IMPROVING KNOWLEDGE ORGANIZATIONS SEARCH INTERFACE DESIGN BY EVALUATING MAIN-STREAM SEARCH INTERFACE DESIGN

Master's (one year) thesis in Informatics (15 credits)

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Abstract

Usage of search is very popular among all kinds of people to locate unknown information in websites. Mainstream search engines like Google work really hard to deliver a simple and effective search experience with the help of professionals and usability lab testing. Search interfaces often show a poor usability for the users who want to find information in different knowledge organizations website. The purpose of this research is to create an understanding for some important characteristics of search interfaces, characteristics that may enhance the usability of knowledge organization search interface design. This Paper aim is to identify and discuss the specialized search interface design for knowledge organizations. This paper provides the detailed information about the search interface design and its improvement. This study gives the specialized wireframe standards for improving knowledge organization search interface design.

Keywords: Interface design, Search Engine, Usability, Knowledge Organization, Search Interface design.
Acknowledgements

The Author is really honored to have worked under the brilliant guidance of Dr. Anders Hjalmarsson, PhD and Dr. Andrea Resmini, PhD. Their ideas and suggestion during the entire thesis period are very valuable and informative. The Author takes immense pleasure and gratitude in thanking them for their great support.

At this point, the author would like to thank the interviewees, who kindly spent their valuable time with the author in order to conduct research and allowing to screen capture their search tasks. Once again, the author wishes to thank the interviewees, without them the empirical part would have not been possible.

Finally, the author would also like to thank friends and family members. Their encouragement and understanding helped the author to make this thesis possible.
# Table of Contents

1 **INTRODUCTION** .................................................................................................................. 1
   1.1 BACKGROUND .................................................................................................................. 1
   1.2 PROBLEM STATEMENT ...................................................................................................... 1
   1.3 RESEARCH QUESTION ....................................................................................................... 2
   1.4 PURPOSE ............................................................................................................................ 2
   1.5 EXPECTED RESULT ............................................................................................................ 2
   1.6 TARGET GROUP .................................................................................................................. 2
   1.7 AUTHOR BACKGROUND ................................................................................................. 3
   1.8 DELIMITATION .................................................................................................................... 3
   1.9 STRUCTURE OF THESIS .................................................................................................... 3
   1.10 ACRONYM LIST ............................................................................................................... 4

2 **RESEARCH DESIGN** .............................................................................................................. 5
   2.1 RESEARCH PERSPECTIVE .................................................................................................. 5
   2.2 RESEARCH STRATEGY ......................................................................................................... 6
   2.3 DATA COLLECTION PROCEDURE ....................................................................................... 7
   2.3.1 SAMPLING CRITERIA ....................................................................................................... 7
   2.3.2 Theoretical study ............................................................................................................ 7
   2.3.3 Empirical study ............................................................................................................... 8
   2.4 DATA ANALYSIS PROCEDURE ......................................................................................... 8
   2.4.1 Comparative Analysis ..................................................................................................... 8
   2.5 STRATEGIES FOR VALIDATION FINDING ......................................................................... 8
   2.6 RESULT PRESENTATION METHOD AND REFERENCING TECHNIQUE ............................. 9

3 **THEORETICAL STUDY** .......................................................................................................... 9
   3.1 KEY CONCEPTS .................................................................................................................. 9
   3.2 SUBJECT AREAS RELEVANT FOR THE RESEARCH .......................................................... 10
   3.3 PREVIOUS RESEARCH ...................................................................................................... 11
   3.4 RELEVANT THEORETICAL STUDY SOURCES ................................................................ 12
   3.5 USABILITY ......................................................................................................................... 12
   3.5.1 Usability Qualities ......................................................................................................... 12
   3.5.2 Importance of Usability ................................................................................................ 13
   3.5.3 Important Usability Principles & Rules ......................................................................... 13
   3.5.4 Top 10 Mistake in Usability ......................................................................................... 14
   3.6 USER CENTERED DESIGN ............................................................................................... 14
   3.6.1 Principles for User Centered Design ............................................................................. 14
   3.6.2 Designing pages for Scanning, not Reading ................................................................. 14
   3.7 INFORMATION ARCHITECTURE ...................................................................................... 15
   3.7.1 Visualizing Information Architecture .......................................................................... 16
   3.8 SEARCH PATTERNS ......................................................................................................... 18
   3.8.1 Behavior of Patterns ..................................................................................................... 18
   3.8.2 Pattern Library .............................................................................................................. 19
LIST OF FIGURES
Figure 1: Wireframe design of Thesis .................................................................3
Figure 2: Research Perspective of empirical study ...........................................6
Figure 3: Wireframe of Theoretical Study ..........................................................11
Figure 4: How User Scans (Krug, 2006) .............................................................15
Figure 5: User Website Navigation (Krug, 2006) .............................................16
Figure 6: Top down Information Architecture (Rosenfeld & Morville2006) ....17
Figure 7: Anatomy of SERP (Morville & Callender, 2010) .............................18
Figure 8: Alternate Search Option (Morville & Rosendeld,2006) .....................19
Figure 9: Search Pagination (Yahoo, 2009) .....................................................20
Figure 10: Site Index of Adobe Website ............................................................20
Figure 11: Footer Sitemap from Apple website ...............................................21
Figure 12: WayBackMachine Archive ...............................................................22
Figure 13: Number of Clicks Used in Knowledge Organization Websites .......31
Figure 14: Number of Clicks in Main-Stream Search Engine ..........................31
Figure 15: Total Time Utilized by Knowledge Organization ................................32
Figure 16: Total Time Utilized by Google ..........................................................32
Figure 17: Task Completion Rate in Knowledge Organization ..........................33
Figure 18: Task Completion Rate in Google .....................................................33
Figure 19: Search Engine Usage Rate ...............................................................34
Figure 20: Usage of Other Option during Search ............................................35
Figure 21: General Wireframe for KO ...............................................................39
Figure 22: Detailed Wireframe of KO ...............................................................40
Figure 23: Detailed Wireframe with spell correction ........................................41
Figure 24: Detailed Wireframe with suggestions ...............................................42
Figure 25: Detailed Wireframe before search ...................................................43
Figure 26: Detail Wireframe of filter option ......................................................43
Figure 27: Example of Output and IA structure .............................................44

LIST OF TABLES
Table 1: List of Acronym Used ........................................................................5
1 Introduction

Chapter 1 mainly focuses on the importance of Search Engines and their Interface design issues, what are the problems faced by the Knowledge workers while performing the search in knowledge organization is discussed, why the author chooses this topic and finally we will get a clear idea of what will be the outcome by conducting this research.

1.1 Background

Search engines have become famous for all users, as one of the (EUROPA, 2007) investigation report states that highest individuals have used Internet search engines. A search engine helps to locate the information which is being searched in the huge collection of information, which has been proven by the study conducted by the media, in which (Media, 1997) over 80% of web searchers uses web search engines to locate online information or service. Search Engines have a major impact on the people perception. People think that if we fail in finding information from a search engine's result, then it's near impossible to find. So people think Search Engine as the tool to find all information which is published on the Internet. (Wiza, Walczak, & Cellary, 2004) pointed out that the search engine has become one of the most important and most frequently used services, which heavily influenced the way users perceive the Internet. Since Search Engine has become part of everyday life, the design of the Search Engine Interface should be simple and efficient. So even a person with less computer knowledge should feel comfortable to handle the search and find the information from huge results. The interface must be user centered and must be universal for all kinds of people like expert and novice to handle a search. Bevan (Bevan, 2004) interpreted that a web site designed using a user centered design process has better chances to be, effective, efficient and satisfying. So, a user centered design plays a vital role in designing the search interfaces. Nowadays, if we need any help or information about a place or famous person or word or even anything, we move to search engines and try to find some useful information from the huge database. (Sullivan, 2010) The famous search engines like Google, twitter, Yahoo and Bing have millions of users visiting and searching for information every day, so they rely on good interface design to efficiently display their search results, offering different filter option such as categorize into web, image, video, book. They also implement spell checking, auto suggestions, and other user-slide features that make the experience of searching more comfortable. So we believe that good Interface design can lead to a greater number of positive outcomes. Recent studies (Koenemann & Belkin, 1996) confirm that when the user is given more information on control over their searches their satisfaction and performance increases. When considering knowledge organization, there would be a large number of knowledge workers using the website for information, so like major search engine interface like Google, Yahoo, Bing, etc.....equal importance must be given to search engine interface of knowledge organization, which will be helpful for all knowledge Workers. So the author would like to make a study by comparing knowledge organization websites with major web site search engine interface design, literature study and semi-structured interview with knowledge workers to propose a common search Interface wireframe design for all knowledge organization using Balsamiq Tools.

1.2 Problem Statement
There are set of highly qualified professional developers who monitors and designs for a mainstream search engine like Google, Yahoo and MSN they have their own usability lab. Jeff Bonforte (Sanders, 2007) senior director of real-time communication at Yahoo mentioned in a meeting at corporate headquarters “Poor Usability is the main reason behind the limited usage of Google services such as Gmail and Google talk compared to Yahoo service”. So Usability plays a vital role in designing Interface, but for most of the knowledge organization there is no much importance given to interface design of search engine where large number of people look for information, for example considering the Hogskolan i Borås website (www.hb.se) where a large number of external traffic (public) and internal traffic (students, administrators and staff) searching for information regarding their study and about the school resources can be successful in their search only if they understand and feel comfortable to handle the search interface.

