

# Do Digital Libraries satisfy Users' Information Demand? Findings from an Empirical Study\*

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## Abstract

Digital libraries are an important information source of high quality information for various user groups in education, research and industry. With an exponential growing amount of digital content, digital libraries face the challenge of enhancing the support for information seeking. This paper takes the users' perspective and investigates whether the users of digital libraries perceive that their information demand is satisfied. The approach taken is an empirical qualitative study with various user groups in two different countries. From an information demand perspective, the main result is the support for the conjecture that there is a coupling between the user's context and the information demand. Furthermore, a usability questionnaire was used to identify shortcomings and propose improvements in the digital library systems applied at the two study locations.

## 1 Introduction

During the last decade, the amount of information available on the Internet, in digital libraries or in enterprise information systems has been growing exponentially. The main challenge of the information society is no longer that the needed information does not exist electronically [8], the challenge rather is to find and provide the right information. Among the research activities working on this challenge are approaches from information filtering and information retrieval [1, 4], context-based ubiquitous computing [2], context-based decision support and problem solving [9] and information logistics [6].

Digital libraries are an important information source of high quality information for various user groups in

education, research and industry. Recent developments in this area aiming at meeting the challenge of the growing amount of digital content include the enhancement of meta-data, enrichment of content or meta-information systems. This paper takes the users' perspective and investigates selected aspects of the users' perception of digital libraries. The guiding question is: Do the users of digital libraries perceive that their information demand is satisfied? This subject can be divided into two aspects: (1) the users' awareness of the own information demand and (2) the usability of the retrieval tools.

The approach taken in this paper is an empirical qualitative study investigating the above questions in various user groups and two different application scenarios: the digital library at Jönköping University (Sweden) and the digital collections of the Karelian Research Center (Russia).

The remaining part of the paper is structured as follows: section 2 introduces the general design of the study. Section 3 presents results from an information demand perspective. Section 4 focuses on findings from a usability perspective. Summary of the work and conclusions are presented in section 5.

## 2 Study Design

The study consisted of two parts: the first part was performed in 2007 at Jönköping University in Sweden, included development of interview guidelines and a usability questionnaire as preparatory activities, and consisted of a pilot study and end user studies. The second part was carried out in 2009 at the Karelian Research Center in Petrozavodsk and used the guidelines and questionnaire from the first part.

### 2.1 Study at Jönköping University

The first part in Jönköping focused on a meta-information system used in the library of Jönköping University, called Samsök. This meta-information system offers a common interface for retrieving information in various "underlying systems", like library catalogues, online archives and full-text

literature databases. Queries entered by the user in the Samsök user interface are transformed to the interfaces (i.e. query language/format and service interface) of the underlying systems, executed in these systems, and the results are presented in the common Samsök user interface with possibility to continue navigation into the underlying systems.

The purpose of the study was to investigate four main questions:

1. How does Samsök support the end-users, in particular in satisfying the end-user's information demand?
2. How does Samsök support the library's activities and services?
3. What are the results of evaluating Samsök from a usability perspective?
4. What improvement potential can be identified based on the results from the first 3 questions?

The scope of the paper is limited to the end-user perspective, i.e. question 2 will not be discussed and for question 3 and 4 only the end user related aspects are included. A complete account of the results is available in [5].

Based on the above questions, guidelines for data collection and a questionnaire were developed for use in end user studies consisting of sessions of the evaluator with one individual user (respondent) at the time. The guidelines had three purposes: to define the *tasks* to be performed by the respondents, to structure the *session* to be performed and to support the evaluator during the observation. The purpose of the questionnaire was to collect data about the usability and usefulness of Samsök from the respondents perspective. The questions used were a sub-set of the Questionnaire for User Interface Satisfaction (QUIS) [7]. The selection of questions was guided by two principles: 1) the question should be relevant in the context of Samsök and 2) it should be questions directed to end-users, i.e. the respondent should be able to answer them.

In the next step, guidelines and questionnaire were evaluated in a pilot study with two respondents. The results were documented by recording the screen events and recording of the users' oral comments while using the system according to the thinking-aloud approach [3]. Within this study, thinking-aloud means that the user was encouraged by the evaluator to say what he/she is thinking and doing when using the system. This leads to a richer set of data for the analysis work.

