



Digital library research 1997-2007

Organisational and people issues

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Abstract

Purpose – This review aims to provide a snapshot of digital library research of the past 11 years (1997-2007) that focuses on organisational and people issues, including those concerning the social/cultural, legal, ethical, and use dimensions.

Design/methodology/approach – The review covers articles published in mainstream peer-reviewed library and information science/studies journals. The analysis was done by drawing on a sample of 577 articles published in both academic and professional LIS journals.

Findings – The analysis reveals that there are several topics that are dominant in the sample. There are significant research streams into one or more aspects of digital library use and usability, organisational and economical issues, as well as legal issues. In comparison, there is very little research in the sample that addresses ethical issues and social/cultural issues. *D-Lib Magazine* tops the list as the journal with the highest number of articles published and in spite of some fluctuations, there was an overall upwards trend for journal publications in these research areas. The years with the largest numbers of works published in these areas in the study sample were 2004, 2005 and 2006.

Research limitations/implications – It would be inaccurate to claim that the literature searches conducted in this study include every relevant journal article. They provide an extensive but not comprehensive sample. Also, to account for inconsistencies in indexing, a range of descriptors related to “digital library” was used in the searches in conjunction with other descriptors representing the various topics related to organisational and people issues. Nevertheless, this does not take into account journal articles that do not mention any of the digital library terms and yet, may discuss digital library themes. Hence, certain issues might have been under-represented in this study.

Originality/value – This review and meta-analysis is the first that focuses on analysing digital library research that has a focus on organisational and people issues. Given the manifestos that digital libraries are to grow into socio-technical systems that function within an organisation and society, the subject area as a whole has also evolved over the years, with a move away from purely technical issues towards the application, use and effectiveness issues. Therefore, it is highly likely that research into these emerging issues will continue to grow and this review provides a preliminary overview of this important development as well as a point of departure to highlight gaps in the literature.

Keywords Digital libraries, Research, Information science, Academic libraries, User studies

Paper type Literature review

Introduction

Since the launch of the Digital Library Initiative (DLI) projects in 1996, there has been substantial attention accorded to digital libraries research and development.

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Concurrent with this interest has been a significant emphasis on the digital library (DL) phenomenon in academic research. Over the past 11 years, there has been a tremendous growth in the number of journals dedicated to discussion of digital libraries (e.g. *International Journal on Digital Libraries*, *D-Lib Magazine*) and various conferences aimed specifically for both professionals and academics working on digital libraries (e.g. The International conferences on digital libraries (ICDL), the European conferences on digital libraries (ECDL), the International conferences on Asian digital libraries (ICADL), the Joint ACM/IEEE conferences on digital libraries).

Given the sheer volume of DL research publications built over the last 11 years, a survey of the literature and an interpretation of this literature in the manner of a meta-analysis are in order. The findings from such analysis would provide useful information to guide future research into this increasingly important phenomenon.

Scope and research questions

Any analysis of DL research will require firstly, a clear delineation. DL discourse has been vigorous not only in the obvious domains of technology, e-services and information architecture, but also in many disciplines outside of library and information studies/sciences (LIS), including managerial ones such as finance, marketing/outreach and logistics, as well as those concerning education, policy and regulation and social issues.

This study covers research articles published in mainstream peer-reviewed LIS journals between January 1997 and December 2007. This focus on LIS journals is necessary as DL is inherently cross-disciplinary in nature and many excellent articles in other disciplines (e.g. managerial publications) may have also embraced this phenomenon. Cronin (1998) has already pointed out that digital libraries (DLs) have in a sense, brought together the convergence of librarians and information scientists, computer scientists, cognitive scientists, cultural anthropologists, electrical engineers and many other professions who share the common desire for a better understanding of the nature of distributed information systems and of knowledge access in a digital environment. It should also be noted that only English-language articles are included in this analysis. There is definitely a scope for further research by extending the coverage.

For the purpose of this research, the definition of DLs provided by the Digital Library Federation (DLF) is adopted as it puts the emphasis on DLs as being much more than information systems, and that there is a social dimension to DLs:

Digital libraries are organisations that provide the resources, including the specialised staff, to select, structure, offer intellectual access to, interpret, distribute, reserve 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 (DLF, 1998).

The analysis reported here is focused on the themes related to organisational and people issues, including those concerning the social/cultural, legal, ethical, and use dimensions. Issues related to these are gaining importance as DLs move from being information systems (in the traditional sense) to becoming learning/knowledge environments that support not only information seeking and resource discovery, but also environments whereby users can communicate and collaborate with each other. The aim of this review is to provide an overview, rather than a definitive account. It

aims to identify the developments of DL research in these areas as revealed by an analysis of main LIS scholarly and professional literature. This analysis aims in particular, to find some answers to the following questions:

- RQ1.* What topics/themes (within the social/cultural, legal, ethical, organisational and use dimensions) are most frequently dealt with in DL research published in the period of 1997-2007? We hope to identify the trends and gaps in research in these areas that will suggest a way forward for future investigation into this increasingly important phenomenon.
- RQ2.* What are the core journals – those that publish the highest number of articles on these topics? This information might be useful to help academics, researchers and professionals interested in these topics focus their effort and attention on the most prolific journals when searching for related works.
- RQ3.* How is DL research published in the mainstream LIS journals examined in this study distributed according to geographical/socio-political regions? Does it have an international and global focus, or is it still mainly based on North American contents?