1.3 Research Question

How to improve the specialized search interface design standards for knowledge organizations by evaluating mainstream search interfaces?

While answering the above question, the following sub questions will also be answered and make a strong building block for the main question.

- What are the basic principles and findings to improve search page design?
- What are the important elements to be considered in enhancing search interface design?

1.4 Purpose

Search interfaces of knowledge organizations often show a poor usability for the users who want to find information through the website. Since the author thinks that the search would be one of the main parts of the website success and being studying Master in Informatics, the author is not satisfied with the non-user friendly Search Interface design of the school website. This opens the wider area for a research to identify the problems and improve the specialized search interface design of knowledge organization website.

The purpose of this research is to create an understanding for some important characteristics of search interfaces, characteristics that may enhance the usability of the knowledge organization search interface and overcome previously identified errors.

1.5 Expected Result

The final result of the thesis would be a standard wireframe design for search interface of knowledge organization, which targets the users who are using search engines to locate required information or people who feel it’s hard to browse through the navigation because of poor design, which would be helpful for considering as reference for future knowledge organization website design.

1.6 Target Group

This study targets the search interface designers, which will be helpful for designing search interface for knowledge organization. The author also considers University of Borås as a target group for his study and for the Department of Computer Science and Business, mainly to Informatics field of study, which may find them interesting to take part in an author study.
to create more knowledge in search interface design and the author also believe that researchers in this field may find the study interesting and researchers can get ideas for further research or as a source of knowledge. The author also believes that the study may be interesting for knowledge organization researchers to learn how their search interface design should be structured in the website.

1.7 Author Background

The author chooses to write the thesis on search interface design, because the author has an interest, studied User Interface design and advance Interaction design. The author has done a Bachelor degree in Information Technology and Master Degree in the field of informatics, during his explore on the school website for information, the author was not satisfied by the interface design which is not up to the standard, so the author taught of proposing a search interface wireframe design for knowledge organization, which could be helpful for large numbers of people who uses search engine as a medium to explore information.

1.8 Delimitation

Search interface design is a vast topic and lot of minor details must be made to ensure the best interface design, the author try to cover only from major research work, famous pattern library and books related to interface design in theoretical study and small interview group for empirical study because of small time frame for thesis and create a wireframe model for knowledge organization search interface, the another major delimitation of this thesis is author stop in designing and no implementation is made to prove the thesis and make a strong approval for this report.

1.9 Structure of Thesis

Figure 1: Wireframe design of Thesis

Thesis structure describes the series of steps which are involved to attain the final result. First we define the problem statement and describe the author background knowledge towards the
topic, then we form the research question and move to the research design, in which the author uses qualitative method to collect data using the semi-structured interview during predefined search tasks with the knowledge workers and collecting data from the journals, search pattern library and literature study in order to make a comparison analysis study and then define the result, finally discuss the outcome of the thesis.

Successful of each level is important to complete a good thesis,

**Chapter 1: Introduction**

This chapter discusses the Background, Problem Statement, Research Question, Purpose, Expected Result, Target Group, Author Background, Delimitation and Structure of the thesis.

**Chapter 2: Research Design**

In this chapter the author discusses the Research Perspective, Research Strategy, Data Collection, Data Analysis, Validating Finding, Result Presentation and Referencing Technique.

**Chapter 3: Theoretical Study**

In this chapter the author studies the important concepts and researches which have been made in previous journals, Books and Pattern Library in relevance to Search Interface Design. Then the Summary of Theoretical Finding based on the framed Research Question.

**Chapter 4: Empirical Study**

In this chapter the author discusses the Purpose, Sampling, Search tasks, interview, Empirical study finding, Evaluation of Empirical result and Summary of Empirical Finding based on the framed Research Question.

**Chapter 5: Analysis and Result**

In this chapter the author discusses the comparative analysis of both the theoretical and empirical study finding based on framed Research Question then proposing Result summary based on the finding and Evaluation of Result is made at the end.

**Chapter 6: Discussion and Conclusion**

In this chapter the author discusses the result and concludes the thesis finding along with the method evaluation, result evaluation and future work.

**Bibliography:** Contains the list of references used to complete this thesis finding.

**Appendix:** Contains the Search Tasks which are used to complete the thesis.

**1.10 Acronym List**
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Text</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>HB</td>
<td>Högskolan I Borås</td>
<td>Name of Knowledge Organization Sweden.</td>
</tr>
<tr>
<td>KI</td>
<td>Karlonska Institute</td>
<td>Name of Knowledge Organization Sweden.</td>
</tr>
<tr>
<td>UU</td>
<td>Uppsala University</td>
<td>Name of Knowledge Organization Sweden.</td>
</tr>
<tr>
<td>KW</td>
<td>Knowledge Worker or Users</td>
<td></td>
</tr>
<tr>
<td>KO</td>
<td>Knowledge Organization</td>
<td></td>
</tr>
<tr>
<td>LIU</td>
<td>Linköping University</td>
<td>Name of Knowledge Organization in Sweden</td>
</tr>
<tr>
<td>IA</td>
<td>Information Architecture</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: List of Acronym Used

2 Research Design

2.1 Research Perspective

The two main research perspectives are Hermeneutics and Positivism. As the author makes his understanding of knowledge through the interpretation of meaningful approach, hermeneutics would be the most related to his research. Mayer's states that hermeneutics aids to the human understanding through sound interpretation (Myers, 2008). Interpretive guides in making a clear sense of an entity, hermeneutics (Taylor, 1976) helps in clear interpretation of the text which is unclear and requires making sense.

According to Prasad contemporary hermeneutics the text is expanded to include the organizational practices and institutions, culture, social structure and economic, cultural artifacts and so on. The hermeneutics can be considered as the general epistemology for the human and social science, aimed to create understanding in contrast to the explanation of natural science way. This could be extended to the interpretation and understanding of the text, historic process, legal structure etc., produced by other human minds (Prasad, 2002).

Researcher can use hermeneutic to be self critical during the research process; this allows the researcher to continually question the prejudices that may have risen during the research process.

2.1.2 Why Hermeneutic perspective?

The hermeneutic perspective emphasizes on understanding rather than testing a phenomenon (W.L. Neuman, 2003). This perspective can be seen as the foundation to research that dependent on context and use various ways to interpret the other’s world. This research helps to create a comprehensive understanding through interpretation and comparison. In this research a holistic perspective of the views of knowledge workers is needed to conclude on the specialized final wireframe standards for knowledge organizations, also the research needs clear and complete understanding of the steps leading to final wireframe design. To be able to understand the empirical and theoretical material it is necessary to have an intuitive and
holistic understanding of the knowledge organization needs in terms of search interface design, so thus hermeneutic perspective will be suitable for this research.

2.1.3 Arguments for Mixed Method Research

Hermeneutic perspective usually goes with the qualitative approach. The choice of qualitative or quantitative approach is not of high importance but whether an ‘analytic’ approach is used to understand the controlled variable or a ‘systemic’ approach to understand the interaction of variable in a complex environment is the main point to be noted (Miles & Huberman, 1984).

According to Johnson et al, mixed method research is referred as the type of research in which both the elements of qualitative and quantitative research approach are used to create a broader understanding of the research problem (Johnson, Onwuegbuzie, & Turner, 2007). In this research the author has used both the qualitative and quantitative methods which are referred as mixed method research in a single study. Bryman (Bryman, 2006) identified different rationales for carrying out mixed method research, this research falls under the rationale that qualitative and quantitative combined simultaneously to answer the research questions to bring completeness to the research.

In the empirical study author have used predefined search task questions and the screen capture software is used to collect the valuable required information when the user performs the search task, semi-structured interview is made parallel to the search task to explore information. The quantitative data is calculated from the screen capture video and the qualitative data is gathered from the semi structured interview, this study would be done in mixed method research to resolve the interface design issue (refer Figure 2).

2.2 Research Strategy

There are two classifications of research strategies they are descriptive, exploratory or explanatory (W.L Neuman, 1994). Exploratory determines the analysis on specific area, find what is happening and create ideas and establish theories based on the analysis. Exploratory helps in a new research area and test the feasibility of future research or propose a new method for future research.
The main objective of this exploratory research is to identify the key issues and key variable, for making a better system for the measurement for the specific variable.

The author has used exploratory research by conducting semi-structured interview with two students in informatics and non-informatics, by distributing predefined search tasks in order to find the difficulty faced through screen capture software, to get a strong foundation and idea for the final result, the author has used exploratory research with qualitative method to guide research towards the final outcome.

The theoretical study explains the previous work and important finding for this research and empirical study will be used to verify against these theoretical findings, also guide to new findings in this research through experience. From the evaluated results of both the theoretical and empirical study the author provides a suggestion using a wireframe design to improve the knowledge organization search interface.

2.3 Data Collection Procedure

Data collection in qualitative research can be done in different methods like text analysis, interview, questionnaires and observation. As Hakim (Hakim, 2000) defines qualitative research provides “individuals’ own accounts of their attitudes, motivations and behavior. It offers richly descriptive reports of individuals’ perceptions, attitudes, beliefs, views and feelings, the meanings and interpretations given to events and things, as well as their behavior; displays how these are put together, more or less coherently and consciously, into frameworks which make sense of their experiences; and illuminates the motivations which connect attitudes and behavior, the discontinuities, or even contradictions between attitudes and behavior, or how conflicting attitudes and motivations are resolved in particular choices made”. The author works on the research in two categories namely, theoretical study and empirical study. The data collection procedure for theoretical study is made from the relevant research works which helps to move forward with the research work. Data are collected from some previous research articles, textbook, journals and online pattern library to give a strong foundation for theoretical study. The author has used search task along with semi-structured interview for the empirical study. The main reason for choosing the search task with semi-structured interview is to collect the useful information when a user performs search tasks in knowledge organizations and mainstream search engine to verify the theoretical finding and to explore new information through semi-structured interview. An empirical study finding is made by combining both the semi-structured qualitative data and screen capture video (analyzing quantitative graph) which results in the mixed method research.