The results of the pilot study were used to improve both the interview guidelines and the questionnaire. The end user studies were performed with in total 12 users, 2 in the pilot study and 10 in the main study part. Among these 10 persons were 5 students, 1 researcher, 3 PhD candidates and 1 subject teacher. The objective was to observe a number of end-users with different roles and background in order to get a rich set of information regarding Samsök's application and potential improvements. It should be observed that the intention was to capture qualitative data, and not to collect data with statistical relevance.

## 2.2 Study at Karelian Research Center

The second part in Karelia used the second and improved version of guidelines and questionnaire from the Jönköping study (see 2.1). The study in Karelia was performed using two sets of digital collections located at the scientific digital library (<http://dl.krc.karelia.ru>) and at the section "Publications" of web-portal ([www.krc.karelia.ru](http://www.krc.karelia.ru)) KarRC RAS. These collections are the result of long-term researches developed at KarRC RAS.

The main questions of our study were aligned with questions 1, 3 and 4 of the Jönköping part:

1. What are the usability results of working with digital collections?
2. How does the digital collections' infrastructure meet the users' information demand?
3. How can we improve the digital collections' infrastructure?

The study was performed with 10 users. Among these users were 5 fourth-year students, 3 PhD students and 2 PhD researchers. Such scope of respondents should give us the different answers to our questions.

## 3 Information Demand Perspective

This section summarizes the results from the end user study from an information demand perspective.

For each respondent in the end user study, the session which was part of the end user study started with a pre-interview. In this pre-interview, the respondent had to briefly describe her/his role at the university, how familiar she/he was with using computers, and the information demand he/she has, which shall be the basis for the information searching. During the information searching, the screen events and the oral comments were recorded. After the use of the system, the respondent was asked to what extent her/his information demand was met by the results from the information searching. Due to the qualitative character of the study we chose to capture this "perceived" relevance rather than to evaluate the found information from a recall/precision perspective.

### 3.1 Observations from Jönköping

#### *Awareness of the own Information Demand*

In general, there is a clear tendency in the interviews that the research and teaching personnel has a more specific and better defined information demand as the students seem to have. Two statements taken from the interviews can serve as example. The first statement is from a student:

*I thought we should look into the area ... We are currently developing a web-portal. I thought I could maybe search something about communities and usability. Some theories. Input to the theoretical frame, short theoretical presentations which I then might apply. [Respondent 2]*

The second statement is from a PhD candidate defining his information demand as follows:

*My research area is something called Discharge Care Planning, which is discharge from hospitals if someone has been patient at a hospital. In Sweden, the term coordinated care planning is also used. This is a quite specific track within nursing care. Currently, I am investigating how some sort of IT system or software – called Medics - is used for this purpose. Could be interesting to check whether there are some publications in the domain, but I have no idea which keywords to use as I didn't search for such material before.* [Respondent 6]

This obvious difference is not really surprising, since research and teaching personnel often has a quite well-defined, often narrow and specific work area, which makes it easier to define the information demand. Furthermore, the experience in using libraries is higher. But this difference illustrates the challenges to be met when improving usability of library systems. There seems to be a necessity to take the user's background into account in order to support information searching really well.

Another important aspect of the study was to investigate to what extent the information demand was met. Among the respondents, only a few perceived the support from the Samsök system as satisfactory for finding (enough) information meeting their information demand. This can be illustrated with some statements like:

*Ehhh.. No, you can't really say that. But I found a book. I wanted to have something that is connected to both, dialect and trust. And from Sweden. But, no. I am not really satisfied with what I found.* [Respondent 10]

*No, I didn't. I did not find any article, but I found a book.* [Respondent 4]

*Is work context important for information demand?*

From an information demand perspective, the main result from the study is the support for the conjecture that there is a tight coupling between the user's context and the information demand: The analysis of the data collected in the interviews and of the observations made during the system use shows a tight connection between the respondent's role (teacher, researcher, student, etc.) and the activities for which the searched information is needed (assignment, lectures, scientific work, etc.).