This work aims to complement and update earlier works by Singh *et al.* (2007), Herring (2000) and Chowdhury and Chowdhury (1999).

Procedure

The literature search included an exhaustive keyword and phrase search across the following electronic databases and online files in order to include different terminology used by individual researchers. The objective was to obtain a broad and representative selection of the literature: ISI Web of Knowledge, Web of Science, Wilson Web, Information Science Abstracts, Library & Information Abstracts, Applied Social Sciences Abstracts, Education Resources Information Centre, Meta Press, Proquest and the Directory of Open Access Journals. A manual checking of supplements from the physical archives in the event that the journal was not published online was also conducted. Additional research was carried out on the web using Google Scholar. To account for inconsistencies in indexing (Herring, 2000), a range of descriptors of DLs was used in the search. These included “digital library”, “d-lib”, “virtual library”, “electronic library”, “e-library” and “elibrary”. These descriptors were used in conjunction with other descriptors representing the various topics related to organisational and people issues. Truncated descriptor terms (e.g. Digital Librar^{*}) were also used in the searches. Nevertheless, it is important to note that this does not take into account journal articles that do not mention any of the digital library terms and yet, may discuss digital library themes such as copyright issues. Hence, certain issues might have been under-represented in this study.

It would be inaccurate to claim that searches from these databases and online files include every journal article. They provide us with an extensive but not comprehensive sample. Nevertheless, they help us to identify articles from the major journals. The literature search for this analysis was focused on journal articles that concerned the targeted dimensions. Abstracts of retrieved journal articles were manually reviewed. In the instance that a review of the abstract was insufficient to ascertain the content of the research paper, the full article was read and scrutinised. Over 900 articles were identified

initially but further scrutiny of these articles revealed that some of them were other forms of publications such as book reviews and editorial columns. At the end of the literature search and checking – a total of 577 articles were deemed relevant and were included in the final analysis. Abstracts of the relevant journal articles were exported to an EndNote database which was subsequently used as the basis for coding and analysis.

The initial coding of the articles was focused on the main dimensions. However, these categories are obviously too broad to convey any useful information. Hence, additional codes to further qualify these higher level categories were introduced. These were in the form of keywords and phrases that were identified and developed during the process of checking and reviewing the abstract (and some times, the full articles). It is natural of course, that any particular article in our sample may subsume several topics/categories. However, in this study, in all cases, an article is assigned to only one primary theme. A random sample of 60 articles (approximately 10 per cent of the articles included in the final analysis) was coded by an independent researcher. The final percentage of agreement for all coding decisions was about 87 per cent, which suggests that the coding classifications used were reliable.

Data analysis: the broad picture

This section begins by presenting a snapshot of the research landscape concerned by examining the main research themes addressed in the research articles in the sample. This analysis is also a step towards determining what is lacking in current research in order to suggest future research for developments in this field.

What topics/themes (within the social/cultural, legal, ethical, organisational and use dimensions) are most frequently dealt with in DLs research published in the period of 1997-2006?

The analysis reveals that there are several topics that are clearly dominant in our sample. For instance, there are a large number of studies that addresses one or more aspects of DL use and usability dimension (199 articles; 34.5 per cent of sample). There is also a considerable body of work that examines aspects related to organisational and economical issues (222 articles; 38.5 per cent of sample) such as planning a DL, funding and licensing issues, collaboration and cooperation, and collection management. Legal issues (115 articles; 19.9 per cent of sample) form the topic of a considerable number of works in the sample. In comparison, analysis of the sample of journal articles shows there is very little DL research in our sample that addresses ethical issues such as trust and social/cultural issues.

Table I presents a summary of the main themes of research under investigation that has been published in our sample. Keywords and phrases searches were conducted against the titles and abstracts of the final sample of 577 articles that were stored in the EndNote library. The number of retrieved articles against each of these searches is presented in brackets. Abstracts of the retrieved articles were manually checked to confirm validity of relevance to the topic concerned. We do not claim this as a definitive mapping of the research areas but is intended more to give an overview of what has been researched and published as journal articles.