2.3.1 Sampling Criteria

Since researchers are not able to collect data from every possible way, sampling criteria plays a vital role during the research. The author mainly focuses the sampling of students during the empirical study because they are the major group using the knowledge organizations. The sampling is made in choosing students of age vary from 23 to 30, two students from informatics and non-informatics background with KO experience of 6 to 2 years during their study in HB.

2.3.2 Theoretical study
The theoretical study involves test analysis from various published relevant research articles. The credibility of the articles was determined by the quality of the publisher. University library helped in collecting published article from various database sources of Springer Link, Sage Publication, IEEE and many more. The author has used books from leading author in the study area as the source for data collection in theoretical study. Website resources from the leading researcher in the field of study area are also used as the source for data collection like Alertbox and Search Patterns.

2.3.3 Empirical study

The author used semi-structured interview to collect more data by interpreting and making an informal conversation covering the research to make a good exploratory research, these conversations could vary in question to different people and the main aim of this semi-structured interview is to explore and get into the user perspective to find the problems faced during the search tasks. The search tasks are structured to test the theoretical findings and explore new information; performed the search task is recorded using screen capture software with the user permission. The captured video is later used to calculate the quantitative data to make a comparative study of search task performed in KO and the mainstream search engine.

2.4 Data analysis procedure

This is the important part of the research; first the author sort out the collected data based on the category, facts and figures and interpretation of the collected result should be objective. Then the number of clicks, task completion rate, search usage, time utilization and usage of other important search feature is analyzed based on playing the captured video of empirical study repeatedly and analyzing each and every move of knowledge workers to collect data and generate charts. Then we must make sure that the collected data answer our research question.

2.4.1 Comparative Analysis

The author has used comparative analysis to discuss the finding of the empirical study and theoretical finding to generate the outcome of this thesis.

2.5 Strategies for Validation finding

In this process the author carefully interprets the collected data, this collection of data has been made from the use of Journals, Books and Online Pattern Libraries in the interface design field to highlight the research question and the text analysis is used to get deeper into the latest search interface design research and important finding. The author made the empirical study by distributing predefined search tasks to knowledge workers and semi-structured Interview to get deeper into the user perspective, the author has chosen two students from the informatics and non-informatics background and collects the outcome from Screen Capture. Since screen capture can be played many times to analysis the data with high quality.

In many research validation journals, the author would include the relevance and usefulness of validity concept in qualitative research (Pyett, 2003). In qualitative research the account is valid “if it represents accurately those features of the phenomena that it is intended to describe, explain our theories” (Hammersley, 1987).
To get the accurate results the author used Michael (Michael, 2002) four evaluation research factor of Quality, Validity, Reliability and Generalizability:

- **The quality** of the research by collecting data from the journals, articles, books, pattern library and from the best online resource for Search Interface design, this enhances the richness of meaning of the data in the research.
- **The validity** of the research is evaluated by strong analysis with support of theoretical finding.
- **Reliability** of the research is enhanced by repeatedly revising the data to ensure the consistency and accuracy of the results.
- **Generalizability** has been used to generalize the finding to cover the circumstances for the wider group.

The author ensures that all the research question and sub questions has been answered in a simple and understandable manner to enhance the quality of research.

### 2.6 Result Presentation Method and Referencing Technique

The author uses text and wireframe to present the results, the end result is guideline for improving the search interface of knowledge organization, so the author uses wireframe diagrams to display the results. The author has used APA 6th Style in which the reference contains the name of the authors and the year in which the reference is published, the reference can be found in the bibliography section with the reference arranged in chronological order of the author names, published year is right next to author name.

### 3 Theoretical Study

#### 3.1 Key Concepts

The key concepts used in this thesis are as follows and detailed information will be given in later chapters,

**Usability:**

“A quality attribute that assesses how easy user interface is to use” (J. Nielsen, 2003).

**User Interface:**

“The way that you accomplish tasks with a product – what you do and how it responds- that’s the interface” (Fadeyev, 2009).

**Search Pattern:**

“A pattern language for search that embraces user psychology and behavior, information architecture, interaction design and emerging technology” (Morville & Callender, 2010).

**Information Architecture:**

” Information Architecture is,
• The structural design of shared information environments.

• The combination of organization, labeling, search, and navigation systems within websites and intranets.

• The art and science of shaping information products and experiences to support usability and findability.

• An emerging discipline and community of practice focused on bringing principles of design and architecture to the digital landscape.” (Rosenfeld & Peter Morville, 2006).

**Wireframe:**

The visual representation of a website, which allows the designers and developers to present their proposed structure and contents of a website in simple line diagram (Kyrnin, 1995).

**Knowledge Organization:**

"The description of documents, their contents, features and purposes, and the organization of these descriptions so as to make these documents and their parts accessible to persons seeking them or the messages that they contain. Knowledge organization encompasses every type and method of indexing, abstracting, cataloguing, classification, records management, bibliography and the creation of textual or bibliographic databases for information retrieval " (Anderson, 1996).

### 3.2 Subject areas relevant for the research

The author has used resource from different subject areas, then the author shows the relevance of the subject area to the research question,

1. Usability
2. Information Architecture
3. Search Patterns
4. Search User Interface
5. User centered design
Subquestion 1: What are the basic principles and findings to improve search page design?

Subquestion 2: What are the important elements to be considered in enhancing search interface design?

Figure 3 explains the sub questions relevant subject area. In the chapter 3.11, after reviewing all the literature findings and subject area the author would answer all the theoretical finding relevant to the sub question in brief.

### 3.3 Previous Research

There has been a lot of research happening in the subject area, some of the well-known works are Alertbox from Jakob Nielsen, which discusses the current problem in web usability. Don’t Make Me Think (Krug, 2006) is one of the key usability design guide book from Steve Krug.

Information Architecture deals with the structure of the websites, in which (Rosenfeld & Morville, 2006) Peter Morville wrote a book along with Louis Rosenfeld which explains how to enhance the information architecture.
Search Patterns (Morville & Callender, 2010) book explains ideas and previous research in this subject area.

Search User Interface by Marti Hearst (M. A. Hearst, 2009) explains the important features for designing and evaluating of search interface, which is widely used in the search interface design.

User centered design is a wide research area which explains the importance of user in designing the interface design lot of proven previous research has been done in this field to show the importance of User in design, so the author includes the proven result of the importance of user and try to give more importance for Search interface design.

3.4 Relevant Theoretical Study sources

The relevant literature collection is made from different books and electronic journal. The Electronic Journal is collected from the University of Borås Library in the subject area of user interface design. The author has also used famous search engines like Google, Yahoo to collected relevant material for the research.

Some of the important electronic journals are,


Some important online sources,


Some important book sources used are,

Morville, P., & Rosenfeld, L. (2006). Information architecture for the world wide web: O'Reilly Media. This is well known book and good contribution to information architecture.

Morville, P. and J. Callender (2010). Search patterns, O'Reilly Media, Inc. This is well known book explains the search patterns.

Hearst, M. (2009). Search user interfaces, Cambridge Univ Pr. This is the latest well known book for search interfaces.

3.5 Usability

3.5.1 Usability Qualities

Usability refers to the method used to improve the ease of use in the design process, Jacob Nielson (J. Nielson, 2003) explains five qualities components for usability they are,
**Learnability**: How easy is it for users to accomplish basic tasks the first time they encounter the design?

**Efficiency**: Once users have learned the design, how quickly can they perform tasks?

**Memorability**: When users return to the design after a period of not using it, how easily can they reestablish proficiency?

**Errors**: How many errors do users make, how severe are these errors, and how easily can they recover from the errors?

**Satisfaction**: How pleasant is it to use the design? ”

### 3.5.2 Importance of Usability

Usability is the necessary condition for the website survival, it’s difficult to use and people leave without proper usability. If the user gets lost in a website or there is no proper explanation for what users can do on site or website information is hard to read or they don’t answer users key question they leave, if you carefully note the pattern the users are not spending much time on reading or figuring out the interface (J. Nielsen, 2003), so it is important to make sure we provide a good usability for the user to complete their task.

### 3.5.3 Important Usability Principles & Rules

There are lots of usability rules and principles available, since this thesis mainly focuses on the search page design and search interface design, the author carefully chooses which is related to the thesis requirement to enhance the quality of the thesis,

#### 7±2 Principle

This principle explains that the capacity of the human brain to process information by dividing the information into chunks and units. George A. Miller ‘s study (Miller, 1955) “Seven, Plus or Minus Two” explained human could retain only five to nine things in their short memory at one time so it’s important that we consider to his principle when the building number of items in (Leggett, 2009) navigation menu to seven.

