

LIBRARY & INFORMATION COMMISSION

DIGITAL LIBRARY RESEARCH REVIEW

FINAL REPORT

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“Five years ago, the library at my laboratory used to occupy several large rooms and employ 30 people. It has been replaced by a digital library that is now ten times bigger - and growing fast. This digital library is staffed by only 12 of the original librarians who are now amongst the best html programmers in the company. This digital library has become an essential part of our lives and the work output has gone up tenfold in 10 years”¹

Professor Peter Cochrane
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Preface

In November 1998 the British Library Research and Innovation Centre (BLRIC) issued a Call for Proposals for a Review of Digital Library Research. Subsequently the contract to undertake this work was awarded to the Centre for Research in Library & Information Management (CERLIM) at the Manchester Metropolitan University. The Study commenced on 4th January 1999 and was completed on 30th June 1999, forming an input to the deliberations of the Panel drawn together by LIC to consider its Digital Libraries Research Call for Proposals. This Report (with some revisions from the version presented to the Panel) forms the major deliverable of the Review.

The following passage is taken from the Call documentation:

The BLRIC wishes to review the progress of digital library research programmes with a view to determining future priorities for research in this area. The current (BLRIC) programme is mainly made up of projects funded under a call for proposals in the financial year 1996/97.....

In order to help set future priorities, BLRIC wishes to fund a project to analyse the findings of current and recently completed projects in its Digital Libraries research programme. The review should also provide an overview of work carried out under other UK digital library research initiatives and any major overseas initiatives or projects.

The majority of the work undertaken during the Review consisted of desk research, but this was supplemented by an Expert Workshop held in Manchester during May 1999, by interviews and discussions with key players and by discussions during a visit to the United States by the Study Director in late May, when emerging agendas in the US Digital Libraries Programme and the new joint NSF/JISC programme were examined. It should be noted, however, that the focus of this report was on providing the background to enable a Digital Libraries Call for Proposals to be formulated: it is not a comprehensive account of all the digital library programmes around the world and is deliberately selective in accordance with the Study's terms of reference.

During the course of the Review responsibility for the work of the British Library's Research & Innovation Centre (BLRIC) passed to the Library & Information Commission (LIC). To avoid confusion, the work previously funded by BLRIC and now the responsibility of LIC is referred to in this report as LIC/RIC.

The author would wish to acknowledge the input of members of the CERLIM team (Geoff Butters, Zoë Clarke, Jenny Craven, Juliet Eve, Eddie Halpin, Margaret Markland, Shelagh Fisher and Peter Wynne), the invaluable input made by attendees at the Expert Workshop and the numerous contributions made by many other individuals in giving their time to discuss these issues.

Professor Peter Brophy
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August 1999

Part I Background

I.1 Definitions

The term 'digital library' has been in use for a considerable time: Harter² has explored its history and the growth of interest in it, remarking that at the beginning of 1997 a search on *AltaVista* produced 30,000 hits on the topic. The concept itself – of information in organised collections using digital technologies – goes back at least as far as Licklider and his influential volume, *Libraries of the Future*³, published in 1965. This was the result of a two year study, funded by the US Council on Library Resources, into “the applicability of some of the newer techniques for handling information to what goes at present by the name of library work – i.e. the operations connected with assembling information in recorded form and of organizing and making it available for use”⁴. It is noteworthy, however, that Licklider and his team defined their scope from the outset as “functions, classes of information, and domains of knowledge in which the items of basic interest are not the print or paper, and not the words and sentences themselves – but the facts, concepts, principles, and ideas that lie behind the visible and tangible aspects of documents”, a definition considerably broader than any found in the contemporary literature. The recommendation of Licklider’s work, with the target that it should be realised by the year 2000, was the development of a ‘precognitive information system’, defined by reference to 25 criteria which included the ability to:

- ◆ “Be available when and where needed
- ◆ Permit several different categories of input, ranging from authority-approved formal contributions ... to informal notes and comments
- ◆ Converse or negotiate with the user while he formulates his requests
- ◆ Adjust itself to the level of sophistication of the individual user
- ◆ Permit users to deal with either metainformation (information describing primary sources) or with substantive information ... or with both at once.
- ◆ Eliminate publication lag”⁵.

As we shall see, many of Licklider’s issues remain the basis of continuing research.

There are very many definitions of the digital library, and at least as many unwritten assumptions – indeed it is surprising how much ‘digital library’ research has been

carried out without defining the term! The US Digital Library Federation has suggested the following definition:

“Digital libraries are organizations that provide resources, including the specialized staff, to select, structure, offer intellectual access to, interpret, distribute, preserve the integrity of, and ensure the persistence over time of collections of digital works so that they are readily and economically available for use by a defined community or set of communities.”⁶

Although the emphasis on ‘specialized staff’ reads a little oddly, this is perhaps the most useful, widely-quoted working definition. It is probably better than the earlier BLRIC definition which saw digital libraries purely as a development of traditional libraries: “*The digital library* is a term now widely accepted as a description of the use of digital technologies by libraries to acquire, store, conserve and provide access to information”⁷, although, as we shall see, the Call acknowledged the wider work extant in this field.

One connecting thread running through descriptions of the digital library is, not surprisingly, the concept of digitisation itself. Its importance lies, at least in part, in what Atkins⁸ has called ‘digital coherence’, namely that “all the objects in a digital library – sounds, images, texts, and everything else – (can) be treated in essentially the same way, for the first time in the history of libraries”. Furthermore, because what is delivered to the user is a copy which is not returned to the library after use, many of the traditional library assumptions and functions are turned on their heads, as is the economic model on which library services - indeed the whole information chain - is based. Allied to these changes is the issue of networkability - digital material can in principle be delivered across communications networks to any desired location. It follows that the concept of the library collection and library user as place-based has become obsolete, since a library can draw together resources from across the networks and thus may not need a physical presence at all, while the user need no longer visit the library physically to gain access to its resources. This in turn leads to debate about the continuing relevance of the concept of ‘library’ in the digital age: if anyone with a PC and a network connection can access any information in any format anywhere in the world, why do we need ‘libraries’? Answering this challenge – and answers there clearly are – lies at the heart of much professional debate and illuminates the research agenda.

The terminology used in the field can be confusing, especially to those not intimately involved in R&D activities. For the purposes of this study we use the term 'digital library' although 'electronic library' could be used interchangeably. 'Virtual library' is also frequently encountered in the literature, although its definition is even more problematic than other terms - its major contribution is to emphasise that the digital library may, at least in terms of 'collections', have no meaningful physical expression but be distributed across a wide range and large number of sites. The term 'hybrid library' also describes an important strand of research but is not synonymous – it may however offer a better descriptor of the model which should underpin short to medium term research in the field. It has been described by Rusbridge⁹:

“The hybrid library was designed to bring a range of technologies from different sources together in the context of a working library, and also to begin to explore integrated systems and services in both the electronic and print environments. The hybrid library should integrate access to all ... kinds of resources ... using different technologies from the digital library world, and across different media.”

We would suggest that the technologies employed are perhaps wider than this definition would encompass, since old technology (e.g. posting of books or photocopies) remains valid for some operations within a hybrid context. One of the complexities of managing real-world libraries is that old and new technologies have to be made to co-exist within a coherent set of services.

Bawden and Rowlands¹⁰, in a recent report, suggest that twenty 'assumptions' underlying writing in the area of digital libraries can be identified. These range from definitional matters (e.g. "Digital libraries will contain material in digital form") through functions (e.g. "Digital libraries will be concerned with preservation of material") to questions of purpose (e.g. "Digital libraries will promote information literacy"), and provide insights into recent literature and underlying assumptions. Bawden and Rowlands conclude that the term 'complex library', as put forward by Crawford¹¹, offers the best compromise. We would disagree: it seems from our study that, for all its faults, the term 'digital library' is too widely used throughout the world to be displaced, and that although both 'complex library' and 'hybrid library' are terms which well-describe present realities of library services, they do not have the widespread acceptance (certainly outside the UK) which would justify their adoption. Nevertheless, digital library research agendas need to recognise the limitations of a

pure 'digital' library model, especially if they are to have impact on current and evolving practice.

I.2 Approaches

One of the reasons that terminology is so confused in this field is that commentators are approaching the subject from very different traditions. In this report we suggest that digital library research needs to be considered from three standpoints:

- ◆ The development of 'traditional' libraries within the new, networked digital environment – where the main commentators are those with a background in traditional libraries;
- ◆ The emergence of services from origins which have nothing to do with 'libraries', and range from applications of computing research to innovative e-businesses. In this area the term 'library' may be used very loosely, with no intention of making a reference to traditional libraries at all;
- ◆ International/national/regional/local policies, social norms and cultural imperatives, which provide underlying drivers for development.

From the Information & Library Service/Science (ILS) community viewpoint, key programmes would be eLib, the EC Telematics for Libraries Programme and the BLRIC Programme, each of which is described below. But the computer science community's Digital Library research programme has entirely different roots, and the two intersect and connect in what sometimes appears an entirely arbitrary and almost random manner. The most glaring instance of the dichotomy is to be found in the European Commission's programmes, where the library-led Telematics for Libraries Programme at times scarcely seemed to intersect with 'digital library' work in ESPRIT and elsewhere. The two approaches are not in conflict and in a few areas they coincide: the ILS community recognises the expertise of computer scientists in building systems, while the latter pays due acknowledgement to the experience of librarians in metadata and in such developments as Dublin Core. Nevertheless, there is an uneasy separation at times, and an issue for debate is whether the differing perspectives could and should be brought closer together. Or, when we talk of 'Digital Libraries', do we in fact mean different things?

I.3 Contextual Issues

The development of digital libraries, as operational realities delivering services to significant user communities, is dependent on a wide range of technological, economic, legal, social and cultural factors. We suggest that the LIC/RIC research agenda should be pursued as an endeavour predicated on the development of real-world services. While there is relevant fundamental or 'blue skies' research, it would not be a primary focus. This is an issue, however, that should be open to debate.

Across the range of applicable research, it is clear that operation within wide area domains (e.g. the whole of higher education, the whole nation, globally) presents new difficulties and challenges. It is no longer adequate to develop a solution just for one library, since all are now interconnected. This raises a series of issues which must be addressed regardless of the specific R&D question. In this section we highlight four: interoperability, scalability, sustainability and personalisation.

Interoperability refers to the ability of systems to work seamlessly together and for information objects to be capable of treatment in a systematic and consistent manner. The UK Interoperability Focus at UKOLN has been established to assist services to address this issue¹² and has suggested that it might best be viewed from five separate viewpoints:

- *Technical Interoperability* is concerned with the standards needed to enable systems to interact and objects to be stored, transported and communicated.
- *Semantic Interoperability* is concerned with bringing standardisation to the ways in which terms are used to describe objects or concepts. For example, the use of a thesaurus may assist interoperability at the semantic level.
- *Political/Human Interoperability* relates to the exercise of control over resources, such as decisions on whether to make them available, and to the ability of staff to handle complex systems which each pose different problems if the end product is to be brought together as an integrated service.
- *Inter-community interoperability* is concerned to facilitate sharing of information objects and collections across communities. For example, the European commission's Fifth Framework Programme is seeking to encourage sharing across libraries, museums, art galleries and other 'memory institutions'.

- *International Interoperability* includes issues such as language and culture.

In a recent report¹³ we suggested that *Accessible interoperability* is also important, especially for disabled users who cannot access standard GUIs and standard hardware. This is related to the use of common accessibility features which are designed to meet the needs of individual users i.e. ensuring that each object presented to the user is consistent in its access requirements and does not require the user to switch, for example, between different software.

If seamless integration between services is to be achieved, then various technologies and processes need to be implemented to act as 'glue' between services. The Web is largely a presentation layer, and much work needs to be done to enhance interoperability between the systems in the underlying layers to allow seamless services. The Resource Discovery Network (RDN)¹⁴ has been established by JISC, funded for a period of 3 years, to identify and describe high quality Internet resources, and to make descriptions and the underlying resources available online. It is planned that the RDN will develop as a distributed organisation comprising a Resource Discovery Network Centre (RDNC)¹⁵ and a range of distributed providers, operating on an international scale, to common standards and within a policy framework. The RDNC will act as managing agent for content and other service access providers which are established or maintained through JISC funding. It will provide guidance in the development of resource discovery systems and co-ordinate the development of a shared interoperability and access strategy whilst contributing to international standards work and service models, and towards the presentation of distributed content in a seamless, integrated manner.