Using the affiliations attached, the analysis found in the study sample that most of the first authors were academic (62.6 per cent), 22.0 per cent were LIS professionals (including those attached to university libraries) and 13.5 per cent were researchers belonging to

Use/usability issues (199 articles; 34.5%)	Usability (57) Interface/interaction design, human computer interface/user interface (48) User-centeredness (33) Accessibility (19) User needs assessment/analysis (16) User education/training (7) Added/add value (6) Quality assurance/quality control (5) User perception/expectation (3) User acceptance/acceptability (3) Personalise/personalisation (2)
Ethical issues (20 articles; 3.5%)	Privacy/confidentiality (10) Trust (6) Individual rights (4)
Legal issues (115 articles; 19.9%)	Copyright (57) Rights management (37) Intellectual property rights/regulatory issues/regulations (21)
Socio-cultural issues (21 articles; 3.6%)	Multilingual (11) Multicultural (3) Cross-cultural (2) Social inclusion/exclusion (2) Cross-lingual (1) Social/team empowerment (1) Learning/knowledge environment (1)
Organisational/economical issues (222 articles; 38.5%)	Collaboration/cooperative efforts (47) Planning (43) Funding (39) Licensing (29) Collection management/policies (16) Marketing (12) Business models (7) Promotion (6) Cost-benefit analysis (6) Internet/electronic commerce (5) Feasibility studies (4) Benchmark/benchmarking (2) Outreach (2) Sustainability (2) Risk management (1) Socio-economic issues (1)

Table I.
A summary of main social/cultural-related themes of DL research published in key LIS journals in the period 1997-2007

research centres (Table II). This causes some concern considering the importance of practice in this field. This of course is not a unique observation. Similarly, in the field of information systems, there seems to be “disconnects between the world of business and academia” and very few publications have been able to bridge the gap successfully (Hirschheim and Klein, 2003). Are practitioners submitting more of their works to conferences? This is something we would like to explore in further studies.

The coding of research methodologies allows us to analyse the research procedures associated with gathering and analysing data presented in the articles. Using the description of methods as shown in Table III (Wareham *et al.*, 2005), and with placing

curriculum analyses in the Data (content) analysis category, the analysis shows that most of the digital research in these areas as published in the study sample consist of case studies, reviews and conceptual analyses (Table IV).

What are the leading journals – those that publish the highest number of articles on these topics?

Data regarding the journals in which the research articles were published were gathered (Table V). As might be expected, *D-Lib Magazine* tops the list as the journal

Table II.
Type of author

Type of author	No. of articles	Percentage of total
Academic	361	62.6
LIS professional	127	22.0
Researcher	78	13.5
Don't know	11	1.9
Total	577	100.0

Table III.
Description of methods

Method	
Conceptual	Conceptual analysis, theoretical analysis, mathematical models, analysis or narration based upon author's experience, observation or thoughts. No strong empirical evidence to support author's conclusion.
Review	Descriptions of current practices, situations and imagined scenarios Literature review, historical rendition, commentaries, current status review, practice review
Data analysis	Document analysis, content analysis, secondary data analysis, field data analysis, and other analysis based on data not from questionnaire instruments and/or experimentation
Survey	Mail survey, online survey, use of questionnaires to obtain quantitative or qualitative data
Experiment	Lab experiment, field experiment, free simulation
Case study	Intensive analysis of cases based upon interviews, observations and analysis in some specific context
Developmental	Techniques, methods, frameworks, instruments to develop some technical application, system, protocol, etc.
Other	Ethnography, action research, other

Table IV.
Types of research method

Types of research	No. of articles	Percentage of total
Case study	210	36.4
Review	127	22.0
Conceptual	106	18.4
Survey	61	10.6
Data/content analysis	37	6.4
Experiment	15	2.6
Developmental	14	2.4
Other	7	1.2
Total	577	100.0

Journal title	No. of articles	Percentage of total
<i>D-Lib Magazine</i>	116	20.1
<i>The Electronic Library</i>	36	6.2
<i>Journal of the American Society for Information Science and Technology</i>	26	4.5
<i>International Journal on Digital Libraries</i>	22	3.8
<i>Library Review</i>	22	3.8
<i>Library Hi-Tech</i>	21	3.6
<i>Program: electronic library and information systems</i>	19	3.3
<i>OCLC Systems & Services</i>	18	3.1
<i>The Journal of Academic Librarianship</i>	17	2.9
<i>Information Processing & Management</i>	17	2.9
<i>Libri</i>	16	2.8
<i>Library Trends</i>	16	2.8
<i>Online Information Review</i>	16	2.8
<i>Information Technology and Libraries</i>	15	2.6
<i>Journal of Library Administration</i>	14	2.4
<i>Aslib Proceedings</i>	11	1.9
<i>Journal of Documentation</i>	10	1.7
<i>Library Management</i>	10	1.7

Table V.
Journals with the highest
number of articles in
sample

with the highest number of articles published. This is followed by: *The Electronic Library*, *Journal of the American Society for Information Science and Technology*, *International Journal on Digital Libraries*, *Library Review*, *Library Hi-Tech*, *Program: electronic library and information systems*, *OCLC Systems & Services*, *The Journal of Academic Librarianship*, *Information Processing & Management*, *Libri*, *Library Trends*, *Online Information Review*, *Information Technology and Libraries*, *Journal of Library Administration*, *Aslib Proceedings*, *Journal of Documentation* and *Library Management*.

In spite of some fluctuations, there was an overall upwards trend for journal publications in these DL research areas (Table VI). The years with the largest numbers of works published in these areas were 2004, 2005 and 2006.

