Enforcement of information seeking behavior through digital library services

Leonidas Papachristopoulos
Library and Information Center, University of Patras, Greece.
leonidasp@upatras.gr

Giannis Tsakonas
Library and Information Center, University of Patras, Greece
Laboratory on Digital Libraries and Electronic Publishing, Department of Archives and Library
Sciences, Ionian University, Greece.
john@lis.upatras.gr, gtsak@ionio.gr

Christos Papatheodorou
Laboratory on Digital Libraries and Electronic Publishing, Department of Archives and Library
Sciences, Ionian University, Greece.
papatheodor@ionio.gr

[1] **Postal address:** Library and Information Center, University of Patras, 26504, Rio, Patras, Greece
[2] **Postal address:** Laboratory on Digital Libraries and Electronic Publishing, Department of Archives and
Library Sciences, Ionian University, Ioannou Theotoki 72, 49100, Corfu, Greece.

Abstract: Digital library are complex information systems, comprised by core and value added services. The
current study attempts to collect through a qualitative approach users' opinions about the usage, usefulness
and usability of DL value added services. Selected value added services from four DLs are related to the
main stages of information life-cycle in order to identify crucial areas of DL interaction. The results show a
major concentration of services in stages that address information searching needs and that the most
significant factors affecting acceptance reside on three levels of factors, namely system, services and
individual's factors.

Key Words: Information seeking, Qualitative evaluation, Value-added services, Services modeling,
Information behavior.

1.0. Introduction

Many researchers have made several attempts to clarify the meaning of the term value and to connect it
with other concepts, such as satisfaction and customer's behavior (Ball, Coelho & Vilares, 2006). Value is
regarded as the overall assessment of the utility of a product based on the perceptions of what is given and
received (Ho & Cheng, 1999). In addition Value Added Services (VAS) are considered the advanced and/or
additional services that a provider offers to enhance a product through unique characteristics, to increase
user experience and to satisfy advanced user requirements. This study attempts to deepen in the concept of
services in the digital libraries (DLs) area. We try to allocate which are the most significant services from a
large set found in four DLs, which affect the users' behavior in various phases of information flow and which
are the factors that create the sense of value. The motivation of this study lies in pursue of understanding
users' views of popular and innovative DL services and enable designers' comprehension on this subtle issue.

2.0. Background

According to Fox (1993) services are all the computational, warehousing and communication mechanisms
that exceed the capabilities of DL in relation to the traditional library services. Previous DL evaluation
studies focused on specific aspects of their operation, like performance or usability (Kengeri et al., 1999;
Rusch-Feja & Siebeky, 1999), but few have concentrated on value added services. Other researchers
surveyed extensively the various information retrieval (IR) features (Smith, 2000; Meyyappan, Chowdhury &
Foo, 2000). Chowdhury & Chowdhury (2000) have categorized IR features of twenty DLs in two main
classes, browsing and search functionalities, and search output. From their study it was evident that DLs do
not address only issues of IR, based on the solid tradition of IR and database retrieval, but they extend their

functionalities to cover users' needs for results management and meaningful presentation. Vilar and Žumer (2005) in their study of web based information systems compared the interface features of four commercial DLs and used two main groups of criteria. These features were further divided to cover aspects of interface design and system functionality. These studies demonstrated the evolution and maturing of DLs from information search supporting systems to powerful mechanisms that support the whole range of information management activities. Eason, Yu and Harker (2000) demonstrated that services, similar to the ones included in this study, are considered as peripheral, due to the dispensability and the effect they have on DL acceptance. Furthermore Nicholas et al. (2006) reported that the usage of value adding services is limited, but nevertheless they constitute a field that demands exploration.

Modelling services in the DL sector is not an easy task. Gonçalves (2004) has categorized the DL services into two categories: information satisfaction services and infrastructure services. Value added services constitute a subcategory of the infrastructure services, which include annotation, visualization and others. Candela et al. (2006) gave a more abstractive view of DL's services. He divided the functions of a DL into four categories: access, submission, management and personalization. Apart from the management category, the others concern the end user. These classifications together with information behaviour models, that examine the stages or facets of information seeking (Ellis & Haugan, 1997; Wilson, 1997), lead to the creation of abstractions of information flow. Several abstractions of the information life-cycle exist in the corpus of scientific literature (Paepcke 1996; Khoo, 2006). Paepcke has used the information life-cycle concept to show the augmented nature of the DL in the information environment. In fact Paepcke manages this cycle to present possible tools that enhance DL interaction. Moreover, Gonçalves et al. (2007) divided the information life-cycle to four phases: seeking, utilization, creation and distribution. Then they defined and associated to each phase particular quality criteria to assess the information's quality path. In our approach DL services are mapped directly to the information cycle phases and we investigate which of these services help the users to fulfil their needs in order to accumulate qualitative information.