#### 3-Click Rule

According to this 3-Click (Leggett, 2009) rule the user stops uses the websites if they don’t find the information within three clicks, this explains the importance of clear navigation and logical structure and an ease of follow website hierarchy, but in most situation number of clicks is irrelevant if the visitor have full control of where they are, where they were and where they can move next, even ten click is okay if the uses feel free and have complete understanding of how system works.

#### First Law of Usability

Steve Krug explains that (Krug, 2006) “Nothing important should ever be more than two clicks away” or “Speak the user’s language,” or even “Be consistent.” to make the website easier to use. Steve Krug explains the first law of usability as “Don’t make me think”, to
make the usability as simple as possible to make the user feel comfortable to achieve their goal.

3.5.4 Top 10 Mistake in Usability

Jakob Nielsen (Jakob Nielsen, 2011) explains the 10 most egregious offenses against user or web design disaster are as follows, in which the author carefully chooses the mistake which is applicable to Search Interface Design.

Bad Search

Always search is the user lifeline when navigation fails; always the simple search box works best, must be able to handle the suggestion for alternate search or when no result is displayed.

Not Changing the Color of Visited Links

Always the user should be able to differentiate the visited and not visited link with color, if all the links in same color then there is a lot of chances for the user to visit the same page again, get more frustrated and leave the site, this should be included in search result page, to give a clear idea for the user to know the past and present location and decide where to go next.

Page Titles with Low Search Engine Visibility

The page title displayed in the search engine result page should contain the part of the heading to give a basic idea for the user if they have a look at the link and it’s also useful for the search engine to grab the result instead of some random numbers.

3.6 User Centered Design

Landauer (T. K. Landauer, 1996) explains that without user centered design, user interface has around 40 flaws which could slow users and lead to errors, which explains the author consideration of user centered design in this thesis.

3.6.1 Principles for User Centered Design

Gould and Lewis (Gould & Lewis, 1985) developed user centered design principles in 1985, which consist of three simple methods,”

1. Early focus on the users and task
2. Empirical measurement
3. Iterative design”

3.6.2 Designing pages for Scanning, not Reading

Steve Krug (Krug, 2006) explains that the user doesn’t read they scan the page, but designers think that the users read and think how stuffs work in website, from user perspective they don’t spend time to explore the website as designers planned, so we need to design the website for scanning, as you could look at the Figure 4 explains the designed for and reality of the user view.
3.7 Information Architecture

Information Architecture is used to structure the website, the author has used information architecture to make sure that the search page contains all the details which is used for navigation, filter and search result are displayed properly to make the search easy for the users with the help of information architecture to build the search page. As the figure 5 explains there are two possibilities for the user to explore a website either through the navigation or through search, the author focused on the search part interface to make sure the user is satisfied with their search interface page information architecture.
3.7.1 Visualizing Information Architecture

Information Architecture plays a vital role in designing web pages, information architecture deals with the formatting of organizing, navigation, search, label system. Peter (Morville & Rosefeld, 2006) explained the information architect question formed for knowledge organization called Gustavus by information architect to build a proper top-down information architecture which is visually explained in Figure 6 and the question framed are as follows, all these questions are build to answer the basic question which may arise when user browsing the website,

1. Where am I?
2. I know what I'm looking for; how do I search for it?
3. How do I get around this site?
4. What's important and unique about this organization?
5. What's available on this site?
6. What's happening there?
7. Do they want my opinion about their site?
8. How can I contact a human?
9. What's their address?

![Image of a website interface with a search bar and various links such as Calendar, Athletics, Academics, Admissions, News, Arts, and A-Z Directory.]

**Figure 6: Top down Information Architecture (Rosenfeld & Morville2006)**

In which the author narrows the above information architect question to visualize the search page information architecture.

2. Where to enter the search term to perform the search?
The above second question regarding search can be considered in two ways, one is each page should have the search box, in second way is when the user lands in the search result page how to enter the search term again to make another search.

5. What are the options available to filter the search?
The above fifth question defines the different ways in which the user can filter their search to narrow their search result. The author omits the fourth question when considering for search page design.
3.8 Search Patterns

Search Patterns by Peter Morville and Jeffery Callender (Morville & Callender, 2010) explains the different patterns which are in common use in the mainstream search engine, in which they explained the anatomy of a search engine result page (SERP) of Google, which is fast, simple and relevant. It’s so fast for navigation so people use it even when people know the URL. Figure 7 explains the different sections which make the Google search interface fast and efficient.

![Figure 7: Anatomy of SERP (Morville & Callender, 2010)](image)

3.8.1 Behavior of Patterns

Search Patterns (Morville & Callender, 2010) explains that the search ends with the quit, there might be only two reasons for this either the user found what they want or they simply quit. We should make sure that when the search result displays no result found, the interface designer must make sure that the alternate suggestion is available for user, which enhances the interface design as explained in the Figure 8. Yale knowledge organization enhances the interface by suggesting alternate suggestions like spell check and alternate search.
3.8.2 Pattern Library

The Yahoo Pattern Library and Welie contains set of solution patterns for a search interface, the author have considered the following search interface to enhance the quality of final output.

Search Pagination (Yahoo, 2009)

What Problem Does This Solve?
When the user needs to look the search results ranked by relevance in search page, there are lots of search results is displayed in a single page.

When to Use This Pattern
This pattern can be used to display a large number of search results within one screen.

What's the Solution?

Break the large information into sequence of page and provide a pagination control to access all the pages which is framed as follows (Yahoo, 2009),”

- Display the navigation controls as a row of links.
- Present links in the following order: 'Prev', page links, 'Next'.
- Display a left arrow after the label 'Prev'.
- Display a right arrow before the label 'Next'.
- Make the arrow(s) clickable.
The page links should contain a maximum set of 10 page links. If fewer pages of results exist, only show page links for the available pages.

When on pages 1-6, the page links should always start at '1'.

When on any page after 6 (7 and onward), the page links should start at the current page minus 5. For example, when on page 7, the first page will be 2 (7 - 5 = 2) and the last page will be 11 (still shows 10 pages.) “Refer Figure 9.

Site Index (Welie, 2008b)

What Problem Does This Solve?
User need to find a specific page.

When to Use This Pattern?
This pattern can be used when there is a large web site with search and main navigation. This is mainly for the beginners who are not familiar with the Information Architecture of the web site.

What’s the Solution?
Show all pages with alphabetical index or topic (Welie, 2008b). All pages are shown per character, it depends on the number of pages per character; tabs are used to browse the index, if more pages share a common topic then index the topic and place the pages under them. Use two columns in your page template for search index because there are no needs for local navigation bars anymore for example have a look at Figure 10.

Figure 10: Site Index of Adobe Website
Footer Sitemap (Welie, 2008a)

What Problem Does This Solve?
User need to find a specific page.

When to Use This Pattern?
In any site which has 2-level of content, in particular for medium–sized sites there are locations where user wants to visit more often.

What’s the Solution?
Show set of categorized links in the footer of every page (Welie, 2008a). By putting some useful links in the footer the user can move quickly to where ever they want to go, for example have a look at figure 11.

![Footer Sitemap from Apple website](image)

**Figure 11: Footer Sitemap from Apple website**

### 3.8.3 WayBackMachine

WaybackMachine is online database which makes the screenshots of website and maintains the history of date on which the site is crawled; the author uses this to study the step by step improvement of major search engines Interface. Figure 12 explains the crawled status of mainstream search engines like Google and MSN along with the knowledge organization www.hb.se, this study helps in watching the screenshot of how the interface improvement have been made in search engines and knowledge organization. As there are lots of updates for mainstream search engine author couldn’t include the entire interface page so I have explained in figure 12, in which the search box represents the website for which the search is done. Along the horizontal bar of the graph the years are represented and along the vertical bar on the graph represent the how frequently it’s being crawled in each year, twelve bars in a year represent the months. Figure 12 represents the website crawl till 2010.
3.9 Search Interface Design

Human-Computer Interaction researchers and practitioners have proposed many guidelines for the successful building of user interface and some researchers proposed very specific guidelines for search interface field. An influential paper from Shneideman which specifies eight design criteria”

1. Offer informative feedback.
2. Support user control.
4. Provide shortcuts for skilled users.
5. Reduce errors; offer simple error handling.
7. Permit easy reversal of actions.
8. Design for closure.” (Shneiderman, Byrd, & Croft, 1997)

Marti A. Hearst (M. A. Hearst, 2009) explain it’s difficult to follow all the Search Interface guidelines of Shneideman, which doesn’t explain how to achieve the goals and important drawback is one guideline conflicts with meeting others guidelines and above miss the Nielson (Jakob Nielsen) “speak the user language”, so for any given interface guidelines will
be superfluous. So Marti Hearst explains the user interface design in general, mainly focus on search interface, which explains the difficulties in search interface design and guidelines for tailored specifically to search user interface based on the results over the past years of research experience, experimentation in this field and test conducted in the marketplace. These guidelines are as follows in which the author chooses the important guideline which is suitable for the knowledge organization Search Interface,”

1. Offer efficient and informative feedback,
2. Balance user control with automated actions,
3. Reduce short-term memory load,
4. Provide shortcuts,
5. Reduce errors,
6. Recognize the importance of small details, and
7. Recognize the importance of aesthetics.” (M. A. Hearst, 2009)

3.9.1 Offer Efficient and Informative Feedback

Show Search Result Immediately

Marti Hearst (M. A. Hearst, 2009) explains the importance of showing some result first when the query is entered to the users, which helps in guiding the user with relevant search data and filter option, but we must make sure that the query filtering option or category label should not be displayed before viewing results directly.