### 3.2 Observations from Karelia

From an information demand perspective the main results are the following.

First of all, we haven't a significant difference in the user groups' awareness of their specific information demand. Some of the students had a more specific and well-defined information demand because they tried to find the information helpful in their scientific work. Experienced scientists tried to find any information that they are interested in. It is also a consequence of specialization of our digital libraries because experienced scientists knew about specific areas of publications at both sites.

Another consequence of specialization of digital libraries is a quite big number of unsuccessful search

queries. Some of the respondents tried to find an information in areas that haven't been studied by scientists of KarRC RAS.

## 4 Usability Perspective

From a usability perspective, the data collected during the end user study and the results of the usability questionnaire were evaluated. The next two sections will present the user study observations from Jönköping and Karelia, respectively. Section 4.3 will summarize the usability questionnaires.

### 4.1 Observations from Jönköping

The analysis of the data collected in Jönköping has been structured into different categories reflecting the activities to be supported by the Samsök system:

- Perform the selection (identify keywords for search, combine them, etc.)
- Interpret search results
- Get full-text version of publication

This section will summarize the above results.

#### Perform Selection

The study showed a number of problems when deciding about the keywords to use while searching, in what sequence to apply them during the search and how to express combinations (e.g. by using "and" or "or") of keywords.

Several informants point out the importance of knowing in advance how a search will be performed in order to achieve a good result. This, in combination with an understanding of the language (the syntax used for formulation the search condition), seems to be essential prerequisites for having real use of Samsök. Since the informants in this study received no training on the tool they lack such an understanding, resulting in an unmanageable amount of search hits (the bulk of them being irrelevant). As a consequence, the informants request functionality for filtering results based on language and date. Several informants express a need for higher competence and better support in the search process.

One problem that was observed with most of the informants was connected to preexisting knowledge about databases and different concepts used in the Samsök interface:

*"But if one searches such broad fields as this there is a risk that there will be too much, at least that is the feeling. But at the same time this perhaps is unavoidable and then one has to sort. And there is the possibility to narrow in, that I saw. If I get in to this different ones where I could choose databases one could exclude a lot. But that requires you to know what to exclude on beforehand"* [RE3]

The statement above exemplifies the library clients' need for pre-existing knowledge regarding the different databases used when searching. The observations also revealed some practical problems with the automatic

selection of databases in the quick search – some users did not realise that the search only was performed in a selection of databases.

The observations also revealed that the informants had problems with interpreting a number of terms in Samsök's interface. *Meta* search is not an intuitive word and thus means that it is not obvious to the user that this is where more advanced searches can be performed. The meta search is appreciated after some use but is perceived as unclear at a first glance. It is not clear how the left part, where the databases are chosen, is to be used. Most of the time the users click on the first list where "categories", "quick groups" and "combine" are instead of selecting a topic category in the lower list despite this being functionality they ask for. Functions for creating personal groupings of databases are requested.

The observations also revealed misinterpretations regarding the following terms; *Topic* terms was confused with *search* terms, the formulations *search database* and *search electronic magazine* were interpreted as searching content rather than on names of databases/publications.

To summarize the problems observed, we can group them according to the cause of the problem:

- *Database knowledge* – Knowledge of relevant databases and how to select the databases to be used during the search
- *Search competency* (general) - General knowledge about structured information search
- *Search competency* (Samsök) – Knowledge about Samsök and how to express queries
- *Functionality* – to be able to express the selection based on criteria important for the users (e.g. language or time interval)
- *Terminology* – regarding difficulties to understand the available choices for meta-search, including the term meta-search as such

### Interpret Search Results

Several informants commented on the large amount of hits in the search results. This is directly connected to the difficulties with performing selection.

A lack of understanding of the link "view collected hits" in the quick search results in the abortion of the search. This is inconsistent with the interface in the meta search. When performing a meta search no indication of collected hits is showed in the result list until all results are collected.