3.0. Research Setting

The objectives of the study were:

1. to identify the searching options that the users utilize in order to accomplish their search tasks,

2. to map the added value services of DLs in information life-cycle and to observe their effect on the user's information behavior, and

3. to determine the encouraging and the discouraging factors which affect the usage of the added value services.

The sample for the research consisted of eleven participants. Eight of them were doctoral students of the Department of Electrical and Computer Engineering and two post graduate students of the Department of Computer Engineering and Informatics of University of Patras. The selection of the participants was based on the content specialization of the DLs, which was pertained to their interests, the educational level, which assured about consistent use of DLs, and their experience level. The sample is considered as experienced in the field of usability of information systems, because was recruited from the Human Computer Interaction Group of University of Patras.

The research instrument was the interview, but two phases preceded it, namely the seminar and the familiarization phase. A seminar was run to present the objectives of the study, the DLs of the research and the research parameters (method, duration and consent agreement). Following the seminar, a two month period of familiarization was given to explore the DL services. The participants would use the DLs in their everyday work to collect the appropriate bibliography and to write a research paper. The services of our study are displayed in Table 1.

Table 1: Services and providers included in the research

Service	Provider	Description
Search	Daffodil, IEEE, ACM, HighWire	Search options that DL offers. Author search, title etc.
Help	Daffodil, IEEE, ACM, HighWire	Advices on DL's issues that interest users.
Thesaurus	Daffodil	Service that offers an hierarchical construction of the terms e.g lower or wider terms.
Chat	Daffodil	An integrated synchronous collaboration tool like Yahoo chat etc.
Co-Authors Network	Daffodil	A graph that displays the relationships between the authors.
Popular articles	IEEE	A list that displays the most visited articles of the DL.
Downloadable Citations	IEEE, ACM	An option that creates automatically a reference for an article in various formats.
My clipboard	Daffodil	A personal space that the user can store temporarily the terms of his search and the authors that his is interested in.
My favourite journals	HighWire Press	Service with which user can confine the search only to the journals that he is interested in.
Search history	Daffodil, IEEE, ACM, HighWire	Service that displays the terms that a user used in previous searches and their results in an abstracted way.
Alerts	HighWire, ACM	Types of newsletters that inform the users on latest additions of the journals
Related terms	Daffodil	Service which displays the additional terms of the articles that the search brought.
Annotations	Daffodil	Service with which user can make a comment on article level, not in text level.
Topic Map	HighWire Press	A graph that displays the relationships between the topics of the articles.
Forthcoming articles	IEEE	Services which display the articles to be published, without having been corrected fully.
My Library	Daffodil	A personal space where the users can store and organize his downloaded articles.