Year of publication	No. of articles	Percentage of total
1997	34	5.9
1998	35	6.1
1999	52	9.0
2000	55	9.5
2001	43	7.5
2002	39	6.8
2003	46	8.0
2004	75	13.0
2005	90	15.6
2006	72	12.5
2007	36	6.2
Total	577	100.0

Table VI.
Publications by year of
publication

How is DL research published in the LIS journals examined in this study distributed according to geographical/socio-political regions? Does it have an international and global focus, or is it still mainly based on North American contents?

In bibliometric terms, examining the country of origin of the authors (based on information gleaned from the affiliation information) provides an indication of the “nationality” of a document and the research it is based on.

In terms of geographical regions, the analysis finds that most of the research and studies are from the North America region, namely the USA (49.2 per cent), closely followed by the UK (17.9 per cent). The numbers of articles are slightly larger if articles resulted from collaboration are added. The third largest category was formed by European (non-UK) contributors with 12.8 per cent, followed by the Asia-Pacific region with 10.9 per cent contributors. As shown in Table VII, there are only a small number of articles that have resulted from collaborations between/among researchers from different countries/regions.

A closer examination

In this section, we highlight some of the interesting research works found in our sample. The aim is to capture some of the key aspects and to provide a picture of the research landscape to-date on DL research that has focused on issues related to the social/cultural, legal, ethic, organisational and use dimensions. We focus particularly on more recently published research and also on what we perceive to be trend-setting research work.

Country of origin	No. of articles	Percentage of total
North America		
United States of America (284)		
Canada (16)	300	52.0
UK (United Kingdom)	103	17.9
Other countries in Europe	74	12.8
Asia-Pacific	63	10.9
Middle East	6	1.0
Africa	4	0.7
South America	3	0.5
<i>Collaboration</i>		
USA/Europe	5	0.9
USA/Asia	4	0.7
USA/UK	4	0.7
UK/Asia	2	0.3
UK/Canada	2	0.3
USA/Middle East	2	0.3
Europe/Asia	1	0.2
USA/Africa	1	0.2
USA/Australia	1	0.2
USA/Europe/Asia	1	0.2
USA/South America	1	0.2
Total	577	100.0

Table VII.
Geographic locations of
articles

Use/usability issues

Within the use/usability-related articles, there is a high concentration of research focusing on usability, interface/interaction design, human-computer interaction/user interface or on issues related to accessibility.

Usability. Overall, 70 per cent (40 of 57 articles) of the articles focusing on usability were published between 2004 and 2007. This is not surprising since DL systems mature in the later years and hence, the increase in works that examine their usability. Most of the articles were published in *Information Processing & Management*, *Journal of the American Society for Information Science and Technology*, *OCLC Systems & Services* and *Online Information Review*.

In an interesting article published in *Interacting with Computers*, Blanford *et al.* (2007) present a case study that looks at introducing scenario-informed design into two DL development processes and found that by doing so, there was disruption to established patterns of working. Blandford and her colleagues found that developers tended to think in terms of two kinds of user: one who was exploring the system with no particular goal in mind and one who knew as much as the developer. They found that scenarios typically work with richer user descriptions that challenge that thinking and the development practice of breaking down the design problem into discrete functions to make it manageable does not fit well with a scenario-based approach to thinking about user behaviour and interactions. The compromise reached was scenario-informed design, whereby scenarios were generated to support reasoning about the use of selected functions within the system. It would be interesting to see further research in this area to determine if scenario-informed design indeed contributes to creating productive common ground between perspectives.

The study by Bilal and Bachir (2007a) was one of a handful of studies that look at the issues of usability and interface design from a cross-cultural and multilingual perspective. They presented the results of a study that examined Arabic-speaking children's interaction with the International Children's Digital Library (ICDL). They discussed the assessment of the ICDL to Arabic-speaking children as a culturally diverse group was grounded in "representations" and "meaning" rather than in internationalisation and localisation. Most of the ICDL representations and their meanings were found to be highly appropriate for older children but inappropriate for younger ones. Another study that address the usability-culture connection was Smith (2006) who looks at applying cognitive theory to usability of DLs in a multiple culture, multiple intelligence context.

The prolific grain of research during 2006 has been the issue of user-centeredness of DLs and on the question of "what do users want from DLs?" (Mon, 2006; van Schaik *et al.*, 2006; Bertot *et al.*, 2006; Pan *et al.*, 2006). One study that stood out among these is that of Xie (2006) who identifies users' criteria and applies them to the evaluation of existing DLs. A compilation of criteria developed by the forty eight participants in this study show that usability and collection quality were the most important criteria for evaluating DLs. Service quality, system performance efficiency, and user opinion solicitation were also deemed essential criteria. The author further compares DL evaluation criteria identified by users and researchers and applied in previous research. The article reveals problems in current DL design and development, discusses suggestions for improving DL design, and presents areas for further

research. There is also a systematic review of usability and impact of DLs by Chowdhury *et al.* (2006).

