful in supporting the development of a leadership course for second tier library staff. SCONUL was also involved in the development of a set of performance indicators to measure quality and impact as well as quantity. Librarians have also been involved in the Quality Assurance Agency's audit process.

The Power of Interaction with Information

Information technology is also being utilised in the context of cultural and arts creative expression. This utilises IT tools and techniques supplemented by video and projection technologies, and tangible and ubiquitous sensors or interaction devices. The latter enables the creative process to be accomplished in a more natural and intuitive manner than current interfaces allow. This will facilitate the development of generic platforms and tools for facilitating creative expression, accessing artistic and cultural material, and developing new forms of communication and interaction between humans and media spaces. Applications include creative work in media production, exploitation of cultural assets, new kinds of contemporary design, facilitating arts and performance, and developing new kinds of museums, which move from passive repositories of collections and artefacts to dynamic and interactive centres of activity and debate. Archives and information are not just seen as content, but also as medium – capable of reinvention, reinterpretation, and recommunication. This has implications for content creation, human/computer interaction, display techniques, and also the next generation of educational and learning environments which can be tuned to human needs and requirements.

Digital Media

The increasing power of computers, speed of networks, and the reducing cost of memory has enabled multimedia information to be handled as readily as numbers or text. One frame of an animation 1,000 by 700 pixels requires 700KB of storage. For 30 frames per sec and 24-bit colour this would need 500 MB. For a 5 minute animation this would require 150 GB (not to mention backups, various revisions etc). Digital

cinemas can receive films via the network and save the production costs of traditional film reproduction – typically \$5 million for the world-wide release of a movie.

The Digital Media Alliance, Florida, defines digital media as “*the creative convergence of digital arts, science, technology and business for human expression, communication, social interaction and education*”. Many traditional media companies now generate their content in digital form for distribution via CD, DVD, or the Internet. Marketing strategies for content increasingly utilise multiple media channels to hit different markets simultaneously. New media forms such as wikis, blogs, podcasts, and the distribution of user-generated content (e.g. YouTube) are all changing the nature of information and how it is stored, accessed, and distributed. Filtering, accreditation, and synthesis of content are created through new hierarchies of peers and information affinity groups on the Internet.

A digital library is a repository where a significant proportion of the assets are in digital form. They are indexed and searchable via electronic means, which is an advantage over paper-based information. When the library is networked, it can provide local and remote access with equal facility.

Remediation

New technology is regarded by some as an intrusion into the more classical world of information and value which will bring its own new kinds of technological values to replace existing aesthetic and cultural ones. In other words, a divorce will be created between the new world and the old world. It can equally be argued that new media achieve their cultural significance by refashioning earlier approaches³. Earlier examples of this are photography refashioning painting, film refashioning stage production, and television refashioning films and radio.

Challenges for Libraries

Information is no longer exclusively library-centric but is also network-centric. The centre of gravity has moved from information provision to information access. Online

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search (via engines such as Google) is replacing physical search. Mass digitisation projects of library collections are accelerating this trend.

Recent discussions have centred round not just *converged* services but also *shared* services. A digitised library does not have to be on an institution's campus any more. National and international networks ensure seamless ubiquity of access. Thus service providers can be anywhere in the global village – bandwidth, distance and time are no longer the primary issues. Librarians who were formerly holders of specialist collections and advisers to users who visited the library are now moving to roles which reflect the increasing accessibility of information.

There are changing patterns of learning, teaching and scholarship – for example in the way information is used and deployed, the ways in which learning is facilitated and measured, and the timescales involved. New genres of scholarly work (e.g. Perseus) exploit the digital library environment to evolve interactions through time, space, and language. Automated analysis of data in publications is now possible. Discipline mark-up languages are available.

Combining the best of both worlds – the traditional library and the online search – to meet the developing requirements of users is a key challenge for the future.

This Volume

The changes that digital convergence is bringing about are substantial and are also likely to be long-lasting. This volume presents key aspects in this rapidly moving field in the areas of libraries, and information sciences, and technology - from international experts who are leaders in their fields.

This book contains contributions outlining the developments in libraries and information access both pre- and post-Follett by many of those who were, and are, closely involved in leading libraries and IT developments (including networking).

Dr Reg Carr

Reg Carr's 36-year professional career in academic libraries, has included 30 years in some of the UK's largest university research libraries (Manchester, Cambridge, Leeds, and Oxford). He has occupied a position of influence and leadership in the developments and innovations in academic research libraries. He was University Librarian Keeper of the Brotherton Collection in the University of Leeds from 1986 until 1997 when he became Director of University Library Services and Bodley's Librarian in the University of Oxford in 1997. He retired in December 2006. He was Secretary of CURL and Chairman of SCONUL and was a member of JISC and Chairman of the JISC sub-committee responsible for overseeing both the influential eLib programme and the development of the Distributed National Electronic Resource. He was on the Board of the international Research Libraries Group from 1997 to 2003. In 2000 he was appointed as an external member of the Board of Overseers' Visiting Committee for the Harvard University Library, and from 2001 to 2005 he was Vice-Chairman of the Digital Preservation Coalition.

The last ten years has been a pivotal decade. There have been technology challenges associated with ensuring that users are able to get information in digital form at the point of need. Management challenges have included how to optimally organise service delivery across physically separate subject libraries within organisations. Estates challenges have included how to provide further space for archives.

This volume reflects the influence that Reg Carr has had upon the field of libraries and information systems, and the contributions from the authors are made in his honour. Readers are also referred to the book published by Reg Carr in 2007⁴.

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