During the third phase the evaluators arranged appointments with each participant. Each interview had an average duration of 25 minutes and was recorded by a video camera. Interviewers asked the participants about the extent of use of the services, their intention to use them and the factors that affect their usage.
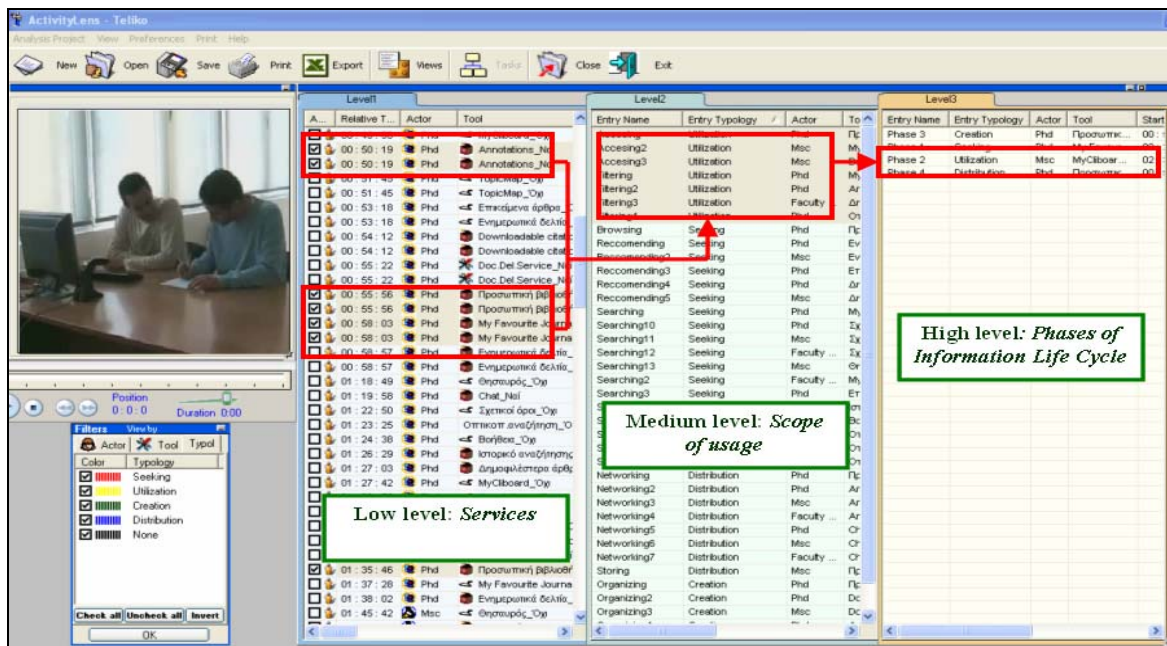
Figure 1: Activity Lens: Hierarchical view of multilevel analysis

ActivityLens (http://www.hci.ece.upatras/activitylens, henceforth AL) software (Fiotakis, Fidas & Avouris, 2007) was used for data analysis. AL is designed to support data analysis of both qualitative and quantitative nature, offering powerful video annotation and statistical processing functionalities. Deploying software's capability for organising data hierarchically, we structured our data in three levels as Figure 1 shows. At the first level we registered the used services. At the second level, we connected the services with the user activities they fulfill. Finally, at the third level we classified each service to a phase of the information life cycle, proposed by Gonçalves et al. (2007). The classification results are displayed in Figure 3.

4.0. Results

A general view of the participants' preferences in using the DL services is shown in Figure 2. Concerning the information seeking phase, the interview results showed that all participants were familiar with the Boolean operators and used them to constrict the search results. Eight of the participants use frequently the advanced search option. Regarding to their search preference, the study showed that the author field stands on the top of their choices followed by the title and the keyword.

Participants classified Thesaurus on the information seeking phase. However, only one of them stated he was user of the service. Two were the basic reasons for not using it: (a) there was non-conformity between the structure of terms that the service offers and the structure that the user has in mind and (b) the service offers poor results.

Six participants stated that the Relative Terms service offers the opportunity to re-examine their searches and that they utilize it in the same phase. The participants who disapproved the service justified it due to the lack of knowledge about its potential benefits. In relation to this service, Search History had almost the same impact, as five participants answered that they use the service. Those who were not using it supported that (a) the level of presentation of the results was prohibiting for them and (b) they weren't satisfied with the results. They preferred to repeat a query than referring to the Search History and thought that the service has little to offer to them. In relation to Relative Terms and Search History, other recommendation services, such as Popular Articles, gathered the preference of five participants of our study sample. Popular Articles represent *"the future references"*, as it constitutes an indicator of scientific orientation.

The current study harvested diverse opinions, which prove that awareness services offer dubious advantages to the users. Six participants answered that use alerts. Participants, who don't use these services, either do not create awareness profiles, due to the perception that the specific process is just lack of time or they had experimented in the past with it and found that it was a source of spamming. However, those who answered positively support that the service keeps them up to date with the advancements of