There is a stream of research in our sample of 2005 articles that examines the design and usability of digital image library. There is a study on DL of historical maps and newspapers (Jones *et al.*, 2005), a study on historical aerial photographs DL (Long *et al.*, 2005), a research that measures functionality, content, and awareness of an online digital image collection by observing participants in a controlled search for a specific image and evaluating their responses to questions (Kramer, 2005) and a study that investigates digital imagery for cultural and historical materials (Chen *et al.*, 2005). Another study by Roda *et al.* (2005) report the experience gained in the development of a digital image library in the academic environment, with the aim of providing perspective developers with insights on the main usability issues raised by this type of project. The article discusses how usability issues have been addressed at design time, highlights the usability problems and advances proposals on how these problems may be further addressed. Some of their findings include that team formation and high turn-over impact usability design and collection management functionalities affect final product usability. A usability guide for future developers of digital image libraries in academia was developed by this team of researchers.

Interface/interaction design, human-computer interaction/user interface. Some of the interesting topics identified in our sample include examining sustainable user-centred design for DLs (Norberg *et al.*, 2005), applying semantic technology to DL (Warren and Alsmeyer, 2005), the role of information visualisation in the re-conceptualisation of DLs (Fast and Sedig, 2005) and DLs for lesser-used language such as the Galician (Places *et al.*, 2007). These articles exemplify the recent body of research that is now going beyond traditional interface/interaction issues to addressing novel, emerging developments in DLs.

User-centeredness. Since Marcum (1997) asked the question, "Digital libraries: for whom? For what?" there has been some interesting research on the user-centeredness of DLs. In our sample, one of the most interesting studies in this category is that of Ercegovac (1997), who reports a case study on the degree of variation in how college students interpret basic DL activities. The study's findings suggest that the notion of the DL as a space is better agreed upon than the notion of the library as a store or service. It would be interesting to examine if this has changed a decade later? Ercegovac did not follow up on this study but in 2007, reports findings from a study that investigates how a new navigational capability in networked DLs can be developed to support user-centeredness, using the Functional Requirements for Bibliographic Records (FRBR) concept.

Ethical issues

In our sample, only a small number of articles address ethics-related issues. This perhaps highlights an area for further research as these issues gain importance along with the growth and development of DLs.

Privacy/confidentiality. Most of the articles in our sample address issues concerning privacy or confidentiality of users of DLs. The topics ranged from access restrictions (Arms, 1998), internet commercialisation/e-commerce and privacy (Heckart, 1999), a DL authentication and authorisation architecture for cross-organisational access management (Milman, 1999) to fair use and privacy in digital rights management

(Tyrväinen, 2005). There are also three articles that focus on the issue of user privacy in a DL environment (Sturges *et al.*, 2001; Khoo, 2002; Davies *et al.*, 2003). The Privacy in the Digital Library Environment project at Loughborough University (Davies *et al.*, 2003) revealed that users had low levels of anxiety about privacy when using libraries but this was probably because they had the expectation that institutions like libraries would not pass on personal data to other bodies. Interestingly, librarians meanwhile, whilst respecting privacy as a professional value in principle, did not give it a high rating against other values. Additionally, a significant minority of libraries was not well prepared for data protection. These studies generally highlight the issues of how digital content technologies are throwing into question, taken-for-granted definitions of privacy and that the notion of what privacy means in relation to the provision of online content remains contested.

Trust. We highlight three articles in our sample that address the issue of trust in DLs. Bearman and Trant (1998) examined how with the ubiquity of digital representations and the proliferation of source information on the Internet, issues concerning the authenticity and integrity of digital resources are complicated. They proposed that it would be crucial to determine the relative authenticity of a number of different representations, through an analysis of the methods that have been chosen to transform the original into a digital form, or through an assessment of the methods used to capture original digital data. Bearman and Trant also believed that it would be essential to be able to establish the integrity of a particular digital copy. Almost seven years later, Jantz and Giarlo (2005) revisit the issues of authenticity and integrity of digital resources, particularly in the context of digital repositories. Jantz and Giarlo did not prescribe any strategies in dealing with the issues concerned but the premise of their article is that there are many technologies available today that will help us build trust in a digital preservation process and that these technologies can be readily integrated into an operational digital preservation framework.

Skogsrud *et al.* (2004), introduced Trust-Serv, a model-driven trust negotiation framework for web services, and show how it can be used to effectively handle trust negotiation in DLs. The framework employs a model for trust negotiation based on state machines, extended with security abstractions. High-level specifications expressed with the state-machine-based model are then translated into formats suitable for automating the trust negotiation process. The proposed framework also supports negotiation policy lifecycle management, an important trait in the dynamic environments that characterize DLs and digital repositories. The authors also discussed a set of policy change operations that enable the dynamic evolution of negotiation policies without disrupting ongoing negotiations. It will be of great interest to assess the long-term viability and impact of this framework.

Legal issues

The literature coded under this theme is predominantly on copyright and rights management issues.

Copyright/rights management. Research on copyright-related issues has been explosive since 2000, commensurate with a growing awareness of the need and responsibility for legal protection of digital contents in DLs, along with an enthusiasm to overcome some of the issues and problems related to this. Before 2000, the major publications were works discussing and questioning the effects of copyright on DLs

(Gadd, 1998; Mann, 1999; Hannay, 1999). Post-2000, the focus shifts to that of proposing strategies and solutions. Sheppard *et al.* (2001) proposed digital watermarking, which embeds a hidden signal into host data as a viable technical solution that can be used in a variety of protocols that attempt to either prevent or deter copyright infringement.