Show Informative Document Surrogates; Highlight Query Terms

Feedback of the search result listing with informative Document surrogates is important, according to the large study made by the Clarke (Clarke, Agichtein, Dumais, & White, 2007) “the query term should appear in the search result surrogate, but if all the query terms are present in the title then summary can include some other relevant information”, query term in the URL is the useful cue for the users, but the length and complexity should be reduced in displaying the URL. Landauer (T. Landauer et al., 1993) explains that the visually highlighting query terms can be the most useful feature for search Interface design.

Allow Sorting of Results by Various Criteria

Another important effective feedback is to allow users to dynamically sort the search results with different criteria, which helps them to achieve the goal easily.

Show Query Term Suggestion

It is useful for users, to show the automatically generated query term suggestion and refinement after a query is issued, which includes the spelling correction suggestion and alternate query term. A lot of researches (Anick, 2003; Bruza, McArthur, & Dennis, 2000; Divoli, Hearst, & Wooldridge, 2008) prove that the “Usability study is generally positive as to the efficacy of term suggestion when the users are not required to make the relevance judgment and to choose from too many terms”. Study (B.J. Jansen, Spink, & Koshman, 2007) in the dogpile web search engine session logs prove that 8.4% of all queries are generated by the reformulation from the assistant provided.
Use Relevance Indicators Sparingly

In the past search engines (Shneiderman, et al., 1997) have shown a numeric score or graphical bars or icons such as the row of stars along document surrogates to indicate the relevance score for the document, (White, Bilenko, & Cucerzan, 2007) but most likely all these relevance scores are opaque to users.

3.9.2 Reduce Short Term Memory Load

The main idea is to provide an information rich search interface by showing user the relevant information rather to remember or keep track of it.

Suggest the Grayed Search Action in the Textbox

This is to display a useful tip in grayed out font in the search box, which disappear when the user clicks in the form, like “Search within results”, Marti Hearst (M. A. Hearst, 2009) explains that most studies suggest that the user do not notice the search box with radio buttons or drop down and change the type In this type of interface when they enter the query.

Integrate Navigation and Search

Information structure after the query search is important for the user to easily achieve the goal; this can be done by category system which is the main tool for navigation information structure and organizing search, category system is a set of meaningful label which is used to group a particular result from huge search result data, in which hierarchical category system is useful and easy to understand for relative simple information structure. This kind of interface is highly used for navigation of information collection with somewhat homogenous content (M. Hearst et al., 2002; Yee, Swearingen, Li, & Hearst, 2003).

3.9.3 Reduce Error

The following should be considered by the interface designers to reduce the user errors,

Avoid Empty Results Sets

The general search usability rule of thumb is to not show the empty search results sets, which can be done by spelling correction, term expansion and faceted interface. The faceted interface must be simple to reverse back when no result is displayed.

3.9.4 Importance of small details

Small details in search interface can make the difference between the success and failure design, Allen (Allen, 1994) found out that varying the order in which the information was shown to searchers dramatically affects how much the searchers has learnt about the information from the document collection. The user of web search engines (Joachims, Granka, Pan, Hembrooke, & Gay, 2005) expects the result in the first few results to be more relevant than those that follows, Silverstein (Jansen & Eastman, 2003) explains that approximately 80% of the web searchers have never viewed more than first ten results in the result list.

3.9.5 Importance of Aesthetics in Design
Search Interface designers must balance the layout, placement and amount of blank space, color, contrast and font used. (Parush, Nadir, & Shtub, 1998) made a study by comparing the 16 different version layout with varying quality of design, grouping, alignment and size and tested with 75 participants they found that the time taken by the worst layout is twice as that of best, good design screen resulted in achieving the shorter search time with higher preference.

3.10 Evaluation of Search Interface Design

Marti Hearst (M. A. Hearst, 2009) explains which evaluation method terms to use for search interfaces. Usually the search interface is usually evaluated with three main aspects of usability which is effectiveness, efficiency and satisfaction which is defined by (DIN, 1998) ISO 9241-11,

1. “Effectiveness: Accuracy and completeness with which users achieve specified goals.
2. Efficiency: Resources expended in relation to the accuracy and completeness with which users achieve goals.
3. Satisfaction: Freedom from discomfort and positive attitudes towards the use of the product.”

Marti Hearst also explains these are the ideal criteria which should be measured when evaluating the search interface, which corresponds directly to the search tasks. The author has chosen Formal Evaluation and Controlled Environment which is one of the three evaluation methods for search user interface.

3.10.1 Formal Evaluation and Controlled Environment

Formal studies of user interfaces are useful for rigorous comparison of different design,

Formal Evaluation

The classic Usability study is done in the lab, you need a computer, camera, desk and chairs to set up a lab, where the camera is placed next to the user to capture the reaction when using the interface along with the screen, click capture and logging the user search log to get a clear idea of user behavior. Click capture helps to find exactly which part of the screen user views and clicks to perform the task. Before the usability study begins the user is asked to sign a consent form to indicate that the audio, video, screen capture, click capture and log is used, maintaining the user anonymity will be protected and the user is free to leave the testing anytime, if they feel uncomfortable to reduce the stress of user. The formal study should state the independent variable such as different design or the queries assigned and dependent variables as time elapsed, the total number of errors made and the participant’s subjective responses to the study.

Experimental Conditions

Experimental design plays a vital role in the user oriented evaluation; care should be taken to reduce the bias effort, when comparison of multiple web search interface care must be taken to minimize the ability of the participant to transfer what they learnt in one interface to another so when using multiple interface the potential bias is addressed by randomizing the order in which the interface is exposed to users (Nowicki, 2003; Su, 2003). Always pilot
study the experiment to make sure it’s short and not making the user tire towards the end. Users preferences are obtained by the questionnaires using the Likert Scales (Shneiderman & Plaisant, 2004), which consist of points with a qualitative range such as “difficult to easy”, “strong agree to strongly disagree”, “never to always” and many more.

3.11 Summary of Theoretical finding

This section deals with the major result finding in the theoretical study and structured according to the research sub question.

3.11.1 Sub-question one

What are the basic elements and principles in search page design?

1. According to 7±2 Principle, Human could retain only five or nine things at a time in short memory, which helps in minimizing the information chunks in any section from five to seven (See Chapter 3.5.3).

2. According to the 3-Click rule, User should achieve the goal in three clicks and it’s allowable in many clicks if they understand how the system works (See Chapter 3.5.3).

3. Top down visualization of Information Architecture makes sure that all basic elements for a page is considered and made visible to the user, to enhance their understanding of search interface design without making the user think about the interface (See Chapter 3.7.1 and Chapter 3.5.3).

4. Search patterns like site index, footer sitemap are used to enhance the search usability of the page and alternate option for search (See Chapter 3.8.2).

3.11.2 Sub-question two

What are the important elements to be considered in enhancing search interface design?

1. Considering the important usability rules and principles in mind along with the most common and worst mistake in usability to avoid the known issues to enhance the quality of search interface design (See Chapter 3.5.3 and Chapter 3.5.4).

2. The importance of user centered design to reduce the future problems and designing pages for scanning, is one of the most important elements in Interface Design (See Chapter 3.6 and Chapter 3.6.2).

3. Most common and worst mistakes in usability design in relation to search page design such as the importance of alternate suggestion, change color of visited link and title of page should be considered to reduce the predefined error (See Chapter 3.5.3).

4. Alternate suggestion and spell check helps user search and reduce the user quit without results (See Chapter 3.8.1).
5. To enhance the quality of design, pre solved search patterns like search pagination are used from the pattern library and waybackmachine used to visualize the development of major search interface design and how frequently its being updated to enhance the usability (See Chapter 3.8.3 and Chapter 3.8.2).

6. It’s always difficult to follow all Search Interface guidelines, one guideline contradicted with other so latest guideline given by Marti Hearst in 2009 is used (See Chapter 3.9).

7. Offer efficient feedback by highlighting the query term, use relevance score sparingly, proving suggestion for query term, filter option to narrow result is displayed only after the query is searched and not before (See Chapter 3.9.1).

8. Grayed text is placed in a text box for special function other than normal search. For faceted category filter option choose a meaningful label to reduce the user from keeping track or remember the data, to reduce the short memory load (See Chapter 3.9.2).

9. Avoid empty result is the usability rule of thumb, which can be achieved by spelling correction, term expansion and easy option to undo faceted search (See Chapter 3.9.3).

10. Small details in search interface can make the difference between success and failure, it changes the ways a user learns the information and approximately 80% of user don’t view more than ten results because they consider that first few results are more relevant than fallows (See Chapter 3.9.4).

11. Balancing of white space along with a good aesthetic design to reduce the search time (See Chapter 3.9.5).

12. Bad usability makes the user task incomplete, which shows the importance of user centered design to find and sort the problem in the beginning (See Chapter 3.5.2).

13. “Speak the user language” to make them feel comfortable and achieve their goals, which is only possible by user centered design (See Chapter 3.5.3).

14. Interface design without considering user centered design results in around 40 flaws (See Chapter 3.6).

15. User doesn’t read the page as intended by designers, but they scan, we need to design pages for scanning, which shows the importance of user perspective in interface design (See Chapter 3.6.2).

**Arguments for an Empirical Study**

The empirical study is used to give space for new knowledge and to validate the findings in theoretical material. The detailed description of how empirical study is performed is explained in Chapter 4.