their field. The most popular types of alert were concerning citation alerts (e.g. Cite Track) and Table of Contents, while the least popular was RSS feed. However the Forthcoming Articles service, which was provided by IEEE, accumulated a disappointing amount of users; only four proved to be users. They don't think significant the release of a primal version of an article, despite someone would suspect that this is a tool of efficient information seeking, but they consider it as merely a recommendation service. In the question if awareness profiles "tight" them with a specific library, the answers were negative. The users don't fasten on a particular source of information in contrast Zauberman's *"locking-in"* (2003). The sample seemed to emphasize on information acquisition rather than the personalization services.
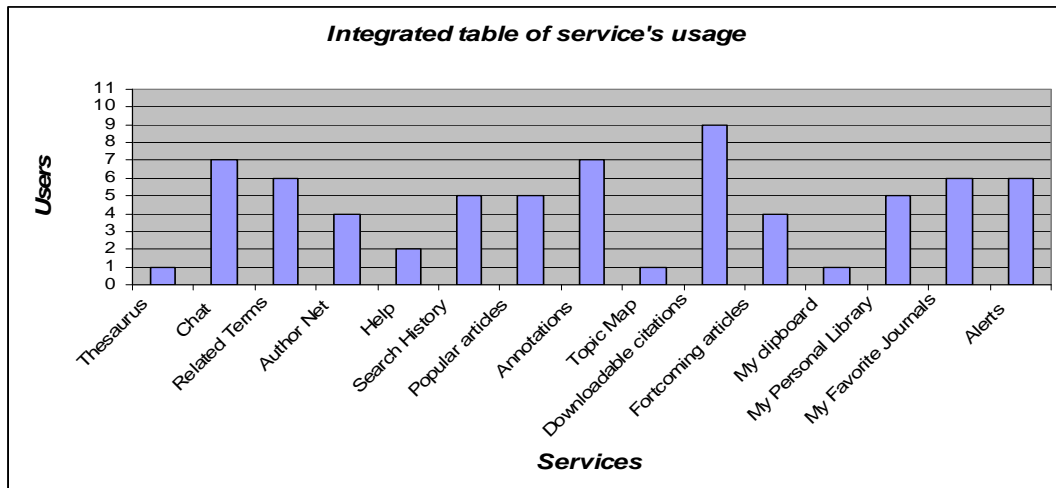

Figure 2: Services acceptance rates

Finding relationships between authors is a potentially acceptable service. Although the participants were impressed by the presentation of results, they considered them untrustworthy and got confused with the visualization. Only four participants were in favour of the service. The rest argued that they prefer to view the results in a Google-like way, instead of a graph, because it is difficult for them to cipher out the results in a graphical environment. Furthermore, they believe that the Co-Authors Network service overlaps with the search service and specifically with the Author field. Although the majority of them considered it as an innovative idea, they think that it should be more interactive and the articles should be accessed through the graph. In its current form the Co-Authors Network service is accessed by the users *"just for a game"* as one stated and was not considered as a regular tool. Topic Map, which concerns mainly to the subjects of the information objects, met almost the same acceptance with Co-Authors Network. The reason for denying the service was the participants' inability to accept advanced visualization tools. In addition, users advocated that can satisfy their needs using the Subject field of the search interface. Although the service was considered impressive, they repeated that it hardly addresses to their information needs and that they argue about its usability in general.

Only two persons said that use Help service. According to our users, the Help service signals the rate of failure for a DL. The main purpose for using this service was for describing other DL services than search options. When they asked about the type of help that they prefer they straightened out Frequently Asked Questions, because it constitutes a *"compact form of knowledge"*. Video tutorial, like the one provided by Daffodil, did not impress them, because they could not trace exact points of interest. It was also found that the current service was consistently used during all phases of information life-cycle.

Personalization services seemed confusing to participants. My Clipboard service accumulated only one positive answer, because the participants confused its role with that of My Personal Library. In contrast, My Personal Library service had higher acceptance -five positive answers. The main justification for not using My Personal Library was the delusion that constitutes a personal space when in fact it isn't. However other personalization services, such as My Favorite Journals, were found interesting -six positive answers- due to the fact that helps the user group interesting journals and run searches only at them. This service was characterized as a *"time saving tool"*, while the participants wanted to be able to add their bookmarks in the DL that they use. They also believed that the service adds quality to their search tasks, because they can benefit from this automatic repetitive mode of search. Additionally participants stated that they use