However, interoperability is not the only generic issue. *Scalability* refers to the ability of solutions to be implemented widely across a whole service or across the whole of a sector (e.g. higher education, the public library network) or perhaps across all library and information services. Very many 'projects' which work well with small numbers of users fail to *scale*, either because the software cannot support larger numbers or because the operational and managerial overheads are too high. For example, a project which relied on users having a particular type of hardware (say a particular sound card) could not be scaled across higher education, though it might just scale across one institution – until the users demanded access from home. More frequently it is the sheer effort and resources required to support a service which

prevent it scaling. Interoperability is, of course, one of the factors which determines the scalability of a service.

Sustainability is the ability of a service to be supported over the long term. Will it be possible for the project firstly to be maintained as a service and secondly to 'grow' with the needs of the users? The first point emphasises that, although extra effort may be required to set up the service, it will then need to operate with minimal overheads and minimal support as one of a portfolio of services offered by the library. The second recognises that the environment and the supporting technologies will develop and change over time, so that the new service needs to be maintained and to grow alongside it. An example of a sustainability problem would be software which was designed exclusively for Windows 3.1. It may have scaled (to an extent) and it may provide reasonable interoperability (after a fashion!), but it would certainly not have been sustainable.

The concepts of scalability and sustainability are linked. So, for example, a careful analysis of both the existing technological base of higher education or public libraries and its likely development, if considered early in the design of a project, can go a long way to ensure that it is both scalable and sustainable. Use of the ATHENS authentication system could be a good example of this. It is already in widespread use, at least within higher education, so scaling should not present problems. Although ATHENS is likely to be replaced in time, any successor system will have to take account of its widespread and growing use and therefore offer some reasonable level of compatibility. It can be argued, therefore, that projects which use ATHENS for authentication are effectively solving their scalability problems as far as authentication is concerned while shifting the sustainability problem onto others – which may not be a bad strategy in this field! ¹⁶

Personalisation refers to the delivery of services to each individual in a manner which fully recognises that user's individual needs, wants and preferences. Where the traditional library has tended, for good operational reasons, to be organised on a 'one size fits all' (or at least, 'all students', 'all staff', ...) basis – with the important exception of reference-type services - the digital library has the capability to recognise, remember and respond to even small nuances of user requirements. Heseltine has written of 'information landscapes' as a key way of conceptualising and realising this idea (see also section II.3 below):

“A landscape is the user’s personal view of the information universe
The landscape metaphor can also be individualized to suit people’s real working needs. Information resources, which are a part but only a part of the landscape, are firmly integrated into people’s working and learning environments. They are not separated out as standalone items. Whereas the concept of the virtual library detaches information resources from real activities, the concept of an information landscape reintegrates them.”¹⁷

In the context of the digital library research agenda we would suggest that the ability of developments to interoperate, to scale, to be sustained in the long term and to address users as individuals are critical issues. Indeed we would argue that all digital library research and development projects should be able to demonstrate that they address these issues.

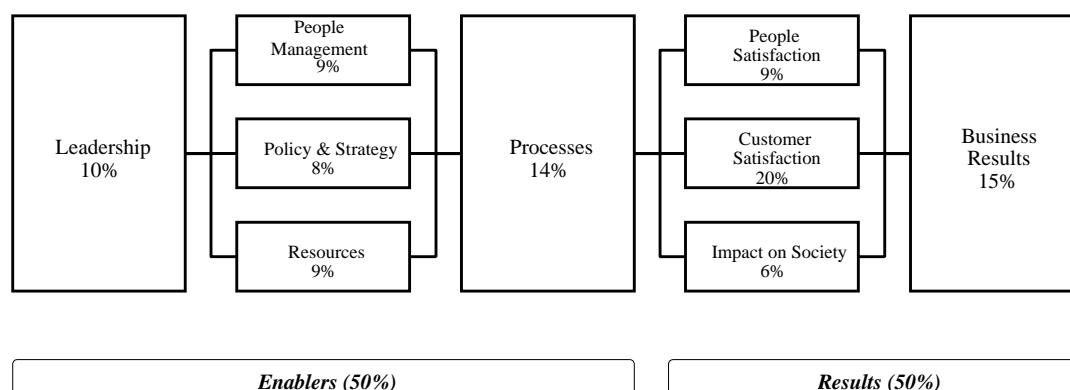
Part II Models of the Digital Library

A number of theoretical models of the Digital Library have been published, and these can be helpful to holistic understanding of the issues which research and development in this area raises. In this part of the Report we summarise some of the most important of these.

II.1 Systems Models

Although not developed specifically to describe the digital library, systems models have been important in developing understanding of libraries as organisations and in library management. The best-articulated description of that approach remains Buckland's ¹⁸ which demonstrates the relationships between resource inputs, processes and outputs, followed by outcomes. In a digital library context, there is clearly a shift in the nature of inputs, processes and outputs (and, maybe, outcomes) but this does not alter the fundamental relationships.

A more recent variant of the systems model has been used in earlier work by CERLIM to address library quality issues. This is the European Foundation for Quality Management (EFQM) 'Business Excellence' model, and may be used to demonstrate the range of issues which need to be addressed in building high quality services, including digital libraries. It is illustrated below (the percentages relate to the contribution each concept makes to the overall assessment of quality and excellence):



One of the important lessons from this kind of model is that the successful digital library is not just a matter of developing appropriate technologies, but depends on the same organisational constraints and requirements as any other service. While in the

research arena we might replace the 'leadership' of the EFQM model with a concept like 'vision', the need to examine services in the round remains.

II.2 Knowledge Models

A study by Owen and Wiercx of NBBI in the Netherlands, undertaken as a Supporting Study within the European Commission's *Telematics for Libraries* Programme, developed what were called 'knowledge models for networked library services'¹⁹: "libraries, as a component of the information chain, act as a link between knowledge sources and users". The authors suggested that they can therefore best be understood as 'knowledge mediators'. In the context of networked information sources, libraries will no longer be "restricted to the catalogue" but will make use of a wider range of tools in fulfilling this function. Three fundamental functions of the digital library were defined in this work:

- ◆ "Making available various types of knowledge resources"
- ◆ "Providing resource discovery mechanisms which allow users to identify relevant or requested resources and their locations"
- ◆ "Providing mechanisms for delivery of specific resources to the user; delivery includes both obtaining a resource when it is not already available in the library, and passing it on to the user in a suitable way."

Owen and Wiercx developed their model further by examining parallels with traditional library functions (such as user support) and then developed a series of 'Application Models' to assist libraries to incorporate networked resources alongside traditional services. In this way their report provided an important contribution to the development of what in the UK has become known as the 'hybrid library'.

II.3 The MODELS Information Architecture

The eLib *Moving to Distributed Environments for Library Services* or MODELS²⁰ project has developed a 'MODELS Information Architecture' (MIA) as a way of describing systems which unify access to service providers through an intermediary while providing flexibility of data presentation to the user – and where the 'user' may in fact be software which processes, analyses and possibly re-uses results in some way on behalf of the human end-user(s). The MIA has been described as both "a

conceptual, heuristic tool for the library community” and “a tool to assist developers as they think about future systems work”.

An extensive description of the MIA has been published recently²¹. In summary, it characterises libraries as ‘brokers’ which both hide the complexities and differences of underlying resource discovery services and facilitate data flows so as to enable processes to be automated. The broker is a ‘trading place’, “where service requests and service providers come together”²². A generalised description of such services includes the provision of:

- ◆ User access, including the presentation of an ‘information landscape’ and support for user profiles.
- ◆ An applications framework consisting of software and data needed to manage the services, passing data between functions.
- ◆ Distributed service interfaces, which determine and control how requests are presented to underlying services.
- ◆ Access control, including the authentication of users and commercial transactions such as payments.

New or revised underlying services are handled by the applications framework and distributed service interfaces without requiring changes to the user access layer, since the service must operate in an environment of rapidly changing target services. Thus adding a new service should be cost-effective (and the library both scalable and sustainable) since it does not require a new user interface to be built.

The applications framework can be defined in terms of four key functions (similar to Owen and Wiercx’s analysis described above): resource discovery, location, request and delivery. These require descriptions of the underlying services, including collection descriptions and interface descriptions (i.e. what information is available and the protocols needed to access it), and profiles of users which enable the system to determine access rights, preferences and so on.

II.4 CRADDL

The Cornell Reference Architecture for Distributed Digital Libraries (CRADDL), part of the US Digital Libraries Programme, defines the core services of the digital library as ‘object naming’ and ‘storage’, ‘object discovery’ and ‘user access’²³. Clearly there

are many similarities between this and the approaches described above, but there are additional emphases which are important to the development of more generic models.

CRADDL emphasises that without effective *naming* conventions and systems effective retrieval is impossible: in the CRADDL model this element consists of the application of Universal Resource Names (URNs) to digital objects, coupled with the provision of a *naming service* which links the URN to physical locations. It thus takes on the traditional library's catalogue-as-finding-tool role, but within a distributed environment.

CRADDL also defines the provision of *index services* which provide the mechanism to enable users to perform structured queries and receive result sets: essentially they are collections of metadata defined according to a criterion which may relate to a physical or virtual 'repository'.

Finally, CRADDL defines *collections* in non-physical terms as "a set of criteria for selecting resources from the broader information space". This is a very important approach because it takes the concept of 'collection' away from 'physical location' (whether physical artefacts or electronic entities on a particular server) back towards the idea of the library creating collections by selecting from the universe of information objects available. In the CRADDL model, however, the collection need have no existence beyond the criteria for its selection: items may be selected for the collection dynamically from a wide range of sources as they are needed. Furthermore, the 'collection' may, through a carefully crafted set of criteria, grow (or even shrink) with the development of its subject. Lagoze and Fielding suggest that this provides three key advantages: location and administrative independence; dynamic information object membership; and extensibility²⁴.

II.5 The 'Control Zone'

Atkinson²⁵ argues that "it is time ... for the academic community to begin work on the creation and management of a single, virtual, distributed, international digital library, a library that has (conceptual, virtual) boundaries, that defines its service operationally on the basis of the opposition between what is inside and outside those boundaries, and that bases that service on the traditional social ethic that has motivated all library operations in modern times". He argues that the role of the

library is to control a systematically selected sub-set of published information, and then to ensure that “such a subset remains stable and accessible over time”. To achieve this he defines five characteristics of such a ‘control zone’:

- ◆ *Core definition* – materials selected by the library on the basis of their content-value and against which material outside the core may be evaluated.
- ◆ *Particularization* – a combination of the *level* of a work and its *significance*, as attested by its being read by specialists and scholars in the field.
- ◆ *Maintenance* – maintenance of the integrity of all objects admitted to the zone, both in terms of physical integrity and authentication – it remains as it was when originally ‘acquired’.
- ◆ *Certification* – moving an information object into the control zone becomes the equivalent of publishing it, so university presses and university libraries are amalgamated in the digital environment.
- ◆ *Standardization and co-ordination* – the use of agreed protocols and standards

This analysis is interesting in addressing one of the major issues of the digital environment, namely how the long-term authority and preservation of digital objects is to be achieved. It suggests that merging publisher and library functions, and undertaking an explicit ‘maintenance’ function, should be seen as important digital library functions.

II.6 Bawden and Rowlands’ Model

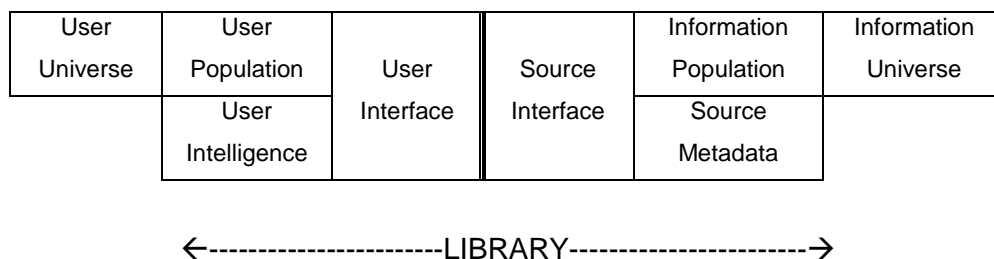
Bawden and Rowlands recent report, *Understanding digital libraries: towards a conceptual framework*²⁶, puts forward a conceptual framework based on Yates’ work-oriented perspective²⁷ and a model adapted from the work of Reid²⁸. An important and most useful aspect of this model is its explicit identification of three ‘domains’ within which understanding of digital libraries can be developed:

- ◆ The **social domain**, which considers information skills and literacy, impacts on organisations and the nature of work, and information law and policy;
- ◆ The **informational domain**, including knowledge organisation and discovery and implications for the information transfer chain;

- ◆ The **systems domain**, including human-computer interaction, software agents and systems architectures.