**4 Empirical Study**
4.1 Purpose

The purpose of the empirical study is to find out the basic element to enhance the search interface design of knowledge organizations websites. By recording the practical experience of the knowledge workers, the author could find out the basic needs and their problem faced in real time, when they are in search of information in the knowledge organization website. This can be achieved by performing the predefined set of search task and semi-structured interview during the search task targeting the theoretical finding. The Author has set four search tasks which will be performed by knowledge workers and screen capture software is used to increase the validity of collected data and keep track of each and every movement made by the knowledge workers. The collected data is then analyzed against the theoretical framework to answer the main research question.

4.2 Sampling

Sampling is the process of selection of population or a group of population from which the study is made to collect the empirical data. Gathering of information from huge population is difficult so the author carefully chooses the small set of knowledge workers to perform the study. Sampling is less expensive, less time consuming and gives more accurate results. The Author targeted the international student (knowledge workers) of different age from (23 to 30) and selected two informatics student and two non-informatics student, studying in knowledge organization (www.hb.se) to perform the empirical study. It has been discussed in Chapter 2, that the author is using qualitative method for research investigation with a base of hermeneutic perspective and exploratory research strategy.

4.3 Search Tasks

Task 1

- Go to www.hb.se and search for the course of One year master programme in Informatics and find the Tuition fee for that course.
- Go to www.ki.se and search for the course of Two year master programme in Health Informatics field and find the tuition fee for that course.
- Go to www.uu.se and search for the course of Two year master programme in Information System field and find the tuition fee for that course.

Task 2

- Find the contact email address of professor name “Andrea Resmini ” in this website http://www.hb.se
- Find the contact email address of professor name “Andreas Lange” in this website http://www.liu.se
- Find the contact email address of professor name “Lars Anders” in this website http://www.harvard.edu/

Task 3

Consider you are helping your Swedish friend to locate a pdf file,
- Science for the profession which is the 5th published report in 2009, its English document in website www.hb.se
- Karolinska Institutet Annual report which is published in 2003, its English document in website www.ki.se
The rise of Africa: miracle or mirage which is the annual report published in 2010, its English document in website www.uu.se

Task 4

Find the information about the news which is,

- Published in 13th June 2005 about the topic “Informatics in borås” in the website www hb se
- Published 20th August 2009 about the topic “Brain cell research and development in KI” in the website www.ki.se
- Published 7th May 2010 about the topic ” Breakthrough in Electronic Signal Research” in the www uu se

When the KW completes all the above task set, the KW is again asked to perform all the four search tasks set in Google search engine, to compare the problems faced, number of clicks used, task completion rate, and time utilized to perform the task set. The entire search task is targeted towards the theoretical finding and to explore new problem faced during the search process. Task 1, Task2, Task3, Task4 is used to identify the search engine usage by the knowledge workers (users), usage of other important help during the search. All four search tasks help to understand the KW usage of search and navigation to complete the task. Task 2 is mainly used to find the problem faced in providing drop-down before search box and providing a search link instead of the search box. Task3 focused on the usage of filter option during search, file type indicator and the proper title for the file type. Task4 is used to check how controlled the knowledge worker (User) is when searching for un-available data in websites and to also check when they give-up their search.

4.4 Interview

The Author has performed a semi-structured interview along with the predefined set of search task to get the broader idea from a user perspective of how they overcome different problems during their search task. Screen capture software is used for analyzing each movement of KW Search tasks, which reduces the pressure of the Author and help to concentrate mainly on how the KW faces difficulty and how they overcome during their search task, the author has chosen the semi-structured interview to interrupts KW and make a valuable exploratory data collection which is discussed in chapter 2.2. The predefined search task is chosen by the author to narrow down the research based on theoretical finding. A pilot study is made by the author to ensure the search task has no error and performs a cross check with some random participant to make sure that all tasks is executable. Appointment is made with the KW to a specific date, time and place to perform the interview. The semi - structured interview question is framed based on the KW search task approach to perform a deep exploratory research.

4.4.1 Knowledge Worker1 (KW1)

KW1 has computer as major of studies, from School of Business and IT, has 2 years of study experience in HB. KW1 has no problems in task 1 after completing the task1 I was keen to ask, there was no suggestion given during the long term search which resulted in no result while searching in HB and are you comfortable with it? The answer author got was ” it would be helpful if there is a suggestion, but as an IT student I have good knowledge on search engine”, when he moved to the task 2 he found it easier to search in www hb se since KW1
studies there, when performing the same task in www.liu.se KW1 went for navigation and then when lost KW1 came to search and explored the drop-down menu for staff search and succeeded the task, in www.harvard.edu KW1 has no problem. After the completion of Task3, the author asked, will you use the drop down before the search box more often? KW1 replied “when I get lost or not achieved the information, I will explore all the options and drop-down is one among them if they are available”. Finally author asked are you confused with the repetition of title during a search in HB? The answer author got was “it was confusing in the beginning and then I changed my mindset for HB search”.

4.4.2 Knowledge Worker2 (KW2)

KW2 has computer as major of studies, from School of Business and IT, has 6 months of study experience in HB. KW2 has faced a lot of problems during his Task1, Task3, Task4 search in HB, since the KW1 has used advance search in HB, it made the cache and when the kw2 searches for Task1 in basic search it display in advance search with big danger icon error, the author asked what happened? KW2 replied “No idea, wondering how it landed in advance search with error”, this happened in all HB website search tasks, KW2 used navigation to overcome this error; KW2 has no idea how to go back to basic search.

4.4.3 Knowledge Worker3 (KW3)

KW3 has biotech as major of studies, from School of Engineering, has 2 years of study experience in HB. KW3 has no problems in Task1, KW3 used customized search box used in Google for UU to complete the task easily, Is it helpful do display KO search box along with the Google result page, KW3 replied this is very useful and reduce the time taken to search. In Task2 KW3 never used a drop down for the first time then noticed it 2nd time, the author asked how often do you used drop down before entering search text in the box, KW3 replied “rare”. During the Task3 KW3 had spent lots of time in clicking all the search result pages long links, no file type indicator or proper title is used to find pdf in HB. Author asked is it difficult without file type indicator or proper title? KW3 replied” yes it’s true, I clicked the entire link to find the pdf file due to improper title and pdf indicator”. KW3 clicked the Tips in UU, but at the end of the task KW3 mentioned nothing useful was found in the Tips.

4.4.4 Knowledge Worker4 (KW4)

KW4 has Sustainable Engineering as major of studies, from School of Engineering, has 6 months of study experience in HB. KW4 has no problem in performing Task1, during the Task2 KW4 used the contact field at Harvard to find the staff information like in HB, but at Harvard they use employee as the link name. In the Task3 same advance search error and went blank for 5 sec then somehow managed to move out of advanced search, the author asked is it comfortable if the search term is displayed in different color? KW4 replied” It’s comfortable for one or two text search, if more text is entered then confusing”.

4.5 Empirical Study Finding

From the screen capture video and semi-structured interview answer, all the search tasks is analyzed. From the screen capture video total number of clicks used to perform the search task are calculated. To maintain the quality of thesis finding, the Number of clicks and Time Utilized are calculated only after when the page loads and then KW changes the language of the website and ready to go. Even the click in the search box is calculated to give the perfect number of click calculation. Page scrolling clicks are not included and text editing clicks in
the search box is not calculated if it’s before clicking search or pressing enter. The entire search task is done by two informatics and two non-informatics KW form HB.

Figure 13 explains the number of clicks made by performing Search Task1, Task3, and Task4 on KO websites of HB, KI, and UU.

Figure 13: Number of Clicks Used in Knowledge Organization Websites

Figure 14 explains the number of clicks made by performing the same search task of Task1, Task3 and Task4 in Google to find the comparative study of click performed by knowledge organization and the mainstream search engine.

Figure 14: Number of Clicks in Main-Stream Search Engine

Figure 15 explains the Total time utilized by KW to perform Search task1, Task3 and Task4 on the KO website of HB, KI and UU.
Figure 15: Total Time Utilized by Knowledge Organization

Figure 16 explains the Total time utilized by performing the same search task of Task1, Task3 and Task4 in Google to find the comparative study of Total time utilized by knowledge organization and the mainstream search engine.

Figure 16: Total Time Utilized by Google

Figure 17 explains the Task Completion Rate by KW to perform search task1 and search task3 in the KO website of HB, KI and UU.

[32]
Figure 17: Task Completion Rate in Knowledge Organization

Figure 18 explains the Task Completion Rate by performing the same search task of Task1 and Task3 in Google to find the comparative study of Task Completion Rate by knowledge organization and mainstream search engine.

Figure 18: Task Completion Rate in Google

Figure 19 explains the Search engine usage by KW during the search tasks of Task1, Task2, Task3 and Task4 in a KO. In which there are four categories,

- USED SEARCH which means the KW used the search right away when enters the KO website.
- USED NAVIGATION which means the KW used the website Navigation to complete the tasks when entering the KO website.
- USED SEARCH WHEN LOST IN NAVIGATION which means the KW used the website navigation first and then got lost and shifted to search engine to complete the search tasks.
• USED NAVIGATION WHEN LOST IN SEARCH which means the KW used the website search engine first and then got lost and shifted to website navigation to complete the search tasks.