such services to refine the results. Subjects that answered negatively, either they had little knowledge about the service or they preferred to run new searches on their own.
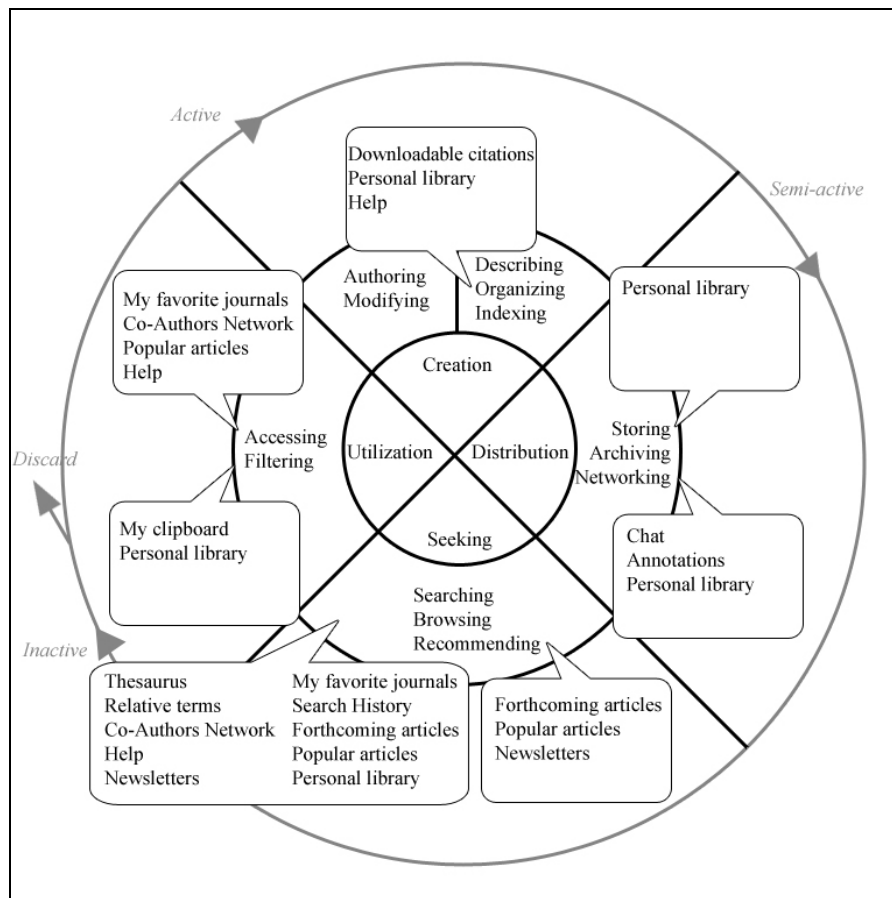

Figure 3: Services mapped on information life-cycle (life-cycle adapted by Goncalves et al., 2007)

Several of the services classified in the Seeking phase were identified for the Utilization phase too. Author related services, support services, the Popular Articles and many of the personalization services, such as the Personal Library, My Favourite Journals and My Clipboard services were regarded as the most significant for the purposes of this phase. In particular My Clipboard gathered the minimum of acceptance between these services. This happened because the participants can't use two personalization services in the same DL. They believe that in case of overlapping services they prefer to choose the one that needs the less investment and gives the most functionality. The participants were pensive to the Co-Authors Network, because it helps them to filter their feed but needs to be more interactive.

In the Creation phase users stated that they needed more support services, personalization, such as My Personal Library, and information management services, like the Downloadable Citations services. Nine participants considered Downloadable Citations as time saving tool, because it helps them to compile the needed bibliography for their own papers.

In the Distribution phase, the participants highlighted services such as My Personal Library, Annotations and Chat. The Annotation service had significant acceptance - seven participants were in favor, but all the participants made remarks on the available space for comments and some interface problems. However, the main problem was the incapability of commenting on the text. During the interview the participants described a tool like Adobe Acrobat Professional, which would be the ideal form of the service. The basic purpose of its use is networking, which feel that plays a vital part on their information behaviour. Synchronous communication services, like the Chat tool, which was found in the Daffodil prototype, were strongly connected with the experience and the type of tools that users use on the web. Almost all of the participants wanted an integrated chat tool in a DL, but with features similar to the ones that use on the web.

5.0. Factors for services' prominence

The factors affecting usage are three: the *system*, the *service* and the *individual factors*. The system factors are divided in two main subclasses: (a) usability and (b) performance. Usability includes issues of interface design and aesthetics. Proper interface design helps users to find the desired services. On the other hand, performance is connected with the reliability of the results and speed of responsiveness.

Concerning the service factors it was found that overlapping characteristics or similarities among services affects their usage. For example, a user selects just one service -the closest to his habits- from a DL among many overlapping services, fulfilling similar user needs. As we saw author search field is overlapping with Author Net service and this fact resulted to the service low acceptance.