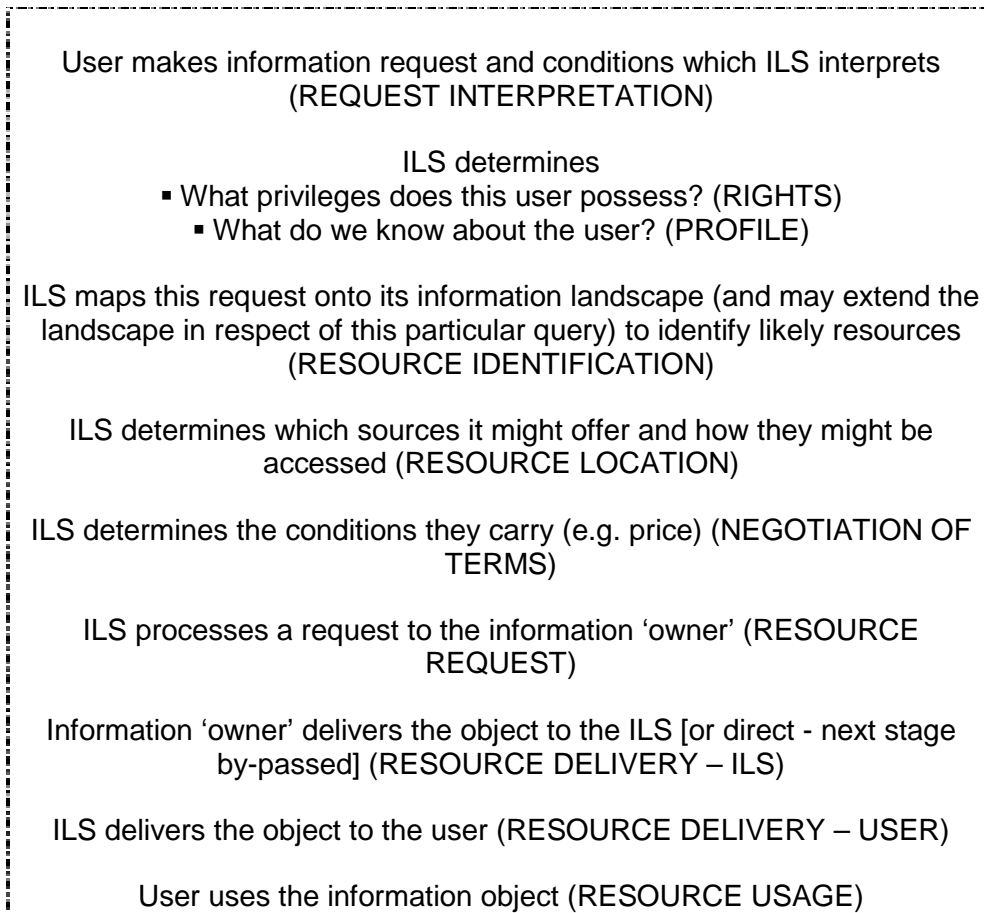
II.7 CERLIM Generic Model

Research in CERLIM has developed a generic model, intended to apply to hybrid as well as digital libraries, which has been used in a number of studies, mainly in the area of performance measurement. An early version of the model was published as part of the eLib 'Management Information for the Electronic Library' study²⁹. A later version has been used in ongoing work in this field and suggests that the digital library is best viewed as an intermediary which devotes attention not just to the digital objects and collections to which it seeks to provide access, but equally to the user population which it serves³⁰.



This model depicts the digital or hybrid library as concerned to identify its population from the 'universe' of potential users, and then to collect intelligence about that population and each individual within it - this is the basis for personalisation of services. The user interface is then designed to enable members of the population to interact with the services offered: it should be noted that the interface can include physical services (such as a helpdesk) as well as IT-based access mechanisms. The mirror image of this activity is the library's selection of information sources from the universe of potential sources, and the creation or acquisition of metadata to describe it. The source interface, as others have described it, enables queries to be routed to appropriate sources and responses to be routed back.

A second model was used in a contribution to the EC PRIDE project to help identify how functional areas may be examined within an holistic model. It is included here as an example only:



II.8 Conclusions

The variety of models described in this section suggest that useful insights can be achieved by theoretical modelling exercises, which not only help to establish the linkages between functions but provide a holistic view, without which individual contributions - whether from research or practice - may be irrelevant or even damaging. It is important that efforts to develop more sophisticated models, and efforts to relate these to practice, are encouraged.

Part III Digital Library Research and Development Agendas

There is a considerable number of related agendas for research and development in this field, promulgated by funding bodies and others, usually with considerable input from practitioners. The practitioner perspective is important and it is noticeable that some of the more successful programmes in terms of service development have emphasised good research-practice collaboration – the Electronic Libraries Programme would be a good example.

In this section we address the more prominent of the digital library research agendas. In general we have not included programmes whose main focus is on digitisation of content, in the belief that this is not primarily a research agenda – although it may raise research questions (see section III.10 below).

III.1 Library & Information Commission

The Library & Information Commission (LIC) issued its research and development agenda, *Prospects: a strategy for action*³¹ in 1998. Based on the LIC's *2020 Vision*, this document provides the basic agenda for UK government-led research, development and innovation in the field. It is important to note that the strategy is defined by the operational needs of libraries and information services moving into key positions within the networked information society: that is, the actions undertaken are expected to have practical outcomes in the relatively short term. *Prospects*, although it acknowledges the importance of fundamental or 'blue skies' research, does not attempt to define the wider agenda.

A typology of research is usefully defined by the Strategy (though some cross-classification should be noted):

- ◆ *Strategic research*: research where “practical applications are likely but cannot yet be specified or where accumulated know-how will serve many purposes” (the *Frascati* definition);
- ◆ *Fundamental or basic research*: theoretical investigation and experimentation which seeks to understand the underlying principles of information management, including data and text storage and retrieval;
- ◆ *Exploratory research*: work with little immediate prospect of application, but which may generate new ideas leading to innovation;

- ◆ *Applied Research*: work which will result in applications or products as well as transferable knowledge;
- ◆ *In-house research*: research within an organisation, the main intention being to benefit that organisation, even though there could be significant gains for others if the knowledge were to be shared;
- ◆ *Demonstrator projects*: projects where the aim is to demonstrate how new concepts can be put into practice;
- ◆ *Action Research*: projects which involve practical, participative and experiential research objectives and techniques.

The Strategy itself identifies three Core Themes and two Fundamental Themes. These are:

- ◆ Core Themes
 - Connectivity: Access to the Information Society
 - The promotion of the role of the Library in ensuring universal access
 - Public Library Network
 - “Much of the R&D to be undertaken is far beyond the scope of the library and information sector alone”
 - Issues include:
 - Management and financial modelling
 - Lifelong learning
 - Integration and subsidiarity
 - Cross-sectoral planning including the National Grid for Learning
 - Social inclusion
 - Content: Resources for the Information Society
 - How best to manage the ‘hybrid library’
 - Preservation of electronic material
 - Content development, including digitisation
 - Issues include
 - Networked resource discovery and criteria for selection for digitisation
 - Licensing, copyright and intellectual property rights
 - Identification and application of standards

- Competencies: Skills for the Information Society
 - The study of personal skills
 - Communication
 - How information is used
 - Information literacy
 - Information management
 - Knowledge development
 - Issues include
 - Skills for the new library
 - A national training strategy
 - Development of new training resources
- ◆ Fundamental Themes
 - The Value and Impact of Library and Information Services in the Information Society
 - The Economics of Library and Information Services in the Information Society

We note that much of the planning in *New Library* and *Building the New Library* is built on the research and development foundation of *Prospects*. This reinforces the view that *Prospects* is primarily a development and applied innovation agenda.

III.2 LIC/RIC Digital Library Programme

The LIC/RIC's current Digital Library programme resulted largely from a Call for Proposals made in 1996. The programme is described as follows:

"The digital library is a term now widely accepted as a description of the use of digital technologies by libraries to acquire, store, conserve and provide access to information. Current digital library research, however, encompasses the whole impact of digital and networking technologies on libraries and the wider information field. Researchers are investigating not only the digitisation of catalogues and collections or the effective use of networked resources but also the meaning of these developments for information providers and users.

The British Library Research and Innovation Centre supports a programme of research projects which explore ways in which digital and networking technologies can support and enhance library and information services. It also seeks to address the issues raised by rapid technological change for

library staff and users. This research is carried out by a number of universities, libraries and other institutions or individuals throughout the United Kingdom. To add value to the programme of research, the Centre aims to bring together those working in the field through conferences and seminars and to foster links with researchers overseas. The Centre maintains especially close links with organisations such as NORDINFO (the Nordic Council for Scientific Information) and the British Library's European national library partners.

The programme as a whole aims to help the library and information community formulate an appropriate and effective response to the challenge posed by the *digital* or *electronic* library. Few greater challenges face our community today.”³²

The projects funded form a somewhat eclectic collection:

- ◆ *Resources for Urban Design Information* (part of the eLib Access to Networked Resources strand, led by the University of Hertfordshire and co-funded with JISC and Sun Microsystems)
- ◆ *REVIEL: Resources for Visually Impaired Users of the Electronic Library* (CERLIM Project, co-funded with JISC)
- ◆ *Journalism and the Internet* (City University)
- ◆ *Digital Libraries, Special Libraries and Social Work Practitioners* (National Institute for Social Work)
- ◆ *Business Use of the Internet as an Information Resource* (University of Strathclyde)
- ◆ *Electronic Serials in Public Libraries* (Loughborough University)
- ◆ *Extremism and the Internet* (CERLIM)
- ◆ *The Internet and Older People* (Monica Blake, Consultant)
- ◆ *Stories from the Web* (Birmingham City Council)
- ◆ *CIRCE: Community Information Resource Service* (Gloucestershire Libraries)
- ◆ *Evaluating the potential of alternative Internet technologies in providing community information* (Queen's University of Belfast)
- ◆ *Open Learning and the Internet* (South Ayrshire Council)

Within the Digital Library area, LIC/RIC funds a number of other actions and activities including, for example, the ongoing work of the UK Office for Library & Information Networking (UKOLN) and specific background studies such as the National Agency for Resource Discovery Scoping Study.

The findings of these projects are, as might be expected, somewhat wide-ranging and most relate closely to the specific issue under examination. Not all have yet finally reported, so the descriptions, quotations and comments on the following pages should not be regarded as necessarily definitive or representative of the programme as a whole:

*Resources for Urban Design Information*³³

Resources for Urban Design Information (RUDI) is one of the eLib Access to Network Resources (ANR) Projects, each of which developed a subject gateway for a specific discipline. The aim was to create a 'one-stop shop' for quality-assured information about the subject, selected by trained experts. RUDI was unusual in receiving BLERIC as well as eLib funding.

RUDI itself was targeted at students, lecturers, researchers and public or private practitioners within Urban Design, Urban Planning, Architecture, Visual Arts, Transport, Geography, Construction, Environmental Conservation and Economic & Social Planning. As with the other ANR projects, the approach proved successful (and, as is noted in Section III.4 below, this was a major strand, and a major strength, of eLib). In RUDI's case, the team were reporting 200,000 requests for files per month in the final quarter 1998.

Considerable effort was expended in creating appropriate metadata for the corpus of resources represented, a process that required very considerable human cataloguing effort. The problem was exacerbated by the lack of a common vocabulary for urban design: a problem which demonstrates the need not only for common syntax but for discipline-dependent thesauri in each defined subject area.

Particular problems were experienced with the need for signed publishing agreements which, in the team's words, meant that 'in the case of any litigation, for whatever reason, the contributor carries the can'. Not surprisingly, many contributors were reluctant to sign such an agreement, and as a result some significant information sources could not be included.

The major issue became that of turning a project into a sustainable service: for example, the Project Team reported that "RUDI cannot compete (with Internet Service Providers) in respect of Web site hosting" and "an early imposition of subscriptions may stifle the resource before it is viable". In general, the project noted that 'the assimilation of a significant (digital) resource is ... a very costly activity'³⁴.

*Resources for Visually-Impaired Users of the Electronic Library (REVIEL)*³⁵

The REVIEL Project undertook wide-ranging investigations into the issues surrounding the accessibility of electronic library services and content to people who are blind or have a visual impairment. The Project explored the wide range of work in this field - from special hardware through software to the creation of accessible text - and created web pages giving links to key sites³⁶.

Among the issues which were researched in this Project were:

- ◆ The roles of different organisations serving blind and visually-impaired people, and especially those active in the development of IT-based services;
- ◆ Methods of making information objects accessible - including audio, tactile, braille and other methods – and their application in digital environments;
- ◆ Web accessibility standards, including the work of the World Wide Web Consortium (W3C) Web Accessibility Initiative (WAI);
- ◆ The accessibility of current digital library services in the UK, both by testing against extant standards and through experiments by visually-impaired users;
- ◆ The legislative position, including the impact in the UK of the Disability Discrimination Act;
- ◆ Metadata issues, including the need for agreement on ways of describing the accessibility of content;
- ◆ Issues associated with user interfaces, including the possibility of customising interfaces and services to meet individual users' needs.