![Search Engine Usage](image)

**Figure 19: Search Engine Usage Rate**

FIGURE 20 explains the total usage of Autosuggest, Date & Relevance, Ascending & Descending, the filter option and spell correction during the entire search task performed by KW on both the KO and mainstream search engine. To maintain the quality of thesis each is calculated and explained below based on the availability on a different website,

- Autosuggest is used 4 times out of 56 available chances, which is approximately 7%.
- Date & Relevance are used 1 time out of 28 available chances, which is approximately 2%.
- Ascending and Descending is used zero times out of 12 available chances, which is 0%.
- Filter Option is used 4 times out of 24 available chances, which is approximately 16%.
- Advance Search is used 4 times out of 56 available chances, which is approximately 7%.
- Spelling correction is used 9 times out of 36 available chances, which is 25%.
4.6 Evaluation of Empirical Results

According to Marti Hearst, evaluation of search interface design is based on the effectiveness, efficiency and satisfaction (See Chapter 3.10). From the above derived output of the number of click captured, time utilized, task completion rate and satisfaction, mainstream search engine is way high in interface design and all KO varies and definitely less than a mainstream search engine, so keeping this in mind the author proves the important need for this thesis to enhance the search interface design of KO with the finding of theoretical and empirical study.

4.7 Empirical Study Summary

Interview with search task was designed to answer the research question,

Main Question: How to improve specialized search interface design standards for knowledge organization by evaluating mainstream search interfaces?

Sub question1: What are the basic principles and findings to improve search page design?

- When KW2 is performing his Search Task1, KW2 went to the final page of finding the Tuition fees, which is available at the 7th Tab; it took KW2 time of 33seconds to analysis the Application Fee tab and completes the task.

- The average clicks used to complete the task in mainstream Search Engine website of Google are very less compared to KO websites of HB, KI, and UU. In which the HB uses highest average click when compared to other KO websites (refer Figure 12 & Figure 13).

- The Usage of Site Index and Footer sitemap could have reduced the time and number of clicks, by placing the site index which is used twice during the search task and calendar and latest news in footer sitemap would reduce the time.
**Sub question2:** What are the important elements to be considered in enhancing search interface design?

- The Task completion rate is greater in mainstream search engine when compared to KO websites of HB, KI and UU. In which HB uses the lowest average of Task completion rate when compared to other KO websites (refer Figure 16 & Figure 17).

- The Time Utilized to complete the search task in mainstream Search Engine is very less compared to KO websites of HB, KI, and UU. In which the KI and HB use very high Time when compared to other UU websites (refer Figure 14 & Figure 15).

- The Usage of Search Engine is more compared to navigation search while searching information on KO websites of HB, KI, LIU, Harvard and UU.

- A lot of white space and unwanted or unused data increases the time taken by the KW during scrolling through white space and looking lot of unwanted data.

- Date & Relevance, Ascending & Descending is not used and removal of these items would increase the search speed and aesthetic look of the search page.

- Autosuggest and Advance option are very sparing used, doesn’t make a big difference while performing the search task.

- Filter Option and Spell Correction make a huge difference when performing the Search Task.

- Drop down in front of Search has very less usage.

- File type Indicator and useful title improve the search speed and time.

- Advanced Search is not efficient and utilized more time to complete the task in HB.

- The highlight of search task with different color is not stable.

- The KW widely uses the visited link by identifying with color change, most of the task which is performed again in Google helps the KW to identify the changed color link and complete the task with less time and clicks.

- Alternate Suggestion must be given if there is an empty result display, only UU has suggestion and help should be given with simple terms to enhance the good control on KW search.

### 5 Analysis and Result

#### 5.1 Analysis
The author has used the comparative analysis method to analyze the results obtained from theoretical and empirical finding. The author has used the research sub-questions as “Frame of Reference” and the context of finding is placed within it. The author has used most important search interface design and search page design which is identified or discussed in theoretical study along with the user centered design approach as “Ground for Comparison”. Because the author wants to know how to improve the knowledge organization search interface design to provide a better interface like a mainstream search engine. The “Thesis” statement includes two sub-research questions based on the comparative analysis method to explore, does the KO search interface design use these principles like mainstream search interface to improve the search experience of KW. “Whereas” is being used to make comparison of both the studies. The author has used the “Organizational Scheme” as “point-by-point” to make a comparative analysis of both the studies which is engaged in debate. The results of theoretical and empirical study is analyzed and compared with each other.

Sub-Question 1

What are the basic principles and findings to improve search page design?

- According to 7±2 Principle, minimize the information chunk in any section to less than seven, so it would be easy for the user to retain the information in short memory at a time (See Chapter 3.5.3). This has been proven in the search task2 performed by KW2; it took 33 seconds to analyze the information in 7th tab.

- According to 3-click rule the user should achieve the goals in 3 clicks; it’s allowable in many clicks if the user understands how the system works (See Chapter 3.5.3). The average number of clicks made to perform tasks in mainstream search engine website on Google is from 2 to 5 and in KO is varies from very high to average.

- Top down visualization of information architecture makes sure that all basic elements for a page is considered and made visible to the user, to enhance their understanding of search interface design without making the user think about the interface (See Chapter 3.7.1 and Chapter 3.5.3). Helps to answer the entire basic KW question and guide a good interface by placing all the information in any page which could help the KW when they are lost, like KW2 who is lost and clicked home page for performing an index search.

- Even when the search engine doesn’t work, alternate suggestion must be provided for KW through site index and footer sitemap to provide a controlled search; this could be achieved by pre solved patterns (See Chapter 3.8.2).

Sub-Question 2

What are the important elements to be considered in enhancing search interface design?

- Considering the important usability rules and principles in mind along with the most common and worst mistake in usability to avoid the known issues to enhance the quality of search interface design (See Chapter 3.5.3 and Chapter 3.5.4). This enhances the
overall performance of KO which is very low compared to the mainstream Search Engine.

- The importance of user centered design to reduce the future problems and designing pages for scanning, is one of the most important elements in interface design (See Chapter 3.6 and Chapter 3.62). This is proved from the results of mainstream search interface design.

- Most common and worst mistakes in usability design in relation to search page design such as the importance of alternate suggestion, change color of visited link and title of page should be considered to reduce the predefined error (See Chapter 3.5.3). In KO websites of HB, KI and UU color change of visited link is same as unvisited link. Most of the Task performed in Google is made easy with the visited link color change. Title of page or Title of the document is important and reduced the search time and number of clicks, which is explained by the Task 3, performed by KW3, due to inappropriate pdf title and non-document type indicator, KW3 confused and clicked all the links to find the required document.

- Alternate suggestion and spell check helps user search and reduce the user quit without results (See Chapter 3.8.1). Spelling correction is very useful during the search task and alternate suggestion helps the novice KW, which is provided by Google and not in KO websites like HB and KI. Alternate suggestion and easy option to undo faceted search helps to avoid the empty result and don’t make user think what to do next which is a first law of usability (See Chapter 3.5.3 and Chapter 3.9.3).

- To enhance the quality of design, pre solved search patterns like search pagination are used from the pattern library and waybackmachine used to visualize the development of major search interface design and how frequently it’s been updated with different designs to enhance the usability (See Chapter 3.8.3 and Chapter 3.8.2).

- It’s always difficult to follow all search interface guidelines, one guideline contradicted with other so latest guideline given by Marti Hearst in 2009 is used (See Chapter 3.9). So latest design guidelines are considered during the wireframe design to provide a good quality of results.

- Offer efficient feedback by highlighting the query term, use relevance score sparingly, proving suggestion for query term, filter option to narrow result is displayed only after the query is a search and not before (See Chapter 3.9.1). Multiple color highlight is not stable in long term search; relevance score is used in HB doesn’t make a difference in terms of result achievement.

- Small details in Search Interface can make the difference between success and failure, it changes the ways a user learns the information and approximately 80% of user don’t view more than ten results because they consider that first few results are more relevant than fallows (See Chapter 3.9.4). This is proved in a search task of KW they don’t go to the next page or to search in the bottom of the page results.

- Balancing of white space along with a good aesthetic design to reduce the search time (See Chapter 3.9.5). On the KO website of HB the search result page has a lot of
unwanted data or space which increases the time taken to scroll the page through white space and time to look at unwanted data.

### 5.2 Result Summary

The wireframe design of the KO search engine interface is designed based on the finding of important element and principles for the search page and search interface design from the analysis of theoretical and empirical study along with a special focus on the user-centered design approach. The design of a wireframe is evaluated on the basis of the analysis finding and latest search interface design guideline.

![General Wireframe for KO](image)

**Figure 21: General Wireframe for KO**

Figure 21 explains the detailed framework of the entire segment which will be used during the search process. The Result display1 is used to display the search results for normal search, Find a person search, Find Course and calendar events. The result display of find person, find course and calendar events will be included in future works, due to the time constrains. On the left side of result display a detailed filter option will be included, which is explained in Figure 21 and Figure 25. In the Footer contact address of the Knowledge Organization is included, quick links are used to give direct links to all frequently used link in KO and Activities is included to make a link to current activities in KO like the blog, Job vacancy and News. Simple search box interface is used, along with the library link to guide the KW to search in KO library. Copy write statement is optional which explain the terms and conditions.
Figure 22 explains the detailed view of KO website wireframe, important filter options are displayed in the left side of result page, in which (N) displays the total number of results found for that filter option for the left side filter option and if you consider the result page N represents the total number of results found for the entered search text. Detailed process of how the filter interface works are explained in Figure 25. Find a person helps to find a person with either Name and/or Department; if the department name is entered the entire person name will be displayed. Find course is used to locate the particular course or search for all courses within the department, level helps to filter the level of study (for example: Bachelor, Master, Research Assistant or Ph.D.). In the left filter option Language filter is of no use, if only one language document is available for the KO. Search Pagination helps to navigate through different pages. Feedback helps to improve the site and Return to top helps the KW to avoid long scrolling.
Figure 23 explains the use of Did you mean: suggest for alternate spelling of the misspelled text.
Figure 24: Detailed Wireframe with suggestions

Figure 24 explains the suggestion which is given to avoid the used quit without result, the left filter options are displayed only if the filter option has found any match for entered search. Help is used to give some basic search option suggestion with an example, which is also included for future work in this field due to time constraints.
Figure 25: Detailed Wireframe before search

Figure 25 explains the simple interface with very basic search box, to make the KW feel comfortable, all other filter options are displayed based on the KW search.