In the wake of the Digital Millennium Copyright Act of 1998, digital rights management (DRM) becomes a major theme. Connaway (2001) discusses the use of DRM in the netLibrary e-book context. A few years after its introduction, Foroughi *et al.* (2002) wrote to remind the DRM industry to provide a balance between fair compensation for the creators of digital content and the rights of end users to access and use information. Davis and Lafferty (2002) and Coyle (2004) discuss the implications for DLs in general while Braid (2004) describes specifically the use of DRM in providing a secure document supply service and the reasons for implementation of a DRM system by the British Library. Ianella (2002) writes about the importance of both the functional architecture that covers the high-level modules of a DRM system that together provide an end-to-end management of rights, as well as the associated information architecture which covers the modelling of the entities within a DRM system as well as their relationships.

Another interesting article is one by MacPherson (2006) that discusses the Context Driven Topologies (CDT), which was proposed to create one global context of geography, knowledge domains and Internet addresses, using centralized spatial databases, geometry and maps. MacPherson introduces a model demonstration project that uses CDT to organize, search and place information in new contexts while protecting the authors' intent. It would be interesting to examine any implementations of CDT in a DL context.

Intellectual property/regulatory issues. Gladney *et al.* (1997) examined the complexity involved in managing both the intellectual integrity of disseminated digital images and also the reputations of the institutions making their collections digitally accessible. Their conclusion was that "Safeguards are nearly always imperfect. The most realistic objective is to make misuse economically unattractive." Two years later, Gladney returns to the subject and examines the views on the study by the National Academies' Committee on Intellectual Property Rights and the Emerging Information Infrastructure. Another article that examines intellectual rights management of digital images is Marmor (2003).

Bearman (2000) discusses the intellectual property conservancies that were conceived as a means to provide public benefits by making digital content donated, or licensed to them freely available and by ensuring its long-term preservation. He also explores the issues non-profit IPC organisations such as The Knowledge Conservancy (www.knowledgeconservancy.org) will face in a digital realm. There is only one article in our sample that addresses issues of indigenous cultural and intellectual property rights (Sullivan, 2002). In this case, Sullivan examines the issues as related to the Maori culture in New Zealand. In a 2007 article, Zhang proposes an intellectual property right evaluation and method to be used in a DL context and suggests that the evaluation should cover aspects such as the novelty, inventiveness, usefulness of the DL resources as well as the access mode and stable right of use.

Socio-cultural issues

Along with ethical issues, this is another category/theme that is poorly represented in our sample. The paucity of research in these areas is worthy of serious consideration, especially as DLs are becoming more than just digital collections, but an environment where users from any domains, countries, culture could interact with each other. While since 2005, there has been a steadily growing stream of articles on multilingual issues, there is still very little published on other issues such as cross-cultural issues, social inclusion or social empowerment.

The main proponents for addressing multilingual, multicultural issues in DLs in the earlier years include Oard (1997), Peters and Picchi (1997) and Borgman (1997). Post-2005, there has been an interesting stream of research on the issues. McCulloch *et al.* (2005) provides an overview of the terminology problem within the DL field and discusses the benefits of the terminology mapping approach associated with the use of multilingual schemes. They also describe various drawbacks such as the labour intensive nature and expense of such an approach, the different levels of granularity in existing schemes and the high maintenance requirements due to scheme updates, and not least the complexity of the nature of user terminology. Within the same year, Information Technologies and Libraries published an interesting case study on the International Children's Digital Library (ICDL) whereby the researchers discuss the designing of the DL for a multilingual, multicultural, multigenerational audience (Hutchinson *et al.*, 2005).

Wang *et al.* (2006) investigate the feasibility of exploiting the Web as the multilingual corpus source to translate unknown query terms for cross-language information retrieval in DLs. The researchers propose a web-based term translation approach to determine effective translations for unknown query terms by mining bilingual search-result pages obtained from a real web search engine to enhance the construction of a domain-specific bilingual lexicon and bring multilingual support to a DL that only has monolingual document collections. Meanwhile, Cousins (2006) presents an overview of The European Library as a portal and discuss the issues of usability this gives in delivery of multicultural, multilingual access to the cultural heritage in Europe's National Libraries. Bilal and Bachir (2007a), reported their findings on Arabic-speaking children's interaction with the cross-cultural and multilingual ICDL in two Information Processing and Management articles (Bilal and Bachir, 2007a, 2007b).

Organisational/economical issues

There is a strong stream of research in our sample that falls into this theme, with 222 articles (38.5 per cent of sample). Given the manifestos for DLs to continue to grow into socio-technical systems/environments, it is likely that research into these issues will continue to grow and may converge with other research streams to reflect the movement of DL research away from technical to also organisational and people issues.

Collaboration/cooperative efforts. Most of the articles on collaboration/cooperative efforts were published after 2001 (35 out of 47 articles; 74.5 per cent). The article that stood out before 2000 was that of Bunker and Zick (1999) where they suggested that collaboration was the key to successful DL development. They discussed three aspects of the University of Washington Digital Library Initiative: the fundamental importance

of collaboration, including the unique and complementary roles of the collaborating partners (i.e. faculty, engineers, students and librarians).