The project presented a design for a 'National Accessible Library Service' (NALS) which would provide a framework within which both digital and traditional services would operate to ensure that blind and visually-impaired people could access the library resources and services which are available to all other citizens. Among other functions, NALS would operate a kite-mark scheme to assure minimum standards of accessibility in all UK libraries

*Journalism and the Internet*³⁷

This one-year project sought to measure the impacts that the Internet is having on the media and on journalism in particular. It categorised journalists and other staff involved in the field, in relation to Internet usage, into seven 'types', the final three being non-users:

- ◆ *Net 'worshippers'* - the young 'computer generation IT whizz kids', most commonly encountered as freelancers and 'not generally seen to be in the mainstream of newspaper production';
- ◆ *The economically-driven* - people working in small newspapers with no library who use the Internet for its wealth of free information;
- ◆ *The pragmatists* - people who use the Internet as one amongst an array of information sources. This is the category into which the majority of information professionals fall;
- ◆ *The occasional dippers* - people, mainly journalists, who use the Internet when other sources fail;
- ◆ *Enthusiastic novices* - people who have heard of the Internet, are intrigued by it but don't know exactly what it has to offer. Both younger and older journalists fall into this category;
- ◆ *Non-believers* - those who are not interested in the Internet, usually for practical reasons. The most frequently cited reason is, interestingly, the problem of authenticating data, but this group also points out that information impoverishment is not a problem journalists experience so they are not looking for new sources;
- ◆ *Resentful dinosaurs* - journalists who see the Internet as a 'threat to their privileged access to information' and 'are not in the least interested in empowerment or democratising the news'.

Of types of Internet usage in journalism, searching the World Wide Web is by far the most prominent.

The major potential issues identified in this Project were: 'information overload', 'authority/quality', 'response times', 'displacement of other sources', 'delegation of searches to end-users' and 'impact on work practices'. However, in all but the last category the findings appear to be that none of these is as yet a major issue – for example: 'there is little evidence to suggest significant displacement' and 'delegation has not increased'.

This Project, based at the UK National Institute for Social Work, examined the ways in which social work practitioners are using the Internet, and looked at the organisational (including library) support which they have. The report notes very small sample sizes and it appears that the study suffered from questionnaire fatigue amongst its target population. It also found that nine of its eleven sample libraries were relying on a dial-up Internet connection with “an identical number identifying themselves as either still learning or being novices in their use of the Internet”. The same number of librarians were “either only vaguely aware or totally unaware of the eLib programme”.

An issue for this kind of population would appear to be the extent to which it is (research) literature based. The lack of an ‘information culture’ was cited by one questionnaire respondent: ‘Social care staff generally have little knowledge of literature, research and practice and no incentive to pursue it. Social work has only a small research focus and very few people read anything beyond occasional glances at *Community Care*’. While this may be an exaggeration, it suggests that before use of Internet sources can become widespread there must be a more proactive research and information culture in a profession.

This Project was designed to investigate the use of Internet-based information sources by Small and Medium sized Enterprises (SMEs) using a small sample of companies in Glasgow and London.

The project found that simple email was the most widely used Internet service; conversely, discussion lists were not used, even after participants had been introduced to each other and to the concept in focus groups. However, part of the reason for this is that by no means all participants had personal email addresses. A number of problems for SMEs were identified: technical barriers (including configuring hardware and software), viruses etc.; lack of knowledge/understanding of Internet searching; lack of time; insufficient Internet connections (in many SMEs, only one); reliance on particular individuals (who may leave); poor technical support from ISPs; poor Web site design; costs; lack of training; fear of time wasting.

The Project suggested that SMEs presently need proactive Internet services which will draw attention to useful information sources and services; a model for what is called a *Staircase of Internet Awareness* is presented. This would enable staff to develop from 'threshold' through 'beginner' and 'intermediate' stages to 'advanced', at which level they would be able to contribute their expertise to 'strategic competitive advantage'.

One issue which could be particularly important is the need to examine process as well as content/medium when looking at SME use, and the need to consider external contacts and agencies as well as traditional information resources (text etc.). The concept of a *virtual SME library/information service* is presented, based on shared resources.

*Electronic Serials in Public Libraries*⁴⁰

This Project, undertaken by the (then) Department of Information & Library Studies at Loughborough University between June 1997 and June 1998, investigated the impact of electronic serials (including newspapers, popular magazines and e-zines) on public libraries. Part of the aim of the Project was to redress the balance of work on access to electronic serials which to date has concentrated on scholarly titles, largely within an academic library context.

The project found that 61% of respondents to its survey had electronic serials, but that on average only six titles were held and these were mainly electronic versions of newspapers (the *Times/Sunday Times* being the most popular). Furthermore, most of these were only available in the main library and perhaps a handful of branch libraries. The overwhelming majority were in CD-ROM format.

The project examined a series of policy issues, such as funding implications, the need for enhanced technical support, complexities of negotiating licences and management issues including performance measurement of electronic serials provision.

Recommendations from this research included:

- ◆ The need for data on the provision of electronic serials in various formats to facilitate the development of national benchmarks
- ◆ The need to extend networks to ensure all public libraries can offer access (which is now, of course, a *New Library* issue)
- ◆ The exploration of Internet-based serials so as to develop gateways, perhaps through EARL
- ◆ A programme to negotiate trial offers with publishers so as to evaluate more titles in context and to extend the range of CD-ROM titles available
- ◆ Collaboration with publishers to achieve solutions to licensing problems
- ◆ The need for public libraries to take an integrated approach to the provision of electronic and printed resources.

*Extremism and the Internet*⁴¹

The *EMAIN* Project explored the ways in which extremist groups, including racists and others, are making use of the Internet and the implications which this has for society, for librarians and for users. The Project showed, providing a range of examples, that the Web has become an attractive medium for such groups and has encouraged the growth of extremist communities. The Project analysed different approaches to the problems this poses: on the one hand there are those who would place limits on the kinds of material that can legitimately be published on the Web; on the other there are those, including many librarians, whose commitment to freedom of expression would lead them to the opposite view. In Britain, librarians need to be aware that they could be liable in law for material which they knowingly allow to be promulgated - for example material which urges racist actions.

Among recommendations of the Project were that there should be

- ◆ Systematic monitoring of extremist web sites;
- ◆ Clarification of the legal rights and responsibilities of librarians in respect of extremist material in the UK;
- ◆ Further investigations of Internet filtering;
- ◆ An informed debate amongst information professionals on the ethical and professional issues;
- ◆ The development of a model Acceptable Use Policy as a guide for all types of library
- ◆ Actions to raise awareness of the issues in the profession
- ◆ International discussion, especially to bring different cultural views to bear and to prevent dominance of one viewpoint.

In this area it is important both to work internationally and to be sensitive to the UK legislative and cultural context, especially as the United States (with its constitutional guarantee of freedom of expression) has been leading research and commentary in this area, yet its legislative basis is entirely different to that of the UK.

*Stories from the Web*⁴²

This Project, based at the Centre for the Child at Birmingham Public Libraries, is designed 'to stimulate the imagination of children and encourage them to share, explore, read and enjoy stories in a geographically distributed, collaborative network environment'. Using a variety of published materials, a web site is being created which provides an interactive environment which is intended to be attractive to children in the age range 8 to 11. The Project is expected to be completed by March 2000.

Although it is too early for conclusions and recommendations to have emerged, the processes of negotiating rights to reproduce material and of developing the Web site have been instructive. Securing the written agreement of rights holders for materials to be used is complex: publishers may not be the only rights holders involved (for example, rights may be held by authors, illustrators, designers and others). With this kind of project, where there is a public deliverable, the rights to the graphics for the web site design along with acknowledgement of the designer need to be negotiated and agreed. Information on these issues is included in an area of the Web site⁴³.

The project will explore a number of issues, including:

- ◆ The impact on library staff, and on their skills and aptitudes;
- ◆ The impact on the institution (both the children's library and its parent library)
- ◆ Whether the development of IT skills by children has an impact on their parents
- ◆ The impacts, if any, on children's reading habits
- ◆ Changes in the way the library is perceived, as the project develops.

Stories from the Web is already providing valuable research findings in particular in relation to children's library services and the use of the Internet. Early findings seem to suggest that providing online access to static literature material (i.e. an online version of a story) is only a starting point. Online literature may need to be supported by online activities to be fully exploited. This suggests that if children's librarians are going to produce effective and successful web resources they may have to continuously develop interactive content for them.

*The Internet and Older People*⁴⁴

This short project examined practical issues concerned with the use of the Internet by older people in the UK based on a literature review, a survey and some interviews.

Noting that there are common misconceptions about 'older people' (and that there is a need to shift from 'viewing older people as frail recipients of welfare' to a perception of them as 'active elders') the Project examined the type of information older people need. It noted that the Internet is particularly useful for information on health and travel, and that local community information is of potentially great value.

Estimates of the use of the Internet by older people vary, but statistics showing that in 1997 6% of Internet users were aged 55+ are quoted.

It is noted that as access to the Internet by older people increases, so too will their use of this resource - and the impact of technologies such as interactive digital television could be significant.

Barriers to use of the Internet by older people include:

- ◆ inexperience of computers in the workplace;
- ◆ difficulty in maintaining computers;
- ◆ physical difficulties with using a mouse;
- ◆ problems with reading screens;
- ◆ psychological barriers.

Anecdotal evidence suggests that older people are beginning to use the Internet in public libraries, and one librarian commented that older people were starting to use email 'because their children or grandchildren were using it'.

The Community Information Research resource (CIRCE) Project examined the feasibility of networking community information between public libraries, including the development of “a local level inter-library demonstrator .. to explore what is possible at present and what needs to be developed” and planning for “the bigger picture – a community information network across the UK”. The project also explored standards for metadata and indexing, integration with larger-scale resource discovery mechanisms and the implications of the *New Library* developments.

Among the conclusions of this project are the following:

- ◆ The need to develop services in full co-operation with other agencies (Essex County Libraries’ *Seamless* Project is cited as an exemplar of this approach)
- ◆ The need for services to act both as information sources and gateways
- ◆ Further work on metadata standards, with an emphasis on unique descriptors within national contexts
- ◆ A broad emphasis for community information which seeks to achieve inclusiveness of all sectors of the community
- ◆ The need for consensus on content with a suggestion that ‘clubs and societies’ information is a logical starting point
- ◆ Further research into community information needs is necessary, including multi-perspective (stakeholder) approaches
- ◆ Technical issues need to be addressed including standards for search and retrieve (e.g. Z39.50), for description (USMARC CIF), location and subject.

CIRCE suggested that a community information demonstrator across a number of local authorities should be pursued as a means of testing out networked approaches. The Project Report also makes suggestions for developing community information services nationally, through a co-ordinating agency such as EARL.

*Evaluating the potential of alternative Internet technologies in providing community information*⁴⁶

[Note: at the time of writing only an interim report on the first nine months work on this Project was available and the description below is based on this]

The aim of this Project is to research and develop Web based community information networks, which will 'enable (local) organisations to format and communicate information and advice in a simple, interactive and easily understandable form'. Three possible scenarios were developed:

- ◆ *Communities as information and advice users* - including the provision to citizens of advice and help in identifying information which is relevant to the problems they are trying to solve, and how to make effective use of that information;
- ◆ *Communities as information providers* - providing opportunities for groups 'to tell others about themselves'. The idea here is that, just as many charities and other bodies now run their own web sites, local community groups could do the same so as to disseminate their own concerns, ideas and successes;
- ◆ *Helping community decision-making* - using the Internet as a tool to enable people and groups to work together, to some extent replacing the traditional meetings and group work in areas such as preparing proposals. This scenario poses the question, 'How can community groups best use Internet tools to work together?'

Implementation will initially be focussed on a community known as 'Southcity' in Belfast, described as 'an eclectic assortment of community support, community action, and community resource centres and groups'. The Southcity Resource and Development Centre has a free access computer suite providing the infrastructure on which the project can be developed. An electronic newsletter ('Southcity Online News') will be among the first tools provided.

*Open learning and the Internet*⁴⁷

The aim of this Project was to demonstrate how Internet-based open learning materials could be integrated with local open learning resources within the public library. The Project was based in South Ayrshire Library's CyberCentre, an innovative development which aimed to provide access to IT equipment and services to the general public, but with a focus on skills development. A learning partnership was set up which enabled the public library to work closely with education providers locally.

The Project focussed on information skills support to the public library users and on the provision of Web-based independent learning materials. Although initially the intention had been to concentrate on open learning packages available online, demand for these was very low and the emphasis shifted to *information* resources to support current learning needs.