Better support for the user when deciding on relevance is needed. This is connected to a lack of understanding of the underlying databases:

*"No, I found this a bit hard, that they are showed like this, OK, this magazine has so and so many hits and this has so many. It would have been much better to just get them listed in a row and not having to continue again by clicking in to an article or magazine because I do not know the magazines. If I had know that I might have been able to select in a different way but now it is just names to me. They could just as well been named*

*1234567 or blue, red, green because I have no idea what it is. It felt a bit, OK but which one should I choose? I take the one with most hits?"* [RE10]

In the part of the interface where the search results is listed a certain amount of problems regarding the navigation between different views were identified. When the view full post is shown use of the web browsers back functionality does not return the user to the previous page but rather to the previous post in the list, hence it is hard to return to the list view.

Conceptually it is also reasonable to question the use of the term weight with respect to search results as this is not a obvious term for describing relevance, something that contributes to confusion.

The problems observed in interpreting the search results can be categorized as follows:

- *Database knowledge* – lack of knowledge regarding the databases makes the interpretation of the search results difficult
- *Incomplete Searches* – users tend to misinterpret to what extent a search is "completed" when they start to look at the hits
- *Navigation between views* – some users had problems to navigate between the list of search results and the view showing details for one search result
- *Terminology* – respondents had difficulties to interpret certain system terms, like meaning of "weight" in search results, significance of different databases, meaning of "get more hits"

### Get Fulltext

It is not obvious how one should go about to get a full text version of an article. Sometimes, this is done by following an ordinary hyperlink while in other cases it is done by means of the SFX screen. The symbol used for SFX is unintuitive and in some views its functionality is not explained and it is therefore consequently unused. Furthermore, the SFX screen gives no feedback on the existence of the article leading to the users using JULIA instead. Many of the problems seems to be related to the users' lack of understanding of the library domain, hence they do not understand the use of and need for "LIBRIS web search".

Sometimes when navigating to full text versions the user is transferred to external websites. This requires the user to interpret and understand additional environments to perform a successful search. As the appearance of these sites are not a part of Samsök this is hard to influence but there is nevertheless important to realise that these different systems are a part of the overall user experience.

To go from search result to full-text of a publication caused some problems for the respondents, which can be summarized in three categories:

*Unclear how to get full-text* – a quite general problem was to access the full-text versions of publications found during the information searching

*Terminology* – the users do not connect the SFX-symbol with the possibility to get the full-text. The users don't know the terms used in the SFX-window.

*Navigation between views* – Samsök offers and requires different ways to navigate to the full-text version. This confuses the respondents who would prefer one clearly defined way to go from search result to full-text

#### 4.2 Observations from Karelia

There are three main categories of results from a usability perspective:

1. usability of the site;
2. performing the search;
3. interpretation of the search result.

Both studied sites estimated by respondents by a single mark if they haven't seen significant difference.

##### Usability of the site

Marks made by respondents show that the usability of both sites is good enough. The most part of respondents made good marks for convenience, usefulness, design and so on. These characteristics are important for stimulating users to further looking for needed information.

Terms used by the sites also didn't cause any doubts.

##### Performing the search

Characteristics related to performing the search have been estimated by respondents in different ways. Respondents hadn't a single opinion about complexity of the search system, functionality and flexibility. It is interesting that the more experienced users made the higher marks for these characteristics.

Opposite estimations made by respondents for time needed to learn about basic and additional search functions. There is also a similar difference between more experienced and less experienced users.

##### Interpretation of the search result

Respondents pointed that there is enough amount of visualized information of the search result, but the number of documents is very small. It is also a consequence of specialization of digital libraries. Any attempts to find out the areas that haven't been studied by researchers of KarRC RAS were not successful.

#### 4.3 Results from the Usability Questionnaire

The results from the usability questionnaire are summarized in the following two tables. Table 1 reflects the answers regarding the general impression. Table 2 addresses the user interface impression.

The questionnaire results gave some indications regarding the users' impressions of Samsök, represented in table 1 below. It should be pointed out that the selection in the survey is too small to derive statistically valid conclusions about a larger population. Instead we view the results as an indication of how the users of Samsök perceive the application. The underlying reason for the not so positive remarks done by the informants

(shadowed cells in the table) is according to our perception that most of them were unsuccessful in finding the type of material they were looking for. It should also be noted that there were users that valued the application as simple, powerful and rewarding despite the fact that they never before had used it.