Regarding the individual factors we have to remark that despite the development of new efficient search tools, such as Author Net, users adhere to the traditional tools, because they do not want to spend time to learn something new. Users stated that they carry their experiences from every day interaction with other web applications and each time they visit a DL they want to keep this behavior instead of being forced to learn something new. Any declination from their traditional interaction patterns is a deterrent factor.

The mentioned factors interact each other. For example the range of available services encourages someone to prefer a DL, while his experience empowers his judgment over the value of the system factors. Users can utilize less useful services, due to the trust of the wider environment of the DL and the whole range of services. The system, the services and individuality create the framework of acceptance. The research showed that a service to be used should combine utilitarian and emotional value according to Boztepe (2007) classification. Individuality is strongly connected with experience, needs, and perceptions and in a higher level with satisfaction, which implies acceptance.

6.0. Conclusions

Although DLs enrich their armory with new services, this doesn't imply successful utilization. Traditional tools may be more attractive than new. Our research followed a path from the simple user's search behavior till his complicated attitude towards innovative services. Taking for granted that a simple search session is unrealistic we researched the chaining reaction of the advent of value added services phenomenon and how this affects the usage of other services. Regarding how users prefer to search for information the study confirmed the opinion of other researchers (Stanford University Libraries, 2002) that the author, title and keywords fields are on the top of users' preferences. In addition the evolving behavior of our sample, which moves from simple to advanced search mode, is justified by Furnas (1998) research, which underlines that each user makes more than one searches. Thus each user should use Boolean operators or advanced services in order to reduce the number of his search sessions. The evolutionary process of search seems to reinforce the role of value added services, as search constitutes a basic service of a DL.

Users were found parsimonious regarding value added services because they insist of using traditional tracks for manipulating their needs. In respect of added value services, the present study agreed with Monopoli and Nicholas' (2000) results, which referred to the total depreciation of the Help service. Although innovative services such as Co-Authors Network and Topic Map are impressive, their role is overlapped and users follow their habits. On the other hand, Personalization services are accepted only if the DL that offers them consists the main user's working and seeking environment. In addition, users don't take advantage of awareness services and profiling (Nicholas et al., 2006). It is very clear that each service means different things to each user, because it is evaluated differently. Apart from Downloadable Citations service, which had the widest acceptance, it is obvious that there is no unanimous acceptance of a service.

Acknowledgements

References

1.   Ball, D., Coelho, P.S. and Vilares, M.J. (2006). Service personalization and loyalty. *Journal of Services Marketing, 20*(6), 391-403.

2.   Boztepe, S. (2007). User value: Competing theories and models. *International Journal of Design, 1*(2), 55-63.

3.   Brophy, P. (1998). It may be electronic but is it any good? Measuring the performance of electronic services. In: *Robots to Knowbots: the wider automation agenda: Proceedings of the Victorian Association for Library Automation 9th Biennial Conference,* 217-230. Melbourne: VALA.

4.   Candela, D. Castelli, D., Fuhr, N., Ioannidis, Y., Klas, C.-P., Pagano, P., Ross, S., Saidis, C., Schek, H.-J., Schuldt, H. and Springmann, M. (2006). *Current digital library systems: user requirements vs provided functionality.* DELOS NoE. Retrieved January 11, 2008 from http://www.delos.info.

5.   Choo, W.C., Detlor, B. and Turnbull, D. (1999). Information-seeking on the Web: An integrated model of browsing and searching. In *Proceedings of the 62nd Annual Meeting of the American Society for Information Science, Washington, DC. Medford, NJ: Information Today,* 3-16. Retrieved January 04 2008, from http://donturn.fis.utoronto.ca/papers/asis99/asis99.html.

6.   Chowdhury, G.G. and Chowdhury, S. (2000). An overview of the information retrieval features of twenty digital libraries. *Program, 34*(4), 341-373.

7.   Eason, K., Yu, L. and Harker, S. (2000). The use and usefulness of functions in electronic journals: the experience of the SuperJournal Project. *Program: electronic library and information systems, 34*(1), 1-28.

8.   Ellis, D. & Haugan, M. (1997). Modelling the information seeking patterns of engineers and research scientists in an industrial environment. *Journal of Documentation, 53*(4), 384-403.

9.   Fiotakis, G., Fidas, C. and Avouris, N. (2007). Comparative usability evaluation of web systems through ActivityLens. In *Proceedings of Panhellenic Conference on Informatics, May 2007, Patras, Greece vol. 1,* 115-126. Athens: New Technology.