A number of useful findings emerged from this work:

- ◆ The usefulness of the Dublin Core standards for metadata, but the need to use an appropriate local thesaurus to provide consistency of terminology;
- ◆ The appropriateness of subject directories which allow users to pursue information skills training in context;
- ◆ Educational background, experience and age appeared to be irrelevant to users' expertise in using the Internet services provided;
- ◆ At the time of the work, public perceptions were of the Internet as an *information* resource rather than an *interactive*, learning medium;
- ◆ Identification of the type of course being offered is a major problem (e.g. some Internet courses are supplements to traditional courses, some are offered with no support for the learner, and so on);
- ◆ Services of this kind make new demands on the skills of librarians, and many public libraries may need to acquire external assistance with technical issues in order to set up Internet based services;
- ◆ The availability of support within the public library is very attractive to users;
- ◆ Considerable work is needed to elucidate the economics of open learning provision in public libraries, bearing in mind particularly the commitment of staff time needed.

In framing our conclusions in Part VI of this Report we have taken into account the findings and recommendations of the current LIC/RIC Programme Projects. Strands which are apparent from this work include:

- ◆ An emphasis on user-centred approaches and the need to understand how users interact with digital resources;
- ◆ The poor level of access to IT, and in some cases unsupportive culture, which act as barriers to the development of digital services with some groups.
- ◆ Issues of accessibility of digital services to minority and disadvantaged groups, including visually-impaired people and the elderly;
- ◆ Concerns for the social and cultural impacts of digital library services, and the roles and responsibilities of library staff in these contexts;
- ◆ The need to shift towards a hybrid approach to the management of library services, blending digital resources with the traditional. The integration of sustainable new digital services into established services is a major issue;
- ◆ Linked to this, the difficulties of managing digital services, including new challenges such as the need for Acceptable Use Agreements, privacy issues, and rights negotiation;
- ◆ Uncertainty about the economic model needed to operate digital libraries, especially where the guiding principle to date has been 'free at the point of use';
- ◆ The need for digital library services to be viewed in a broad context which includes players other than libraries.

III.3 The British Library's Digital Library Programme

It should be noted that the British Library's *Digital Library Programme* (i.e. the Library's own internal programme) is not included in the above activity. The latest statement (May 1999) on this programme is as follows:

“Towards the Digital Library

The development of the digital library will enable the British Library to embrace the digital information age. Digital technology will be used to preserve and extend the Library's unparalleled collection. Access to the collection will become boundless with users from all over the world, at any time, having simple, fast access to digitised materials using computer networks, particularly the Internet. The British Library's initiative will contribute to the creation of a national digital information network together with the "New Library: The People's Network" public library initiative and the National Grid for Learning plan.

The British Library has been using the Government's Private Finance Initiative (PFI) to develop the project. After a market-sounding exercise carried out in spring 1997 the Department for Culture, Media and Sport gave approval for the Library's business case to seek private sector involvement in a financially free-standing project to build digital library services.

After a series of evaluation phases the Library invited a consortium comprising Dawson Holdings plc and The Stationery Office to develop further the proposal which it submitted in August, 1998 in response to the Library's Invitation to Negotiate.

Unfortunately, the British Library and the consortium bidding for the Digital Library PFI have been unable to find a mutually agreeable solution. As a consequence, this negotiation was wound up amicably in early December. Both parties are disappointed at the outcome, particularly in view of the commitment they have made over the last twelve months to working towards a final proposal.

It was always acknowledged that the financially free-standing PFI approach adopted was complex and high risk in the rapidly evolving information market-place. In the end, it has not proved possible to balance the objectives of the Library with the commercial operating requirements of the consortium.

The Library will now explore its options for alternative solutions to its digital library requirements.”

The BL *Vision* for its Digital Library is given in Appendix I.

At the beginning of June 1999 a new procurement process was initiated for a 'Digital Library System'. Appendix I also contains an extract from the published Briefing Document for this system ⁴⁸.

III.4 The Electronic Libraries Programme

In 1993, the UK Higher Education Funding Councils published a seminal report into the future needs and development of academic libraries in the UK. The Follett Report⁴⁹, named after the Chairman of the Committee which was responsible for its production, was the result of a wide-ranging enquiry into the development of library services in a challenging environment where student numbers were rising rapidly, library costs were spiraling and information technology would make as yet unknown impacts. The first of these factors, essentially the shift of UK higher education from an élite to a mass system, was the most pressing political imperative for the establishment of the Committee, but the commitment to explore and take action on the opportunities offered by IT may in the long run prove the most significant.

The outcome of the Follett Report's acceptance by the funding councils was multi-faceted. It resulted in considerable funding being made available for new library buildings, gave impetus to a requirement on institutions to develop their information strategies (which, it may be noted, were emphatically not to be simply IT strategies) and started a process of review of co-operative arrangements to provide access to research collections, which has most recently resulted in the Research Support Libraries Programme ⁵⁰. The IT-related recommendations of the Report, however, were directed to the Follett Implementation Group for Information Technology (with the memorable acronym of FIGIT). FIGIT (working closely with the Higher Education Funding Councils' Joint Information Services Committee (JISC), Information Services Sub-Committee) in its turn set up the Electronic Libraries Programme (eLib): presently, following various administrative changes, eLib comes under JISC's Committee for Electronic Information (CEI).

The first two major Calls for Proposals under eLib resulted in the funding of almost 60 projects, under a number of programme areas:

- ◆ Electronic Publishing
 - Electronic Journals
 - Pre-prints and Grey Literature
 - Quality Assurance and Teaching
- ◆ Learning and Teaching
 - On Demand Publishing and Electronic Reserve
 - Digitisation and Images
- ◆ Resource Access
 - Document Delivery
 - Access to Network Resources (the Subject Gateways)
- ◆ Training and Awareness
- ◆ Supporting Studies

In contrast with the US Digital Libraries Initiative (see below) the emphasis was on involving a wide cross-section of the higher education ILS community in relatively small projects (although it may be noted that in comparison with a typical BLRIC funded project, the sums involved were large). The methodological emphasis was very much on action research, and it was accepted that much of the value would occur through the involvement of professional staff in the research, development and implementation process. A particular strength of eLib has been its emphasis on evaluation, ably assisted by staff of the Tavistock Institute.

Phase 3 of eLib has seen a shift of emphasis, with four main approaches:

- ◆ Hybrid Libraries
- ◆ Clumps (Large Scale Resource Discovery)
- ◆ Digital Preservation
- ◆ Turning projects (from phases 1 & 2) into services

The hybrid library/clump concepts are central to this final phase of eLib. The following description is taken from a recent CERLIM paper⁵¹:

“The *hybrid library* concept recognises that both ‘traditional’ (i.e. print-based) and electronic services have disadvantages. For example:

In the traditional model

- ◆ Each item (book or journal issue – volume when bound) must be used serially (i.e. one user at a time)
- ◆ Libraries can only stock a restricted range of all the items of potential interest to their users
- ◆ Publication processes, involving long lead times between author, publisher, printer, distributor and library, mean material is dated even when added to stock
- ◆ The cost of stocking little used items is very high, since staffing and space costs are dominant
- ◆ There are high cost associated with handling physical objects (e.g. re-shelving, shelf tidying)
- ◆ Heavily used items, such as core text books, wear out.

In the electronic model

- ◆ The quality of sources is often uncertain or simply unknown
- ◆ Browsing is difficult at the detailed item level, since computer displays are entirely page-oriented
- ◆ The economic model is uncertain, resulting in severe restrictions on accessing valuable content where suppliers must ensure that copies cannot 'leak' into general circulation.
- ◆ There is no consensus on achieving preservation, and no provisions for legal deposit.
- ◆ The library is poor at encouraging social interaction, since 'group' study via technology is as yet artificial, limited and generally unattractive.

It seems highly unlikely that the undoubted benefits of the electronic or digital model will enable it to become dominant in the foreseeable future. Not only does the traditional, largely print-based model have several advantages, but there is an enormous investment in 'legacy systems' – content and infrastructure, including systems for publishing content in traditional forms, which has been built up over many years and which retains immense value.

It follows that most users will continue to be offered a mix of formats via a mix of delivery systems. The challenge for library managers is to create integrated services which provide a 'seamless' service to the user. The user should be able to access services through consistent interfaces which provide compatible features (so that, for example, the user does not have to adjust her search strategy and syntax each time she wishes to use a different source). The hybrid library should not, however, be homogeneous: it should be able to adjust its services to the needs and rights of each user – for example by 'remembering' previous search strategies, by storing details of the user groups to which the individual belongs and by 'knowing' the user's willingness to pay for premium services.

A complementary idea emerges when the individual library is considered in its broader context. This context may be geographic – for example, within a metropolitan area. It may be based on subject domain, such as medicine or music. It could be created from a commonality of interest – as for example with the major academic libraries in the Consortium of Research Libraries (CURL). For the individual user there is a need to present these groups as if they were a single resource – they are brought together as a *clump*. The clump will again be presented through a consistent interface – indeed for many purposes the user may not need to be aware that the different libraries even exist. So, for example, the 'music' clump could be presented as a single resource, available to users of all its constituent libraries. For some services, of course, the source library will need to be known – for example, when the user decides to go and consult the physical stock. The management of the clump is complex, because it relies on co-operative agreements between different libraries which have different resources, different clienteles and different missions.”

The following projects (have been funded in phase 3 (the named organisation is the co-ordinator):

- ◆ Hybrid Libraries
 - AGORA (University of East Anglia)
 - BUILDER (Birmingham University)
 - HEADLINE (London School of Economics)

- HyLiFe (University of Northumbria and Manchester Metropolitan University - CERLIM)
- MALIBU (King's College London)
- ◆ Clumps
 - CAIRNS (Glasgow University)
 - M25 Link (London School of Economics)
 - Music Libraries Online (University of Central England)
 - RIDING (University of Sheffield)
- ◆ Digital Preservation
 - CEDARS (University of Leeds)
- ◆ Projects funded to enable them to be turned into services
 - Electronic Document Delivery (EDDIS and SEREN)
 - Electronic Journals and Pre-Prints (Education On-Line, EPRESS, Internet Archaeology, Electronic Law Journals, NewsAgent)
 - Electronic Reserve Support (HERON)
 - Subject Based Internet Gateways (ADAM, Biz/ed, EEVL, History, OMNI, ROADS, SOSIG, WoPEc)
 - Others (Digimap Plus, Eurotext, MODELS, Netskills)

In parallel with phase 3 of eLib, JISC and CEI have developed the concept of the National Distributed Electronic Resource (NDER) and have funded a number of initiatives, of which the RDN (described above) is perhaps the most prominent and important.

III.5 European Commission: Framework III, IV and V Programmes

The European Commission's 'Libraries Programme' ⁵² was launched in 1990, following a number of exploratory studies, as part of the 'Telematics Application Programme' (TAP) under the 3rd Framework Programme. There were four Action Lines in this first programme:

- ◆ Computerised bibliographies – the creation and enhancement of catalogues and bibliographies, and work on standards and interoperability

- ◆ Library networking and interconnection of systems, setting up new networked services and exploiting open systems interconnection (OSI) standards
- ◆ Innovative library systems – using technology to create more cost effective solutions
- ◆ Technology-based library products and tools – designed to stimulate the development of what would be commercial products.

A total of 51 projects and 3 concerted actions were supported. Characteristics of these projects were their involvement of partners from more than two (in reality nearly always at least three) EU states and an emphasis on involving the less favoured regions (LFRs) – at that time mainly parts of Southern Europe. There was also an emphasis on the use of OSI standards and in particular SR (as opposed to Z39.50). The range of projects was large, although there was a concentration on the exploitation of electronic document (including images and audio) delivery systems. The Commission particularly encouraged work on document delivery and electronic publishing. Examples of projects include:

- ◆ AIDA (Alternatives for International Document Availability) using the ISO ILL protocol and with an emphasis on the Internet as the delivery mechanism between participating Italian and Portuguese libraries;
- ◆ BIBDEL (Libraries without Walls: the Delivery of Library Services to Distant Users) which explored IT based mechanisms for supporting distant learners in the UK, Ireland and Greece
- ◆ CANTATE (Computer Access to Notation and Text in Music Libraries) which investigated how sheet music could be accessed from libraries using a networked approach, examining in particular the suitability of SMDL for encoding sheet music.
- ◆ DALI (Document and Library Integration) which developed, piloted and evaluated a service for multimedia document delivery in a distributed environment, using SR. Authorisation and cost recovery were supported.
- ◆ DECIDE, DECIMAL, EQLIPSE and MINSTREL, four projects concerned with management information and decision support for traditional libraries.
- ◆ DECOMATE (Delivery of Copyright Material to End-users) aimed to provide end-users access to copyright materials in electronic form. Three university libraries in three different countries received part of their journal holdings in

electronic form (page images) directly from the publisher. Software was developed to link bibliographic records to electronic full-text articles and to allow the user to view documents or have them delivered in printed form. The system was operated experimentally in Tilburg, LSE and Barcelona.