Perception	1	2	3	4	5
1.1 Terrible - Wonderful		2	7	1	
1.2 Frustrat. - Rewarding	3	3		4	
1.3 Boring - Stimulating	4		4	2	
1.4 Difficult – Easy	2	2	5		1
1.5 Insufficient - Powerful		4	1	5	
1.6 Rigid – Flexible		7	2	1	

Table 1 – Respondents' general perception of Samsök

The following table describes results of the study at KarRC RAS. These results show that the search system meet the user's purposes.

Perception	1	2	3	4	5
1.1 Terrible - Wonderful			2	8	
1.2 Frustrat. - Rewarding			3	2	5
1.3 Boring - Stimulating		1	2	3	4
1.4 Difficult – Easy	2	1	2	3	2
1.5 Insufficient - Powerful		1	1	5	3
1.6 Rigid – Flexible		2	7	1	

Table 2 – Respondents' general perception of KarRC RAS' digital libraries

The questionnaire also contained a number of questions regarding the design and learnability of Samsök, the results from which is listed in table 2 below. Parts of the table has been shadowed to point out the cases where opinions strongly various between different informants.

Perception	1	2	3	4	5	
2.1 Design		2	4	2	2	
2.2 Terminology		3	1	3	3	
2.3 Graphic symbols		2	4	1	3	
2.4 System status		1	3	5	1	
2.5 Feedback (content)		2	4	3	1	
2.6 Feedback (visibility)		2	3	5		
2.7 Search results – amount of information		2	3	4	1	
2.8 Learning - basic		1		5	4	
2.9 Learning - advanced		1	1	3	3	2
2.10 Navigation		1	1	2	5	1
2.11 Response time (search)		2	3	3	2	
2.12 Response time (navigation)		1	3	1	2	3

Table 3 – Respondents' impression of Samsök's user interface

The terminology in the interface was perceived as relatively clear while the graphical symbols was considered harder to interpret. Regarding the systems status, i.e. how easy it is to understand what the system is doing at the moment, the answers are polarised. This is most likely due to the users' different experience of using web applications. The feedback given by the system gets a vaguely positive judgment. The users generally think that it is relatively simple to learn the simpler parts of Samsök while the more advanced parts (meta search) is perceived as more difficult to understand. The navigation was by most perceived as relatively simple to handle while the response times when searching and navigating indicates certain problems. Especially the response time for searches hints that involved servers have different response times – some users have not experienced this as a problem while others have.

Themes that stands out in the survey is according to us that Samsök suffers from less than stable response times and that the users' impressions on a whole leans towards less positive judgements such as boring and frustrating.

The following table shows marks made by respondents of KarRC RAS.

Perception	1	2	3	4	5
2.1 Design			3	2	5
2.2 Terminology			1	5	4
2.3 Graphic symbols				3	7
2.4 System status			1	7	2
2.5 Feedback (content)			1	5	4
2.6 Feedback (visibility)			1		9
2.7 Search results – amount of information	2	1	2	3	2
2.8 Learning - basic	2	1		4	3
2.9 Learning - advanced	2	1	3	3	1
2.10 Navigation			3	5	2
2.11 Response time (search)			2	3	5
2.12 Response time (navigation)		1	1	4	4

Table 4 – Respondents' impression of KarRC RAS' digital libraries user interface

The strict design with absence of superfluous elements of design and functions makes the interface convenient. But the lack of information makes users dissatisfied.

## 5 Conclusions

Six categories of experiences form the use of Samsök were discussed in section 3.3 Three of these are directly connected to different phases in the search process; *Selection*, *Interpretation*, and *Collecting full-text*. The remaining three categories are more connected to the overall use of Samsök; *General opinions*, *reasons for contacting the library*, and *proposals for further development*. Within each category a number of

problematic themes have been generated from the interviews and observations. The following themes has been identified:

*Database knowledge* – a basic understanding of academic databases is required to utilise Samsök. This introduces problems to the activities, selection and interpretation.

*Search competence* (general) – information searching requires some general knowledge that many of the survey's informants do not have. An example of this is competence in evaluating the quality of different types of publications as well as the competence to, for a given problem, identify relevant topics and search terms.