Figure 26: Detail Wireframe of filter option

Figure 26 explains the process involved for filter options, check box is used to reduce the complexity of undo filter option. Show more helps to expand the filter option and user can filter with multiple check boxes, each time the user clicks the filter search is altered, show less compress the box with selected filter and can be easily undone.
5.3 Evaluation of Results

- Visualizing the information architecture of any page design is necessary, to think in KW perspective to answer all basic questions and need for the KW to navigate and to avoid stuck in search page (See Chapter 3.7.1). This evaluation makes a good information architecture of proposed search interface design for the KO.

1. Where am I?
2. Where to enter the search term to perform the search?
3. How do I get around this site?
4. What's important and unique about this organization?
5. What are the options available to filter the search?
6. What's happening there?
7. Do they want my opinion about their site?
8. How can I contact a human?
9. What's their address?

- The file type indicator, change color for visited link with simple and efficient way of using and organizing the data, avoiding unwanted white space is one of the key features implemented in the result.

- Easy undo filter option and search suggestion gives an edge over quitting without result, even when the KW got lost in the navigation, this search page would guide into the required information with various search options.
Due to time constrains this result is not evaluated in real time, but it would be implemented in the future work.

6 Discussion

6.1 Conclusion

This study has found some aspects related to the interface design principles and usability principles in designing the KO search interface with user-centered approach. All of the important aspects found in the theoretical part are then verified with the empirical part. As interface design is really important to make a simple and efficient KW search engine, the author has analyzed most important design principles, rule and pattern from various sources and discussed in the theoretical part to give an effective interface design and standards like mainstream search engine interface. The empirical study has exposed the lagging of interface design in different KO, in order to perform an easy and simple search, the author has considered the important finding from both the study in a comparative manner and designed the final result based on the finding in user-centered approach. The implementation of the finding in the final result is one of the challenges faced by the author. Since this design is a combination of strong theoretical analysis with the latest principles along with the user centered finding of search approach of KW, make a strong foundation for the final design. The main research question of this study “Improving Knowledge Organizations search interface design by evaluating mainstream search interface design?” has thus been answered with the different important aspects discussed above and in Chapter 5.2 & Chapter 5.3.

6.2 Implication in Informatics

Informatics deals with combining the information with the latest technology in a user centered perspective. This thesis mainly focused on the enhancement of the information available in KO with interface design and principles in user centered perspective to build a simple and effective search interface design for KO to help KW in terms of result achievement and good interface design to improve the effectiveness, efficiency and satisfaction of the KW.

6.3 Method Evaluation

The main purpose of the theoretical study of text analysis is to find the relevant information in different subject area and relate to the context of the thesis requirement. This gives a strong foundation and idea for building research question for this thesis. A sampling of different subject area is difficult and it is carefully chosen by the author to give a strong foundation for this thesis. In the empirical study the author has conducted semi-structured interviews with predefined search task and capture the screen video KW search tasks, to have a detailed finding which will support the study. This helped in how different KW performs search and which is very important in designing the final wireframe design. The KW is first introduced one task in one university at a time, this reduces the bias effects discussed in chapter 3.10.1, the KW are informed about the screen capture and their data identity will not be released, to make them feel comfortable during the task, the author clearly explained that this process is to test the ability of KO website and not KW, so they feel comfortable and performed a normal search. Semi-structured question is framed based on the user approach and experience, this helps to get deep and look into KW eyes on how they perceive and process the information.

6.4 Result Evaluation
To get the accurate results the author used Michael (Michael, 2002) four evaluation research factor of Quality, Validity, Reliability and Generalizability.

- **Quality** of the research by collecting data from the journals, articles, books, pattern library and from the best online resource for Search Interface design, this enhances the richness of meaning of the data in the research. The author maintains the quality of data which is used to perform the study from the reliable resource. Knowledge Workers of different age and department are used to perform different search task to explore more idea in terms of exploratory research to increase the quality of empirical study.

- **Validity** of the research is evaluated by strong analysis with support of theoretical finding. The author has validated the finding of theoretical study with the empirical study and verifies the finding to provide a strong analysis of both the theoretical and empirical study.

- **Reliability** of the research is enhanced by repeatedly revising the data to ensure the consistency and accuracy of the results. The author has revised the data collected from the screen capture video to ensure all the interpreted data are accurate. The author has revised the document multiple times along with the help of a supervisor to ensure the consistency of document and accuracy of results.

- **Generalizability** has been used to generalize the finding to cover the circumstances for the wider group. The author has made a general design for KO which would be helpful in providing a strong wireframe foundation for the KO search engine interface design. The author has also mentioned the optional data to make it effective and available for any KO throughout the world. This would be useful of any search interface design in terms of knowledge and how study is made.

The author ensures that all the research question and sub question has been answered in a simple and understandable manner to enhance the quality of research (see Chapter 5.2 & Chapter5.3).

**6.5 Possibilities to generalize**

The author has made a theoretical foundation which would help different search interface designers, since search is wide topic and it’s really difficult to narrow the finding of design principles and guidelines which is mainly for search design is time consuming and difficult, so this thesis would be helpful for all the search researchers. Since user centered design is a must in all designs, this thesis is also based on the user centered approach, so this would be important to future researchers in the search area, in terms of search knowledge and guidelines for structuring a search study.

**6.6 Base for Future Research**

The author has included some future research in this thesis due to time constrains, like implementing the wireframe design in KO, design interface for person search, calendar events and course search. This would be major assert to improve the KO search interface, to make a
simple and effective search experience for KW throughout the world. Future research in this field is a great assert to all KO to build a strong foundation and simple organized interface search to make the KW achieve the results like other mainstream search engines in terms of effectiveness, efficiency and satisfaction.
References


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APPENDIX
Recording consent form

Thank you for participating in our usability research.
We will be recording your session to observe and benefit from your comments to publish a thesis. I understand that my usability test session will be recorded. I grant Högskolan i Borås permission to use this recording for Master thesis, for the purpose of improving the designs being tested.

☐ I agree to allow Högskolan i Borås to record my Search Tasks.

1. Name :
2. Age :
3. Department :

Search Tasks

Task 1

- Go to www.hh.se and search for the course of One year master programme in Informatics and find the tuition fee for that course.
- Go to www.bi.se and search for the course of Two year master programme in Health Informatics field and find the tuition fee for that course.
- Go to www.um.se and search for the course of Two year master programme in Information System field and find the tuition fee for that course.

Task 2

- Find the contact email address of professor name “Andrea Resmini” in this website http://www.hh.se
- Find the contact email address of professor name “Andreas Lange” in this website http://www.bi.se
- Find the contact email address of professor name “Lars Anders” in this website http://www.harvard.edu/
Task 3
Consider you are helping your Swedish friend to locate a pdf file,

- Science for the profession which is the 5th published report in 2009, its English document in website www.hh.se

- Karolinska Institutet Annual report which is published in 2003, its English document in website www.ki.se

- The rise of Africa: miracle or mirage which is the annual report published in 2010, its English document in website www.uu.se

Task 4
Find the information about the news which is,

- Published in 13th June 2005 about the topic “Informatics in borås” in the website www.hh.se

- Published 20th August 2009 about the topic “Brain cell research and development in KI” in the website www.ki.se

- Published 7th May 2010 about the topic “Breakthrough in Electronic Signal Research” in the website www.uu.se
University of Borås is a modern university in the city center. We give courses in business administration and informatics, library and information science, fashion and textiles, behavioral sciences and teacher education, engineering and health sciences.

In the School of Business and Informatics (IDA), we have focused on the students' future needs. Therefore we have created programs in which employability is a key word. Subject integration and contextualization are other important concepts. The department has a closeness, both between students and teachers as well as between industry and education.

Our courses in business administration give students the opportunity to learn more about different businesses and governments and how governance and organization of these activities take place. They may also learn about society development and organizations' adaptation to the outside world. They have the opportunity to improve their ability to analyze, develop and control activities, whether they want to engage in auditing, management or marketing.

Among our IT courses, there's always something for those who want to design the future of IT-based communications, analyze the needs and demands on organizations' information to design their content structures, integrating IT and business development, developing their ability to analyze and design business processes or focus on programming and development of good use of IT in enterprises and organizations.

The research in the school is well recognized and oriented towards professionalism as well as design and development. The overall research profile is Business-IT-Services which combine knowledge and skills in informatics as well as in business administration. The research is profession-oriented, which is reflected in the research, in many cases conducted on action research-based grounds, with businesses and government organizations at local, national and international arenas. The research design and professional orientation is manifested also in InnovationLab, which is the department's and university's unit for research-supporting system development.