- ◆ ELISE (Electronic Library Image Service for Europe) which modelled a system to provide access to full colour image information banks (slides of museum exhibits and illustrated manuscripts and cartographic material)
- ◆ EUROPAGATE (European SR-Z39.50 Gateway) which built and operated a pilot gateway service through which users could access both Z39.50 and ISO SR servers to provide online access to catalogues.
- ◆ EXLIB (Expansion of European Library Systems for the Visually Disadvantaged) which explored issues concerned with providing library access for visually-impaired people.
- ◆ ONE (OPAC Network in Europe) which was designed to provide SR target development and interconnection. The project involved national library services in Norway, Sweden, Finland, Denmark, the Netherlands, the UK, Germany and Austria.
- ◆ SELF (The provision of self-service facilities for library users) which developed a generic specification for electronic self-service library services.

It was clear from the outcomes of these projects that networked services held the key to the future and, under the 4th Framework Programme, the Libraries work programme was refined with this in mind. Three Action Lines were defined:

- ◆ Action Line A: Network-oriented internal library systems, with an emphasis on systems to enable libraries to handle electronic documents.
- ◆ Action Line B: Telematic systems for library co-operation and networking, which focused on issues related to the 'access' mission of libraries, including interlibrary loan systems, bibliographic data exchange and so on.
- ◆ Action Line C: Library services for access to networked information resources, which emphasised the role of libraries as brokers between users and networked information resources available globally.

It may be noted that the standards-development driven OSI/SR approach had by this time given way to the pragmatic realities of Z39.50.

Examples of projects funded under the 4th Framework Programme (most of which are at the time of writing still ongoing) would include:

- ◆ BIBLINK (Linking Publishers and National Bibliographic Services), a project designed to improve links between publishers and national libraries or national bibliographic agencies. A demonstrator developed a BIBLINK workspace to handle Dublin Core and SGML as exchange formats with the publishers, and to produce output records in UNIMARC for conversion and input to the different national bibliographic formats.
- ◆ DELICAT (Data Enhancement of Library Catalogues) designed to improve the quality control of bibliographic database records by means of a knowledge-based error-detection system designed to be connected to library networks using client-server architecture.
- ◆ DERAL (Distance Education in Rural Areas via Libraries) designed to encourage public libraries to play an increasing role in delivering educational courses.
- ◆ ELISE II (Electronic Library Image Service for Europe - Phase II) - an example of a continuation project funded on the basis of 3rd Framework experience.
- ◆ EQUINOX (Library Performance Measurement and Quality Management System) a project building on the four 3rd Framework decision support projects, but with a particular emphasis on the electronic library.
- ◆ LIBERATOR (Libraries in European Regions - Access to Telematics and Other Resources) designed to establish and develop exemplars of regional information services (RIS) in three diverse European regions.
- ◆ LISTED (Library Integrated System for Telematics-based Education) integrating Flexible and Distance Learning (FDL) solutions into a public library environment.
- ◆ MALVINE (Manuscripts and Letters via Integrated Networks in Europe) providing new and enhanced access to disparate modern manuscript holdings kept and catalogued in European libraries, archives, documentation centres and museums.

- ◆ ONE-II (OPAC Network in Europe- II) designed to produce software adding facilities for interlibrary loan, electronic document delivery and on-line payment capabilities to the common software developed in the ONE project under the 3rd Framework programme.
- ◆ PRIDE (People & Resources Identification for a Distributed Environment) which is producing directory services designed to enable authenticated access to distributed collections and services, including charging mechanisms.
- ◆ TESTLAB (Testing Systems using Telematics for Library Access for Blind and Visually Handicapped Readers) which, building on EXLIB, established a series of practical trials in public and academic libraries whereby blind and visually handicapped readers were able to gain access to catalogues and digital documents in forms which they could read.
- ◆ UNIVERSE (Large Scale Demonstrators for Global, Open Distributed Library Services) which aims to deliver and utilise a 'logical union catalogue' that is capable of providing a single point of contact for electronic information services for specific subject domains. It includes Search and Retrieve of very large scale, transparent multiple databases, multimedia document delivery, Inter-Library Loans - integrated into the search and retrieve process and collaborative cataloguing / record supply.

In addition to funding projects, the Framework Programmes support a variety of other 'measures' such as concerted actions and studies. For example, ECUP (the European Copyright User Platform) has been very successful in making the end-user and library voice heard in debates on copyright legislation while EFILA (European Forum of Implementors of Library Applications) has made great contributions to standards development and to representing Europe in international activity in this area.

Quite separately from the Libraries Programme, the DELOS Working Group, part of the European Research Community for Informatics and Mathematics (ERCIM) Digital Library Initiative (see next section), was funded by the ESPRIT Programme within the 4th Framework Programme. Its objective was to promote research into the further development of digital library technologies, in particular to

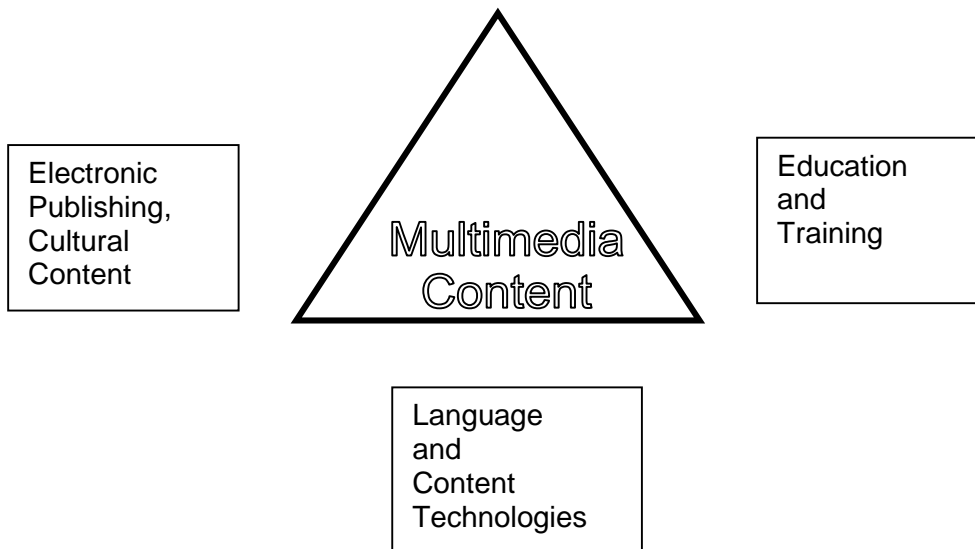
- ◆ stimulate research activities in areas which are relevant for the efficient and cost-effective development of digital library systems,
- ◆ encourage collaboration between research teams working in the field of digital libraries, and
- ◆ establish links with on-going projects and activities in the field of digital libraries in industry and other public and private institutions.

The 5th Framework Programme has been launched only recently, with the first major Call for Proposals in the IST area closing on 16th June 1999 – clearly it will be some time after that before results are known (probably September/October but possibly later). The most significant feature of the new Programme is that there is no longer a sector-specific ‘libraries’ theme; instead the emphasis is on cross-sectoral work, with a particular encouragement for different types of ‘memory institution’ (libraries, museums, art galleries, archives, etc.) to work together. Therefore it will not be easy to categorise projects as ‘digital library’ or ‘other’.

Framework 5 has five areas or ‘key actions’:

- ◆ *Systems and Services for the Citizen*
- ◆ *New Methods of Work and Electronic Commerce*
- ◆ *Multimedia Content and Tools*
- ◆ *Essential Technologies and Infrastructure*
- ◆ *Future and Emerging Technologies*

The area which appears to be most similar to the previous Libraries Programme is ‘Multimedia Content and Tools’. It has been described diagrammatically in the following way:



The priorities will be as follows:

- ◆ Social and business models for multimedia content
- ◆ Authoring and design systems
- ◆ Content management and personalisation
- ◆ Open platforms and tools for personalised learning
- ◆ The flexible university
- ◆ Advanced training systems
- ◆ Multilinguality in digital content and services
- ◆ Neural interactivity
- ◆ Multi-sensory forms of content
- ◆ Media representation and access: new models and standards

It is worth noting that Framework 5 projects are expected to be somewhat larger than the average project in the former Libraries Programme (probably in the region of 1,000,000 euros or more).

III.6 The ERCIM Digital Library Initiative

The European Research Community for Informatics and Mathematics (ERCIM) has an active *Digital Library Initiative*, which has achieved a high profile in the research community not least through the DELOS Working Group, which has organised a series of conferences and other meetings, and co-ordinated joint actions with the US National Science Foundation. There are strong links between the ERCIM work and the information retrieval research community. So, for example, a recent Workshop on

User Interfaces in Digital Libraries included papers on *information seeking behaviour, human-computer interfaces, intelligent information retrieval, information visualization* and so on. Each of the DELOS Workshops has raised issues for further research. As an example, the one referred to above discussed the following:

“Information seeking and retrieval. One important issue in Digital Library research is issues related to HCI and distributed information seeking and retrieval (ISR). We should consider information seeking and retrieval as embedded activities within Digital Libraries.

Evaluation. Currently, a lot of different applications are being developed and used. We need techniques and methods to analyse and evaluate different systems as well as different users, their behaviour, and tasks, when interacting with distributed information resources.

Support for interaction. We need to support interactions with information, such as texts and multimedia, in information seeking activities. This includes access to multilingual information. It is also important to construct conceptual models and theories in order to understand the interactions in distributed Digital Libraries.

Modalities. Future Digital Libraries will encompass alternative modalities for representations of information seeking activities.

Integration. Integrating the user interface closely with the functionalities of the system is desirable: usefulness cannot be added after the functional design.”

It will be seen that many of the issues being explored by ERCIM are identical to, or analogous with, issues in ILS-led digital library research. However, there is also a view that the two strands are in fact talking about different concepts. The ILS community's concept of the 'digital library' is close to the description of the hybrid library given above and acknowledges the strengths of the traditional library heritage, for example on its emphasis on place and social interaction. The computing community's vision is of distributed banks of digital resources brought together at the PC desktop, preferably without human intermediaries, and thus might better claim the term 'virtual library'. Of course, this somewhat parodies the situation; nevertheless, the differences are real and significant.

The DELOS Working Group is collaborating with US National Science Foundation (NSF) funded research groups so as to jointly explore technical, social and economic issues, plan common research agendas, share research results, and explore national, technical, and social expectations about digital libraries. The reports of a series of working groups (co-sponsored by NSF and the EC via DELOS) under the title *An International Research Agenda for Digital Libraries* provide an interesting summary of thinking arising from the US NSF (see below) and the EU ESPRIT etc. work.⁵³ There were five series of groups:

- ◆ Intellectual Property and Economics
- ◆ Interoperability
- ◆ Metadata
- ◆ Multilingual Information Access
- ◆ Resource Discovery in a Global Distributed Digital Library

III.7 US Digital Libraries Initiative

The origins of the US Digital Libraries Initiative (DLI) are to be found in discussions between researchers and major funders in the late 1980s and early 1990s, leading to the announcement of the first DLI in late 1993. Funding for the DLI was provided by the National Science Foundation (NSF), the Defense Advanced Research Projects Agency (DARPA) and the National Aeronautics and Space Administration (NASA).

The emphasis of the Programme, in contrast to eLib, was on very large projects – only six were funded on the basis of this first call (at University of California, Berkeley; University of Michigan; University of Illinois; University of California, Santa Barbara; Stanford; and Carnegie Mellon University). Each involved large numbers of partners – Berkeley's, for example, involved the University's Computer Science Division, School of Information Management & Systems, Research Program in Environmental Planning & Geographic Information Systems, Instructional Technology Program, Museum of Vertebrate Zoology and the Library, together with California Academy of Sciences, California Environmental Resources Evaluation System, California Department of Water Resources, California Resources Agency, San Diego Supercomputer Center, Stanford University, University of California Santa Barbara, US Geological Service, Hewlett-Packard, IBM Almaden Research Center, Informix, Microsoft, NEC, Sharp, Sun Microsystems, and Xerox's Palo Alto Research Center.