There were two important articles in 2002. Allard talks about how DLs provide the technological mechanisms to cross national and disciplinary boundaries, and to promote an organisational structure that encourages communication between scholars who are both creating and consuming information. Allard introduced two models of electronically-based scholarly organisations that promote international collaboration and facilitate knowledge creation, and her proposed eight-steps towards building the effective organisation for utilising DLs for international collaboration. In another paper, Fox *et al.* (2002) present a summary of application domains for a worldwide development of a DL, institutions engaged in those application domains, example of their activities and technical challenges faced in these activities. The authors also explore possible benefits in such effort.

In 2004, an article published in *Reference and User Services Quarterly* describes the work undertaken to build the Bioregion and First Nations Collections of the Southern Oregon Digital Archives, which is a DL of over 1,100 volumes of ecological materials relating to the Siskiyou-Klamath-Cascade bioregion of the USA, including publications from a wide range of US Government departments. The work usefully discussed collaboration efforts with Government agencies, the methods used to build relationships with other Native American studies programmes, scope and contents concerns, issues of copyright and permissions as well as reciprocity (Face and Hollens, 2004).

In 2005, Barton provides an overview of activities in the field of virtual museums and considers a number of issues for which there are parallels in the field of DLs. Barton finds that virtual museums and DLs have much in common with increasingly blurring boundaries between them. Barton proposes that collaboration between the museum and library communities is essential if solutions to the problems of cross-domain searching are to be found and its potential to facilitate new knowledge creation fully exploited. However, she warns that any collaborative approach must take into account the differences, as well as the similarities, between the two communities, as these differences are fundamental and defining. Within the same year, Collier (2005) publishes an article in *Journal of Documentation* that describes the process and results of the business-planning work package of The European Library (TEL) project, in which eight national libraries collaborated on a joint approach to access to their DLs. Collier recommended a three-part business planning methodology for such collaboration: first, a literature review and the mapping of the partners' existing and planned digital products and services, then a structured interview or survey to determine the partners' business requirements from TEL, followed by a harmonisation process. Finally, the results are to be combined with normal business planning elements to produce a mission and final business plan. Collier claims that this methodology has proven to be an effective method of achieving mutual agreement among partners with widely different aims and characteristics.

There are a handful of comprehensive case studies published in 2006 and 2007. Yeates and Guy (2006) describe the creation of a large-scale cultural heritage consortium in the South East of England for disseminating local heritage via the web and the management lessons resulting from this project. Borgman (2006) describes lessons about collaboration learnt from the findings of two large, long-term DL

research projects: Alexandria Digital Earth Prototype Project (ADEPT) and the Center for Embedded Networked Sensing (CENS) project. Borgman states that personal DLs offer a middle ground between private control and public release of content, and is therefore a promising direction for the design of DLs that will facilitate collaboration in e-Research. Hicks *et al.* (2007) discuss the OhioLINK's consortia of libraries and identify lessons learnt, including those on data content standards.

Planning. A lot of the articles coded under the theme of "planning" deal with the concerns and issues with regard to strategies and/or strategic planning for DLs (Ross and Economou, 1998; Skaliczki, 1999; Choi, 2003; Cervone, 2004; Collier, 2004; Sreekumar and Sunitha, 2005; Lopatin, 2006; Lavoie *et al.*, 2006; Collier, 2006).

Funding. Among the main streams of research under this theme is that of consortia and funding and sustainability issues. Payne (1998) talks about how library consortia can be organized according to a variety of models ranging from loosely affiliated "buying clubs" to tightly integrated virtual or actual organisations, to promote organisational stability, flexibility and equity for the member institutions. Peterson (2001) discusses these issues based on the experience of the Montana State University's IMLS (Institute of Museum and Library Services) funded project to build an image database of Native American peoples. Hamilton (2004) discusses how economic sustainability is a pressing concern for many DL projects and that one of the main means of achieving economic sustainability is to make the DL an integral part of its parent organisation. Hamilton suggests that librarians must be prepared to network and cultivate useful contacts and funding sources can include sponsorship, in-kind support, fee charging and the ultimate aim should be integration. Griffin (2005) traces the funding patterns for DLs from the mid-1990s and concluded that new social networks and organisations were formed as a consequence of new technological environments, diverse communities found common ground and cause to pursue knowledge-making and knowledge management using digital resources. As a result, cross-disciplinary and multi-sector collaboration became a fixture of DLs research efforts. In a recent article, Kavulya (2007) proposes that DLs in the Sub-Saharan region can be strategic gateways to the global information and a boost to development in the region. The goal of establishing DLs in the region can be achieved through measures such as adoption of modern information communication technologies, amassing relevant digital content, investing in digital skills for library staff and users, and via strategic partnerships between local institutions, and funding agencies and above all government-backed strategy on DLs.