10.   Fox, E.A. (1993). Sourcebook on digital libraries: Report for the National Science Foundation, Tech. Rep. TR-93-35, Computer Science Dept., VPI&SU, Blacksburg, Va. Retrieved January 15, 2008 from http://fox.cs.vt.edu/DLSB.html.

11.   Furnas, G.W. and Rauch, S.J. (1998). Considerations for information environments and the NaviQue workspace. In: *Proceedings of the third ACM conference on Digital libraries, Pittsburgh, Pennsylvania, USA,* 79-88. New York: ACM Press.

12.   Gonçalves, M.A. (2004). *Streams, structures, spaces, scenarios and societies (5S): a formal digital library framework and its applications.* Ph.D. thesis. Virginia Polytechnic Institute and State University.

13.   Gonçalves, M.A., Moreira, B.L, Fox, E.A. and Watson, L.T. (2007). "What is a good digital library?": a quality model for digital libraries. *Information Processing and Management, 43*(5), 1416-1437.

14.   Ho, D. and Cheng, E. (1999). Techniques, quest for value mix. *Managing Service Quality, 9*(3), 204-208.

15.   Kengeri, R., Seals, C.D., Harley, H.D., Reddy, H.P. and Fox, E.A. (1999). Usability study of digital libraries: ACM, IEEE-CS, NCSTRL, NDLTD. *International Journal on Digital Libraries, 2*(2-3), 157-169.

16.   Khoo, M. (2006). A sociotechnical framework for evaluating a large-scale distributed educational digital library. In Gonzalo J., Thanos C., Veredjo M.F. and Carrasco R.C. (eds.) Research and Advanced Technology for Digital Libraries (ECDL 2006), *LNCS Vol. 4172,* 449-452. Berlin: Springer-Verlag.

17.   Leckie, G.J., Pettigrew, K.E. and Sylvain, C. (1996). Modelling the information-seeking of professionals: A general model derived from research on engineers, health care professionals, and lawyers. *Library Quarterly, 66*(2), 161-193.

18.   Meyyappan, N., Chowdhury G.G. and Foo, S. (2000). A review of the status of 20 digital libraries. *Journal of Information Science, 26*(5), 337-355.

19.   Miao, H. and Bassham, M.W. (2007). Embracing customer service in libraries. *Library Management 28*(1-2), 53-61.

20.   Monopoli, M. & Nicholas, D. (2000). A user-centred approach to the evaluation of Subject Based Information Gateways: case study SOSIG. *Aslib Proceedings, 52*(6), 218-231.

21.   Nicholas, D., Huntington, P., Monopoli, M. & Watkinson, A. (2006). Engaging with scholarly digital libraries (publisher platforms): the extent to which 'added value' functions are used. *Information Processing & Management, 42*(3), 826-842.

22.   Paepcke, A. (1996). Digital libraries: Searching is not enough; what we learned on-site. *Dlib Magazine,* May 1996. Retrieved 14 January, 2008 from http://www.dlib.org/dlib/may96/stanford/05paepcke.html.

23.   Rusch-Feja, D. and Siebeky, U. (1999). Evaluation of usage and acceptance of electronic journals: results of an electronic survey of Max Planck Society researchers including usage statistics from Elsevier, Springer and Academic Press (Full Report). *D-Lib Magazine, 5*(10). Retrieved 14 January, 2008 from http://webdoc.sub.gwdg.de/edoc/aw/d-lib/dlib/october99/rusch-feja/10rusch-feja-full-report.html.

24.   Schiffman, L.G. and Kanuk, L.L. (1987). *Consumer behaviour*. Englewood Cliffs: Prentice-Hall.

25.   Smith, A.G. (2000). Search features of digital libraries. *Information Research, 5*(3). Retrieved January 11, 2008 from http://informationr.net/ir/5-3/paper73.html.

26.   Stanford University Libraries (2002). Ejournal user study. Retrieved July 20, 2008 from http://eJUST.stanford.edu.

27.   Vilar, P. & Zumer, M. (2005). Comparison and evaluation of the user interfaces of e-journals. *Journal of Documentation, 61*(2), 203-227.

28.   Wilson, T.D. (1997). Information behaviour: an interdisciplinary approach. *Information Processing and Management, 33*(4), 551-572.

29.   Zauberman, G. (2003). The intertemporal dynamics of consumer lock-in. *Journal of consumer research, 30*(3), 405-419.