Because of their size, the initial DLI projects tended to cover a considerable range of issues. A useful summary of the foci which emerged from this first round of funding is provided by an *All Projects Meeting* held at the University of California, Berkeley in January 1998⁵⁴. The topics covered were:

- ◆ Ontology-based collection metadata
- ◆ Recognition and retrieval of news video
- ◆ Finding objects in large collections of images
- ◆ Semantic interoperability for Geographic Information Systems
- ◆ Education, deployment and evaluation
- ◆ Working towards scalable, distributed digital libraries: processing and resource discovery revisited
- ◆ Service Market Society
- ◆ From Usability to Use
- ◆ Infrastructure and advanced user support of query construction
- ◆ Multivalent document and collaboration
- ◆ Awareness services for Digital Libraries
- ◆ Advanced Visualization Services
- ◆ Collaborative Environments
- ◆ Future steps in query by content
- ◆ Full text, metadata and image retrieval for the digital library
- ◆ A new generic indexing technology for digital library support
- ◆ The anatomy of a large-scale hypertextual web search engine

The links between this rather heterogeneous list and the discussions of the DELOS Working Groups referred to above are clear.

The second Digital Libraries Initiative (DLI2) is described in the following terms:

“Digital Libraries Initiative Phase Two is a multi-agency initiative which seeks to provide leadership in research fundamental to the development of the next generation of digital libraries, to advance the use and usability of globally distributed, networked information resources, and to encourage existing and new communities to focus on innovative applications areas.

Since digital libraries can serve as intellectual infrastructure, this Initiative looks to stimulate partnering arrangements necessary to create next-generation operational systems in such areas as education, engineering and design, earth and space sciences, biosciences, geography, economics, and the arts and humanities. It will address the digital libraries life cycle from information creation, access and use, to archiving and preservation.

Research to gain a better understanding of the long term social, behavioral and economic implications of and effects of new digital libraries capabilities in such areas of human activity as research, education, commerce, defense, health services and recreation is an important part of this initiative.”⁵⁵

A joint NSF/JISC US/UK Call for Proposals appeared in late 1998: the results of this were announced in mid-June 1999 – six projects have been selected for funding:

- ◆ Cross-Domain Resource Discovery: Integrated Discovery and Use of Textual, Numeric and Spatial Data: University of California, Berkeley / University of Liverpool
- ◆ HARMONY: Metadata for resource discovery of multimedia digital objects: Cornell University / ILRT / DSTC
- ◆ Integrating and Navigating ePrint Archives through Citation-Linking: Cornell University / Southampton University / Los Alamos National Laboratory
- ◆ Online Music Recognition and Searching (OMRAS): University of Massachusetts / King's College, London
- ◆ Emulation options for digital preservation: technology emulation as a method for long-term access and preservation of digital resources: University of Michigan / CURL
- ◆ The IMesh Toolkit: An architecture and toolkit for distributed subject gateways: University of Wisconsin-Madison / UKOLN / ILRT.

III.8 US National Digital Library Program

An initiative of the Library of Congress, the National Digital Library Program (NDLP) has been built on the progress made between 1989 and 1995 under the *American Memory* project. *American Memory* now provides access to over 50 collections of digitised material in subjects ranging from Agriculture to Sport.

Staff of the NDLP have identified the following agenda of key issues to be resolved if the NDL is to become a reality⁵⁶:

- ◆ Building the resource
 - Develop improved technology for digitizing analog materials
 - Design search and retrieval tools that compensate for abbreviated or incomplete cataloging or descriptive information
 - Design tools that facilitate the enhancement of cataloging or descriptive information by incorporating the contributions of users
- ◆ Interoperability
 - Establish protocols and standards to facilitate the assembly of distributed digital libraries
- ◆ Intellectual Property
 - Address legal concerns associated with access, copying, and dissemination of physical and digital materials
- ◆ Effective Access
 - Integrate access to both digital and physical materials
 - Develop approaches that can present heterogeneous resources in a coherent way
 - Make the National Digital Library useful to different communities of users and for different purposes
 - Provide more efficient and more flexible tools for transforming digital content to suit the needs of end users
- ◆ Sustaining the Resource
 - Develop economic models for the support of the National Digital Library

III.9 Other Programmes

There are significant Digital Library programmes in Australia, New Zealand, Japan, Canada and a number of European countries (as well as the UK) including the Netherlands, Germany and France. Some of these have significant features which should be taken into account in any comprehensive review of digital library research. All are producing digitised collections which have international significance.

Australia has developed a national approach through the leadership of the National Library of Australia (NLA) ⁵⁷, whose vision is 'for a national library infrastructure that uses digital technology to enhance the preservation of and access to both traditional collections and emerging digital collections' ⁵⁸ - interestingly this is the 'hybrid library' approach discussed earlier. The NLA has been running the PANDORA Project⁵⁹ which has developed policy, guidelines and procedures for the preservation of Australian Internet publications, and a 'proof-of-concept' archive has been established. The NLA has also established an Australian Libraries Gateway providing access both to libraries and to directories of services. Among the key issues identified by the NLA are the issue of permanent naming (a project to implement URNs is under way) and the lack of rights management systems and processes.

Because of its geographically-dispersed nature and history, Australian libraries have a particular interest in remote document delivery. The current development of LIDDAS (Local Interlending and Document Supply System) and its integration with ILL utilities and other services is worthy of particular note, as is the involvement of Australian partners, led by Macquarie University, in the EC funded PRIDE project (see section III.5 above).

New Zealand has an interesting Digital Library Project based at the University of Waikato⁶⁰ which, among other aspects, has concentrated on the automated extracting of index terms from digitised documents. One issue which has been addressed is the use of distributed extracting to reduce network charges (since New Zealand users face potentially high charges when so much information has to be transferred across the trans-Pacific Internet link).

In **Japan** there have been a series of digital library projects and initiatives. The University of Library and Information Science, Tsukuba is active in the field and hosted the International Symposium on Research, Development and Practice in

Digital Libraries in November 1997⁶¹. The University is also hosting an international symposium in October 1999⁶². An 'Electronic Library Pilot Project' has been established under the Ministry of International Trade and Industry (MITI), Center for Information Infrastructure (CII), involving the IT Promotion Agency (IPA) and the National Diet Library, involving over 40 public libraries. IPA and the Japan Information Processing Development Center (JIPDEC) are designing the infrastructure for the next generation public digital library, the 'Next Generation Digital Library Systems Research and Development Project'. The project architecture suggests that there will be three key components: messaging technologies to enable communication between objects, users and agents; agent technologies to act on behalf of users and librarians; and database technologies, the "stock rooms of digital libraries".⁶³

Canada has established its Canadian Initiative on Digital Libraries⁶⁴ as a co-operative grouping bringing together different players from across the nation, and with over 50 libraries in membership. This grouping agreed three priority areas for action: creation and production of content; organisational and access issues, especially related to metadata, and advocacy and promotional issues. Canada has been heavily involved in experiments with rolling out Z39.50 access to library services, and is building the 'Virtual Canadian Union Catalogue' (vCuc)⁶⁵.

In addition there are significant activities in the USA other than those funded by the NSF/DARPA/NASA/LC including activities funded by the libraries themselves (although in the main, as elsewhere, these tend to be digitisation projects). Similarly, there are significant activities across Europe, outside the European Commission funded programmes: again, however, the emphasis is mainly on digitisation.

III.10 Other Issues

The programmes and projects described in this Chapter cover a great deal of ground. As noted earlier this review has not explored the very many digitisation projects which can be found around the world, although it is noted that they are subject to the same set of underlying design issues as services. The existence of a rapidly growing range of digitised collections does, however, pose some particular questions, the most obvious of which are concerned with digital preservation. There is a growing body of research in this field.

Two Expert Workshops on digital preservation have been held at the University of Warwick in the UK. Warwick I, held in 1995, laid the groundwork for a number of subsequent actions, not least being a programme of research co-ordinated by the British Library's National Preservation Office, work through the Arts & Humanities Data Service and not least the eLib phase 3 CEDARS (CURL Exemplars in Digital Archives) Project.

Warwick II, held in March 1999, discussed the development of a plan of action on digital preservation through groups focussing on organisation and co-ordination, cost benefit analysis, rights issues and access, and awareness raising. The specific recommendations of these groups have been published⁶⁶. A theme running through these recommendations is the need to explore models and create exemplars which will enable the issues to be better understood by a wider community. An 'International Digital Preservation Forum' should be created.

The emphasis on exemplars in the Warwick II workshop might be extended more widely. There are a number of interesting examples of 'digital libraries' (if we use that term broadly) which present useful lessons for those interested in the research and development agenda. Of these, perhaps the most noteworthy is SCRAN (Scottish Cultural Resources Access Network)⁶⁷. In order to make available digitised content in its field, SCRAN has developed procedures and expertise in a number of areas which may be taken as pointers for other developers: examples would be rights clearance, metadata development (including development of its own standards where none existed⁶⁸), gateway services and so on. It is interesting to note how international standards (Z39.50, Dublin Core and so on) have been blended with local developments to create a real-world service.

This last observation serves to emphasise a point made in the introduction to this Chapter, namely that the digital library research and development agendas often are, and certainly need to be, influenced by practitioners. The programmes which have been described are designed to deliver real-world services to real users, and most participants would agree that the research agenda must be heavily focussed on this requirement.

Part IV Other Major Influences

There are clearly many significant influences on the development of the digital library outside the major R&D programmes, which themselves tend to have a somewhat partial view of their constituencies - those devoted to meeting the needs of academic researchers are quite obviously dominant. In this section we consider a selection of other influences.

IV.1 Commercial Players

Although some programmes, most notably the EC Libraries Programme, have involved commercial players in R&D, in general their involvement in ILS-led programmes (e.g. BLRIC, eLib) has been limited. For example, only one library systems supplier has made a major impact in eLib (and that has been somewhat controversial!). In the United States, organisations such as OCLC have made significant contributions and some publishers (e.g. Elsevier) have been quite active, although again they could not claim to be dominant in, say, the DLI programmes.

It is noticeable that a considerable amount of relevant activity is ongoing in the commercial sector, tending to occur in parallel with the Digital Libraries R&D programmes run by computing experts (ERCIM etc.) referred to earlier in this Report. The danger, of course, is that if we (i.e. the ILS community) try to 'capture' too much of this agenda, the focus becomes too broad for us to be anything other than minor bit players on a very large world stage – dominated by software companies, Internet companies, major publishers and broadcasting organisations. To what extent should ILS researchers try to become involved in this activity? It includes:

- ◆ Development of Web standards and of the Web itself, mainly through W3C
- ◆ Digital TV, including transmission and content perspectives, and increasingly as a means of providing interactivity and Internet access
- ◆ Push services, such as those developed by ISPs and financial information services
- ◆ Publisher-led electronic journals, electronic books and other electronic publications
- ◆ Electronic commerce, including developments such as SET, led by the major credit card companies and banks, and innovative Internet-based operations like Amazon

- ◆ Processing of large-volume streamed data, such as that obtained from satellite observations
- ◆ The development of local, regional, national and international ICT infrastructures.

It is inherent to the nature of the Information Society that technologies and services based on digital content will interact and in many cases merge. The positioning of 'libraries' within this broad spectrum is a key issue for its community, and the positioning of ILS research programmes where they can make significant contributions is, to say the least, problematic.

IV.2 Government Policy

The rapid development of UK government policy in many areas over the last two years presents a useful example of the ways in which ILS research agendas can be influenced by broader policy initiatives. To what extent should the Digital Library research agenda be influenced by, and adjusted to fit, such policies or commitments as:

- ◆ Broad government actions to combat exclusion, which increasingly recognise the need to promote inclusion in the Information Society
- ◆ Commitment to lifelong learning, with a strong emphasis on IT-based learning and the development of content
- ◆ Regionalisation, which may call into question national approaches
- ◆ Open government
- ◆ Freedom of information
- ◆ Exploitation of the potential of public libraries as 'community information/learning centres'
- ◆ Further 'massification' of higher education
- ◆ Greater integration in Europe, whether or not it includes joining the Euro.

The research agenda needs to take account of these kinds of policy development, without becoming simply a policy support programme: there is a balance to be struck between short term studies guiding the implementation of particular policies and broader (and deeper) research which can itself underpin further development of policy and practice.

IV.3 Legacy Systems and Cultures

We are not designing digital libraries on a clean canvas. Libraries exist, have existed for many years and have huge and valuable resources, systems and expertise on which to draw. At the same time, the downside of building on existing services is that the transition from old to new is painful, costly and takes time.

Evidence suggests that traditional libraries can make a successful transition to the digital paradigm. It is interesting, for example, that all UK universities have embraced the future of digital information services by building on – and transforming – their existing libraries. None have decided to disestablish the library in order to bring in a wholly new service. If we are interested in a research agenda which has applicable results, it is important that we recognise this. It is, incidentally, part of the motivation for the emphasis on hybrid libraries in the final phase of eLib.