Licensing. In 1999, Ann Okerson reported in an article published in *D-Lib Magazine*, on the LIBLICENSE Project which was established to inform and educate members of the information supply chain, particularly librarians, about how effectively to contract for electronic information resources. Several years later, Okerson (2004) concluded that the information community gains advantages from working in the licensing environment, beyond those in the print world where take-it-or-leave-it pricing was governed by a copyright regime. She also stated that copyright law is needed as a foundation for effective licensing but licenses can offer new modes and opportunities to assure the survival and prosperity of the scholarly and scientific publishing and reading communities. In the following year it was stated by Wyatt that as libraries move into the digital age, they will be forced to rely upon licensing agreements to obtain electronic information and warned that librarians need to be aware of the

current status of the law so that they may better negotiate licenses which protect the library's rights of interlibrary loan, fair use and archival rights.

Other organisational/economical issues. There were several topics addressed with regard to DL collection management. Gwinn (1998) discussed how libraries could formulate programmes for digitisation to attract funding and examined past experience of dealings with the US federal government over the funding of microfilming. Gwinn noted the differences in approach arising from the greater visibility of libraries in the digital world, the need for maintenance and updating of electronic media and public enthusiasm for electronic media. Miller (2002) explored issues related to the selection and purchase of digital content, both from vendors and creation in-house, and the degree to which standard collection management principles apply in DL context. Atkinson (2003) then published an interesting review of some of the standard issues relating to cooperative collection development, first with respect to traditional materials, and then from the standpoint of an environment increasingly dependent upon licensed electronic resources.

Examining the articles on marketing, promotion and outreach reveals several interesting topics. Dugdale and Dugdale (2000) analysed the development of the ResIde Electronic Library at the University of the West of England (UWE), originally, an eLib-funded research project. The authors examined the potential of the system in increasing economy, efficiency and effectiveness in services. Dugdale and Dugdale concluded that while economy and efficiency were relatively easy concepts to define and use, effectiveness could be both contested and multifaceted, varying in accordance with both subjective preference and interests represented. Competing views of effectiveness needed to be balanced whilst emphasising those aspects of the system that would appeal to senior UWE management in a time of the rising "audit society" in higher education. Turner *et al.* (2003) discussed the benefits of developing a network to raise awareness of DL resources, using the National electronic Library for Health's DLNet as an example. In the year that follows, the same authors published another article outlining how this collaborative approach has enabled a greater reach for marketing campaigns and offered economies of scale (Rosen *et al.*, 2004). In 2005, Henderson provided a summary and description of one form of marketing – the relationship marketing method, with examples of DL applications as illustration of its relevance in the context of practice.

There were two prominent articles on cost-benefit analysis for DLs in our sample. Byrd *et al.* (2001) introduced Virginia's Digital Library Program (DLP) and Virginia Historical Inventory Project (VHI), discussed the costs and benefits of creating the library and compared the one-time development cost and subsequent delivery of the digital resource to the long term costs and benefits of providing access to these materials via traditional means. Moreover, Kollofel and Kaandorp (2003) described the development of a model for academic libraries that is a cooperative venture between the libraries of the universities of Utrecht in the Netherlands, Lulea in Sweden and Bremen in Germany.

In our sample, there is an interesting article that examines the socio-economic issues, particularly on the concern of digital divide. Cullen (2001) examines a number of these issues at the national level in the USA, UK, Canada and New Zealand, looking for evidence of the "digital divide", assessing factors that contribute to it, and evaluating strategies that can help reduce it. The author further explores the relevance of these

strategies to developing countries and strategies for reducing the international digital divide. It is somewhat curious that there have not been more articles in our sample on this topic considering the attention that has been given to this topic. This perhaps signals a gap in DL research into this topic.

Conclusion: what's next?

This review and meta-analysis has attempted to draw a profile of the DL research focusing on social/cultural, legal, ethical, organisational and use dimensions of the last 11 years (1997-2007), drawing on a sample of 577 articles published in both academic and professional LIS journals.

It is our intention to extend this study. We would like to further investigate the main topics and themes to ascertain the progress in this field, to examine the different foci (and editorial preferences if any) in the journals and to consider other aspects such as methodology/research instrument used, information regarding the researchers and context, population of the studies involved in the research and information on sample size. We would also like to extend the meta-analysis to cover articles published in conference proceedings and journals in fields other than LIS. This will provide an even more comprehensive view of the research in these DL research domains.

We hope nevertheless, in the current study, to have provided a snapshot of the DL research activities related to these dimensions. We have profiled the major themes and discussed the issues within each domain and use that as a point of departure to point out some gaps in the literature in our sample. As mentioned in the analysis/review above when appropriate, numerous opportunities exist for DL scholars in various domains. Themes that are non-existent or are lightly represented in the current literature signal opportunities for researchers to be innovative in their choice of topics. Given that manifestos that DLs are to grow into socio-technical systems that function within an organisation and society, the subject area as a whole has also evolved over the years, with a move away from purely technical issues towards the application, use and effectiveness issues. Therefore, it is highly likely that we will continue to see research into these emerging issues to continue to grow and research into the various streams may converge to reflect the movement. There is obviously still a great deal of important work yet to be accomplished in DL research and this review provides a preliminary overview of this important development.

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