*Search competence* (Samsök) – viewed as a tool Samsök requires its users to have some knowledge regarding how to formulate search terms and selecting suitable databases for the meta search. Several informants had problems with these parts.

*Unclear access to full-text* – there is at the moment several different ways to access full-text versions of articles, something that confuses users and in the worst case scenario means that they do not understand that a full-text version is available.

*Terms and symbols* – there is a number of terms and symbols used in Samsök that is hard to understand for the uninitiated users. One such term is meta-search, another is weight and the symbol used for SFX a third.

*Requested functionality* – some functionality, with respect to the users' information demand, is missing or hidden in Samsök. An example of this is the possibility to search based on language and dates. Other examples of the same problems identified by the informants are the possibility to search within search results as well as gaining simple access to search history.

*Unfinished searches* – it is possible to view collected hits despite the fact that the search still is ongoing. This is not obvious to the user in the current design. Furthermore, it is not obvious that more hits and then with higher relevance can be collected with the function "collect more hits".

*Navigation* between views – a number of problems in Samsök is related to the navigation. One such problem is that the use of the browsers back-button breaks the expected behaviour of taking the user back to the previous screen. Another is that the linking to external documents is inconsistent and unintuitive.

*Response times* – the response times of the system vary depending between the different observations, resulting in negative judgements from the informants.

*Overall perception* – The survey showed on a frustration amongst some of the informants regarding the use of Samsök. Some of them even perceived the system as a boring tool.

The study of the digital libraries of KarRC RAS highlighted a different main problem – the lack of content. On the one hand our digital libraries aims to make public the work of the researcher of KarRC RAS, but on the other hand the small amount of content makes users dissatisfied in looking for specific

information. The consequence of this is a small number of users who regularly use the digital libraries. With a growing amount of content, other usability issues might be raised, like for example navigation in large lists of hits for a query.

## 6 Summary

This paper investigates whether the users of digital libraries perceive that their information demand is satisfied. The approach taken is an empirical qualitative study with various user groups in Jönköping and Karelia. This study includes two aspects: the users' awareness of the own information demand and the usability of the retrieval tools.

From an information demand perspective, the main result from the study is the support for the conjecture that there is a coupling between the user's context and the information demand: The analysis of the data collected in Jönköping shows a tight connection between the respondent's role (teacher, researcher, student, etc.) and the activities for which the searched information is needed (assignment, lectures, scientific work, etc.). With respect to usability, there seems to be a necessity to take the user's background into account in order to support information searching really well. Furthermore, in the Jönköping study there is a clear tendency that the research and teaching personnel has a more specific and better defined information demand as the students seem to have. This observation from Jönköping that researchers seem to be more aware of their information demand was not confirmed in the Karelian part.

The usability questionnaire was helpful in identifying shortcomings and proposing improvements, both for the Samsök system in Jönköping and the digital collections in Karelia. However, the two systems are far too different regarding user interfaces, functionality and amount of content that a comparison of the findings should be considered. A commonality between both cases is that we observed that usability was graded worse by those users who were not successful in retrieving content meeting their information demand.

The main limit of the research presented here is the limitation to just two digital libraries/collections and to just groups of 10 end users in every part of the study. It would be worthwhile and interesting to include a larger number of both digital libraries and users.

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## Удовлетворяют ли электронные библиотеки информационным запросам пользователей? Эмпирическое исследование

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Электронные библиотеки являются важным источником информации для различных групп пользователей в области промышленности, образования и науки. Взрывной рост объемов информации, представленной в цифровом виде, ведет к тому, что пользователи электронных библиотек все чаще сталкиваются с проблемами поиска информации. В статье представлено исследование, цель которого — оценить насколько хорошо пользователи могут удовлетворить свои потребности в информации с помощью электронных библиотек. Объектом исследования данной эмпирической работы являются различные группы пользователей двух стран. С точки зрения удовлетворения информационных запросов, основной полученный результат — это подтверждение наличия связи между контекстом поиска и информационными запросами. На основе специально разработанного опросника, среди

пользователей, участвующих в исследовании, было проведено анкетирование для определения недостатков и возможностей улучшения систем поддержки электронных библиотек.

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