At the same time we should not underestimate the difficulties of transition. It is arguable, for example, that most library 'systems' (i.e. what we used to call 'housekeeping systems') are built on the wrong model for future requirements since they use a holdings/ process design (acquire-catalogue-hold-lend-withdraw) at a time when the key paradigm is discover-locate-request-deliver. Part of the agenda should perhaps be work which aids understanding of transition and helps to build systems which enable libraries to transform themselves gracefully from one paradigm to another. Others may argue that the issue is not one of transformation, but of building multi-paradigm services.

It is also important to acknowledge that only limited attention has yet been paid to some of the key cultural, social and economic issues which need to be resolved if digital libraries are to become valuable resources and services. Thus, without presenting an exhaustive list, the following might be thought to merit particular attention:

- ◆ The economic models as we shift to a totally different publication and information access/delivery chain in a world where the rules of trade are being rewritten by the move to e-commerce.
- ◆ Competition between suppliers and brokers in a global networked environment.

- ◆ The social impacts of digital libraries, not least on disadvantaged and marginalised sections of society.
- ◆ The management of digital (and hybrid) libraries and the tools needed to achieve efficiency, effectiveness and excellence.
- ◆ The place and nature of 'library' services within a broader sector of 'memory institutions' (museums, archives, galleries and so on).
- ◆ What the term 'library' means within, for example, integrated learning environments which blend together information access, resource-based learning and teaching, and in so doing redefine the tutor-student relationship.

Most digital library research and development programmes have paid little attention to these issues, although eLib has funded some activities like IMPEL and BLRIC has been more ready than most to fund this kind of work.

Part V Expert Views

As part of the Review, an Expert Workshop was held by invitation at the Manchester Metropolitan University on 18th May 1999: the list of those attending is given in Appendix II. Some invitees who were unable to attend sent written comments.

The workshop was invited to address four questions:

- ◆ What are the key research and development issues which need to be resolved if we are to realise 'digital libraries'?
- ◆ What contributions can the LIS R&D community, working with LIS practitioners, make?
- ◆ Should LIC (ex BLRIC) funded 'Digital Library' research should be predominantly applicable research?
- ◆ What priorities should BLRIC/LIC be encouraging and/or funding?
- ◆ Bearing in mind the end of eLib's R&D programme, should the community be seeking to establish an alternative, major programme? If so, what should its focus be? Who should we look to for funding?

The discussion was wide-ranging, but there was general agreement on a number of points:

- ◆ The provision of **core texts** for students across education remains one of the major issues. Although this was one of the motivators for the Follett Review there is as yet little evidence that solutions have been found. Although digitisation is often seen as the answer to this issue, problems such as infrastructure, funding and copyright need to be overcome first. It is notable that a number of promising experiments, such as ELINOR at De Montfort University, appear to have foundered over scaling problems. The new national service, HERON, may be able to overcome this. In the meantime, there is some evidence that the use of web resources may be circumventing the problem – but may also circumvent the library.

- ◆ The different library models (e.g. system-based and library-based) need to be considered alongside one another (and mapped onto one another) rather than as alternatives. It is important that libraries facilitate access to learning and learning environments, which implies that greater understanding of how people learn is needed before digital library services are designed. Collaboration between the library and academic departments is essential if the right mix of skills and knowledge is to be brought to bear.
- ◆ Care needs to be taken not to assume that there is only one type of 'user'. Digitisation permits the development of individualisation. In part this will build on the library tradition of individual service (e.g. at the reference desk) although it can be much more pervasive. Research is needed – drawing on past research – into how users actually use information services in digital environments.
- ◆ Questions of user satisfaction and the link to quality of service are important, although care is needed in the interpretation of student experience – the issue is one of stretching students rather than keeping them happy! The evaluation of, for example, interfaces thus needs to be designed with care to address the overall objective.
- ◆ Lessons may be learned from the special library sector on personalisation of services, as they have extensive experience of SDI services.
- ◆ The upskilling of library staff is a major issue, especially to enable them to become motivators who encourage the use of digital services and systems.
- ◆ Debate on digital libraries tends to be dominated by the needs of the academic sector. There is a need to redress the balance and consider the role of, for example, public libraries in leading digital library developments.

The Panel was invited to suggest one or two key themes for research in digital libraries which they would like to see pursued. The following suggestions were made:

- ◆ User studies, including how they interact with digital resources
- ◆ Managing libraries in the hybrid and digital contexts
- ◆ The role of public libraries in facilitating access to information

- ◆ Preservation of digital materials
- ◆ Cultural and organisational issues, including the impact of the digital library on teaching and learning
- ◆ Studies of non-users
- ◆ Information overload, and systems to enable users to manage it
- ◆ Monitoring the development of the public library network
- ◆ Interface development and design principles (for example, what makes Amazon.co.uk's interface – allegedly - effective and attractive?)
- ◆ Reconceptualisation of the concept of the 'library'
- ◆ Intermediary roles – and the skills needed by intermediaries
- ◆ Interoperability between services offered by different 'memory institutions'
- ◆ User-assessment of the quality of information services and their content
- ◆ Metadata quality
- ◆ Accessible services – not only in terms of disability, but in relation to learning styles, ability, and so on
- ◆ User skills development as an ongoing issue, rather than a one-off 'skills to use the digital library' approach
- ◆ Increased understanding of the interactions (user, technical, domain, etc.) that occur within digital libraries.

It was notable that the debate in the Expert Workshop concentrated on non-technical issues, and was most concerned that research should address the reality of user interaction with digital library – and hybrid library – systems. In our specific conclusions (Part VI) we have tried to reflect this emphasis.

Part VI Conclusions

VI.1 The General Digital Library Research Agenda

There can be no doubt that the digital library research agenda is huge. Preceding sections of this Report have demonstrated the very wide range of concerns which those involved in digital library research have displayed. Different players categorise the issues in different ways, but we would suggest that, taking a UK perspective and approaching the issues from library/information science practitioner and researcher standpoints, the following are the major areas requiring research effort:

- ◆ **Content:** issues concerned with content encoding standards and representation; resource and collection description; maintenance and persistence of digital objects; preservation of digital objects; scalability of datasets; collection development; authority of content.
- ◆ **Retrieval:** issues concerned with formulation of queries (closely linked to work on information-seeking behaviour); cross-domain searching; content-based retrieval and retrieval of multimedia objects;
- ◆ **Authentication and Authorisation** including payment systems and integration of heterogeneous payment/contractual systems.
- ◆ **Delivery:** the delivery of objects from heterogeneous sources and systems to heterogeneous intermediate and end-user systems; maintaining coherence.
- ◆ **Interoperability:** especially interoperability of heterogeneous services; (see also the discussion in section 1.3 above)
- ◆ **Customers of digital libraries:** including end-user interface design; personalisation; personalised delivery; use of digital resources (information seeking behaviour and how resources/systems are actually used); affordability.
- ◆ **Accessibility:** the ability of all users, including those who are in some way disabled, to access all digital library services, including multimedia.
- ◆ **Integration:** the digital library as a component of work or life systems, such as learning environments; relationships between 'memory institutions' to create seamless 'memory services' and 'memory resources'.
- ◆ **Economics:** redesigning the information chain in the light of e-commerce and changed opportunities/relationships of networked information

- ◆ **Legal:** legislative and contractual issues, including IPR, copyright, data protection, privacy, rights negotiation, auditing
- ◆ **Social and Political:** the digital library's impacts and potential impacts; effects of digital libraries on inclusion/exclusion and other socio-political agendas
- ◆ **Transition:** the managed shift from traditional via hybrid to digital services; extracting value from legacy systems in digital environments
- ◆ **Skills:** customer and staff skill requirements and upgrading

It will be noted that digitisation programmes as such are not included within the research agenda, although they do raise a number of research issues.

In addition to the specific research areas outlined, it is suggested that there is a need to concentrate some effort on **intra-integrative studies** (perhaps using a series of techniques such as scenario building and case studies) to emphasise that the digital library is a holistic concept and to test the integration of component technologies and techniques in either test-bed or real-world settings.

As noted in Part I, the issues of **scalability, sustainability, interoperability** and **personalisation** will pervade all digital library research.

VI.2 Issues for the Library & Information Commission

Note: this section of the Report has been superseded by the Call for Proposals issued in August 1999.

VI.3 Conclusion

In this Report we have identified the major trends and emphases of digital library research and development and examined the directions in which such research is moving. With a wide variety of bodies active in the field, each with subtly different understandings of the "digital library" it is perhaps surprising that the research effort is as coherent as it is. Nevertheless, with many large scale projects under way it is clear that the Library & Information Commission will need to be highly selective in its funding and in its selection of projects which it can support.

Appendix I The British Library's Digital Library Programme

[Note: the text reproduced here is taken from the BL web site – extracted 10.5.99 – at that time the latest update had been December 1998]

“Our vision of the digital library services

The British Library is one of the great libraries of the world, it has one of the finest collections in the world and the range and effectiveness of the services it provides globally from this collection are unrivalled. As publishing moves to digital media formats, so the Library's users will expect the Library to develop capabilities in the collection, storage, preservation and use of those digital media if it is to retain its core role as a key resource for scholarship, research and innovation. Digital media capabilities will additionally bring significant opportunities for the Library to improve access and the value it provides from its collections.

The digital library will consist of a critical mass of digitally held documents - words, still images, moving images, sound and any combination of these. These documents may be held in more than one place and their provenance may be more than one institution. Provision of the documents will be subject to agreement with and, as required, recompense to copyright and intellectual property owners. The material is and will be both current and historical, and in principle covers all subject areas.

Through the digital library, the British Library will be able to enhance the services provided to our current core user base, and also to reach new users. Digital collections and services will supplement rather than replace the traditional collection and services. Reading room users will be able to combine electronic with paper resources, and the use of electronic sources to satisfy remote document delivery will increase. British Library staff will demonstrate both traditional and digital library competencies.”

[The following text is reproduced from the June 1999 BL Digital Library System Procurement Documentation.]

“The Library's current priorities in terms of digital materials are:

- improving world wide web access to BL collections and services.

- acquisitions: substantially more will be spent on acquisitions in each of the next 3 years -with particular emphasis on material which is most used, or most likely to be much used in the future, and on digital materials.
- the extension of UK legal deposit legislation to electronic material.
- co-operation: a major commitment will be made to greater co-operation, with other UK libraries in particular, on collection development, access, record creation, preservation and bibliographic services.
- preservation and care of the collection.

To achieve these ambitions, the British Library intends to put in place a digital library infrastructure which fully supports its strategic and service objectives. A key part of this infrastructure will be the Digital Library System (DLS) which will guarantee the integrity of, and continuing access to, the full range of digital materials within the Library's collections.

The Digital Library System (DLS) will enable the Library to meet its strategic and operational objectives in relation to the collection of digital materials and the provision of access to them as follows:

- It will provide extensive and hospitable IT solutions to enable the Library to store, preserve and provide access to the UK digital published output, whether acquired through purchase, the extension of Legal Deposit or a combination of the two. It will support the full volume projections for digital publications required for the Library's collection (see Section 5.). It will be a key component of the UK national digital archive of published material.
- It will support the collection of digital materials necessary for the remote document supply services - electronic journals and patents - for the increased benefit of research and industry.
- It will provide a system to hold all other digital materials purchased or otherwise acquired for the collection and the Library's services.
- It will enable the Library to maintain continuing access to digital materials, regardless of origin, for future generations of users.
- It will support greatly increased access to digital materials within the Library's Reading Rooms and remotely, the latter underpinning the Public Library Network and contributing to the national Grid for Learning.

- For wider public access it will support the digitisation of significant parts of the Library's unique historical collections undertaken with the aid of project funding."

Appendix II Expert Workshop

Digital Libraries Research Review Workshop

Tuesday 18th May 1999.

Participants

Micheline Beaulieu	Sheffield University
Peter Brophy	Manchester Metropolitan University
Geoff Butters	Manchester Metropolitan University
Zoë Clarke	Manchester Metropolitan University
Sheila Corrall	Reading University
Jenny Craven	Manchester Metropolitan University
John Crawford	Glasgow Caledonian University
Dr Eric Davies	Loughborough University
Juliet Eve	Manchester Metropolitan University
Forbes Gibb	Strathclyde Business School
Dick Hartley	Manchester Metropolitan University
Mark Hepworth	Loughborough University
Adrienne Muir	Library and Information Commission
Philip Payne	Leeds Metropolitan University
Glyn Rowland	Liverpool John Moores University
Jean Steward	University of East Anglia
Keiji Suzuki	Kyoto University Library
Alan Wheatley	University of Wales, Aberystwyth
Susi Woodhouse	EARL
Peter Wynne	Manchester Metropolitan University

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